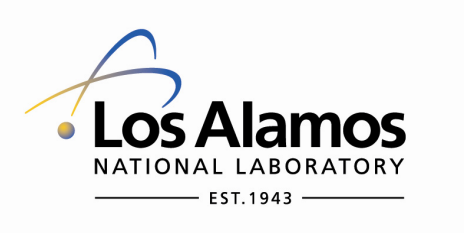
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Corrective Measures Evaluation Report for Material Disposal Area H, Solid Waste Management Unit 54-004, at Technical Area 54, Revision 1



Prepared by the Environmental Programs Directorate

Los Alamos National Laboratory, operated by Los Alamos National Security, LLC, for the U.S. Department of Energy under Contract No. DE-AC52-06NA25396, has prepared this document pursuant to the Compliance Order on Consent, signed March 1, 2005. The Compliance Order on Consent contains requirements for the investigation and cleanup, including corrective action, of contamination at Los Alamos National Laboratory. The U.S. government has rights to use, reproduce, and distribute this document. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.

EP2011-0291

Corrective Measures Evaluation Report for Material Disposal Area H, Solid Waste Management Unit 54-004, at Technical Area 54, Revision 1

September 2011

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EXECUTIVE SUMMARY

This report documents the corrective measures evaluation (CME) conducted for Material Disposal Area (MDA) H, Solid Waste Management Unit (SWMU) 54-004, at Los Alamos National Laboratory's Technical Area 54 in accordance with the Compliance Order on Consent (the Consent Order). MDA H is composed of nine subsurface shafts used for the disposal of security-classified solid-form waste. SWMU 54-004 is collocated with one Resource Conservation and Recovery Act–regulated unit (Shaft 9). This CME is part of a comprehensive, integrated approach to remediate and close these nine subsurface disposal shafts. The goal of this CME is to recommend a corrective measures alternative for closure of SWMU 54-004 and the regulated unit and to address the associated releases in accordance with the Consent Order.

Waste was disposed of in the nine MDA H shafts over approximately 26 yr. Wastes disposed of in the shafts include lithium hydride, high explosives, metals, radionuclides, classified materials, and volatile organic compounds. The waste disposed of at MDA H may be sensitive to sparks, friction, heat, physical impact, pinching, air, and/or moisture. The objectives of this CME are to identify and evaluate technically appropriate corrective measures alternatives that will

- achieve cleanup objectives in a timely manner,
- protect human and ecological receptors,
- control or eliminate the sources of contamination,
- control migration of released contaminants, and
- manage remediation waste in accordance with state and federal regulations.

A conceptual site model (CSM) was developed to evaluate primary and secondary release mechanisms from the source area (shafts). The CSM evaluates the exposure pathways and potential risks. The remedial action objectives (RAOs) for the source area are as follows:

- prevent future human health and ecological exposure to waste through inadvertent excavation
- prevent future disruption and dispersal of waste by physical disruption or infiltration of moisture

To complete the CME, treatment technologies were identified and screened for applicability to the sources of contamination present at MDA H. Applicable technologies were then combined into corrective measures alternatives. The corrective measures alternatives were screened against the threshold criteria per Section VII.D.4.a of the Consent Order. Alternatives that satisfy the threshold criteria were then evaluated and ranked against the remedial alternative evaluation criteria (also known as the balancing criteria) identified in Section VII.D.4.b of the Consent Order. The highest-ranking alternative was selected as the recommended corrective measures alternative.

As a result of this evaluation, the recommended corrective measures alternative includes constructing an evapotranspiration (ET) cover over the shafts to provide a barrier against human and ecological exposure to waste and contaminated soils. The ET cover also restricts the infiltration of water into the waste by providing a soil medium to hold infiltrated water until it is removed by evaporation at the surface and transpiration through vegetation. Institutional controls will be included to ensure that the RAOs are satisfied. The impact of the recommended alternative on the CSM demonstrates the resulting reduction in exposure potential and future risk.

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1.0 INTRODUCTION

This report documents the corrective measures evaluation (CME) conducted for Material Disposal Area (MDA) H, Solid Waste Management Unit (SWMU) 54-004, at Los Alamos National Laboratory (LANL or the Laboratory). This CME was developed and is submitted pursuant to the March 2005 Compliance Order on Consent (Consent Order).

The Laboratory is a multidisciplinary research facility owned by the U.S. Department of Energy (DOE) and managed by Los Alamos National Security, LLC. The Laboratory is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 40 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas that are separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 ft to 7800 ft above mean sea level (amsl). The eastern portion of the Pajarito Plateau stands 300 ft to 1000 ft above the Rio Grande.

The Laboratory is divided into numerous technical areas (TAs) based upon facility operations. Several TAs include MDAs where waste was previously disposed of. MDA H subsurface disposal units are located within the boundaries of Technical Area 54 (TA-54) (Figures 1.0-1 and 1.0-2). MDA H is defined as the subsurface disposal shafts contained within SWMU 54-004 that are subject to corrective action under the Consent Order. One of these shafts, Shaft 9, is a regulated unit as defined in 40 Code of Federal Regulations (CFR) 264.90(a)(2) and is discussed below. SWMU 54-004 was used for the disposal of security-classified solid-form waste.

The Laboratory is participating in a national effort by DOE to clean up sites and facilities formerly involved in weapons research and development. The goal of the Laboratory's effort is to ensure past operations do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, the Laboratory is currently investigating sites potentially contaminated by past Laboratory operations. These sites are designated as either SWMUs or areas of concern (AOCs).

The objectives of this CME are to identify and evaluate potential remedial alternatives to address any hazardous wastes and hazardous constituents released from the SWMU and the regulated unit at MDA H and to recommend a preferred remedy.

The requirements of the Consent Order do not apply to radionuclides, including, but not limited to, source, special nuclear or byproduct material as defined in the amended Atomic Energy Act of 1954, or the radioactive portion of mixed waste. DOE's authority to regulate nuclear safety is governed by the provisions of 10 CFR Parts 830 through 835. Pursuant to these regulations, DOE is required to review and approve all activities and work related to radionuclides, including activities and work under the Consent Order.

The Resource and Conservation Act– (RCRA-) regulated unit at MDA H is a subset of the SWMU. A "regulated unit" is defined in 40 CFR 264.90(a)(2) as "any landfill, surface impoundment, waste pile or land treatment unit that received wastes after July 26, 1982 or that certified closure after July 26, 1983." Closure under Subpart F of Parts 264 and 265 for regulated units is prescriptive, including design requirements for caps on land disposal units and post-closure care (including cap maintenance and groundwater monitoring). The U.S. Environmental Protection Agency (EPA) recognized that complex sites, such as MDA H, are potentially subject to two different sets of RCRA requirements that apply to a single release if both regulated units and SWMUs have contributed to the release. To avoid unnecessary impediments to cleanups while ensuring that both SWMUs and regulated units are cleaned up in a manner that is protective of human health and the environment, 40 CFR 264.110(c) provides EPA and

authorized states, such as New Mexico, with the discretion to prescribe alternative requirements. MDA H meets the requirements for the application of 40 CFR 264.110(c) on the following grounds.

- MDA H consists of Shafts 1 through 8, which comprise a SWMU listed in Attachment K of the Laboratory's Hazardous Waste Facility Permit. Shaft 9 received hazardous waste after July 26, 1982, and is considered a "regulated unit." This regulated unit is situated among the shafts in the subsurface SWMU.
- The New Mexico Environment Department (NMED) has directed the Laboratory to address all nine disposal shafts under corrective action per 20.4.1.500 New Mexico Administrative Code (NMAC) (NMED 2000, 068569).
- The alternative requirements for MDA H are set out in the Consent Order, which is an "enforceable document" as defined in 40 CFR 270.1(c)(7).

This CME report is organized according to the Consent Order requirements. Table 1.0-1 summarizes the Consent Order requirements and identifies where the applicable requirements are addressed in this report. Section 1 provides an overview of the CME. Section 2 provides a brief site history, discusses the waste inventory, and summarizes the results of previous investigations. Section 3 describes surface and subsurface site conditions. Section 4 summarizes the conceptual site model (CSM) and includes a description of sources, pathways, and receptors. Section 5 details the regulatory criteria for the CME, including applicable cleanup standards, risk-based screening levels, and risk-based cleanup goals for each pertinent medium at MDA H subsurface units. The Consent Order evaluation criteria process used for screening and evaluating the available treatment technologies as well as the recommended corrective measures alternatives are also discussed. The identification and screening of technologies are presented in section 6. The corrective measures alternatives are developed from the retained technologies and described in section 7. The alternatives are also screened against the four threshold criteria identified in Section VII.D.4.a of the Consent Order in section 7. Alternatives that pass the threshold criteria are evaluated further in section 8 against the five remedial alternative evaluation criteria (balancing criteria) of Section VII.D.4.b of the Consent Order. The recommended corrective measures alternative is selected in section 9. The design criteria to meet cleanup objectives are presented in section 10, the proposed schedule is provided in section 11, and references and map data sources are presented in section 12.

This CME report includes appendixes that provide supporting information for sections 1 though 12. Appendix A provides the acronyms and abbreviations that are used throughout the report as well as a metric conversion table and data qualifier definitions. Appendix B provides the waste inventory for MDA H. Appendix C provides an analysis of the disposed waste at MDA H and its effect on remediation alternatives. Appendix D provides information on the groundwater chemistry in the regional aquifer. Appendix E provides a discussion of the local geology and hydrology. Appendix F provides the cost estimates for the corrective measures alternatives identified and carried through section 7. Preliminary design information for potential corrective measures is included in Appendixes G and H: a multilayer cover and an evapotranspiration (ET) cover, respectively.

2.0 BACKGROUND INFORMATION

TA-54 is situated in the east-central portion of the Laboratory on Mesita del Buey (Figure 1.0-2). TA-54 includes four MDAs designated as G, H, J, and L; a waste characterization, container storage, and transfer facility (TA-54 West); active radioactive waste storage and disposal operations at Area G; active hazardous and mixed-waste storage operations at Area L; and administrative and support areas. The transfer facility is located at the western end of TA-54, and MDAs H and J are located approximately

500 ft and 1000 ft (152 m and 305 m) southeast of the transfer facility, respectively. Area L is located approximately 1 mi (1.6 km) southeast of the transfer facility. MDA G is located approximately 0.5 mi (0.8 km) southeast of Area L.

MDA H is a 70-ft by 200-ft (0.3-acre) fenced area located on Mesita del Buey, which is a small mesa that lies between Pajarito Canyon and Cañada del Buey (Figure 2.0-1). Mesita del Buey is a 100- to 140-ft-high finger-shaped mesa that trends southeast. The elevation of Mesita del Buey ranges from 6885 to 6890 ft at MDA H. The mesa is approximately 500 ft wide and is bounded by the basin of Cañada del Buey (450 ft to the north) and the basin of Pajarito Canyon (360 ft to the south) (Figure 1.0-1).

The following sections summarize site information. Further information about the current site conditions at MDA H are detailed in the MDA H RCRA facility investigation (RFI) report (LANL 2001, 070158), the addendum to the RFI report (LANL 2002, 073270), and quarterly periodic monitoring reports (PMRs) for pore gas (LANL 2010, 111123). These documents describe the site and include information on the disposal units, waste inventories, characterization activities, analytical sampling results, and assessments of potential present-day risks to human health and the environment.

2.1 Site History

MDA H operated from May 1960 until August 1986 as the Laboratory's designated disposal area for classified, solid-form waste. Disposal of solid-form waste materials was restricted to items or materials that were determined by authorized personnel to be both classified and no longer required for their intended use. This determination was recorded on disposal forms that accompanied the waste to MDA H. Liquids were prohibited from disposal (Clayton 1960, 011515; Dickason 1960, 011514).

MDA H consists of nine inactive vertical disposal shafts arranged in a line approximately 15 ft inside the southern fence (Figure 2.0-1). Each shaft is cylindrical with a diameter of 6 ft and a depth of 60 ft. Shafts 1 through 8 were filled with waste to within 6 ft of the surface, then covered with 3 ft of concrete and brought to grade with 3 ft of crushed tuff. Shaft 9 was also filled with waste to within 6 ft of the surface but brought to grade with 6 ft of concrete.

To protect against the possible impacts of mesa-edge instability, all MDA H disposal shafts were located a minimum of 60 ft from the mesa edge. The surface of MDA H is vegetated with native grasses that stabilize the soil against erosion. In addition, the surface is contoured to redirect stormwater runoff around the site and into a single drainage to Pajarito Canyon. Because the material disposed of at MDA H was classified, double packaging with an opaque outer material, such as plastic bags or drums, was required. Lightweight wastes were dropped into the shafts, while heavier materials were lowered in by heavy equipment. Based on early disposal records, the density of waste materials varied from 5 to over 400 lb/ft^3 in the shafts. Between waste disposal events, each shaft was covered with a locked steel plate to prevent unauthorized access to classified materials and minimize collection of precipitation and runoff.

Title 10 of the Code of Federal Regulations Part 830 (10 CFR 830), Subpart B "Safety Basis Requirements," and Section 204 of 10 CFR 830, "Documented Safety Analysis" (DSA), require documented safety analysis for each nuclear environmental site (NES) at the Laboratory. The NESs are inactive below-ground sites containing sufficient material generated from historical Laboratory activities to warrant categorization as nuclear facilities. On November 26, 2003, the National Nuclear Security Administration (NNSA) concurred with the Laboratory's initial hazard assessment of MDA H as an NES. The NES consists of waste disposal units that contain the governed material and an Inventory Isolation System (IIS). The IIS is charged with protection of the governed material from potential impacts associated with disturbance or accidents.

2.2 MDA H Waste Inventory

As described above, waste was disposed of in the MDA H shafts over approximately 26 yr. During this period, disposal events were recorded in a single Los Alamos Scientific Laboratory (LASL) logbook (LASL 1960–1986, 070034) that contains brief, unclassified descriptions of the waste, including approximate weights. The logbook was transcribed into a spreadsheet, which was reproduced as Appendix B. The waste descriptions include information sufficient to identify the types of potentially hazardous and radioactive waste at MDA H and to assist in evaluating the alternatives in this CME.

The logbook shows that a variety of wastes were disposed of in the shafts. Logbook entries include waste that potentially meets the RCRA definition of characteristic hazardous waste such as lithium hydride and high explosives (HE). Additional potentially hazardous wastes or constituents not listed in logbook entries are expected to be present based on process knowledge. These materials, including barium, cadmium, chromium, lead, mercury, and silver, were used as shielding, solders, parts, or coatings. Other hazardous constituents, such as beryllium and copper, are also listed in logbook entries. Volatile organic compounds (VOCs) were not listed in the logbook entries, but are detected in trace amounts in vapor-phase sampling at MDA H (e.g., LANL 2010, 111123). Radionuclides listed in or identified from the logbook entries include tritium, uranium-234, uranium-235/236, uranium-238, plutonium-238, plutonium-239/240, plutonium-241, and plutonium-242.

The largest component of the MDA H waste inventory is metal (57%), both radioactive (24% depleted uranium [DU]) and nonradioactive (33% other metals). Potentially reactive materials, such as lithium compounds, represent approximately 1% of the inventory. Graphite represents approximately 9% of the inventory, and radioactive materials other than DU account for approximately 24% of the inventory. Plastics account for approximately 9% of the inventory; paper and HE each constitute less than 1% of the inventory (LASL 1960–1986, 070034). Table 2.2-1 and Figure 2.2-1 summarize the inventory of waste disposed of at MDA H. Appendix B details the waste inventory for each disposal shaft. The total mass of all waste in the MDA H disposal shafts is estimated to be 391,229 lb[1] (Omicron 2003, 075940). A review was conducted by subject matter experts on the characteristics of the complex mixture of waste disposed of in the shafts (Appendix C). It was determined that the waste is sensitive to sparks, friction, heat, physical impact, pinching, air, and/or moisture.

2.3 Site Description

2.3.1 Surface Soils

The soils of Mesita del Buey are derived from the weathering of the Tshirege Member tuffs (phenocrysts and phenocryst fragments, devitrified glass, and minor lithic fragments) and from wind-blown sources. Soils on the flanks of the mesa are developed on Tshirege Member tuffs and colluvium with additions from wind-blown and water-transported sources. Native surface soils have been disturbed by waste management operations over much of Mesita del Buey, but when present, native soils are generally thickest near the center of the mesa and thinnest on the edges.

In general, soils on the mesa surface are thin and poorly developed; they tend to be sandy near the surface and more clay-like beneath the surface. More highly developed soil profiles exist on the north-facing slopes, and they tend to be richer in organic matter. Soil profiles on the south-facing slopes tend to be poorly developed. Soil-forming processes have been identified along fractures in the upper part of the

[1] Weights provided within the logbook are missing for approximately 2% of the entries.

mesa, and the translocation of clay minerals from surface soils into fractures has been described at Mesita del Buey (Newman 1996, 059118).

The original soils near MDA H were poorly developed, as is typical of soils derived from Bandelier Tuff and formed under semiarid climate conditions (Nyhan et al. 1978, 005702, p. 24). In general, undisturbed soils on the mesa tops are composed of the Carjo loam, the Hackroy loam, and the Seaby loam.

Canyon bottoms (Cañada del Buey and Pajarito Canyon) near MDA H are covered with colluvium and alluvium that has eroded from the tuff and soils on the mesa top and canyon walls. The canyon rims and slopes are composed of soils from the Hackroy-Rock outcrop complex; the canyon bottoms are composed of Tocal loam, a very fine, sandy loam. Since disposal activities began at Area H, Cañada del Buey has experienced a period of accretion, and eroded soils from Area H as well as other areas at TA-54 have been deposited on the canyon bottom and stream banks. Potentially, these soils may be redistributed downstream during stormwater runoff events.

2.3.2 Subsurface Geology

A brief description of the local geologic conditions at MDA H is summarized in this section. A generalized stratigraphic column for MDA H is shown in Figure 2.3-1. Appendix E, section E-2, describes the sitewide geology for the entire TA-54 site. Cross-sections in the vicinity of MDA H are shown in Figures E-2.1-2, E-2.1-3, and E-2.1-4.

MDA H is located on Mesita del Buey, an erosional high stand of Bandelier Tuff in the eastern part of the Pajarito Plateau. Mesita del Buey is capped by partly to moderately welded tuff of unit 2 of the Tshirege Member of the Bandelier Tuff (Qbt 2). Qbt 2 is underlain by nonwelded devitrified Tshirege tuff (Qbt 1v), nonwelded vitric Tshirege tuff (Qbt 1g), thin basal Tshirege Tsankawi fall deposits (Qbtt), Cerro Toledo sediments (Qct), Otowi Member of the Bandelier Tuff nonwelded vitric ash flows (Qbo), and Guaje Pumice Bed (Qbog) fall deposits (Appendix E, section E-2.1). The Bandelier Tuff is about 550 ft thick at MDA H. These tuffs overlie the 365-ft-thick Cerros del Rio volcanic series that is made up of basalt lavas (Tb4) and interbedded flow breccias, scoria deposits, and interflow sediments. The Cerros del Rio volcanics overlie the Puye Formation (Tpf) that is largely made up of fanglomerate deposits that were shed from local volcanic sources. The Puye Formation is underlain by pumice-rich alluvial fan deposits of Miocene age and riverine deposits of the Miocene Chamita Formation. The Miocene pumiceous deposits (Tjfp) are about 150 ft thick; these deposits thin eastward and pinch out in the vicinity of MDA L. The Chamita Formation (Tcar) of the Santa Fe Group consists of variably calcite-cemented sands, silty sands, and gravels. The regional water table occurs at a depth of about 1000 ft in the Puye Formation. Thus, the regional aquifer near MDA H is largely made up of porous Pliocene and Miocene sedimentary deposits.

2.3.3 Surface Water

No perennial streams flow on Mesita del Buey; water flows only as stormwater, snowmelt runoff on the mesa, and in small drainages off the mesa to the north and the south. Stormwater flows at a number of points along the perimeter of TA-54 as identified and characterized in the “TA-54 Storm Water Pollution Prevention Plan” (LANL 2009, 109438) prepared for the Laboratory’s National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit. As a result of runoff, surface erosion occurs primarily as shallow sheet erosion on the relatively flat parts of the mesa and as channel erosion in major drainages from the mesa top. The surface of MDA H is contoured to direct stormwater runoff around MDA H and into a single drainage toward Pajarito Canyon (LANL 2001, 070158).

2.3.4 Vadose Zone Hydrology

The vadose zone is the zone between the land surface and the regional water table within which the hydraulic pressure is less than atmospheric. Beneath MDA H, the pores within the vadose zone are unsaturated (i.e., they contain both air and water). Mesita del Buey is one of the drier mesas at the Laboratory and on the Pajarito Plateau. Infiltration occurs into the shallow subsurface mostly during snowmelt or following intense summer thunderstorms. Moisture from the shallow subsurface of the mesa is removed by ET. Figure 2.3-2 presents data showing that average potential ET rates exceed precipitation rates throughout the year at TA-54. That is, little to no water is available for infiltration at the site. Percolation into the deeper subsurface of the mesa appears to be very low. Newman et al. (2005, 099163) estimated percolation rates and vadose zone travel times in undisturbed, disturbed, and paved areas across TA-54 using moisture, chloride, and stable isotope data from shallow (1- to 2-m-deep) cores. The study looked at vegetated and unvegetated areas. Under undisturbed and vegetated conditions, percolation rates on Mesita del Buey are estimated to be approximately 0.2 mm/yr; under disturbed conditions and beneath pavement, less ET occurs and percolation rates can range up to 10 mm/yr (Newman et al. 2005, 099163). Similar average percolation rates are confirmed by several independent studies (Birdsell et al. 2005, 092048; Kwicklis et al. 2005, 090069). These studies evaluated average travel times for conservative waterborne contaminants (dissolved constituents that do not adsorb or precipitate and are not present in the vapor phase) from the surface to the regional aquifer. Travel times of several hundred years to several thousand years are predicted under disturbed and undisturbed conditions, respectively (LANL 2005, 089332; Stauffer et al. 2005, 097432). Vapor-phase contaminants may migrate more quickly, and adsorbing constituents will migrate more slowly. The CSM for contaminant migration through the unsaturated zone at TA-54 is summarized in section 4 of this report.

At MDA H, neutron logging was used to determine volumetric moisture content in three boreholes in 2005 through 2007, 54-01023, 54-15461, and 54-15462 (Figures 2.3-3 and 2.3-4) (LANL 2007, 099140). The moisture content in the upper 140 ft below ground surface (bgs) is generally between 3% and 15% by volume. At approximately 150 ft bgs, the moisture content increases to approximately 20% to 40% by volume. This occurs at the base of unit 1v-c; an increase in moisture content at the base of unit 1 v-c is observed in core samples collected across the Laboratory and is thought to be related to the fine-grained nature of this unit. Moisture contents below this unit to depths of approximately 250 ft decrease to 10% to 25%. These moisture content values are low given that the porosity of the tuffs are in the 40% to 50% range; for fully saturated conditions, the volumetric moisture content is equivalent to the porosity. At these moisture contents, the fractures beneath MDA H are expected to be dry, and pore water is located in the tuff matrix.

No significant perched-intermediate groundwater has been observed directly beneath MDA H. Boreholes 54-609985 and 54-15462 (Figure 2.3-3), the deepest boreholes near MDA H, were drilled to depths of 300 ft through the mesa top and completed in the Otowi Member ash-flow tuffs. These did not encounter perched groundwater (LANL 2009, 108298). However, a small spatially limited saturated zone just beneath the canyon alluvium is observed below Cañada del Buey at wells CDBO-6 and CDBO-7 (Figure 2.3-5) within the colonnade portion of unit 1v (Qbt 1v-c) of the Tshirege Member of the Bandelier Tuff (Qbt 1v) (LANL 2009, 105754). Water is continuously present at CDBO-6, but is often absent at CDBO-7; its source is believed to be recharge of surface water. The downcanyon extent of the perched zone at CDBO-7 may be limited by rising of unit Qbt 1v-c above the canyon floor just east of well CDBO-7. The base of the unit is thought to be a hydrostratigraphic perching horizon (LANL 1999, 064617). This shallow perched zone does not appear to extend beneath MDA H to the south, as evidenced by neutron-log data measured in boreholes 54-01023, 54-15461, and 54-15462 discussed above, but it may be related to higher (although not saturated) moisture content seen in that unit beneath

MDA H (Figure 2.3-4). In addition, during drilling at wells R-37 and R-52, located just to the southeast of CDBO-6 and CDBO-7, perched water was not observed within unit Qbt 1v-c.

In addition, deep perched-intermediate groundwater occurs beneath Pajarito Canyon to the south (wells R-40 screen 1, R-40i, R-51, and Seismic Hazards Borehole 4 (SHB-4), and beneath Cañada del Buey to the north of MDA H (R-37 screen 1 and R-52) (Figure 2.3-5). The perched groundwater at R-40 screen 1 and R-40i occurs in fractured lavas of the Cerros del Rio basalt between depths of approximately 584 and 784 ft bgs (Appendix E, Figure E-2.1-4). Screen 1 of well R-40 was completed from 751.6 to 785 ft bgs in the lower part of the perched-intermediate groundwater, and screen 2 was completed from 849.3 to 870.0 ft bgs in the regional aquifer. In addition, a 3-in. polyvinyl chloride (PVC) well (R-40i) was installed in the annulus between the R-40 well casing and the borehole wall to provide groundwater samples in a productive zone in the upper part of the perched zone; the PVC well screen was placed from 649.7 to 669 ft bgs. At R-40, the vertical distance between the base of the perched-intermediate zone and the regional water table is approximately 70 ft; the small vertical separation suggests that there may be limited hydraulic separation between the two zones. At well R-51, perched groundwater was encountered in two zones during drilling (Appendix E, Figure E-2.1-3). The upper perched zone is located at a depth of approximately 161 ft bgs in sedimentary deposits of the Cerro Toledo interval, and the lower perched zone is located between depths of 502 and 568 ft bgs in the stratigraphic sequence that includes the Guaje Pumice Bed, Puye Formation, and uppermost part of Cerros del Rio basalt (LANL 2010, 109949). The upper perched zone at well R-51 is similar to another possible perched interval that was noted when core hole SHB-4 was drilled for the Laboratory's Seismic Hazards Program (Gardner et al. 1993, 012582). During drilling of SHB-4, wet core samples were returned from depths of approximately 125 to 145 ft bgs within the lower part of the Cerro Toledo interval or upper Otowi Member (Gardner et al. 1993, 012582). The perched-intermediate zones beneath Pajarito Canyon probably result from local infiltration along the canyon floor that supports perennial, perched alluvial groundwater in this area. There may also be a component caused by lateral propagation of large-scale, mountain-front aquifer recharge occurring to the west of MDA H.

Perched-intermediate water was also encountered at wells R-37 and R-52, which are located on a narrow mesa between the north and south forks of Cañada del Buey (Appendix E, Figures E-2.1-3 and E-2.1-4). Well R-37, located 0.5 km east-northeast of MDA H, was originally intended as a regional aquifer monitoring well for MDAs H and J. Because perched groundwater was encountered during drilling at this location, well R-37 was built with two well screens (Appendix E): screen 1 was completed in perched-intermediate groundwater, and screen 2 was completed in the regional aquifer (LANL 2009, 107116). During drilling at R-37, perched groundwater was first noted in basaltic gravels underlying the Cerros del Rio basalt. Water levels for this perched zone stabilized at approximately 912 ft bgs in the lower part of the basalt. R-37, screen 1 targets the basaltic gravels. Underlying silts and fine sands do not appear to be as productive and, together with the deeper claystone deposits (956–991 ft bgs), may represent the perching horizons. At R-37, the vertical distance between the perched-intermediate zone and the regional aquifer is approximately 70 ft (similar to the distance at R-40; see above and Appendix E); the small vertical separation suggests that there may be limited hydraulic separation between the two zones. A similar perched groundwater zone was encountered when regional aquifer monitoring well R-52 was drilled 0.3 km northeast of MDA H (LANL 2010, 110533). The perched-intermediate zones encountered at wells R-37 and R-52 may result from local infiltration along Pajarito Canyon, Cañada del Buey, or even Mortandad Canyon to the north. In addition, there may be a component caused by lateral propagation of large-scale mountain-front aquifer recharge occurring to the west of MDA H.

It is uncertain whether the perched-intermediate zones observed at R-40 screen 1, R-51, R-37 screen 1, and R-52 are connected and extend beneath MDA H (Figures E-2.1-2, E-2.1-3, and E-2.1-4). Such a connection is considered possible given the substantial thickness of the perched zones and their relative

high groundwater capacity. However, differences in water chemistry between the different perched-intermediate zones indicate some separation between these groundwater zones, as supported by evidence presented in Appendix D. The perched-intermediate zone groundwater at R-37 screen 1 has different major ion chemistry and trace metal chemistry than perched-intermediate zone groundwaters at R-40i and R-40 screen 1. In addition, 1,4-dioxane and tritium are detected at R-37 screen 1, but these constituents are not detected at R-40i and R-40 screen 1. However, other constituents indicate potential mixing of waters at R-37 screen 1 and R-40 screen 1.

Wells R-37 screen 1, R-40 screen 1, and R-40i are well-positioned to provide adequate monitoring of perched-intermediate groundwater in the vicinity of MDA H. These wells monitor the potential early arrival of contaminants above the regional water table. The perched-intermediate zones may discharge into the regional aquifer downgradient of MDA H and could locally impact the water-level contours (see section 2.3.5).

2.3.5 Regional Aquifer Hydrology and Groundwater Monitoring Network

The regional aquifer beneath the Pajarito Plateau occurs at depths between 1200 ft (366 m) along the western edge of the Pajarito Plateau and approximately 600 ft (183 m) along the eastern edge. Beneath MDA H, the regional water-table elevation is approximately 5810 ft amsl or approximately 900 ft (300 m) bgs. The regional water table is observed within the Puye Formation beneath MDA H (Figures E-2.1-2, E-2.1-3, E-2.1-4, and E-2.1-12, Appendix E). The regional water-table map is shown in Figure E-3.3-1 of Appendix E and reflects new data collected at recently installed regional wells in the vicinity of MDA H.

As with the conditions observed elsewhere beneath the Pajarito Plateau, the regional aquifer beneath MDA H is a complex heterogeneous system that includes deep, predominantly confined zones and shallow, predominantly unconfined zones. There are no lithologic observations that demonstrate the existence of clearly defined aquitards or confining layers that provide hydraulic separation between the deep and shallow zones of the regional aquifer. However, the vertical hydraulic stratification of the regional aquifer has been observed at numerous aquifer locations where there are deep and shallow monitoring well screens. The vertical hydraulic stratification is indicated by (1) pronounced vertical differences in hydraulic heads and (2) a lack of vertical propagation of pumping drawdown caused by pumping tests and water supply-well pumping. The vertical stratification of the regional aquifer is also demonstrated by the PM-2 spinner test (LANL 2009, 106939, Appendix J). The vertical hydraulic separation is most likely caused by pronounced vertical aquifer anisotropy; that is, the lateral permeability is substantially higher than the vertical permeability. The anisotropy is probably caused by the depositional layering of the hydrostratigraphic units. Based on the existing observations, the degree of hydraulic communication between these zones is (1) relatively poor and (2) spatially variable depending on local hydrogeologic conditions and hydrostratigraphy. The poor hydraulic communication between the two zones does not preclude the possibility that some contaminant migration may occur between the shallow and deep zones. Between the two zones, the hydraulic gradient has a downward vertical component because of water-supply pumping in the deep zone, creating the possibility that downward contaminant flow may occur along “hydraulic windows,” although these flows have not been directly observed.

The groundwater flow in the regional aquifer beneath MDA H is predominantly to the northeast. The upper portions of the regional aquifer are under phreatic (unconfined) conditions. The direction of the potential contaminant transport in the regional aquifer is expected to follow the hydraulic gradients along the regional water table, although the heterogeneity and stratification of the Puye Formation may cause permeability anisotropy that could lead to deviations from the predominant flow direction. In the area downgradient of MDA H, the direction of the regional aquifer flow is believed to be dominantly toward the

northeast, based on regional water-table maps. However, there is some uncertainty about the flow regime related to (1) eastward thinning of the Puye Formation at the top of the regional aquifer and (2) decreased depth of the Santa Fe Group sediments below the regional water table in the area between wells R-37 and R-34 (Figures E-2.1-2 through E-2.1-4). The regional structure of the groundwater flow in the aquifer in the area near MDA H may also be impacted by (1) water-supply pumping; (2) the local-scale infiltration recharge along Pajarito Canyon and, to a far lesser extent, Cañada del Buey; (3) the lateral propagation of large-scale mountain-front aquifer recharge occurring to the west of MDA H; and (4) the presence of Cerros del Rio lavas within the regional aquifer east of MDA H (Figures E-2.1-2, E-2.1-3, E-2.1-4, and Figure E-2.1-12; Appendix E). Hydrogeologic factors affecting groundwater flow directions and their uncertainties are further discussed in Appendix E.

The deeper portions of the regional aquifer beneath TA-54 are predominantly within stratified sedimentary deposits of the Chamita Formation (Figures E-2.1-2, E-2.1-3, and E-2.1-4, Appendix E). Hydrodynamically, the deeper portion of the aquifer is under confined conditions, and it is stressed by Pajarito Plateau water-supply pumping; the deep section pumped by the water-supply wells is approximately 120 ft beneath the regional water table. The intensive pumping causes small water-level fluctuations in the shallow phreatic zone. Based on the existing hydrogeological information, it has either already been observed or is expected that all the monitoring wells located in the vicinity of MDA H (R-51, R-52, R-37, and R-40) respond to the water-supply pumping at PM-2 and PM-4 (Table E-3.1-2). Currently, the largest pumping-induced seasonal fluctuations in the shallow phreatic zone near MDA H occur at R-20 screen 1, which varies up to 0.6 ft (0.2 m) (LANL 2009, 106939, Appendix M). Well R-20 is located 0.25 mi east-southeast of well PM-2 (Figure 2.3-5). These low-magnitude responses in the phreatic zone from municipal well pumping are in sharp contrast to the larger responses (up to 10 to 20 ft) at monitoring well screens completed in deeper parts of the aquifer (e.g., R-20 screen 3 [now plugged and abandoned]; see LANL 2009, 106939, Appendix M), indicating that the hydraulic communication between the phreatic zone and deeper parts of the aquifer is poor. Regardless of the poor hydraulic communication between the deep and shallow sections of the aquifer, it is plausible that the shape of the regional water table is influenced by the water-supply pumping at PM-2 in the area southeast of MDA H (near wells R-40, R-20, and R-54) (Figure E-3.3-2, Appendix E). The poor hydraulic communication between the two zones suggests that the dominant transport of potential contaminants would occur within the phreatic zone, but it does not preclude the possibility that lesser migration of potential contaminants would occur between the shallow and deep zones. Between the two zones, the hydraulic gradient has a downward vertical component because of water supply pumping in the deep zone, creating the possibility that downward contaminant migration may occur along highly permeable aquifer features, which create hydraulic connection between the deep and shallow regional aquifer zones (also called “hydraulic windows”). However, such aquifer features and downward contaminant migration have not been directly observed.

There is an effective regional groundwater monitoring network around MDA H. Two monitoring wells are located downgradient of MDA H (R-52 and R-37), and one well is located upgradient (R-51). R-40 may also be considered a potential downgradient well because it is located between MDA H and PM-2, and it provides the ability to detect contaminants that may be drawn toward PM-2 by water-supply pumping. All the monitoring wells are screened near the top of the regional aquifer in relatively permeable sedimentary deposits. Hydrogeologic data suggest that the screened regional aquifer zones at the monitoring wells near MDA H are either unconfined or partially confined. This suggests that the upper regional well screens and the regional water table are hydraulically connected and that the screens are well placed to monitor for the arrival of contaminants at the water table.

2.4 Summary of Previous Investigations

MDA H has been the subject of numerous investigation activities. Phase I RFI activities were initially conducted in 1994 and 1995. Additional RFI activities were conducted in 2001 and 2002, and ongoing pore-gas monitoring activities continue at the site. Investigation activities are summarized in the following sections.

2.4.1 Summary of Phase I RFI

Initial Phase I RFI activities were conducted at MDA H in 1994 and 1995 (LANL 2001, 070158). Additional RFI activities were conducted in 2001 and 2002 to address data gaps identified by NMED during review of the RFI report (LANL 2001, 070158). The 1994–1995 investigation activities included sediment sampling in the drainage between the mesa-top outfall and Pajarito Canyon and the installation and sampling of four boreholes near MDA H. The 2001–2002 investigation activities included additional sediment sampling, installation of an ambient-air monitoring station adjacent to MDA H, installation of two additional boreholes, and sampling of the two new boreholes and one existing borehole. The results of the initial Phase I RFI activities are documented in the RFI report for channel sediment pathways from MDAs G, H, J, and L (LANL 1996, 054462) and the RFI report for MDA H (LANL 2001, 070158). Results of the 2001–2002 investigation activities are documented in the addendum to the RFI report for MDA H (LANL 2002, 073270). A summary of the 1994–1995 and 2001–2002 investigation sampling results is provided in Tables 2.4-1 through 2.4-9.

Constituents were further evaluated during the 2001–2002 RFI to identify the COPCs present. These COPCs are presented in Table 2.4-10.

For the risk-screening assessments performed in the RFI, residential land use was considered to be most restrictive, and therefore, the potential present-day risks were evaluated using this scenario (LANL 2001, 070158, p. 43). Human health and ecological risk screening assessments performed as part of the RFI report (LANL 2001, 070158) concluded that MDA H poses no unacceptable present-day risk to human health and the environment.

All the carcinogenic COPCs were detected below their respective screening action levels (SALs, named soil screening levels [SSLs] in current risk screening assessments), and the total potential cancer risk was calculated to be 1×10^{-7}, which is below NMED's target risk level of 1×10^{-5} (LANL 2001, 070158, p. 43).

All of the noncarcinogenic COPCs were detected below 10% of their respective SALs, indicating that exposure to either one or all of these COPCs do not present an unacceptable risk. The hazard index (HI) for noncarcinogenic COPCs was calculated to be 0.04, well below the NMED's target HI level of 1.0 (LANL 2001, 070158, p. 44).

The RFI addendum (LANL 2002, 073270) concluded that the additional data were sufficient to address the data gaps relating to tritium in the air and tuff as well as the nature and extent of contaminants in the sediments. The additional data did not change the conclusions of the earlier RFI with respect to potential human health or ecological risks. The RFI addendum also proposed collecting ambient-air VOC data to confirm the conclusion, based on pore-gas data, that subsurface ambient-air VOC concentrations were negligible. Acetone, detected in two samples from 5.1 to 6 ppb, was the only analyte identified during the 2003 ambient-air sampling data.

2.4.2 Summary of Transport Modeling Performed for the 2005 MDA H Corrective Measures Study

A system-level transport model for MDA H was developed using the GoldSim computer code and presented in the corrective measures study (CMS) report for MDA H (LANL 2005, 089332). The GoldSim model was used to simulate biotic transport, soil erosion, and aqueous-phase and gas-phase (radon and tritium) subsurface migration over time for chemicals present in the waste shafts at MDA H (LANL 2005, 089332; Appendix H). The GoldSim model incorporated input from more detailed, process-level models. Figure 2.4-1 shows the process-level models that supported the GoldSim system-level model, which combined

- shallow infiltration and leakage through the top of the waste (represented using the code HELP),
- vadose zone flow and transport (using the code FEHM),
- biointrusion (using internal functionally within GoldSim),
- migration to groundwater (GoldSim), and
- erosion (GoldSim).

The model evaluated the combined effects of these environmental processes on contaminant concentrations over 1000 yr in possible exposure media.

For the model, the waste inventory of the nine disposal shafts at MDA H is represented as a single shaft divided into an upper and lower waste cell. The upper waste cell was considered to be the upper 17 ft of the waste in all nine shafts, which is considered to be available to biota (e.g., plant rooting or animal burrowing). It was assumed that all contaminants in the disposed wastes except uranium were immediately available for release and transport regardless of their physical form or packaging. The MDA H area was assumed to be covered with 1 cm of a gravel mulch cap, which was estimated to last 50 yr. The upper-bound concentrations of chemicals in surface soil over time as a result of erosion and biointrusion processes were estimated and found to be lower than background levels over the 1000-yr modeling period (LANL 2005, 089332, Table H-3.0-1). Over the course of 1000 yr, cumulative soil erosion is calculated to be approximately 8.5 cm. In addition, contaminants are not predicted to reach groundwater at measurable concentrations within the 1000-yr modeling period (LANL 2005, 089332, p. F-15). Long-term impacts to human health from site exposure are calculated to be below levels of concern for the entire 1000-yr period (LANL 2005, 089332, pp. H-36 through H-39).

2.4.3 Fracture Flow Study

An alternate groundwater-pathway risk assessment for fracture-facilitated contaminant transport was conducted to determine whether an alternate conceptual model of fracture-facilitated transport would result in different risks than those calculated using the original matrix-dominated conceptual model that was presented in the original CMS report for MDA H (LANL 2005, 089332; Appendix O). The results indicated that the addition of fracture flow to the matrix-flow evaluation decreases the time required for contaminants to be transported through the upper fractured tuff units. Even with the addition of fracture-facilitated transport, however, contaminants would not reach, and therefore not impact, the regional aquifer for several hundred to several thousand years.

2.4.4 Summary of Pore-Gas Monitoring

Quarterly pore-gas monitoring activities have been conducted at MDA H since the second quarter of fiscal year (FY) 2005 to characterize VOC and tritium concentrations present in the vadose zone beneath MDA H. Currently, pore-gas monitoring activities are implemented quarterly as directed by NMED in a June 23, 2009, letter to the Laboratory (NMED 2009, 106234).

Pore-gas monitoring activities at MDA H currently include screening 28 sampling ports in 4 vapor-monitoring boreholes. VOC and tritium samples are collected quarterly from each of the 28 sampling ports within each stratigraphic unit. Pore-gas monitoring borehole locations are shown in Figure 2.3-3 and are presented in Table 2.4-11.

Results of long-term pore-gas monitoring activities at MDA H have concluded that tritium is the primary constituent in the subsurface at MDA H. VOCs are present at low concentrations in subsurface vapor. The screening method presented in the PMRs (shown in Table 2.4-12) uses Henry's law to identify the vapor-phase VOC concentration threshold that would have to be exceeded for a given VOC to potentially impact the groundwater at concentrations exceeding applicable groundwater standards. No VOCs detected in pore gas exceed the groundwater screening comparison. The VOCs measured at MDA H monitoring locations pose no potential threat to groundwater. The nature and extent of VOCs detected in pore gas are discussed in section 3.2.3 and in Appendix D.

2.4.5 Summary of Pajarito Canyon Investigation

Sediment, surface water, and groundwater data are collected as part of the canyons investigations. These data are very useful in determining whether SWMUs (particularly those with outfall/mesa slope aspects) have contamination or release histories that manifest in the canyon floor and whether they are at levels that represent unacceptable human health risk or adverse ecological affects. These data are presented in canyons investigation reports. For MDA H, potential releases are discussed within this and previous documents (LANL 2001, 070158; LANL 2002, 073270) that address nature and extent from the subsurface units that constitute MDA H.

For this section, the data from Pajarito Canyon, located south of MDA H, are used to address potential impacts from MDA H on shallow surface media, including sediment, surface water, alluvial groundwater, and biota. The possible impact of releases from MDA H on sediment in Pajarito Canyon was evaluated using data collected from a sediment investigation at reach PA-3 East, which is downcanyon from MDA H (LANL 2009, 106939). These sediment data indicate no recognizable impacts from MDA H in canyon-bottom sediments. The spatial distribution of COPCs indicates that TA-09, TA-18, and possibly TA-16 are the main sources of mobile contaminants in surface water and groundwater in Pajarito Canyon. Groundwater data from alluvial wells located upgradient and downgradient of MDA H also indicate no recognizable impacts from MDA H in alluvial groundwater. Biota investigations for the segment of Pajarito Canyon adjacent to MDA H also indicate no adverse effects.

2.5 Status of Groundwater Monitoring

Groundwater monitoring at the Laboratory is currently conducted in accordance with the 2010 Interim Facility-Wide Groundwater Monitoring Plan (IFGMP) (LANL 2010, 109830). The monitoring at TA-54 provides the basis for accurately describing the groundwater conditions beneath TA-54, including MDA H. The groundwater monitoring network for TA-54 includes both perched-intermediate and regional wells (Figure 2.3-5). The monitoring well network at MDA H includes one new regional well, R-52, drilled in 2010 that is part of the overall effort to further characterize the groundwater conditions.

At TA-54, groundwater monitoring is being conducted to support both the corrective measures process for SWMUs under the Consent Order and in support of the RCRA permit for operating units within TA-54. The Consent Order (Section IV.A.1) states, “Implementation of the groundwater monitoring requirements of this Consent Order will fulfill the groundwater monitoring requirements of the Hazardous Waste Regulations, 20.4.1.500 4103 NMAC (incorporating 40 C.F.R. Part 264, Subpart F).”

Groundwater characterization for TA-54 is conducted with perched-intermediate well screens at R-40i, R-40 screen 1, R-23i, R-37 screen 1, and R-55i and at 18 regional wells: R-20, R-21, R-22, R-23, R-32, R-37, R-38, R-39, R-40, R-41, R-49, R-51, R-52, R-53, R-54, R-55, R-56, and R-57 (Figure 2.3-5). R-22 is not currently sampled because the sampling system was pulled for redevelopment. Final disposition of the well is being determined. The actively sampled wells have one or two screens, all of which are equipped with purgeable sampling systems. Wells specific to MDA H include wells R-37, R-40, R-40i, R-51, and R-52 as detailed in Table 2.5-1. Table 2.5-2 shows the monitoring frequency and analytical suites specified for the active screens in these wells in the 2010 IFGMP (LANL 2010, 109830). Each screen is also equipped with a dedicated pressure transducer for continuous monitoring of groundwater levels.

Data from the groundwater monitoring network around TA-54 show sporadic detections of a variety of potential contaminants, including several VOCs, general inorganic chemicals, trace metals, and tritium (Appendix D). The temporal and spatial nature of the occurrences do not, however, clearly indicate the presence of a discernable plume or a source related to MDA H or other sources at TA-54 (LANL 2009, 106939). Further evaluation of existing groundwater data for MDA H is included in section 3.2.4 of this report.

3.0 SITE CONDITIONS

The following subsections summarize the surface and subsurface conditions at MDA H.

3.1 Surface Conditions

The disposal shafts were drilled into the native tuff. Currently, MDA H has a vegetated surface above Shafts 1 through 8 that has been contoured to direct surface runoff away from the shafts and off-site. Shaft 9 has a concrete plug that is exposed at the surface.

MDA H is posted as an NES and is surrounded by an 8-ft-high chainlink fence. MDA H is under the control of the DOE and the Laboratory, which plan, control, and restrict all land use at TA-54. Access is gained through a locked gate only. No on-site activity may be conducted without prior review and approval of the activity by the facility manager. Access to Pajarito Road is also restricted to Laboratory employees.

3.2 Subsurface Conditions

The subsurface conditions, including the utilities and the disposal shafts as well as the nature and extent of vadose zone and groundwater contaminants, are detailed below.

3.2.1 Subsurface Utilities

There are no subsurface utilities within the MDA H fence line. Subsurface utilities adjacent to MDA H are shown in Figure 2.3-3.

3.2.2 Disposal Shafts

The MDA H disposal shafts are 6 ft in diameter and 60 ft deep. The shafts are unlined and filled with waste to 6 ft bgs. In eight of the nine disposal shafts (Shafts 1 through 8), the upper 6 ft is sealed with 3 ft of concrete beneath 3 ft of crushed tuff, while the upper 6 ft of the remaining shaft (Shaft 9) is sealed with 6 ft of concrete. The 6-ft-diameter concrete plug, with either the 3- or 6-ft-thick concrete seal, provides protection against erosion and intrusion by environmental receptors (i.e., deep-rooting plants and burrowing animals) and human receptors.

3.2.3 Nature and Extent of Vadose Zone Contaminants

Subsurface VOC vapors are present in the vadose zone within the mesa at MDA H and are monitored at four pore-gas monitoring boreholes (Figure 2.3-3). The source of VOC vapors in the subsurface at MDA H is thought to be residual contamination from wastes in the shafts (Omicron 2003, 075940). Volatilization of VOCs is probably responsible for very low soil-vapor concentrations currently detected in the periodically sampled pore-gas boreholes. However, the low concentrations do not pose a risk to groundwater, based on screening values presented in the PMRs from the pore-gas vapor samples at MDA H (e.g., LANL 2010, 111123) (Table 2.4-11).

Appendix B provides an estimate of the total mass of VOCs found at MDA H. The estimated mass, based on vapor-monitoring results from June 2010 (LANL 2010, 111123), is 2.1 kg (4.6 lb). The results from the June 2010 monitoring showed 26 VOCs were present in samples. Most of the estimated mass is associated with alcohols (approximately 70%) and ketones (approximately 25%). An estimated 5% of the total estimated mass, approximately 0.1 kg (0.22 lb), is associated with halogenated VOCs, which are generally a greater threat to groundwater. Most halogenated VOCs were found in only a few of the 28 sampling ports being monitored. For the VOCs detected most frequently, the highest concentrations were detected in the sampling ports in units Qbt 1v and Qbt 1g (60 to 205 ft bgs) and decreased with depth in the lower units (Qct and Qbo).

Inorganic chemicals were disposed of at MDA H, but few have been observed above the background values (BVs) in core samples collected at the site. Although these inorganic chemicals migrate as waterborne contaminants, their transport is controlled by vadose zone water percolation rates, which are low in the unsaturated zone beneath MDA H, generally estimated to be less than 1 mm/yr (Newman et al. 2005, 099163). During RFI activities, copper was detected at concentrations above the BV in the uppermost core samples from each of the four boreholes (LANL 2001, 070158, p. 39). However, the concentration of copper decreased with depth. Cyanide and selenium had detection limits (DLs) above BVs, but were not detected in the vadose zone. These results indicate little, if any, migration of metals and other inorganic chemicals from the disposal units.

3.2.4 Nature and Extent of Groundwater Contaminants

Groundwater monitoring at TA-54 provides the basis for accurately describing groundwater conditions beneath TA-54. To evaluate the potential impact of MDA H on water quality in the regional aquifer, a screening protocol was implemented to evaluate the presence of contaminants in groundwater from wells that compose the monitoring network for MDA H (Appendix D). The MDA H network wells include the following five upgradient and downgradient regional wells: R-37, R-40, R-40i, R-51, and R-52 (Figure 2.3-5). Table D-1.0-1 summarizes well installation and rehabilitation dates and the number of groundwater sampling events at each well as of May 2011. At least four quarters of groundwater data are available for each of these wells.

In Appendix D, validated water-quality data available for the wells as of August 2011 are screened against one-half of the groundwater cleanup level as well as against the Laboratory's groundwater BVs (for naturally occurring constituents). A summary of all chemicals detected at these wells relative to these screening levels is presented in Appendix D. Evaluation of these screening results in Appendix D considers factors such as frequency of detection, data for corresponding quality assurance/quality control samples such as field duplicates and blanks, persistence, trends, and relationship to field activities at a well such as redevelopment or installation of a sampling system.

Three trace metals exceeded the lowest applicable groundwater standards at least once: antimony (at R-40 screen 1), iron (at R-40i), and manganese (at R-40 screen 1 and R-40i). The conditions under which these exceedances occurred are generally attributed to residual effects of drilling and to the location of R-40 screen 1 in a low-permeability formation that cannot produce sufficient water to purge the well screen before sampling (Appendix D). No organic constituents exceeded the lowest applicable groundwater standards in water-quality samples collected from one of the monitoring wells near MDA H.

Based on the analysis in Appendix D, there is no compelling evidence that contaminants sourced at MDA H are present at any MDA H groundwater monitoring wells. At R-37 screen 1, 1,4-dioxane has been detected several times above one-half of its standard, and tritium is also detected routinely (at a low level) at this perched-intermediate screen (section D-4). These constituents may be local contaminants in the perched-intermediate aquifer at this location, but, as discussed in Appendix D, sources other than MDA H are more likely.

TA-54 monitoring network wells, including those specific to MDA H, will continue to be sampled on a quarterly basis, consistent with the 2010 IFGMP (LANL 2010, 109830). However, it is noted that water-quality sampling of the uppermost screen in R-40 is proposed to be discontinued in the 2011 IFGMP (LANL 2011, 205231) for the reason mentioned above.

4.0 CONCEPTUAL SITE MODEL FOR MDA H

A CSM is a representation of site conditions that conveys what is known or suspected about the sources, releases and release mechanisms, contaminant fate and transport, exposure pathways, potential receptors, and risks. Conceptual site models are developed based on analyses and interpretations of existing site knowledge, observations, and data. They describe potential contaminant sources, release mechanisms (i.e., transport pathways), exposure media, and potential receptors (EPA 1989, 008021, pp. 4-10). The sources, pathways, and receptors applicable to MDA H are shown in Figure 4.0-1. The MDA H CSM was used to support risk-based decision making and as an aid in identifying potential remedial alternatives.

The CSM that displays the release mechanisms from the sources (the disposal shafts) to potential receptors and the resulting risks are shown in Figure 4.0-2. In addition, the CSM diagram describes whether the exposure pathways are complete under current and future site conditions. For the future scenario, it is assumed that institutional controls are not maintained and no remedy is implemented. Current and future risks are also qualitatively evaluated for the purpose of this CME.

4.1 Primary Sources of Contamination

The primary source of contamination is buried waste in the nine disposal shafts. MDA H was used as the Laboratory's site for disposal of security-classified, solid-form waste from 1960 to 1986. Radioactive materials and hazardous wastes were disposed of in the shafts at MDA H (see sections 2.1 and 2.2). The

hazardous contaminants disposed of at MDA H included heavy metals, inorganic chemicals, graphite, plastic, HE, and residual quantities of VOCs. For the purposes of this CME report, the CSM specifically applies to the transport and risks associated with the hazardous constituents.

4.2 Primary Release Mechanisms

Six primary release mechanisms for the waste from the shafts were identified (Figure 4.0-2). These include releases of shaft waste by (1) biointrusion/leaching into subsurface soils, (2) volatilization of organic compounds into the soil vapor, (3) excavation, (4) biointrusion/surface erosion, (5) cliff retreat/seismic events, and (6) disruption/dispersal.

The primary release mechanism, biointrusion into the waste, has the potential to spread contaminants into subsurface soils or to the surface through (1) absorption/uptake of soluble chemicals by plant roots or (2) movement of wastes by burrowing animals. For plants common to Mesita del Buey, roots are most abundant in the upper 6.6 ft (2 m) but may extend deeper for some shrubs and trees (Tierney and Foxx 1987, 006669). Burrow depths for ants and small mammals are generally less than 3.3 ft (1 m), although a small fraction of burrows extend to depths of 6.6 ft (2 m) (Tierney and Foxx 1987, 006669). The rooting and burrow depths cited are similar to the estimated shaft cap thicknesses with concrete extending from 3 to 6 ft (0.9 to 1.8 m) bgs for eight of the shafts (Shafts 1 through 8) and from 0 to 6 ft (0 to 1.8 m) bgs for the other shaft (Shaft 9). Shallow-rooting plants and animal burrows are present at MDA H, and some intrusion into the waste is possible, although the concrete covering the shafts will limit intrusion. The site is periodically mowed to reduce combustible plant material when needed, but plants are generally left in place to limit erosion. Under the future conditions assumed in the CSM, which include further loss of cover maintenance, deeper-rooted plant communities and larger animal populations may be established.

The other part of the biointrusion primary release mechanism is leaching. The leaching of wastes into the subsurface soils beneath and adjacent to the shafts potentially occurs at the site. Leach rates are expected to be controlled by infiltration rates, which are estimated to be less than 1 mm/yr because MDA H is vegetated (section 2.3.4). Investigation data indicate little, if any, migration of heavy metals and other inorganic chemicals because of leaching from the disposal units (section 3.2.4 and LANL 2001, 070158, p. 39).

Another primary release mechanism, volatilization of VOCs, is probably responsible for very low soil-vapor concentrations currently present. The source of VOC vapors in the subsurface at MDA H is believed to be residual contamination from cleaning solvents on machined parts and minimal amounts of waste oil (potentially mixed with solvents) (Omicron 2003, 075940). The concentrations are low enough that they do not pose a risk to groundwater, based on screening values presented in the PMRs for vapor sampling at MDA H (e.g., LANL 2010, 111123). In addition, a VOC mass balance presented in Appendix D indicates very small amounts of VOCs currently present at the site; a total VOC mass of 2.1 kg is estimated with 0.1 kg because of chlorinated VOCs.

The third primary release mechanism is inadvertent excavation into the shafts. The concrete plugs above the shafts may inhibit excavation. Exposure by excavation is a function of the volume and depth of waste removed and will depend largely upon site access. Excavation into wastes is currently prohibited by site controls, but lack of these controls in the future may increase the potential for this release mechanism.

Erosion (coupled with biointrusion) is the fourth primary release mechanism that can expose waste. For the most part, surface erosion will result in a gradual thinning of the crushed tuff covering the shafts and of the mesa itself over extended periods of time, and eroded sediments will be transported into the adjacent canyons. However, the quantities and intensities of precipitation falling on the site will influence the generation of surface runoff and, hence, the rates and patterns of erosion (Wilson et al. 2005, 092034).

Exposure of the waste by cliff retreat is the fifth primary release mechanism that is not currently observed because the shafts are set back approximately 75 ft from the southwestern edge of the mesa. However, cliff retreat and seismic events are release mechanisms that may expose wastes in the future (Appendix E).

Disruption and dispersal of the waste is the sixth primary release mechanism that could be caused by sparks, friction, heat, physical impacts, waste pinching, air, and/or moisture interacting with the waste in the future (i.e., HE). However, explosives-containing wastes left undisturbed in the shafts at MDA H are expected to be stable (Appendix C).

4.3 Secondary Sources of Contamination

Two secondary sources, subsurface soils and soil vapor, are generated directly from primary release mechanisms (Figure 4.0-2). Surface soils are also included as a secondary source because migration of contaminants from subsurface soils to surface soils can occur through biointrusion, volatilization, excavation, erosion, and/or subsidence.

4.4 Secondary Release Mechanisms

Several secondary release mechanisms can further spread contaminants from secondary sources toward potential receptors (Figure 4.0-2). For surface soils, the secondary release mechanisms are (1) stormwater runoff and erosion, (2) volatilization/vapor diffusion, (3) excavation, (4) biointrusion, and (5) wind. For subsurface soils, the secondary release mechanisms are (1) leaching, (2) volatilization/vapor diffusion, (3) excavation, and (4) biointrusion. For soil vapor, the only secondary release mechanism is vapor transport.

Erosion, excavation, and biointrusion affect migration for contaminants mixed with surface and subsurface soils, much like the primary release mechanism for waste (described above, section 4.2) because much of the waste material is surrounded by crushed tuff.

Currently, limited contaminant transport by the secondary release mechanism, stormwater runoff and erosion of surface soils, occurs at MDA H. No surface release or residual contamination is evident or documented for MDA H (LANL 2001, 070158, p. 38). Past sampling of drainage channels surrounding MDA H indicates that lead was the only inorganic chemical detected above the sediment BV in the drainage channel but was similar to BVs (LANL 2001, 070158, p. 38). Yet, these release mechanisms will become slightly more likely if cover maintenance is discontinued. Another secondary release mechanism, volatilization and vapor diffusion of VOCs, can occur from both surface soils and subsurface soils with subsequent migration in soil vapor. VOCs in waste or in pore water volatilize to form soil vapor as determined by Henry's law partitioning, and these vapors can diffuse upward to the surface or downward toward the groundwater. However, surface flux measurements showed near zero releases of VOCs to the surface at MDA H (Trujillo et al. 1998, 058242); soil-vapor concentrations are low enough that they do not pose a risk to groundwater based on the soil-vapor concentrations presented in the PMRs for MDA H (LANL 2010, 111123).

The secondary release mechanism, leaching of contaminants from the disposal units into the subsurface soils and downward migration by percolating water, will occur at a slow rate because of minimal water infiltration from the surface of MDA H, as discussed in section 4.2. Travel times because of the leaching of dissolved-phase, nonsorbing species (such as general inorganic anions and nonvolatile organic compounds) from the source areas to the regional aquifer are predicted in excess of several hundred years under this scenario, assuming uniform subsurface groundwater flow (LANL 2005, 089332).

Adsorbing contaminants, like positively charged metals, have longer travel times than the nonadsorbing constituents. In addition, most of the waste at the site (>57% and possibly as high as 80%) is in solid metal form and therefore would not readily be leached by any infiltrating water (Figure 2.2-1). Both vadose zone and regional groundwater data for inorganic and organic chemicals indicate that this release mechanism does not pose a threat to groundwater.

The secondary release mechanism for soil vapor consists of vapor diffusion through the tuff units and a combination of vapor diffusion and advection (i.e., the horizontal transfer of a property such as heat, caused by air movement), in the basalt.

4.5 Exposure Media

Contact with contaminated environmental media creates exposure pathways for both human and ecological receptors. Seven potential exposure media are identified for MDA H: (1) sediment, (2) surface water, (3) air, (4) soil, (5) dust, (6) groundwater, and (7) waste (Figure 4.0-2).

4.6 Receptors and Risks

Three potential receptors are identified: (1) human, (2) ecological, and (3) groundwater. Groundwater is included above as an exposure medium because it is used by both human and ecological receptors. Groundwater is also included in the CSM as a receptor because it is a resource. Human and ecological receptors may be exposed to potentially contaminated media if pathways become complete through exposure routes such as inhalation, ingestion, or dermal contact. The air pathway from surface soils includes releases both to outside air and for vapor intrusion into buildings. Risks to human health and the environment (noted as HH and Eco in Figure 4.0-2) may occur if elevated concentrations of contaminants are present in the exposure media.

Both current and future risks are qualitatively evaluated in Figure 4.0-2. The future risk scenario assumes lack of institutional controls. Assessment of future risk is informed in part by predictions made for the 2005 MDA H CMS report (LANL 2005, 089332), as summarized in section 2.4.2.

Under current conditions, several transport pathways are considered to be potentially complete.

- Based on field data, the stormwater runoff and erosion pathways are potentially complete. The risk from exposure is very low because current surface and subsurface contaminant levels do not pose an unacceptable risk to human health (LANL 2001, 070158, p. 54).
- The biointrusion pathway is considered to be complete for surface soils and for subsurface soils and potentially complete for wastes. Whether the biointrusion pathway is complete depends on the depth because the density of plant roots and animal burrows decreases with depth (section 4.2). The waste is in the form of metal pieces, which are not readily degraded for immediate uptake by plants or animals. Therefore, the risk from exposure is very low. The concrete covers on the shafts also help to minimize exposure.
- Erosion of the subsurface soil directly above the waste is a potentially complete pathway. However, modeling predicted approximately 0.3 ft of cumulative soil erosion over a 1000-yr period at MDA H (LANL 2005, 089332). The waste is currently at least 6 ft bgs. The very low exposure risk is based on uncertainty related to the erosion rate, waste inventory, and concentrations of hazardous contaminants in the waste.
- All other pathways to human health and ecological receptors as well as to the groundwater (i.e., volatilization/vapor diffusion, excavation, wind, and diffusion/volatilization/vapor transport to

groundwater, disruption/dispersal, and cliff retreat/seismic events) are currently considered to be incomplete.

- In addition, the leaching pathway for both the vadose zone and regional groundwater is currently incomplete for both inorganic and organic chemicals.

Under future conditions, the transport processes have time to develop, and pathways may become complete. For the CSM, no institutional controls are assumed to remain. These changes impact the following pathways and exposure scenarios. Most risks are for human health and ecological receptors unless groundwater is specified.

- Stormwater runoff and erosion of surface soil/sediment may result in complete pathways for exposure to sediment and surface water. The future risk of these pathways is considered to be very low because surface soil concentrations would not contain any shaft contaminants (LANL 2005, 089332, p. H-21).
- The air pathway (via volatilization/vapor diffusion) remains incomplete for VOCs because of the low vapor concentrations of the VOCs in the shafts (LANL 2010, 111123) and the small estimated mass of chlorinated VOCs (Appendix B).
- Wind may result in a complete pathway for exposure to dust. The future risk of this pathway is considered to be very low because surface soil concentrations would be low (LANL 2005, 089332, p. H-21).
- The potential for excavation into surface soils, subsurface soils, and waste increases in the future if people inadvertently enter the site. Exposure risks are very low from surface soils, low from subsurface soils, and medium from waste. Soil concentrations are assumed to increase with depth because of a greater likelihood of the soil mixing with waste. The assumed future medium exposure risk that would result from excavation of waste is because of the potential for the pyrophoricity (i.e., capable of igniting spontaneously when exposed to air) and shock sensitivity of the material disposed of in the shafts (Appendix C).
- Whether the biointrusion pathway is complete under future conditions depends on the depth because the density of plant roots and animal burrows decreases with depth. However, without maintenance, the surface soil will degrade and erode with time. Under the future scenario, the pathway is considered to be complete for surface soils and subsurface soils and potentially complete for wastes. Future exposure risks are assumed to be low because of the nature of the metal waste forms, which are generally low-solubility, solid material parts that would very slowly release contaminants in transportable/bioavailable form (LANL 2005, 089332, p. H-2).
- Leaching of water soluble contaminants from subsurface soils to groundwater is considered to be a potentially complete future pathway. However, completion of the pathways is expected to occur over a long time frame (e.g., several hundred to several thousand years) because of low mesa-top infiltration rates, the distance to groundwater, and because many of the water soluble contaminants (such as metals) strongly adsorb to surface and rocks. This pathway results in a very low future risk from exposure.
- Vapor transport of vapor-phase contaminants to groundwater is considered to be an incomplete pathway because of the low vapor concentrations (LANL 2010, 111123) and the small estimated mass of chlorinated VOCs (Appendix B).
- Erosion continues to result in a potentially complete pathway to the waste. However, modeling of erosion predicted cumulative soil erosion of approximately 0.3 ft over a 1000-yr period at MDA H (LANL 2005, 089332). The waste is currently at least 6 ft bgs. The conservative, future low-

exposure risk is based on uncertainty related to the erosion rate, waste inventory, and concentrations of hazardous constituents in the waste.

- Exposure of waste from cliff retreat and seismic activities may result in a potentially complete pathway. However, cliff retreat occurs over a long timeframe. The disposal units are located a minimum of 50 ft from the mesa edge and are not expected to be impacted by cliff retreat for more than 10,000 yr (Broxton and Eller 1995, 058207; Reneau and Raymond 1995, 054709), resulting in a very low future risk from exposure.
- Wastes left undisturbed in the shafts at MDA H are expected to remain stable and are subject to slow degradation and mineralization. Disruption and dispersal of waste may result in a potentially complete exposure pathway with a high future risk to receptors. Sparks, friction, heat, physical impacts, waste pinching, air, and/or moisture may potentially cause detonation or other unwanted chemical reactions because of the nature of the waste (Appendix C).

4.7 Remedial Action Objectives

The remedial action objectives (RAOs) address exposure pathways with the potential for medium and high risk from exposure. Based on the CSM, the RAOs for MDA H are as follows:

- prevent human health and ecological exposure to the waste through excavation and
- prevent disruption and dispersal of waste by physical disruption or infiltration of moisture.

5.0 CORRECTIVE ACTIONS AND CLOSURE REQUIREMENTS

MDA H is subject to a CME as outlined in Section VII.D of the Consent Order. The regulated unit is subject to corrective action under the Consent Order pursuant to the alternative closure requirements in 40 CFR 264.110(c). The radioactive material in the shafts is subject to radiological protection requirements under DOE Order 5400.5. The corrective action requirements for the disposal units are discussed below.

5.1 Regulated Unit and SWMU

One of the nine shafts at MDA H (Shaft 9) received hazardous waste after July 26, 1982, and is considered a “regulated unit” under RCRA and subject to closure requirements specified in Section 20.4.1.500 of the NMAC. As discussed in section 1.0, the regulated unit will be closed under alternative requirements established under the Consent Order rather than the closure requirements of 40 CFR 264 Subparts G and N. The alternative requirements will be established using the CME process for MDA H contained in Section VII.D of the Consent Order. Upon NMED’s selection of the remedy for MDA H, the Laboratory will prepare and submit a corrective measures implementation (CMI) plan. Shaft 9 meets the criteria in 40 CFR 264.110(c) for the use of “alternative requirements” rather than closure under 40 CFR 264 Subpart N. Therefore, it will be remediated through corrective action under the Consent Order.

The cleanup and screening levels described in Section VIII of the Consent Order (Table 5.1-1) were followed in this CME to determine the recommended corrective measures alternative. The cleanup levels are based on the New Mexico Water Quality Control Commission’s (NMWQCC’s) groundwater and surface water standards and NMED’s cleanup levels for protection of human health, which are consistent with the EPA’s National Oil and Hazardous Substance Pollution Contingency Plan, 40 CFR Section 300.430(e)(2)(i)(A)(*2*).

NMED selected a carcinogenic human health target risk level of 10^{-5} and a noncarcinogenic HI of 1.0 for establishing site-specific cleanup levels for one or more contaminants when toxicological data are published. NMED and the EPA have established SSLs and maximum contaminant levels (MCLs), and the NMWQCC has adopted groundwater and surface water standards that are described below.

5.1.1 Soil

For residential and industrial land use, NMED specified an SSL based on a target total excess cancer risk of 10^{-5} and, for noncarcinogenic contaminants, a target HI of 1.. Residential and industrial SSLs are from NMED's "Technical Background Document for Development of Soil Screening Levels, Revision 5.0" (NMED 2009, 108070). If an NMED SSL has not been established for a contaminant for which toxicological information is published, the Laboratory uses the most recent version of the EPA Region 6 human health medium-specific screening level for residential and industrial soil (NMED 2009, 108070).

If an excavation alternative is selected, these SSLs will be used as cleanup levels as specified in Section VIII.B.1 of the Consent Order.

5.1.2 Groundwater

The corrective measures alternative chosen will be required to meet the groundwater quality standards given in Section VIII.A of the Consent Order. These standards include the NMWQCC groundwater standards, including alternative abatement standards (20.6.2.4103 NMAC), drinking water MCLs adopted by EPA under the federal Safe Drinking Water Act (42 U.S. Code Sections 300f to 300j-26) or the Environmental Improvement Board (20.7.10 NMAC). If both an NMWQCC standard and an MCL have been established for an individual substance, then the lower of the two levels is considered the cleanup level for that substance.

If no MCL or NMWQCC standard is available, the Laboratory will use the EPA regional tap water screening levels (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm) adjusted to 10^{-5} risk for carcinogens and/or an HI of 1.0 for noncarcinogens as the basis for proposing a cleanup level for the contaminant. If the naturally occurring (background) concentration of a contaminant exceeds the standard, then the cleanup goal defaults to the background concentration for that specific contaminant. Table 5.1-1 presents the groundwater quality standards used in this CME.

5.1.3 Surface Water

No permanent surface water is present at MDA H, and MDA H does not have discharges of pollutants to surface water subject to a permit under Section 402 of the federal Clean Water Act. Therefore, the surface water cleanup levels contained in Section VIII.C of the Consent Order are not applicable to corrective measures at MDA H.

5.2 DOE Closure Requirements

Neither radionuclides nor the radioactive portion of mixed wastes are subject to the Consent Order. DOE is solely responsible for regulating nuclear safety at its facilities. DOE Order 458.1, Radiation Protection of the Public and the Environment, specifies that the radiological protection requirements for the public, contained in the Order, must be met for as long as DOE maintains control over the property. The Order further notes that DOE cannot release the property from its control unless the DOE Order 458.1 requirements for unrestricted release are met. Therefore, DOE Order 5400.5 effectively establishes requirements for DOE to maintain MDA H indefinitely in a manner that is protective of the public. In

accordance with DOE Policy 454.1, Use of Institutional Controls, DOE will implement and maintain institutional controls as long as necessary to protect human health and the environment.

In 2003, the NNSA agreed with the Laboratory's initial hazard characterization of MDA H as a Hazard Category 3 NES, based upon the radioactive content of materials disposed. The site is defined in accordance with 10 CFR 830, Nuclear Safety Management (CFR 2001). Specific hazards and controls are allowed under the approved DSA following DOE Standard 1120-2005, Integration of Environment, Safety, and Health into Facility Disposition Activities, Volume 1 of 2: Technical Standard. Section III.K of the Consent Order states that nothing in the Consent Order shall require the performance of any work or activity that is inconsistent with nuclear safety requirements in 10 CFR Parts 830 through 835.

The DOE sets specific inactive site surveillance, maintenance, and characterization requirements for allowed NESs under a DSA. Corrective action activities would require the following modification to the existing DSA and NNSA/DOE approval prior to implementation:

- the basic description of the proposed activity and its operations, including safety structures, systems, and components;
- a hazards analysis of the activities and/or safety structures, systems, and components; and
- the hazard controls and their bases.

5.3 Consent Order CME Requirements

The purpose of the CME is to identify and evaluate potential remedial alternatives for MDA H. This CME focuses on realistic remedies, is tailored to this site, and is consistent with expected future land uses.

Consent Order–specified evaluation criteria were used in this report to select the recommended corrective measures alternative for MDA H shafts based on evaluation of specific site conditions, including the contaminant inventory, the design of the disposal units, the environmental setting, and the nature and extent of contamination. Sections VII.D.4.a and VII.D.4.b of the Consent Order provide threshold and balancing criteria for screening and evaluation of prospective corrective measures, respectively. These criteria are listed in sections 5.3.1 and 5.3.2. Figure 5.3-1 presents a flow chart of the selection process used to determine the recommended corrective measures alternative using all four sets of criteria.

5.3.1 Threshold Criteria

All alternatives were screened based on the threshold criteria described in Section VII.D.4.a of the Consent Order. The alternative selected must meet the following criteria:

1. be protective of human health and the environment;
2. attain media cleanup standards;
3. control the source or sources of release so as to reduce or eliminate, to the extent practicable, further releases of contaminants that may pose a threat to human health and the environment; and
4. comply with applicable standards for management of wastes.

5.3.2 Remedial Alternative Evaluation Criteria (Balancing Criteria)

Section VII.D.4.b of the Consent Order identifies five evaluation criteria (also known as balancing criteria) against which each alternative shall be evaluated in proposing a recommended alternative. The balancing criteria are as follows:

1. long-term reliability and effectiveness;
2. reduction of toxicity, mobility, or volume;
3. short-term effectiveness;
4. implementability; and
5. cost.

The justification for the recommended corrective measures alternative includes the supporting rationale based on the factors listed in sections 7 and 8, as well as a discussion of short- and long-term objectives for the site, and the benefits and possible risks of the alternative.

6.0 IDENTIFICATION OF TREATMENT TECHNOLOGIES

Section 6.1 describes the process used to identify treatment technologies, and section 6.2 screens treatment technologies for MDA H. The technologies retained for further evaluation in the process described in section 6.2 are summarized in section 6.3 and carried forward to section 7 for inclusion into the corrective measures alternatives.

6.1 Classification of Treatment Technologies

General types of corrective measures technologies applicable to MDA H site conditions and waste types were selected from the comprehensive technology list developed by the Federal Remediation Technologies Roundtable (Table B-1, also available at http://www.frtr.gov/matrix2/section1/list-of-tables.html).

For wastes disposed of at MDA H, potentially appropriate technologies fall into the four general categories listed below:

- containment,
- in situ treatment,
- excavation/retrieval, and
- ex situ treatment.

Within the containment category, the subcategories evaluated are vertical barriers, deep and near-surface horizontal barriers, and surface barriers. Within the treatment categories, the subcategories include biological, chemical, physical, and thermal treatment. The excavation/retrieval technology will require either on-site waste disposal, off-site waste disposal, or ex situ treatment.

Of the wastes disposed of in the shafts at MDA H, approximately 80% consisted of metals in various forms (solid mass to finely milled shavings). Approximately 24% of the total metals content consisted of uranium, much of which is DU (24%). Up to 13% of the waste in the shafts is HE-associated material. Based upon the potentially reactive nature of some of the waste, as summarized in Appendix C, many

available technologies normally considered for remediation of similar shafts fail to adequately meet the RAOs as defined in section 4.7. Furthermore, while very low concentrations of VOCs have been identified in area soil pore gas, records indicate that organic compounds were present only in minor amounts as residuals on solid waste placed in the shafts (Omicron 2003, 075940). Evaluation of measured VOC concentrations and a mass estimate presented in Appendix D indicate that VOCs do not pose a current or future risk to groundwater (LANL 2010, 111123).

6.2 Screening of Technologies

Corrective action guidance from EPA (1994, 095975, p. 58) and DOE (1993, 073487, pp. 4-51 and 4-52) requires that potential corrective measures technologies be screened to eliminate those that prove impractical to implement, that rely on technologies not likely to perform satisfactorily or reliably, or that do not achieve the corrective action objectives within a reasonable time frame. When technologies provide similar benefits, cost is often also used as a screening tool.

For the MDA H CME, the screening of technologies included the following:

- a review of site setting, characterization data, and the CSM to identify conditions that may limit or promote the use of certain technologies;
- identification of the waste characteristics that limit the effectiveness or feasibility of technologies; and
- identification of the level of technology development, performance record and inherent construction, and operations and maintenance (O&M) requirements for each technology considered.

6.2.1 Containment Technologies

Containment technologies are intended to limit migration of contaminants or limit infiltration into the vadose zone. Such technologies may include surface and subsurface barriers, and various orientations and compositions of barriers may be used. The general functionality and potential applicability of each containment technology considered at MDA H are discussed below.

6.2.1.1 Vertical Barriers

Vertical barrier technologies, such as grout curtains, synthetic membranes, and reactive barriers, were considered of limited benefit for MDA H applications because the absence of near-surface groundwater at the site already limits lateral migration of most contaminants. Based upon measured soil-vapor levels at MDA H, the total mass of VOCs is estimated to be 2.1 kg (Appendix D), well below concentrations that pose current or future adverse impacts to groundwater.

Vertical barrier technologies were not retained.

6.2.1.2 Deep Subsurface Horizontal Barriers

The purpose of a deep subsurface horizontal barrier, such as forced grout injection, is to contain downward aqueous-phase contaminant transport and is generally suitable for sites with known aqueous-phase releases and/or climates with significant infiltration from the surface. Bottom barriers are horizontal subsurface barriers (i.e., underground barriers that run parallel to the surface) that prevent vertical liquid

migration by providing a floor of impermeable materials beneath the waste. Groundwater monitoring data have not demonstrated that aqueous-phase liquids are being released.

Deep subsurface horizontal barrier technologies were not retained.

6.2.1.3 Near-Surface Horizontal Barriers

Near-surface horizontal barriers created by a soil-grout mixture or vitrification could potentially provide protection from exposure by controlling intrusion into the waste by plants, animals, or people. Additionally, these barriers could limit the transport of contaminants by reducing infiltration of water through the waste. However, these technologies do not provide water storage. Rainfall that does not infiltrate may migrate to the edge of the treated area, potentially creating a focused area of recharge and increasing infiltration in those areas.

Near-surface horizontal barrier technologies were not retained.

6.2.1.4 Surface Barriers

Barriers placed on the surface of disposal sites provide exposure protection, restrict infiltration of water, provide resistance to water and wind erosion, prevent or minimize intrusion into wastes by plants or animals, act as a deterrent to inadvertent disturbance by human intrusion, and limit flux of gas-phase contaminants.

Surface barriers can allow MDA H to meet the threshold criteria for protecting human health and the environment.

Surface barriers would likely be drawn from the following readily available technologies.

Asphalt Cover

Asphalt provides protection from contaminated soils and waste as well as a substantial barrier to surface erosion processes, but has been shown at another Laboratory site, MDA AB Area 2 at TA-49 (LANL 1999, 063918, p. 22), to trap moisture that will otherwise be evaporated or transpired from the subsurface. Such trapped moisture could induce downward transport of dissolved contaminants toward groundwater. Because maintaining low moisture content is a desirable feature for MDA H, an asphalt cover is not suitable for this site.

Asphalt cover technology was not retained.

Concrete Cap

A concrete cap consists of a single layer of concrete that provides protection from contaminated soils and waste. However, as with the asphalt cover, moisture trapped under the cap is of concern. Such trapped moisture could induce downward transport of dissolved contaminants toward groundwater. Additionally, because of the size of the cap required to cover the pit/impoundment and shafts, the potential exists for significant cracking, thus limiting its effectiveness.

Concrete cap technology was not retained.

Soil Barrier

A soil barrier consists of adding soil and planting vegetation over the disposal unit to provide an exposure barrier to contaminated soils and waste. The soil barrier is not equivalent to a store-and-release type of cover and only protects against erosion and inadvertent access. A soil barrier, unlike an ET cover, does not restrict infiltration of water and is therefore not applicable to MDA H.

Soil barrier technology was not retained.

Biointrusion Barriers

Various materials have been used as biointrusion barriers to control the intrusion of plants and animals into hazardous waste landfills. Installation of horizontal barriers constructed of angular cobbles, 4 to 6 in. in diameter with an overlying filter layer composed of sand and gravel, inhibits deep-rooting plants and discourages burrowing animals. The filter layer is designed to prevent fine soils in the overlying cover soil from migrating into the barrier. Results of an animal intrusion experiment conducted at the Laboratory using pocket gophers demonstrated that cobbles and cobbles with gravel effectively prevented animal intrusion. The weight and size of the cobbles prevented these animals from burrowing below the barrier. Cobbles were also effective in limiting root intrusion because the spaces between the cobbles are relatively free of soil and water (Nyhan 1989, 006876).

Chainlink fencing laid on the surface of a cover has been successfully used at a Laboratory site to discourage burrowing animals, while having no observable impact on beneficial vegetation (LANL 1999, 063919).

As a standalone technology, a biointrusion barrier does not restrict infiltration of water and was not retained. However, biointrusion barriers can be incorporated into enhanced cover designs considered for MDA H.

Compacted Clay Cover

Compacted clay covers have successfully controlled excess infiltration at RCRA-regulated landfills. However, clay liners are far less effective in arid to semiarid climates than more humid environments because the clay tends to dry out and crack, allowing moisture to flow directly into disposal units (Mulder and Haven 1995, 071297, p. 7). As a standalone technology, a compacted clay cover is not suitable for MDA H. However, compacted clay layers can be incorporated into multilayer cover designs considered for MDA H.

Compacted clay cover technology was not retained.

Multilayer Cover (RCRA Cover)

This technology was evaluated even though the regulated unit at MDA H is being addressed under the Consent Order using alternative requirements.

The multilayer cover consists of different geologic and synthetic materials layered in a specific order to control various potentially detrimental processes and conditions (e.g., infiltration, erosion, and biointrusion). RCRA Subtitle C covers belong within this category. A standard RCRA Subtitle C cover includes the following: a surface vegetation layer, a sand drainage layer, a flexible geomembrane, and a base layer of compacted soil (typically clay) to meet hydraulic conductivity limits. The geomembrane is a

thin impermeable barrier of synthetic material that offers very little structural capacity. Multilayer covers can be compromised if any of their components are not suited for the site.

Los Alamos's arid climate is considered potentially incompatible with the typical clay layer of the RCRA Subtitle C multilayer cover. Clay components are far less effective in arid to semiarid climates because the clay tends to dry out and crack, allowing moisture to flow directly into the disposal unit (Mulder and Haven 1995, 071297, p. 7). While there are long-term concerns associated with desiccation of the clay layer, the geomembrane may provide additional protection against infiltration of water should the clay layer crack.

Therefore, multilayer cover technology was retained.

ET Cover

The ET cover concept relies on the soil to act as a "sponge" until infiltrated water can be removed via ET (Dwyer 2003, 097902). Generally, ET is defined as the combination of water removal by evaporation from the surface and transpiration through vegetation.

ET covers are designed to provide infiltration protection for arid and semiarid environments where materials such as clays and synthetic/geosynthetic membranes are less reliable. ET covers may consist of multiple layers of geologic materials suited to achieve the ET criteria. Suitable vegetation is a significant component for most ET covers to aid in the dewatering of the cover material(s). The vegetated ET cover was developed specifically for landfills located in arid and semiarid environments such as Los Alamos (Barnes et al. 1990, 070209, pp. 1201–1202). The earliest research on ET covers was conducted by the Laboratory at a test site within a few miles of MDA H (Nyhan et al. 1984, 008797; Nyhan 1989, 006876; Nyhan et al. 1989, 006874).

The Los Alamos climate's demand for water or potential ET far exceeds the annual precipitation (Figure 2.3-2). The ET cover also provides a medium for native vegetation.

Therefore, ET cover technology was retained.

6.2.2 In Situ Treatment Technologies

In situ waste treatment technologies are used to reduce the mobility and/or toxicity of wastes or to increase the stability without removing the wastes from their disposal location. In situ treatment generally requires longer time periods than other types of waste treatment, and there is less certainty about the uniformity of treatment because of the variability in soil and aquifer characteristics and because the effectiveness of the process is more difficult to verify. Different in situ methods (biological, chemical, physical, and thermal) are appropriate for different contaminants and disposal environments.

6.2.2.1 Natural Attenuation

Natural attenuation uses natural subsurface processes to reduce contaminant concentrations to acceptable levels. The natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil, soil vapor, or groundwater. These in situ processes include adsorption, biodegradation, dispersion, dilution, sorption, volatilization, radioactive decay, chemical reactions with subsurface materials, and chemical or biological stabilization.

Consideration of the natural attenuation technology requires evaluation of contaminant degradation rates and products as well as concentrations at potential downgradient receptor points. The primary objective is demonstrating that natural processes of contaminant degradation will reduce contaminant concentrations below regulatory standards or risk-based levels before potential exposure pathways are completed. In addition, long-term monitoring is conducted to measure degradation rates to evaluate compliance with cleanup objectives. Commonly targeted contaminants for natural attenuation include halogenated VOCs, semivolatile organic compounds (SVOCs), and fuel hydrocarbons. Based upon measured soil-vapor levels at MDA H, the total mass of VOCs is estimated to be 2.1 kg (Appendix D), well below concentrations that could pose future adverse impacts to groundwater. VOCs are not considered a potential current or future impact to groundwater at MDA H. The waste disposed of at MDA H is primarily in solid form and is expected to remain stable in its current undisturbed state. Because of the low levels of VOCs present at the site, natural attenuation is not an effective technology for MDA H.

Natural attenuation technology was not retained.

6.2.2.2 Biological Treatment Technologies

Biological methods, using various microorganisms or vegetation, have been effective in metabolizing a variety of organic contaminants and also in changing the solubility of certain inorganic chemical and radioactive species in low concentrations during the wastewater treatment processes. Potential in situ biological treatment technologies, including bioventing, enhanced bioremediation, and phytoremediation, provide limited benefit because of the dry soils present at MDA H. Biological treatment is also less viable for many chlorine-containing organic chemicals and may lead to byproducts that are more toxic than the original contaminant, such as TCE to vinyl chloride.

Biological treatment technologies were not retained.

6.2.2.3 Chemical Treatment Technologies

Chemical treatment, such as chemical oxidation or soil flushing, uses the physical properties of the contaminants or the contaminated medium to destroy (i.e., chemically convert), separate, or contain the contamination.

These technologies were not considered potentially applicable to the MDA H site because of difficulties in delivering the reactive chemicals uniformly to the soil. Incorporating large quantities of hazardous oxidizing materials or extraction fluids poses additional concerns for workers and possibly the environment.

Chemical treatment technologies were not retained.

6.2.2.4 Physical Treatment Technologies

In situ physical treatment technologies are a diverse group of technologies that include methods to remove mobile contaminants, to increase the mobility of contaminants, to further stabilize contaminants, and to destroy contaminants in place.

Physical treatment technologies would likely be drawn from the following technologies.

Soil-Vapor Extraction

This technology uses vacuum blowers to accelerate the removal of vapor-phase contaminants, primarily VOCs and methane, from the vadose zone. The blowers create a negative pressure or vacuum in one or more boreholes. The vacuum removes the gases or vapors from boreholes by advective transport. This technology commonly requires a treatment system for the contaminated subsurface vapor that is extracted from the subsurface. Soil-vapor extraction (SVE) can be applied as either an active system or as a passive system that uses ambient meteorological conditions to extract vapor-phase contaminants. Passive SVE is enhanced by the use of a wellhead control device that restricts the inward flow of ambient air into the subsurface under high atmospheric barometric conditions, allowing only outward flow of air. SVE is not a viable technology for MDA H based upon the low levels of organic contaminants in the vadose zone, the increased air flow, and the significant potential adverse effects that could result from implementation.

SVE technology was not retained.

Pneumatic Fracturing

Pneumatic fracturing uses the injection of a fluid under pressure to create open fractures in the area where a contaminant plume exists. There is no contaminant plume at MDA H; therefore, this technology is not applicable. Opening subsurface flow paths allows access to the contaminated media for removal or treatment. Pneumatic fracturing has the potential to introduce large amounts of water into a formation that has optimal low-moisture content and is not desirable. The shallow tuff is already highly fractured; therefore, pneumatic fracturing has limited benefit. Based upon the waste's sensitivity to vibration, increased moisture, and the significant potential adverse effects that could result from implementation, pneumatic fracturing is not a feasible technology.

Pneumatic fracturing technology was not retained.

Dynamic Compaction

Dynamic compaction is used to compact and consolidate wastes in place to reduce the potential for settling or sinking over time. The technology has been successfully demonstrated on landfills where subsidence (i.e., settling) over large areas is likely and where waste is near the surface and of a homogenous waste form. Dynamic compaction may adversely affect existing waste forms, creating the potential for release. Furthermore, dynamic compaction is not a viable technology for MDA H because of the shock sensitivity of the waste at MDA H and the significant potential adverse effects that could result from implementation.

Dynamic compaction technology was not retained.

Jet Grouting Stabilization

Jet grouting employs high pressure injection of a cementitious grout slurry into a soil strata to hydraulically mix the in situ material with the grout. The grout slurry is injected into and/or around the waste to fill void spaces and to reduce the porosity within and between buried objects. The objective of this treatment is to stabilize the waste form to reduce the infiltration and movement of surface water into and through the waste and to reduce the future potential for subsidence of waste and overburden. One method involves injecting grout into holes drilled through the waste while simultaneously pulverizing the waste and mixing it with the grout. This approach is applicable only for homogeneous, soil-like wastes.

Given the heterogeneous nature of the waste at MDA H as well as its shock sensitivity, this technology is not viable.

A second waste stabilization method involves the direct injection of grout into void spaces surrounding the waste. A pipe or auger is drilled into the subsurface and slowly rotated and pressurized. The high pressure (4000–13,000 psi) forces the grout out laterally through special ports on the sides of the pipe or auger. The slurry exits the jet port at very high velocity, penetrating the soil several inches to several feet away from the ports. The rotating ports destroy soft soil formations while mixing the native soil with cement. Finally, the rotating pipe/auger is drawn slowly upward at a controlled rate to create a nearly cylindrical column of treated soil.

The waste material in the shafts extends to a depth of approximately 65 ft bgs. The integrity of the drums and other waste containers in the shafts could be damaged by high-pressure injection of grout. The use of this treatment technology would also likely damage the shafts themselves. Significant adverse effects could result from implementation of jet grouting because of the risk of introducing air and moisture under high pressure and the shock sensitivity of the waste at MDA H.

Jet-grouting stabilization technology was not retained.

6.2.2.5 Thermal Treatment Technologies

Thermal treatment technologies have been developed and implemented to decompose heat-sensitive contaminants into less toxic or less mobile forms or to enhance the extractability of a contaminant by heating it into a vapor phase. Heat is generated or delivered using several types of radiation (i.e., microwave, radio frequency, or thermal), using direct conductance of electricity or injecting already-heated materials (e.g., steam). Because of the thermal sensitivity of the waste materials in the shafts, applying a heat source to the waste would likely result in detrimental impacts to the site. Therefore, application of this technology at MDA H would provide no benefit.

Thermal treatment technologies were not retained.

6.2.3 Excavation/Retrieval Technologies

A review was conducted by subject matter experts of the characteristics of the complex mixture of waste disposed of in the shafts (Appendix C). It was determined that the waste is sensitive to sparks, friction, heat, physical impact, pinching, air, and/or moisture. Potential risks associated with excavation include

- sparks from excavation equipment, abrading uranium components, or handling and adverse interactions of HE or pyrophoric metals;
- friction from excavation equipment or handling;
- impact/crush from equipment or dropping; and
- pinching from equipment or handling.

Such processes could also result in inadvertent pinching of residual amounts of HE remaining in crevices, cracks, and machinery components.

6.2.3.1 Excavation

Excavation/removal of the waste materials in the shafts at MDA H would require extensive excavation of the surrounding soils as well as the waste in the shafts themselves. The implementation of the excavation

technologies has the potential to introduce unwanted and uncontrolled energy sources into the interred waste materials. Potential risks associated with excavation include vibration, friction, heat generation, sparks, impact, or crushing of waste. Because of the shock sensitivity and the thermal sensitivity of the waste materials in the shafts, the excavation/removal technologies are not viable for MDA H.

However, despite these risks, the excavation technology was retained to provide an evaluation of a full range of alternatives.

6.2.3.2 Overcoring Retrieval—Shafts

Overcoring retrieval is a technology for retrieving an entire shaft without digging a trench. This method typically involves using a crane to lift and suspend a large-diameter steel casing over the shaft. The diameter of the casing is larger than that of the shaft. The casing is then driven into the ground by a vibratory driver until the casing encompasses the entire shaft. Once the casing has reached the appropriate depth, the casing's open bottom is sealed shut by injecting grout into the ground within the casing to the base of the core. When the seal has cured and hardened, the entire casing is lifted to retrieve the intact shaft contained within. The excavated core is then backfilled.

This technology has been demonstrated at the DOE facility in Hanford, Washington, to a depth of 25 ft. The shafts at MDA H extend to a depth of 60 ft, and there is significant uncertainty regarding the performance of this technology at that depth.

Overcoring retrieval technology was not retained.

6.2.3.3 Waste Container Retrieval—Shafts

Although access to the MDA H disposal shafts can be gained by removing the concrete caps, the small diameter of the shafts provides limited space for manipulating their contents. Total removal can only be accomplished by using a crane and manual rigging equipment. While not impossible, this type of excavation is not desirable because of potential risks to workers. Use of grappling devices or magnetic lifts is possible for certain inventory items; however, because of their size or shape, many items can be removed only by manual rigging. Additionally, the unknown conditions of the waste packaging increases the risk to workers and the environment. It is known that the older shafts were not containerized. Therefore, the safety hazards of working in the narrow shafts eliminate this technology as a viable technology for the shafts at MDA H.

Waste container retrieval technology was not retained.

6.2.4 Ex Situ Treatment Technologies

If MDA H were excavated, waste materials and/or contaminated media would require characterization to determine whether the waste material meets the waste acceptance criteria (WAC) of the appropriate treatment, storage, and disposal facility. Some of the waste may require treatment before it is reused as backfill or placed in an approved facility. General treatment technologies include neutralization, extraction, thermal treatment, stabilization, and the various debris treatments specified under RCRA. Additionally, these technologies require excavation/removal technologies that are not feasible for MDA H.

Therefore, ex situ treatment technologies were not retained.

6.2.5 Waste Management and Disposal

Waste management and disposal are not treatment technologies that apply directly to the RAOs of the waste unit, but because many technologies require waste removal, waste management options are discussed below.

On-Site RCRA Landfill

This technology would require the construction of a new landfill at the Laboratory designed to meet the RCRA Subtitle C minimum technology requirements (MTRs). A RCRA Subtitle C landfill is defined as a disposal facility or part of a facility where hazardous waste is placed. Consolidation or placement of wastes into a RCRA landfill has strict requirements, such as land disposal restrictions (LDRs). RCRA landfill operating permits typically require renewal every 10 yr and include an active monitoring program.

At this time, the Laboratory is not considering the construction of a RCRA landfill. A new RCRA landfill would require a siting study and permit approvals, including public comment. This option would delay final action through the permitting approval process and construction of the new landfill. This delay impacts the Consent Order corrective action requirements.

On-site RCRA landfill is not a preferred option for waste management and disposal.

On-Site Corrective Action Management Unit

Corrective action management units (CAMUs) are used for the on-site management of remediation wastes under RCRA. A CAMU under RCRA is used for on-site treatment, storage, or disposal of hazardous wastes managed during cleanup. Consolidation or placement of remediation wastes into a CAMU is not considered land disposal and does not trigger LDRs or create a unit subject to MTRs. CAMUs can be temporary or permanent (i.e., they can be closed after removing waste or can become a disposal unit).

A CAMU would require prior approval by the New Mexico Secretary of the Environment, a process that includes public comment or incorporation into the existing RCRA permit. This option would delay final action through the approval process and construction of the CAMU. This delay impacts the Consent Order corrective action requirements.

On-site CAMU is not a preferred option for waste management and disposal.

Off-Site Disposal

Off-site disposal allows waste to be shipped off-site to permitted facilities. Transportation of wastes in approved trucking containers will occur on public highways. Facilities considered for this option include the Nevada National Security Site, the Waste Isolation Pilot Plant, EnergySolutions in Clive, Utah, and other approved facilities. The off-site disposal option is readily available and applicable to MDA H wastes.

Therefore, off-site disposal is the preferred option for waste management and disposal.

6.3 Summary of Technologies Suitable for MDA H

Technologies considered applicable for MDA H and retained for further consideration in developing corrective measures alternatives in section 7 are summarized below.

6.3.1 Containment Technologies

The following technologies are suitable to contain the waste in the shafts at MDA H:

- Surface Barriers—Multilayer Cover (RCRA Cover)
- Surface Barriers—ET Cover

6.3.2 In Situ Treatment Technologies

The waste in the shafts is sensitive to sparks, friction, heat, physical impact, pinching, air, and/or moisture, and there are low concentrations of VOCs in the vadose zone. Therefore, in situ treatment technologies are ruled out at MDA H.

6.3.3 Excavation/Retrieval Technologies

The following technology is suitable for removal of the waste in the shafts at MDA H:

- Excavation

6.3.4 Waste Management and Disposal

The following option is suitable for managing and disposing of waste removed from MDA H:

- Off-Site Disposal

7.0 IDENTIFICATION AND SCREENING OF CORRECTIVE MEASURES ALTERNATIVES

The process for alternative identification and screening employed in this CME began with identifying and screening technologies that can be used to address the RAOs previously identified. Table 7.0-1 presents a matrix of the potential corrective measures alternatives using the technologies that were carried forward from section 6. The corrective measures alternatives are as follows:

Alternative 1—No Action

Alternative 2A—Multilayer Cover and Institutional Controls

Alternative 2B—ET Cover and Institutional Controls

Alternative 3—Excavation and Institutional Controls

Preliminary cover design information for the multilayer cover and the ET cover is provided in Appendixes G and H, respectively.

Section 7.1 identifies activities that will be undertaken before corrective measures begin. Section 7.2 presents the threshold screening criteria that are listed in Section VII.D.4.a of the Consent Order. Section 7.3 presents the screening of the alternatives against the threshold criteria. The alternatives that satisfy all four of the threshold criteria are carried forward into section 8, where they are evaluated against the remedial alternative evaluation criteria (also referred to as balancing criteria) defined in Section VII.D.4.b of the Consent Order.

7.1 Activities Undertaken Before Implementation of Corrective Measures

DOE sets forth specific inactive site surveillance, maintenance, and characterization requirements for designated NESs. MDA H has few aboveground structural components, other than site fencing for the NES (Figure 7.1-1); therefore, minimal site activities are required before remedy implementation. Corrective action activities would require the following modifications to the existing DSA and NNSA/DOE approval before implementation:

- the basic description of the proposed activity and its operations, including safety structures, systems, and components;
- a hazards analysis of the activities and/or safety structures, systems, and components; and
- the hazard controls and their basis for these controls.

The specific activities, structures, systems, and components associated with the selected remedy will be described and evaluated in accordance with Title 10 CFR 830 Nuclear Safety Management requirements, and the proposed activities must be authorized by DOE before implementation.

7.2 Corrective Measures Threshold Screening Criteria

Section VII.D.4.a of the Consent Order states that to be selected, the remedy alternative must

1. *Be protective of human health and the environment.*

   Protection of human health and the environment should be evaluated based on reasonably anticipated land use, both now and in the future. It should take into consideration the potential exposure pathways identified in the CSM.

2. *Attain media cleanup standards.*

   The applicable cleanup standards developed in accordance with Section VIII of the Consent Order are presented in section 5.1. EPA guidance (61 Federal Register 19432, May 1, 1996) states, “Media cleanup standards should reflect the potential risks of the facility and media in question by considering the toxicity of the constituents of concern, exposure pathways, and fate and transport characteristics.” EPA guidance further explains, “Attaining media cleanup standards does not necessarily entail removal or treatment of all contaminated material above specific constituent concentrations. Depending on the site-specific circumstances, remedies may attain media cleanup standards through various combinations of removal, treatment, engineering and institutional controls.” EPA also stated in this preamble that reasonably expected land use is a key factor in evaluating how to meet media cleanup standards. TA-54, including MDA H, will be subject to long-term DOE ownership and institutional controls because of its history and waste inventory. The affected medium at MDA H is the soil surrounding the shafts.

3. *Control the source or sources of releases so as to reduce or eliminate, to the extent practicable, further releases of contaminants that may pose a threat to human health and the environment.*

   Source control measures evaluated may include a combination of treatment, containment, removal, and institutional controls.

4. *Comply with applicable standards for management of wastes*.

A remedy must be able to comply with all applicable regulatory requirements for management of any wastes removed or generated during corrective action as well as closure requirements for any waste or contamination remaining following implementation of the remedial alternative.

7.3 Description and Screening of Technologies Retained

This section describes the potential corrective measures alternatives for MDA H and presents a qualitative evaluation of these alternatives against the threshold criteria contained in Section VII.D.4.a of the Consent Order. Table 7.3-1 summarizes the evaluation performed in section 7.3.

7.3.1 Alternative 1: No Action

Alternative1 represents a true no-action alternative. Under this alternative, no action will be taken. Institutional controls will not be maintained, and pore-gas monitoring will not be performed. No maintenance of the surface soil will be performed. In summary, this alternative includes

- no monitoring of soil vapor,
- no maintenance, and
- no institutional controls.

7.3.1.1 Protection of Human Health and the Environment

The surface soil will likely erode, which will increase the potential for exposure to waste. The potential will exist for exposure through direct contact and biointrusion. This alternative is not protective of human health and the environment.

7.3.1.2 Attainment of Media Cleanup Standards

Under this alternative, the existing waste inventory, which includes wastes subject to regulation as hazardous wastes under RCRA, will not be removed or treated. This alternative does not comply with the EPA guidance for attaining media cleanup standards when waste is left in place. This alternative does not attain media cleanup standards.

7.3.1.3 Control of Sources and Releases

The potential exists for water infiltration into the waste material potentially leading to the dispersal or disruption of the waste material. Erosion of soil has the potential to expose buried waste, resulting in potential releases. This alternative will not control sources and releases.

7.3.1.4 Compliance with Applicable Waste Management Standards

No waste will be generated under the no-action alternative; therefore, it complies with applicable waste management standards.

7.3.1.5 Summary

Although the no-action alternative does not satisfy all of the threshold criteria, it is carried forward for comparison purposes in evaluating the other alternatives.

7.3.2 Alternative 2A: Multilayer Cover and Institutional Controls

Under this alternative, one multilayer cover will be installed over MDA H (Figure 7.3-1). Appendix G details the conceptual design of this proposed multilayer cover. The cover would be approximately 0.6 acres. The conceptual multilayer cover design (Figure 7.3-2) and construction consists of (from the ground surface to the top):

- site preparation of the existing soil surface, leaving existing concrete/crushed-tuff plugs on shafts;
- a 2-ft layer of compacted natural or amended soil with a maximum saturated hydraulic conductivity of 1×10^{-7} cm/s (e.g., clay layer);
- a 40-mil flexible geomembrane liner, such as linear high-density polyethylene (HDPE), to limit downward moisture movement;
- a 1-ft drainage layer of sand, having a minimum saturated hydraulic conductivity of 1×10^{-2} cm/s; and
- a 2-ft soil and vegetation layer graded at slopes between 3%–5%.

Institutional and engineering controls will be implemented to limit the potential for future exposure to buried waste and potentially contaminated surface and subsurface soil. These controls are assumed to remain in place for 100 yr. A restrictive covenant will be placed on the deed and recorded locally and in the EPA institutional controls database. Active maintenance will be performed for 30 yr to address erosion and animal burrowing and to manage vegetation. Fencing will be used to restrict site access.

The multilayer cover minimizes exposure on the surface of the waste facility, prevents vertical infiltration of water into wastes that could potentially cause a disruption or dispersal of waste, and creates a land surface that can support vegetation.

7.3.2.1 Protection of Human Health and the Environment

A multilayer cover will provide protection against erosion, direct contact, biointrusion, and moisture infiltration. The multilayer cover, as described above, places a minimum of 5 ft of varying soil layers between a potential human or ecological receptor and the top of the existing operational cover, thereby breaking the exposure pathway. The multilayer cover is designed to restrict infiltration of water, thereby reducing the release mechanism of disruption and dispersal of the waste.

Institutional controls will be implemented to provide access controls, thereby restricting human exposure. This alternative is protective of human health and the environment.

7.3.2.2 Attainment of Media Cleanup Standards

Under this alternative, the existing waste inventory, which includes wastes subject to regulation as hazardous wastes under RCRA, would not be removed or treated. The installation of a multilayer cover attains media cleanup standards when waste is left in place by breaking the exposure pathway and reducing risk for human and ecological receptors. A multilayer cover will also minimize or eliminate infiltration of precipitation that could otherwise cause a disruption or dispersal of waste.

This alternative attains media cleanup standards.

7.3.2.3 Control of Sources and Releases

A multilayer cover will minimize or eliminate infiltration of precipitation that could cause a disruption or dispersal of waste. A multilayer cover will also limit exposure to waste and reduces the potential for erosion.

This alternative will control sources and releases.

7.3.2.4 Compliance with Applicable Waste Management Standards

No waste is projected to be generated during the construction of the multilayer cover.

This alternative complies with applicable waste management standards.

7.3.2.5 Summary

This alternative complies with each of the four threshold criteria. Therefore, this alternative is retained for further consideration.

7.3.3 Alternative 2B: ET Cover and Institutional Controls

Under this alternative, one ET cover will be installed over MDA H (Figure 7.3-1). Appendix H details the conceptual design of this proposed ET cover. The cover would be approximately 0.6 acres. The conceptual ET cover design (Figure 7.3-3) and construction consists of (from the ground surface to the top)

- site preparation of the existing soil surface, leaving existing concrete/crushed-tuff plugs on shafts;
- 1 ft of angular cobbles with a minimum diameter of 4 to 6 in. to act as a biointrusion barrier;
- 0.5 ft of sand and gravel mixture to prevent the mixing of soil layers;
- 3.5 ft of natural or amended soil that meets the water storage capacity of a typical sandy loam; and
- 1.5 ft of natural or amended soil and vegetation, with minimal slopes, to ensure a desired stand of vegetation is maintained.

Institutional and engineering controls will be implemented to limit the potential for future exposure to buried waste and potentially contaminated surface and subsurface soil. These controls are assumed to remain in place for 100 yr. A restrictive covenant will be placed on the deed and recorded locally and in the EPA institutional controls database. Active monitoring and maintenance will be performed for 30 yr. Moisture monitoring will be performed to evaluate the performance of the ET cover. Maintenance activities will be performed to address erosion, animal burrowing, and to manage vegetation. Fencing will be used to restrict site access.

The ET cover minimizes exposure on the surface of the waste facility, prevents vertical infiltration of water into wastes that could potentially cause a disruption or dispersal of waste, and creates a land surface that can support vegetation.

The ET cover takes advantage of the semiarid site conditions by evaporating and transpiring water from the cover. The surface of the cover has minimum slope to limit erosion. The ET cover includes little or no clay and no geosynthetic membrane materials, both of which are considered more likely to fail because the clay tends to dry out and crack and the polymer degrades in an arid to semiarid environment.

Engineered ET covers have demonstrated effectiveness in reducing infiltration in semiarid regions (Davenport et al. 1998, 069674, p. 1; Dwyer et al. 2000, 069673, pp. 23–26). ET covers can be adapted to enhance specific desired properties for a given application, such as increased erosion resistance with the addition of gravel surface amendments, enhanced or limited plant growth and types for transpiration by varying depths of enriched soil, modification of the size of the ET reservoir layer above the waste layer by varying the depths of the primary crushed-tuff ET layer, or prevention of biointrusion by using barriers such as cobbles.

7.3.3.1 Protection of Human Health and the Environment

An ET cover will provide protection against erosion, direct contact, biointrusion, and moisture infiltration. The ET cover, as described above, places a minimum of 6.5 ft of varying soil layers between a potential human or ecological receptor and the top of the existing operational cover, thereby breaking the exposure pathway. The ET cover is designed to restrict infiltration of water, thereby reducing the release mechanism of disruption and dispersal of waste.

Institutional controls will be implemented to provide access controls, thereby restricting human exposure.

This alternative is protective of human health and the environment.

7.3.3.2 Attainment of Media Cleanup Standards

Under this alternative, the existing waste inventory, which includes wastes subject to regulation as hazardous wastes under RCRA, would not be removed or treated. The installation of an ET cover attains media cleanup standards when waste is left in place by breaking the exposure pathway and reducing risk for human and ecological receptors. An ET cover will also minimize or eliminate infiltration of precipitation that could otherwise cause a disruption or dispersal of waste.

This alternative attains media cleanup standards.

7.3.3.3 Control of Sources and Releases

An ET cover will minimize or eliminate infiltration of precipitation that could otherwise cause a disruption or dispersal of waste. An ET cover will also limit exposure to waste and reduces the potential for erosion.

This alternative will control sources and releases.

7.3.3.4 Compliance with Applicable Waste Management Standards

No waste is projected to be generated during the construction of the ET cover.

This alternative complies with applicable waste management standards.

7.3.3.5 Summary

This alternative complies with each of the four threshold criteria. Therefore, this alternative is retained for further consideration.

7.3.4 Alternative 3: Excavation and Institutional Controls

Under this alternative, the shafts will be excavated. Excavation of the shafts will be accomplished using remote excavation methods. The estimated volume of excavated materials is provided below. Confirmatory sampling will be conducted to ensure that all contaminated material has been removed from the excavations.

A summary of the excavation of the shafts (Figure 7.3-4) would include the following:

- construction of an on-site waste analysis and segregation facility for characterization and classification;
- construction of an excavation enclosure with supplied air and HEPA filters to control releases and for weather protection;
- excavation to be performed remotely;
- excavation, analysis, and segregation of the waste in the shafts regulated by the Consent Order;
- off-site treatment and disposal of wastes;
- shaft excavation estimated to be 260 ft × 120 ft × 62 ft for a total of 71,644 yd^3 of material;
- excavation of the nine shafts and associated contaminated material (426 20-yd^3 roll-offs) estimated to produce 8520 yd^3 of mixed low-level waste;
- excavation, segregation, analysis, treatment, and disposal activities will be complete within a 1-yr period; and
- replacement in the original excavation of any environmental media meeting the industrial SSLs and backfilled to grade.

Institutional and engineering controls (e.g., fencing) will be implemented to restrict access to the area during site activities. A restrictive covenant, which is assumed to remain in place for 100 yr, will be placed on the deed and recorded locally and in the EPA institutional controls database. Maintenance activities will be performed for 30 yr to address erosion and to manage vegetation.

7.3.4.1 Protection of Human Health and the Environment

Excavation of the shafts will remove source material.

Institutional controls will be implemented to provide access controls, thereby restricting human exposure.

This alternative is protective of human health and the environment.

7.3.4.2 Attainment of Media Cleanup Standards

Wastes will be excavated from the shafts to a level that meets industrial SSLs. Investigative sampling has indicated that soil concentrations beneath shafts are currently below the cleanup standards. Environmental media with concentrations below industrial SSLs may be returned to the original disposal unit.

This alternative attains media cleanup standards.

7.3.4.3 Control of Sourced and Releases

Excavation of the shafts will remove source material.

This alternative eliminates sources and releases.

7.3.4.4 Compliance with Applicable Waste Management Standards

Excavated wastes that exceed cleanup standards will be prepared for off-site shipment to meet the WAC of the permitted disposal facility.

This alternative complies with applicable waste management standards.

7.3.4.5 Summary

This alternative complies with each of the four threshold criteria; however, as stated in section 6.2.3, excavation is not considered feasible because of sensitivity of the waste to sparks, friction, heat, physical impact, pinching, air, and/or moisture and because it is likely inconsistent with nuclear safety requirements imposed by DOE (Section III.K of the Consent Order). For the purposes of comparison to a complete range of alternatives (i.e., no action to complete excavation), this alternative is retained for further consideration.

8.0 EVALUATION OF TECHNOLOGIES AGAINST REMEDIAL ALTERNATIVE EVALUATION CRITERIA

Corrective measures alternatives appropriate for MDA H were screened against the Consent Order threshold criteria in section 7. Alternatives found to meet the Consent Order threshold criteria have been brought forward for further evaluation along with the no-action and excavation alternatives. These alternatives are evaluated against the remedial alternative evaluation criteria (also known as the balancing criteria) from Section VII.D.4.b of the Consent Order.

8.1 Remedial Alternative Evaluation Criteria (Consent Order Section VII.D.4.b)

Section VII.D.4.b of the Consent Order requires the evaluation of each remedial alternative for the factors listed below. These factors shall be balanced in proposing a recommended alternative.

8.1.1 Long-Term Reliability and Effectiveness (Consent Order Section VII.D.4.b.i)

This factor considers the magnitude of risks that will remain after implementation of the remedy, the extent of long-term monitoring or other management that will be required after implementation of the remedy, the uncertainties associated with leaving contaminants in place, and the potential for failure of the remedy. Preference is given to a remedy that reduces risks with little long-term management and that has proved effective under similar conditions.

8.1.2 Reduction of Toxicity, Mobility, or Volume (Consent Order Section VII.D.4.b.ii)

This factor considers the reduction in the toxicity, mobility, and volume of contaminants. Preference is given to a remedy that uses treatment to more completely and permanently reduce the toxicity, mobility, and volume of contaminants.

8.1.3 Short-Term Effectiveness (Consent Order Section VII.D.4.b.iii)

This factor considers the short-term reduction in existing risks that the remedy would achieve; the time needed to achieve that reduction; and the short-term risks that might be posed to the community, workers, and the environment during implementation of the remedy. Preference is given to a remedy that quickly reduces short-term risks without creating significant additional risks.

8.1.4 Implementability (Consent Order Section VII.D.4.b.iv)

This factor considers installation and construction difficulties; O&M difficulties; difficulties with cleanup technology; permitting and approvals; and the availability of necessary equipment, services, expertise, and storage and disposal capacity. Permitting includes NMED and DOE requirements. Preference is given to a remedy that can be implemented quickly and easily and poses fewer difficulties.

8.1.5 Cost (Consent Order Section VII.D.4.b.v)

This factor considers both capital costs and O&M costs. Capital costs shall include, without limitation, construction and installation costs; equipment costs; land development costs; and indirect costs, including engineering costs, legal fees, permitting fees, startup and shakedown costs, and contingency allowances. O&M costs shall include, without limitation, operating labor and materials costs, maintenance labor and materials costs, replacement costs, utilities, monitoring and reporting costs, administrative costs, indirect costs, and contingency allowances. All costs shall be calculated based on their net present value (PV). Preference is given to a remedy that is less costly but does not sacrifice protection of human health and the environment.

8.2 Evaluation of Alternatives for MDA H

8.2.1 Alternative 1: No Action

The no-action alternative is described in section 7.3.1.

8.2.1.1 Long-Term Reliability and Effectiveness

An increase in risk is associated with implementation of this alternative because it removes institutional controls. No long-term monitoring or other management will be conducted after the remedy is implemented. Uncertainty is associated with future exposure to waste resulting from the lack of institutional controls. This alternative does not involve implementation of any action; therefore, no potential exists for remedy failure. This alternative does not provide long-term reliability and effectiveness.

8.2.1.2 Reduction of Toxicity, Mobility, or Volume

Under the no-action alternative, no reduction in toxicity, mobility, or volume occurs.

8.2.1.3 Short-Term Effectiveness

Under the no-action alternative, risk is neither created nor alleviated in the short term.

8.2.1.4 Implementability

Under the no-action alternative, no remedy is implemented.

8.2.1.5 Cost

Under the no-action alternative, there are no costs.

8.2.2 Alternative 2A: Multilayer Cover and Institutional Controls

This alternative is described in section 7.3.2.

8.2.2.1 Long-Term Reliability and Effectiveness

Installation of a multilayer cover will reduce erosion, biointrusion, and infiltration and will also reduce the potential for future exposure. Los Alamos's arid climate is considered potentially incompatible with the typical clay layer of the cover because clay components may become desiccated and crack when installed in arid to semiarid environments. Long-term maintenance requirements for multilayer covers include visual inspection, removal of unwanted debris and large woody plants, erosion control, and mowing.

Residual uncertainty and long-term risk will be associated with waste that remains in place. Institutional controls will be used to manage this uncertainty by restricting site access.

8.2.2.2 Reduction of Toxicity, Mobility, or Volume

The multilayer cover will reduce mobility of waste by controlling erosion and infiltration but will have no impact on reduction of toxicity or volume.

8.2.2.3 Short-Term Effectiveness

A multilayer cover can be constructed in a short time frame (i.e., approximately 1 yr). This cover poses relatively low risk to the community, workers, and the environment during construction because it does not involve any waste excavation or management. The greatest impacts to human health during cover installation are associated with the physical hazards of construction activities and traffic risks while transporting raw materials to the site. Workers will not be exposed to buried waste during cover construction.

This alternative is effective in the short term without creating significant additional risk.

8.2.2.4 Implementability

The multilayer cover is installed using standard construction techniques and presents minimal installation and construction difficulties. Following installation, low to moderate maintenance is required.

8.2.2.5 Cost

The capital cost for installation of site fencing as part of institutional controls is estimated to be $77,000. The capital cost for installation of the multilayer cover is estimated to be $847,000. The total O&M costs for the multilayer cover are estimated to be $445,000.

The indirect capital costs are estimated to be $2,045,000, which includes design of the alternative as well as professional management and contingency. Indirect O&M costs are estimated to be $484,000, which includes professional management and contingency.

The total PV cost is estimated to be $4,049,000 (Table 8.2-1). Assumptions and cost estimates are provided in Appendix F.

8.2.3 Alternative 2B: ET Cover and Institutional Controls

This alternative is described in section 7.3.3.

8.2.3.1 Long-Term Reliability and Effectiveness

Installation of an ET cover will reduce erosion, biointrusion, and infiltration and will also reduce the potential for future exposure. The ET cover is reliable over the long term, and it does not suffer from desiccation issues associated with standard RCRA covers. Long-term maintenance requirements for ET covers include visual inspection, removal of unwanted debris and large woody plants, erosion control, and mowing. ET covers have demonstrated effectiveness in arid and semiarid climates, and the possibility of failure is relatively low (Dwyer 2007, 098276).

Residual uncertainty and long-term risk will be associated with waste that remains in place. Institutional controls will be used to manage this uncertainty by restricting site access.

8.2.3.2 Reduction of Toxicity, Mobility, or Volume

The ET cover will reduce mobility of waste by controlling erosion and infiltration but will have no impact on reduction of toxicity or volume.

8.2.3.3 Short-Term Effectiveness

An ET cover can be constructed in a short time frame (i.e., approximately 1 yr). This cover poses relatively low risk to the community, workers, and the environment during construction because it does not involve any waste excavation or management. The greatest impacts to human health during cover installation are associated with the physical hazards of construction activities and traffic risks while transporting raw materials to the site. Workers will not be exposed to buried waste during ET cover construction.

This alternative is effective in the short term without creating significant additional risk.

8.2.3.4 Implementability

The ET cover is installed using standard construction techniques and presents minimal installation and construction difficulties. Following installation, low to moderate maintenance is required.

8.2.3.5 Cost

The capital cost for installation of site fencing as part of institutional controls is estimated to be $77,000. The capital cost for installation of the ET cover is estimated to be $830,000. The total O&M costs for the ET cover are estimated to be $445,000.

The indirect capital costs are estimated to be $1,949,000, which includes design of the alternative as well as professional management and contingency. Indirect O&M costs are estimated to be $484,000, which includes professional management and contingency.

The total PV cost is estimated to be $3,902,000 (Table 8.2-2). Assumptions and cost estimates are provided in Appendix F.

8.2.4 Alternative 3: Excavation and Institutional Controls

This alternative is described in section 7.3.4.

8.2.4.1 Long-Term Reliability and Effectiveness

Removal of the waste in the shafts will eliminate the source and the potential for future exposure. Uncertainties will be managed by collecting confirmatory samples to determine the extent of the excavation. After the waste has been removed, the excavation will be backfilled and the area regraded, revegetated, and maintained to establish the vegetation. This alternative transfers the potential impact of the waste to the permitted off-site disposal facility.

Institutional controls will be used to manage this uncertainty by restricting site access.

8.2.4.2 Reduction of Toxicity, Mobility, or Volume

The removal of waste in the shafts will reduce toxicity and mobility of contaminants from the current site. However, the sorting and segregation of the excavated materials will increase the volume of waste to be disposed of by increasing the amount of packaging materials necessary for transport and disposal.

8.2.4.3 Short-Term Effectiveness

Excavation, sorting, segregation, analysis, waste determination and transport and disposal of the waste would be conducted over a 1-yr period. Before the excavation activities begin, a waste sorting and segregation facility would be built. Removal activities have a higher risk for injuries and accidents. Disturbance and excavation of the units increase the possibility of accidental release of hazardous materials. The possibility of release upon disturbance of the units containing unknown chemical waste increases the short-term risk of contaminant dispersal.

Potential accidents resulting from excavation and associated waste handling include industrial hazards/accidents, fires with release of hazardous materials, explosions and associated releases of radioactive materials, spills of hazardous and radioactive materials, inadvertent exposures to penetrating radiation, and transportation accidents. Additional information on the risk associated with the excavation alternative is provided in Appendix C.

This alternative is effective in the short term, because waste is removed; however, additional risk is created as a result of excavating and transporting the waste.

8.2.4.4 Implementability

The shafts will be excavated using a tiered approach based on hazard level and assessment of specific inventory. Excavation will be accomplished using remote handling methods. Following excavation of waste, no maintenance is required.

8.2.4.5 Cost

The capital cost for installation of site fencing as part of institutional controls is estimated to be $408,000. The total capital costs for the excavation of the shafts are estimated to be $113,594,000, of which $48,280,000 is estimated for disposal of waste materials.

The indirect capital costs are estimated to be $217,714,000, which includes design of the alternative as well as professional management and contingency. Indirect O&M costs are estimated to be $248,000, which includes professional management and contingency.

The total PV cost is estimated to be $346,510,000 (Table 8.2-3). Assumptions and cost estimates are provided in Appendix F.

9.0 SELECTION OF THE RECOMMENDED CORRECTIVE MEASURES ALTERNATIVE

The purpose of this CME is to identify, develop, and evaluate corrective measures alternatives and recommend the corrective measure for MDA H. Alternatives that met the threshold criteria in section 7 were evaluated against the remedial alternative evaluation criteria (i.e., the balancing criteria) in section 8. A comparative analysis of the alternatives and their relative rating for each of the balancing criteria is provided in section 9.1. The recommended alternative is discussed in section 9.2.

9.1 Comparative Analysis of the Alternatives for MDA H

Alternatives were evaluated against the five balancing criteria in section 8. Each alternative has been rated per the rating system shown in Table 9.1-1. The relative rating for each alternative against the balancing criteria is provided in Table 9.1-2.

9.1.1 Long-Term Reliability and Effectiveness

Alternative 3, excavation and institutional controls, provides the highest degree of long-term reliability and effectiveness because all the waste materials at the site are removed (Rating = 5, 1 to 5 scale). Alternative 1, no action, provides the least degree of long-term reliability and effectiveness because no action is taken and therefore is rated the lowest, 1.

An ET cover provides a higher degree of long-term reliability and effectiveness in comparison to the multilayer cover because of the potential desiccation in the clay layers of the multilayer cover. Therefore, Alternative 2B, ET cover and institutional controls, is rated higher, 3, than Alternative 2A, multilayer cover and institutional controls, which is rated 2.

9.1.2 Reduction of Toxicity, Mobility, or Volume

Alternative 3, excavation and institutional controls, provides the highest degree of reduction of toxicity, mobility, or volume because all wastes at the site are removed (Rating = 5, 1 to 5 scale). Alternative 1, no action, provides the least degree of reduction of toxicity, mobility, or volume because no action is taken and therefore is rated the lowest, 1.

Each type of cover provides similar performance. Therefore, Alternatives 2A, multilayer cover and institutional controls, and 2B, ET cover and institutional controls, are rated equally, 3.

9.1.3 Short-Term Effectiveness

Excavation of waste materials achieves risk reduction by removing the source material but adds short-term risk because of the hazards associated with performing the tasks. For this reason, Alternative 3, excavation and institutional controls, is rated lowest (Rating = 1, 1 to 5 scale).

Each type of cover provides similar performance as potential exposure pathways are broken. Because excavation is not required as part of Alternatives 2A, multilayer cover and institutional controls, and 2B, ET cover and institutional controls, they are rated equally, 4. No action is taken under Alternative 1, and, while no additional risk is generated, there is also no risk reduction. For these reasons, Alternative 1 is rated a 3.

9.1.4 Implementability

Alternative 1, no action, is the easiest to implement because no remedy is required, so it is rated the highest (Rating = 5, 1 to 5 scale). Excavation of waste materials adds complexity to implementability because of safety controls for performing the tasks and the handling of waste. Because Alternative 3, excavation and institutional controls, includes excavation of all waste materials, it is rated the lowest, 1.

Because each type of cover has similar design and construction requirements that have been shown to be implementable, Alternatives 2A, multilayer cover and institutional controls, and 2B, ET cover and institutional controls, are rated equally, 3.

9.1.5 Cost

Alternative 1, no action, has no cost, so it is rated the highest (Rating = 5, 1 to 5 scale). The cost criterion is impacted most by the excavation of waste materials, handling of the waste, and the disposal of the waste. Because Alternative 3, excavation and institutional controls, includes excavation of all waste material and has the highest cost, it is rated the lowest, 1.

Because each type of cover has similar cost requirements and excavation is not required, Alternatives 2A, multilayer cover and institutional controls, and 2B, ET cover and institutional controls, are rated equally, 4.

9.2 Selection of Recommended Corrective Measure

Based on the alternative evaluation, the recommended alternative for MDA H is Alternative 2B: ET cover and institutional controls.

The recommended alternative effectively addresses the RAOs developed from the CSM and from the uncertainty associated with waste in the shafts. The RAOs include the following:

- prevent human health and ecological exposure to the waste through excavation and
- prevent disruption and dispersal of waste by physical disruption or infiltration of moisture.

An ET cover can be constructed in a short time frame (i.e., approximately 1 yr). This cover poses relatively low risk to the community, workers, and the environment during construction because it does not involve any waste excavation or management. This alternative achieves cleanup in a timely manner.

An ET cover will provide protection against erosion, direct contact, biointrusion, and moisture infiltration. The ET cover puts a minimum of 6.5 ft of varying soil layers between a potential human or ecological receptor and the top of the disposal shafts, thereby breaking the exposure pathway. The ET cover is

designed to restrict infiltration of water, thereby reducing the release mechanism of disruption and dispersal of the waste. Institutional controls will be implemented to provide access controls, thereby restricting human exposure. This alternative is protective of human health and the environment.

An ET cover will minimize or eliminate infiltration of precipitation that could cause a disruption or dispersal of waste. An ET cover will also limit exposure to waste and contaminated surface and subsurface soils and reduces the potential for erosion. This alternative will control sources and the migration of released contaminants.

No waste is expected to be generated during the construction of the ET cover. Remediation wastes will be managed in accordance with state and federal regulations under this alternative.

The CSMs have been refined to illustrate the impact of the recommended alternative on the source areas and release mechanisms and the resulting reduction in exposure potential (e.g., incomplete pathways) and future risk. The refined CSM is shown in Figure 9.2-1.

10.0 DESIGN CRITERIA TO MEET CLEANUP OBJECTIVES

This section presents a preliminary plan and key specifications for design and implementation of the recommended alternative.

10.1 Design Approach

Selection of the recommended alternative requires designing an ET cover during the CMI phase for MDA H. The CMI plan will include DOE Order 5400.5 design requirements.

The design process will include the following actions.

ET Cover

One ET cover will be installed over MDA H (Figure 7.3-1). The cover will be approximately 0.6 acres. The preliminary cover design includes

- 1 ft of angular cobbles with a minimum diameter of 4 to 6 in. to act as a biointrusion barrier;
- 0.5 ft of sand and gravel mixture to prevent the mixing of soil layers;
- 3.5 ft of natural or amended soil that meets the water storage capacity of a typical sandy loam; and
- 1.5 ft of natural or amended soil and vegetation, with minimal slopes, to ensure a desired stand of vegetation is maintained.

The preliminary ET cover design may be modified based on further evaluation of the critical design requirements. The critical design requirements include the following:

- identifying critical infiltration events, including identification of the design precipitation event (i.e., maximum precipitation event that the design can endure) or series of events
- determining the minimum required water-storage capacity of MDA H soil based on the design precipitation events identified above
- determining the minimum required thickness and contours required to ensure the ET cover can control erosion and infiltration during the 30-yr maintenance period (per DOE guidance) based on

the design precipitation events identified above; also, determining the minimum thickness required to establish and maintain vegetation

- identifying the seed mixture to be used and meeting with representatives of San Ildefonso Pueblo to ensure the mixture has no adverse effect on adjacent Pueblo lands, identifying the surface treatment to be employed before seeding, and identifying the frequency of watering necessary to establish vegetation on the cover
- planning for long-term maintenance requirements of the ET cover that includes annual inspection and repair for erosion and subsidence, removal of debris and large woody plants, removal of burrowing animals, and mowing as needed to maintain the ET cover

10.2 Preliminary Design Criteria and Rationale

Preparation of the CMI plan includes a schedule for design of the recommended alternative, including development of design drawings, calculations, and supporting documentation that will be submitted to NMED according to the CMI schedule. The CMI plan will be written to ensure the following:

- The cover will have sufficient thickness and will be contoured to control erosion resulting from the worst-case precipitation event.
- The cover will have sufficient thickness and incorporate a biointrusion barrier to restrict deep-rooting vegetation and burrowing animals.
- The cover will have sufficient capacity to store the “maximum” infiltration quantity resulting from the worst-case precipitation event until it can be removed through ET.
- The proposed seed mixture used to stabilize the cover with vegetation will closely emulate the local shallow-rooting plant community, will ensure the vegetative cover remains viable, and will have no detrimental effect on neighboring Pueblo lands.
- The surface treatment method will encourage native vegetation establishment and growth as well as reduce erosion.

10.2.1 Surface Treatment

Surface treatments, such as soil nutrients, a gravel layer, or a soil-gravel admixture, may be warranted in the semiarid climate at the Laboratory to help establish native vegetation and reduce erosion. During the CMI design phase, a seed mix will be specified to stabilize the cover with native vegetation similar to the undisturbed and well-established plant communities inhabiting Mesita del Buey.

The addition of a layer of soil-gravel admixture on the surface of the cover provides erosion protection for the design precipitation event and promotes ET from native species of grasses. Erosion and water-balance studies at the Laboratory indicate moderate amounts of gravel mixed into the cover topsoil will control both water and wind erosion with little effect on the vegetation or the soil-water balance (Wilson et al. 2005, 092034). The protection from water erosion depends on the depth, velocity, and duration of stormwater flowing across the MDA H cover. Flow values can be established from the physical properties (i.e., slope, convex or concave grading, slope uniformity, and length of flow paths) of the cover and the intensity of the precipitation (i.e., precipitation rates, infiltration versus runoff relationships, snowmelt, and off-site flows). As wind blows and water flows over the cover surface, some winnowing of fines from the admixture is expected, creating a vegetated, erosion-resistant surface.

An ET cover is intended to function in unsaturated conditions; consequently, obtaining very low saturated hydraulic conductivity is not essential to a successful cover. The ET cover soil moisture characteristics and cover compaction density are crucial parameters. Compaction density requirements will be based on the design criteria used but generally will achieve a density in the upper soil layer that approximates the surrounding undisturbed soil. Uniformity of compaction is critical to avoid creating preferential infiltration pathways.

The recommendation on surface treatment is based on review of site-specific conditions at nearby MDA G and Laboratory data from cover experiments at TA-51 (Nyhan et al. 1996, 063111). The best surface layer will be chosen during the CMI design phase and after discussion with NMED. Additional information and specifications for the surface treatment are provided in Appendix H.

10.2.2 Cover Soil

The performance of the ET cover relies on its thickness, materials, and placement. The ET cover for MDA H will be thick enough to ensure that the water-storage capacity exceeds the maximum infiltration resulting from the design precipitation event. Additional information and specifications for the cover soil are provided in Appendix H.

10.2.3 Filter Media

Inclusion of a filter media layer with a particle size between that of the cover soil and the biointrusion barrier will enhance the water storage of the cover by providing a capillary break. Additional information and specifications for the filter media are provided in Appendix H.

10.2.4 Biointrusion Barrier

When the final cover depth is established in the CMI, the biointrusion barrier requirements will be evaluated to optimize performance. The biointrusion barrier must prevent deep-rooting plants and burrowing animals from encroaching into the waste where they may become exposed, create conduits for water infiltration, or transport waste to the surface. Additional information and specifications for the biointrusion barrier are provided in Appendix H.

10.3 General O&M Requirements

An O&M manual based on the design and monitoring requirements for the ET cover will be prepared and submitted as part of the CMI plan. O&M considerations will include irrigation need, moisture monitoring, erosion monitoring, biota monitoring, and cover maintenance.

10.3.1 Long-Term Monitoring Requirements

To ensure adequate detection monitoring in the regional groundwater monitoring network, an additional regional aquifer monitoring well east-southeast of MDA H is recommended in Appendix E. Because of potential perched-intermediate zones in this area, an additional well in the perched zone, if identified, is also recommended. Because these wells are part of the long-term monitoring plan for MDA H, they are not included as a component of the recommended alternative. However, the addition of these new groundwater monitoring wells will be included as part of the CMI plan.

Groundwater monitoring of the regional aquifer will be conducted in accordance with requirements in the Laboratory's Hazardous Waste Facility Permit.

10.4 Additional Engineering Data Required

Before the CMI design is completed, additional data are required, including but not limited to

- verifying the existing depths to the top of waste in the shafts using ground-penetrating radar to accurately determine the operational cover thickness,
- testing the geotechnical properties of all materials used for the ET cover,
- verifying the locations of buried utilities to determine any potential conflicts, and
- reviewing existing plans and specifications for the water lines that parallel MDA H along Mesita del Buey Road to determine the existing condition of the lines and the best method for installing pressure sensors and automatic shut-off valves should a water line break occur.

These upgrades will be completed before the start of cover construction.

10.5 Additional Requirements

10.5.1 Permits and Regulatory Requirements

NMED will select a final remedy, issue a Statement of Basis for the selected remedy, and designate a period of time for public comment (section 11). DSA approval will be obtained for working within the NES boundary.

10.5.2 Access, Easements, Right-of-Way Agreements

Access, easements, and right-of-way agreements are managed through the Laboratory and will be developed as required once the corrective measure is selected.

10.5.3 Health and Safety Requirements

A site-specific health and safety plan will be prepared describing the health and safety requirements to be followed during construction of the ET cover, O&M activities, and monitoring activities.

10.5.4 Community-Relations Activities

A community-relations program will be developed in accordance with Section VII.E.4 of the Consent Order to keep northern New Mexico stakeholders and other interested parties regularly informed of project activities and progress at MDA H.

11.0 SCHEDULE FOR COMPLETION OF ACTIVITIES

The Consent Order requires that a schedule for completion of activities be submitted in the CME report. Activities leading to completion of the remedy include planning, design, and construction of the ET cover. Several milestones for completion of the corrective measure at MDA H are presented in the Consent Order, along with schedule updates. In addition to these milestones, the Consent Order requires the CME report to include a proposed schedule for implementation of the preferred remedy. The schedule identifies the duration of corrective action operations, the frequency of monitoring and sampling activities, and the dates for submitting inspection and monitoring reports to NMED, including all status reports and preliminary data.

Proposed Milestones

Proposed milestones include the following.

- NMED will prepare a Statement of Basis for remedy selection and issue the statement for public comment.
- NMED will receive public comments on the Statement of Basis for at least 60 d following public notice. NMED shall provide an opportunity for a public hearing that may extend the public comment period.
- Based upon the Laboratory's preferred remedy in the CME, the Laboratory requests the submittal of a CMI plan within 18 mo after NMED selects a final remedy. The plan will contain detailed engineering design drawings and system specifications for all elements of the remedy and a schedule for implementation of the corrective action.
- DSA approval for activities to be performed within an NES will be obtained.
- Closure of Shaft 9 will be performed in accordance with RCRA closure requirements under 40 CFR 264 Subparts F and G. As directed by NMED (2000, 068569), closure of Shaft 9 will be incorporated into the corrective action of Shafts 1 through 8 in accordance with the alternate requirements of 20.4.1 NMAC 264.110(c).
- The corrective measure will be implemented and a remedy completion report submitted in accordance with the schedule in the CMI plan. Following approval of the CMI plan, construction of the Laboratory's preferred remedy is expected to take 12 mo.
- Monitoring and maintenance, including reporting requirements, will be completed according to the CMI plan.
- Following completion of the remedy, groundwater monitoring will be conducted and reported as required by the Laboratory's Hazardous Waste Facility Permit.

12.0 REFERENCES AND MAP DATA SOURCES

12.1 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. 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.

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12.2 Map Data Sources

Hypsography, 20- and 100-ft Contour Intervals; Los Alamos National Laboratory, ENV-Environmental Remediation and Surveillance Program; 1991

LANL DOE Boundary; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; Development Edition of 05 January 2005

LANL Technical Areas; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; Development Edition of 05 January 2005

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Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; Development Edition of 17 January 2006

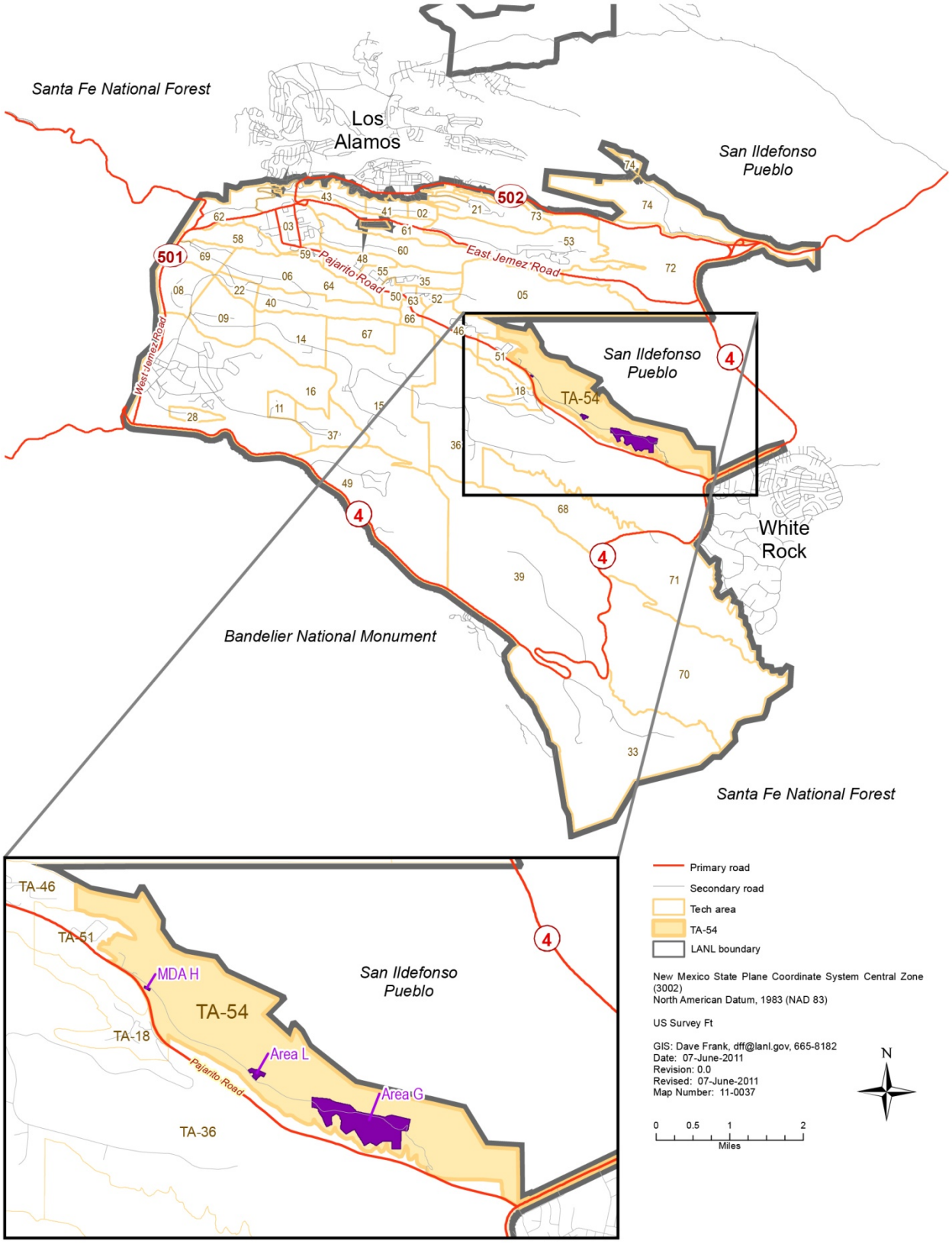


Figure 1.0-1 Location of MDA H in TA-54 with respect to Laboratory technical areas and surrounding landholdings

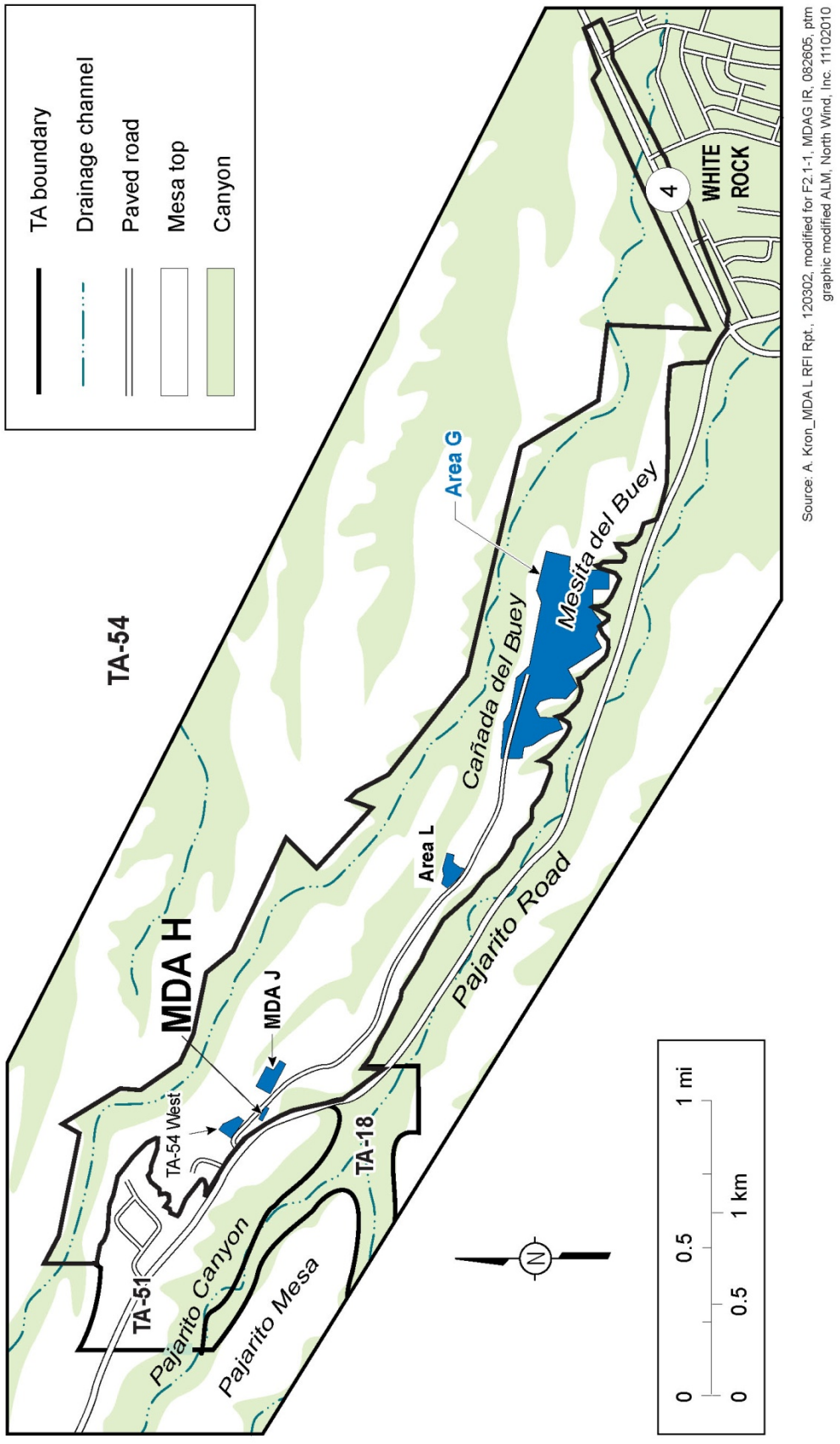


Figure 1.0-2 Location of MDA H in TA-54

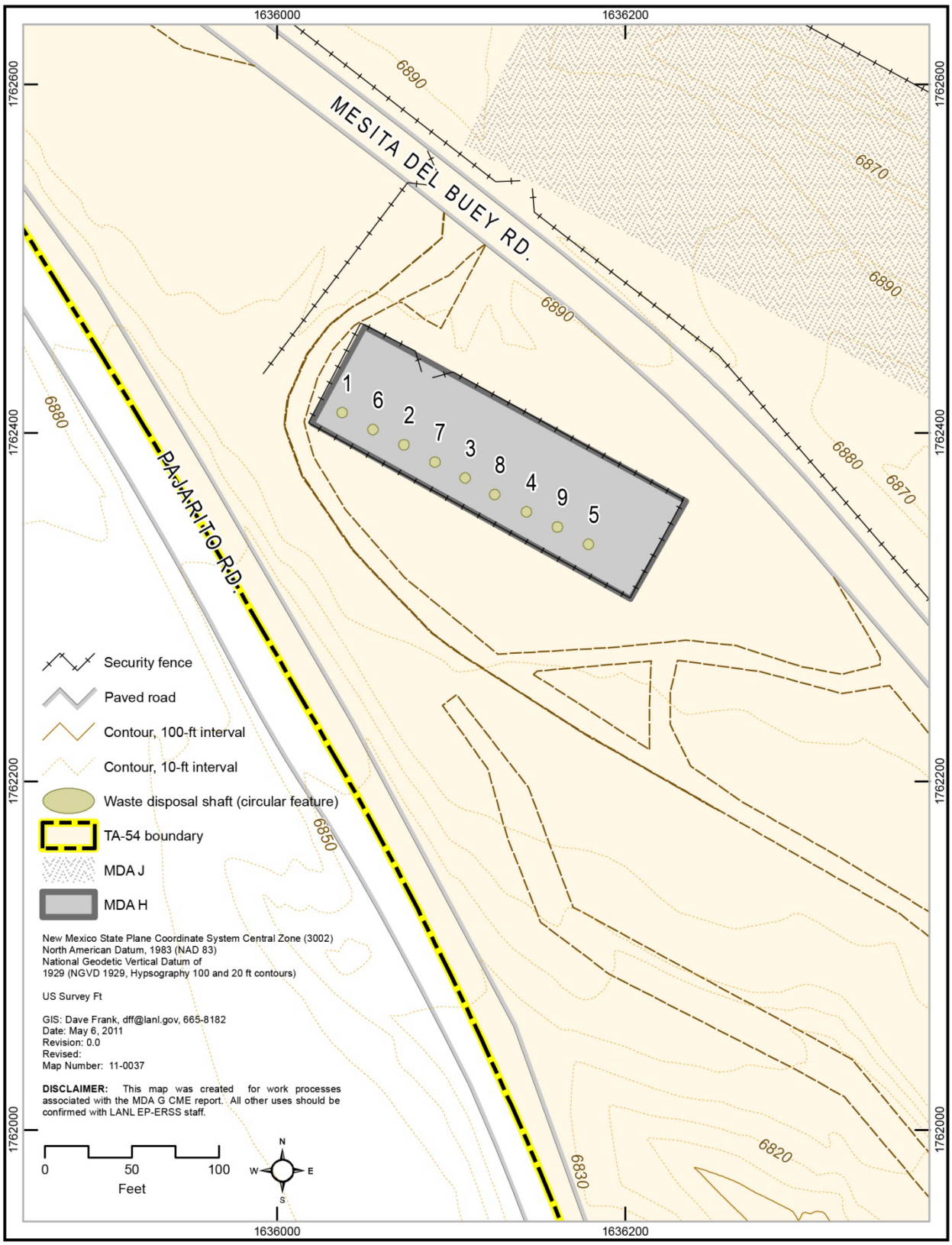


Figure 2.0-1 Locations of inactive disposal shafts at MDA H

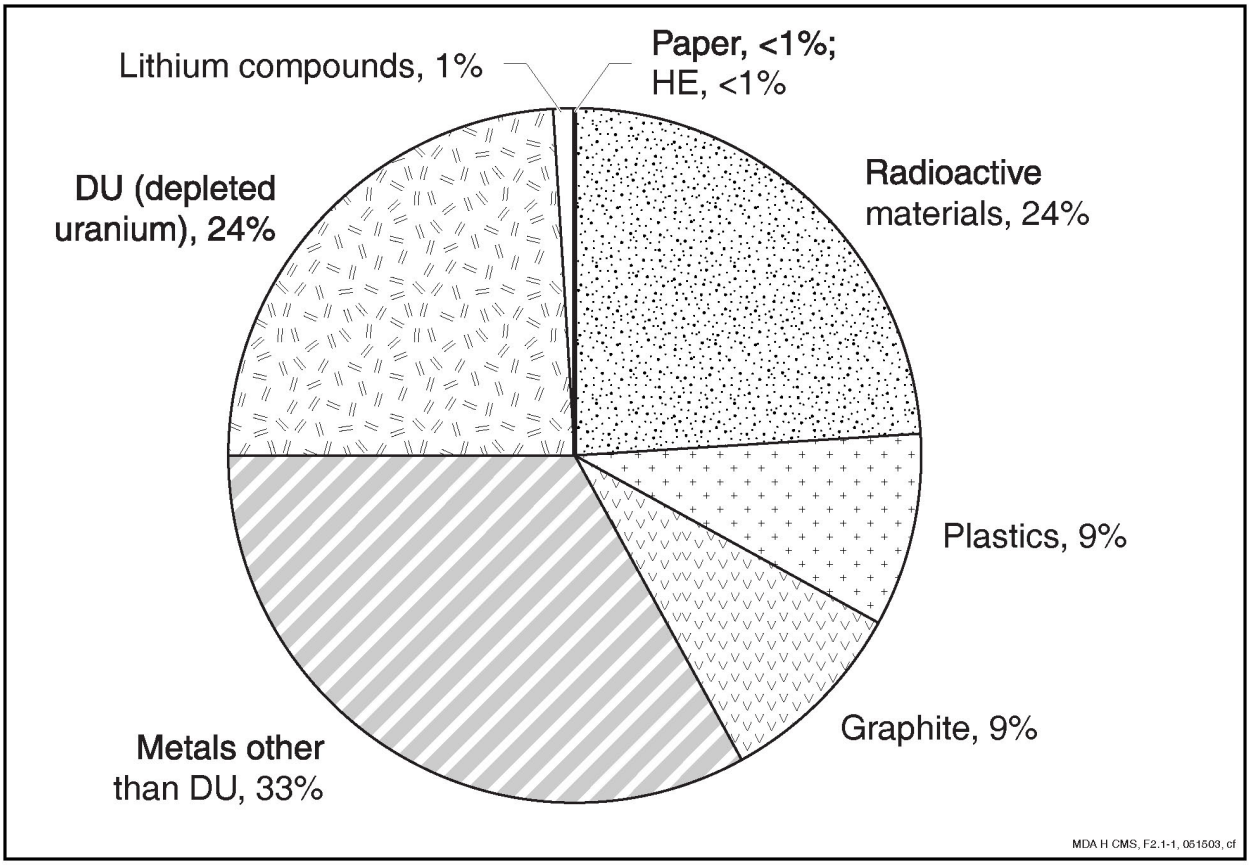


Figure 2.2-1 Breakdown of logbook entries of identified waste materials disposed of in shafts (percentages by weight)

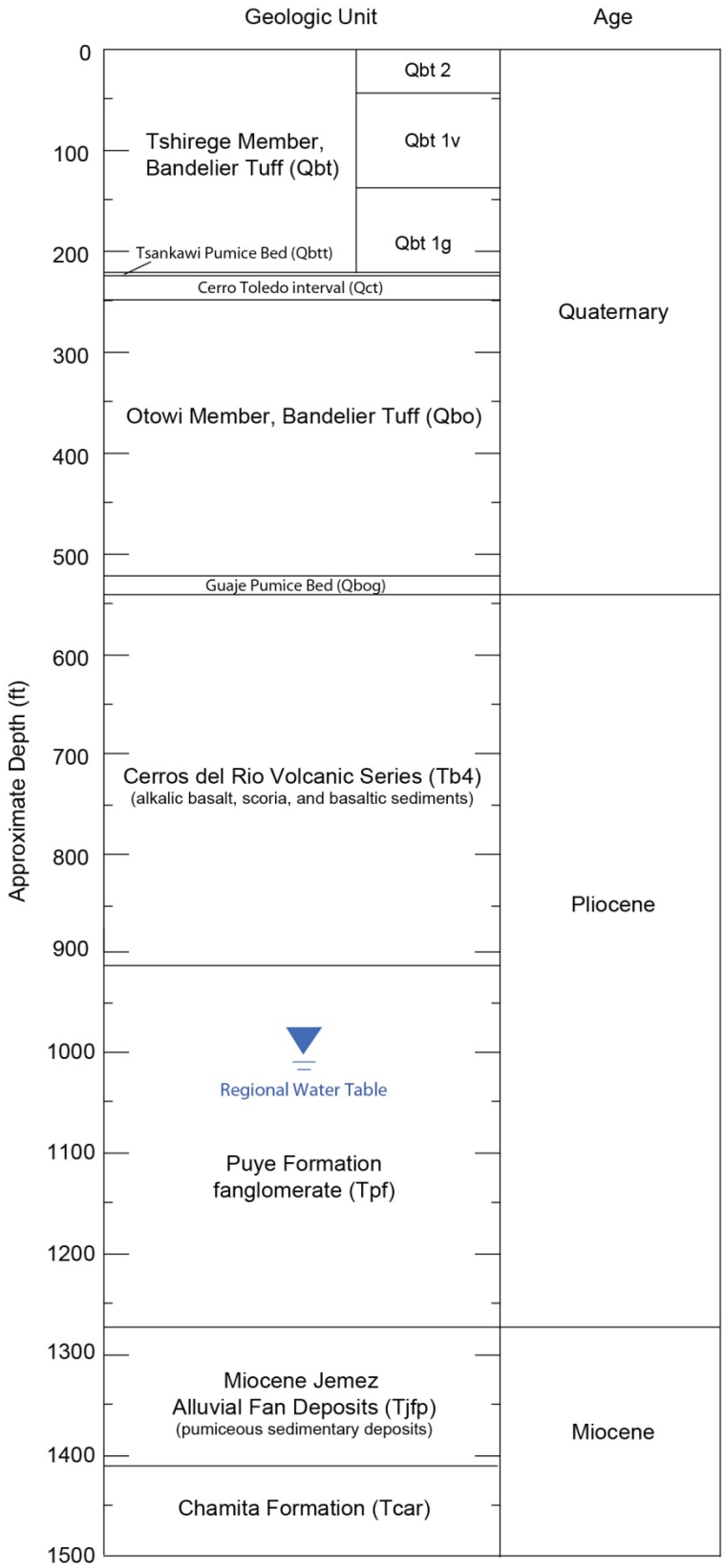


Figure 2.3-1 Generalized stratigraphic column for MDA H

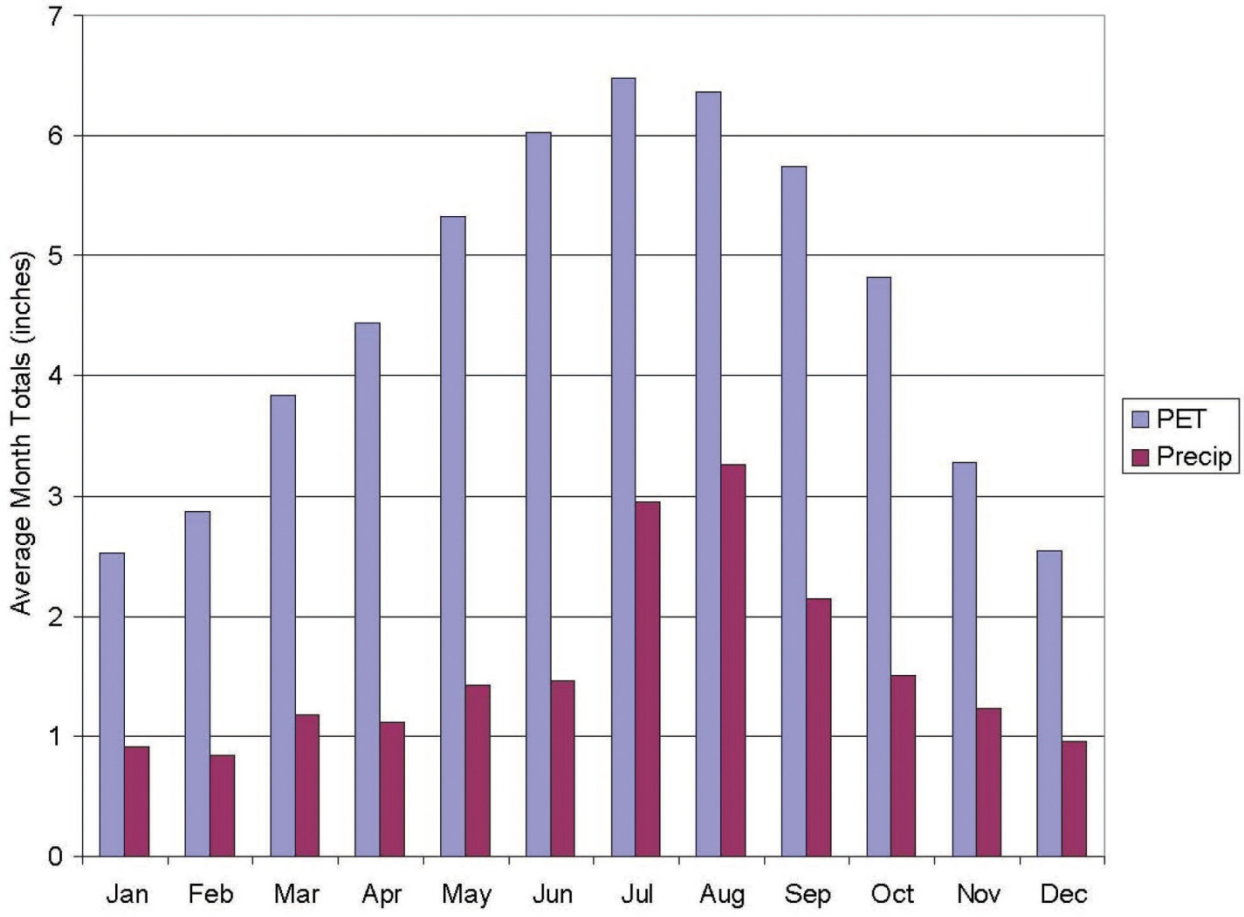


Figure 2.3-2 Climate's demand for water (potential ET) compared with supply of water (precipitation) for Los Alamos, New Mexico

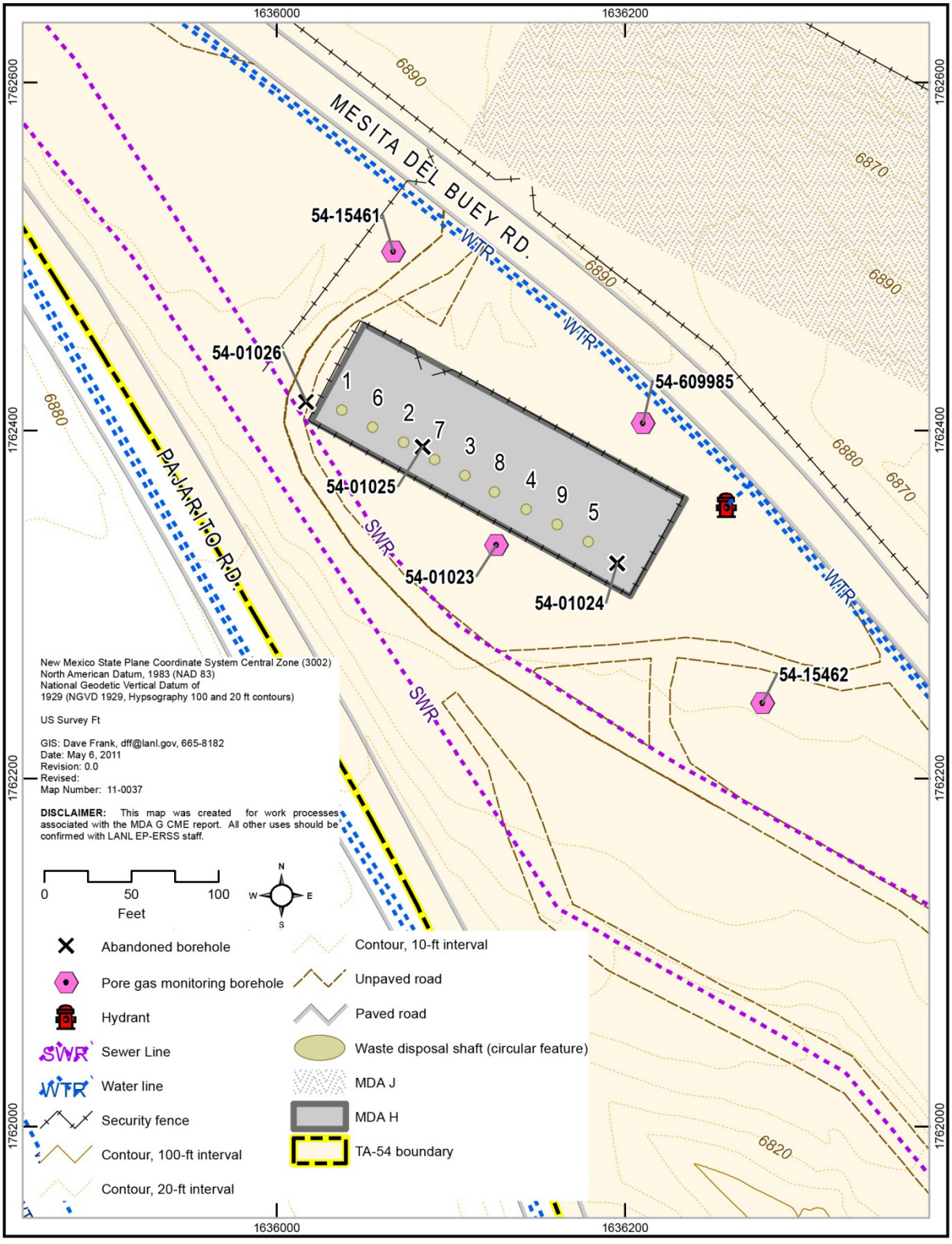
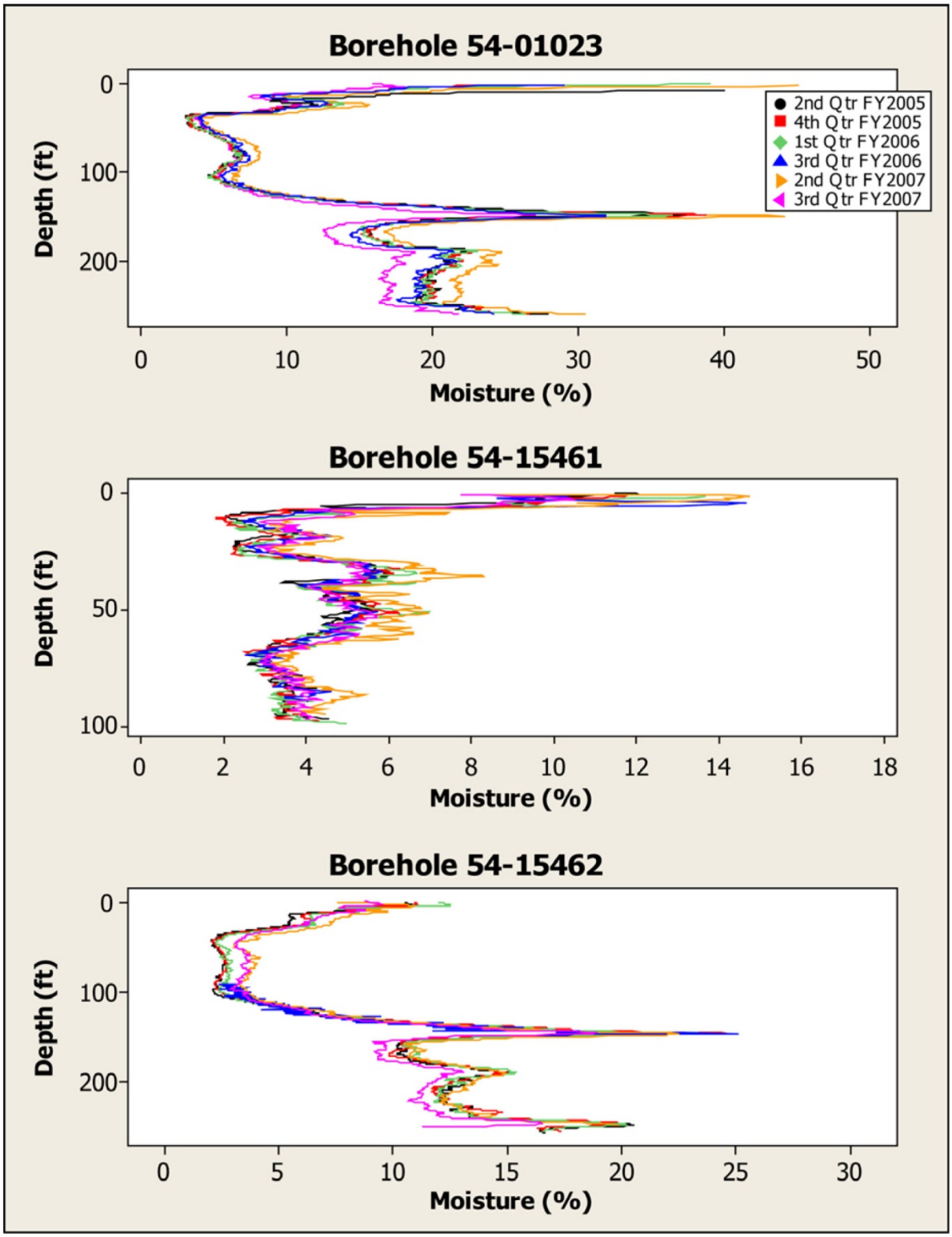


Figure 2.3-3 Location of pore-gas monitoring boreholes and abandoned RFI boreholes



Source: LANL (2007, 099140).

Figure 2.3-4 Moisture monitoring results for MDA H (percent by volume)

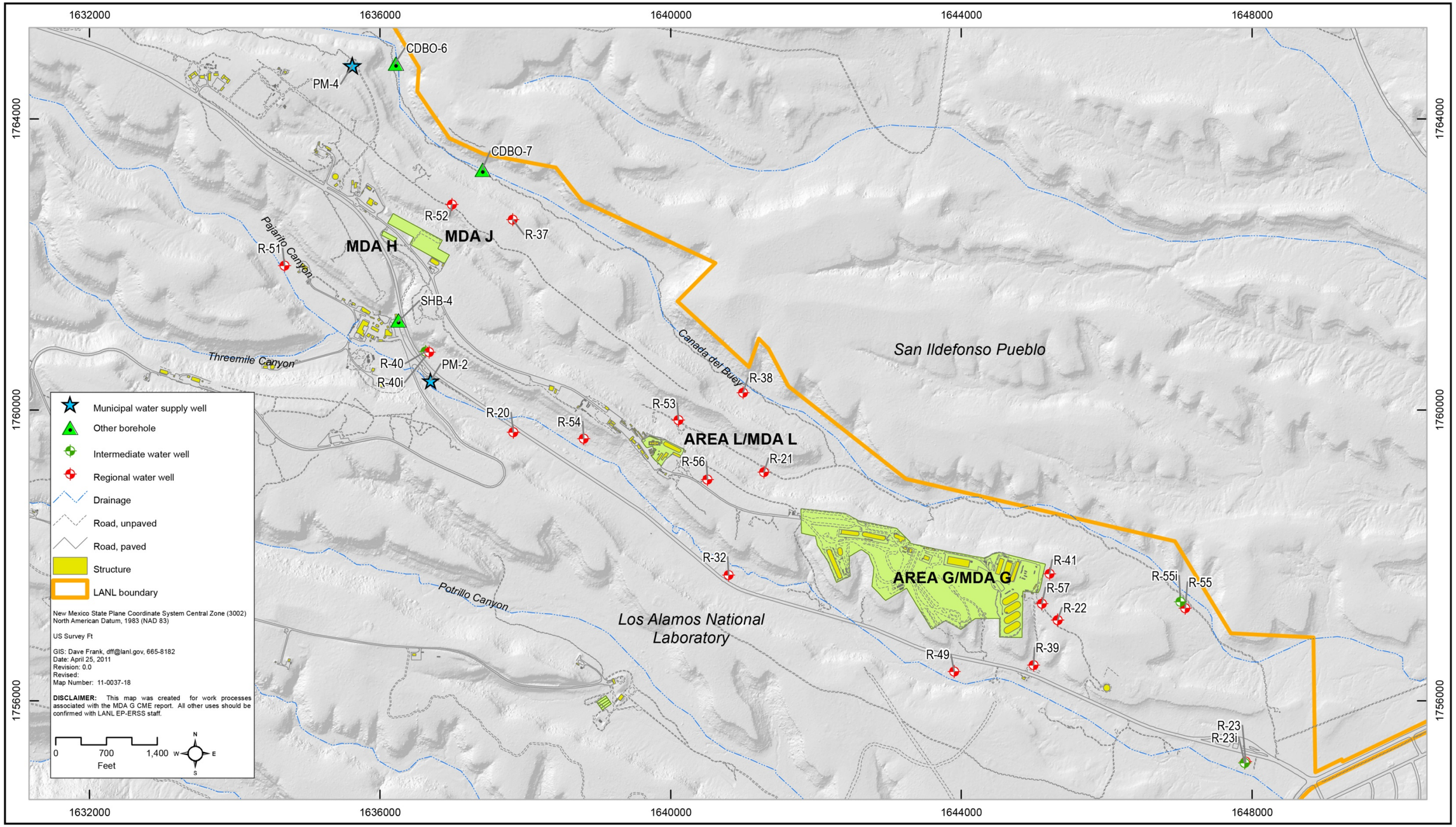


Figure 2.3-5 TA-54 groundwater monitoring network, also showing water-supply wells and shallow monitoring wells CDBO-6 and CDBO-7

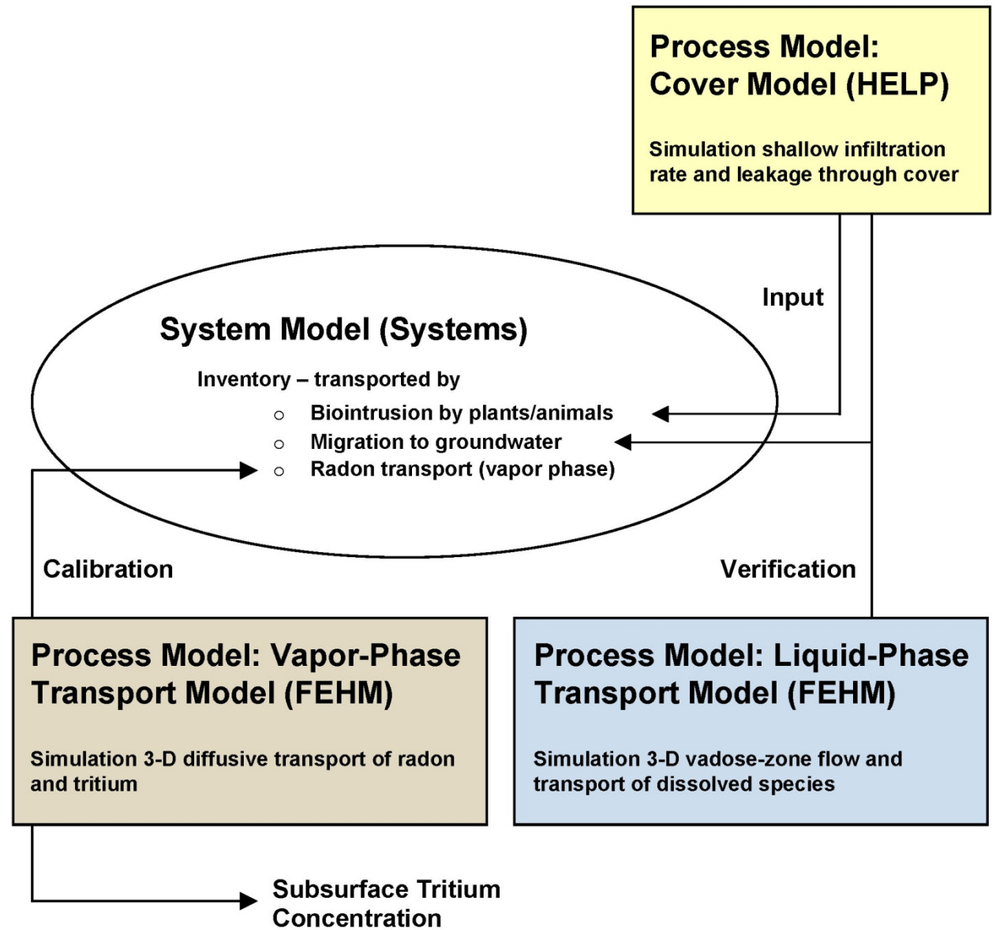
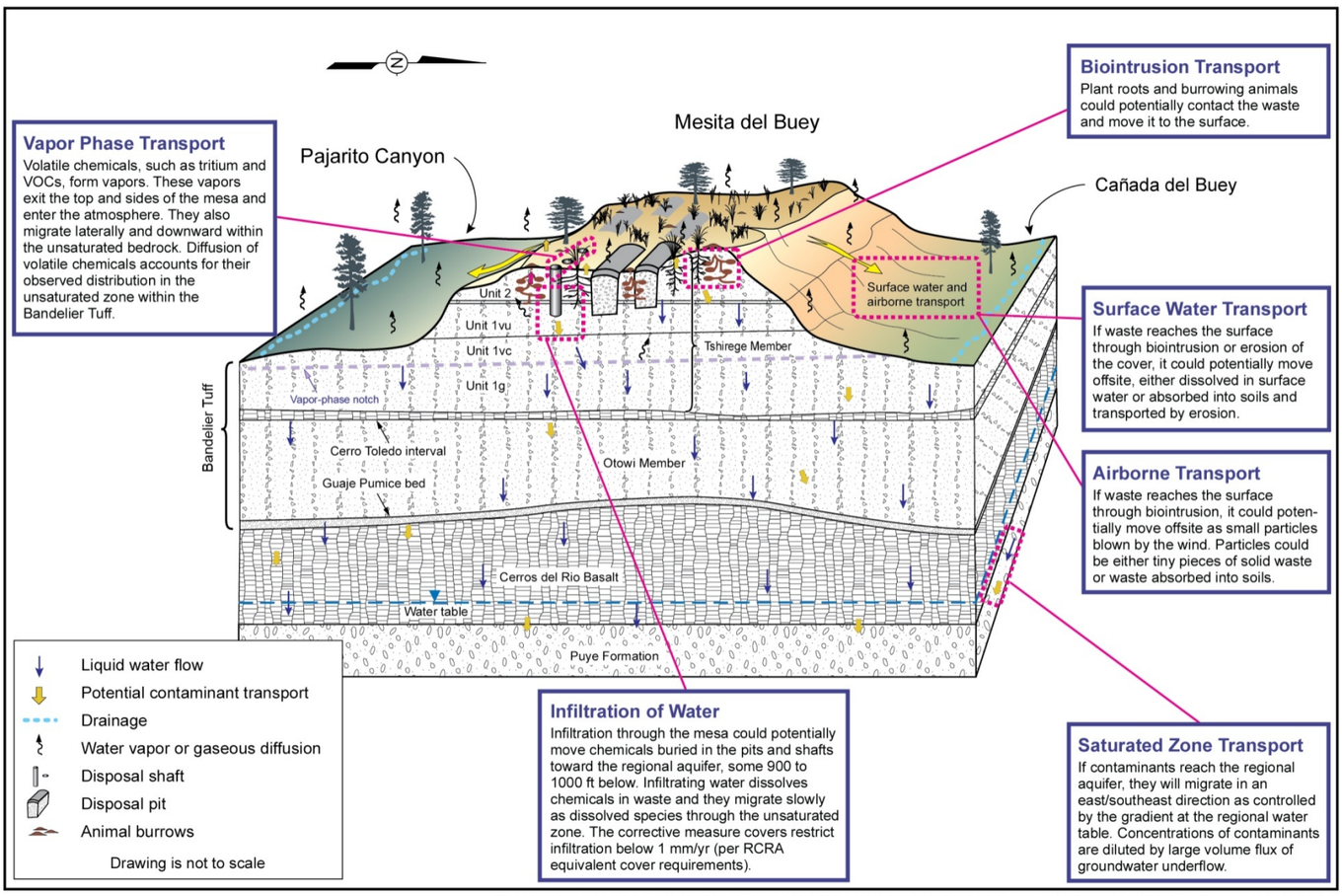


Figure 2.4-1 Links between the system model and the three process models



L Tauxe, 062101 after A. Kron, Rev. for F2.3-1, MDA H RS, 122001, RLM_Rev. for MDA H CMS Rpt., 051403, cf; modified 101507, ptm; modified 041211, ptm

Figure 4.0-1 Hydrogeologic conceptual site model for MDA H at TA-54

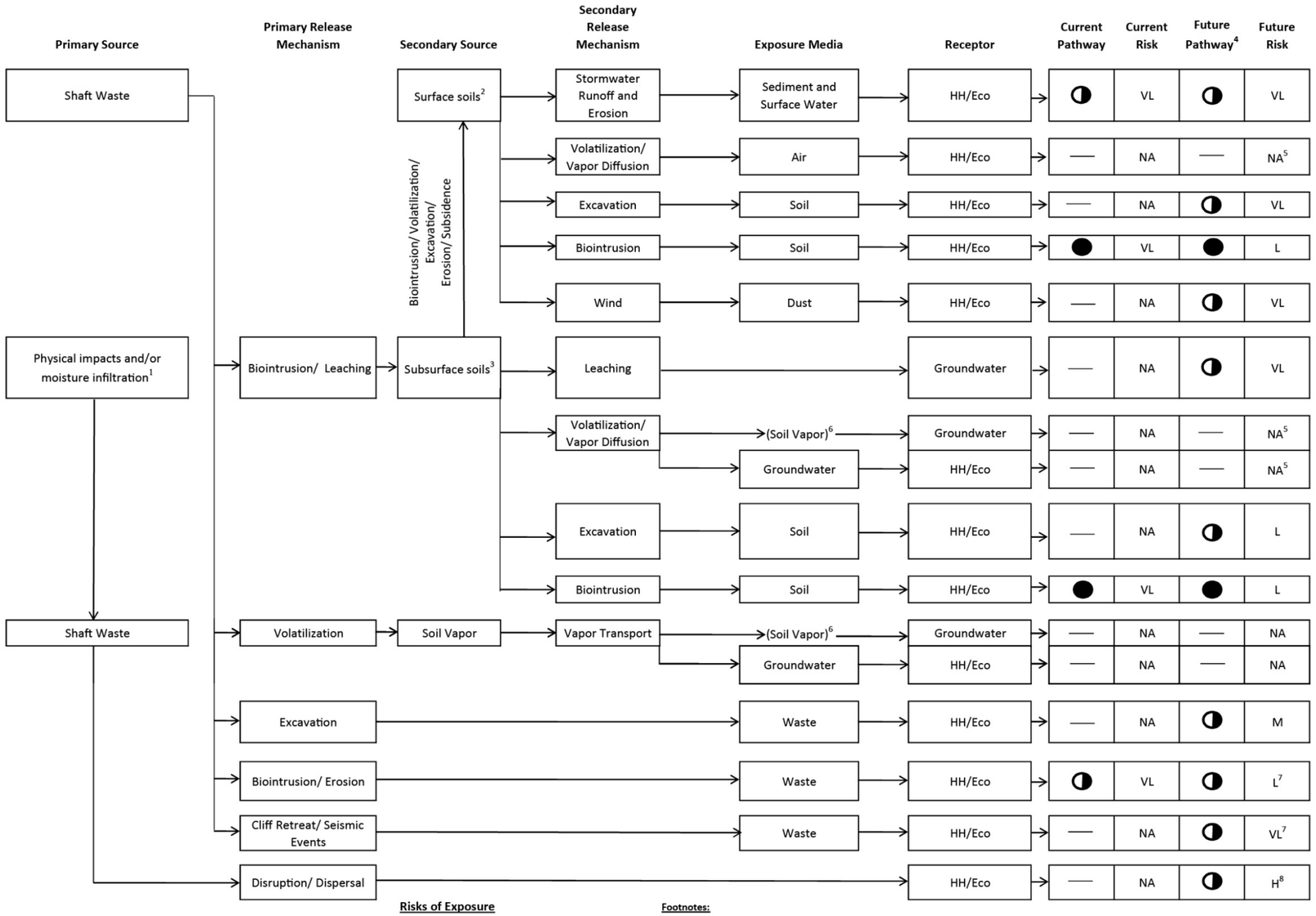


Figure 4.0-2 Conceptual site model

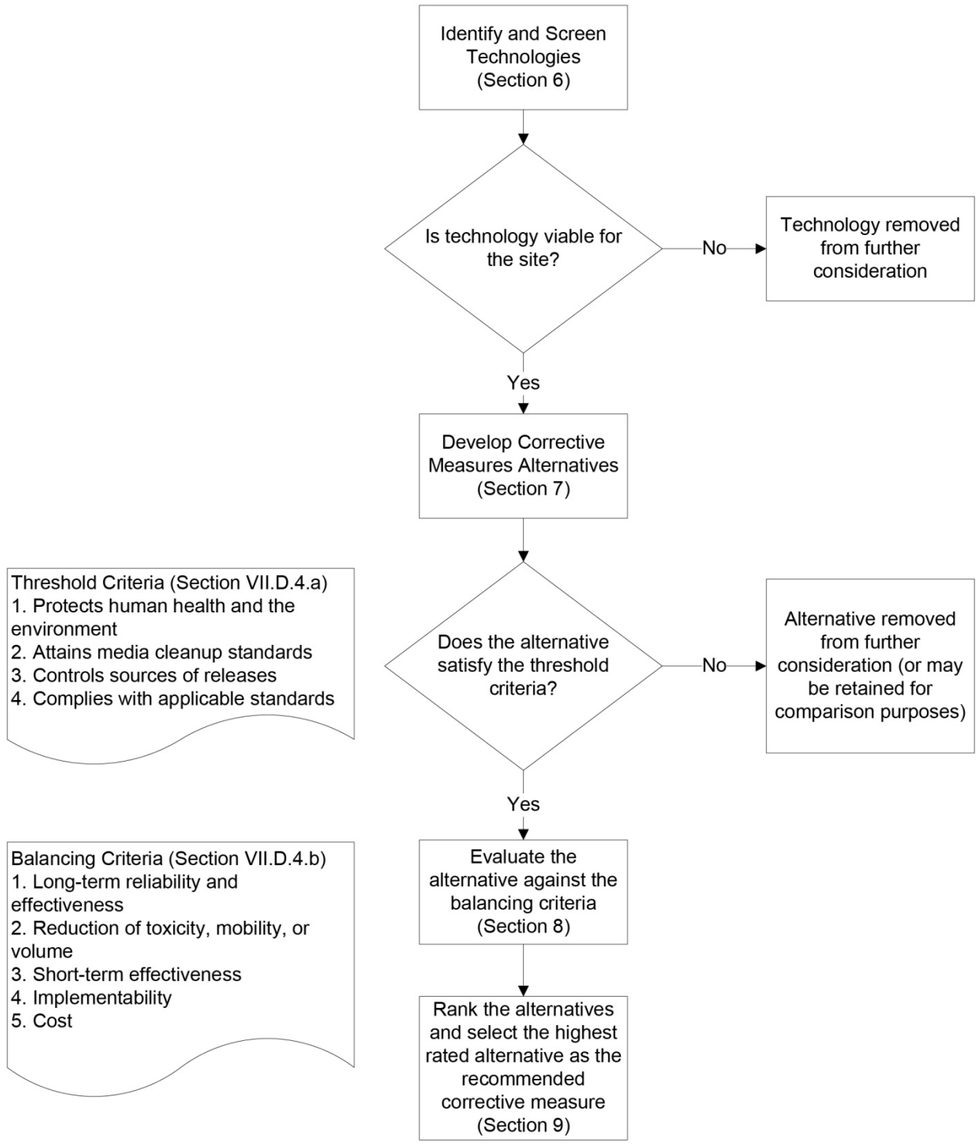


Figure 5.3-1 The selection process for the preferred corrective measures alternative

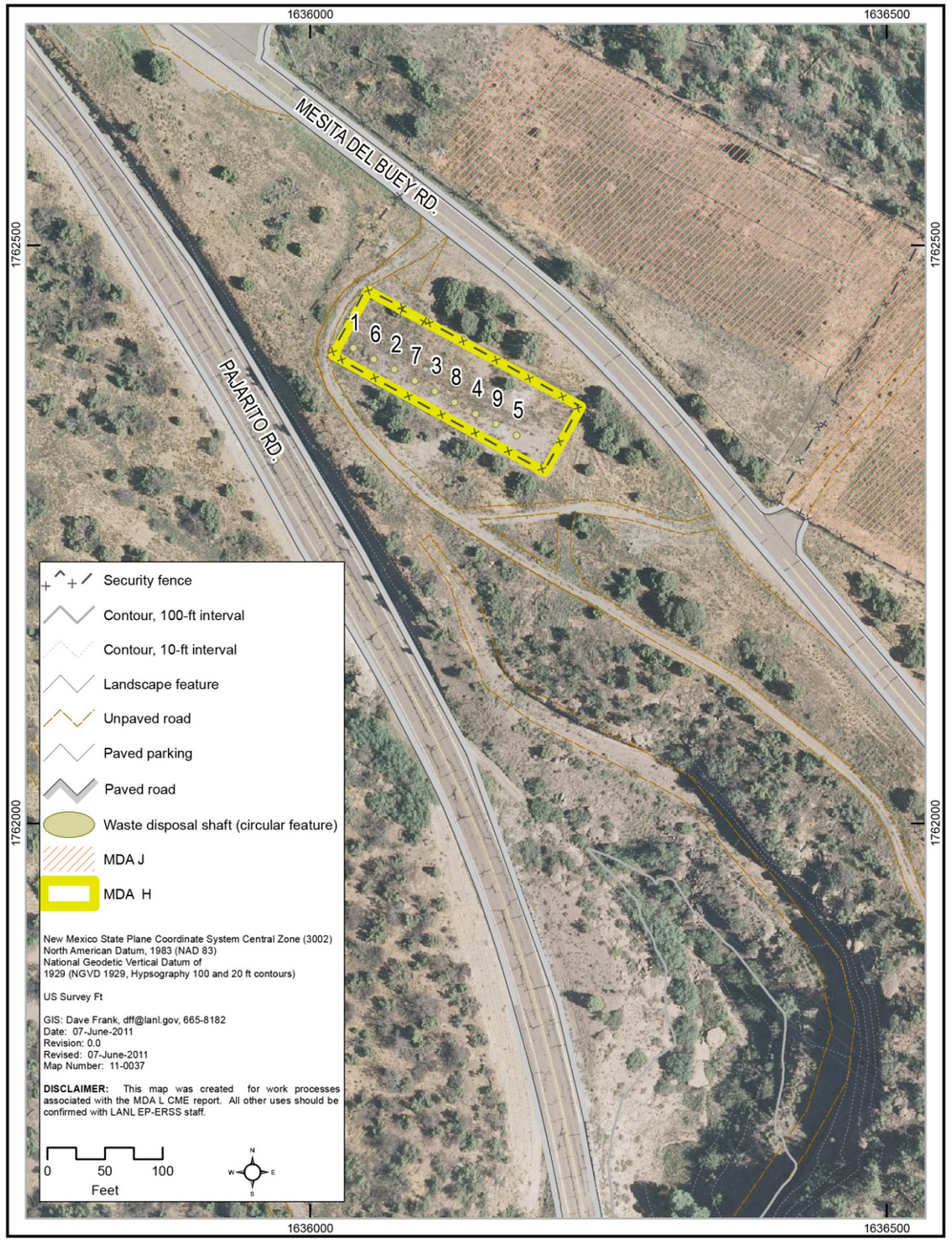


Figure 7.1-1 Site layout of MDA H

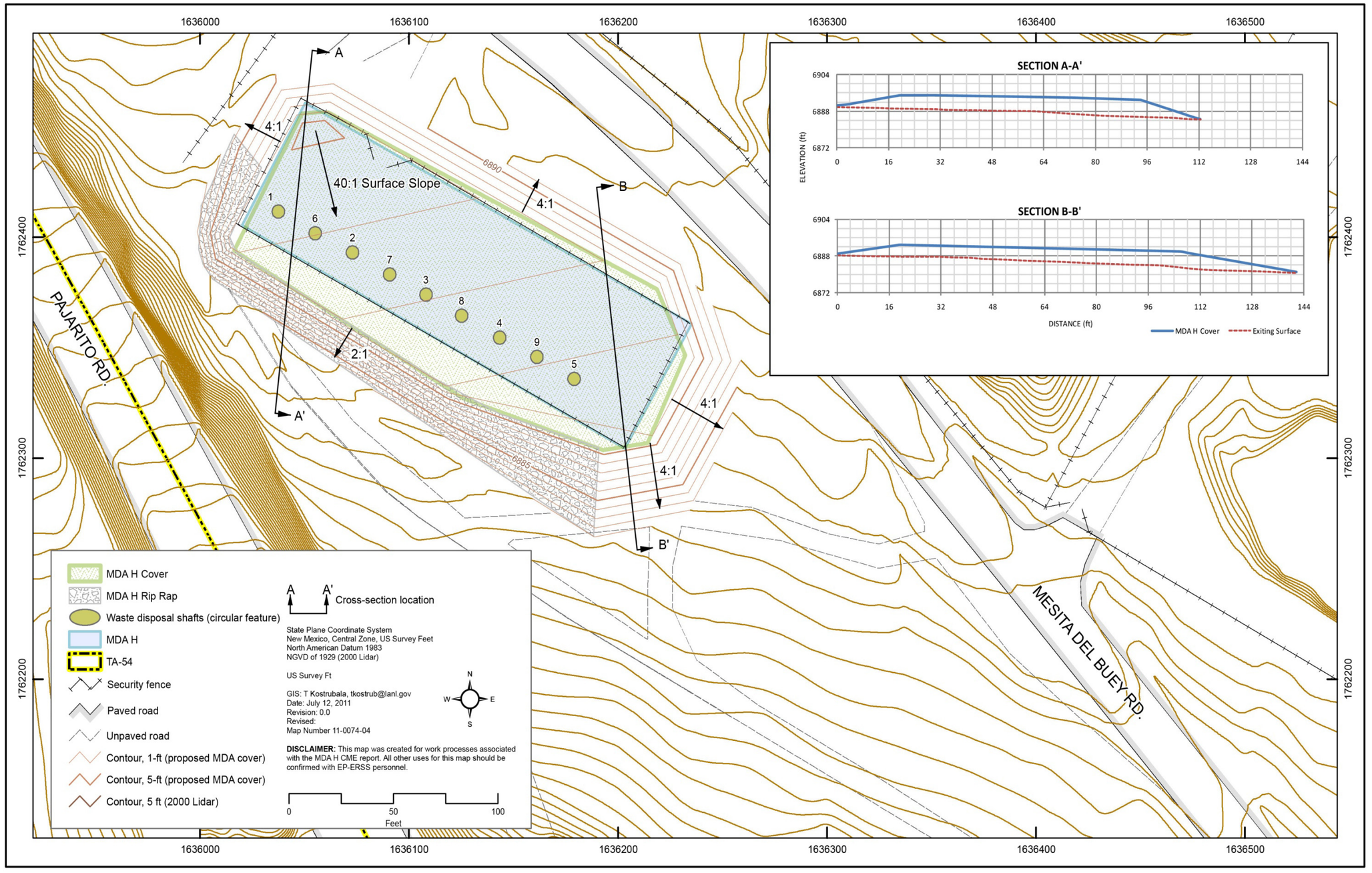


Figure 7.3-1 Conceptual cover layout for Alternatives 2A and 2B

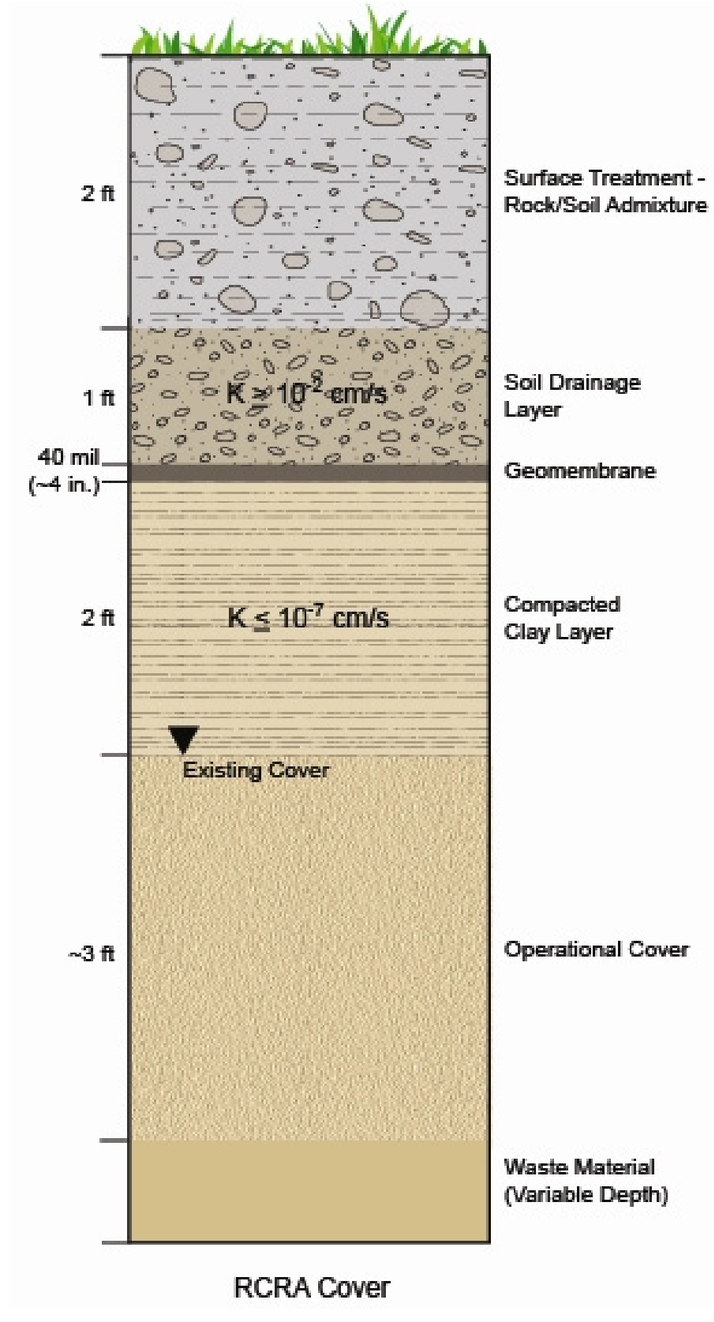


Figure 7.3-2 Cross-section of RCRA cover

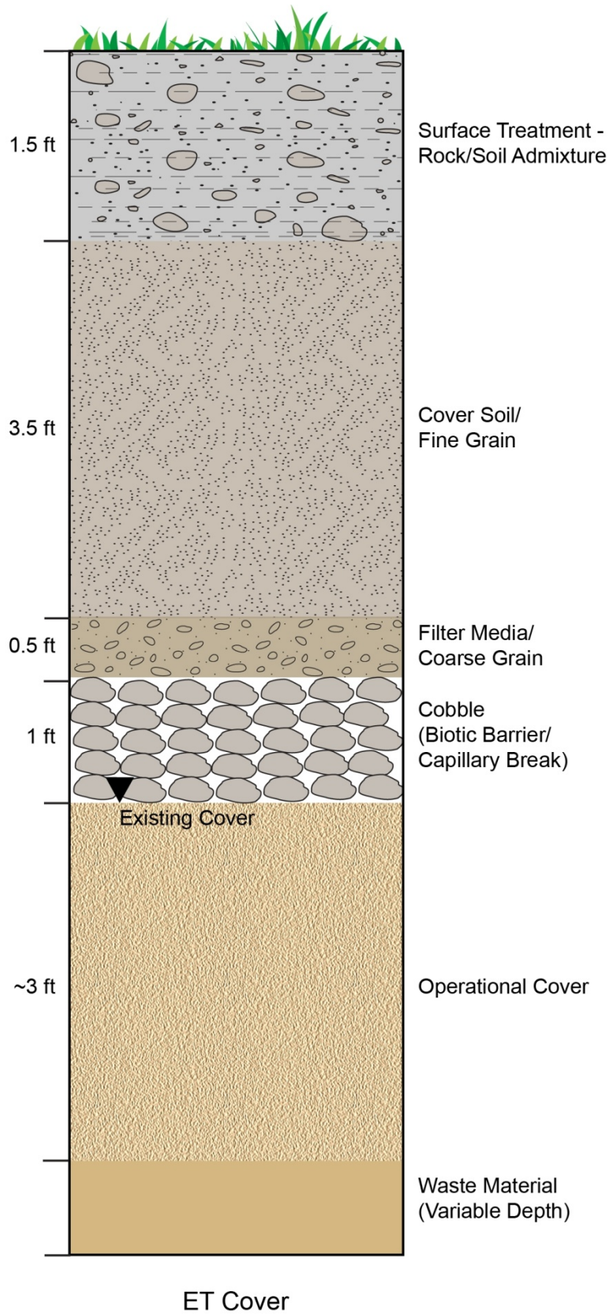


Figure 7.3-3 Cross-section of ET cover

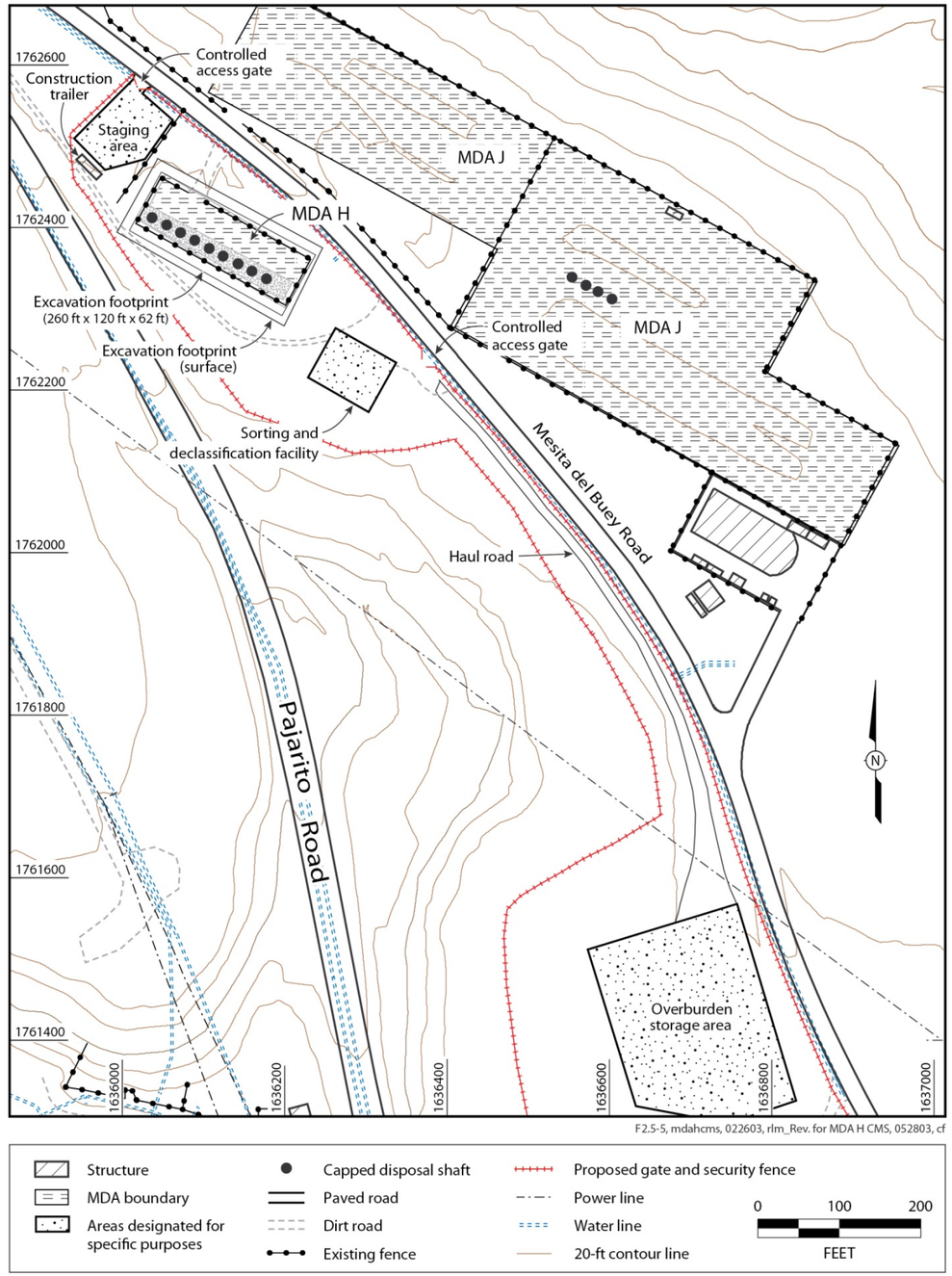


Figure 7.3-4 Typical cross-section of shaft excavation

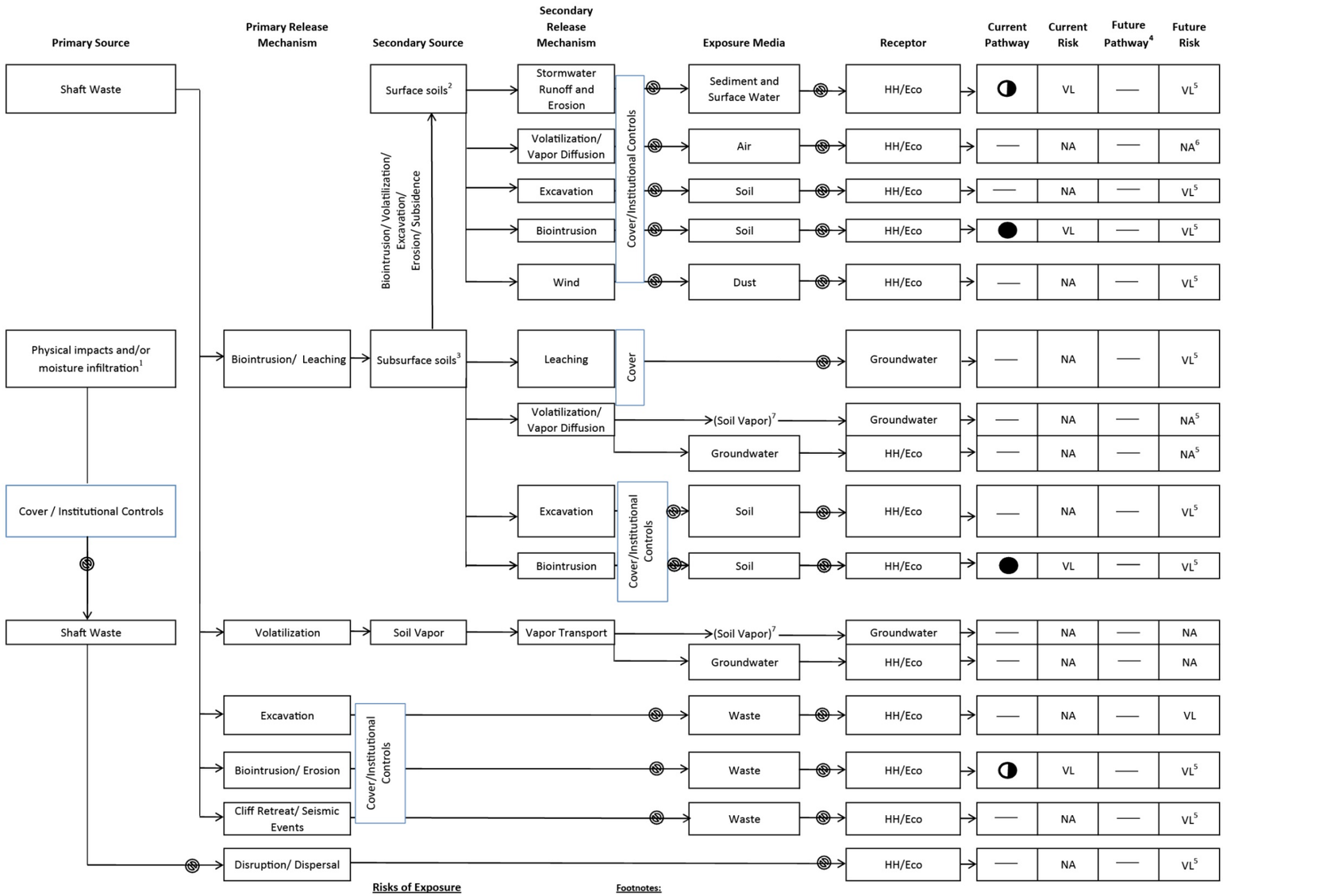


Figure 9.2-1 Refined conceptual site model

Table 1.0-1
Consent Order Requirement Crosswalk

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
1	The Respondents shall follow the Corrective Measures Evaluation Report format outlined in Section XI.F of this Consent Order.	VII.D.2	Table of contents
2	The corrective measures evaluation shall evaluate potential remedial alternatives and shall recommend a preferred remedy that will be protective of human health and the environment and attain the appropriate cleanup goals.	VII.D.2	Sections 5–9
3	1. A description of the location, status, and current use of the site.	VII.D.2	Sections 1 and 2
4	2. A description of the history of site operations and the history of releases of contaminants.	VII.D.2	Section 2
5	3. A description of site surface conditions.	VII.D.2	Sections 2 and 3
6	4. A description of site subsurface conditions.	VII.D.2	Sections 2 and 3
7	5. A description of on- and off-site contamination in all affected media.	VII.D.2	Sections 2 and 4
8	6. An identification and description of all sources of contaminants.	VII.D.2	Sections 2 and 4
9	7. An identification and description of contaminant migration pathways.	VII.D.2	Section 4
10	8. An identification and description of potential receptors.	VII.D.2	Section 4
11	9. A description of cleanup standards or other applicable regulatory criteria.	VII.D.2	Section 5
12	10. An identification and description of a range of remedy alternatives.	VII.D.2	Section 7
13	11. Remedial alternative pilot or bench scale testing results.	VII.D.2	None
14	12. A detailed evaluation and rating of each of the remedy alternatives, applying the criteria set forth in Section VII.D.4.	VII.D.2	Section 8
15	13. An identification of a proposed preferred remedy or remedies.	VII.D.2	Section 9
16	14. Design criteria of the selected remedy or remedies.	VII.D.2	Section 10
17	15. A proposed schedule for implementation of the preferred remedy.	VII.D.2	Section 11
18	The Respondents shall select corrective measures that are capable of achieving the cleanup standards and goals outlined in Section VIII of this Consent Order including, as applicable, approved alternate cleanup goals established by a risk assessment.	VII.D.3	Section 5 discusses goals but none were exceeded in the investigation report risk assessment

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
19	The Respondents shall evaluate each of the remedy alternatives for the following threshold criteria. To be selected, the remedy alternative must: 1. Be protective of human health and the environment. 2. Attain media cleanup standards. 3. Control the source or sources of releases so as to reduce or eliminate, to the extent practicable, further releases of contaminants that may pose a threat to human health and the environment. 4. Comply with applicable standards for management of wastes.	VII.D.4.a	Section 7
20	The remedy shall be evaluated for long-term reliability and effectiveness. This factor includes consideration of the magnitude of risks that will remain after implementation of the remedy; the extent of long-term monitoring, or other management that will be required after implementation of the remedy; the uncertainties associated with leaving contaminants in place; and the potential for failure of the remedy. Respondents shall give preference to a remedy that reduces risks with little long-term management, and that has proven effective under similar conditions.	VII.D.4.b.i	Section 8
21	The remedy shall be evaluated for its reduction in the toxicity, mobility, and volume of contaminants. Respondents shall give preference to a remedy that uses treatment to more completely and permanently reduce the toxicity, mobility, and volume of contaminants.	VII.D.4.b.ii	Section 8
22	The remedy shall be evaluated for its short-term effectiveness. This factor includes consideration of the short-term reduction in existing risks that the remedy would achieve; the time needed to achieve that reduction; and the short-term risks that might be posed to the community, workers, and the environment during implementation of the remedy. Respondents shall give preference to a remedy that quickly reduces short-term risks, without creating significant additional risks.	VII.D.4.b.iii	Section 8
23	The remedy shall be evaluated for its implementability or the difficulty of implementing the remedy. This factor includes consideration of installation and construction difficulties; operation and maintenance difficulties; difficulties with cleanup technology; permitting and approvals; and the availability of necessary equipment, services, expertise, and storage and disposal capacity. Respondents shall give preference to a remedy that can be implemented quickly and easily, and poses fewer and lesser difficulties.	VII.D.4.b.iv	Section 8

Table 1.0-1 (continued)

No.	Consent Order Requirement	Consent Order Section Reference	CME Report Section
24	The remedy shall be evaluated for its cost. This factor includes a consideration of both capital costs, and operation and maintenance costs. Capital costs shall include, without limitation, construction and installation costs; equipment costs; land development costs; and indirect costs including engineering costs, legal fees, permitting fees, startup and shakedown costs, and contingency allowances. Operation and maintenance costs shall include, without limitation, operating labor and materials costs; maintenance labor and materials costs; replacement costs; utilities; monitoring and reporting costs; administrative costs; indirect costs; and contingency allowances. All costs shall be calculated based on their net present value. Respondents shall give preference to a remedy that is less costly, but does not sacrifice protection of health and the environment.	VII.D.4.b.v	Section 8

Table 2.2-1
Summary of Wastes in MDA H Disposal Shafts

Inventory Waste Description	Mass (wt) of Material Reported in Logbook	Estimated Weight or Activity of Waste	Assumptions/Comments
Metals			
Aluminum (Al)	4976	58,700[a]	Not applicable
Barium (Ba)	Not reported	5300 lb	Estimated to be 40% of mock/inert HE.
Beryllium (Be)	238 lb	6534 lb	In solid form as part of shapes and weapon components. Material considered strategic and recycled when possible. Additional quantity of Be added based on process knowledge of Laboratory operations.
Cadmium (Cd)	Not reported	20 lb[a]	In solid form as part of shapes and weapon components.
Chromium (Cr)	Not reported	1960 lb	In chrome-plated parts. The available Cr in the environment only from non-stainless steel Cr. Cr estimate based on process knowledge of Laboratory operations.
Copper (Cu)	230 lb	2350 lb[a]	In solid form as part of shapes and weapon components.
Lead (Pb)	Not reported	78,250 lb[a]	In solid form as part of shapes and weapon components. Material recycled when possible.
Lithium (Li) and lithium compounds: Lithium Lithium hydride (LiH) Lithium fluoride (LiF) Lithium boride	4959 lb (total) 75 lb 466 lb 4408 lb 10 lb	4341 lb (total) 75 lb 466 lb 3790 lb 10 lb	Solid form and potentially reactive/toxic. 4408 lb LiF PBX[b] contains 86% LiF (3790 lb). Lithium samples assumed to be in the form of LiH.
Mercury (Hg)	Not reported	1300 lb[a]	Part of electrical components.
Silver (Ag): Silver in developed film Nonfilm silver	 (Listed under plastic) Not reported	 1310 lb[c] 39 lb[a]	Processed film disposed at MDA H containing Ag that is unavailable for biological uptake and not included in the total available Ag. Ag in film based on a maximum of 45 troy ounces per 100 lb of waste processed industrial x-ray film (0.0686 lb per troy ounce). Non-film Ag assumed to be present either as plating or electrical parts.
Steels	Steel listed as one of many materials (not broken out)	156,490 lb[a]	In solid form as part of shapes and weapon components. Includes stainless steels.
Tungsten (W)	11,500 lb	11,500 lb	Not applicable

Table 2.2-1 (continued)

Inventory Waste Description	Mass (wt) of Material Reported in Logbook	Estimated Weight or Activity of Waste	Assumptions/Comments
Specific Types of Waste			
Graphite	47,162 lb	47,162 lb	Not applicable
High explosives (HE): HE (RDX)[d] HE contaminated (RDX)	51,958 lb (total) 4783 lb 47,175 lb	1275 lb (total) 992 lb 283 lb	Unless otherwise specified, HE assumed to be RDX based on mobility and toxicity; 4408 lb LiF PBX[b] contains 14% RDX (617 lb) +375 lb = 992 lb. HE-contaminated assumes invisible surface contamination, ≤0.6% of the total waste mass (47,175 x 0.006 = 283 lb).
Mock/inert HE	13,260 lb	13,260 lb	Cyanuric acid estimated to be 40% of mock/inert HE.
Paper	755 lb	755 lb	Not applicable
Plastics: Film Magnetic media Plastic (nonspecific) Slides	54,461 lb (total) 42,346 lb 4337 lb 6555 lb 1223 lb	53,151 lb (total) 41,036 lb 4337 lb 6555 lb 1223 lb	Film weight less silver weight (54,461–1310 = 53,151 lb).
Radioactive Wastes			
Uranium Depleted uranium Enriched uranium Fuel elements	67,055 lb (total)	265,300/(104,800)[e] lb (total) 284.5/(94.2) Ci 233,000/(93,000) lb 14,600/(1100) lb 17,700/(10,700) lb	Standard ratios apply for converting depleted uranium, "units", and fuel elements[f] (enriched uranium and highly enriched uranium) masses to isotopic abundances.
Plutonium	300 lb (total)	300 lb (total)/0.014 Ci	Plutonium surface contamination. For bounding purposes, assumed maximum concentration of 100 nCi/g; assumed volume contamination is "Pu-52" based on process knowledge.
Tritium	80 lb	3.5-106 Ci	Residual radioactivity in stainless-steel canisters of known mass; estimated activity based on fiscal year 1995 and 2002 measured tritium values (Appendix I).
Shapes and Parts Without Material Description[f]	134,295 lb	Not applicable	
Total	391,229 lb	709,297/(548,797)[e] lb	

[a] Waste metal estimates were calculated after review of waste generated from a similar operation at Sandia National Laboratories, and then adjusted for operational and programmatic differences.

[b] PBX = Plastic-bonded explosives.

[c] Silver is not leachable based on knowledge of the waste form.

[d] RDX = 1,3,5-trinitro-1,3,5-triazacyclohexane (cyclotrimethylenetrinitramine).

[e] The first number represents the maximum (upper-bound) amount of material present in the waste. The number in parentheses is the best estimate of material present in the shafts.

[f] Based on the classified nature of these objects, specific information is not recorded in the logbooks.

Table 2.4-1
Frequency of Detected Inorganic Chemicals in Channel Sediment Samples

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range[a] (mg/kg)	BV (mg/kg)	Frequency of Detects above BV	Frequency of Nondetects above BV
Aluminum	Sediment	4	4	1140–4800	15,400	0/4	0/4
Antimony	Sediment	4	0	[0.2–0.2]	0.83	0/4	0/4
Arsenic	Sediment	4	0	[0.91–1.7]	3.98	0/4	0/4
Barium	Sediment	4	3	[32.4]–71	127	0/4	0/4
Beryllium	Sediment	4	0	[0.2–0.39]	1.31	0/4	0/4
Boron	Sediment	4	0	[1.6–1.6]	na[b]	0/4	NA[c]
Cadmium	Sediment	4	0	[0.26–0.68]	0.4	0/4	3/4
Calcium	Sediment	4	2	[912]–1590	4420	0/4	0/4
Chromium	Sediment	4	4	2.4–4.8	10.5	0/4	0/4
Cobalt	Sediment	4	0	[1.7–4.6]	4.73	0/4	0/4
Copper	Sediment	4	0	[2.1–4.1]	11.2	0/4	0/4
Iron	Sediment	4	4	3690–5890	13800	0/4	0/4
Lead	Sediment	4	4	13.1–21.3	19.7	2/4	0/4
Magnesium	Sediment	4	0	[513–948]	2370	0/4	0/4
Manganese	Sediment	4	4	116–300	543	0/4	0/4
Molybdenum	Sediment	4	0	[5.2–5.3]	na	0/4	NA
Nickel	Sediment	4	0	[1.2–2.9]	9.38	0/4	0/4
Potassium	Sediment	4	0	[195–723]	2690	0/4	0/4
Silver	Sediment	4	0	[0.6–0.61]	1	0/4	0/4
Sodium	Sediment	4	0	[28.7–67.5]	1470	0/4	0/4
Thallium	Sediment	4	0	[0.2–0.2]	0.73	0/4	0/4
Vanadium	Sediment	4	1	[6.7]–11.2	19.7	0/4	0/4
Zinc	Sediment	4	4	0.2–35.3	60.2	0/4	0/4

[a] Values in square brackets indicate nondetects.

[b] na = Not available.

[c] NA = Not analyzed.

Table 2.4-2
Frequency of Detected Radionuclides in Channel Sediment Samples

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range[a] (pCi/g)	BV (pCi/g)	Frequency of Detects above BV
Americium-241	Sediment	5	2	[0.003–0.00842]	0.04	0/5
Cesium-134	Sediment	1	0	[0.00608–0.00608]	na[b]	0/1
Cesium-137	Sediment	3	3	0.054–0.48	0.9	0/3
Cobalt-60	Sediment	1	0	[-0.00384–0.00384]	na	0/1
Europium-152	Sediment	1	0	[-0.00905–0.00905]	na	0/1
Plutonium-238	Sediment	4	0	[0.001–0.003]	0.006	0/4
Plutonium-239	Sediment	4	1	[0.001]–0.017	0.068	0/4
Polonium-210	Sediment	4	4	0.61–2.16	na	4/4
Ruthenium-106	Sediment	1	0	[-0.0147–0.0147]	na	0/1
Sodium-22	Sediment	1	0	[-0.00356–0.00356]	na	0/1
Strontium-90	Sediment	5	0	[-0.02–0.14]	1.04	0/5
Thorium-228	Sediment	5	5	0.84–1.22	2.28	0/5
Thorium-230	Sediment	5	5	0.587–1.21	2.29	0/5
Thorium-232	Sediment	5	5	0.87–1.3	2.33	0/5
Tritium	Sediment	5	4	[-0.448]–0.111001	0.093	1/5
Uranium-234	Sediment	4	4	0.71–1.34	2.59	0/4
Uranium-235	Sediment	4	0	[0.05–0.08]	0.2	0/4
Uranium-238	Sediment	4	4	0.77–1.36	2.29	0/4

[a] Values in square brackets indicate nondetects.

[b] na = Not available.

Table 2.4-3
Frequency of Detected Inorganic Chemicals in Tuff Samples

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range[a] (mg/kg)	BV (mg/kg)[b]	Frequency of Detects above BV
Aluminum	Qbt 2	13	13	187–3140	7340	0/13
	Qbt 1v	20	20	167–2570	8170	0/20
Antimony	Qbt 2	13	2	[0.1]–[4.9]	0.5	1/13 2/13 DLs[c] > BV
	Qbt 1v	20	0	[0.1]–[5.0]	0.5	4/20 DLs > BV
Arsenic	Qbt 2	13	4	[0.2]–2.1	2.79	0/13
	Qbt 1v	20	8	[0.2]–1.8	1.81	0/20
Barium	Qbt 2	13	13	2.8–18	46	0/13
	Qbt 1v	20	20	1.7–10.7	26.5	0/20
Beryllium	Qbt 2	13	9	[0.08]–[0.49]	1.21	0/13
	Qbt 1v	20	16	0.1–[0.5]	1.7	0/20
Cadmium	Qbt 2	13	1	[0.02]–[0.49]	1.73	0/13
	Qbt 1v	20	2	[0.02]–0.52	0.4	1/20 4/20 DLs > BV
Calcium	Qbt 2	13	13	155–776	2200	0/13
	Qbt 1v	20	20	202–754	3700	0/20
Chromium	Qbt 2	13	9	[0.3]–7.0	7.14	0/13
	Qbt 1v	20	12	[0.3]–3.0	2.24	1/20
Cobalt	Qbt 2	13	8	0.14–1.8	3.14	0/13
	Qbt 1v	20	5	0.14–[1.01]	1.78	0/20
Copper	Qbt 2	13	9	[0.5]–35.4	4.66	4/13
	Qbt 1v	20	15	0.37–1.7	3.26	0/20
Cyanide	Qbt 2	11	0	[0.15–1.01]	0.5	2/11 DLs > BV
	Qbt 1v	15	0	[0.15–1.02]	0.5	4/15 DLs > BV
Iron	Qbt 2	13	13	685–4650	14500	0/13
	Qbt 1v	20	20	250–5330	9900	0/20
Lead	Qbt 2	13	13	1.3–16.2	11.2	1/13
	Qbt 1v	20	20	1.02–27.2	18.4	1/20
Magnesium	Qbt 2	13	13	27.8–400	1690	0/13
	Qbt 1v	20	20	27.6–321	780	0/20
Manganese	Qbt 2	13	13	49.6–212	482	0/13
	Qbt 1v	20	20	44.8–238	408	0/20
Mercury	Qbt 2	13	0	[0.02–0.1]	0.1	0/13
	Qbt 1v	20	3	[0.02]–0.07	0.1	0/20
Nickel	Qbt 2	13	8	[0.6]–6.0	6.58	0/13
	Qbt 1v	20	5	[0.6]–1.9	2.0	0/20

Table 2.4-3 (continued)

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range[a] (mg/kg)	BV (mg/kg)[b]	Frequency of Detects above BV
Potassium	Qbt 2	13	12	90–871	3500	0/13
	Qbt 1v	20	15	[89.9]–271	6670	0/20
Selenium	Qbt 2	13	1	[0.2]–[0.95]	0.3	5/13 DLs > BV
	Qbt 1v	20	1	[0.2]–[0.46]	0.3	1/20 5/20 DLs > BV
Silver	Qbt 2	13	0	[0.1]–[1.3]	1.0	1/13 DL > BV
	Qbt 1v	20	1	[0.1]–0.71	1.0	0/20
Sodium	Qbt 2	13	13	64.9–771	2770	0/13
	Qbt 1v	20	20	78.9–382	6330	0/20
Thallium	Qbt 2	13	1	[0.1]–1.7	1.1	1/13
	Qbt 1v	20	0	[0.1]–[0.5]	1.24	0/20
Vanadium	Qbt 2	13	12	0.94–3.8	17	0/13
	Qbt 1v	20	16	0.7–3.3	4.38	0/20
Zinc	Qbt 2	13	13	8.4–32.5	63.5	0/13
	Qbt 1v	20	20	7.0–45	84.6	0/20

[a] Values in square brackets indicate nondetects.

[b] Tuff BVs obtained from LANL (1998, 059730).

[c] DLs = Detection limits.

Table 2.4-4
Frequency of Detected Radionuclides in Tuff Samples

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range[a] (pCi/g)	Sediment BV or Fallout Value[b] (pCi/g)	Frequency of Detects or Detects above BV or Fallout Value
Americium-241	Tuff	33	0	[-0.11–0.37]	—[c]	0/33
Cesium-134	Tuff	17	0	[0.05–0.14]	No value	0/17
Cesium-137	Tuff	33	0	[-0.032–0.1]	No value	0/33
Cobalt-60	Tuff	33	0	[-0.03–0.09]	No value	0/33
Europium-152	Tuff	16	0	[-0.07–0.23]	No value	0/16
Ruthenium-106	Tuff	33	0	[-0.44–0.67]	No value	0/33
Sodium-22	Tuff	33	0	[-0.52–0.08]	No value	0/33
Tritium[d]	Tuff	33	22	[1.3]–777,000	No value	22/33
Uranium-235	Qbt 2	6	0	[0.11–0.13]	0.09	0/6
	Qbt 1v	11	0	[0.11–0.13]	0.14	0/11

[a] Values in square brackets indicate nondetects.

[b] Tuff background and fallout values obtained from LANL (1998, 059730).

[c] — = No value.

[d] Tritium values are in pCi/mL.

Table 2.4-5
Frequency of Detected Organic Chemicals in Tuff Samples

Suite or Analyte	Number of Analyses	Number of Detects	Concentration Range* (mg/kg)	Estimated Quantitation Limit (mg/kg)	Frequency of Detects
SVOCs					
Benzoic acid	33	1	0.49–[3.5]	0.81–3.5	1/33
Bis(2-ethylhexyl)phthalate	33	5	[0.038]–3.8	0.04–0.34	5/33
Di-n-butylphthalate	33	6	0.043–[0.35]	0.33–0.35	6/33
Diethylphthalate	33	1	0.28–[0.35]	0.33–0.35	1/33
Dimethylphthalate	33	1	0.042–[0.35]	0.33–0.35	1/33
Naphthalene	33	1	0.001–[0.35]	0.005–0.35	1/33
Pesticide/PCB					
Endosulfan sulfate	33	1	[0.000671]–[0.00351]	0.000671–0.00351	1/33
VOCs					
Acetone	33	2	[0.002]–[0.025]	0.002–0.021	2/33
Benzene	33	1	0.003–[0.0052]	0.005–0.0052	1/33
Butanone [2-]	33	2	0.002–[0.021]	0.01–0.021	2/33
Butylbenzene [n-]	33	1	0.0013–[0.0052]	0.005–0.0052	1/33
Butylbenzene [sec-]	33	2	0.0011–[0.0052]	0.005–0.0052	2/33
Hexachlorobutadiene	33	1	0.002–[0.005]	0.005–0.35	1/33
Methylene chloride	33	3	0.002–[0.011]	0.003–0.011	3/33
Toluene	33	3	0.001–[0.0052]	0.005–0.0052	3/33
Trichlorobenzene[1,2,3-]	9	2	0.001–[0.005]	0.005	2/9
Trichlorobenzene[1,2,4-]	33	1	0.001–[0.005]	0.005–0.35	1/33
Trichlorofluoromethane	33	6	0.002–0.007	0.005–0.0052	6/33

*Values in square brackets indicate nondetects.

Table 2.4-6
Detected Organic Chemicals in Tuff Samples

Analyte	Location ID	Sample ID	Sample Concentration (mg/kg)	Media	Depth (ft)
Acetone	54-1024	0554-95-0321	0.016	Qbt 2	9–9.2
	54-1026	0554-95-0312	0.011	Qbt 1v	76.5–78
Benzene	54-1026	0554-95-0312	0.003(J)	Qbt 1v	76.5–78
Benzoic acid	54-1026	0554-95-0300	0.49(J)	Qbt 2	16.5–18.1
Bis(2-ethylhexyl)phthalate	54-1024	0554-95-0323	1.3	Qbt 2	18.5–20
	54-1025	0554-95-0339	0.083(J)	Qbt 2	9–9.2
	54-1025	0554-95-0341	3.8	Qbt 2	17–18.8
	54-1025	0554-95-0347	0.085(J)	Qbt 1v	51–52.7
	54-1025	0554-95-0355	0.19(J)	Qbt 1v	86–90
2-Butanone	54-1023	0554-95-0284	0.002(J)	Qbt 2	15.5–17
	54-1023	0554-95-0288	0.007(J)	Qbt 1v	37–38.5
n-Butylbenzene	54-1025	0554-95-0349	0.0013(J)	Qbt 1v	61–62.8
sec-Butylbenzene	54-1025	0554-95-0347	0.011(J)	Qbt 1v	51–52.7
	54-1025	0554-95-0349	0.012(J)	Qbt 1v	61–62.8
Diethylphthalate	54-1024	0554-95-0325	0.28(J)	Qbt 2	26–27.8
Dimethylphthalate	54-1024	0554-95-0325	0.042(J)	Qbt 2	26–27.8
Di-n-butylphthalate	54-1023	0554-95-0286	0.057(J)	Qbt 2	27–28.5
	54-1023	0554-95-0288	0.05(J)	Qbt 1v	37–38.5
	54-1023	0554-95-0290	0.051(J)	Qbt 1v	47–48.5
	54-1023	0554-95-0292	0.047(J)	Qbt 1v	57–58.5
	54-1024	0554-95-0337	0.046(J)	Qbt 1v	86–87.8
	54-1026	0554-95-0302	0.047(J)	Qbt 2	26.5–28
Endosulfan sulfate	54-1024	0554-95-0327	0.000674	Qbt 2	36–37.8
Hexachlorobutadiene	54-1025	0554-95-0349	0.002(J)	Qbt 1v	61–62.8
Methylene chloride	54-1024	0554-95-0327	0.002(J)	Qbt 2	36–37.8
	54-1024	0554-95-0331	0.002(J)	Qbt 1v	61–62.5
	54-1024	0554-95-0333	0.002(J)	Qbt 1v	71–72.8
Naphthalene	54-1025	0554-95-0349	0.001(J)	Qbt 1v	61–62.8
Toluene	54-1026	0554-95-0308	0.002(J)	Qbt 1v	58–60
	54-1026	0554-95-0310	0.001(J)	Qbt 1v	66.5–68
	54-1026	0554-95-0312	0.001(J)	Qbt 1v	76.5–78
1,2,3-Trichlorobenzene	54-1025	0554-95-0347	0.001(J)	Qbt 1v	51–52.7
	54-1025	0554-95-0349	0.002(J)	Qbt 1v	61–62.8
1,2,4-Trichlorobenzene	54-1025	0554-95-0349	0.001(J)	Qbt 1v	61–62.8

Table 2.4-6 (continued)

Analyte	Location ID	Sample ID	Sample Concentration (mg/kg)	Media	Depth (ft)
Trichlorofluoromethane	54-1024	0554-95-0325	0.004(J)	Qbt 2	26–27.8
	54-1024	0554-95-0327	0.007	Qbt 2	36–37.8
	54-1024	0554-95-0329	0.002(J)	Qbt 1v	51–52.5
	54-1024	0554-95-0331	0.006	Qbt 1v	61–62.5
	54-1024	0554-95-0333	0.006	Qbt 1v	71–72.8
	54-1024	0554-95-0337	0.007	Qbt 1v	86–87.8

Note: Data qualifiers are defined in Appendix A.

Table 2.4-7
Frequency of Detects for Tritium in Pore Gas

Analyte	Analyte Code	Number of Analyses	Number of Detects	Number of Detected Locations	Concentration Range (pCi/L)	Location of Minimum Detected	Location of Maximum Detected
Tritium	H-3	33	32	3	[480]–3080000	54-15462 (50 ft)	54-15462 (100 ft)

Table 2.4-8
Frequency of Detects for VOCs in Pore Gas

Analyte	Analyte Code	Number of Analyses	Number of Detects	Number of Detected Locations	Concentration Range (ppbv)	Location of Minimum Detected	Location of Maximum Detected
Ethylbenzene	100-41-4	37	8	3	[0.68–10]	54-15462 (100 ft)	54-15461 (50 ft)
Styrene	100-42-5	37	1	1	[0.68–10]	54-15462 (100 ft)	54-15461 (50 ft)
Butadiene[1,3-]	106-99-0	37	1	1	[2.7–41]	54-15462 (100 ft)	54-15461 (50 ft)
Methyl-2-pentanone[4-]	108-10-1	37	1	1	[0.68–41]	54-15462 (100 ft)	54-15461 (50 ft)
Trimethylbenzene[1,3,5-]	108-67-8	37	3	2	[0.68–10]	54-15462 (100 ft)	54-15461 (50 ft)
Toluene	108-88-3	37	31	3	[0.8]–2300	54-01023 (100 ft)	54-15461 (95 ft)
Hexane	110-54-3	37	2	2	[2.7]–72	54-15462 (100 ft)	54-15461 (50 ft)
Cyclohexane	110-82-7	37	8	3	[2.7–41]	54-15462 (100 ft)	54-15461 (50 ft)
Propylene	115-07-1	37	1	1	[2.7–41]	54-15462 (100 ft)	54-15461 (50 ft)
Tetrachloroethene	127-18-4	37	6	2	[0.67]–19	54-15461 (50 ft)	54-15462 (100 ft)
Xylene (total)	1330-20-7	4	4	2	1.4–25	54-15462 (50 ft)	54-15461 (50 ft)
n-Heptane	142-82-5	37	1	1	[2.7–41]	54-15462 (100 ft)	54-15461 (50 ft)
Carbon tetrachloride	56-23-5	37	18	3	[0.67–10]	54-15461 (50 ft)	54-15461 (50 ft)
Ethyltoluene[4-]	622-96-8	33	12	3	0.7–[41]	54-15462 (100 ft)	54-15461 (50 ft)
Ethanol	64-17-5	37	14	3	[3.2]–48	54-15462 (50 ft)	54-15461 (50 ft)
Methanol	67-56-1	37	2	2	[68–1000]	54-15462 (100 ft)	54-15461 (50 ft)
Propanol[2-]	67-63-0	37	5	3	[3.2–41]	54-15462 (200 ft)	54-15461 (50 ft)
Acetone	67-64-1	37	22	5	[3.2]–51	54-15462 (50 ft)	54-15462 (233 ft)
Butanol[1-]	71-36-3	37	1	1	[6.7–100]	54-15461 (50 ft)	54-15461 (50 ft)
Benzene	71-43-2	37	6	2	[0.68]–34	54-15462 (100 ft)	54-15461 (50 ft)
Trichloroethane[1,1,1-]	71-55-6	37	25	3	[0.67]–26	54-15461 (50 ft)	54-15462 (50 ft)
Chloromethane	74-87-3	37	1	1	[0.67–10]	54-15461 (50 ft)	54-15461 (50 ft)
Methylene chloride	75-09-2	37	8	2	[0.79]–17	54-15462 (50 ft)	54-15461 (50 ft)
Carbon disulfide	75-15-0	37	9	3	[0.8–41]	54-15461 (100 ft)	54-15461 (50 ft)
Trichlorofluoromethane	75-69-4	33	20	3	[0.8–10]	54-15461 (100 ft)	54-15461 (50 ft)
Dichlorodifluoromethane	75-71-8	33	18	3	[0.8–10]	54-15461 (100 ft)	54-15461 (50 ft)
Trichloro-1,2,2-trifluoroethane[1,1,2-]	76-13-1	37	16	2	[0.67–10]	54-15461 (50 ft)	54-15461 (50 ft)
Dichloropropane[1,2-]	78-87-5	37	2	1	[0.67–10]	54-15461 (50 ft)	54-15461 (50 ft)
Butanone[2-]	78-93-3	37	6	2	[0.68–41]	54-15462 (100 ft)	54-15461 (50 ft)
Trichloroethene	79-01-6	37	7	3	[0.67–10]	54-15461 (50 ft)	54-15461 (50 ft)
Xylene[1,2-]	95-47-6	37	10	3	[0.68–10]	54-15462 (100 ft)	54-15461 (50 ft)
Trimethylbenzene[1,2,4-]	95-63-6	37	19	3	[0.79–10]	54-15462 (50 ft)	54-15461 (50 ft)
Xylene[1,3-]+xylene[1,4-]	Xylene[1,3 and 1,4]	33	19	3	[0.8–10]	54-01023 (250 ft)	54-15461 (50 ft)

Table 2.4-9
Monitoring of Tritium in Air

Start Time	End Time	Ambient Air Concentration (pCi/m^3)
3/26/01 9:37	4/9/01 9:19	4.0
4/9/01 9:19	4/23/01 9:00	3.1
4/23/01 9:00	5/7/01 9:08	5.9
5/7/01 9:08	5/21/01 9:26	3.1
5/21/01 9:26	6/4/01 8:46	14.2
6/4/01 8:46	6/18/01 8:12	15.5
6/18/01 8:12	7/2/01 9:56	26.0
7/2/01 9:56	7/16/01 8:47	27.1
7/16/01 8:47	7/31/01 9:45	29.8
7/31/01 9:45	8/14/01 8:03	42.4
8/14/01 8:03	8/28/01 9:44	38.1
8/28/01 9:44	9/13/01 7:52	9.8
9/10/01 7:52	9/25/01 8:57	53.7
9/25/01 8:57	10/9/01 9:34	70.1
10/9/01 9:34	10/24/01 10:27	51.9
11/5/01 13:44	11/20/01 11:45	68.6
10/24/01 10:27	11/5/01 13:44	40.3
11/20/01 11:45	12/3/01 9:45	19.0
12/3/01 9:45	12/17/01 9:35	10.2
12/17/01 9:35	1/7/02 9:53	12.0
1/7/02 9:53	1/22/02 10:09	17.0
1/22/02 10:09	2/4/02 8:38	13.7
2/4/02 8:38	2/19/02 11:52	15.3
2/19/02 11:52	3/4/02 9:30	22.7
3/4/02 9:30	3/18/02 10:56	25.1
3/18/02 10:56	4/2/02 8:28	24.1

Table 2.4-10
Summary of RFI Sampling Results for COPCs

Analyte	Medium	COPC (y/n?)	Rationale
Summary of 2001 RFI Data Review for COPCs			
Copper	Sediment	No	Not detected above sediment BV
	Tuff	Yes	Statistical tests found copper to be different from Qbt 2 background.
Cadmium	Sediment	Yes	DLs above the sediment BV and sediment background data set
	Tuff	No	Not statistically different from tuff backgrounds
Cyanide	Sediment	No	Not detected above the sediment BV
	Tuff	Yes	DLs above the tuff BV
Selenium	Sediment	Yes	DLs above the sediment BV
	Tuff	Yes	DLs above the tuff BVs
Tritium	Sediment	Yes	Detected at a concentration above the fallout value in one sample
	Tuff	Yes	Detected in the majority of tuff samples
Methoxychlor	Sediment	Yes	Detected at low concentrations in two samples
	Tuff	No	Not detected in any tuff samples
Endosulfan sulfate	Tuff	Yes	Detected in one tuff sample below the estimated quantitation limit
	Sediment	No	Not detected in any sediment samples
Benzoic acid, bis(2-ethylhexyl)phthalate, diethylphthalate, dimethylphthalate, di-n-butylphthlalate, napthalene	Tuff	Yes	Detected in one to six tuff samples
	Sediment	NA*	Not analyzed for in sediment samples
Summary of 2001 RFI Data Review for COPCs			
Acetone, benzene, 2-butanone, n-butylbenzene, sec-butylbenzene, hexachlorobutadiene, methylene chloride, toluene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, trichlorofluoromethane	Tuff	Yes	Detected in one to six tuff samples
	Sediment	NA	Not analyzed for in sediment samples

Table 2.4-10 (continued)

Analyte	Medium	COPC (y/n?)	Rationale
Summary of 2002 RFI Addendum Data Review for COPCs			
Selenium	Sediment	Yes	Detected at 0.41 mg/kg; above the sediment BV of 0.3 mg/kg
Tritium	Pore gas	Yes	Concentrations ranging from 1.4–6400 pCi/mL of water vapor collected on silica gel
	Ambient air	No	Concentrations below EPA dose standard of 10 mrem/yr
VOCs (primarily acetone, toluene, 1,1,1-trichloroethane, and trichloroethylene)	Pore gas	Yes	Thirty-three detected VOCs. Concentrations <0.1 parts per million by volume (ppmv) with the exception of toluene. Toluene concentrations up to 2.3 ppmv.
	Ambient air	No	Only acetone detected in 2003 sampling. The 6 parts per million (ppm) detected is below the Occupational Safety and Health Administration 8-hr time-weighted average permissible exposure limit of 1000 ppm.

*NA = Not analyzed.

Table 2.4-11
NMED-Approved MDA H Subsurface Vapor-Monitoring Locations, Port Depths, and Corresponding Sampling Intervals

Borehole ID	VOC and Tritium Sampling Port Depth Intervals (ft bgs)
54-01023[a]	12.5 (10–15), 62.5 (60–65), 102.5 (100–105), 152.5 (150–155), 202.5 (200–205), 247.5 (245–250), 260.5 (258–263)
54-15461	11 (10–12), 61 (60–62), 96 (95–97)
54-15462[a]	12.5 (10–15), 62.5 (60–65), 102.5 (100–105), 152.5 (150–155), 202.5 (200–205), 247.5 (245–250), 260.5 (258–263), 282.5 (280–285), 297.5 (295–300)
54-609985[b]	6.5 (4–9), 62.5 (60–65), 102.5 (100–105), 152.5 (150–155), 202.5 (200–205), 247.5 (245–250), 260.5 (258–263), 282.5 (280–285), 297.5 (295–300)

Note: Depths denote locations where VOC and tritium samples will be collected. Sampling intervals are given in parentheses.

[a] Borehole was redrilled November 2009; depths reflect new ports and intervals.

[b] New borehole was drilled in November 2009.

Table 2.4-12
Screening of VOCs Detected in Pore Gas at MDA H during Third Quarter Fiscal Year 2010

VOCs	Maximum Pore Gas Concentration (µg/m³)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m³)	Screening Value (unitless)	Potential for Groundwater Impact[a]
Acetone	25	35,200	0.00071	No
Benzene	10	1140	0.0088	No
Butanol[1-]	13	1332	0.0098	No
Butanone[2-]	9.6	16,330	0.00059	No
Carbon disulfide	7.7	590,000	0.000013	No
Carbon tetrachloride	17	5500	0.0031	No
Chlorodifluoromethane	20	170,000,000	0.00000012	No
Chloroform	100	12,000	0.0083	No
Cyclohexane	85	79,300,000	0.0000011	No
Dichlorodifluoromethane	71	5,460,000	0.000013	No
Dichloroethane[1,1-]	4.8	5750	0.00083	No
Dichloroethane[1,2-]	5.9	240	0.025	No
Dichloroethene[1,1-]	4.4	5500	0.0008	No
Dichloropropane[1,2-]	5.2	600	0.0087	No
Ethanol	32	na[b]	na	No
Ethylbenzene	6.7	226,100	0.00003	No
Hexane	29	65,120,000	0.00000045	No
Methylene chloride	3.2	650	0.0049	No
Propanol[2-]	25	na	na	No
Tetrachloroethene	7.7	3600	0.0021	No
Toluene	33	204,000	0.00016	No
Trichloro-1,2,2-trifluoroethane[1,1,2-]	41	1,298,000,000	0.000000032	No
Trichloroethane[1,1,1-]	170	42,300	0.004	No
Trichloroethene	13	2000	0.0065	No
Trichlorofluoromethane	77	5,200,000	0.000015	No
Xylene[1,2-]	4.1	132,000	0.000031	No
Xylene[1,3-]+xylene[1,4-]	15	167,000	0.000090	No

Note: Calculated concentrations in pore gas corresponding to groundwater screening levels derived from denominator of Equation 3.0-3 of the MDA H PMR (LANL 2010, 111123). Screening value derived from Equation 3.0-3 of the MDA H PMR (LANL 2010, 111123).

[a] If the screening value is less than 1, the concentration of the VOC in pore gas does not have the potential to exceed the groundwater screening level.

[b] na = Not available.

Table 2.5-1
Role of Monitoring Network Wells in the TA-54 Monitoring Group

Location	Aquifer	MDA G	MDA H	MDA L	Comments
R-20 (2 screens)	Regional	n/a*	n/a	Upgradient or downgradient (if PM-2 is pumping)	Potentially downgradient of MDA L if PM-2 is pumping; PM-2 is not currently used for water supply; however, Los Alamos County plans to start using it in Sept 2011
R-21	Regional	Upgradient	n/a	Downgradient	No comment
R-22 (inactive well)	Regional	Downgradient	n/a	n/a	No comment
R-23	Regional	Downgradient	n/a	n/a	MDA G farfield
R-23i (3 screens)	Intermediate	Downgradient	n/a	n/a	MDA G farfield
R-32	Regional	Upgradient	n/a	Downgradient	No comment
R-37 screen 1	Intermediate	n/a	Downgradient	n/a	No comment
R-37 screen 2	Regional	n/a	Downgradient	n/a	No comment
R-38	Regional	Upgradient	n/a	Downgradient	No comment
R-39	Regional	Downgradient	n/a	n/a	No comment
R-40 screen 1	Intermediate	n/a	Downgradient	Upgradient	Suspended from sampling because of poor yield.
R-40 screen 2	Regional	n/a	Upgradient (“sidegradient”) or Downgradient (if PM-2 is pumping)	Upgradient	Potentially downgradient of MDA H if PM-2 is pumping; PM-2 is not currently used for water supply; however, Los Alamos County plans to start using it in Sept 2011
R-40i	Intermediate	n/a	Downgradient	Upgradient	No comment
R-41 screen 2	Regional	Downgradient	n/a	n/a	No comment
R-49 (2 screens)	Regional	Downgradient	n/a	n/a	No comment
R-51 (2 screens)	Regional	n/a	Upgradient	n/a	No comment
R-52 (2 screens)	Regional	n/a	Downgradient	n/a	No comment
R-53 (2 screens)	Regional	n/a	n/a	Downgradient	No comment
R-54 (2 screens)	Regional	n/a	n/a	Upgradient or downgradient (if PM-2 is pumping)	Potentially downgradient of MDA L if PM-2 is pumping; PM-2 is not currently used for water supply; however, Los Alamos County plans to start using it in Sept 2011
R-55 (2 screens)	Regional	Downgradient	n/a	n/a	MDA G farfield
R-55i	Intermediate	Downgradient	n/a	n/a	MDA G farfield
R-56 (2 screens)	Regional	Upgradient	n/a	Downgradient	No comment
R-57 (2 screens)	Regional	Downgradient	n/a	n/a	No comment

*n/a = Well is not applicable to MDA.

Table 2.5-2
Interim Monitoring Plan for Wells in the TA-54 Monitoring Group, MDAs G, H, and L

Well	TAL Metals[a]	VOCs + TICs[b]	SVOCs + TICs[b]	Pesticides	PCBs[c]	HEXP[d]	Dioxins/Furans	RAD[e]	Low-Level Tritium[f]	General Inorganics[g]	Perchlorate	Stable Isotopes[h]	Field Parameters[i]
Wells Downgradient of MDA G													
R-22 screen 1	TBD[j]	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R-22 screens 2 through 5	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
R-23i[k] piezometer (port 1)	Q	Q	S	—[l]	—	S	—	A	S	Q	S	A	Q
R-23i[k] screen 1 (port 2)	Q	Q	S	—	—	S	—	A	S	Q	S	A	Q
R-23i[k] screen 2 (port 3)	Q	Q	S	—	—	S	—	A	S	Q	S	A	Q
R-23[k]	Q	Q	Q	A	A	A	A	A	Q	Q	Q	A	Q
R-39	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-41 screen 1	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-41 screen 2	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-49 screen 1	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-49 screen 2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-55 screen 1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-55 screen 2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-57 screen 1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-57 screen 2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
Wells Downgradient of MDA H													
R-20 screen 1[m]	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-20 screen 2[m]	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-37 screen 1	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-37 screen 2	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-40i[n]	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-40 screen 1[n]	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-40 screen 2[m]	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-52 screen 1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-52 screen 2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
Wells Downgradient of MDA L													
R-21	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-32	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-38	Q	Q	Q	A	A	A	A	A	Q	Q	Q	S	Q
R-53 screen 1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-53 screen 2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-54 screen 1[m]	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-54 screen 2[m]	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q

Table 2.5-2 (continued)

Well	TAL Metals[a]	VOCs + TICs[b]	SVOCs + TICs[b]	Pesticides	PCBs[c]	HEXP[d]	Dioxins/Furans	RAD[e]	Low-Level Tritium[f]	General Inorganics[g]	Perchlorate	Stable Isotopes[h]	Field Parameters[i]
R-56 screen 1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-56 screen 2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
Wells Upgradient of MDAs G, H, and L													
R-51 screen 1	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q
R-51 screen 2	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	S	Q

Source: Table 5.4-1 of the 2010 IFGMP (LANL 2010, 109830).

Notes: Sampling suites and frequencies: Q = quarterly (4 times/yr); S = semiannual (2 times/yr); A = annual (1 time/yr); Nonfiltered and filtered samples will be collected for general inorganics (excluding anions) and metals. Anions and perchlorate samples will be filtered. Samples collected for radionuclide analysis will be nonfiltered only for all water media. Organic and HEXP constituents are nonfiltered for all water media. Stable isotope samples for nitrogen isotopes are filtered; stable isotope samples for deuterium and oxygen isotopes are not filtered.

[a] Metals analysis includes the 23 target analyte list (TAL) metals, plus boron, molybdenum, silicon dioxide, strontium, tin, and uranium.

[b] VOC = Volatile organic compound; SVOC = semivolatile organic compound; TIC = tentatively-identified compound.

[c] PCB = Polychlorinated biphenyl (compound).

[d] HEXP = High explosive (compounds). The HEXP analytical suite includes the Consent Order list of the normal SW-846:8330 analytes plus pentaerythritol tetranitrate (PETN); triaminotrinitrobenzene (TATB); 3,5-dinitroaniline, tri(o-cresyl)phosphate (TOCP); 2,4-diamino-6-nitrotoluene; and 2,6-diamino-4-nitrotoluene. These additional analytes are analyzed by SW-846:8321A.

[e] The radionuclide (RAD) suite includes gross alpha, gross beta, alpha spectroscopy, gamma spectroscopy, and strontium-90.

[f] Low-level tritium is analyzed using electrolytic enrichment or direct counting.

[g] General inorganic analysis includes major anions (bromide, chloride, fluoride, sulfate); major cations (calcium, magnesium, sodium, potassium); nitrate plus nitrite (as N); total Kjeldahl nitrogen (TKN); ammonia; total phosphorus, total organic carbon (TOC); total dissolved solids (TDS); alkalinity; specific conductivity; pH; and hardness.

[h] Analysis for stable nitrogen, deuterium, and oxygen isotopes.

[i] Field parameters include pH, turbidity, specific conductance, dissolved oxygen, and temperature at all locations. Oxidation-reduction potential (ORP) will be measured if a flow-through cell is used. Alkalinity (ALK) will be measured for all samples either in the field or at the on-site EES-14 laboratory.

[j] TBD = To be determined.

[k] In the 2010 IFGMP (LANL 2010, 109830, Table 5.4-1), wells R-23 and R-23i are assigned to "General Surveillance Monitoring Locations." These wells are included in Table 2.5-1 above because they are relevant downgradient wells.

[l] — = This analytical suite is not scheduled to be collected at this location.

[m] Wells R-20 and R-54 are generally upgradient of MDA L. However, these wells potentially could be downgradient of MDA L if pumping at water-supply well PM-2 affects the local gradient. Similarly, well R-40 screen 2 is generally upgradient of MDA H but could potentially be downgradient of this MDA if pumping at PM-2 affects the local gradient.

[n] The gradient in the perched intermediate zone is not known with sufficient accuracy to determine whether or not wells R-40i and R-40 screen 1 are downgradient of MDA H.

Table 5.1-1
Summary of Regulatory Criteria and Cleanup Levels

Media	Regulatory Standard
Groundwater*	NMWQCC standards Safe Drinking Water Act standards EPA regional tap water screening levels
Surface water	NMWQCC standards Clean Water Act standards State of New Mexico Standards for Interstate and Intrastate Surface Waters
Soil	NMED "Technical Background Document for Development of Soil Screening Levels" EPA Region 6 Human Health Medium Specific Screening Level

* If both an NMWQCC standard and an MCL have been established for an individual substance, then the lower of the two levels is considered the cleanup level for the substance.

Table 7.0-1
Summary of Potential Corrective Measures Alternatives

Shafts	No Action	Containment	Excavation
Exposure pathways of concern include • direct exposure to waste by means of excavation and • disruption/dispersal of waste	Alternative 1—No action	Alternative 2A—Multilayer cover Alternative 2B—ET cover	Alternative 3—Excavation

Table 7.3-1
Screening of Alternatives against the Threshold Screening Criteria

Alternative	Description	Threshold Screening Criteria			
		Protective of HH&E*	Attains Media Cleanup Standards	Controls Source and Releases	Complies with Waste Management Standards
Alternative 1 No action	This technology includes no monitoring, no maintenance, and no institutional controls.	No Potential remains for exposure through excavation. Does not prevent disruption or infiltration.	No Does not comply with the EPA guidance for attaining media cleanup standards when waste is left in place.	No No source removal or control. Does not provide protection against infiltration and disruption or dispersal.	Yes No waste will be generated.
Alternative 2A Multilayer cover	A multilayer cover will be constructed over the shafts. Monitoring will be conducted for 30 yr. Institutional controls will be implemented for 100 yr	Yes The multilayer cover provides protection against exposure through excavation, infiltration, disruption, and dispersal. Institutional controls restrict site access.	Yes Complies with the EPA guidance for attaining media cleanup standards when waste is left in place.	Yes The cover will minimize/ eliminate moisture infiltration. The cover will provide protection from exposure to waste, soils, and reduce erosion.	Yes Any waste generated under this technology will comply with all applicable regulatory requirements.

Table 7.3-1 (continued)

Technology	Description	Threshold Screening Criteria			
		Protective of HH&E*	Attains Media Cleanup Standards	Controls Source and Releases	Complies with Waste Management Standards
Alternative 2B ET cover	An ET cover will be constructed over the shafts. Monitoring will be conducted for 30 yr. Institutional controls will be implemented for 100 yr.	Yes The ET cover provides protection against exposure through excavation, infiltration, disruption, and dispersal. Institutional controls restrict site access.	Yes Complies with the EPA guidance for attaining media cleanup standards when waste is left in place	Yes The cover will minimize/ eliminate moisture infiltration. Provides protection against excavation, infiltration, disruption, or dispersal.	Yes Any waste generated under this technology will comply with all applicable regulatory requirements.
Alternative 3 Excavation	Waste from the shafts will be excavated and sent off-site for treatment and/or disposal. The excavated area will be backfilled with clean fill material. Some treated waste may be returned to the unit if it meets the media cleanup standards. Monitoring will be conducted for 30 yr. Institutional controls will be implemented for 100 yr.	Yes Removal of the waste will be protective of human health and the environment by eliminating the source.	Yes The shafts will be excavated.	Yes Excavation will remove the source material and prevent future releases.	Yes Any waste generated under this technology will comply with all applicable regulatory requirements. This includes complying with WAC for off-site disposal of excavated wastes.

*HH&E = Human health and the environment.

Table 8.2-1
Cost Estimate for Alternative 2A

		Item Description	Labor Cost	Material Cost	Equipment Cost	Subcontractor Cost	Other Costs	Gross Cost	Parametric Quantity	Parametric Unit	Parametric Cost
Alt.2A Multilayer (RCRA) Cover, Institutional Controls											
Direct Costs	Site Fencing										
		Site Fencing	$17,593	$57,101	$2,704			$77,398	700	LF	$111
		Fencing Total						**$77,398**			
	RCRA Cover										
		Site Prep	$16,284	$17,111	$7,455	$1,198		$42,048	1	LS	$42,048
		Compacted Clay (2 ft)	$66,180	$165,893	$82,782			$314,855	1939	CY	$162
		Geomembrane (40 mil HDPE)	$11,986	$38,432	$3,512			$53,930	0.6	AC	$89,884
		Drainage Layer (1 ft)	$9,901	$40,623	$7,445			$57,969	969	CY	$60
		Cover Soil/Surface Treatment (2 ft)	$26,317	$80,251	$21,870			$128,438	1938	CY	$66
		Shoulder Fill	$128,852	$45,671	$6,508			$181,031	651	CY	$278
		Revegetation	$2,103	$65,235	$975			$68,313	0.6	AC	$113,855
		RCRA Cover Total						**$846,585**			
	Distributables										
		Distributables Total	$140,821	$9,930				**$150,751**			
	O&M										
		Cover Inspections and Maintenance (100 yr)	$216,166					$216,166	100	YR	$2,162
		Annual Long Term Monitoring Report (100 yr)	$228,758					$228,758	100	YR	$2,288
		O&M Total						**$444,925**			
Indirect Costs	Indirect Capital Costs										
		Design				$250,362		$250,362			
		Professional Management	$754,892					$754,892			
		Contingency					$1,039,987	$1,039,987			
		Indirect Total						**$2,045,242**			
	Indirect O&M										
		Professional Management	$174,098					$174,098			
		Contingency					$309,510	$309,510			
		Indirect O&M Total						**$483,608**			
		Total Costs 2A Multilayer (RCRA) Cover, IC						**$4,048,508**			

Notes: Labor costs are RS Mean's determination of the proper craft mix and productivity rate to complete the specific task in the detailed cost estimate in Appendix F. Material costs are products necessary to complete the specific tasks in the detailed cost estimate in Appendix F. Equipment costs are the mechanized and/or hand tools needed to complete the specific tasks in the detailed cost estimate in Appendix F. Subcontract costs are a lump sum costs, usually based on past history, to complete the specific tasks in the detailed cost estimate in Appendix F. This includes material, labor, and equipment to perform the task. Craft distributables include a $7 per direct job hour cost to account for the nonlabor costs associated with temporary utilities/services, small tools, consumables, construction equipment not specifically identified in direct work line items, and training costs. Costs included in the above table are burdened including (New Mexico gross receipts tax, general and administrative, infrastructure, and Associate Directorate support taxes). The specific costs listed in the detailed cost estimate in Appendix F do not include this burden. Contingency costs are calculated at 50% of all other costs and have been separated by capital and O&M costs to produce two separate contingencies. LF = Linear feet; LS = lump sum; CY = cubic yards; AC = acres; EA = each; YR = yearly.

Table 8.2-2
Cost Estimate for Alternative 2B

		Item Description	Labor Cost	Material Cost	Equipment Cost	Subcontractor Cost	Other Costs	Gross Cost	Parametric Quantity	Parametric Unit	Parametric Cost
Alt.2B ET Cover, Institutional Controls											
Direct Costs	Site Fencing										
		Site Fencing	$17,593	$57,101	$2,704			$77,398	700	LF	$111
		Fencing Total						**$77,398**			
	ET Cover										
		Site Prep	$16,284	$17,111	$7,455	$1,198		$42,048	1	LS	$42,048
		Biobarrier (1 ft)	$2,108	$45,882	$3,366			$51,356	969	CY	$53
		Filter Layer (0.5 ft)	$3,608	$36,822	$3,683			$44,113	484	CY	$91
		Fine Grained Cover Layer (3.5 ft)	$15,882	$235,233	$24,447			$275,561	3393	CY	$81
		Cover Soil/Surface Treatment (1.5 ft)	$19,744	$60,174	$16,408			$96,326	1453	CY	$66
		Shoulder fill	$128,853	$45,671	$6,508			$181,032	651	CY	$278
		Revegetation	$2,103	$65,235	$975			$68,313	0.6	AC	$113,855
		TDR Moisture Monitoring	$7,566	$64,167				$71,733	1	LS	$71,733
		ET Cover Total						**$830,483**			
	Distributables										
		Distributables Total	$108,646	$7,666				**$116,312**			
	O&M										
		Cover Inspections and Maintenance (100 yr)	$216,166					$216,166	100	YR	$2,161.66
		Annual Long Term Monitoring Report (100 yr)	$228,758					$228,758	100	YR	$2,287.58
		O&M Total						**$444,925**			
Indirect Costs	Indirect Capital Costs										
		Design				$238,576		$238,576			
		Professional Management	$719,392					$719,392			
		Contingency					$991,080	$991,080			
		Indirect Total						**$1,949,048**			
	Indirect O&M										
		Professional Management	$174,098					$174,098			
		Contingency					$309,510	$309,510			
		Indirect O&M Total						**$483,608**			
		Total Costs 2B ET Cover, IC						**$3,901,774**			

Notes: Labor costs are RS Mean's determination of the proper craft mix and productivity rate to complete the specific task in the detailed cost estimate in Appendix F. Material costs are products necessary to complete the specific tasks in the detailed cost estimate in Appendix F. Equipment costs are the mechanized and/or hand tools needed to complete the specific tasks in the detailed cost estimate in Appendix F. Subcontract costs are a lump sum costs, usually based on past history, to complete the specific tasks in the detailed cost estimate in Appendix F. This includes material, labor, and equipment to perform the task. Craft distributables include a $7 per direct job hour cost to account for the nonlabor costs associated with temporary utilities/services, small tools, consumables, construction equipment not specifically identified in direct work line items, and training costs. Costs included in the above table are burdened including (New Mexico gross receipts tax, general and administrative, infrastructure, and Associate Directorate support taxes). The specific costs listed in the detailed cost estimate in Appendix F do not include this burden. Contingency costs are calculated at 50% of all other costs and have been separated by capital and O&M costs to produce two separate contingencies. LF = Linear feet; LS = lump sum; CY = cubic yards; AC = acres; EA = each; YR = yearly.

Table 8.2-3
Cost Estimate for Alternative 3

Item Description			Labor Cost	Material Cost	Equipment Cost	Subcontractor Cost	Other Costs	Gross Cost	Parametric Quantity	Parametric Unit	Parametric Cost
Alt.3 Excavation and Institutional Controls											
Direct Costs	Site Fencing										
		Site Fencing	$90,349	$304,737	$13,350			$408,435	3800	LF	$107
		Fencing Total						**$408,435**	3800		
	Excavation										
		Excavation Site Prep	$203,625	$44,074	$306,012	$2,397		$556,108	1	LS	$556,108
		Utility Relocate	$18,337	$19,157	$9,692			$47,186	400	LF	$118
		Electrical Supply	$1,217,511	$534,099	$1,036			$1,752,646	1000	LF	$1,753
		Pile Walls & Blast Walls	$722,668	$2,610,881	$15,144	$30,000,917		$33,349,610	760	LF	$43,881
		Excavation Enclosure				$6,398,361		$6,398,361	32400	SF	$197
		Processing Facility Enclosure	$25,170	$29,366	$2,312	$1,513,168		$1,570,017	7900	SF	$199
		Excavation of MDA H	$3,018,289	$1,674,296	$678,916	$28,747	$1,037	$5,401,284	71644	CY	$75
		Confirmatory Sampling	$279,211		$774	$7,533,236		$7,813,221	1248	EA	$6,261
		Backfill	$680,120	$113,414	$519,067			$1,312,600	71644	CY	$18
		Disposal of Waste	$18,908,863	$8,824,000	$3,961,851	$16,386,217	$198,911	$48,279,843	8520	CY	$5,667
		Equipment Decon	$38,039	$126,623	$53	$519,117		$683,832	1	LS	$683,832
		Demolition of Processing Facility Enclosure				$5,695,974		$5,695,974	40300	SF	$141
		Demolition of Electrical Supply	$664,891		$238			$665,130	1000	LF	$665
		Revegetation	$2,103	$65,235	$975			$68,313	0.6	AC	$113,855
		Excavation Total						**$113,594,125**			
	Distributables										
		Distributables	$13,373,276	$943,590				**$14,316,866**			
	O&M										
		Annual Long Term Monitoring Report (100 yr)	$228,758					$228,758	100	YR	$2,288
		O&M Total						**$228,758**			
Indirect Costs	Indirect Capital Costs										
		Design					$18,644,739	$18,644,739			
		Professional Management	$83,724,553					$83,724,553			
		Contingency					$115,344,356	$115,344,356			
		Indirect Total						**$217,713,647**			
	Indirect O&M										
		Professional Management	$89,512					$89,512			
		Contingency					$159,135	$159,135			
		Indirect O&M Total						**$248,647**			
		Total Cost for 3 Excavation, IC						**$346,510,479**			

Notes: Labor costs are RS Mean's determination of the proper craft mix and productivity rate to complete the specific task in the detailed cost estimate in Appendix F. Material costs are products necessary to complete the specific tasks in the detailed cost estimate in Appendix F. Equipment costs are the mechanized and/or hand tools needed to complete the specific tasks in the detailed cost estimate in Appendix F. Subcontract costs are a lump sum costs, usually based on past history, to complete the specific tasks in the detailed cost estimate in Appendix F. This includes material, labor, and equipment to perform the task. Craft distributables include a $7 per direct job hour cost to account for the nonlabor costs associated with temporary utilities/services, small tools, consumables, construction equipment not specifically identified in direct work line items, and training costs. Costs included in the above table are burdened including (New Mexico gross receipts tax, general and administrative, infrastructure, and Associate Directorate support taxes). The specific costs listed in the detailed cost estimate in Appendix F do not include this burden. Contingency costs are calculated at 50% of all other costs and have been separated by capital and O&M costs to produce two separate contingencies. LF = Linear feet; LS = lump sum; CY = cubic yards; AC = acres; EA = each; YR = yearly.

Table 9.1-1
Explanation of Ranking System Used for Evaluating Remedial Alternative Evaluation Criteria

Balancing Criteria	Rating				
	1	2	3	4	5
Long-Term Reliability and Effectiveness	Not demonstrated as effective; Potential for remedy failure	→			Reduces risk with little long-term management, and has proven effective under similar conditions
Reduction of Toxicity Mobility, or Volume	No reduction of toxicity, mobility, or volume of contaminants	→			Completely and permanently reduces the toxicity, mobility, and volume of contaminants
Short-Term Effectiveness	Provides no short-term risk reduction and may create significant additional risks to the community, workers, and the environment	→			Quickly reduces short-term risk, without creating significant additional risks
Implementability	Difficult to implement. Significant amount of time needed for implementation	→			Can be implemented quickly and easily, and poses few difficulties
Cost	Highest costs	→			Less costly and does not sacrifice protection of human health and the environment

Table 9.1-2
Screening of Alternatives against the Balancing Criteria

Alternative	Balancing Criteria	Rating Justification	Rating
Alternative 1 No Action	Long-Term Reliability and Effectiveness	This alternative is rated lowest in long-term reliability and effectiveness because there is high long-term risk, high uncertainty with leaving waste in place, a potentially high amount of long-term management and monitoring, and high potential for remedy failure.	1
	Reduction of Toxicity, Mobility, or Volume	This alternative is rated lowest in reduction of toxicity, mobility, or volume because there is no reduction.	1
	Short-Term Effectiveness	This alternative is mid-rated for short-term effectiveness because no additional risk is generated, although no risk reduction is obtained.	3
	Implementability	This alternative is rated highest in implementability because it is easiest to implement, as no remedy is required.	5
	Cost	This alternative is rated highest in the cost criteria because it has no associated costs.	5
	Total		15

Table 9.1-2 (continued)

Alternative	Balancing Criteria	Rating Justification	Rating
Alternative 2A Multilayer cover and institutional controls	Long-Term Reliability and Effectiveness	A multilayer cover is more reliable in the long term compared with Alternative 1. However, because of the potential for desiccation of the clay layers, it is rated as less reliable than Alternative 2B and Alternative 3, which includes excavation.	2
	Reduction of Toxicity, Mobility, or Volume	The multilayer cover reduces infiltration, therefore reducing mobility. This alternative is comparable to Alternative 2B but is rated lower than Alternative 3, which includes excavation.	3
	Short-Term Effectiveness	This alternative is comparable to Alternative 2B but is rated higher than Alternative 3, which includes excavation, because of the risks associated with excavation and waste handling.	4
	Implementability	This alternative uses standard construction techniques. This alternative is comparable to Alternative 2B but is rated higher than Alternative 3, which includes excavation, because of the additional difficulty with performing excavation and waste handling.	3
	Cost	This alternative is comparable in cost with Alternative 2B but is rated higher than Alternative 3, which includes excavation, because of its additional costs for excavation and waste handling.	4
	Total		16

Table 9.1-2 (continued)

Alternative	Balancing Criteria	Rating Justification	Rating
Alternative 2B ET cover and institutional controls	Long-Term Reliability and Effectiveness	This alternative is more reliable in the long term compared with Alternative 1. This alternative is rated higher than Alternative 2A because it does not have the desiccation issue associated with the clay layer. Excavation provides more long-term reliability; therefore, Alternative 3 is rated higher.	3
	Reduction of Toxicity, Mobility, or Volume	The ET cover reduces infiltration, therefore reducing mobility. This alternative is comparable to Alternative 2A but is rated lower than Alternative 3, which includes excavation.	3
	Short-Term Effectiveness	This alternative is comparable to Alternative 2A, but is rated higher than Alternative 3, which includes excavation, because of the risks associated with excavation and waste handling.	4
	Implementability	This alternative uses standard construction techniques. This alternative is comparable to Alternative 2A but is rated higher than Alternative 3, which includes excavation, because of the additional difficulty with performing excavation and waste handling.	3
	Cost	This alternative is comparable in cost with Alternative 2A but is rated higher than Alternative 3, which includes excavation, because of its additional costs for excavation and waste handling.	4
	Total		17

Table 9.1-2 (continued)

Alternative	Balancing Criteria	Rating Justification	Rating
Alternative 3 Excavation and institutional controls	Long-Term Reliability and Effectiveness	Excavation provides the most reliable long-term effectiveness because all wastes are removed. This alternative is rated higher than all other alternatives.	5
	Reduction of Toxicity, Mobility, or Volume	Excavation reduces volume of waste at the site. This alternative provides the greatest reduction in toxicity, mobility, or volume because all waste is removed; therefore, this alternative is rated higher than all other alternatives.	5
	Short-Term Effectiveness	This alternative is rated lower than all other alternatives because of the increased short-term risks associated with excavation and waste handling.	1
	Implementability	This alternative is rated lower than all other alternatives because of the additional difficulty with performing excavation to depths required to retrieve wastes from the shafts.	1
	Cost	This alternative is rated lower than all other alternatives because of the additional costs for excavation to depths required to retrieve wastes from the shafts and for waste handling.	1
	Total		13

Appendix A

Acronyms and Abbreviations,
Metric Conversion Table, and Data Qualifier Definitions

A-1.0 ACRONYMS AND ABBREVIATIONS

ACZ	acceptable compaction zone
AOC	area of concern
APV	access port valve
amsl	above mean sea level
ARSL	American Radiation Services Laboratory
ASTM	American Society for Testing and Materials
bgs	below ground surface
BHC	benzene hexachloride
BV	background value
CAMU	corrective action management unit
CdRVF	Cerros del Rio volcanic field
CFR	Code of Federal Regulations
CME	corrective measures evaluation
CMI	corrective measures implementation
CMS	corrective measures study
Consent Order	Compliance Order on Consent
COPC	chemical of potential concern
CSM	conceptual site model
CV	casing volume
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethylene
DL	detection limit
DO	dissolved oxygen
DOE	Department of Energy (U.S.)
DSA	document safety analysis
DU	depleted uranium
EPA	Environmental Protection Agency (U.S.)
ER	environmental restoration
ET	evapotranspiration
EU	enriched uranium
FD	field duplicate
FLUTe	Flexible Liner Underground Technologies

FY	fiscal year
GBIR	Groundwater Background Investigation Report
gpd	gallons per day
gpm	gallons per minute
HDPE	high-density polyethylene
HE	high explosives
HELP	Hydrologic Evaluation of Landfill Performance
HEU	highly enriched uranium
HH&E	human health and the environment
HI	hazard index
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
hp	horse power
HWB	Hazardous Waste Bureau (NMED)
IFGMP	Interim Facility-Wide Groundwater Monitoring Plan
IIS	Inventory Isolation System
JMVF	Jemez Mountain volcanic field
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (Laboratory's name before January 1, 1981)
LDR	land disposal restriction
LiH	lithium hydride
LiF	lithium fluoride
Ma	million years ago
MCL	maximum contaminant level
MDA	material disposal area
MDD	maximum dry density
meq	millaequivalent(s)
MTR	minimum technology requirement
NCRS	Natural Resources Conservation Service
NES	nuclear environmental site
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NTU	nephelometric turbidity unit(s)

O&M	operations and maintenance
OMB	Office of Budget and Management
ORP	oxygen-reduction potential
P&A	plugged and abandoned
PBX	plastic-bonded explosives
PCB	polychlorinated biphenyl
PCE	perchloroethene (also tetrachloroethene)
PET	potential evapotranspiration
PETN	pentaerythritol tetranitrate
PLS	pure live seed
PMR	periodic monitoring report
PQL	practical quantitation limit
PV	present value
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RFI	RCRA facility investigation
RPF	Records Processing Facility
RSL	regional screening level
SNL	Sandia National Laboratories (New Mexico)
SOP	standard operating procedure
SAL	screening action level
SHB	seismic hazards borehole
SNL	Sandia National Laboratories
SSD	saturated surface dry
SSL	soil screening level
SU	standard unit
SVE	soil-vapor extraction
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area

TAL	target analyte list
TATB	triaminotrinitrobenzene
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TD	total depth
TDR	time-domain reflectometer
TDS	total dissolved solids
TIC	tentatively identified compound
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TOCP	tri(o-cresyl)phosphate
UMTL	University of Miami Tritium Laboratory
UTL	upper tolerance limit
VOC	volatile organic compound
WAC	waste acceptance criteria

A-2.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	By	To Obtain US Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-3.0 DATA QUALIFIER DEFINITIONS

Data Qualifier	Definition
U	The analyte was analyzed for but not detected.
J	The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.
J+	The analyte was positively identified, and the result is likely to be biased high.
J-	The analyte was positively identified, and the result is likely to be biased low.
UJ	The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific detection or quantitation limit.
R	The data are rejected as a result of major problems with quality assurance/quality control (QA/QC) parameters.

Appendix B

Waste Inventory for Material Disposal Area H

B-1.0 INTRODUCTION

Waste was disposed of in the Material Disposal Area (MDA) H shafts over approximately 26 yr from May 1960 until August 1986. During this period, disposal events were recorded in a single Los Alamos Scientific Laboratory (LASL) logbook that contains brief, unclassified descriptions of the waste, including approximate weights. Information from the logbook is summarized in Table B-1.0-1. Logbook descriptions include sufficient information to identify many of the potential hazardous wastes, constituents, and radionuclides in the inventory (LASL 1960–1986, 070034). However, the quantities of the materials disposed of can only be estimated because the details in the logbook are insufficient, and some descriptions of the materials disposed of at MDA H are still classified. Therefore, the documented logbook information was supplemented by a review of waste disposal records, process knowledge of current and former site operations, and best professional and engineering judgment from subject matter experts. In addition, the quantities and metal composition of components excavated and recovered from the Classified Waste Landfill at Sandia National Laboratories (SNL), a site with similar disposal materials, were reviewed to support the estimates of the MDA H metals inventory. These efforts resulted in the refined estimate of the waste inventory at MDA H that is discussed in this section (Omicron 2003, 075940).

The percentages by weight of material disposed of in the shafts at MDA H as recorded in the logbook are shown in Figure 2.2-1 of the report. The largest component of the MDA H waste inventory, 57%, is metal, both radioactive and nonradioactive (24% depleted uranium [DU] and 33% other metals). Potentially reactive materials, such as lithium compounds, represent approximately 1% of the inventory. Graphite represents approximately 9% of the inventory, and radioactive materials other than DU account for approximately 24% of the inventory. Plastics account for approximately 9% of the inventory, and paper and high explosives (HE) each constitute less than 1% of the inventory (LASL 1960–1986, 070034).

Logbook entries include waste that potentially meets the Resource and Conservation and Recovery Act definition of characteristic hazardous waste such as lithium hydride and HE. Additional potentially hazardous wastes or constituents not listed in logbook entries are expected to be present based on process knowledge. These materials, including barium, cadmium, chromium, lead, mercury, and silver, were used as shielding, solders, parts, or coatings. Other hazardous constituents, such as beryllium and copper, are listed in logbook entries. Volatile organic compounds (VOCs) are not listed in the logbook entries, but are detected in trace amounts in vapor-phase sampling at MDA H (e.g., LANL 2010, 111123). Radionuclides listed in or identified from the logbook entries include tritium, uranium-234, uranium-235/236, uranium-238, plutonium-238, plutonium-239/240, plutonium-241, and plutonium-242.

Much of the inventory at MDA H includes design-phase materials in the form of shapes, molds, modules, and mockups (Table B-1.0-1). One of the assumptions made and used to estimate the inventory is that strategic materials (e.g., beryllium) would have been used only in the final design stages of the research and development process. In initial design phases, the parts would have been constructed of cardboard or wood; in the second phase, they would have been constructed of metals, such as aluminum or steel; and in the final phase, the parts would have been constructed of DU or other strategic materials. The wood or cardboard would have been destroyed (i.e., burned), and the nonradioactive materials would have been recycled, leaving only the materials that were not easily recycled.

The total amount of uranium disposed of at MDA H is uncertain because descriptions of the individual isotopes are classified and because disposed of items listed as “shapes and parts” may be DU. Therefore, both upper-bound and best-estimate values were developed for the uranium inventory. The upper-bound value is the maximum quantity of uranium that could have been disposed of at MDA H, and the best-estimate value is the quantity of uranium that is believed to have been disposed of at MDA H.

The results of the inventory analysis for the corrective measures evaluation are summarized in Table 2.2-1.

B-1.1 Metals

The estimated amounts of metals disposed of at MDA H are based on (1) logbook entries, (2) interviews with site workers from MDA H and the facilities generating the wastes disposed of at MDA H, and (3) information about material excavated from the Classified Waste Landfill at SNL. The logbook information indicates that the classified objects disposed of at MDA H contained specific types of metals, but the logbook information does not list the actual quantities of metals or the composition of the objects. Therefore, metal quantities and the composition of metal-containing components excavated and recovered from the Classified Waste Landfill at SNL were reviewed to estimate metal quantities for aluminum, beryllium, cadmium, chromium, copper, lead, mercury, silver, and steel (Galloway 2001, 071343; Omicron 2003, 075940). The total mass of waste recorded at MDA H is 391,229 lb. A percentage of the total mass of waste disposed of in the shafts (based on programmatic differences between the two laboratories) was used to estimate a reasonable maximum mass of these specific metals disposed of at MDA H. Mass estimates are described below.

- Aluminum is listed in the MDA H inventory. It was used in large quantities for Los Alamos National Laboratory (LANL or the Laboratory) operations based on weight, cost, and ease of casting/machining. These same properties made aluminum easy to declassify and recycle. Most classified aluminum parts would not have been disposed of at MDA H, with the exception of parts that were contaminated. The mass of aluminum was increased to 15% of the total MDA H inventory (58,700 lb) based on the SNL inventory.
- Barium is not listed in the MDA H inventory. Based on process knowledge of Laboratory operations, barium is estimated to be present as 40% (5300 lb) of the mock/inert HE listed in the logbook.
- Beryllium is listed in the MDA H inventory. Beryllium was used in some classified shapes, although it is not listed as a component of the shapes in the MDA H inventory. Beryllium or beryllium alloys were recycled whenever possible; thus, limited quantities were estimated to have been disposed of at MDA H. The mass of beryllium was increased to 1.7% of the total inventory (6534 lb) based on process knowledge of Laboratory operations.
- Cadmium is not listed in the MDA H inventory. Based on process knowledge of Laboratory operations, cadmium was used in the form of coatings. Based on programmatic differences between the Laboratory and SNL operations, the mass of cadmium in the MDA H inventory is estimated to be 0.005% (20 lb) (Myers 2002, 073709).
- Chromium is not listed in the MDA H inventory. Based on process knowledge of Laboratory operations, chromium was used during plating of certain parts. The chromium/nickel mass in stainless steel was not included in the inventory because it is unavailable for environmental transport. The mass of chromium is estimated to be 0.5% (1960 lb) of the total MDA H inventory based on process knowledge of Laboratory operations.
- Copper is listed in the MDA H inventory. Copper was present in shapes, electrical components, and batteries based on process knowledge of Laboratory operations. Based on programmatic differences between the Laboratory and SNL operations, the estimated mass of copper was increased to 0.6% (2350 lb) of the MDA H inventory (Myers 2002, 073709).
- Lithium and lithium compounds are listed in the MDA H inventory. The mass of lithium and lithium compounds identified in logbook entries is 1.3% (4959 lb) of the total MDA H inventory. Lithium compounds identified include lithium hydride (LiH), lithium fluoride (LiF), and lithium boride. The

bulk of the lithium compounds are from a disposal of 4408 lb of "Lithium fluoride (LiF) [plastic-bonded explosive] PBX containing 86% LiF" (Omicron 2003, 075940). Based on process knowledge of Laboratory operations, lithium and lithium compounds could have been present in some of the parts as well as in samples. An additional 15 lb of LiH was added to the disposal made on December 18, 1981, according to a memorandum dated March 6, 1986 (Omicron 2003, 075940).

- Steel is listed in the MDA H inventory. Steel in all forms, such as alloys, was used in large quantities for Laboratory operations based on cost, availability, and ease of machining. These properties also made non-contaminated steel parts easy to declassify and recycle. Most classified steel parts, except those that were contaminated, would have been disposed of off-site. The mass of steel is estimated to be 40% (156,490 lb) of the total MDA H inventory based on the SNL inventory.
- Lead is not listed in the MDA H inventory. Based on process knowledge of Laboratory operations, lead was used in solders as well as in models to give density without adding a radioactive component. Lead would have also been used for shielding of high-energy particles. Non-contaminated classified lead parts would have been recycled whenever possible. The mass of lead is estimated to be 20% (78,250 lb) of the total MDA H inventory based on the SNL inventory.
- Mercury is not listed in the MDA H inventory. Based on process knowledge of Laboratory operations, mercury would have been present in electrical components and batteries. Based on programmatic differences between Laboratory and SNL operations, the mass of mercury is estimated to be 0.33% (1300 lb) of the total MDA H inventory (Myers 2002, 073709).
- Silver is not listed in the MDA H inventory; however, developed film is listed. Based on process knowledge of Laboratory operations, silver would have also been present in electrical or plated waste items disposed of at MDA H and is estimated to be 0.01% (39 lb) of the total MDA H inventory. Silver present in developed film is not readily available for release and environmental transport and would represent up to 3.1 wt% (1310 lb) of the film weight based on the assumption that industrial-type x-ray films were used.
- Tungsten is listed in the MDA H inventory. The mass of tungsten is identified in the logbook entries as 11,500 lb. Based on process knowledge of Laboratory operations, tungsten was used for tools and high-strength applications and is included in the steel estimate above.

B-1.2 High Explosives

The estimate of HE is based entirely on logbook entries. It was assumed that any HE-contaminated material in the logbook entries is residual contamination, representing no more than 1 wt% of the discarded HE-contaminated object before "flashing" (i.e., burning) of the object (LANL 2001, 071344). The common Laboratory practice (then and now) is to flash objects to remove unreacted explosives before disposal (LASL 1961, 030561). All HE-contaminated material recorded in the logbook was assumed to be contaminated with residual RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) because RDX was the most commonly used explosive during MDA H operations. In addition, the assumption that all HE is RDX is protective based on the relative mobility, persistence, and toxicity of this explosive compared with other conventional HE. The quantity of RDX estimated to exist from HE-contaminated material in the MDA H inventory is approximately 283 lb.

Only two logbook disposal entries (Table B-1.0-1) record the disposal of large quantities of HE at MDA H. Both disposals occurred in Shaft 3. The first logbook entry recorded is the disposal of 4408 lb of "lithium fluoride PBX … containing 14% RDX (powder form)" (LASL 1963, 073218). The second logbook entry

reported 375 lb of “1 lot H.E. classif[ied] mat’l” waste was disposed of in Shaft 3. The second disposal is assumed to be 100% RDX. The total RDX for these two disposals is 992 lb. Thus, an estimated total of 1275 lb of RDX was disposed of in the MDA H shafts.

B-1.3 Plutonium

Three logbook entries (Table B-1.0-1) describe disposal of “shapes” (weapon molds/components) contained in drums contaminated with residual amounts of plutonium. A total of 300 lb of waste is listed in the MDA H logbook as “Pu contaminated.” Inventory estimates of the amount and isotopic composition of the residual plutonium were based on the assumptions that (1) the plutonium contamination existed in the form of plutonium oxide (because plutonium readily oxidizes), (2) the amount of plutonium contamination was detectable by instruments in use at the time of disposal (with an assumed detection limit of 100 nCi/g), and (3) the isotopic ratio (plutonium-52) was that of the most common plutonium-contaminated waste disposed of at MDA G. (MDA G and MDA H received waste from the same technical areas [TAs], and this was the most prevalent plutonium material disposed of at MDA G for which accurate records exist.) Based on these assumptions, the maximum calculated total activity of plutonium at MDA H is approximately 0.014 Ci in the 300 lb of plutonium-contaminated waste disposed of in the shafts.

B-1.4 Tritium

The information in the logbook entries is not sufficient to accurately estimate the tritium inventory. Tritium disposed of at MDA H was most likely not disposed of as a gas, based on knowledge of its uses at the Laboratory and site operators’ knowledge that tritiated wastewater at the Laboratory was adsorbed onto a solid matrix and disposed of at MDA G (Dickason 1960, 011514; LASL 1961, 030561). It is not anticipated that tritium is present as a solid (such as lithium tritide) at MDA H because it was both valuable and easily recoverable in its solid form. Therefore, the inventory is estimated to range between 3.5 and 167 Ci based on field data for tritium (LANL 2005, 089332, Appendix I) and not corrected for decay.

B-1.5 Uranium

Logbook entries describe DU in the form of shapes, molds, modules, mockups, and scrap. Most entries do not specify uranium mass or composition. Based on process knowledge of Laboratory operations, uranium-contaminated waste in the MDA H inventory includes the following isotopes: uranium-234, uranium-235/236, and uranium-238. Each radioisotope has different characteristics that are important in the context of potential long-term impacts. Most important is uranium-234, which decays over very long periods into radium, radon gas, and uranium-235. Naturally occurring uranium is mostly uranium-238 (>99%) with small amounts of uranium-235 (<1%) and even smaller amounts of uranium-234 (<0.01%). Enriched uranium (EU) has more uranium-235 than naturally occurring uranium; DU has less uranium-235 than naturally occurring uranium. EU is used in nuclear applications (e.g., fuel elements); DU (<0.72% uranium-235) is used for nonnuclear applications (e.g., weapon mockups).

Logbook entries list 93,000 lb of DU present in the MDA H inventory (24% of the total mass recorded at MDA H). Based on past disposal practices and engineering judgment, an upper-bound estimate was developed for DU because many of the entries for shapes and parts in the logbook could have been made from DU; however, material was not always specified in the logbook entry. Therefore, the estimated mass of DU was increased to 233,000 lb as an upper-bound estimate (80% of the mass associated with shapes, molds, modules, mockups, and scrap).

Logbook entries are not specific about the mass or composition of EU disposed of at MDA H. The three categories of EU that may have been disposed of at MDA H include EU, highly enriched uranium (HEU), and fuel elements. Based on process knowledge of Laboratory operations and the total mass listed in the logbook entries that may have contained EU/HEU, the best estimate for the quantity of EU/HEU was restricted to a maximum of 44 lb per disposal. The estimate of EU/HEU was also based on the pre-1964 quantities of HEU used per test in Appendix D of the Nuclear Weapons Databook (Cochran et al. 1987, 075921). This assumption is reasonable because criticality would have become a major concern at higher masses. The best estimate of EU/HEU is 1100 lb.

An upper-bound mass of EU/HEU was calculated to be 14,600 lb, based on the total mass of logbook entries that may have contained EU/HEU. The documented mass of these categories of waste was converted directly into activity of constituent uranium isotopes, using standard mass ratios for the different uranium material types. EU isotopic activity percentages were calculated to be 91.1% uranium-238, 8.7% uranium-235, 0.075% uranium-234, and 0.09% uranium-236 using mass percentage conversions from Taggart (1992, 070212). HEU isotopic activity percentages were found to represent a maximum of 93.3% uranium-235, 1.1% uranium-234, 0.2% uranium-236, and 5.4% uranium-238 (Haskin 1995, 070214). For the EU and HEU, a ratio of 95:5 EU to HEU was used to determine isotopic properties. This ratio is considered to be bounding because accountable HEU was significantly more valuable than EU and was easily recoverable.

Based on logbook entries, the upper-bound mass of fuel elements was estimated to be 17,700 lb, with the entire mass in the logbook entries assumed to be uranium. The composition of the fuel elements was assumed to be the same as EU for the upper-bound value. The best estimate of uranium mass in the fuel elements was based on the following assumptions.

- Fuel elements listed as “unloaded” were considered to have been emptied of uranium, thereby reducing the mass of fuel elements by 3400 lb.
- Cladding and associated hardware were 25% of the mass, thereby reducing the mass of the fuel elements by an additional 3600 lb.

The resulting best estimate of uranium mass of fuel elements is 10,700 lb. The best estimate and upper-bound values for the uranium inventory are listed in Table 2.2-1.

Based on the information provided in the MDA H disposal logbook (LASL 1960–1986, 070034), uranium fuel elements may have been irradiated in a neutron flux. However, because of the restrictions placed on the MDA H operations by the Laboratory’s SP-2 Group Office (the Laboratory security group responsible for MDA H at the time), the rules for accepting these materials at MDA H prohibited gram quantities of fissile materials. SP-2 worked with the Health Physics Group, H-1, to ensure that this requirement was met. Based on this restriction, only short-term irradiation could have been conducted without allowing the fuel elements to generate gram quantities of fissile material within the fuel elements.

B-1.6 Other Types of Waste

B-1.6.1 Graphite

Logbook entries (Table B-1.0-1) describe disposal of “graphite” shapes and scrap material. A total of 47,162 lb of waste containing graphite is listed in the MDA H logbook.

B-1.6.2 Mock/Inert HE

Logbook entries (Table B-1.0-1) describe disposal of “inert” (mock) shapes and scrap material. A total of 13,260 lb of mock/inert HE waste is listed in the MDA H logbook.

B-1.6.3 Paper

Logbook entries (Table B-1.0-1) describe disposal of “documents” because of either classification or their contamination by radioactive materials. A total of 755 lb of documents or paper waste is listed in the MDA H logbook.

B-1.6.4 Plastic

Logbook entries describe plastic in the form of shapes and scrap. Most entries do not specify mass or composition of the plastics. Plastics include materials such as film, magnetic media, slides, and other nonspecific plastic (such as polymers, foams, glues, epoxy resins, elastomers, rubber, etc.). A total of 54,461 lb of waste as plastic, including film (42,346 lb), magnetic media (4337 lb), slides (1223 lb), and other nonspecific plastic (6555 lb) is listed in the MDA H logbook.

B-1.6.5 Volatile Organic Compounds

VOCs are not listed in the logbook entries but are detected in trace amounts in vapor-phase sampling at MDA H (e.g., LANL 2010, 111123). The source of VOC vapors in the subsurface at MDA H is thought to be residual contamination from lubricants or cleaning solvents used on machined parts and minimal amounts of waste oil that potentially mixed with solvents (Omicron 2003, 075940). An estimate for the current-day mass of VOCs in the subsurface at MDA H, based on July 2010 vapor-sampling data, is presented below in section B-2. The estimated total mass of VOCs includes both liquid and vapor phases and is 4.6 lb. Most is associated with alcohols (approximately 69%) and ketones (approximately 24%). Less than 5% of the total estimated mass (approximately 0.22 lb) is associated with halogenated VOCs.

B-2.0 ESTIMATED INVENTORY OF VOLATILE ORGANIC COMPOUNDS IN THE VADOSE ZONE AT MATERIAL DISPOSAL AREA H

This section provides an estimate of the inventory of VOCs present in the vadose zone beneath MDA H based on vapor-monitoring data gathered at the site.

B-2.1 Purpose

Quarterly pore-gas monitoring activities have been conducted at MDA H since the second quarter of fiscal year 2005 to characterize VOC and tritium concentrations present in the vadose zone beneath MDA H. Currently, pore-gas samples are collected at 28 ports in 4 vapor-monitoring boreholes. Monitoring activities are implemented quarterly as directed by the New Mexico Environment Department (NMED) in a June 23, 2009, letter to the Laboratory.(NMED 2009, 106234). These data are used here to estimate the mass of VOCs in the vadose zone at MDA H.

Based on available information, the source of VOCs is expected to be incidental contamination of the wastes disposed of at MDA H. The inventory of VOCs associated with this type of source would be small compared with sources such as disposal of bulk solvent wastes. To determine whether the results of

pore-gas monitoring at MDA H were consistent with such a source, these data were used to estimate the inventory of VOCs in the subsurface at MDA H.

The inventory of VOCs present in the subsurface is estimated based on the concentrations of VOCs measured in pore gas and equilibrium partitioning relations. This estimate was used to quantify the mass in the vapor phase, dissolved phase, and when adsorbed to solids. For the purpose of this evaluation, only a rough order of magnitude inventory estimate was needed. Therefore, simplifying assumptions were made for some of the data. When assumptions were necessary, they were made to yield more conservative results (e.g., a higher estimate of the inventory). The approach used for estimating the VOC inventory and the results of the evaluation are described below.

B-2.2 Approach

VOCs present in subsurface media will be in pore gas as vapors, dissolved into pore water, and adsorbed onto solid media. Detected concentrations of VOCs in pore gas are orders of magnitude less than the vapor pressures of these chemicals, which is evidence that VOCs are not present as a separate, nonaqueous liquid phase. Several equilibrium partitioning constants describe the relationship between the concentrations of chemicals in these various phases. These constants were used to develop an expression for the overall concentration of a VOC in the bulk medium (i.e., tuff) as a function of the concentration in the vapor phase. Measured vapor-phase concentrations were then used to calculate the bulk concentration in tuff, which was used to estimate the overall mass of the inventory based on an assumed volume of affected media.

The first partitioning constant used is Henry's law coefficient. The dimensionless form of Henry's law coefficient describes the equilibrium relationship between the volumetric concentrations of chemicals in air and in water.

$$H' = C_{air} / C_{water} \qquad \textbf{Equation B-1}$$

Where H' = the dimensionless form of Henry's law coefficient,

C_{air} = the volumetric concentration of chemical in air (M/L^3), and

C_{water} = the volumetric concentration of chemical in water (M/L^3).

Rearranging Equation B-1 gives

$$C_{water} = C_{air} / H' \qquad \textbf{Equation B-2}$$

The second partitioning constant used is the distribution coefficient. The distribution coefficient describes the equilibrium relationship between the concentrations of chemicals dissolved in water and adsorbed on solids.

$$K_d = C_{solid} / C_{water} \qquad \textbf{Equation B-3}$$

Where K_d = the distribution coefficient (L^3/M) and

C_{solid} = the mass concentration of contaminant in soil or tuff (M/M).

For organic chemicals, the adsorption of chemicals onto the solid phase is strongly influenced by the amount of organic carbon present in the solid. The distribution coefficient can be estimated from the organic carbon distribution coefficient and the fraction of organic carbon in tuff.

$$K_d = K_{oc}\, f_{oc} \qquad \textbf{Equation B-4}$$

Where K_{oc} is the organic carbon distribution coefficient (L^3/M) and

f_{oc} is the fraction of organic carbon in tuff (M/M).

Rearranging Equation B-3 and substituting Equation B-2 and Equation B-4 give

$$C_{solid} = K_{oc}\, f_{oc}\, C_{air} \Big/ H' \qquad \textbf{Equation B-5}$$

The bulk concentration of chemical in tuff is equal to the total mass of chemical in all three phases per unit mass of tuff.

$$C_{bulk} = \frac{M_{air} + M_{water} + M_{solid}}{M_{soil}} \qquad \textbf{Equation B-6}$$

Where C_{bulk} = the bulk concentration of chemical in tuff (M/M),

M_{air} = the mass of chemical present in the vapor phase in pore gas (M),

M_{water} = the mass of chemical present in the liquid phase in pore water (M),

M_{solid} = the mass of chemical present in the solid phase in tuff (M), and

M_{soil} = the mass of the soil or tuff.

The mass of chemical present in the vapor phase in pore gas is equal to the product of the concentration in air and the volume of air. The latter is equal to the product of the air-filled porosity and the volume of tuff. The mass of contaminant present in the liquid phase in pore water is equal to the product of the concentration in water and the volume of water. The latter is equal to the product of the water-filled porosity and the volume of tuff. The mass of contaminant present in the solid phase in tuff is equal to the product of the concentration in the solid phase and the mass of tuff. The latter is equal to the product of the volume of tuff and the bulk density of tuff.

Using the relationships described above, Equation B-6 can be rewritten as

$$C_{bulk} = \frac{\left(C_{air}\, V_{soil}\, \theta_{air}\right) + \left(C_{air}\, V_{soil}\, \theta_{water} \Big/ H'\right) + \left(C_{air}\, K_{oc}\, f_{oc}\, V_{soil}\, \rho_{soil} \Big/ H'\right)}{V_{soil}\, \rho_{soil}} \qquad \textbf{Equation B-7}$$

where V_{soil} = the volume of tuff (L^3),

θ_{air} = the air-filled porosity (L^3/L^3),

θ_{water} = the water-filled porosity or volumetric water content (L^3/L^3), and

ρ_{soil} = the bulk density of tuff (M/L^3).

Equation B-7 can be simplified to

$$C_{bulk} = \frac{C_{air}\left(\theta_{air} + \theta_{water}/H' + (K_{oc}\, f_{oc}\, \rho_{soil})/H'\right)}{\rho_{soil}} \qquad \textbf{Equation B-8}$$

Equation B-8 gives the bulk concentration of VOC in tuff as a function of the pore-gas concentration and properties of the chemical and tuff. The sources of the data used in Equation B-8 and any associated assumptions are described below.

- C_{air}– The pore-gas monitoring results provide the concentration of a particular VOC measured at each sampling point. To simplify the analysis, a uniform pore-gas concentration was assumed for the entire affected volume. This concentration was calculated as the average of the detected values from the sample results collected during June 2010. Using only the detected values in the calculation overestimates the average concentration, particularly for VOCs having a high frequency of nondetects. Most of the VOCs detected at MDA H were detected in less than half the samples.
- θ_{air}– The air-filled porosity will depend on the total porosity and moisture content of the tuff, both of which will vary depending on geologic unit and depth. To simplify the analysis, a single value of 0.4 was assumed for the entire affected volume. This value was selected as being representative of tuff at the Laboratory beneath dry mesas, such as Mesita del Buey where MDA H is located.
- θ_{water}– The volumetric water content will vary depending on the physical properties of the geologic unit. To simplify the analysis, a single value of 0.05 was assumed for the entire affected volume. This value was selected as being representative of tuff at the Laboratory beneath dry mesas.
- H' and K_{oc}– Henry's law coefficient and organic carbon distribution coefficient are physical properties of the VOC, and H' is a function of temperature. The values for these two coefficients were obtained from the NMED soil screening level technical background document (NMED 2009, 108070). If values were not available from this source, they were obtained from the U.S. Environmental Protection Agency (EPA) regional screening level database (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm). The values of H' and K_{oc} used are presented in Table B-2.2-1.
- f_{oc}– The fraction of organic carbon depends on the amount of organic matter present in the tuff and varies depending on the amount of weathering and biological activity. A single value of 0.0005 (0.05%) was assumed to be representative of tuff in the subsurface beneath MDA H. This value is a factor of 3 less than the representative value for soil presented by NMED (2009, 108070) and reflects the lower organic content of tuff.
- ρ_{soil}– The bulk density depends on the total porosity of the tuff and the density of the solids composing the tuff and will vary depending on geologic unit. A single value of 1.46 kg/L was used based on the total porosity of 0.45 and an assumed solids density of 2.65. This single value is assumed to be representative of tuff in the subsurface beneath MDA H.

B-2.3 Results

Equation B-8 was used with the data described above to calculate a bulk concentration for each detected VOC (Table B-2.3-1). To calculate a mass inventory, concentrations of each VOC were multiplied by the

mass of affected tuff. The latter was calculated from the estimated dimensions of the plume and the bulk density of tuff. Based on the available monitoring data, the VOC plume was assumed to have dimensions of 450 ft long × 200 ft wide × 300 ft deep, resulting in a volume of 2.7×10^7 ft^3, or 7.65×10^8 L. The mass of tuff was calculated as this volume multiplied by the dry bulk density of tuff (1.46 kg/L). This mass (1.12×10^9 kg) was multiplied by the bulk concentration of each VOC to obtain the chemical inventory. These results are presented in Table B-2.3-1 and summarized by chemical class in Table B-2.3-2.

Table B-2.3-3 provides the average concentration calculated for each analyte that was used as input to the mass estimates provided in Tables B-2.3-1 and B-2.3-2. As the definition of C_{air} notes above, these averages use only detected values and neglect nondetects; this yields a considerably higher estimated average concentration than would be calculated if the nondetects were included. Table B-2.3-3 shows the detected values used to calculate the averages. It is clear that most constituents are not detected in all 28 ports. These average concentrations were assumed to be present in the entire volume calculated above, which includes areas where many of the constituents are not detected. The combination of the overestimated concentration and volume yields a high predicted mass, especially for constituents that are detected at only a few sampling ports.

B-2.4 Discussion

The estimated VOC inventory in the subsurface at MDA H is on the order of 2 kg. This estimate is considered to be high (conservative) based on the assumptions used in the calculation (section B-2.3). This order of magnitude estimate is consistent with the expected source of VOCs (i.e., incidental contamination of the wastes disposed at MDA H rather than disposal of bulk chemical wastes). This result is also consistent with operational history at Technical Area 54 (TA-54). Specifically, MDA H was established for disposal of classified solid-form wastes, which would likely not include bulk solvent wastes.

Ninety-two percent of the estimated inventory at MDA H is associated with alcohols and ketones (e.g., butanol and acetone). These classes of chemicals are soluble in water and have low Henry's law coefficients (i.e., they partition more strongly into the aqueous phase than into the vapor phase). Thus, most of the inventory of these compounds is dissolved into the pore water. In contrast, halogenated VOCs (e.g., tetrachloroethene), which are generally the most toxic and of the most concern with respect to potential groundwater contamination, are not soluble in water (high Henry's law coefficient) and partition strongly into the vapor phase (air-filled pore space). These compose less than 5% of the total estimated inventory (approximately 0.1 kg).

B-3.0 REFERENCES

The following list includes all documents cited in this appendix. 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.

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Table B-1.0-1
Disposal Records by Shaft

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
1	5-3-60	1344	Tungsten carbide	Tungsten carbide			1	1 ft × 1 ft × 1 ft	100	60.0	From storage in CMB-6
1	5-4-60	1345	SM		2	Truckload	1024	16 ft × 8 ft × 4 ft	12,575	58.8	From storage in Ice House
1	5-9-60	1346	Sleeve				1	1 ft × 1 ft × 1 ft	10	58.8	
1	5-23-60	1347	SM				1	1 ft × 1 ft × 1 ft	100	58.8	
1	5-27-60	1348	1 case, 2 carriers		1	Case	18	3 ft × 2 ft × 3 ft	300	58.1	
1	5-27-60	1348	1 case, 2 carriers		2	Carriers	18	3 ft × 2 ft × 3 ft	300		
1	6-14-60	1578	SP				0.125	6 in. × 6 in. × 6 in.	50	58.1	
1	6-21-60	None	S	Contamination (unknown type)			Negligible		Negligible	58.1	
1	6-22-60	1579	SM	Aluminum, graphite, plaster, phenolic, rubber			56	2 ft × 2 ft × 14 ft	1875	56.1	
1	7-7-60	1580	Scrap	Tungsten carbide and tungsten alloy	8	Boxes	21.875	12 1/2 in. × 10 1/2 in. × 36 in.	11,400	55.0	8 each boxes large size from SM-38 carpenter shop
1	7-7-60	1580	Scrap	Tungsten carbide and tungsten alloy	1	Box	12.7	21 1/2 in. × 20 in. × 7 ft1 in.	11,400		8 each boxes large size from SM-38 carpenter shop
1	8-1-60	1582	Film, x-ray	Film			60	5 ft × 4 ft × 3 ft	300	54.8	
1	8-2-60	1583	Film, x-ray	Film	33	Boxes	33 (2.625)	18 in. × 18 in. × 14 in.	6900	49.8	
1	8-2-60	1583	Film, x-ray	Film	33	Boxes	86.6	18 in. × 18 in. × 14 in.	6900		
1	8-2-60	1584	SM	Aluminum and steel			4.4	20 in. × 16 in. × 24 in.	100	49.7	
1	8-3-60		Alpha sources		2	Each				50.0	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
1	8-8-60	1590	Inert objects		26	Boxes	26 (1.7778)	16 in. × 12 in. × 16 in.	700	48.4	
1	8-8-60	1590	Inert objects		26	Boxes	46.2	16 in. × 12 in. × 16 in.	700		
1	8-16-60	1592	SM						20	48.3	
1	8-17-60	1594	Cones						100	48.2	
1	8-17-60	1594	SM						100		
1	8-17-60	1594	SM						100		
1	8-17-60	1595	SP		300	Grams			0.7	48.2	
1	8-29-60	1596	SM	Copper					5	48.2	
1	9-9-60	1586	SM				27		1000	47.2	
1	9-27-60	1352	SM		27	Pieces			975	45.9	
1	10-7-60	1354B	Cones						1	45.8	
1	10-7-60	1354B	Cylinders						1		
1	10-7-60	1354B	SM						1		
1	10-26-60	1361B	Film, radiographic	Film			25		1000	45.0	
1	12-15-60	1372B	SM						100	44.8	
1	1-16-61	1375B	Scrap pieces	D-38					69	44.7	
1	1-20-61	1375B	Scrap pieces	D-38					69		
1	1-23-61	1606B	Scrap	D-38					50	44.7	
1	1-24-61	1608B	SM						250	44.3	
1	2-21-61	1617B	Scrap pieces	D-38					50	44.2	
1	2-24-61	1619B	Scrap pieces	D-38					150	44.0	
1	2-24-61	1620B	Scrap pieces	D-38					75	43.9	
1	3-10-61	1876B	SP							43.9	
1	3-15-61	1878B	Cable harness assemblies						251	43.6	
1	3-17-61	1877B	SP						200	43.3	
1	3-20-61	1879B	Inert objects						350	42.8	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
1	3-21-61	None	Film	Film					2000	39.9	
1	3-29-61	1628B	Unit						1016	38.5	
1	4-4-61	1629B	SP				27		1000	37.5	
1	6-14-61	1708B	Film, x-ray	Film			8		325	37.3	
1	6-19-61	1709B	SP						5	37.3	
1	6-28-61	1891B	SP		19	Units			190	36.0	
1	7-25-61	2036B	Radioactive solid waste	Radioactive solid waste	7	Drums			638	35.4	
1	8-2-61		S	Film			1		35	35.4	
1	8-17-61	1893B	Radioactive solid waste, (from Silas Mason on RR-36734, 8/22/61)	Radioactive solid waste	2	Drums			90	35.3	
1	9-19-61	1894B	Film, x-Ray	Film			20		900	34.4	
1	9-27-61	2061B	SM						29,580	6.0	
2	10-17-61	2068B	SM						2655	55.8	
2	11-1-61	2040B	SM	D-38					240	55.5	
2	11-7-61	2041B	Scrap pieces	D-38					100	55.3	
2	11-17-61	2044B	Container	SS					20	55.3	
2	11-28-61	2076B	SM						10	55.3	
2	11-28-61	2080B	SM						25	55.2	
2	12-21-61	2081B	Assorted plastic parts	Plastic					4500	48.2	
2	2-20-62	2091B	Scrap pieces	D-38					300	47.7	
2	2-21-62	2095B	SM						200	47.4	
2	3-2-62	2100B	SM	D-38					100	47.3	
2	3-26-62	1856B	SM						50	47.2	
2	3-28-62	1861B	SM		1	Lot			3725	45.0	
2	3-28-62	1861B	X-ray film	Film	14	Boxes	35		1400	39.2	
2	3-28-62	1865B	Film, 16 mm	Film					10	39.2	
2	5-31-62	3078B	SM	D-38					400	38.5	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
2	6-6-62	3082B	Module, support blocks						15	38.5	
2	6-8-62	3083B	Scrap pieces	D-38					100	38.3	
2	6-27-62	3088B	SM						500	37.6	
2	6-27-62	3089B	Various components	Graphite					1000	36.0	
2	7-5-62	3094B	SM	D-38			4		175	35.8	
2	7-17-62	3097B	SM		1	Lot	160		3075	33.0	
2	7-17-62	3097B	X-ray film	Film	10	Box	160		3075		
2	8-3-62	3030B	SM	D-38	3	Barrels	6		225	32.8	
2	8-9-62	3033B	SM		5	Boxes			280	32.5	
2	8-17-62	3035B	X-ray film	Film	21	Boxes			2100	30.6	
2	8-22-62	3037B	Air masks, oxygen, not classified		4	Each				30.6	
2	9-4-62	3038B	SM	Graphite	1	Package			100	30.5	
2	9-5-62	3040B	SM		2	Pieces			1000	29.6	
2	9-12-62	3053B	SM		2	Pieces			150	29.5	
2	9-13-62	3054B	SM	Graphite	5	Barrels, packing			400	29.1	
2	9-20-62	3055B	Reflector cylinder	Graphite	1	Each			500	28.6	
2	9-25-62	3056B	Support disc		1	Each			1500	27.3	
2	9-28-62	3058B	SM		18	Each			200	27.1	TA-16-27
2	9-28-62	3058B	SM		4	Each			200	27.1	TA-16-10
2	10-12-62	3046B	SM		1	Box			100	27.0	
2	10-25-62	3061B	SM	D-38	3	Barrels, packing			400	26.6	
2	10-31-62	3063	SM	D-38	6	Barrels, packing			600	26.1	
2	11-16-62	3047B	Various components	Graphite	60	Pieces			3074	23.2	
2	11-16-62	3047B	Various components	Graphite	3	Boxes			3074	0.0	
2	11-29-62	3050B	SM		8	Drums			2099	21.3	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
2	11-29-62	3050B	SM		3	Boxes			2099	0.0	
2	12-4-62	3067B	Carriers		1	Lot			1575	19.9	TA-16, S-Site
2	12-4-62	3067B	SM		1	Lot			1575		TA-16, S-Site
2	12-4-62	3067B	Molds		1	Lot			1575		TA-16, S-Site
2	1-2-63	3068B	Carrying case		1	Each			1	19.8	
2	1-4-63	3069B	Film, x-ray	Film			50		1080	18.9	
2	1-22-63	2705B	SM	D-38 and scrap	2	Boxes			50	18.8	
2	2-5-63	2715B	Foils and prints		4	Boxes			200	18.6	
2	2-8-63	2718B	SM	Graphite	1	Box			5	18.6	
2	2-14-63	2720B	SM	Styrofoam	5	Boxes			20	18.6	
2	2-19-63	2780B	SM	D-38	6	Barrels, packing			400	18.2	
2	3-6-63	2777B	SP	Rubber	1	Each			5	18.2	
2	3-14-63	2779B	SM		1	Lot			7950	10.9	
2	3-22-63	2781B	SM	Cold and D-38	4	Boxes			150	10.8	
2	3-29-63	2784B	SM	D-38	2	Boxes			80	10.7	
2	3-29-63	2785B	SM	D-38	4	Drums			250	10.5	
2	3-29-63	2785B	SM	Aluminum	1	Drums			250		
2	4-2-63	2786B	Tubes	Aluminum	6	Tubes	0.153	56 in. × 1 in.	5	10.5	
2	4-2-63	2786B	SM	Graphite					5		
2	4-4-63	2787B	SP		1	Lot			15	10.5	
2	4-5-63	2789B	SM	D-38	4	Drums			225	10.2	
2	4-16-63	2792B	SP	Graphite	5	Boxes			200	10.1	
2	5-9-63	2151B	X-ray film	Film	1	Lot			4350	6.1	
2	5-9-63	2151B	SM		1	Lot			4350		
2	5-15-63	2155B	D-38 and cold stock	D-38 and cold stock	2	Boxes			68	6.0	
3	6-4-63	2156B	1 unit		1	Drums			250	59.7	55 gal
3	6-5-63	2157B	Lithium fluoride PBX	Lithium fluoride PBX					4408	53.6	
3	6-10-63	2158B	D-38	D-38	4	Package			185	53.3	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
3	6-24-63	2162B	S/N Units		13	Each			100	53.2	
3	7-1-63	2164B	SM	D-38 graphite					400	52.6	
3	7-1-63	2165B	SM	D-38 graphite	3	Boxes			100	52.5	
3	7-3-63	2166B	SM	D-38	18	Barrels, packing			2125	49.6	
3	7-16-63	2816B	SM		1	Box			25	49.5	
3	7-16-63	2817B	SM		38	Each			1475	47.5	
3	7-17-63	2712B	Tank, "Cambridge Corp.", Model A S/N-B-30116		1	Each			2500	44.1	
3	7-24-63	2102B	Slides	Glass	92 (total)	Each			10	44.1	
3	7-24-63	2102B	Slides	Glass	67	Each		3 1/4 × 4 in.	10		
3	7-24-63	2102B	Slides	Glass	25	Each		4 in. × 5 in.	10		
3	7-31-63	2819B	SM		2	Cans			250	43.7	
3	8-1-63	2103B	Film, x-ray (60 each cartons)	Film	2	Lots			3300	39.2	
3	8-23-63	2105B	Film, x-ray (56 each cartons)	Film	2	Lots			2800	35.3	
3	8-23-63	2821B	SM						400	34.8	
3	8-23-63	2822B	SM						35	34.7	
3	8-27-63	2107B	SM	Aluminum and SS	1	Unit			1200	33.1	
3	8-27-63	2107B	SM	D-38	1	Unit			1200		
3	8-28-63	2823B	SM	D-38	2	Boxes			95	32.9	
3	9-6-63	2824B	SM	Beryllium	1	Box			13	32.9	
3	9-16-63	2108B	Modules, unfinished, tie rod	D-38					195	32.7	
3	9-17-63	2825B	S/N units		6	Each			100	32.5	
3	9-17-63	2825B	SP		1	Box			100		
3	9-18-63	2177B	SP	Graphite	1	Lot			150	32.3	
3	9-20-63	2110B	SM	Beryllium	1	Lot			25	32.3	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
3	9-20-63	2178B	SM	Graphite and metal	1	Box			10	32.3	
3	9-26-63	2126B	SM		2	Boxes			25	32.2	
3	9-27-63	2179B	SM	Metal	1				350	31.8	
3	9-30-63	2180B	SP	HE	1	Lot			375	31.2	
3	10-1-63	2181	SP		14	Each			1	31.2	
3	10-2-63	2127B	Film x-ray	Film	31	Box			1500	29.2	
3	10-17-63	2128	SM		41	Each			250	28.8	
3	11-13-63	2184	SM		1	Box			150	28.6	
3	11-13-63	2187	SM		1	Package			125	28.4	
3	11-13-63	2187	SM		2	Boxes			125		
3	12-4-63	2190	SM	Metal	1	Lot			900	27.2	
3	12-4-63	2190	SP	Film	6	Boxes			900		
3	1-10-64	2194	SM		3	Boxes			207	26.9	
3	1-16-64	2197	SM		2	Each			7	26.9	
3	1-29-64	2129	SP	Film	9	Cartons			300	26.5	
3	2-11-64	2143	SM	D-38	15	Drums			1400	24.6	
3	2-11-64	2182	Y tubes		1	Lot			75	24.5	
3	2-11-64	2182	Serial numbered items		19				75		
3	2-14-64	2146	SM	D-38	6	Drums			342	24.0	
3	3-6-64	2150	SM	D-38	41	Each			2000	21.2	
3	3-23-64	2119	SM	Titanium and steel	10	Each			25	21.2	
3	3-24-64	2120	SP	Graphite	3	Boxes			200	20.9	
3	5-7-64	2135	SP	HE contaminated	1	Lot			600	20.1	
3	5-14-64	2476	SM	D-38 and cold stock	2	Package			200	19.8	
3	5-14-64	2476	SM	D-38 and cold stock	2	Boxes			200		
3	5-15-64	2174	SP	Graphite	3	Boxes			75	19.7	
3	5-21-64	2478	SP		1	Box			25	19.7	
3	5-27-64	2479	SP	Graphite	13	Boxes			400	19.1	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
3	6-11-64	2352	SP	Aluminum	1	Lot			150	18.9	
3	6-15-64	2353	SP	Graphite	I	Lot			1000	17.6	
3	6-23-64	2134	SM		7	Each			465	16.9	
3	7-13-64	2482	SM		1	Package			10	16.9	
3	7-21-64	2483	SM		2	Boxes			400	16.4	
3	7-24-64	2487	SM	Steel and aluminum	6	Boxes			300	15.9	
3	7-27-64	2357	SP	Film	6	Boxes			700	15.0	
3	7-27-64	2488	SP		4	Drums			300	14.6	
3	8-4-64	2490	SP		2	Drums			200	14.3	
3	8-4-64	2491	SP		1	Lot			250	13.9	
3	10-14-64	2533	Fuel elements	Fuel elements	2	Package			75	13.8	
3	10-23-64	2537	Unloaded fuel elements	Fuel elements, unloaded	1	Box			30	13.8	
3	10-30-64	2538	Scrap	Graphite	I	Lot			200	13.5	
3	11-5-64	2542	SP	Graphite	1	Package			5	13.5	
3	11-6-64	2541	SP		1	Each			400	13.0	
3	11-11-64 and 11-12-64	2545	SP	Graphite					3500	8.2	
3	11-12-64	2544	SM	D-38					200	7.9	
3	11-16-64	2547	SP	HE contaminated					1200	6.2	
3	11-19-64	2550	Fuel elements	Fuel elements					150	6.0	
4	12-23-64	2557	SP		1	Box			15	60.0	
4	1-6-65	2560	SP		2	Lots			350	59.4	
4	1-19-65	2563	SP	Graphite	9	Drums			1000	57.9	
4	1-20-65	2564	Cold stock and D-38	Cold stock and D-38	5	Containers			250	57.6	
4	1-27-65	2567	SP	D-38, lithium, etc.	1	Lot			75	57.4	
4	2-18-65	2367	X-ray film, 15 cartons	Film	1	Lot			500	56.7	
4	3-1-65	2583	SP		1	Lot			10	56.7	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
4	3-5-65	2587	Hedgehog train units and detonators	Detonators	1	Lot			600	55.8	
4	3-23-65	2593	SP		1	Lot			350	55.2	
4	4-6-65	2597	SP	Graphite	4	Drums			350	54.7	
4	4-6-65	2599	Cold stock and D-38	Cold stock and D-38	1	Lot			400	54.1	
4	4-16-65	3352	SP		1	Box			75	54.0	
4	5-4-65	3362	SP		1	Lot			250	53.6	
4	5-5-65	3364	Fuel elements	Fuel elements	8	Bundles			100	53.4	
4	5-20-65	3356	X-ray film	Film	31	Boxes			1700	50.9	
4	5-29-65	3357	SP	Graphite	1	Lot			200	50.6	
4	7-14-65	3372	SP	Graphite	3	Boxes	6		120	50.4	Trash boxes
4	7-14-65	3375	SP		5	Drums			380	49.8	
4	7-15-65	3374	Ring and slug assemblies		1	Drums	7.35		750	48.7	55-gal. drum
4	7-20-65	3377	SP		1	Lot			2000	45.6	
4	7-21-65	3359	Graph and D-38	Graph and D-38	8	Boxes			50	45.6	
4	8-10-65	3378	SP	Contains U-235	2	Boxes	1		250	45.2	
4	8-18-65	3382	Tritium cont	Tritium cont	1	Unit	0.5		15	45.2	
4	8-25-65	3360	SP		6	Units			50	45.1	
4	9-3-65	3384	Cold scrap and D-38	Cold scrap and D-38	6	Boxes			250	44.7	
4	9-20-65	3386	Photos	Film	5	Boxes			100	44.6	
4	9-20-65	3386	Fuel elements	Fuel elements	5	Boxes			100		
4	9-23-65	3388	SP		1	Lot			150	44.3	
4	9-30-65	3391	SP	Tritium cont	2		0.5		20	44.3	
4	10-1-65	3392	SP		11	Boxes			175	44.0	
4	10-14-65	3393	SP	HE contaminated	1	Load			3850	38.2	
4	10-25-65	3394	Fuel elements (unloaded and D-38)	Fuel elements (unloaded and D-38)	1	Lot			850	36.9	
4	10-26-65	3502	SM	SS- Be	2	Drums	7.35		100	36.8	25-gal. drums

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
4	11-4-65	3395	SP		1	Truckload			2500	33.0	
4	11-17-65	3397	SP	Magnesium	2	Each			3	33.0	
4	11-23-65	3398	Unload fuel elements (scrap)	Fuel elements, unload	9	Containers			100	32.8	
4	11-23-65	3399	SP		4	Boxes			250	32.5	
4	11-23-65	3503	SM	D-38	2	Drums			175	32.2	
4	1-5-66	3504	SM		2	Drums			100	32.0	
4	1-5-66	3504	SM		1	Box			100		
4	1-28-66	3426	Cold stock and D-38	Cold stock and D-38	4	Boxes			150	31.8	
4	1-28-66	3427	Fuel elements	Fuel elements	5	Boxes			250	31.4	
4	1-28-66	3428	S	Contaminated	3	Boxes	1.5		75	31.3	
4	1-28-66	3430	SM	Tritium	2 1	Boxes box			30	31.3	From TA-41
4	2-4-66	3433	Unloaded fuel elements	Fuel elements, unloaded	3	Boxes			100	31.1	
4	2-18-66	3435	SP	HE cont	1	Truckload			2900	26.7	
4	2-25-66	3436	Fuel elements (unloaded) and scrap	Fuel elements, unloaded	5	Boxes			225	26.4	
4	2-25-66	3437	SP		2	Boxes			75	26.3	
4	3-1-66	3438	SP	Graphite	4	Drums			400	25.7	
4	3-10-66	3441	Fuel elements - unloaded	Fuel elements, unloaded	9	Each			20	25.6	
4	4-4-66	3509	Keys		1	Box			100	25.5	
4	4-6-66	3446	S	Paper	5	Plastic bag					
4	4-12-66	3448	SP		15	Boxes			450	24.8	
4	4-13-66	3508	Radiographic film	Film	12	Cartons	96		3000	20.3	
4	4-21-66	3447	SP	Graphite	15	Drums			1500	18.0	
4	5-2-66	3449	Fuel elements - scrap	Fuel elements	9	Boxes			750	16.9	
4	5-4-66	3450	SM		2	Drums			75	16.7	
4	5-5-66	3451	Miscellaneous scrap		5	Boxes			250	16.4	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
4	5-31-66	3453	SM	Tritium cont	1	Each	0.1		15	16.3	
4	5-31-66	3455	SM		10	Drums			500	15.6	
4	6-2-66	3454	SM		2	Drums			100	15.4	
4	6-15-66	3510	Scrap	D-38	9	Bundles			250	15.0	
4	6-15-66	3510	Scrap	D-38	4	Boxes			250		
4	6-22-66	3457	Radiographic film	Film	118	Boxes			4120	8.8	
4	6-22-66	3458	SM	Aluminum and D-38	1	Drums			25	8.8	
4	6-24-66	3459	SM		2	Boxes			650	7.8	
4	7-28-66	3513	Module clamps		1	Box			75	7.7	
4	8-9-66	3462	SM	Lithium hydride	8	Boxes			400	7.1	
4	8-16-66	3463	Cold stock and D-38	Cold stock and D-38	3	Boxes			200	6.8	
4	8-16-66	3464	SM		7	Boxes			250	6.4	
4	8-29-66	3407	SM		11	Boxes			255	6.0	
5	10-7-66	3467	SM	Graphite	6	Drums			620	59.4	
5	10-13-66	3468	Unloaded fuel elements	Fuel elements, unloaded	5	Boxes			200	59.2	
5	10-13-66	3470	SM	D-38, SS, and aluminum	3	Drums			80	59.1	
5	10-13-66	3869	Unloaded fuel elements and scrap	Fuel elements, unloaded	14	Boxes			525	58.6	
5	11/66	3533	Glass-mounted slides		1	Lot			700	57.9	
5	11-9-66	3473	SP		1	Lot			600	57.3	
5	12-1-66	3497	SP	Graphite					1000	56.3	Conf. R.D.
5	12-2-66	3474	SM	D-38					25,925	30.7	
5	12-6-66	3521	SM						350	30.3	
5	12-14-66	2499	SM						75	30.2	
5	12-14-66	3500	SM	D-38					10	30.2	
5	12-15-66	3527	SM						360	29.9	
5	12-19-66	3475	SM		1	Box			175	29.7	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
5	12-19-66	3528	D-38 impregnated fuel elements	Fuel elements, D-38 impregnated	10	Boxes			200	29.5	
5	12-19-66	3529	Unloaded fuel elements	Fuel elements, unloaded	3	Boxes			150	29.4	
5	1-12-67	3532	Fuel elements	Fuel elements	1	Box			30	29.3	
5	1-16-67	3585	Unloaded fuel elements	Fuel elements, unloaded	3	Each			5	29.3	
5	1-26-67	3524	SM	HE contaminated					400	28.9	
5	1-27-67	3587	SM	Graphite					3	28.9	
5	1-30-67	3538	SM						15	28.9	
5	2-3-67	3540	SM	S/Ns					174	28.7	
5	2-27-67	3525	SM	Graphite					3300	25.5	
5	2-28-67	3544	Records	Pu contaminated					25	25.5	
5	4-12-67	3547	Cold scrap and D-38	Cold scrap and D-38	9	Boxes			325	25.1	
5	4-19-67	3551	SM	Aluminum, SS, titanium	1	Lot			400	24.7	
5	4-24-67	3552	Fuel elements, unloaded and 38	Fuel elements	6	Each			10	24.7	
5	4-28-67	3591	Scrap fuel elements	Fuel elements	13	Cartons			410	24.3	
5	5-5-67	3592	Unloaded fuel elements	Fuel elements, unloaded	4	Cartons			160	24.2	
5	5-10-67	3553	SM		1	Lot			150	24.0	
5	5-15-67	3554	SM	D-38	4	Drums			180	23.8	
5	5-19-67 thru 6-8-67	3566	Obsolete reactor parts and hardware						10,655	13.3	
5	6-15-67	3560	SM	Fuel elements	7	Boxes			225	13.1	
5	7-18-67	3562	SM		1	Lot			600	12.5	
5	9-6-67	3567	SM	Graphite	8	Boxes			400	12.1	
5	9-7-67	3568	SM	Depleted uranium	1	Lot			250	11.8	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
5	9-20-67	3570	Unloaded fuel elements	Fuel elements, unloaded	11	Boxes			660	11.2	
5	9-27-67	3572	SM	HE contaminated	1	Lot			5200	6.0	
5	11-11-67	3531	Fuel elements and modules, unloaded and D-38	Fuel elements, unloaded and D-38	1	Lot			35	6.0	
6	7-12-67	6550B	SM		1	Lot			2575	56.2	
6	10-9-67	6478	SM	HE cont	2	Loads			18,425	28.6	
6	10-17-67	6477	Mounted slides	Glass	4	Boxes			50	28.5	
6	10-26-67	3573	SM		2	Drums			250	28.2	
6	11-10-67	6481	SM		8	Boxes			175	27.9	
6	11-10-67	6482	SM		1	Lot			150	27.7	
6	11-16-67	3574	Scrap	Graphite	4	Drums			400	27.1	
6	12-1-67	3575	Graphite fuel elements	Fuel elements, graphite	6	Boxes			275	26.7	
6	1-16-68	2524	Cold scrap and D-38	Cold scrap and D-38	9	Bundles			600	25.8	
6	1-16-68	2524	Cold scrap and D-38	Cold scrap and D-38	5	Boxes			600		
6	1-16-68	6530	Scrap	D-38 graphite	6	Drums			450	25.1	
6	1-18-68	6582	SM		1	Garbage can			100	25.0	
6	2-7-68	None	SM		3	Boxes			80	24.8	
6	2-20-68	6535	SM		12	Drums			1500	22.6	
6	2-20-68	6536	SM		13	Boxes			550	21.8	
6	2-27-68	6537	SM	HE cont	1	Box			25	21.7	
6	2-27-68	6538	SM	HE cont	1	Truckload			2425	18.1	
6	3-8-68	6542	SM		6	Drums			200	17.8	
6	4-17-68	6545	SM		3	Boxes			125	17.6	
6	5-7-68	6492	Fuel elements, 500 each	Fuel elements	18	Boxes			1000	16.1	
6	5-8-68	6546	SM	D-38	4	Drums			75	16.0	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
6	5-8-68	6546	SM	D-38	2	Cans			75		
6	5-23-68	6495	Shells - expended - mortar		4	Each			20	16.0	
6	5-24-68	6551	SM	Aluminum	42				225	15.7	
6	7-10-68	6549	Unloaded fuel elements	Fuel elements, unloaded	9	Boxes			475	14.9	
6	7-16-68	6301	SM						40	14.9	
6	7-22-68	2525	Cold scrap and D-38	Cold scrap and D-38	12	Bundles			1000	13.4	
6	7-22-68	2525	Cold scrap and D-38	Cold scrap and D-38	6	Boxes			1000		
6	8-1-68	6554	Depleted uranium	Depleted uranium	11	Drums			513	12.6	
6	8-1-68	6551A	SP		1	Box			30	12.6	
6	8-8-68	6555B	SP		1	Box			30	12.5	
6	8-29-68	6304	SP	Containing D-38	4	Drums			500	11.8	
6	9-23-68	6305	SP		1	Lot			100	11.6	
6	12-3-68	6307	SM	Metal	2	Each			500	10.9	
6	12-17-68	6308	SM	Aluminum, SS, Tuballoy					225	10.6	
6	12-17-68	6309	SM	SS, copper, beryllium					75	10.4	
6	1-13-69	6564	Fuel elements	Fuel elements	15	Boxes			900	9.1	
6	1-31-69	6566B	Documents		1	Box			35	9.0	
6	2-5-69	6567B	SM		3	Drums			750	7.9	
6	2-12-69	6311	SM	HE cont					1000	6.4	
6	2-25-69	6312	Scrap fuel elements	Fuel elements	1	Lot			75	6.3	
6	2-25-69	6313	SM						200	6.0	
6	3-6-69	6314	S	Glass					10	6.0	
7	3-20-69	6316	SM	D-38					10	60.0	
7	3-21-69	6317	SM	D-38 and cold stock and D-38					325	59.5	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
7	3-21-69	6318	Obsolete parts						200	59.3	Part of GMX-7 material disposed of in Hot Dump
7	3-27-69	6319	Cold stock and D-38	Cold stock and D-38		Can			500	58.6	
7	4-4-69	6320	Miscellaneous scrap	60 kg D-38					250	58.2	
7	4-7-69	6321	SM						150	58.0	
7	4-29-69	6570	Fuel elements	Fuel elements					500	57.3	
7	6-13-69	6876	S	Film	8	ft				57.3	
7	6-18-69	6322	Scrap	D-38					750	56.3	
7	7-3-69	None	Obsolete, damaged, etc., seals (government security)						125	56.1	
7	8-5-69	6881	SP						6575	46.9	
7	8-19-69	None	Obsolete, damaged, etc., seals (government security)						25	46.9	
7	8-29-69	6325	SM		3	Drums			150	46.7	
7	9-19-69	6885	SP	Fuel elements, graphite	7	Boxes			500	46.0	
7	9-19-69	6886	SP	Fuel elements, graphite	1	Package			35	45.9	
7	9-25-69	6887	Machine gun, spare barrels, and other components						25	45.9	
7	9-30-69	6858	S						20	45.9	
7	10-1-69	6883	SM	Beryllium					25	45.8	
7	10-3-69	6889	SP	Plastic	3	Boxes			150	45.6	
7	10-9-69	6888	Samples	D-38 etc.					1753	43.2	
7	10-23-69	6891	SM		1	Lot			1000	41.8	
7	10-26-69	6894	SM	Pu contaminated	4	Drums			100	41.7	
7	11-14-69	6895	GBV		8	Units			5	41.7	
7	11-26-69	6897	SM	Pu contaminated	7	Drums			175	41.4	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
7	12-18-69	6899	SM	Graphite D-38	1	Lot			400	40.9	
7	12-24-69	6900B	Slides - #635262, 65, 68, and 70		1	Box			5	40.9	
7	1-9-70	6926B	Data processing sheets		1	Box			20	40.8	
7	1-9-70	6927B	SP	Graphite	2	Boxes			200	40.5	
7	1-9-70	6928B	S		1	Box			20	40.5	
7	1-9-70	6929B	SM	D-38 and other	5	Drums			200	40.2	
7	1-19-70	6930B	Shredded drawings		1	Lot			150	40.0	
7	1-19-70	6931B	SP		1	Each			150	39.8	
7	1-19-70	6932B	Tubes		8	Each			5	39.8	
7	2-3-70	6862B	SP	Graphite					1000	38.4	
7	2-10-70	6934B	SP		2	Boxes			40	38.4	
7	2-18-70	6936B	SP	Steel and copper	4	Boxes			150	38.2	
7	2-18-70	6936B	SP		4	Boxes			150		
7	2-19-70	6454	SP		1	Lot			3000	34.0	
7	2-19-70	6454	Vessels		13	Each			3000		
7	3-6-70	6942	SP	Fuel elements, graphite	3	Lots			7675	23.3	
7	3-12-70	6865	SP	HE contaminated					500	22.6	
7	3-16-70	6939	SM	D-35	6	Boxes			150	22.4	
7	3-19-70	6941	Slides, mounted	Glass	5	Each			5	22.4	
7	3-19-70	6943	SP		1	Lot			600	21.6	
7	4-6-70	6945	Lantern slides		35	Each			5	21.5	
7	4-7-70	6946	SP	Fuel elements, graphite	20	Boxes			800	20.4	
7	4-7-70	6947	SP		3	Drums			150	20.2	
7	4-7-70	6947	SP		1	Box			150		
7	4-15-70		Mounted slides, etc.	Glass					25	20.2	
7	4-20-70	6948	SP						350	19.7	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
7	5-8-70	6820	SP		1	Each				19.7	
7	5-8-70	6869	SP		2	Barrels			1000	18.3	
7	5-11-70	6870	Keys and cores	Keys and cores	1	Lot			275	17.9	
7	5-20-70	6906	SP		1	Each			1377	16.0	
7	5-25-70	6457	SP		5	Each			35	16.0	
7	7-8-70	6907	SP		1	Each			10	15.9	
7	7-22-70	6909	SP	Lithium hydride	2	Containers			1	15.9	
7	8-4-70	6954	Magnetic tape recordings		8	C/B boxes			200	15.7	
7	8-5-70	6913	SP	HE contaminated	1	Lot			2075	12.8	
7	9-17-70	6957	X-units with load coil assemblies		86	Each			2150	9.8	
7	9-29-70	6458	SP		3	Boxes			100	9.6	
7	10-23-70	6459	Transmitters, receivers, covers, and miscellaneous items						150	9.4	
7	11-10-70	6917	Klystrons		3	Each			5	9.4	
7	12-11-70	6964	SP		1	Garbage can			100	9.3	
7	1-29-71	6965B	Slides and signs		1	Lot			5	9.3	
7	1-29-71	6966B	Slides and negatives		1	Lot			25	9.3	
7	2-17-71	3183B	SP						25	9.2	
7	2-19-71	6976B	Scrap fuel elements (unloaded)	Fuel elements, (unloaded)					50	9.1	
7	2-19-71	6976B	Radiographic plates						50		
7	4-1-71	3412B	SP	Inert HE	1	Lot			1600	6.9	
7	5-10-71	3414B	SP		1	Box			75	6.8	
7	5-11-71	3413B	Test sets		18	Each			25	6.8	
7	6-4-71	3418B	Slides (Jane Hall collection)		1	Lot			40	6.7	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
7	8-24-71	6464B	Squibs and miscellaneous items		1	Lot			500	6.0	
7	9-8-71	5804B	SP		1	Lot			20	6.0	
8	10-4-71	5810B	SM	Steel	1	Box			40	59.9	
8	11-22-71	6467	SM		7	Each			100	59.8	
8	11-22-71	5814B	Source, dummy neutron		3	Each				59.8	
8	12-3-71	5816	SP	HE contaminated	1	Load			5475	52.1	
8	12-6-71	5815	SP		2	Garbage can			75	52.0	
8	3-22-72	5857	SP		1	Box			20	52.0	
8	3-24-72	5858	S	Paper	1	Box			50	51.9	
8	4-7-72	5859	Recorder charts and paper		3	Boxes			50	51.9	
8	5-12-72	5864	SP		3	Garbage can			200	51.6	
8	5-31-72	5865	S		1	Box			50	51.5	Contaminated by association with U-235
8	7-13-72	5875	S		36	Each			3	51.5	
8	8-7-72	5655	SP		1	Lot			75	51.4	
8	8-15-72	5656	SP		1	Lot			2060	48.5	Possible declassified
8	8-15-72	5656	Load rings and components		1	Lot			2060		Possible declassified
8	8-30-72	5657	Mylar tape	Mylar	1	Box			10	48.5	
8	8-30-72	5658	SP		2	Boxes			15	48.5	
8	9-25-72	5662	SP		5	Boxes			150	48.3	
8	11-9-72	5666	SM		3	Cans	14.0		400	47.7	35 gal.
8	11-15-72	5670	Voice tapes (recordings)		64	Rolls			75	47.6	
8	1-29-73	6256	Slides (negatives)	Film	11	Each		4 in. × 3 1/4 in.	1	47.6	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
8	2-21-73	3189	Miscellaneous metal parts		1	Lot			500	46.9	
8	3-2-73	6992	Analogue computer tapes	Computer tape	1	Lot			1200	45.2	
8	3-6-73	7260	SP		11	Boxes			300	44.8	
8	3-14-73	7264	SP		1	Lot			150	44.6	
8	3-28-73	7265	SP.		1	Lot			150	44.4	
8	4-13-73	3190	Silos, remnants of silo program		16	Each			15	44.4	
8	4-13-73	7267	S		1	Lot			60	44.3	
8	4-24-73	3191	SP		9	Each			300	43.8	
8	4-24-73	3191	Silo parts display		1	Each			300		
8	4-24-73	3191	SP		1	Container			300		
8	7-20-73	7357	SP		1	Lot			150	43.6	
8	7-26-73	7355	SP		1	Lot			50	43.6	
8	8-10-73	7358	Classified neg. slides (S-RD) per CD #61		8	Each			1	43.6	
8	10-18-73	7366	S		22	Each				43.6	
8	11-2-73	7362	Lithium boride material	Lithium boride	3	Cans	0.40		10	43.6	1 gal., metal
8	11-14-73	7367	Dies, pressing, LASL drawing # Y-4187-D		2	Units			80	43.4	
8	2-28-74	6473	1A and 1J valves (uncl.)		63	Each			300	43.0	
8	2-28-74	6473	SP		16	Each			300		
8	3-26-74	7372	SP		1	Lot			250	42.7	
8	5-10-74	7375	SP	Metal	1	Lot			20	42.6	
8	6-27-74	7333	SP		1	Lot			4175	36.8	
8	7-12-74	7331	S		3	Each			1	36.8	
8	7-16-74	7335	S		1	Lot			15	36.8	
8	7-16-74	7335	S		1	Lot			15		

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
8	8-8-74	6580	SP		1	Each			50	36.7	
8	9-11-74	6584	Part S/N 874A13-002		1	Each			5	36.7	
8	9-11-74	6584	Miscellaneous parts		1	Box			5		
8	9-24-74	7000	SP		3	Each			25	36.7	
8	9-30-74	7341	SP		1	Lot			10	36.6	
8	2-7-75	7285	SP	Lithium samples	74	Each			50	36.6	
8	4-24-75	7287	SP		6	Boxes			430	36.0	
8	5-16-75	7293	SP		56	Each			15	35.9	
8	9-23-75	8130	SP		1	Load			3000	31.7	
8	8-3-76	8149	SP		1	Lot			30	31.7	
8	8-23-76	7307	SP		1	Lot			1500	29.6	
8	10-1-76	7310	SP		1	Lot			5800	21.5	
8	11-16-76	7308	SP		1	Lot			2600	17.8	
8	11-16-76	7309	SP		1	Lot			3700	12.6	
8	11-16-76	7309	File safe, CL, 04D Legal, (LASL P/N 139515)	File safe	1	Each			3700		
8	12-14-76	7314	SP		2	Boxes			65	12.6	
8	9-29-77	8989	SP		1	Lot			2575	8.9	
8	7-10-79	9305	SP		5 ea.	Drums, metal			2000	6.1	
8	7-10-79	9305	SP		5 ea.	Drums, metal			2000		
8	7-16-79	9306	Part No. 422212		5	Each			100	6.0	
8	7-16-79	9306	Part No: 422213		5	Each			100		
9	7-23-80	9310	SP						70	59.9	
9	7-23-80	9311	SP						150	59.7	
9	7-23-80	9314	SP						300	59.2	
9	7-21-81	9036	SP						200	58.9	
9	12-8-81	9309B	SP						100	58.8	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
9	12-8-81	9318B	SP	LiH- 10g (+), Be – unknown amount, D-38 – unknown amount					15	58.7	From C&D information, 15 lb of LiH added based on Memorandum HSE7-86-78
9	12-8-81	9321B	SP	File system cartridges						58.7	From C&D information
9	1-19-82	9051B	SP						200	58.5	
9	1-21-82	9322B	SP						1000	56.9	
9	1-25-82	9052	SP						5810	48.1	
9	4-13-82	9023	SP								
9	4-13-82	9324B	SP						4000	42.1	
9	4-13-82	9325B	SP						4000	36.0	
9	8-17-82	9056B	SP						250	35.6	
9	1-5-83	9337B	SP	From C&D information –unknown from TA-41 - #W30					500	34.8	
9	6-8-83	9341B	SP	From C&D information Be					Unknown	0.0	
9	6-17-83	9343B	SP	From C&D information Be sample					Unknown	0.0	
9	10-16-84	12532	SP						5000	27.3	
9	1-8-85	12378	Computer tape—degaussed [3]	Computer tape			60		300	26.8	
9	1-31-85		6-drawer file with combo locks	File safe	1	Box			250	26.4	
9	1-31-85		Combination locks		1	Box			250		
9	2-28-85		Keys and cores	Keys/cores			2	~1 or 2 ft^3	75	26.3	
9	3-18-85	11707, 13290	Computer tape degaussed – 3 tapes/sack (50 lb per sack)	Computer tape	21	Sacks		15 in. × 7 in.	1000	24.8	

Table B-1.0-1 (continued)

Shaft No.	Date	Form 252-R	Nomenclature and/or Description	Materials	Quantity	Unit of Measure	Volume (ft^3)	Dimensions	Weight (lb)	Depth in Shaft*	Remarks
9	3-20-85	11882	Al_20_3 and SS parts - in sack	Al_20_3 and SS			1.337		40	24.7	10-gal. drum
9	9-24-85	9170B	S		7	Envelopes			141	24.5	
9	10-17-85	13375B	Computer disk packs—digital RPO6	Computer disk pack	16				80	24.4	
9	12-24-85		Keys, cores, locks	Keys and cores			6		400	23.8	
9	1-15-86		3 drawers (file) with boxes of combo locks	File and locks			10		200	23.5	~ 8–10 ft^3
9	3-25-86	12383B	Graphite w/motor oil	Graphite with motor oil	3	Drums	1.47		40	23.4	11 gal.
9	4-7-86	13310	Computer disk packs, disk pack platters	Computer disk pack						21.9	
9	4-7-86	13311	Computer disk packs, disk pack platters	Computer disk pack					1000		
9	5-8-86	12382	Computer disk pack	Computer disk pack			1		7	21.9	
9	7-22-86	10087	Computer disks pack, disk pack platters	Computer disk pack			90		200	21.6	
9	8-29-86	10088	Computer disk pack	Computer disk pack	4	Bags	8		200	21.3	

Notes: Blank cells indicate not recorded. S = scrap, SM = scrap metal, SP = scrap pieces, SS = stainless steel, D-38 = depleted uranium, cold stock = nonradioactive materials, S/N = serial number or part number.

*Depth is based on average densities. Location within shafts is approximate based on mass except when known (measured) depths have been included for shafts 1 and 2.

Table B-2.2-1
Henry's Law Coefficients and Distribution Coefficients

Chemical	H' (dimensionless)	K_{oc} (L/kg)
Acetone	0.0016	1.98
Benzene	0.228	166
Butanol[1-]	0.00036[a]	2.44[a]
Butanone[2-]	0.0023	3.83
Carbon disulfide	0.59	1.00
Carbon tetrachloride	1.1	48.6
Chlorodifluoromethane	1.7	35
Chloroform	0.15	35
Cyclohexane	6.1[a]	166[a]
Dichlorodifluoromethane	14.0	48.6
Dichloroethane[1,1-]	0.23	35
Dichloroethene[1,1-]	1.1	35
Dichloropropene[1,2-]	0.12	67.7
Ethanol	na[b]	na
Ethylbenzene	0.323	518
Hexane	74	149
Methylene chloride	0.13	23.7
Propanol[2-]	na	na
Tetrachloroethene	0.72	107
Toluene	0.272	268
Trichloro-1,2,2-trifluoroethane[1,1,2-]	22.0	225
Trichloroethane[1,1,1-]	0.705	48.6
Trichloroethene	0.4	67.7
Trichlorofluoromethane	4.0	48.6
Xylene[1,2-]	0.213	443
Xylene[1,3-]+xylene[1,4-]	0.27	443

Note: Values from NMED 2009 (108070) unless otherwise noted.

[a] Value from Environmental Protection Agency regional screening level database (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[b] na = Not available (parameters for this constituent are not included in the EPA regional screening database because this constituent does not have a groundwater cleanup level).

Table B-2.3-1
Results of VOC Mass Inventory Estimate for MDA H

Chemical	Average Pore Gas Concentration (µg/m^3)	Calculated Bulk Concentration (µg/kg)	Mass Inventory (g)
Acetone	17.14	3.82E-01	4.27E+02
Benzene	6.55	5.16E-03	5.76E+00
Butanol[1-]	13.00	1.30E+00	1.45E+03
Butanone[2-]	4.20	6.72E-02	7.50E+01
Carbon disulfide	7.23	2.41E-03	2.69E+00
Carbon tetrachloride	10.55	3.45E-03	3.85E+00
Chlorodifluoromethane	19.00	5.78E-03	6.46E+00
Chloroform	36.57	2.26E-02	2.53E+01
Cyclohexane	28.89	8.42E-03	9.40E+00
Dichlorodifluoromethane	38.94	1.08E-02	1.21E+01
Dichloroethane[1,1-]	4.50	2.25E-03	2.51E+00
Dichloroethene[1,1-]	4.00	1.28E-03	1.43E+00
Dichloropropene[1,2-]	4.83	4.06E-03	4.54E+00
Ethanol	23.40	na*	na
Ethylbenzene	6.70	7.92E-03	8.84E+00
Hexane	15.55	4.28E-03	4.78E+00
Methylene chloride	4.60	2.89E-03	3.23E+00
Propanol[2-]	19.50	na	na
Tetrachloroethene	6.55	2.59E-03	2.89E+00
Toluene	14.01	1.25E-02	1.40E+01
Trichloro-1,2,2-trifluoroethane[1,1,2-]	18.95	5.32E-03	5.94E+00
Trichloroethane[1,1,1-]	43.03	1.54E-02	1.71E+01
Trichloroethene	6.89	3.06E-03	3.42E+00
Trichlorofluoromethane	37.13	1.07E-02	1.20E+01
Xylene[1,2-]	4.10	6.05E-03	6.75E+00
Xylene[1,3-]+xylene[1,4-]	7.47	9.12E-03	1.02E+01
Total			2.12E+03

Note: Values from NMED 2009 (108070) unless otherwise noted.

* na = Henry's law coefficient and/or partition coefficient were not available and concentration and inventory could not be calculated.

Table B-2.3-2
Calculated Bulk Concentrations and Mass Inventories by Chemical Class

Chemical	Bulk Concentration (µg/kg)	Mass Inventory (g)	Percent of Total Inventory*
Alcohols			
Butanol[1-]	1.30E+00	1.45E+03	69%
Halogenated Aliphatics			
Carbon tetrachloride	3.45E-03	3.85E+00	
Chlorodifluoromethane	5.78E-03	6.46E+00	
Chloroform	2.26E-02	2.53E+01	
Dichlorodifluoromethane	1.08E-02	1.21E+01	
Dichloroethane[1,1-]	2.25E-03	2.51E+00	
Dichloroethene[1,1-]	1.28E-03	1.43E+00	
Dichloropropene[1,2-]	4.06E-03	4.54E+00	
Methylene chloride	2.89E-03	3.23E+00	
Tetrachloroethene	2.59E-03	2.89E+00	
Trichloro-1,2,2-trifluoroethane[1,1,2-]	5.32E-03	5.94E+00	
Trichloroethane[1,1,1-]	1.54E-02	1.71E+01	
Trichloroethene	3.06E-03	3.42E+00	
Trichlorofluoromethane	1.07E-02	1.20E+01	
Subtotal	3.2E-02	1.01E+02	4.8%
Ketones			
Acetone	3.82E-01	4.72E+02	
Butanone[2-]	6.72E-02	7.50E+01	
Subtotal	2.7E+00	5.02E+02	24%
Nonhalogenated Aliphatics			
Carbon disulfide	2.41E-03	2.69E+00	
Cyclohexane	8.42E-03	9.40E+00	
Hexane	4.28E-03	4.78E+00	
Subtotal	9.4E-03	1.69 E+01	0.8%
Nonhalogenated Aromatic			
Benzene	5.16E-03	5.76E+00	
Ethylbenzene	7.92E-03	8.84E+00	
Toluene	1.25E-02	1.40E+01	
Xylene[1,2-]	6.05E-03	6.75E+00	
Xylene[1,3]+xylene[1,4-]	9.13E-03	1.02E+01	
Subtotal	2.4E-01	4.55E+01	2.2%
Total	1.0E+01	2.12E+03	100%

* Percentages are not calculated for individual chemicals.

Table B-2.3-3
Average Calculations by Analyte

Location	Depth (ft)	Date	Sample	Analyte	Result	Unit	2nd Qualifier
54-01023	10–15	6/8/2010	MD54-10-14362	Acetone	12	µg/m^3	—*
54-01023	150–155	6/8/2010	MD54-10-14365	Acetone	19	µg/m^3	—
54-01023	245–250	6/8/2010	MD54-10-14367	Acetone	15	µg/m^3	—
54-01023	258–263	6/8/2010	MD54-10-14368	Acetone	17	µg/m^3	—
54-15461	10–12	6/7/2010	MD54-10-14350	Acetone	25	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Acetone	20	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Acetone	11	µg/m^3	—
54-15462	258–263	6/7/2010	MD54-10-14359	Acetone	15	µg/m^3	—
54-15462	280–285	6/7/2010	MD54-10-14360	Acetone	17	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Acetone	14	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14361	Acetone	14	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Acetone	18	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Acetone	22	µg/m^3	—
54-609985	295–300	6/8/2010	MD54-10-14389	Acetone	21	µg/m^3	—
				Average	**17.14**		
54-01023	150–155	6/8/2010	MD54-10-14365	Benzene	3.1	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Benzene	10	µg/m^3	—
				Average	**6.55**		
54-15462	60–65	6/7/2010	MD54-10-14354	Butanol[1-]	13	µg/m^3	—
				Average	13		
54-01023	10–15	6/8/2010	MD54-10-14362	Butanone[2-]	2.7	µg/m^3	—
54-01023	150–155	6/8/2010	MD54-10-14365	Butanone[2-]	9.6	µg/m^3	—
54-01023	258–263	6/8/2010	MD54-10-14368	Butanone[2-]	2.6	µg/m^3	—
54-15461	10–12	6/7/2010	MD54-10-14350	Butanone[2-]	3.4	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Butanone[2-]	4.9	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Butanone[2-]	6.2	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Butanone[2-]	2.7	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Butanone[2-]	3	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Butanone[2-]	2.5	µg/m^3	—
				Average	**4.178**		
54-15462	200–205	6/7/2010	MD54-10-14357	Carbon disulfide	7.7	µg/m^3	—
54-15462	280–285	6/7/2010	MD54-10-14360	Carbon disulfide	6.4	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Carbon disulfide	7.6	µg/m^3	—
				Average	**7.233**		
54-01023	200–205	6/8/2010	MD54-10-14366	Carbon tetrachloride	7	µg/m^3	—
54-01023	245–250	6/8/2010	MD54-10-14367	Carbon tetrachloride	6.4	µg/m^3	J+

Table B-2.3-3 (continued)

Location	Depth (ft)	Date	Sample	Analyte	Result	Unit	2nd Qualifier
54-01023	258–263	6/8/2010	MD54-10-14368	Carbon tetrachloride	7.9	µg/m^3	J+
54-15462	280–285	6/7/2010	MD54-10-14360	Carbon tetrachloride	6	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Carbon tetrachloride	6.3	µg/m^3	J
54-15462	295–300	6/7/2010	MD54-10-14361	Carbon tetrachloride	6	µg/m^3	J
54-609985	150–155	6/8/2010	MD54-10-14381	Carbon tetrachloride	7.5	µg/m^3	J+
54-609985	200–205	6/8/2010	MD54-10-14382	Carbon tetrachloride	14	µg/m^3	J+
54-609985	245–250	6/8/2010	MD54-10-14383	Carbon tetrachloride	17	µg/m^3	J+
54-609985	258–263	6/8/2010	MD54-10-14384	Carbon tetrachloride	14	µg/m^3	J+
54-609985	280–285	6/8/2010	MD54-10-14385	Carbon tetrachloride	16	µg/m^3	J+
54-609985	295–300	6/8/2010	MD54-10-14389	Carbon tetrachloride	13	µg/m^3	J+
54-609985	295–300	6/8/2010	MD54-10-14386	Carbon tetrachloride	16	µg/m^3	J+
				Average	**10.55**		
54-609985	200–205	6/8/2010	MD54-10-14382	Chlorodifluoromethane	18	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Chlorodifluoromethane	20	µg/m^3	—
				Average	**19**		
54-01023	10–15	6/8/2010	MD54-10-14362	Chloroform	13	µg/m^3	—
54-15462	10–15	6/7/2010	MD54-10-14353	Chloroform	22	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Chloroform	36	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Chloroform	100	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Chloroform	77	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Chloroform	28	µg/m^3	—
54-15462	258–263	6/7/2010	MD54-10-14359	Chloroform	43	µg/m^3	—
54-15462	280–285	6/7/2010	MD54-10-14360	Chloroform	58	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Chloroform	48	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14361	Chloroform	47	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Chloroform	49	µg/m^3	—
54-609985	100–105	6/8/2010	MD54-10-14380	Chloroform	20	µg/m^3	—
54-609985	150–155	6/8/2010	MD54-10-14381	Chloroform	5.3	µg/m^3	—
54-609985	200–205	6/8/2010	MD54-10-14382	Chloroform	56	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Chloroform	27	µg/m^3	—
54-609985	258–263	6/8/2010	MD54-10-14384	Chloroform	20	µg/m^3	—
54-609985	280–285	6/8/2010	MD54-10-14385	Chloroform	25	µg/m^3	—
54-609985	295–300	6/8/2010	MD54-10-14386	Chloroform	20	µg/m^3	—
54-609985	295–300	6/8/2010	MD54-10-14389	Chloroform	16	µg/m^3	—
54-609985	60–65	6/8/2010	MD54-10-14379	Chloroform	21	µg/m^3	—
				Average	**36.57**		
54-01023	150–155	6/8/2010	MD54-10-14365	Cyclohexane	4.3	µg/m^3	—
54-01023	200–205	6/8/2010	MD54-10-14366	Cyclohexane	10	µg/m^3	—

Table B-2.3-3 (continued)

Location	Depth (ft)	Date	Sample	Analyte	Result	Unit	2nd Qualifier
54-01023	245–250	6/8/2010	MD54-10-14367	Cyclohexane	14	µg/m^3	—
54-01023	258–263	6/8/2010	MD54-10-14368	Cyclohexane	5.2	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Cyclohexane	6.7	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Cyclohexane	7.9	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Cyclohexane	11	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Cyclohexane	11	µg/m^3	—
54-15462	258–263	6/7/2010	MD54-10-14359	Cyclohexane	5.5	µg/m^3	—
54-15462	280–285	6/7/2010	MD54-10-14360	Cyclohexane	19	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Cyclohexane	33	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14361	Cyclohexane	33	µg/m^3	—
54-609985	150–155	6/8/2010	MD54-10-14381	Cyclohexane	8.3	µg/m^3	—
54-609985	200–205	6/8/2010	MD54-10-14382	Cyclohexane	37	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Cyclohexane	56	µg/m^3	—
54-609985	258–263	6/8/2010	MD54-10-14384	Cyclohexane	55	µg/m^3	—
54-609985	280–285	6/8/2010	MD54-10-14385	Cyclohexane	80	µg/m^3	—
54-609985	295–300	6/8/2010	MD54-10-14386	Cyclohexane	85	µg/m^3	—
54-609985	295–300	6/8/2010	MD54-10-14389	Cyclohexane	67	µg/m^3	—
				Average	**28.89**		
54-01023	10–15	6/8/2010	MD54-10-14362	Dichlorodifluoromethane	29	µg/m^3	J+
54-01023	100–105	6/8/2010	MD54-10-14364	Dichlorodifluoromethane	30	µg/m^3	J+
54-01023	150–155	6/8/2010	MD54-10-14365	Dichlorodifluoromethane	28	µg/m^3	J+
54-01023	200–205	6/8/2010	MD54-10-14366	Dichlorodifluoromethane	30	µg/m^3	J+
54-01023	245–250	6/8/2010	MD54-10-14367	Dichlorodifluoromethane	21	µg/m^3	J
54-01023	258–263	6/8/2010	MD54-10-14388	Dichlorodifluoromethane	24	µg/m^3	J
54-01023	258–263	6/8/2010	MD54-10-14368	Dichlorodifluoromethane	24	µg/m^3	J
54-01023	60–65	6/8/2010	MD54-10-14363	Dichlorodifluoromethane	39	µg/m^3	J+
54-15461	10–12	6/7/2010	MD54-10-14350	Dichlorodifluoromethane	14	µg/m^3	—
54-15461	60–62	6/7/2010	MD54-10-14351	Dichlorodifluoromethane	19	µg/m^3	—
54-15461	95–97	6/7/2010	MD54-10-14352	Dichlorodifluoromethane	20	µg/m^3	—
54-15462	10–15	6/7/2010	MD54-10-14353	Dichlorodifluoromethane	32	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Dichlorodifluoromethane	41	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Dichlorodifluoromethane	71	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Dichlorodifluoromethane	58	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Dichlorodifluoromethane	39	µg/m^3	—
54-15462	258–263	6/7/2010	MD54-10-14359	Dichlorodifluoromethane	56	µg/m^3	—
54-15462	280–285	6/7/2010	MD54-10-14360	Dichlorodifluoromethane	48	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14361	Dichlorodifluoromethane	42	µg/m^3	J
54-15462	295–300	6/7/2010	MD54-10-14387	Dichlorodifluoromethane	42	µg/m^3	J

Table B-2.3-3 (continued)

Location	Depth (ft)	Date	Sample	Analyte	Result	Unit	2nd Qualifier
54-15462	60–65	6/7/2010	MD54-10-14354	Dichlorodifluoromethane	48	µg/m^3	—
54-609985	100–105	6/8/2010	MD54-10-14380	Dichlorodifluoromethane	60	µg/m^3	J
54-609985	150–155	6/8/2010	MD54-10-14381	Dichlorodifluoromethane	63	µg/m^3	J
54-609985	200–205	6/8/2010	MD54-10-14382	Dichlorodifluoromethane	58	µg/m^3	J
54-609985	245–250	6/8/2010	MD54-10-14383	Dichlorodifluoromethane	49	µg/m^3	J
54-609985	258–263	6/8/2010	MD54-10-14384	Dichlorodifluoromethane	41	µg/m^3	J
54-609985	280–285	6/8/2010	MD54-10-14385	Dichlorodifluoromethane	44	µg/m^3	J
54-609985	295–300	6/8/2010	MD54-10-14386	Dichlorodifluoromethane	40	µg/m^3	J
54-609985	295–300	6/8/2010	MD54-10-14389	Dichlorodifluoromethane	33	µg/m^3	J
54-609985	4–9	6/8/2010	MD54-10-14378	Dichlorodifluoromethane	15	µg/m^3	J
54-609985	60–65	6/8/2010	MD54-10-14379	Dichlorodifluoromethane	49	µg/m^3	J
				Average	**38.94**		
54-15462	100–105	6/7/2010	MD54-10-14355	Dichloroethane[1,1-]	3.5	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Dichloroethane[1,1-]	4.8	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Dichloroethane[1,1-]	3.8	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Dichloroethane[1,2-]	5.9	µg/m^3	—
				Average	**4.5**		
54-15462	150–155	6/7/2010	MD54-10-14356	Dichloroethene[1,1-]	3.6	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Dichloroethene[1,1-]	4.4	µg/m^3	—
				Average	**4**		
54-01023	200–205	6/8/2010	MD54-10-14366	Dichloropropane[1,2-]	5.2	µg/m^3	—
54-609985	200–205	6/8/2010	MD54-10-14382	Dichloropropane[1,2-]	4.9	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Dichloropropane[1,2-]	4.4	µg/m^3	—
				Average	**4.833**		
54-01023	150–155	6/8/2010	MD54-10-14365	Ethanol	12	µg/m^3	—
54-01023	258–263	6/8/2010	MD54-10-14388	Ethanol	38	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Ethanol	22	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Ethanol	32	µg/m^3	—
54-609985	295–300	6/8/2010	MD54-10-14389	Ethanol	13	µg/m^3	—
				Average	**23.4**		
54-15462	245–250	6/7/2010	MD54-10-14358	Ethylbenzene	6.7	µg/m^3	—
				Average	**6.7**		
54-01023	150–155	6/8/2010	MD54-10-14365	Hexane	3.6	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Hexane	23	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Hexane	29	µg/m^3	—
54-15462	258–263	6/7/2010	MD54-10-14359	Hexane	6.6	µg/m^3	—
				Average	**15.55**		
54-609985	245–250	6/8/2010	MD54-10-14383	Methylene chloride	3.2	µg/m^3	—

Table B-2.3-3 (continued)

Location	Depth (ft)	Date	Sample	Analyte	Result	Unit	2nd Qualifier
54-609985	295–300	6/8/2010	MD54-10-14389	Methylene chloride	6	µg/m^3	—
				Average	**4.6**		
54-15462	100–105	6/7/2010	MD54-10-14355	Propanol[2-]	25	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Propanol[2-]	14	µg/m^3	—
				Average	**19.5**		
54-01023	10–15	6/8/2010	MD54-10-14362	Tetrachloroethene	6.2	µg/m^3	—
54-15461	60–62	6/7/2010	MD54-10-14351	Tetrachloroethene	6.8	µg/m^3	—
54-15462	10–15	6/7/2010	MD54-10-14353	Tetrachloroethene	7.7	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Tetrachloroethene	5.2	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Tetrachloroethene	6.2	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Tetrachloroethene	7.2	µg/m^3	—
				Average	**6.55**		
54-01023	150–155	6/8/2010	MD54-10-14365	Toluene	9.9	µg/m^3	—
54-15461	95–97	6/7/2010	MD54-10-14352	Toluene	6.2	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Toluene	15	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Toluene	33	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Toluene	9.3	µg/m^3	—
54-609985	295–300	6/8/2010	MD54-10-14389	Toluene	9.7	µg/m^3	—
54-609985	60–65	6/8/2010	MD54-10-14379	Toluene	15	µg/m^3	—
				Average	**14.01**		
54-01023	100–105	6/8/2010	MD54-10-14364	Trichloro-1,2,2-trifluoroethane[1,1,2-]	12	µg/m^3	—
54-01023	150–155	6/8/2010	MD54-10-14365	Trichloro-1,2,2-trifluoroethane[1,1,2-]	13	µg/m^3	—
54-01023	200–205	6/8/2010	MD54-10-14366	Trichloro-1,2,2-trifluoroethane[1,1,2-]	15	µg/m^3	—
54-01023	245–250	6/8/2010	MD54-10-14367	Trichloro-1,2,2-trifluoroethane[1,1,2-]	8.9	µg/m^3	—
54-01023	258–263	6/8/2010	MD54-10-14368	Trichloro-1,2,2-trifluoroethane[1,1,2-]	11	µg/m^3	—
54-01023	60–65	6/8/2010	MD54-10-14363	Trichloro-1,2,2-trifluoroethane[1,1,2-]	10	µg/m^3	—
54-15462	10–15	6/7/2010	MD54-10-14353	Trichloro-1,2,2-trifluoroethane[1,1,2-]	20	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Trichloro-1,2,2-trifluoroethane[1,1,2-]	21	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Trichloro-1,2,2-trifluoroethane[1,1,2-]	41	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Trichloro-1,2,2-trifluoroethane[1,1,2-]	30	µg/m^3	—

Table B-2.3-3 (continued)

Location	Depth (ft)	Date	Sample	Analyte	Result	Unit	2nd Qualifier
54-15462	245–250	6/7/2010	MD54-10-14358	Trichloro-1,2,2-trifluoroethane[1,1,2-]	17	µg/m^3	—
54-15462	258–263	6/7/2010	MD54-10-14359	Trichloro-1,2,2-trifluoroethane[1,1,2-]	26	µg/m^3	—
54-15462	280–285	6/7/2010	MD54-10-14360	Trichloro-1,2,2-trifluoroethane[1,1,2-]	22	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14361	Trichloro-1,2,2-trifluoroethane[1,1,2-]	19	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Trichloro-1,2,2-trifluoroethane[1,1,2-]	20	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Trichloro-1,2,2-trifluoroethane[1,1,2-]	29	µg/m^3	—
54-609985	100–105	6/8/2010	MD54-10-14380	Trichloro-1,2,2-trifluoroethane[1,1,2-]	18	µg/m^3	—
54-609985	150–155	6/8/2010	MD54-10-14381	Trichloro-1,2,2-trifluoroethane[1,1,2-]	20	µg/m^3	—
54-609985	200–205	6/8/2010	MD54-10-14382	Trichloro-1,2,2-trifluoroethane[1,1,2-]	22	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Trichloro-1,2,2-trifluoroethane[1,1,2-]	17	µg/m^3	—
54-609985	258–263	6/8/2010	MD54-10-14384	Trichloro-1,2,2-trifluoroethane[1,1,2-]	15	µg/m^3	—
54-609985	280–285	6/8/2010	MD54-10-14385	Trichloro-1,2,2-trifluoroethane[1,1,2-]	14	µg/m^3	—
54-609985	60–65	6/8/2010	MD54-10-14379	Trichloro-1,2,2-trifluoroethane[1,1,2-]	15	µg/m^3	—
				Average	**18.95**		
54-01023	10–15	6/8/2010	MD54-10-14362	Trichloroethane[1,1,1-]	7.9	µg/m^3	—
54-01023	100–105	6/8/2010	MD54-10-14364	Trichloroethane[1,1,1-]	29	µg/m^3	—
54-01023	150–155	6/8/2010	MD54-10-14365	Trichloroethane[1,1,1-]	35	µg/m^3	—
54-01023	200–205	6/8/2010	MD54-10-14366	Trichloroethane[1,1,1-]	30	µg/m^3	—
54-01023	245–250	6/8/2010	MD54-10-14367	Trichloroethane[1,1,1-]	11	µg/m^3	—
54-01023	258–263	6/8/2010	MD54-10-14368	Trichloroethane[1,1,1-]	11	µg/m^3	—
54-01023	258–263	6/8/2010	MD54-10-14388	Trichloroethane[1,1,1-]	11	µg/m^3	J+
54-01023	60–65	6/8/2010	MD54-10-14363	Trichloroethane[1,1,1-]	17	µg/m^3	—
54-15461	10–12	6/7/2010	MD54-10-14350	Trichloroethane[1,1,1-]	12	µg/m^3	—
54-15461	60–62	6/7/2010	MD54-10-14351	Trichloroethane[1,1,1-]	12	µg/m^3	—
54-15461	95–97	6/7/2010	MD54-10-14352	Trichloroethane[1,1,1-]	12	µg/m^3	—
54-15462	10–15	6/7/2010	MD54-10-14353	Trichloroethane[1,1,1-]	93	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Trichloroethane[1,1,1-]	110	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Trichloroethane[1,1,1-]	170	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Trichloroethane[1,1,1-]	100	µg/m^3	—

Table B-2.3-3 (continued)

Location	Depth (ft)	Date	Sample	Analyte	Result	Unit	2nd Qualifier
54-15462	245–250	6/7/2010	MD54-10-14358	Trichloroethane[1,1,1-]	36	µg/m^3	—
54-15462	258–263	6/7/2010	MD54-10-14359	Trichloroethane[1,1,1-]	47	µg/m^3	—
54-15462	280–285	6/7/2010	MD54-10-14360	Trichloroethane[1,1,1-]	33	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Trichloroethane[1,1,1-]	28	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14361	Trichloroethane[1,1,1-]	26	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Trichloroethane[1,1,1-]	140	µg/m^3	—
54-609985	100–105	6/8/2010	MD54-10-14380	Trichloroethane[1,1,1-]	66	µg/m^3	—
54-609985	150–155	6/8/2010	MD54-10-14381	Trichloroethane[1,1,1-]	76	µg/m^3	—
54-609985	200–205	6/8/2010	MD54-10-14382	Trichloroethane[1,1,1-]	53	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Trichloroethane[1,1,1-]	27	µg/m^3	—
54-609985	258–263	6/8/2010	MD54-10-14384	Trichloroethane[1,1,1-]	20	µg/m^3	J+
54-609985	280–285	6/8/2010	MD54-10-14385	Trichloroethane[1,1,1-]	16	µg/m^3	J+
54-609985	295–300	6/8/2010	MD54-10-14386	Trichloroethane[1,1,1-]	14	µg/m^3	J+
54-609985	295–300	6/8/2010	MD54-10-14389	Trichloroethane[1,1,1-]	10	µg/m^3	J+
54-609985	4–9	6/8/2010	MD54-10-14378	Trichloroethane[1,1,1-]	23	µg/m^3	—
54-609985	60–65	6/8/2010	MD54-10-14379	Trichloroethane[1,1,1-]	58	µg/m^3	—
				Average	**43.03**		
54-01023	100–105	6/8/2010	MD54-10-14364	Trichloroethene	6.1	µg/m^3	—
54-01023	150–155	6/8/2010	MD54-10-14365	Trichloroethene	4.9	µg/m^3	—
54-01023	200–205	6/8/2010	MD54-10-14366	Trichloroethene	5	µg/m^3	—
54-01023	60–65	6/8/2010	MD54-10-14363	Trichloroethene	4.9	µg/m^3	—
54-15461	60–62	6/7/2010	MD54-10-14351	Trichloroethene	5.2	µg/m^3	—
54-15462	10–15	6/7/2010	MD54-10-14353	Trichloroethene	5.7	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Trichloroethene	8	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Trichloroethene	9.5	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Trichloroethene	13	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Trichloroethene	9.2	µg/m^3	—
54-609985	100–105	6/8/2010	MD54-10-14380	Trichloroethene	6.3	µg/m^3	—
54-609985	150–155	6/8/2010	MD54-10-14381	Trichloroethene	7.4	µg/m^3	—
54-609985	200–205	6/8/2010	MD54-10-14382	Trichloroethene	5.8	µg/m^3	—
54-609985	60–65	6/8/2010	MD54-10-14379	Trichloroethene	5.5	µg/m^3	—
				Average	**6.893**		
54-01023	10–15	6/8/2010	MD54-10-14362	Trichlorofluoromethane	36	µg/m^3	J+
54-01023	100–105	6/8/2010	MD54-10-14364	Trichlorofluoromethane	61	µg/m^3	J+
54-01023	150–155	6/8/2010	MD54-10-14365	Trichlorofluoromethane	35	µg/m^3	J+
54-01023	200–205	6/8/2010	MD54-10-14366	Trichlorofluoromethane	34	µg/m^3	J+
54-01023	245–250	6/8/2010	MD54-10-14367	Trichlorofluoromethane	21	µg/m^3	—
54-01023	258–263	6/8/2010	MD54-10-14368	Trichlorofluoromethane	24	µg/m^3	—

Table B-2.3-3 (continued)

Location	Depth (ft)	Date	Sample	Analyte	Result	Unit	2nd Qualifier
54-01023	258–263	6/8/2010	MD54-10-14388	Trichlorofluoromethane	24	µg/m^3	J+
54-01023	60–65	6/8/2010	MD54-10-14363	Trichlorofluoromethane	77	µg/m^3	J+
54-15461	10–12	6/7/2010	MD54-10-14350	Trichlorofluoromethane	11	µg/m^3	—
54-15461	60–62	6/7/2010	MD54-10-14351	Trichlorofluoromethane	16	µg/m^3	—
54-15461	95–97	6/7/2010	MD54-10-14352	Trichlorofluoromethane	18	µg/m^3	—
54-15462	10–15	6/7/2010	MD54-10-14353	Trichlorofluoromethane	36	µg/m^3	—
54-15462	100–105	6/7/2010	MD54-10-14355	Trichlorofluoromethane	42	µg/m^3	—
54-15462	150–155	6/7/2010	MD54-10-14356	Trichlorofluoromethane	73	µg/m^3	—
54-15462	200–205	6/7/2010	MD54-10-14357	Trichlorofluoromethane	46	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Trichlorofluoromethane	27	µg/m^3	—
54-15462	258–263	6/7/2010	MD54-10-14359	Trichlorofluoromethane	38	µg/m^3	—
54-15462	280–285	6/7/2010	MD54-10-14360	Trichlorofluoromethane	34	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14361	Trichlorofluoromethane	27	µg/m^3	—
54-15462	295–300	6/7/2010	MD54-10-14387	Trichlorofluoromethane	29	µg/m^3	—
54-15462	60–65	6/7/2010	MD54-10-14354	Trichlorofluoromethane	54	µg/m^3	—
54-609985	100–105	6/8/2010	MD54-10-14380	Trichlorofluoromethane	60	µg/m^3	—
54-609985	150–155	6/8/2010	MD54-10-14381	Trichlorofluoromethane	60	µg/m^3	—
54-609985	200–205	6/8/2010	MD54-10-14382	Trichlorofluoromethane	48	µg/m^3	—
54-609985	245–250	6/8/2010	MD54-10-14383	Trichlorofluoromethane	37	µg/m^3	—
54-609985	258–263	6/8/2010	MD54-10-14384	Trichlorofluoromethane	30	µg/m^3	J+
54-609985	280–285	6/8/2010	MD54-10-14385	Trichlorofluoromethane	31	µg/m^3	J+
54-609985	295–300	6/8/2010	MD54-10-14389	Trichlorofluoromethane	23	µg/m^3	J+
54-609985	295–300	6/8/2010	MD54-10-14386	Trichlorofluoromethane	29	µg/m^3	J+
54-609985	4–9	6/8/2010	MD54-10-14378	Trichlorofluoromethane	14	µg/m^3	—
54-609985	60–65	6/8/2010	MD54-10-14379	Trichlorofluoromethane	56	µg/m^3	—
				Average	**37.13**		
54-15462	245–250	6/7/2010	MD54-10-14358	Xylene[1,2-]	4.1	µg/m^3	—
				Average	**4.1**		
54-01023	150–155	6/8/2010	MD54-10-14365	Xylene[1,3-]+xylene[1,4-]	3.8	µg/m^3	J
54-15462	100–105	6/7/2010	MD54-10-14355	Xylene[1,3-]+xylene[1,4-]	3.6	µg/m^3	—
54-15462	245–250	6/7/2010	MD54-10-14358	Xylene[1,3-]+xylene[1,4-]	15	µg/m^3	—
				Average	**7.467**		

Note: Data qualifiers are defined in Appendix A.
*— = Data require no secondary qualifier.

Appendix C

Characteristics of Disposed Waste
and Their Effect on Remediation Alternatives

SME Review and Assessment of MDA H Waste Characteristics on Site Closure

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Background

The question of uranium metal and/or high explosive (HE) instability (e.g. pyrophoricity[1] and deflagration/detonation[2], respectively) has been raised regarding potential risks during environmental remediation activities at the MDA-H disposal site. Such remediation activities could include jet grouting, in situ vitrification, in situ thermal treatment, excavation, and/or surface work using heavy equipment. The purpose of this document is to summarize factors influencing uranium metal pyrophoricity and high explosives instability, and whether remedial action poses a risk for disruption and dispersal event(s). In addition, the general extent to which uranium is pyrophoric and HE is unstable in its present state in disposal shafts at MDA-H is discussed. The possibility of a uranium fire is a serious matter, first in terms of dispersal of hazardous materials within and beyond the MDA, and second in terms of subsequent required decontamination. Since uranium and plutonium metal have been known to ignite spontaneously, concern about the pyrophoricity is decidedly justified.[3]

Summary of Findings and Recommendations

Subject matter experts (SMEs) in high explosives, materials science, actinides and geoscience were assembled from Los Alamos National Laboratory, and a technical assessment of information available on wastes emplaced into shafts at MDA-H has been performed. The SMEs evaluated waste disposed in shafts that can result in problems for remedial actions due to long-term stability, chemical reactions, mixing, releases or other issues. This document summarizes key bounding aspects of waste in the shafts identified, particularly as it may impact stabilization, protection and/or remediation actions for the site.

Key issues initially identified for review include waste characteristics, combinations, and stability. Particular components of interest are actinide materials, high explosive materials, and other chemical components. Remedial action alternatives, including especially jet grouting, are under evaluation for the site and the impacts and risks of such approaches are the focus of the assessment.

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1 Pyrophoric definition: igniting spontaneously, from Latin pyrophorus, from Greek fire-bearing

2 Deflagration and detonation definitions – deflagrate: a rapid chemical reaction proceeding along the surface at subsonic velocity; detonate: a violent chemical reaction proceeding through the reacted material toward the unreacted material at supersonic velocity. *"DoD Ammunition and Explosives Safety Standards"*, **1992**, DOD 6055.9-STD

3 D. E. Patterson, "The Rocky Flats Fire," *Fire Journal*, **64**, 5-7, 15 (January, **1970**)

High Explosives or Mock High Explosives

Documented estimates of MDA-H inventory place 1275 lbs of RDX explosive in MDA-H disposal shafts. A wide variety of explosives were in use for weapons programs during the period from 1960 through 1985.[4]

Mechanisms that may cause unwanted reactions in explosives include spark, friction, heat, impact and pinch.[5] Spark may cause localized hot spots on HE surfaces and lead to deflagration. Friction may cause localized heating and lead to deflagration. Heat may lead directly to deflagration. Impacts may cause localized compression-heating leading to violent deflagration, or if of sufficient strength, detonation. Pinching may cause compression-heating and lead to violent deflagration or detonation.

All of the explosives used during the time the shafts were being filled have the potential to transition from deflagration to detonation.[6,7] The dangers of a detonation are well known. Less well appreciated are the effects of deflagration. For instance, black powder does not detonate, but deflagrates, and has been used as a propellant or blasting agent for hundreds of years. Violent deflagration may also cause huge amounts (100 times the explosive volume) of rapidly expanding gas to be produced, as is the case of a carbide cannon. Energy sources, such as sparks, may also act indirectly on explosives through an intermediary, such as a flammable/detonable gas, to cause a reaction in explosives. Combinations, such as water on uranium or lithium, may lead to formation of hydrogen-gas intermediaries and heat, or directly to flame-producing reactions.

The MDA-H inventory includes both materials that were flashed[8] and materials that include major amounts of HE. In general, items that are flashed are suspected to have HE on or in them (gears, cracks, joints, springs, threads, etc.). Molds, HE machining tools and fixtures, melt cast equipment and HE mixing/blending equipment are other examples of items that have usually been flashed. These items are almost always non combustible (metal, glass, etc.). Sealed containers are not flashed, nor are items with HE bonded to certain metals. Parts that contain HE that could make a solid fuel rocket-like device if ignited or large consolidated pieces that could deflagrate or detonate are not flashed. However, pieces that are flashed may still contain explosives. Low melt temperature HE

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4 Those explosives include RDX (Royal Demolition Explosive or Research Department Explosive, an explosive nitramine compound, hexahydro-1,3,5-trinitro-1,3,5 triazine), TNT (trinitrotoluene, a solid nitroaromatic compound), HMX (high melting explosive, an explosive polynitramine, octahydro-1,3,5,7-tetranitro-1,3,5,7 tetrazocine), PETN (Pentaerythritol tetranitrate, used as the primary ingredient in detonating fuses and as a component mixed with hexahydro-1,2,5-trinitro-1,3,4-triazine in "plastic" explosives such as Semtex), Picric acid, azides, styphnates, and various mixtures of mock explosives such as Comp B (explosives are made from TNT, RDX, and wax, such as 59.5 percent RDX, 39.5 percent TNT and 1 percent wax with desensitizing agents added).

5 L. C. Smith and B. G. Craig, *Primer on SDT, DDT, XDT, Pickup and Sympathetic Detonation*, **1979**, LA-UR-79-3106, LASL

6 J. M. McAfee, B. W. Asay, A. W. Campbell, and J. B. Ramsay, Deflagration to Detonation in Granular HMX. - Ninth Symposium (International) on Detonation, **1989**, pp 265-279

7 J.M. McAfee, B.W. Asay, and J.B. Bdzil, Deflagration-To-Detonation in Granular HMX: Ignition, Kinetics, and Shock Formation. - Tenth International Detonation Symposium, **1993**, pp 716-723, LA-UR-93-1754

8 Flashing of materials with small amounts of explosive contamination involves rapid heating of the item (e.g. a metal part, pipe or piece of ductwork) that results in reaction of explosive. At LANL, this has been accomplished using high temperature, forced-air propane torches at Open Burn facilities.

can partially burn, melt and run into all kinds of nooks and crannies, thereby remaining a risk for deflagration or detonation if inappropriately disturbed.

Explosive containing wastes left undisturbed in the shafts at MDA-H are expected to be stable and only subject to slow natural degradation and mineralization.[9] However, local disruption by processes that can introduce sparking, friction, impact, heating and/or pinching would be expected to greatly increase risks of deflagration and possibly detonation.

Inorganic Materials, specifically depleted uranium and other actinides

Current estimates of MDA-H inventory place 93,000 lbs of depleted uranium (DU), 1100 lbs of enriched uranium (EU), and 10,700 lbs of uranium fuel elements in MDA-H disposal shafts. Minor amounts (300 lbs) of plutonium-contaminated wastes were also disposed in the shafts.

In the case of actinides, uranium and plutonium metals are highly reactive substances that can react with practically every element in the periodic table except the noble gases.[10] Oxides formed on uranium metal surfaces are not adherent and spall[11] off after a certain thickness is reached.[12,13,14] As with most metal oxides, the free energy of formation of uranium and plutonium oxides is negative (heat is given off when oxides form from metallic materials). Most metal oxides have a free energy of formation that is on the order of kilocalories per mole, while actinide metal oxides have a free energy of formation on the order of hundreds of kilocalories per mole.[15] As a consequence, the actinide metals are thermodynamically unstable in air, and in principle, one would expect complete conversion of actinide metal into the oxide that is most air stable. In practice this does not occur due to the kinetics of the oxidation process in air.

When an object experiences combustion, or catches fire, it is undergoing oxidation, and chemically, all elemental materials not in their highest stable oxidation state in air can burn. Consequently, all metallic objects that form stable oxides can oxidize in air, under appropriate conditions. Many metals oxidize so slowly that the heat generated during oxidation is dissipated and ignition temperature is never reached. However, under proper conditions, some metals oxidize rapidly in the presence of air or moisture, generating

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[9] J. C. Pennington, D. Gunnison, D. W. Harrelson, J. M. Brannon, M. Zakikhani, T. F. Jenkins, J. U. Clarke, C. A. Hayes, T. Myers, E. Perkins, D. Ringelberg, D. Townsend, H. Fredrickson, J. H. May, "Natural attenuation of explosives in soil and water systems at Department of Defense sites: Interim report," Technical Report EL-99-8, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. **1999.**

[10] *The Chemistry of the Actinide and Transactinide Elements*, L.R. Morss, N.M. Edelstein, and J. Fuger, Eds, **2006**, Springer.

[11] Spall (v): to break off chips, scales, or slabs

[12] C. A. Colmenares, "The Oxidation of Thorium, Uranium and Plutonium," *Prog. Solid State Chem.*, **9**, 139, **1975**.

[13] I. Grenthe, J. Drożdżyński, T. Fujino, E. C. Buck, T. E. Albrecht-Schmitt, S. F. Wolf, "Chapter 5, Uranium" in *The Chemistry of the Actinides and Transactinides*, 3rd Edition, Lester R. Morss, Norman M. Edelstein, Jean Fuger, Eds. **2006**, Springer, New York, 813-1264.

[14] D. L. Clark, D. W. Keogh, M. P. Neu, W. Runde, "*Uranium and Uranium Compounds*," *Kirk-Othmer Encylopedia of Chemical Technology*, 5th Ed., Wiley Interscience, **2006**, Vol 25, 391-454.

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sufficient heat to reach their ignition temperature and undergo autoignition. Generally, autoignition can occur anytime that a reaction or reactions are strongly exothermic, have negative free energies of reaction at the ignition temperature, and have a greater rate of heat production than rate of heat transfer away from the reaction zone. In such instances, the surface oxidation becomes vigorous enough to make the reaction self-sustaining. While such reactions are generally less likely to be vigorous underground due to limitations on oxygen and moisture supply to dispersed waste materials, they are possible in complex and concentrated waste accumulations, with similarities to processes exhibited by coal seam and peat fires.

C. R. Schmitt has reviewed the parameters that induce the pyrophoricity of various materials and points out that they are numerous and often interrelated.[16] The variables cited by Schmitt as affecting pyrophoricity include (1) particle size and activity; (2) moisture content; (3) hydrogen content; (4) stress; (5) purity and composition; (6) amount of surface oxide; and (7) mass of material.

Pyrophoricity of uranium is well-known, and DOE has issued several reports and handbooks on safe handling of metallic uranium.[17,18] Most metallic uranium is handled in massive forms (e.g. multi-gram sized items or larger) that do not present a significant fire risk unless exposed to a severe and prolonged external fire. Once ignited, massive metal burns very slowly. Unless covered with oil, massive uranium burns with virtually no visible flame. Alternatively, uranium can be stabilized against pyrophoricity by encasing it with another metal and for power reactor purposes, uranium fuel elements are always encased in a metal cladding (usually zirconium or stainless steel).

Disposal of actinide waste materials has included a wide range of forms, from physical parts to finely divided shavings or dusts. In general, plutonium has been of sufficient value that it was recovered for reuse, if at all possible. Similarly, enriched uranium was usually recovered. In contrast, depleted uranium was in relatively great supply and so was often disposed, as is documented for MDA-H. Uranium in finely divided form is readily ignitable, and uranium scrap from machining operations is subject to spontaneous ignition. Uranium metal turnings will form a protective coating of oxide on the surface. As turnings are pulled apart, they often throw sparks as the oxide coated is scraped away to reveal a fresh metal surface. This reaction can usually be avoided by initial storage under dry oil. Grinding dust has been known to ignite even under water, and fires have occurred spontaneously in drums of coarser scrap after prolonged exposure to moist air. Uranium surfaces treated with concentrated nitric acid are subject to explosion or spontaneous ignition in air. Moist dust, turnings, and chips react slowly with water to form hydrogen, which would be expected to be occurring even in buried materials. Because of uranium's thermal conductivity, larger pieces generally have to be heated entirely to their ignition temperature before igniting.

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Recommendations

Based on the discussion above specifically regarding uranium and high explosives in the MDA-H shafts, the SME group is of the opinion that any remedial action that results in excavation, drilling, in situ vitrification, thermal treatment, or jet grouting poses substantial hazards of reactions that could be uncontrollable. In this case, it is our combined opinion that options for leaving the material in place, with an appropriate cap that limits infiltration of water should be considered.

Drilling introduces energy sources near, or into, the shafts. Local activities that introduce spark, friction, heat and pinching are possible detrimental impacts to system stability. Water could enter the shafts and interact with waste materials in various ways, including as a component of grout or drilling mud if either are employed. Jet grouting is a particular concern as both a source of water that may intrude into wastes in shafts, and as a mechanism that introduces high pressures that could impact and mix waste materials, or serve to remove the protective oxide coating from uranium metal scraps. Curing grout/concrete produces heat and, while the level of heat would not necessarily be a major concern by itself, it may accelerate other unwanted chemical reactions. Water in the injected grout or drilling mud could cause some leaching of Barium from the HE and increase reactions of metal components.

Excavation of the shafts would introduce many unwanted energy sources into the interred materials. Reasonable scenarios associated with excavation include: sparks, from excavation equipment, sparks from abrading uranium components, or handling and adverse interactions of HE or pyrophoric metals; friction from excavation equipment or handling; impact/crush from equipment, or dropping; and pinching from equipment or handling. Such processes could also result in inadvertent pinching of residual amounts of HE remaining in crevices, cracks and machinery components (gears, threads, etc.), even those that have been treated by flashing.

The least intrusive remedial actions for the MDA-H shafts containing complex mixtures of waste materials, would involve emplacement of a surface cap system to limit intrusion and water infiltration. The present stability of the overall system would be maintained, and care can be taken to avoid compressing materials within the shafts.

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DOE-EA1464-Corrective Measures.pdf

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Appendix H Borehole Logs ER2000-0669, pages H-1 – H-13 (May 2001)
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Appendix M Uranium Corrosion ER2005-0020, pages M-1 – M-4 (June 2005)
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Appendix O An Alternate Groundwater-Pathway Risk Assessment for Material Disposal Area H: Fracture-Facilitated Contaminant Transport EP2004-0395 (LAUR-04-4956) 26p. (September 2004)
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Contributors Biographical Data

Dr. David R. Janecky is an environmental science and operations group manager at Los Alamos National Laboratory (LANL) in the Environmental Stewardship Group, Environmental Protection Division. He received an A.B. in Geology from University of California, Berkeley in 1975, and a Ph.D. in Geology from the University of Minnesota in 1982, Minneapolis. His work focuses primarily on line management and technical project development/implementation for environmental compliance, science, and technical assistance. Dr. Janecky's research interests are in geochemistry of aqueous transport and reaction processes (spanning a temperature range of at least -40°C to 1200°C). Following participation as a researcher in the geoscience and actinide geochemistry program that resulted in certification of the WIPP repository, he spent four years (1996-2000) as the lead for NQA Software Quality Assurance effort of the LANL TRU Waste Characterization and Certification Program which achieved certification and first shipments to WIPP. David was also a lead member of the Actinide Migration Evaluation external advisory team at Rocky Flats Environmental Technology Site from 1996-2006, and continues to participate in evaluation of long-term stewardship of that site. He contributes to technical review panels for DOE, NSF and EPA.

Dr. David L. Clark received a B.S. in chemistry in 1982 from the University of Washington and a Ph.D. in inorganic chemistry in 1986 from Indiana University. His thesis work was recognized by the American Chemical Society with the Nobel Laureate Signature Award for the best chemistry Ph.D. thesis in the United States. Clark was a postdoctoral fellow at the University of Oxford before joining Los Alamos National Laboratory as a J. Robert Oppenheimer Fellow in 1988. He became a Technical Staff Member in the Isotope and Nuclear Chemistry Division in 1989. Since then he has held various leadership positions at the Laboratory, including program management for nuclear weapons and Office of Science programs, and Director of the Glenn T. Seaborg Institute for Transactinium Science between 1997-2009. He was a lead member of the Actinide Migration Evaluation external advisory team at Rocky Flats Environmental Technology Site from 1996-2006. He is currently a Fellow of the American Association for the Advancement of Science, a Laboratory Fellow, and Leader of the Plutonium Science Strategy for Los Alamos National Laboratory. His research interests are in the structure and bonding of actinide materials, applications of synchrotron radiation to actinide science, behavior of actinides in the environment, and in the aging effects of nuclear weapons materials. He has published 150 peer-reviewed publications.

Herbert Harry is an R & D Engineer and Project Leader at Los Alamos National Laboratory (LANL) in the High Explosives Science and Technology group (WX-7). He has 23 years experience in explosive testing and characterization.

Dr. Dane R. Spearing is the Deputy Group Leader for the Nuclear Materials Science Group (MST-16) at Los Alamos National Laboratory (LANL). He earned a B.S. in geology from the University of Michigan in 1988, and a Ph.D. in geology (minor in materials science and engineering) from Stanford University in 1993. During his post-doctoral research at LANL from 1996 to 1998, he developed methodologies for the

long-term storage and disposition of plutonium and other actinides in ceramic waste forms. From 1998 through 2009, his research has focused on the interactions between Pu metal and various storage materials in support of the 94-1 program and the pit surveillance program. As the current Deputy Group Leader for MST-16, he oversees numerous actinide materials science research programs that investigate Pu-aging, pit surveillance and manufacturing, actinide interactions with the environment, and fundamental actinide chemistry.

Paul Dunn is the Group Leader for the Materials Science and Technology: Metallurgy(MST-6) at Los Alamos National Laboratory. He earned his duel B.S. degrees in Physical Metallurgy and Extractive Metallurgy in 1983 and M.S. in Welding Metallurgy in 1985 from the Colorado School of Mines. Since joining Los Alamos, he has worked extensively in the Nuclear Weapons Program, developing new processes for casting and melting of uranium and uranium alloys. As the Group Leader for MST-6, he oversees programs in every element of the Nuclear Weapons portfolio and provides the Los Alamos prototyping capability for all uranium components used at the Laboratory.

Appendix D

Contaminants Detected in
Deep Wells in the Technical Area 54 Monitoring Network

D-1.0 INTRODUCTION

This appendix discusses contaminants detected during the monitoring of groundwater in wells assigned to the Technical Area 54 (TA-54) monitoring network for Material Disposal Areas (MDAs) G, H, and L. Groundwater monitoring at Los Alamos National Laboratory (LANL or the Laboratory) is currently conducted in accordance with the 2010 Interim Facility-Wide Groundwater Monitoring Plan (2010 IFGMP) (LANL 2010, 109830). Wells assigned to the TA-54 monitoring network include perched-intermediate and regional (hereafter, "deep") wells R-20, R-21, R-22, R-23, R-23i, R-32, R-37, R-38, R-39, R-40, R-40i, R-41, R-49, R-51, R-52, R-53, R-54, R-55, R-55i, R-56, and R-57 (Table 2.5-1; Figure 2.3-5). Although none of the TA-54 monitoring network wells are equally applicable to all three MDAs, it is recognized that all the wells contribute in an integrated fashion to monitoring for different potential sources of groundwater contaminants. Table D-1.0-1 summarizes information about screened intervals and sampling systems installed in these monitoring wells and the range of sampling dates for which water-quality data are available.

- Section D-2.0 outlines an approach for conducting reliability assessments of deep monitoring wells to determine their capability for producing reliable water-quality samples and to identify any potential effects of well installation, rehabilitation, or sampling protocol on data quality.
- Section D-3.0 summarizes the results of reliability assessments of the deep wells and addresses the capability of each screen to provide reliable data for contaminants relevant to MDAs G, H, and L.
- Section D-4.0 summarizes chemicals of potential concern (COPCs) detected in water-quality samples from these wells. COPC detections in groundwater are then compared with those known, or potentially expected, to be present in the vadose zone below MDAs G, H, and L, and potential sources of the COPCs detected in groundwater are discussed. For informational purposes, this section also provides data for activities of tritium and detections of radionuclides.
- Based on these data evaluations, section D-5.0 presents conclusions concerning the transport of COPCs from the vadose zone below MDAs G, H, and L to the deep groundwater downgradient of these MDAs.
- Attachment D-1 (on DVD), Analytical Suites and Results and Analytical Reports, contains the full set of analytical data for water-quality samples from all monitoring wells assigned to the TA-54 monitoring network.
- Attachment D-2, Geochemical Trend Plots for Technical Area 54 Monitoring Network Wells, compiles figures that depict geochemical trends for these wells and that support the reliability assessments in section D-3.0.

D-2.0 RELIABILITY ASSESSMENT PROTOCOL

The specific objective of a reliability assessment is to determine the current effectiveness of a deep well (including its sampling system) as it relates to the water-quality data objectives of the specific monitoring network to which it is assigned, which, in this case, is the TA-54 monitoring network specific to MDAs G, H, and L. Data examined for the assessment include field parameters monitored during purging before sample collection, field parameters associated with samples at the time of collection, major ion concentrations, trace metal concentrations, and detections of organic constituents. The assessments are based on site-specific geochemical criteria and generally focus on data obtained for the most recent sampling events. Each category of data is described below in greater detail.

Field parameters. Time-series data for field parameters monitored during purging before sample collection are examined for attaining stable values by the end of purging, and time-series trends are also compared for a sequence of events at the same location. Stabilization criteria are prescribed in Standard Operating Procedure (SOP) 5232, Groundwater Sampling, and are derived from the stabilization criteria recommended by the U.S. Environmental Protection Agency (EPA) (Yeskis and Zavala 2002, 204429) and from the Compliance Order on Consent (the Consent Order). The most sensitive indicator parameters are dissolved oxygen (DO) and turbidity (in nephelometric turbidity units [NTU]). Other parameters such as water temperature, specific conductance, pH, and oxidation-reduction potential (ORP) are also monitored but are considered less sensitive indicators of formation water. Final field-parameter values associated with the sample at the time of collection are compared with the range observed in background locations for perched-intermediate groundwater and regional groundwater.

Inorganic analytes. Analytical data for common inorganic ions and trace metals are examined for stability and for excursions from background concentrations, including the following:

- trends in concentrations of key indicators for the presence of residual drilling or construction products used in the screened interval, such as sodium (Na), chloride (Cl), sulfate (SO_4), and total organic carbon (TOC);
- trends in relative concentrations of major ions for identifying mixing of waters with different compositions; and
- comparison of concentrations for major ions and selected trace metals with concentration ranges for plateau-scale and site-specific background groundwater, as described below, to identify possible excursions from expected geochemical conditions.

Concentration trends may be depicted using time-series plots, standard trilinear diagrams, or modified Schoeller plots.

- Trilinear diagrams, also called Piper plots, show major ions as percentages of milliequivalents (meq) in two base triangles. The total cations and the total anions are set equal to 100%, and the data points in the two triangles are projected onto an adjacent grid. The main purpose of the Piper diagram is to show clustering of data points to indicate samples with similar compositions.
- Schoeller plots are semilogarithmic diagrams originally developed to represent major ion analyses in meq/L and to show different hydrochemical water types on the same diagram. This type of graphical representation has the advantage that, unlike the trilinear diagrams, actual sample concentrations are displayed and compared. The modified Schoeller plot used for the reliability assessment represents analyses as mg/L or µg/L to avoid the need to make assumptions about ion speciation, which may be particularly problematic for trace metals.

Organic analytes. Detections of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) are compiled for examination of temporal trends, evidence for the presence of residual organic drilling materials, and detections of area-specific COPCs.

Field documentation. As appropriate, field notes, groundwater sampling logs, and sample collection logs for each sampling event also may be examined for observations about unusual odors, colors, or other indications of impacted water samples.

Tritium. Tritium activities in groundwater are commonly used to evaluate the presence of a component of modern water or a contaminant plume in the screened interval. The presence or absence of tritium at a location may provide a useful tracer of flow and transport pathways because it travels conservatively in groundwater.

Plateau-scale background values for assessment. For naturally occurring analytes, statistical summaries of water-quality data for background groundwater locations establish an upper bound of concentrations against which data from the assessed wells are compared as a preliminary assessment step. Upper bounds of plateau-scale background values used in the reliability assessments are established by the upper tolerance limit (UTL) in the Groundwater Background Investigation Report, Revision 3 (hereafter, GBIR, R3) (LANL 2007, 095817). Some naturally occurring constituents do not have numerical background values that are based on UTLs in GBIR, R3, because the data do not meet the statistical criteria for UTL calculations. The GBIR is being updated to establish appropriate screening levels for these cases in accordance with EPA guidance.

Site-specific background values for assessment. Reliability may be assessed with greater specificity by comparing analytical concentrations with those in groundwater from other deep wells in sufficiently similar hydrogeologic settings and at which effects from downhole materials or local contaminants are known to be absent or negligible. The approach allows for the inclusion of wells not hydraulically upgradient of the well being assessed. This is similar to the interwell comparison approach described in sections 5.2.4 and 6.3.2 of the EPA guidance document, "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities" ("Unified Guidance") (EPA 2009, 110369).

The development and use of site-specific background values is illustrated in the "Reliability Assessment for Well R-47i" (LANL 2011, 201564). In that report, groundwater background values were derived from data for deep wells screened in the Puye Formation (Tpf) or the Cerro Toledo interval (Qct). This set of background values can be viewed as representative of deep groundwater in these lithologic units where they underlie the central Pajarito Plateau in an area bounded approximately by Mortandad and Water Canyons between NM 4 and NM 501. It is noted that this data set may not fully encompass the range of groundwater compositions in other local lithologic units in the vicinity of the TA-54 monitoring network wells, such as the Santa Fe Formation (Tsf) and the Cerros del Rio basalt (Tb4). Nonetheless, the 5^{th} and 95^{th} percentile concentrations calculated from the Tpf-Qct data set are included on the Schoeller plots in Attachment D-2 to facilitate quick visual identification of possible excursions from background geochemical conditions.

Under some conditions, some or all of the constituents measured in the sample collected at the end of development may also be appropriate to use as site-specific background values or to augment the background data set compiled for the interwell comparison. This is similar to the intrawell comparison approach described in sections 5.2.4 and 6.3.2 of EPA's Unified Guidance (EPA 2009, 110369).

In the future, the groundwater background values are expected to be based on analyte concentrations in an upgradient portion of the groundwater monitoring network specific to each MDA and in those downgradient or off-gradient monitoring wells that do not show contamination. However, implementation of this protocol is deferred until newly completed wells have reequilibrated to predrilling geochemistry. The reliability assessment in section D-3.0 summarizes the status of deep wells in the TA-54 monitoring network, including upgradient wells and downgradient, or off-gradient, wells that are candidates for defining background values for the TA-54 monitoring network wells.

D-3.0 GEOCHEMICAL PERFORMANCE OF MONITORING WELLS

Reliability of the geochemical performances of some of the TA-54 monitoring network wells were previously reported in the "Well Screen Analysis Report, Revision 2" (LANL 2007, 096330); "Technical Area 54 Well Evaluation and Network Recommendations, Revision 1" (LANL 2007, 098548, Appendix B); the 2010 IFGMP (LANL 2010, 109830); "Corrective Measures Evaluation Report for Material Disposal Area G, Consolidated Unit 54-013(b)-99, at Technical Area 54, Revision 2" (LANL 2010, 111362,

Appendix D); "Corrective Measures Evaluation Report for Material Disposal Area H, Solid Waste Management Unit 54-004, at Technical Area 54" (LANL 2010, 111506, Appendix E); and "Corrective Measures Evaluation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54, Revision 1" (LANL 2010, 110852, Appendix D). This section complements earlier evaluations by applying the approach described in section D-2.0 to the most recent water-quality samples. This section also extends the assessment protocol to newly completed wells such as R-53, R-54, R-55i, R-55, R-56, and R-57.

Key observations are summarized below, focusing on the capability of each well to provide reliable data for COPCs known to be present in the vadose zone beneath MDAs G, H, or L based on core samples and vapor monitoring. The vapor-phase organics detected at highest concentrations in the pore gas at MDA G are 1,1,1-trichloroethane (TCA); 1,1,2-trichloro-1,2,2-trifluoroethane; trichloroethene (TCE); 1,1-dichloroethene; 1,1-dichloroethane; and perchloroethene (PCE) (LANL 2010, 108496, Table 3.0-2). Similarly, the vapor-phase organics detected at highest concentrations in the vadose zone beneath MDA L are TCA, TCE, and PCE.

For convenience, most water-quality data used in these assessments are compiled into the following tables:

- Purge volumes and final field parameters (Table D-3.0-1)
- General inorganic constituents (Table D-3.0-2)
- Trace metals in filtered samples (Table D-3.0-3)
- Stable isotopes (Table D-3.0-4)

D-3.1 Well R-20

Well R-20 includes two intervals screened in the regional aquifer. This well is upgradient of MDA L (or potentially downgradient of MDA L if water-supply well PM-2 is pumping).

R-20 was equipped with a nonpurgeable Westbay sampling system until 2007 (Table D-1.0-1). Water-quality data from samples collected during this period may not be fully reliable indicators of predrilling groundwater chemistry. Residual effects of drilling and construction in these screens included the presence of inorganic and organic chemicals used downhole and persistent iron- or sulfate-reducing conditions. The well was redeveloped and converted to a purgeable sampling configuration in 2007. The assessments presented below apply to the current sampling configuration. However, COPC detection statistics for samples collected from this well using the Westbay sampling system are included in section D-4.0.

R-20 screen 1 (port P1A) is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA L based on the following observations for the four most recent sampling events.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R20-1 in Attachment D-2).
- Slightly reducing conditions are present as indicated, for example, by DO ≤2 mg/L, nitrate-nitrite as nitrogen (NO_3+NO_2-N), and perchlorate (ClO_4) <0.2 µg/L (Tables D-3.0-1 and D-3.0-2). Based on the results of an extended-purge event in January 2011, slightly reducing conditions are representative of this location and may be related to the location of this well near a zone of enhanced infiltration (discussed in section D-4.4). Nitrate-reducing conditions also manifest as

variability observed in $\delta^{15}N$ values measured for NO_3 (Table D-3.0-4), with some values extending above the range in natural background groundwater (4.7 ± 0.9 permil) because of isotopic fractionation by nitrate-reducing microbial processes.

- No evidence is observed of the presence of residual organic materials. For example, TOC is ≤1.1 mg/L (Table D-3.1-1), and acetone is not detected (Figure D-3.1-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and total dissolved solids (TDS) are stable and below UTLs for regional background groundwater (Table D-3.0-2; Figure D2-R20-2 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <5 NTU (Table D-3.0-1). Aluminum (Al), a common indicator of formation solids, is not detected in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R20-3 in Attachment D-2). Similarly, iron (Fe) is either not detected or is detected at <100 µg/L in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R20-3 in Attachment D-2).
- No evidence is observed of water chemistry significantly out of equilibrium with formation mineralogy. Concentrations of major cations and trace metals are stable; all are below UTLs for regional background except for barium (Ba) (Table D-3.0-3; Figure D2-R20-3 in Attachment D-2). The average Ba concentration (86 µg/L) is above the UTL (57 µg/L) but only slightly above the 95th percentile concentration (81 µg/L) for regional background groundwater.
- This screen is assigned to the watch list in the 2011 Interim Facility-Wide Groundwater Monitoring Plan (hereafter, the 2011 IFGMP) (LANL 2011, 205231, Appendix F) because of issues concerning the sampling system and anomalous odors noted by the sampling team collecting the water samples.

R-20 screen 2 (port P2A) is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA L based on the following observations for the four most recent sampling events.

- Field parameters meet stability criteria the screen is purged in accordance with SOP-5232 (Figure D2-R20-4 in Attachment D-2).
- Oxic conditions may be present as indicated, for example, by an average DO concentration of 2.5 mg/L, detections of NO_3+NO_2-N at 0.2 mg/L, and detections of ClO_4 at 0.2 µg/L (Tables D-3.0-1 and D-3.0-2). Based on results of an extended-purge event in January 2011, these conditions are representative of this location.
- No evidence is observed of the presence of residual organic materials; NH_3-N <0.1 mg/L, total Kjeldahl nitrogen (TKN) <0.1 mg/L, and acetone is not detected (Figure D-3.0-1).
- Evidence is observed of the possible presence of local contaminants. The average TOC concentration (2.1 mg/L, Table D-3.0-2) for the four most recent sampling events exceeds the maximum detected concentration in regional background groundwater (1.37 mg/L); toluene, TCE, and xylene isomers are consistently detected below their respective practical quantitation limits (PQLs) (Figure D-3.1-1). Possible sources of these constituents are discussed in section D-4.4.
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2; Figure D2-R20-5 in Attachment D-2) are stable and below UTLs for regional background groundwater.

- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <5 NTU (Table D-3.0-1). Al and Fe concentrations are nondetect or negligibly low in unfiltered samples (Table D-3.0-3).
- No evidence is observed of water chemistry significantly out of equilibrium with formation mineralogy. Concentrations of major cations and trace metals are stable; average concentrations are below UTLs for regional background, except for Ba concentrations (Figure D2-R20-6 in Attachment D-2). The average Ba concentration (170 µg/L, Table D-3.0-3) is above the UTL (57 µg/L) as well as above the 95th percentile concentration (81 µg/L) for regional background groundwater. The reason for this condition in R-20 screen 2 is not fully understood, but the stability of the Ba concentrations suggests they are representative of groundwater in the formation next to the screened interval.
- This screen is assigned to the watch list in the 2011 IFGMP (LANL 2011, 205231, Appendix F) because of anomalous odors noted by the sampling team collecting the water samples. The watch list is used to identify deep monitoring wells for which the reliability of water-quality data for certain constituents has issues or has not yet been established.

D-3.2 Well R-21

Well R-21 contains a single screen in the regional aquifer, upgradient of MDA G and downgradient of MDA L. This well serves as a background location for establishing background values for naturally occurring chemical and radionuclides in regional groundwater beneath the Pajarito Plateau and the Laboratory in GBIR, R3 (LANL 2007, 095817) and the GBIR, Revision 4 (hereafter GBIR, R4) (LANL 2010, 110535). This well also served as a background location for establishing background values for groundwater in deep wells screened in Tpf or Qct.

R-21 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA L based on the following observations.

- Field parameters meet stability criteria when the well is purged in accordance with SOP-5232 (Figure D2-R21-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. TOC <1 mg/L (Table D-3.0-2), NH_3-N <0.1 mg/L, TKN <0.1 mg/L, and acetone is not detected.
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2; Figure D2-R21-2 in Attachment D-2) are stable and below UTLs for regional background groundwater.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <5 NTU (Table D-3.0-1). Al and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R21-3 in Attachment D-2).
- No evidence is observed of the presence of local contamination at this location.

D-3.3 Well R-22

Well R-22 is currently inactive for water-quality sampling. Well R-22 was originally constructed as a multiscreen well equipped with a nonpurgeable Westbay sampling system for five intervals screened in

the regional aquifer (Table D-1.0-1). R-22 was redeveloped from April to July 2009, focusing on screens 1 and 5. Before redevelopment, geochemical conditions in screen 1 were sulfate-reducing and indicated the apparent presence of residual inorganic and organic chemicals associated with materials used downhole during drilling or well construction. Evaluation of the samples collected at the end of an extended purge of screen 1 from June to July 2009, indicated water quality had mostly stabilized and oxidizing regional aquifer water was being drawn into the screen (LANL 2009, 106796). A decision for a final sampling configuration for R-22 is pending.

Samples collected using the Westbay sampling system at this well may not provide reliable water-quality data for predrilling groundwater chemistry. Nonetheless, COPC detection statistics for samples collected from R-22 during this period of time are included in section D-4.0.

D-3.4 Well R-23i

Well R-23i contains a piezometer (port P1A) and two screens (ports P2A and P3a) in perched-intermediate groundwater beneath Pajarito Canyon downgradient of MDA G.

The R-23i piezometer (port P1A) is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA G based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R23i-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1.1 mg/L, NH_3-N <0.1 mg/L, TKN ≤0.1 mg/L, and acetone is not detected (Table D-3.0-2 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. However, this screen shows the presence of local contaminants that affect the applicability of some of the geochemical evaluation criteria. In particular, specific conductance (Table D-3.0-1) and concentrations of Na, alkalinity, Cl, and TDS (Table D-3.0-2; Figure D2-R23i-2 in Attachment D-2) are above UTLs for perched-intermediate background groundwater. Sulfate concentrations are also above the 95th percentile of the Tpf-Qct data set. Possible sources of these constituents are discussed in the Pajarito Canyon Investigation Report, Revision 1 (LANL 2009, 106939) and in section D-4.4.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is consistently below 5 NTU (Table D-3.0-1). Al and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R23i-3 in Attachment D-2).

R-23i screen 1 (port P2A) is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA G based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R23i-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials; TOC ≤1.1 mg/L, NH_3-N <0.1 mg/L, TKN <0.1 mg/L, and acetone is not detected (Table D-3.0-2 and Attachment D-1).

- No evidence is observed of the presence of residual inorganic drilling or construction products. However, this screen shows the presence of local contaminants that affect the applicability of some of the geochemical evaluation criteria. For example, although concentrations of Cl, SO_4, and TDS are below UTLs for perched-intermediate background groundwater, they are above corresponding 95th percentiles of the Tpf-Qct data set (Table D-3.0-2; Figure D2-R23i-4 in Attachment D-2). Possible sources of these constituents are discussed in the Pajarito Canyon Investigation Report, Revision 1 (LANL 2009, 106939) and in section D-4.4.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is consistently below 5 NTU (Table D-3.0-1). Al and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R23i-6 in Attachment D-2).

R-23i screen 2 (port P3A) is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA G based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R23i-7 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials; TOC ≤1.1 mg/L, NH_3-N <0.1 mg/L, TKN <0.1 mg/L, and acetone is not detected (Table D-3.0-2 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. However, this screen shows the presence of local contaminants that affect the applicability of some of the geochemical evaluation criteria. For example, although concentrations of Cl, SO_4, and TDS are below UTLs for perched-intermediate background groundwater, they are above corresponding 95th percentiles of the Tpf-Qct data set (Table D-3.0-2; Figure D2-R23i-8). Possible sources of these constituents are discussed in the Pajarito Canyon Investigation Report, Revision 1 (LANL 2009, 106939) and in section D-4.4.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is consistently below 5 NTU (Table D-3.0-1). Al and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R23i-9 in Attachment D-2).

D-3.5 Well R-23

Well R-23 contains a single screen in the regional aquifer beneath Pajarito Canyon downgradient of MDA G.

R-23 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA G based on the following observations.

- Field parameters meet stability criteria when the well is purged in accordance with SOP-5232 (Figure D2-R23-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >5 mg/L, NO_3+NO_2-N at 0.3 mg/L, and ClO_4 at 0.3 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Although TOC exceeds 1.1 mg/L in some samples (Table D-3.0-2), NH_3-N <0.1 mg/L, TKN <0.1 mg/L, and acetone is not detected (Attachment D-1). Diethylphthalate is frequently detected, generally below its PQL

(Attachment D-1); the origin of this SVOC is not known, but it is not a COPC known to be present in the vadose zone beneath MDA G.

- No evidence is observed of the presence of residual inorganic drilling or construction products. However, this screen may show the presence of local contaminants that affect the applicability of some of the geochemical evaluation criteria. For example, although concentrations of Cl and SO_4 are below UTLs for regional background groundwater, they are above corresponding 95th percentiles of the Tpf-Qct data set (Table D-3.0-2; Figure D2-R23-2 in Attachment D-2). NO_3+NO_2-N concentrations are above the UTL for regional groundwater as well as the corresponding 95th percentile of the Tpf-Qct data set. Possible sources of these constituents are discussed in the Pajarito Canyon Investigation Report, Revision 1 (LANL 2009, 106939) and in section D-4.4.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is consistently <5 NTU (Table D-3.0-1). Al and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3 and Figure D2-R23-3 in Attachment D-2).

D-3.6 Well R-32

Well R-32 contains a single screen in the regional aquifer, upgradient of MDA G and downgradient of MDA L.

Before 2007, well R-32 was equipped with a nonpurgeable Westbay sampling system (Table D-1.0-1). Some water-quality data from samples collected during this period may not be fully reliable indicators of predrilling groundwater chemistry. In particular, residual effects of drilling and construction in the deeper screen (port MP3A) included the presence of inorganic and organic chemicals used downhole and persistent iron- or sulfate-reducing conditions. R-32 was redeveloped and converted to a single-screen sampling configuration in 2007. The assessment presented below applies to the current sampling configuration. However, COPC detection statistics for samples collected from R-32 using the Westbay sampling system are included in section D-4.0.

R-32 is capable of providing reliable water-quality data for COPCs detected in the vadose zones beneath MDAs G and L based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R32-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic drilling materials. TOC <1 mg/L (Table D-3.0-2), and NH_3-N, TKN, and acetone generally are not detected in recent samples (Figure D-3.6-1; Attachment D-1). Bis(2-ethylhexyl)phthalate and toluene were detected in samples collected before 2010 but have not been detected in recent samples (Figure D-3.6-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. However, this screen may show the presence of local contaminants that affect the applicability of some of the geochemical evaluation criteria. For example, although concentrations of Cl, NO_3+NO_2-N, and SO_4 are below UTLs for regional background groundwater, they are above corresponding 95th percentiles of the Tpf-Qct data set (Table D-3.0-2; Figure D2-R32-2 in Attachment D-2). Possible sources of these constituents are discussed in the Pajarito Canyon Investigation Report, Revision 1 (LANL 2009, 106939) and in section D-4.4.

- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3 and Figure D2-R32-3 in Attachment D-2).

D-3.7 Well R-37

Well R-37 is a dual-screen well with screens in perched-intermediate groundwater and the regional aquifer, downgradient of MDA H.

R-37 screen 1 (port P1A) is capable of providing reliable water-quality data for tritium and organic COPCs detected in the vadose zone beneath MDA H based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R37-1 in Attachment D-2).
- Slightly reducing conditions may be present as indicated, for example, by consistent detections of DO ≤2 mg/L, but oxic conditions are indicated by NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2). The stability of these concentrations suggests they are reliable indicators of predrilling groundwater chemistry at this location (Figures D2-R37-1 and D2-R37-2 in Attachment D-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1.1 mg/L, NH_3-N <0.1 mg/L, total TKN ≤0.1 mg/L, and acetone is not detected (Table D-3.0-2 and Attachment D-1). Consistent detection of 1,4-dioxane (Attachment D-1) indicates the presence of local contamination of unknown origin; possible sources of this SVOC are discussed in section D-4.4.
- No evidence is observed of the presence of residual inorganic drilling or construction products. However, this screen shows the presence of local contaminants that affect the applicability of some of the geochemical evaluation criteria. In particular, specific conductance (Table D-3.0-1) and concentrations of Cl and SO_4 (Table D-3.0-2; Figure D2-R37-2 in Attachment D-2) are above UTLs for perched-intermediate background groundwater. Alkalinity, Na, and TDS concentrations are also above the corresponding 95th percentiles of the Tpf-Qct data set. Possible sources of these constituents are discussed in section D-4.4.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is consistently below 5 NTU (Table D-3.0-1). Al and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R37-3 in Attachment D-2).
- This screen is assigned to the watch list in the 2011 IFGMP (LANL 2011, 205231, Appendix F) because of minor drilling-related issues and evidence that groundwater in the screened interval may not have fully reequilibrated with the adjacent formation.

R-37 screen 2 (port P2A) is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA H based on the following observations.

- Field parameters meet stability criteria when the well is purged in accordance with SOP-5232 (Figure D2-R37-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).

- No evidence is observed of the presence of residual organic materials. TOC <1 mg/L (Table D-3.0-2), NH_3-N <0.1 mg/L, TKN <0.1 mg/L, and acetone is not detected (Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2; Figure D2-R21-2 in Attachment D-2) are stable and below UTLs for regional background groundwater and only slightly above corresponding 95th percentiles of the Tpf-Qct data set.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <5 NTU (Table D-3.0-1). Al and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R37-6 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.

D-3.8 Well R-38

Well R-38 contains a single screen in the regional aquifer upgradient of MDA G and downgradient of MDA L.

R-38 is capable of providing reliable water-quality data for COPCs detected in the vadose zones beneath MDAs G and L based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R38-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials from drilling or construction activities. Generally, TOC <1.1 mg/L and NH_3-N, TKN, and acetone are nondetects (Table D-3.0-2, Figure D-3.8-1). Bis(2-ethylhexyl)phthalate, benzene, chloromethane, and toluene were detected in 2009 but generally have not been detected in the most recent samples (Figure D-3.8-1 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2; Figure D2-R38-2 in Attachment D-2) are stable and below UTLs for regional background groundwater for regional background groundwater, and only slightly above corresponding 95th percentiles of the Tpf-Qct data set.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R38-3 in Attachment D-2).
- No evidence is observed of the presence of local contamination at this location.

D-3.9 Well R-39

Well R-39 contains a single screen in the regional aquifer, downgradient of MDA G.

R-39 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA G based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R39-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials from drilling or construction activities. Generally, TOC <1 mg/L and NH_3-N, TKN, and acetone are nondetects (Table D-3.0-2, Attachment D-1). Chloromethane and toluene were detected in samples collected in 2009 and 2010 but not in the most recent samples (Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2; Figure D2-R39-2 in Attachment D-2) are stable, below UTLs for regional background groundwater, and only slightly above corresponding 95th percentiles of the Tpf-Qct data set.
- The possible presence of minor quantities of formation solids in water-quality samples is indicated by the detection of Al and Fe concentrations in unfiltered samples. However, decreasing concentration trends indicate this condition will resolve in the near future. In addition, turbidity is <5 NTU (Table D-3.0-1), and concentrations of these two trace metals are nondetect in filtered samples (Table D-3.0-3; Figure D2-R39-3 in Attachment D-2).
- No evidence is observed of the presence of local contamination at this location.

D-3.10 Well R-40i

Well R-40i is a piezometer screened in the perched-intermediate zone, downgradient of MDA H and upgradient of MDA L.

R-40i is not capable at present of providing reliable water-quality data for organic COPCs detected in the vadose zones beneath MDAs H and L based on the observations listed below.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R40i-1 in Attachment D-2). However, the water is sudsy and has an odor.
- Reducing conditions are present as indicated, for example, by consistent observations of DO <2 mg/L, nondetects for NO_3+NO_2-N and ClO_4 , Fe >1000 µg/L in filtered samples, and Mn >300 µg/L (Tables D-3.0-1, D-3.0-2, and D-3.0-3; Figures D2-R40i-2 and D2-R40i-3 in Attachment D-2).
- Organic drilling products were used in this interval and residual organic materials are present as indicated by TOC >10 mg/L (Table D-3.0-2), detections of NH_3-N and TKN, and the sudsy condition of the water samples. Chloromethane and toluene were detected in samples collected in 2009 but not in the most recent samples (Attachment D-1).
- Residual inorganic drilling or construction products are present as indicated, for example, by concentrations of Na (average 22 mg/L, Table D-3.0-2) above the UTL of 12.2 mg/L for perched-intermediate background groundwater (Figure D2-R40i-2 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Concentrations of Al are nondetect in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R40i-3 in Attachment D-2).

- This well screen is capable of providing reliable data for tritium. Continued sampling of this well is proposed in the 2011 IFGMP for a limited set of analyses that include tritium (LANL 2011, 205231).
- This screen is assigned to the watch list in the 2011 IFGMP (LANL 2011, 205231, Appendix F) because of conditions noted above.
- No compelling evidence is observed of the presence of local contamination at this screened interval although this possibility cannot be ruled out at this time. However, the absence of consistent detections of tritium activity using a sensitive low-level analytical method supports the absence of contamination.

D-3.11 Well R-40

Well R-40 is a dual-screen well with screens in perched-intermediate and regional groundwaters. Well R-20 screen 1 samples perched-intermediate groundwater that is considered to be downgradient of MDA H and upgradient of MDA L. R-20 screen 2 samples regional groundwater upgradient (or "sidegradient") of MDA H (or downgradient if PM-2 is pumping) and upgradient of MDA L.

R-40 screen 1 is not capable of providing reliable water-quality data for COPCs detected in the vadose zones beneath MDAs H and L based on the following observations.

- The screen is located in a tight formation and cannot provide water for a 3–casing volume (CV) purge because the water level drops to the elevation of the pump intake after purging of 1 CV. The screened interval takes 2 wk to recover from purging of 1 CV. Not all field parameters have stabilized at the time samples are collected (Figure D2-R40-1 in Attachment D-2). Typically the screen has been purged dry, and samples are collected the following day.
- Sampling of this well screen is proposed to be discontinued in the 2011 IFGMP (LANL 2011, 205231). Monitoring is limited to water-level measurements for the reasons given above (LANL 2011, 205231, Appendix F).

R-40 screen 2 is capable of providing reliable water-quality data for COPCs detected in the vadose zones beneath MDAs H and L based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R40-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1 mg/L (Table D-3.0-2) and NH_3-N, TKN, and acetone are not detected (Attachment D-1). Toluene was detected in samples collected in 2009 and early 2010 but not in the most recent samples (Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2) are stable, below UTLs for regional background groundwater, and below corresponding 95th percentiles of the Tpf-Qct data set (Figure D2-R40-5 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are

generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R40-6 in Attachment D-2).

- This well screen is capable of providing representative data for all COPCs
- No evidence is observed of the presence of local contamination in this screened interval.

D-3.12 Well R-41

Well R-41 is a dual-screen well with screens in perched-intermediate and regional groundwaters, downgradient of MDA G. The upper screen (port P1A) has been dry since installation.

R-41 screen 2 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA G based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R41-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1 mg/L (Table D-3.0-2) and NH_3-N, TKN, and acetone are not detected (Attachment D-1). Chloromethane and toluene were detected in 2009 but have not been detected in the most recent samples (Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2) are stable and below UTLs for regional background groundwater although slightly above corresponding 95th percentiles of the Tpf-Qct data set (Figure D2-R41-2 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R41-3 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.

D-3.13 Well R-49

Well R-49 is a dual-screen well with both screens in the regional aquifer, downgradient of MDA G.

R-49 screen 1 is capable of providing reliable water-quality data for tritium and organic COPCs detected in the vadose zone beneath MDA G based on the following observations.

- Field parameters for the samples collected in 2011 meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R49-1 in Attachment D-2). The first two characterization samples (collected in 2010) did not provide stable field data for specific conductivity and turbidity, but this condition has been resolved in recent samples.
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1 mg/L (Table D-3.0-2) and NH_3-N, TKN, and acetone are not detected (Attachment D-1).

Chloromethane and toluene were detected in the first characterization sample collected in June 2009 but have not been detected in subsequent samples (Attachment D-1).

- No evidence is observed of the presence of residual inorganic drilling or construction products in recent samples. Geochemical conditions improved significantly following an extended purge of this screen on June 10–11, 2010. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2) are stable and below UTLs for regional background groundwater although slightly above corresponding 95th percentiles of the Tpf-Qct data set (Figure D2-R49-2 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R49-3 in Attachment D-2).
- No compelling evidence is observed of the presence of local contamination in this screened interval. The geochemical performance of this screen will continue to be reassessed as additional data become available.

R-49 screen 2 is capable of providing reliable water-quality data for tritium and COPCs detected in the vadose zone beneath MDA G based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R-49-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1 mg/L (Table D-3.0-2) and NH_3-N, TKN, and acetone are not detected (Attachment D-1). Chloromethane and toluene were detected in samples collected in March 2010 but not in any other samples (Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2) are stable and below UTLs for regional background groundwater although slightly above corresponding 95th percentiles of the Tpf-Qct data set (Figure D2-R49-5 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R49-6 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.

D-3.14 Well R-51

Well R-51 is a dual-screen well with both screens in the regional aquifer, upgradient of MDA H.

R-51 screen 1 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA H based on the following observations for the four most recent sampling events.

- Field parameters in recent samples meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R51-1 in Attachment D-2).

- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2) in recent samples.
- No evidence is observed of the presence of residual organic materials. TOC <1 mg/L (Table D-3.0-2), TKN, and acetone are not detected, and NH_3-N is not detected above 0.07 mg/L.
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS in the most recent samples (Table D-3.0-2) are stable and below UTLs for regional background groundwater (Figure D2-R51-2 in Attachment D-2). Na and SO_4 concentrations were elevated in the sample collected in October 2010 but otherwise have been stable and within the range of regional background values.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is <2 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R51-3 in Attachment D-2).

R-51 screen 2 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA H although it may not yet be capable of providing reliable water-quality data for some inorganic COPCs. Based on the following observations for the four most recent sampling events, water quality in the screened interval may not have completely equilibrated with the adjacent formation, particularly for sampling events before 2011:

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R51-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1 mg/L, NH_3-N is nondetect or detected <0.1 mg/L, and TKN is not detected. Acetone was detected only in samples collected in July 2010 and not in the preceding or three subsequent events.
- Some evidence is observed of the presence of a small component of residual inorganic drilling or construction products. Although concentrations of Na and SO_4 (Table D-3.0-2) are below UTLs for regional background groundwater (Figure D2-R51-5 in Attachment D-2), they exceed the range expected for site-specific background and decreased steadily for the last three sampling events.
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is generally stable and <5 NTU. Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Figure D2-R51-6 in Attachment D-2).
- Groundwater in this screen interval is expected to reequilibrate fully with native groundwater by the end of 2011.

D-3.15 Well R-52

Well R-52 is a dual-screen well with both screens in the regional aquifer, downgradient of MDA H.

R-52 screen 1 is capable of providing reliable water-quality data for tritium and COPCs detected in the vadose zone beneath MDA H based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R-52-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. In the most recent samples, TOC <1 mg/L (Table D-3.0-2) and NH_3-N, TKN, and acetone are not detected (Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2) are stable and below UTLs for regional background groundwater although slightly above corresponding 95th percentiles of the Tpf-Qct data set (Figure D2-R-52-2 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-52-3 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.

R-52 screen 2 is capable of providing reliable water-quality data for tritium and COPCs detected in the vadose zone beneath MDA H based on the following observations.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R-52-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. In the most recent samples, TOC <1 mg/L (Table D-3.0-2) and NH_3-N, TKN, and acetone are not detected (Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2) are stable and below UTLs for regional background groundwater although slightly above corresponding 95th percentiles of the Tpf-Qct data set (Figure D2-R-52-5 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-52-6 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.
- This screen is assigned to the watch list in the 2011 IFGMP (LANL 2011, 205231, Appendix F) because of anomalous odors noted by the sampling team collecting the water samples.

D-3.16 Well R-53

Well R-53 is a dual-screen well with both screens in the regional aquifer, downgradient of MDA L.

R-53 screen 1 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA L based on the following observations for the four most recent sampling events.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R53-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1 mg/L (Table D-3.0-2) and NH_3-N and TKN are not detected. Acetone was detected only in samples collected in July 2010 and not in the three subsequent events.
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS (Table D-3.0-2) are stable and below UTLs for regional background groundwater (Figure D2-R53-2 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <1 NTU (Table D-3.0-1). Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R53-3 in Attachment D-2).

R-53 screen 2 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA L based on the following observations for the four most recent sampling events.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R53-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. Generally, TOC <1 mg/L, NH_3-N is nondetect or detected <0.1 mg/L, and TKN is not detected. Acetone was detected only in samples collected in July 2010 and not in the preceding or three subsequent events.
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are stable and below UTLs for regional background groundwater (Figure D2-R53-5 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is generally stable and <1 NTU. Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Figure D2-R53-6 in Attachment D-2).

D-3.17 Well R-54

Well R-54 is a dual-screen well with both screens in the regional aquifer, upgradient of MDA L (or downgradient of MDA L if PM-2 is pumping).

R-54 screen 1 is capable of providing reliable data for tritium but may not yet be fully capable of providing reliable water-quality data for organic COPCs detected in the vadose zone beneath MDA L. Based on the following observations for the most recent sampling events, water quality in the screened interval may not have completely reequilibrated with the adjacent formation, particularly for sampling events before 2011:

- Some field parameters have not stabilized after 3 CVs have been purged (Figure D2-R54-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of NO_3+NO_2-N between 0.2 and 0.3 mg/L, and ClO_4 at 0.2 µg/L (Table D-3.0-2). However, DO concentrations below 2 mg/L (Table D-3.0-1) and $\delta^{15}N$ values heavier than background (Table D-3.0-4) indicate the presence of microbial activity associated with degradation of residual organics (see next bullet). These observations are typical for the first year of water-quality data following well completion.
- Residual organic materials may be present in the screened interval. Acetone is not detected, and NH_3-N and TKN are nondetect or detected <0.1 mg/L. However, TOC concentrations are variable and range from 0.6 mg/L to 7 mg/L for the four most recent sampling events (Table D-3.0-2).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are below UTLs for regional background groundwater but are more variable than is typical for a fully equilibrated screened interval (Table D-3.0-2; Figure D2-R54-2 in Attachment D-2).
- Formation solids may be present in water-quality samples. Although turbidity is <2 NTU at the time samples are collected, Fe and Mn concentrations are elevated in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R54-3 in Attachment D-2).
- This screen is assigned to the watch list in the 2011 IFGMP (LANL 2011, 205231, Appendix F) because of issues noted above.

R-54 screen 2 is capable of providing reliable water-quality data for COPCs detected in the vadose zone beneath MDA L based on the following observations for the four most recent sampling events.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R54-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials; TOC <1 mg/L, NH_3-N is nondetect or detected <0.1 mg/L, and TKN and acetone are not detected.
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are stable and below UTLs for regional background groundwater Table D-3.0-2; Figure D2-R54-5 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is generally stable and <1 NTU. Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R54-6 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.

D-3.18 Well R-55i

Well R-55i is a single-screen well in perched-intermediate groundwater, downgradient of MDA G.

R-55i is expected to be capable of providing reliable data for tritium and organic COPCs detected in the vadose zone beneath MDA G. However, this conclusion is preliminary because this is a relatively new well; presently, data are only available for two water-quality samples and a longer data record is needed.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R54-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N ≥0.2 mg/L, and ClO_4 ≥0.2 µg/L (Table D-3.0-2).
- Residual organic materials may be present in the screened interval. TOC >2 mg/L, acetone and toluene are detected, and TKN >0.1 mg/Lin the first sample (Table D-3.0-2 and Attachment D-1).
- The presence of residual inorganic drilling or construction products cannot be determined with certainty at this time. This screen shows the presence of local contaminants that affect the applicability of some of the geochemical evaluation criteria. In particular, specific conductance (Table D-3.0-1) and concentrations of alkalinity, Cl, NO_3+NO2-N, and TDS (Table D-3.0-2; Figure D2-R55i-2 in Attachment D-2) are above UTLs for perched-intermediate background groundwater. SO_4 concentrations are also above the corresponding 95th percentile of the Tpf-Qct data set. Possible sources of these constituents are discussed in section D-4.4 (Table D-3.0-2; Figure D2-R55i-2 in Attachment D-2).
- Formation solids may be present in water-quality samples. Although turbidity is <2 NTU at the time samples are collected, Fe and Mn concentrations are elevated in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R55i-3 in Attachment D-2).
- This screen is assigned to the watch list in the 2011 IFGMP (LANL 2011, 205231, Appendix F) because of its status as a new well.

D-3.19 Well R-55

Well R-55 is a dual-screen well with both screens in the regional aquifer, downgradient of MDA G.

R-55 screen 1 is capable of providing reliable data for tritium and organic COPCs detected in the vadose zone beneath MDA G.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R55-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Table D-3.0-2).
- No evidence is observed of the presence of residual organic materials; TOC <1 mg/L, NH_3-N is nondetect or detected <0.1 mg/L, and TKN and acetone are not detected (Table D-3.0-2 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are stable and below UTLs for regional background groundwater Table D-3.0-2; Figure D2-R55-2 in Attachment D-2).

- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <5 NTU. Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R55-3 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.

R-55 screen 2 is capable of providing reliable data for tritium and organic COPCs detected in the vadose zone beneath MDA G.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R55-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Table D-3.0-2).
- No evidence is observed of the presence of residual organic materials; TOC <1 mg/L, NH_3-N is nondetect or detected <0.1 mg/L, and TKN and acetone are not detected (Table D-3.0-2 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are stable and below UTLs for regional background groundwater Table D-3.0-2; Figure D2-R55-5 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <5 NTU. Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R55-6 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.

D-3.20 Well R-56

Well R-56 is a dual-screen well with both screens in the regional aquifer, upgradient of MDA G and downgradient of MDA L.

R-56 screen 1 is capable of providing reliable data for tritium and organic COPCs detected in the vadose zones beneath MDAs G and L.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R56-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Table D-3.0-2).
- No evidence is observed of the presence of residual organic materials; TOC <1 mg/L, NH_3-N is nondetect or detected <0.1 mg/L, and TKN and acetone are not detected (Table D-3.0-2 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are stable and below UTLs for regional background groundwater Table D-3.0-2; Figure D2-R56-2 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <5 NTU. Al and Fe concentrations are generally

nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R56-3 in Attachment D-2).

- No evidence is observed of the presence of local contamination in this screened interval.

R-56 screen 2 is capable of providing reliable data for tritium and organic COPCs detected in the vadose zones beneath MDAs G and L.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R56-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. TOC <1 mg/L and NH_3-N, TKN, and acetone are not detected (Table D-3.0-2 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are stable (Table D-3.0-2) and below UTLs for regional background groundwater (Figure D2-R56-5 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is generally stable and <1 NTU (Table D-3.0-1). Al is not detected and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R56-6 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is generally stable and <1 NTU. Al is not detected and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-2; Figure D2-R56-6 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.

D-3.21 Well R-57

Well R-57 is a dual-screen well with both screens in the regional aquifer, downgradient of MDA G.

R-57 screen 1 is expected to be capable of providing reliable data for tritium and organic COPCs detected in the vadose zone beneath MDA G. However, this conclusion is preliminary because this is a relatively new well; presently, data are available for only two water-quality samples and a longer data record is needed.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R57-1 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by consistent detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Table D-3.0-2).
- No evidence is observed of the presence of residual organic materials; TOC <1 mg/L, NH_3-N is nondetect or detected <0.1 mg/L, and TKN and acetone are not detected (Table D-3.0-2 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are stable and below UTLs for regional background groundwater Table D-3.0-2; Figure D2-R57-2 in Attachment D-2).

- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is stable and <5 NTU. Al and Fe concentrations are generally nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R57-3 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.
- This screen is assigned to the watch list in the 2011 IFGMP (LANL 2011, 205231, Appendix F) because of its status as a new well.

R-57 screen 2 is expected to be capable of providing reliable data for tritium and organic COPCs detected in the vadose zone beneath MDA G. However, this conclusion is preliminary because this is a relatively new well; presently, data are available for only two water-quality samples and a longer data record is needed.

- Field parameters meet stability criteria when the screen is purged in accordance with SOP-5232 (Figure D2-R57-4 in Attachment D-2).
- Oxic conditions are present as indicated, for example, by detections of DO >2 mg/L, NO_3+NO_2-N >0.2 mg/L, and ClO_4 >0.2 µg/L (Tables D-3.0-1 and D-3.0-2).
- No evidence is observed of the presence of residual organic materials. TOC <1 mg/L and NH_3-N, TKN, and acetone are not detected (Table D-3.0-2 and Attachment D-1).
- No evidence is observed of the presence of residual inorganic drilling or construction products. Concentrations of Na, Cl, SO_4, and TDS are stable (Table D-3.0-2) and below UTLs for regional background groundwater (Figure D2-R57-5 in Attachment D-2).
- No evidence is observed of the presence of a significant quantity of formation solids in water-quality samples. Turbidity is generally stable and <1 NTU (Table D-3.0-1). Al is not detected and Fe concentrations are nondetect or negligibly low in filtered and unfiltered samples (Table D-3.0-3; Figure D2-R57-6 in Attachment D-2).
- No evidence is observed of the presence of local contamination in this screened interval.
- This screen is assigned to the watch list in the 2011 IFGMP (LANL 2011, 205231, Appendix F) because of its status as a new well.

D-4.0 COPC DETECTIONS IN MONITORING WELLS

D-4.1 Screening Protocol

Sampling of the network wells for TA-54 began in 2001 and 2003 following the completion of R-22 and R-23, respectively. Since then, over 300 sampling events have taken place in the 21 wells. Water-quality data collected during these sampling events are screened against one-half of the groundwater cleanup level and against the Laboratory's groundwater background values (Attachment D-1). Selection of the screening values is described in section 5.1.2 of the corrective measures evaluation (CME) report and follows the approach prescribed for the development of groundwater cleanup levels in Section VIII of the Consent Order.

The outcome of the screening protocol is presented in frequency of detection tables that summarize detections of organic compounds as well as inorganic constituents detected above groundwater background concentrations (Attachment D-1 on DVD). The detection status for an analytical result is established using the combined set of laboratory-assigned validation qualifiers and reason codes

assigned during data validation. For detected constituents, the screening tables include summary information such as the total number of samples collected for each analyte at the location where it was detected; the numbers of detections; the mean and maximum detected values; the number of detections exceeding groundwater background values (for naturally occurring inorganic constituents); the number of detections exceeding the lowest applicable regulatory or risk-based screening levels; and the number of detections exceeding one-half the lowest applicable screening levels. Analytical data for field duplicates are included in the statistics presented in the frequency of detection tables.

D-4.2 Organic COPC Detections

Table D-4.2-1 presents a statistical summary of high-explosive and organic COPCs detected in deep monitoring wells specific to MDAs G, H, and L and scheduled for water-quality sampling under the 2010 IFGMP. This table includes monitoring wells specific to MDAs G, H, and L but for which sampling was discontinued in the 2010 IFGMP because of conversion to a different sampling configuration or abandonment following removal of the Westbay sampling system (port designations “MP”). As shown in Table D.4.2-1, 71 organic constituents have been detected, including 22 SVOCs, 26 VOCs, 6 high explosive compounds, 5 dioxins/furans, 2 polychlorinated biphenyl (PCB) compounds, and 10 pesticides.

The majority of these cases are sporadic detections at low concentrations at or below the PQL of the analytical method. Of the 71 organic constituents, only 21 have been detected more than once in the same screened interval, and it is important to note this statistic includes analytes detected in field duplicates such that two detections of a given analyte may occur in a single sampling event.
Table D-4.2-2 summarizes the occurrences of the 21 organic constituents detected more than once at the same location for more than one sampling event. Table D-4.2-3 shows detected and nondetected organic analytes with PQLs greater than applicable regulatory standards.

Among the detected organic compounds, 11 have been detected at concentrations that exceed one-half the lowest applicable groundwater cleanup level (standard) determined following the approach in the Consent Order, Section VIII: benzene (R-38); benzo(a)pyrene (R-22); benzo(b)fluoranthene (R-22 and R-55); bis(2-ethylhexyl)phthalate (R-22, R-32, R-37, R-38, R-40, and R-54); 1-4-dioxane (R-20, R-37, and R-38); indeno(1,2,3-cd)pyrene (R-55); methylene chloride (R-23 and R-49); 4-methylphenol (R-22); pentachlorophenol (R-22); phenol (R-22); and TCE (R-20).

Among the detected organic compounds, nine have been detected at concentrations that exceed the lowest applicable groundwater cleanup level (standard): benzene (R-38); benzo(a)pyrene (R-22); benzo(b)fluoranthene (R-22 and R-55); bis(2-ethylhexyl)phthalate (R-23, R-32, R-38, and R-54); 1,4-dioxane (R-20); indeno(1,2,3-cd)pyrene (R-55); 4-methylphenol (R-22); pentachlorophenol (R-22); and phenol (R-22) (Table D.4.2-1)

Review of the data provided in Table D.4.2-1 show the following.

Benzene

At well R-38, benzene was detected at 6.34 µg/L, which is above the EPA MCL of 5 µg/L, in the first sample collected in February 2009. Benzene was detected below the MCL later in 2009 and has not been detected since in this well.

Benzo(a)pyrene

At well R-22 screen 5 (port MP5A), benzo(a)pyrene was detected at 0.23 µg/L, which is slightly above the EPA MCL of 0.20 µg/L and below the PQL of 1 µg/L. This sample was collected in December 2001 from samples collected between March 2001 and February 2009.

Benzo(b)fluoranthene

The detections of benzo(b)fluoranthene above the EPA tap standard of 0.29 µg/L were from samples collected at wells R-22 and R-55.

- At well R-22 screen 5 (port MP5A), it was detected at 0.4 µg/L, which is above the standard but below the PQL of 1 µg/L. The sample was collected and analyzed in December 2001 from samples collected between March 2001 and February 2009.
- At well R-55 screen 2 (port P2A), it was detected at 0.42 µg/L, which is above the standard but below the PQL of 1 µg/L. The sample was collected in the first sampling event during September 2010, but benzo(b)fluoranthene was not detected in the two subsequent sampling events.

Bis(2-ethylhexyl)phthalate

The detections of bis(2-ethylhexyl)phthalate above the EPA MCL standard of 6 µg/L were from samples collected at wells R-23, R-32, R-38, and R-54.

- At well R-23, it was detected at 7.6 µg/L, which is above the standard but below the PQL of 10 µg/L, in December 2003. This was the only time between December 2003 and April 2011 that bis(2-ethylhexyl)phthalate was detected at this well.
- At well R-32, it was detected at 6 µg/L, which is equivalent to the standard but below the PQL of 10 µg/L in June 2008. It has not been detected at this well in samples collected between June 2009 and May 2011.
- At well R-38, it was detected 3 times (out of 12 analyses) above the standard between February 2009 and May 2009. The maximum concentration was 35.6 µg/L, and the average concentration was 8.3 µg/L.
- At well R-54 screen 1(port P1A), it was detected at 11.2 µg/L, which is above the standard. This sample was the first sample collected from this well screen in February 2010. It has not been detected at this screen in samples collected between June 2010 and May 2011.

Dioxane(1,4-)

At well R-20 screen 2 (port P2A), 1,4-dioxane was detected at 61.4 µg/L, which is above the EPA tap water standard of 6.7 µg/L. This analyte has been detected only once above the standard using EPA Method 8260. This method has been discontinued for this analyte in favor of EPA Method 8270. Dioxane(1,4-) has not been detected using EPA Method 8270 from 2009 to 2011.

At well R-37 screen 1 (port P1A), 1,4-dioxane has been detected above one-half the EPA tap water standard of 6.7 µg/L, but it has not exceeded the standard.

Indeno(1,2,3-cd)pyrene

At well R-55 screen 2 (port P2A), indeno(1,2,3-cd)pyrene was detected at 0.466 µg/L, which is above the EPA tap standard of 0.29 µg/L but below the PQL of 1 µg/L. This sample was collected in September 2010. Indeno(1,2,3-cd)pyrene has not been detected in samples collected at this well screen between February and April 2011.

Methylphenol(4-)

At well R-22 screen 4 (port MP4A), 4-methylphenol was detected at 210 µg/L, which is above the EPA tap standard of 180 µg/L and the PQL of 10 µg/L. It was detected above the standard in one out of seven samples collected from this location and analyzed for 4-methylphenol.

Pentachlorophenol

At well R-22 screen 5 (port MP5A), pentachlorophenol was detected at 6.19 µg/L, which is above the EPA MCL of 1 µg/L but below the PQL of 10 µg/L. It was detected above the standard in one out of eight samples collected from this well screen and analyzed for pentachlorophenol.

Phenol

At well R-22 screen 4 (port MP4A), phenol was detected at 32 µg/L which is above the New Mexico groundwater standard of 5 µg/L. It was detected above the standard in one out of seven samples collected from this screen and analyzed for phenol.

At well R-22 screen 5 (port MP5A), phenol was detected at 19 µg/L which is above the New Mexico groundwater standard of 5 µg/L. It was detected above the standard in one out of eight samples collected from this screen and analyzed for phenol.

D-4.3 Inorganic COPC Detections above Screening Levels

Table D-4.3-1 presents a statistical summary of inorganic constituents detected above one-half standard or full standard in deep monitoring wells specific to MDAs G, H and L and scheduled for water-quality sampling under the 2010 IFGMP. Table D-4.3-1 also presents a statistical summary of inorganic constituents detected above one-half standard or the standard for monitoring wells specific to MDAs G, H or L but for which sampling was discontinued in the 2010 IFGMP because of conversion to a different sampling configuration or abandonment following removal of the Westbay sampling system (port designations “MP”). As shown in this table, 11 inorganic constituents have been detected above one-half standard, including fluoride, nitrate-nitrite, TDS, and 8 metals in filtered samples. The majority of these cases are associated with the first year or two following well completion or redevelopment, or with a screened interval impacted by residual effects of drilling or redevelopment. Table D-4.3-2 summarizes the occurrences of the 11 inorganic constituents detected above one-half standard more than once at the same location for more than one sampling event.

Among inorganic COPCs, eight constituents have been detected above the lowest applicable groundwater standard (Table D-4.3-1). They include two general inorganics (nitrate-nitrite and total dissolved solids) and six metals (aluminum, antimony, arsenic, iron, lead, and manganese).

Review of the data provided in Table D-4.3-1 show the following:

Nitrate-Nitrite

The only detection of nitrate-nitrite above the EPA MCL of 10 mg/L was 748 mg/L at R-20 screen 1 (port P1A). This is most likely the result from a sample that was improperly preserved with nitric acid instead of the required sulfuric acid. The remaining nitrate-nitrite detections from the TA-54 monitoring network range from 0.01 mg/L to 3.88 mg/L.

Total Dissolved Solids

At well R-23, the concentration of total dissolved solids (2900 mg/L) exceeds the New Mexico groundwater standard of 1000 mg/L appears to be an analytical reporting error because such a high concentration is inconsistent with concentrations reported for individual dissolved constituents, none of which are out of line with the overall stable geochemical trends at this well.

Aluminum

At well R-32, the reanalysis of aluminum in the one sample detected at 6850 µg/L, which is above the New Mexico groundwater standard of 5000 µg/L, resulted in a nondetect value. Therefore, the 6850 µg/L result is suspect.

Antimony

At well R-40 screen 1 (port P1A), the two antimony results detected above the EPA MCL were collected in October 2010. No results were detected above the MCL before or after this sampling event.

Arsenic

At well R-20 screen 3 (port MP3A), the one detection of arsenic at 10.6 µg/L, which is above the EPA MCL of 10 µg/L. This well screen has now been plugged and abandoned because of residual effects of drilling products.

Iron

The detections of iron above the NM groundwater standard of 1000 µg/L were from samples collected at wells R-20, R-22, R-32, R-40, and R-54.

- For wells R-20 (port MP3A) and R-32 (port MP3A), the screens have been plugged and abandoned because of residual effects of drilling products.
- Eighteen of the remaining detections were at well R-22, which is off-line and a decision for its final sampling configuration is pending.
- At well R-32, the one result detected (3850 µg/L) above the standard is suspect because the unfiltered sample taken at the same time was nondetect.
- At well R-40i, the five detections above the standard may be attributed to reducing conditions at this screen (see section D-4.4).
- At well R-54 screen 1 (port P1A), iron was detected above the standard in three of the six samples. The average detected concentration at this screen was 1548 µg/L.

Lead

The one detection of lead above the New Mexico groundwater standard of 15 µg/L (19.7 µg/L) was from a sample collected at R-22 screen 3 (port MP3A). R-22 is currently off-line and a decision for its final sampling configuration is pending.

Manganese

The detections of manganese above the New Mexico groundwater standard of 200 µg/L were from samples collected at wells R-20, R-22, R-23, R-32, R-40, R-54, and R-55i.

- At well R-20 screen 2 (port MP2A), five detections were above the standard before well rehabilitation. Results were below New Mexico groundwater standard after well rehabilitation.
- At well R-20 screen 3 (port MP3A) and R-32 screen 3 (MP3A), the screens have been plugged and abandoned because of residual effects of drilling products.
- Twenty-one of the remaining detections were at well R-22, which is currently off-line and a decision for its final sampling configuration is pending.
- Of the 25 samples analyzed for manganese at R-23, one result was detected above the standard. This was only detected in the first sampling event at this well.
- At well R-40 screen 1 (port P1A), only one result (400 µg/L) out of seven was detected above the standard in December 2009.
- At well R-40i, manganese was consistently detected above the standard. The average concentration at this location is 301 µg/L.
- At well R-54 screen 1 (port P1A), manganese was detected above the standard in three of the six samples at this screen.
- At well R-55i, manganese was consistently detected above the standard. The average concentration at this location is 528 µg/L.

For informational purposes, Table 4.3-3 presents detections of radionuclides, including tritium, in the TA-54 groundwater monitoring wells.

D-4.4 COPC Sources

Sources of the COPCs detected in deep groundwater wells have not been determined with certainty. Four candidate sources are discussed here.

COPCs from MDA L

Among the three vapor-phase organics detected at highest concentrations in the vadose zone beneath MDA L (TCA, TCE, and PCE), only TCE has been detected in any of the monitoring wells near MDA L. Two primary lines of evidence indicate that MDA L is not the likely source of the TCE or other organics detected in the seven regional wells nearest to MDA L. First, TCA, the VOC detected at the highest concentration in the vapor phase below MDA L, including at the deepest port located within the basalt (Figure B-3.1-9 of Appendix B of the MDA L CME report), has not been detected in any of the six regional wells that are downgradient of MDA L. Secondly, other organic analytes detected in the vapor phase beneath MDA L are at relatively low levels in the vadose zone monitoring wells compared with those observed for the three main vadose-zone VOCs.

Indications are that the largely sporadic detections of VOCs in regional groundwater beneath MDA L (as summarized in section D-4.2 and presented for selected constituents detected in well R-20 in Figure D-3.1-1) are not likely to be associated with the vapor-phase contamination beneath and sourced from MDA L. However, there is uncertainty related to transport of VOCs present in the vadose zone beneath MDA L through the Cerros del Rio basalt toward groundwater, as described in the conceptual site model (section 4 of this report) and in Appendix C of the MDA L CME report. The pathway is considered to be potentially complete, and remediation of the vapor plume is recommended in section 9 of the MDA L CME to break the potential pathway.

COPCs from MDA G

The vapor-phase VOCs detected at highest concentrations in the pore gas at MDA G are TCA; 1,1,2-trichloro-1,2,2-trifluoroethane; TCE, 1,1-dichloroethene; 1,1-dichloroethane; and PCE (LANL 2010, 108496, Table 3.0-2). Of these six VOCs, only TCE has been detected in the monitoring wells downgradient of MDA G (Tables D-4.2-1 and 4.2-2). Two primary lines of evidence indicate MDA G is not the likely source of the TCE or other organics detected in the deep groundwater wells downgradient of MDA G. First, none of the VOCs detected at the highest concentrations in the vapor phase below MDA G have been detected in the six regional wells closest to MDA G; the location at which TCE was detected once (R-23i) is considerably downgradient of MDA G and is along a potential line of infiltration beneath Pajarito Canyon. Secondly, the VOCs detected with the greatest frequency in the wells closest to MDA G—chloromethane and toluene—are either not detected in the vapor plume beneath MDA G or else are detected only at relatively low levels. Therefore, indications are that the largely sporadic detections of VOCs in regional groundwater immediately downgradient of MDA G (as summarized in Tables D-4.2-1 and D-4.2-2) are not associated with the vapor-phase contamination beneath and sourced from MDA G. However, there is uncertainty related to transport of VOCs present in the vadose zone beneath MDA G through the Cerros del Rio basalt toward groundwater, as described in the conceptual site model (section 4 of the MDA G CME report). The pathway is considered to be potentially complete, and remediation of the vapor plume is recommended in section 9 of the MDA G CME to break the potential pathway.

COPCs from MDA H

Toluene and 1,4-dioxane have been detected in wells downgradient of MDA H (Tables D-4.2-1 and D-4.2-2). Although it is conceivable that these constituents are present because of vapor-phase transport beneath MDA H, this source is not likely given the extremely low VOC concentrations in the vapor-phase beneath MDA H (Table B-2.3-1 of the MDA H CME report) and because 1,4-dioxane is a semivolatile compound.

COPCs from TA-18 or Other Potential Release Sites in the Pajarito Canyon Watershed

R-20 is located beneath Pajarito Canyon downgradient of TA-18 and near a zone of enhanced infiltration (LANL 2009, 106939, section 7.2.1 and Appendix H). Former septic systems at TA-18 are a potential source of VOCs in the canyon. Elevated nitrate concentrations to 65 ft at well R-20 suggest the presence of a driving force for the transport of soluble contaminants in alluvial groundwater into the underlying bedrock at the confluence of Threemile Canyon with Pajarito Canyon. In addition, borehole samples and alluvial groundwater samples have indicated the presence of inorganic, organic, and radionuclide COPCs in the subsurface beneath the canyon bottom (LANL 2009, 106939). Subsurface samples to depths of 180 ft below ground surface (bgs) will be collected near two former sanitary lagoons [Consolidated Unit 18-001(a)] and an inactive septic system [Solid Waste Management Unit 18-003(e)] in TA-18 as part

of the lower Pajarito Canyon Aggregate Area investigation (LANL 2010, 111328). These units are located approximately 2500 ft up- and downcanyon of R-20, respectively, and will provide information regarding VOCs and other constituents that were potentially released to Pajarito Canyon.

TCE, xylene[1,3], and xylene[1,4] are detected in regional aquifer water collected from the lower screen of R-20. The concentrations and the concentration histories for these constituents both appear to be strongly correlated (Figure D-3.1-1). However, their distributions in the vapor plume at MDA L are dissimilar. For example, based on data collected from the third quarter of fiscal year 2009 through the second quarter of 2010, xylene[1,3] and xylene[1,4] were detected at low levels in only 7 ports in 4 vapor monitoring wells, with 6 of these ports located east of the MDA L fence line; TCE and TCA are detected in all 25 boreholes and 89 ports sampled, with maximum concentrations occurring within the MDA L fence line and close to the disposal units (LANL 2010, 109955). Xylene[1,3] and xylene[1,4] concentrations are less than 1% of TCE concentrations in collocated samples. It seems unlikely that the few low-concentration xylene detections in the vapor plume at MDA L would manifest as detectable concentrations at R-20 that are correlated to the TCE concentrations, especially given they are not collocated. In addition, it seems unlikely that TCA would be absent at R-20 if the other constituents are from MDA L, given that the TCA and TCE are well correlated in the deep portion of the vapor plume (Figure B-3.1-10 of the MDA L CME report). This analysis suggests a source other than MDA L for the TCE and xylenes detected at R-20. However, a caveat of this analysis is that it is based on current-day vapor distributions. If the distributions of TCA, TCE, and the xylene constituents within the vapor plume beneath MDA L were significantly different in the past, this conclusion may not be correct.

R-23 and R-23i are located within Pajarito Canyon downgradient of TA-18. Borehole samples and alluvial groundwater samples have indicated the presence of inorganic, organic, and radionuclide COPCs in the subsurface beneath the canyon bottom (LANL 2009, 106939). Water levels at well R-23i appear to be impacted by surface water flow and alluvial water levels in Pajarito Canyon, especially at alluvial well PCO-3. Infiltration near R-23i and R-23 may be focused through the Cerros del Rio basalt, which is located close to the surface in this part of the canyon (LANL 2009, 106939). Therefore, it is possible the water chemistry at wells R-23i and R-23 may be impacted by surface water and alluvial groundwater in Pajarito Canyon.

Lateral flow along perching horizons may transport contaminants from nearby wet canyon sources such that they are detected in wells near MDA H. For example, elevated concentrations of 1,4-dioxane, chloride, perchlorate, and tritium are present at intermediate well MCOI-6 in Mortandad Canyon (LANL 2006, 094161); these constituents could potentially be transported southward toward R-37 (Figures E-2.1-3 and E-2.1-4). Similarly, chloride, 1,4-dioxane, and tritium are observed at elevated concentrations in upcanyon sources in Pajarito Canyon (e.g., at shallow wells 03-B-10 and 03-B-13). These contaminants may be transported toward R-37 by means of infiltration in the canyon floor of Pajarito Canyon and by lateral flow along perching horizons in the vadose zone. Even if not present in the source, concentrations of many major ions as well as trace metals are likely to be altered from natural conditions as a result of water-rock interactions along the flow path if contaminants are present in the groundwater. This mechanism could account for slightly elevated concentrations of chloride, magnesium, iron, manganese, and molybdenum detected in perched-intermediate groundwater.

Contaminants from Residual Materials or Products Used Downhole

A large proportion of the VOC and SVOC detections occur during the initial year of sampling or in the first year following screen rehabilitation and sampling-system conversion activities. In these cases, the analyte typically shows a maximum concentration in the first one or two sampling rounds and decreases steadily thereafter because of its gradual removal from the screen interval via advective flow, purging, and

biodegradation. Organic VOC detections frequently occur along with elevated concentrations of total organic carbon, acetone, or other common indicators of residual organic products. Organic analytes that may be present in residual downhole products primarily as a result of their introduction into the product during the manufacturing process include acetone, toluene, benzene, and the plasticizers bis(2-ethylhexyl)phthalate and diethylphthalate.

Elevated iron and manganese concentrations at R-40i are thought to be related to reducing conditions caused by the presence of residual organic drilling products remaining at this well screen (section D-3.10). Temporarily elevated concentrations of constituents are also commonly observed during the first few sampling events following well completion or installation of a sampling system from suspended particulates or colloidal material from the formation or from residual mixing of groundwater from higher saturated zones. With time, these constituents gradually approach predrilling concentrations as the interval is flushed by ambient groundwater flow. However, this natural return to equilibrium conditions is quite prolonged at some screens, such as R-40 screen 1, because of the extremely low permeability of the screened interval (section D-3.11 and Appendix E) and may account for the continued presence of zinc in groundwater at R-40 screen 1. Drilling products or materials used downhole also cannot be ruled out as sources of trace metals because of their presence in lubricants and greases, and 1,4-dioxane may be present in products that contain diethylene glycol.

Sporadic Low-Level Detections

Some of the sporadic low-level detections may be the result of field or laboratory contamination or analytical errors. For example, acetone, 2-butanone, chloromethane, and toluene are among the VOCs detected with the greatest frequency in equipment blanks, field blanks, and field trip blanks collected during groundwater sampling events.

Analytical error may also be the case for the single detection of 1,4-dioxane reported for R-20 screen 2 (61 µg/L for a sample collected on September 18, 2008) obtained as part of the VOC analytical suite using EPA Method 8260. This analytical method is prone to false detections of 1,4-dioxane, which is now analyzed as part of the SVOC analytical suite using the more sensitive EPA Method 8270. Dioxane[1,4-] has not been detected in R-20 screen 2 samples analyzed using the more sensitive method. Laboratory contamination is the also likely cause for the improbably high nitrate-nitrite concentration reported for R-20 screen 1 (748 mg/L as nitrogen for a sample collected on August 3, 2010; Table D-4.3-1).

Analytical error may also be the case for the single detections of benzo(a)pyrene, benzo(b)fluoranthene, 4-methylphenol, and phenol reported for screened intervals at well R-22.

Groundwater characterization and monitoring is ongoing at TA-54 in accordance with annual revisions to the IFGMP. Monitoring frequency and analyte suites are specified in annual updates to the IFGMP.

D-5.0 CONCLUSIONS

The analysis of existing groundwater monitoring data presented in this appendix suggests a low probability that constituents detected in perched-intermediate and regional groundwater at TA-54 are because of contaminant transport from the three TA-54 MDAs.

At MDA L, the analysis of existing groundwater monitoring data considered in light of the vapor transport model presented in Appendix B of the MDA L CME suggests a low probability that the VOCs detected in the regional aquifer in the vicinity of MDA L are from vapor-phase transport from the MDA L VOC vapor plume under the assumption that the current soil-vapor-phase contaminant concentrations are

representative of the source contaminant concentrations in the past. The analysis indicates that if the VOCs detected in the groundwater are associated with MDA L, then detectable concentrations of TCA, TCE, and numerous other compounds found in the MDA L plume should also be present.

The analysis of existing groundwater monitoring data presented in this appendix suggests a low probability that the organic COPCs detected in the perched-intermediate zone or in the regional aquifer downgradient of MDA G are from vapor-phase transport from the MDA G VOC vapor plume. Detections at wells immediately downgradient of MDA G are sporadic, and none of the detected compounds has been consistently detected beyond the first 2 yr following well completion or installation of a sampling system. The analysis also indicates that if the VOCs detected in the groundwater are associated with MDA G, then detectable concentrations of TCA and several other VOCs found in the MDA G plume should also be present.

Based on the preceding analysis, no compelling evidence indicates contaminants sourced at MDA H are present at any MDA H groundwater monitoring wells. Although 1,4-dioxane may be a local contaminant in the perched-intermediate groundwater at R-37, sources other than MDA H are more likely. A longer period of record for MDA H monitoring wells as well as for other wells in the TA-54 groundwater monitoring network will help in an integrated fashion to distinguish potential sources of contaminants.

Although groundwater data do indicate that VOCs have reached groundwater beneath TA-54, there is uncertainty related to transport of VOCs present in the vadose zone beneath MDAs L and G through the Cerros del Rio basalt toward groundwater, as described in the conceptual site models (section 4 of the MDAs L and G CME reports). The pathway is considered to be potentially complete based on this uncertainty, and remediation of the vapor plume is recommended in those CMEs to break the potential pathway. Remediation is not recommended for MDA H because of the very low VOC concentrations and inventory present at that site.

D-6.0 REFERENCES

The following list includes all documents cited in this appendix. 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 New Mexico Environment Department 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.

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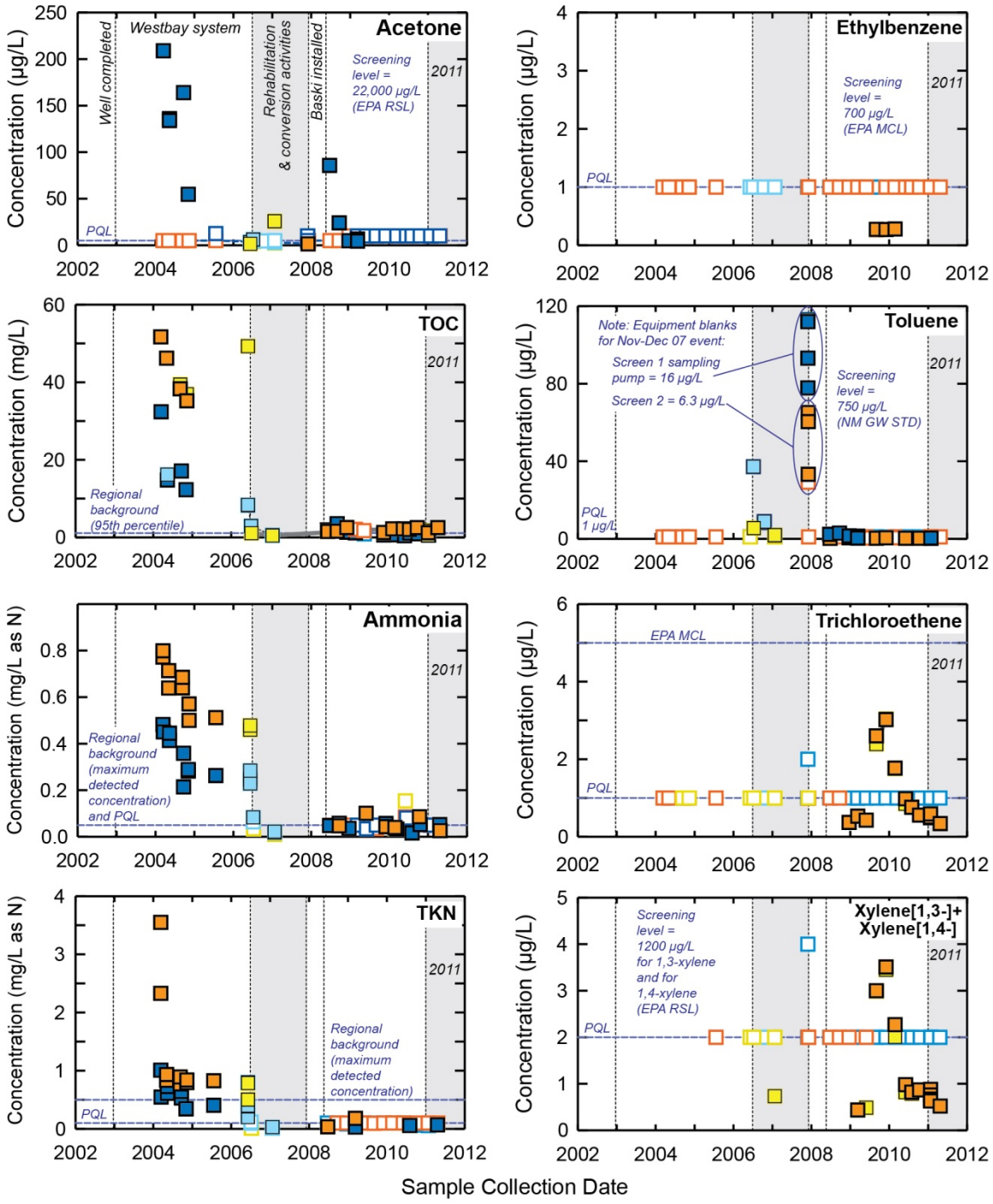
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	Screen 1	Screen 2
Primary sample	Detect / Nondetect	Detect / Nondetect
Field duplicate or redevelopment sample	Detect / Nondetect	Detect / Nondetect
Data source: LANL water-quality database		

Notes:
1) Practical Quantitation Limits (PQL) and screening levels from 2010 Interim Plan (LANL 2010, 109830, section C-4.1).
2) EPA MCL = EPA maximum contaminant level; EPA RSL = EPA regional screening level (for tapwater); NM GW STD = New Mexico Groundwater Human Health Standard
3) Regional background = upper limit for background regional groundwater (LANL 2007, 095817, Table 4.2-3).

Figure D-3.1-1 Concentration trends for selected organic chemicals and indicators of residual organic drilling products in R-20 screens 1 and 2

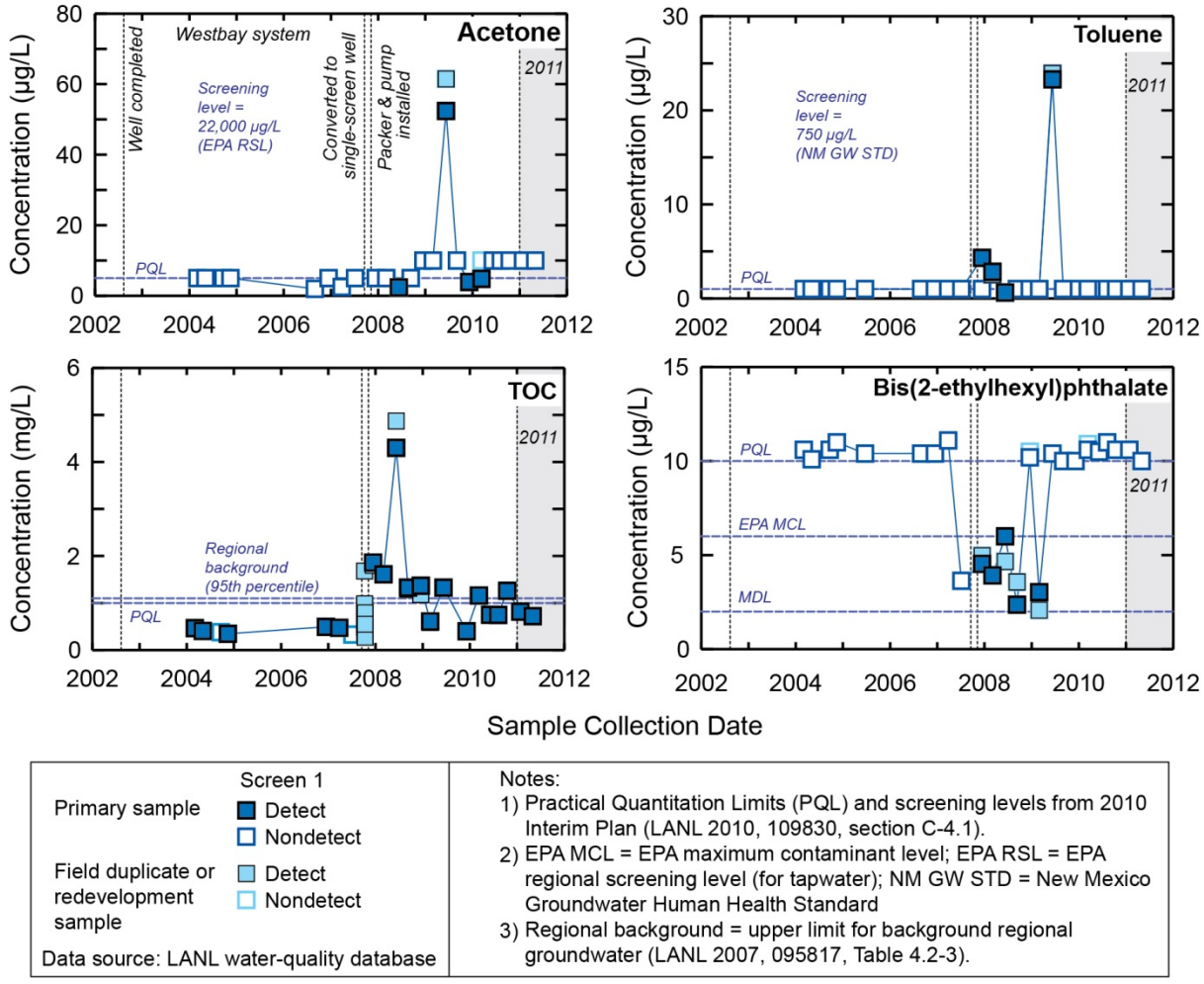
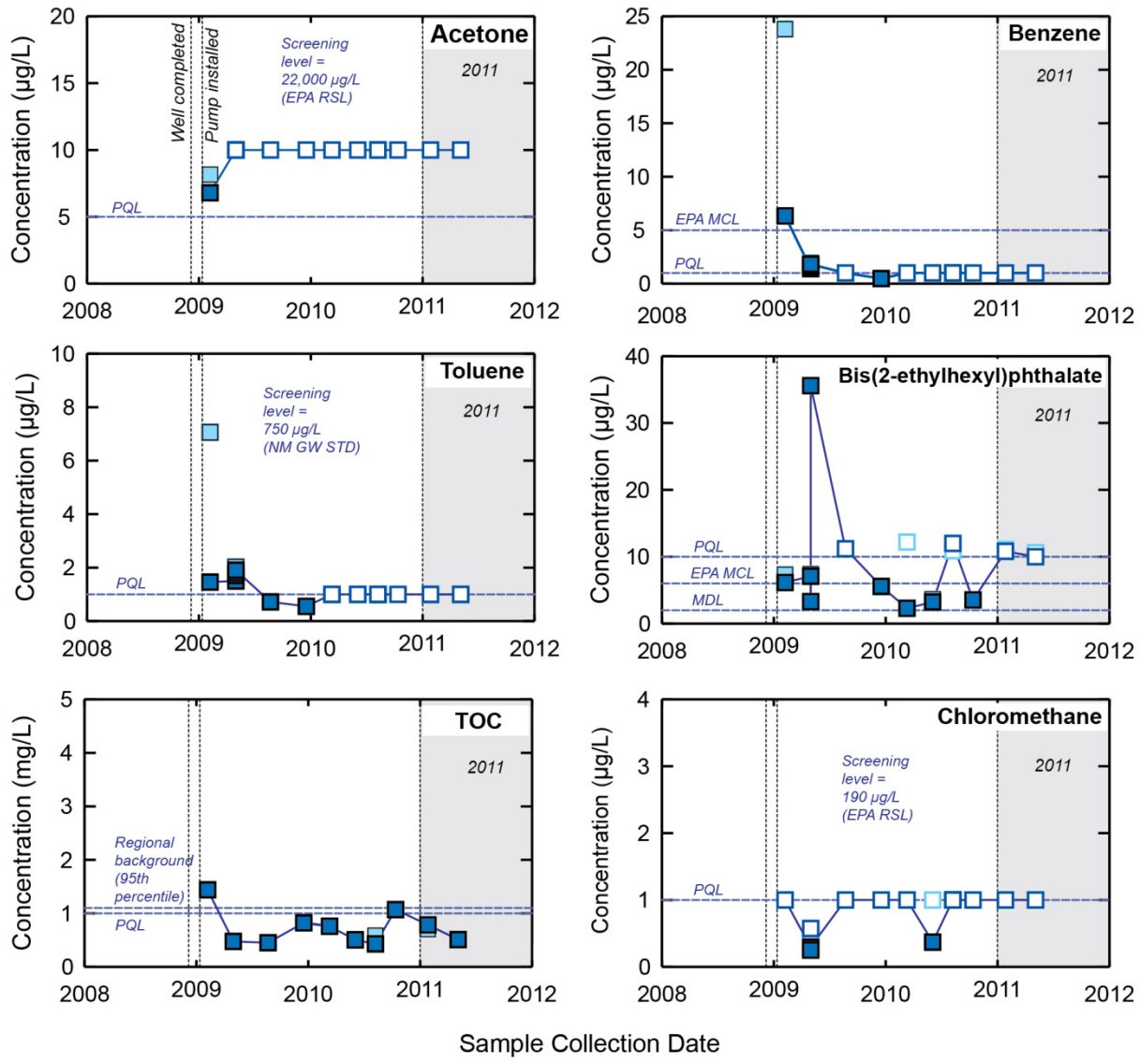


Figure D-3.6-1 Concentration trends for selected organic chemicals and indicators of residual organic drilling products in R-32



Primary sample: Detect / Nondetect Field duplicate: Detect / Nondetect Data source: LANL water-quality database	Notes: 1) Practical Quantitation Limits (PQL) and screening levels from 2010 Interim Plan (LANL 2010, 109830, section C-4.1). 2) EPA MCL = EPA maximum contaminant level; EPA RSL = EPA regional screening level (for tapwater); NM GW STD = New Mexico Groundwater Human Health Standard 3) Regional background = upper limit for background regional groundwater (LANL 2007, 095817, Table 4.2-3).

Figure D-3.8-1 Concentration trends for selected organic analytes and indicators of residual organic drilling products in R-38

Table D-1.0-1
Perched-Intermediate and Regional Wells in the TA-54 Monitoring Well Network

Well	Screen and Port Designation	Depth (ft bgs)	Total No. of Sampling Events[a]	Earliest Sampling Event	Most Recent Sampling Event	Sampling System	Chronology of Events Relevant to Groundwater Sampling
R-20	Screen 1 Port P1A	905	6	11-Mar-04	6-Jun-06	Westbay	• Multiple-screened regional well was completed on 15-Sept-02. Westbay multiport sampling system was installed on 18-Jan-03. • Westbay system was removed 28-Jun-06; screens 1, 2, and 3 isolated by temporary packers. • Packers were removed on 12-Nov-07 for redevelopment, abandonment of screen 3, and testing activities. Single packer was installed between screens 1 and 2 on 05-Dec-07. • Screen 3 was plugged and abandoned on 18-Nov-07 because of unfavorable geochemical conditions resulting from residual drilling, construction, and development products. • Baski dual-pump sampling system and Baski k-packer were installed on 22-May-08 (LANL 2008, 103100). • Potential cross-flow occurred between screened intervals in 2009 because of underinflated packer; water-quality samples not affected (LANL 2010, 108783). • Extended purge of screen 1 was conducted from 26-Jan-11 to 27-Jan-11; extended purge of screen 2 was conducted 21-Jan-11. The pump in screen 1 malfunctioned during the extended purge event and is scheduled for replacement in 2011.
			4	6-Jul-06	30-Nov-07	Temporary packers	
			13	21-Jun-08	20-Apr-11	Baski system	
	Screen 2 Port P2A	1147	6	10-Mar-04	7-Jun-06	Westbay system	
			3	8-Jul-06	4-Dec-07	Temporary packers	
			13	23-Jun-08	25-Apr-11	Baski system	
	Screen 3 Port MP3A	1330	6	9-Mar-04	8-Jun-06	Westbay system	
			4	7-Jul-06	19-Jan-07	Temporary packers	
R-21	Single	889	25	31-Mar-04	19-Apr-11	Single completion well	• Single-screen regional well was completed on 26-Nov-02. Dedicated submersible pump installed on 14-Feb-03.

Table D-1.0-1 (continued)

Well	Screen and Port Designation	Depth (ft bgs)	Total No. of Sampling Events[a]	Earliest Sampling Event	Most Recent Sampling Event	Sampling System	Chronology of Events Relevant to Groundwater Sampling
R-22	Screen 1 Port MP1A	907	19	13-Mar-01	26-Feb-09	Westbay	• Well R-22 was completed on 19-Oct-00. Portland cement was used in the annular space above screens 1 and 2, between screens 2 and 3, and between screens 3 and 4. • Screens 1 and 2 did not produce sufficient water for pump development before the sampling system was installed. • Westbay multiport sampling system was installed on 8-Dec-00 (Ball et al. 2002, 071471). • Westbay system was removed between 19-Apr-09 and 3-May-09 for redevelopment focused on screens 1 and 5. • Several specific-capacity tests and purging, and sampling events were conducted between 13-May-09 and 2-Jul-09 in configurations that included a single packer and double packers as well as open-hole (no packers). Analytical samples were collected from screen 1 during the extended purging activity conducted from 23-Jun-09 to 2-Jul-09 using a pneumatic Bennett pump and inflatable packer. Analytical samples were collected from screen 5 during the extended hydraulic testing and purging activity conducted from 17-May-09 to 27-May-09 using a 10-hp pump and single inflatable packer above the pump. • The sample collected from screen 1 at the end of redevelopment on 02-Jul-09 is included in the statistical summaries of analyte detections (section D-3.0). Data for earlier samples and other screens are discussed in the text but are not included in the statistical summaries. • Four temporary inflatable packers were installed on 28-May-09 and 30-May-09 to isolate the five screens from one another. • Well R-22 was removed from sampling under the 2010 IFGMP until a decision has been made concerning its final post-conversion configuration.
			15 (4)[b]	24-Jun-09	2-Jul-09	Bennett pump	
	Screen 2 Port MP2A	963	19	12-Mar-01	26-Feb-09	Westbay	
	Screen 3 Port MP3A	1274	19	8-Mar-01	27-Feb-09	Westbay	
	Screen 4 Port MP4A	1378	19	7-Mar-01	26-Feb-09	Westbay	
	Screen 5 Port MP5A	1448	20	6-Mar-01	26-Feb-09	Westbay	
			29 (8)[b]	18-May-09	26-May-09	10-hp pump, single inflatable packer	

Table D-1.0-1 (continued)

Well	Screen and Port Designation	Depth (ft bgs)	Total No. of Sampling Events[a]	Earliest Sampling Event	Most Recent Sampling Event	Sampling System	Chronology of Events Relevant to Groundwater Sampling
R-23i	Piezometer Port P1A	400	14	6-Sep-07	28-Apr-11	Portable pump	• Well was completed on 10-Nov-05. • Sampling system was installed in well on 15-Dec-06. • A piezometer was installed in well annulus. Development methods were limited to bailing, or bailing and swabbing. Geochemistry appears to be affected by seasonal water-level changes (LANL 2010, 109830, Table F-4.0-1). R-23i was sampled using portable Bennett pump. • Some samples from screen 2 in 2009 potentially affected by cross-flow (LANL 2010, 109830, Table F-4.0-1). Sampling system was removed for repairs in Dec-09. • Well was redeveloped in Jan-10 before reinstallation of the Baski sampling system on 2-Mar-10 (Koch and Schmeer 2010, 201566).
	Screen 1 Port P2A	470	19	3-Oct-06	3-May-11	Baski dual-pump	
	Screen 2 Port P3A	524	17	11-Oct-06	18-Apr-11	Baski dual-pump	
R-23	Single	816	25	17-Dec-03	18-Apr-11	Dedicated pump	• Well R-23 was completed on 02-Oct-02. • Dedicated submersible pump was installed on 14-Feb-03.
R-32	Screen 1 Port MP1A	871	9	1-Mar-04	7-Jul-07	Westbay system	• Multiple-screen regional well was completed on 12-Aug-02. Westbay multiport sampling system was installed on 17-Nov-02. Screen 2 never used for water-quality sampling. • Westbay system was removed 18-Sept-07 for well rehabilitation and conversion to single completion well at screen 1 (LANL 2007, 100572). • Screens 2 and 3 were plugged and abandoned on 20-Sept-07 because of unfavorable geochemical conditions resulting from residual drilling, construction and development products (LANL 2007, 100572). • Baski k-packer and dedicated submersible pump were installed on 07-Nov-07 (LANL 2007, 100572).
	Screen 3 Port MP3A	976	10	3-Mar-04	6-Jul-07	Westbay system	
	Single	867.5	15	14-Dec-07	2-May-11	Single completion well	
R-37	Screen 1 Port P1A	929	10	13-Jul-09	3-May-11	Baski dual-pump	• Well R-37 was completed 06-Jun-09. • Baski dual-pump system was installed 19-Dec-09.
	Screen 2 Port P2A	1026	9	22-Jun-09	26-Apr-11	Baski dual-pump	
R-38	Single	821.2	10	6-Feb-09	6-May-11	Single completion well	• Single-screen regional was well completed on 07-Dec-08. Dedicated submersible pump installed 12-Jan-09. • First characterization sample was collected 06-Feb-09. Characterization sampling completed.

Table D-1.0-1 (continued)

Well	Screen and Port Designation	Depth (ft bgs)	Total No. of Sampling Events[a]	Earliest Sampling Event	Most Recent Sampling Event	Sampling System	Chronology of Events Relevant to Groundwater Sampling
R-39	Single	859	11	19-Feb-09	21-Apr-11	Dedicated pump	• Fluid-assisted air-rotary drilling was performed in an open borehole using AQF-2 foaming agent from surface to 717 ft bgs; no foam was added from 717 ft bgs to TD. • Drilling was completed on 12-Nov-08. Regional water table at 824 ft bgs (13-Nov-08). • Well R-39 was completed by 01-Dec-08. • Well development and aquifer testing were completed on 22-Dec-08. • Dedicated submersible pump installed on 19-Feb-09.
R-40i	Single	649.7	7	28-Jan-09	20-Oct-11	Single completion well	• 3-in. polyvinyl chloride piezometer completed in the annulus of well R-40. • Dedicated pump installed. • The screen was redeveloped 21-Jan-11 because of the persistent presence of drilling products manifested by sudsy water and odor. An extended purge event was conducted 12-Jul-11, but results were not available in time to be included in this report.
R-40	Screen 1 Port P1A	751.6	8	21-Apr-09	5-May-11	Baski system	• Dual-screen well R-40 was completed 05-Jan-09. Inflatable packer was installed 07-Jan-09; replaced with TAM International detachable packer 20-Jan-09. • Mixing occurred between perched-intermediate groundwater and the regional aquifer during the 60 d that it took to install the annular backfill material once the borehole total depth was reached. Geochemical evaluations indicate that water-quality impacts of mixing were largely mitigated by subsequent development and testing activities and by purging protocols (LANL 2010, 108498). • Aquifer test was conducted on 21-Apr-09 (screen 1), and 05-Jan-09, and 28-Apr-09 (screen 2). • Dual-pump Baski sampling system was installed Jun-09 (LANL 2010, 108498). • Screen 1 has limited purge capability because of tight formation in which it is completed; water level draws down to bottom of screen during purging and requires weeks to recover. Subsequently only a prioritized suite of water-quality samples are collected.
	Screen 2 Port P2A	849.3	9	15-Jan-09	26-Apr-11	Baski system	

Table D-1.0-1 (continued)

Well	Screen and Port Designation	Depth (ft bgs)	Total No. of Sampling Events[a]	Earliest Sampling Event	Most Recent Sampling Event	Sampling System	Chronology of Events Relevant to Groundwater Sampling
R-41	Screen 1 (no port designation)	~935	0	n/a	n/a	n/a	• Dual-rotary fluid-assisted drilling was performed using AQF-2 foaming agent from surface to 775 ft bgs; no foam was added from 775 ft bgs to TD. • Drilling was completed on 21-Feb-09. • Well R-41 was completed on 19-Mar-09. Regional water table was encountered at 960 ft bgs (22-Mar-09). • Only the lower screen interval produced water and was able to be developed. • Dedicated submersible pump was installed in screen 2 on 06-Jul-09, with a Baski inflatable packer installed between screens 1 and 2. • Screen 1 has been dry since installation.
	Screen 2 Port P2A	965	9	2-Apr-09	21-Apr-11	Dedicated pump	
R-49	Screen 1 Port P1A	845	9	23-Jun-09	2-May-11	Baski dual-APV	• Dual-rotary fluid-assisted drilling was performed using AQF-2 foaming agent from surface to 577 ft bgs; no foam was added from 577 ft bgs to TD. • Drilling was completed on 30-Apr-09. • Well R-49 was completed on 1-Jun-09. Regional water table at 832 ft bgs (composite depth, 9-Jun-09). • Well development and aquifer testing were completed on 23-Jun-09. • Baski dual-APV sampling system was installed on 20-Aug-09.
	Screen 2 Port P2A	906	9	18-Jun-09	29-Apr-11	Baski dual-APV	
R-51	Screen 1 Port P1A	915	6	8-Mar-10	9-May-11	Baski dual-APV	• Fluid-assisted air-rotary and dual-rotary drilling was performed using AQF-2 foaming agent from surface to 776 ft bgs; no foam was added from 776 ft bgs to TD. • Drilling was completed on 14-Jan-10. • Well completed on 08-Feb-10. Regional water table at 891 ft bgs (composite depth, 17-Feb-10). • Well development was completed on 08-Mar-10 (upper screen) and 22-Feb-10 (lower screen). Baski dual-APV sampling system was installed on 07-May-10.
	Screen 2 Port P2A	1031	6	22-Feb-10	9-May-11	Baski dual-APV	

Table D-1.0-1 (continued)

Well	Screen and Port Designation	Depth (ft bgs)	Total No. of Sampling Events[a]	Earliest Sampling Event	Most Recent Sampling Event	Sampling System	Chronology of Events Relevant to Groundwater Sampling
R-52	Screen 1 Port P1A	1035	5	2-May-10	4-May-11	Baski dual-APV	• Fluid-assisted air-rotary and dual-rotary drilling was performed using AQF-2 foaming agent from surface to 915 ft bgs; no foam was added from 915 ft bgs to TD. • Drilling was completed on 06-Feb-10. Regional water table at 1021 ft bgs (composite depth, 7-Feb-10). • Well R-52 was completed on 05-Apr-10. • Baski dual-APV sampling system was installed by 19-Jul-10.
	Screen 2 Port P2A	1107	5	23-Apr-10	4-May-11	Baski dual-APV	
R-53	Screen 1 Port P1A	849.2	1	19-Apr-10	19-Apr-10	Temporary packers	• Dual-screen regional well was completed on 29-Mar-2010. • Baski dual-APV* sampling system and pump were installed 07-Jul-10 (LANL 2010, 110516). • First characterization sample was collected April 2010. Characterization sampling was completed.
	Screen 1 Port P1A	849.2	4	26-Jul-10	6-May-11	Baski system	
	Screen 2 Port P2A	959.7	1	14-Apr-10	14-Apr-10	Temporary packers	
	Screen 2 Port P2A	959.7	4	26-Jul-10	6-May-11	Baski system	
R-54	Screen 1 Port P1A	830	1	15-Feb-10	15-Feb-10	Temporary packers	• Dual-screen regional well was completed on 29-Jan-10. • Baski dual-APV sampling system and pump were installed on 17-May-10 (LANL 2010, 109828). • First characterization sample was collected Feb-10. Characterization sampling was completed.
	Screen 1 Port P1A	830	5	18-Jun-10	4-May-11	Baski system	
	Screen 2 Port P2A	915	1	21-Feb-10	21-Feb-10	Temporary packers	
	Screen 2 Port P2A	915	5	18-Jun-10	5-May-11	Baski system	
R-55i	Single	510	2	23-Mar-11	10-May-11	Dedicated pump	• Dual-rotary fluid-assisted drilling was performed using AQF-2 foaming agent from surface to 400 ft bgs (LANL 2011, 203665). • No additives other than potable water were used below 400 ft bgs to the total borehole depth of 565 ft bgs. • Drilling was completed on 08-Jan-11. Depth to water before well completion was 498.4 ft. • Well R-55i was completed on 18-Jan-11, with a 20-ft screened interval in the Cerros del Rio volcanic series. • A dedicated sampling system was installed on 15-Mar-11.

Table D-1.0-1 (continued)

Well	Screen and Port Designation	Depth (ft bgs)	Total No. of Sampling Events[a]	Earliest Sampling Event	Most Recent Sampling Event	Sampling System	Chronology of Events Relevant to Groundwater Sampling
R-55	Screen 1 Port P1A	860	1	9-Sep-10	9-Sep-10	Portable pump	• Dual-rotary fluid-assisted drilling was performed using AQF-2 foaming agent from surface to 682 ft bgs; no foam was added from 682 ft bgs to TD. • Drilling was completed on 29-Jun-10. Regional water table at 843.5 ft bgs (composite depth, 30-Jun-10). • Well R-55 was completed on 25-Aug-10. • Baski system was scheduled to be installed in late 2010.
	Screen 1 Port P1A	860	2	7-Feb-11	28-Apr-11	Baski system	
	Screen 2 Port P2A	994.4	1	14-Sep-10	14-Sep-10	Portable pump	
	Screen 2 Port P2A	994.4	2	1-Feb-11	28-Apr-11	Baski system	
R-56	Screen 1 Port P1A	945	1	19-Aug-10	19-Aug-10	Temporary packers	• Dual-screen regional well was completed on 19-Jul-10 (LANL 2010, 111512). • Baski dual-APV sampling system and pump was installed 20-Jan-11. • First characterization sample was collected Aug-10 (temporary packer in place). Cross-flow between screened intervals occurred during installation of the Baski sampling system. Additional characterization sampling is in progress.
	Screen 1 Port P1A	945	2	3-Feb-11	10-May-11	Baski system	
	Screen 2 Port P2A	1046.6	1	13-Aug-10	13-Aug-10	Temporary packers	
	Screen 2 Port P2A	1046.6	2	7-Feb-11	10-May-11	Baski system	
R-57	Screen 1 Port P1A	910	2	1-Jul-10	9-May-11	Baski dual-APV	• Dual-rotary fluid-assisted drilling was performed using AQF-2 foaming agent from surface to 786 ft bgs (LANL 2010, 111310). No additives other than potable water were used below 786 ft bgs to the total borehole depth of 1081.6 ft bgs. • Drilling was completed on 24-Apr-10. Depth to water before well completion was 896.7 ft (composite depth). • Well R-57 was completed as a dual-screen regional-aquifer well on 8-Jun-10 with the upper 20-ft screened interval in the dacitic lava flows at the bottom of the Cerros del Rio volcanic series and the lower 20-ft screened interval within the Puye Formation. • A dual-valve Baski sampling system was installed on 16-Dec-10 (Koch and Schmeer, 2011, 201566).
	Screen 2 Port P2A	972	2	25-Jun-10	9-May-11	Baski dual-APV	

Sources: Well completion reports for R-20 (LANL 2003, 079600); R-21 (Kleinfelder 2003, 090047); R-22 (Ball et al. 2002, 071471); R-23 (LANL 2003, 079601); R-23i (Kleinfelder 2006, 092495); R-32 (LANL 2003, 079602); R-37 (LANL 2009, 107116); R-38 (LANL 2009, 105298); R-39 (LANL 2009, 105620); R-40 (LANL 2009, 106432); R-41 (LANL 2009, 106453); R-49 (LANL 2009, 107450); R-51 (LANL 2010, 109949); R-52 (LANL 2010, 110533); R-53 (LANL 2010, 110516); R-54 (LANL 2010, 109828). Fact sheets for R-55 (LANL 2010, 110717); R-56 (LANL 2010, 110482), and R-57 (LANL 2010, 109836). Well rehabilitation and conversion reports for R-20 (LANL 2008, 100473) and R-32 (LANL 2007, 100572). Well redevelopment report for R-22 (LANL 2009, 106796). Assessment of cross flow in monitoring wells with inflatable packers (LANL 2010, 108783).

Notes: APV = access port valve; hp = horsepower; N = number; TD = total depth; n/a = not applicable.

[a] Sampling events for analyses by off-site laboratories.

[b] The first number indicates the number of discrete sampling events for perchlorate; the number in parentheses indicates the number of discrete sampling events for VOCs.

Table D-3.0-1
Final Field Parameters for Recent Sampling Events

Location	Port Name	Depth (ft bgs)	Date	Purge Volume (gal.)	Purged CV	DO (mg/L)	ORP (mV)	Field pH	Specific Conductance (µS/cm)	Temperature °C	Turbidity (NTU)	Alkalinity[a] (mg/L as $CaCO_3$)
R-20	P1A	905	3-Aug-10	197	3.0	1.8	-19	8.2	137	20	0.8	82
R-20	P1A	905	20-Oct-10	271	4.1	2.4	92	8.2	152	18	0.5	79
R-20	P1A	905	27-Jan-11	576	7.9	1.2	331	8.2	145	14	1.6	72
R-20	P1A	905	20-Apr-11	75	1.0	1.2	-102	8.6	145	18	1.8	78
R-20	P1A	905	27-Jul-11	205	2.7	2.3	-32	8.5	142	19	0.8	86
R-20	P2A	1147	30-Jul-10	124	3.0	2.0	-70	7.8	137	20	1.1	84
R-20	P2A	1147	11-Oct-10	187	4.6	1.8	89	7.8	138	20	0.3	83
R-20	P2A	1147	21-Jan-11	513	12.5	3.0	231	7.9	128	20	0.4	78
R-20	P2A	1147	25-Apr-11	125	3.0	2.4	-75	7.9	142	20	0.7	83
R-20	P2A	1147	25-Jul-11	126	3.1	2.5	-77	8.0	144	20	0.4	86
R-21	Single	889	11-Aug-10	660	3.2	5.7	195	7.7	132	23	0.6	74
R-21	Single	889	11-Oct-10	702	3.4	5.3	89	7.9	126	21	0.2	75
R-21	Single	889	27-Jan-11	695	3.4	5.3	74	7.9	124	21	0.2	68
R-21	Single	889	19-Apr-11	619	3.0	6.3	149	8.0	127	21	0.2	73
R-21	Single	889	21-Jul-11	618	3.0	6.2	85	8.0	128	21	0.3	78
R-23	Single	816	12-Aug-10	240	5.0	5.2	363	7.3	173	20	1.9	88
R-23	Single	816	22-Oct-10	280	5.8	7.8	280	7.8	169	21	0.5	90
R-23	Single	816	24-Jan-11	340	7.5	5.6	207	7.7	166	19	0.5	89
R-23	Single	816	18-Apr-11	202	4.4	6.9	103	8.1	172	22	0.7	91
R-23	Single	816	22-Jul-11	174	3.8	6.9	119	8.1	174	22	1.3	—[b]
R-23i	P1A	400	9-Aug-10	9	3.0	5.7	267	7.4	289	20	2.3	121
R-23i	P1A	400	21-Oct-10	24	7.7	7.0	418	7.3	296	15	4.6	129
R-23i	P1A	400	14-Jan-11	22	7.1	5.4	250	7.6	277	14	2.9	130
R-23i	P1A	400	28-Apr-11	13	4.2	6.8	172	7.6	275	15	3.1	127
R-23i	P1A	400	28-Jul-11	19	6.0	6.6	203	7.7	295	18	1.3	—

Table D-3.0-1 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purge Volume (gal.)	Purged CV	DO (mg/L)	ORP (mV)	Field pH	Specific Conductance (µS/cm)	Temperature °C	Turbidity (NTU)	Alkalinity[a] (mg/L as $CaCO_3$)
R-23i	P2A	470	4-Aug-10	117	3.0	5.3	54	7.8	214	17	0.4	103
R-23i	P2A	470	18-Oct-10	132	3.4	4.7	57	7.8	207	16	1.5	105
R-23i	P2A	470	18-Jan-11	156	3.9	5.1	350	8.0	206	15	0.3	104
R-23i	P2A	470	3-May-11	115	3.0	6.0	260	8.1	190	16	0.4	102
R-23i	P2A	470	26-Jul-11	115	3.0	5.7	214	8.2	196	17	1.3	—
R-23i	P3A	524	4-Aug-10	125	2.9	5.4	10	8.0	211	20	1.0	99
R-23i	P3A	524	18-Oct-10	170	4.0	5.3	-19	8.0	203	18	0.9	100
R-23i	P3A	524	24-Jan-11	155	3.6	5.4	128	8.0	203	17	1.4	97
R-23i	P3A	524	18-Apr-11	129	3.0	6.1	80	8.2	189	17	1.2	103
R-23i	P3A	524	29-Jul-11	147	3.5	7.0	180	8.2	198	18	1.4	—
R-32	Single	868	6-Aug-10	305	3.4	4.0	108	6.9	175	21	0.7	91
R-32	Single	868	14-Oct-10	326	3.7	4.1	136	6.8	171	19	0.9	93
R-32	Single	868	25-Jan-11	325	3.7	4.4	392	6.9	168	18	0.8	92
R-32	Single	868	2-May-11	279	3.2	4.2	82	7.0	172	18	0.5	90
R-32	Single	868	27-Jul-11	300	3.4	4.5	189	7.0	170	20	0.6	95
R-37	P1A	929	5-Aug-10	155	2.9	3.9	—	10.6	232	18	1.7	130
R-37	P1A	929	12-Oct-10	170	3.2	1.7	-14	7.8	235	19	0.6	133
R-37	P1A	929	21-Jan-11	293	5.6	1.5	49	8.4	233	17	0.8	131
R-37	P1A	929	3-May-11	147	2.8	1.8	70	8.0	237	18	0.5	129
R-37	P1A	929	19-Jul-11	164	3.1	1.8	153	8.1	239	18	0.3	—
R-37	P2A	1026	10-Aug-10	360	6.5	6.7	363	7.6	131	22	8.1	78
R-37	P2A	1026	14-Oct-10	266	4.8	6.6	182	7.8	137	22	1.3	79
R-37	P2A	1026	25-Jan-11	—	—	8.3	392	7.9	135	22	0.8	79
R-37	P2A	1026	26-Apr-11	163	3.0	7.5	65	8.1	130	21	1.3	77
R-37	P2A	1026	13-Jul-11	252	4.7	8.0	96	8.0	118	22	0.6	—
R-38	Single	821	6-Aug-10	300	7.0	4.7	117	7.2	145	20	0.8	80

Table D-3.0-1 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purge Volume (gal.)	Purged CV	DO (mg/L)	ORP (mV)	Field pH	Specific Conductance (µS/cm)	Temperature °C	Turbidity (NTU)	Alkalinity[a] (mg/L as $CaCO_3$)
R-38	Single	821	11-Oct-10	162	3.8	6.6	311	7.3	141	18	1.4	81
R-38	Single	821	27-Jan-11	129	3.0	6.0	59	7.4	132	18	0.9	73
R-38	Single	821	6-May-11	163	3.8	7.0	46	7.3	142	19	0.6	79
R-38	Single	821	26-Jul-11	129	3.0	7.0	114	7.4	135	19	0.9	82
R-39	Single	859	12-Aug-10	190	3.9	3.8	166	7.8	144	24	2.3	80
R-39	Single	859	8-Oct-10	210	4.3	5.2	430	7.8	143	20	2.4	81
R-39	Single	859	26-Jan-11	227	4.7	5.1	73	8.1	134	22	3.6	79
R-39	Single	859	21-Apr-11	147	3.0	6.3	134	8.1	140	23	2.2	77
R-39	Single	859	28-Jul-11	163	3.4	6.7	155	8.1	139	23	2.4	—
R-40i	Single	650	4-Dec-09	39	3.0	1.4	-158	7.2	257	15	1.3	NC
R-40i	Single	650	3-Mar-10	26	2.0	1.4	-120	7.1	256	16	1.3	NC
R-40i	Single	650	17-Jun-10	39	3.0	1.5	-127	7.2	282	19	0.1	176
R-40i	Single	650	28-Jul-10	46	3.5	1.3	-147	7.0	253	17	1.2	161
R-40i	Single	650	20-Oct-10	50	3.8	1.3	-85	6.9	266	17	1.5	166
R-40i	Single	650	21-Jan-11	39	3.0	0.7	-138	7.4	255	16	0.3	167
R-40i	Single	650	29-Apr-11	50	3.9	6.3	-156	7.5	255	17	0.3	161
R-40i	Single	650	12-Jul-11	78	6.0	0.2	-117	7.5	242	17	1.0	154
R-40	P1A	752	4-Jun-10	40	1.3	3.3	99	7.5	208	18	4.6	—
R-40	P1A	752	28-Jul-10	40	1.4	2.0	67	7.8	212	18	1.4	141
R-40	P1A	752	20-Oct-10	40	1.4	3.5	422	8.4	210	16	4.8	121
R-40	P1A	752	21-Jan-11	30	1.0	3.1	150	8.5	216	12	0.9	131
R-40	P1A	752	5-May-11	33	1.1	0.8	82	8.6	208	17	0.8	—
R-40	P1A	752	11-Jul-11	40	1.3	5.7	265	8.9	195	16	1.5	—
R-40	P2A	849	27-Jul-10	165	4.0	7.7	59	7.7	123	21	3.4	77
R-40	P2A	849	19-Oct-10	170	4.1	7.8	123	7.8	131	21	1.8	75
R-40	P2A	849	19-Jan-11	127	3.0	7.7	374	7.7	123	20	1.0	73

Table D-3.0-1 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purge Volume (gal.)	Purged CV	DO (mg/L)	ORP (mV)	Field pH	Specific Conductance (µS/cm)	Temperature °C	Turbidity (NTU)	Alkalinity[a] (mg/L as $CaCO_3$)
R-40	P2A	849	26-Apr-11	138	3.0	7.9	49	7.9	116	20	0.7	72
R-40	P2A	849	8-Jul-11	128	3.1	8.2	102	8.2	119	21	0.7	76
R-41	P2A	965	9-Aug-10	182	5.0	4.3	23	8.0	159	24	1.0	91
R-41	P2A	965	8-Oct-10	150	4.1	4.1	386	7.9	173	21	1.0	92
R-41	P2A	965	12-Jan-11	170	4.7	4.6	64	8.1	164	23	0.8	91
R-41	P2A	965	21-Apr-11	123	3.4	5.6	28	8.0	165	23	0.5	88
R-41	P2A	965	15-Jul-11	111	3.1	6.0	104	8.1	164	23	0.4	—
R-49	P1A	845	29-Jul-10	322	4.1	3.7	-44	7.8	145	23	42.2	91
R-49	P1A	845	7-Oct-10	280	3.5	3.7	253	7.9	167	23	4.4	93
R-49	P1A	845	19-Jan-11	350	4.4	3.7	34	8.0	169	21	2.8	91
R-49	P1A	845	2-May-11	251	3.2	4.5	19	8.1	162	22	1.1	89
R-49	P1A	845	8-Jul-11	245	3.1	4.6	23	8.0	160	23	1.7	—
R-49	P2A	906	29-Jul-10	230	4.0	5.7	-20	7.8	125	23	1.0	78
R-49	P2A	906	7-Oct-10	220	3.8	5.9	504	7.8	141	22	0.3	78
R-49	P2A	906	26-Jan-11	188	3.2	5.1	87	7.9	162	21	1.0	78
R-49	P2A	906	29-Apr-11	183	3.1	6.4	30	8.0	143	23	0.1	77
R-49	P2A	906	25-Jul-11	175	3.0	6.5	221	8.0	146	23	0.2	—
R-51	P1A	915	26-Jul-10	275	4.4	6.5	289	8.0	118	21	1.2	76
R-51	P1A	915	19-Oct-10	296	4.8	5.7	318	8.1	146	21	1.3	82
R-51	P1A	915	11-Jan-11	188	3.0	6.9	71	8.6	131	20	1.4	57
R-51	P1A	915	9-May-11	195	3.1	8.0	107	8.2	125	21	1.7	74
R-51	P1A	915	28-Jul-11	353	5.6	7.4	178	8.2	103	21	2.4	—
R-51	P2A	1031	26-Jul-10	211	2.3	6.0	424	7.9	135	21	2.5	82
R-51	P2A	1031	19-Oct-10	216	5.8	6.3	222	8.0	147	22	1.0	82
R-51	P2A	1031	11-Jan-11	273	3.0	4.9	96	8.4	140	21	1.7	77
R-51	P2A	1031	9-May-11	276	3.0	6.1	100	8.2	128	22	1.0	78

Table D-3.0-1 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purge Volume (gal.)	Purged CV	DO (mg/L)	ORP (mV)	Field pH	Specific Conductance (µS/cm)	Temperature °C	Turbidity (NTU)	Alkalinity[a] (mg/L as $CaCO_3$)
R-51	P2A	1031	28-Jul-11	341	3.7	6.0	141	8.1	114	22	0.7	—
R-52	P1A	1035	5-Aug-10	275	4.2	5.6	377	7.8	145	23	1.3	84
R-52	P1A	1035	12-Oct-10	247	3.8	5.1	—	7.9	164	22	0.9	83
R-52	P1A	1035	13-Jan-11	196	3.0	5.9	78	8.3	145	22	1.3	82
R-52	P1A	1035	4-May-11	237	3.6	6.6	154	8.5	128	22	0.9	78
R-52	P1A	1035	18-Jul-11	262	4.1	8.7	141	8.1	140	22	0.7	—
R-52	P2A	1107	5-Aug-10	210	4.9	6.1	396	7.5	131	23	1.8	74
R-52	P2A	1107	12-Oct-10	237	5.5	7.0	353	7.7	129	21	0.7	75
R-52	P2A	1107	13-Jan-11	130	3.0	6.4	91	7.6	121	21	0.6	75
R-52	P2A	1107	4-May-11	251	5.8	6.6	169	7.9	123	22	0.3	73
R-52	P2A	1107	18-Jul-11	165	3.8	7.7	98	7.9	113	22	0.2	—
R-53	P1A	849	26-Jul-10	240	3.1	3.7	79	7.5	103	22	0.9	78
R-53	P1A	849	12-Oct-10	301	3.9	4.4	149	7.8	130	21	1.3	76
R-53	P1A	849	14-Jan-11	231	3.0	6.3	214	7.8	125	21	1.2	75
R-53	P1A	849	6-May-11	232	3.0	5.7	145	7.9	129	22	0.7	75
R-53	P1A	849	14-Jul-11	232	3.0	5.8	118	8.0	127	22	0.4	77
R-53	P2A	960	26-Jul-10	390	4.2	5.5	142	7.7	100	22	0.8	75
R-53	P2A	960	12-Oct-10	359	3.8	5.5	145	8.1	126	21	0.5	74
R-53	P2A	960	13-Jan-11	281	3.0	6.7	195	8.1	122	20	1.1	74
R-53	P2A	960	6-May-11	281	3.0	6.1	111	8.1	126	22	0.3	73
R-53	P2A	960	14-Jul-11	285	3.0	6.4	122	8.1	126	22	0.1	75
R-54	P1A	830	27-Jul-10	210	3.8	2.4	104	6.8	198	23	2.8	105
R-54	P1A	830	13-Oct-10	240	4.3	0.3	-77	7.6	221	21	2.0	125
R-54	P1A	830	14-Jan-11	166	3.0	1.4	-75	7.0	185	21	1.5	111
R-54	P1A	830	4-May-11	664	12.0	2.7	-63	7.3	133	22	0.4	87
R-54	P1A	830	12-Jul-11	210	3.8	1.5	-59	7.0	176	22	0.4	103

Table D-3.0-1 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purge Volume (gal.)	Purged CV	DO (mg/L)	ORP (mV)	Field pH	Specific Conductance (µS/cm)	Temperature °C	Turbidity (NTU)	Alkalinity[a] (mg/L as $CaCO_3$)
R-54	P2A	915	27-Jul-10	225	3.7	5.2	150	8.1	132	22	1.3	77
R-54	P2A	915	13-Oct-10	246	4.0	4.9	112	8.1	123	20	0.8	78
R-54	P2A	915	12-Jan-11	184	3.0	5.7	108	8.2	124	21	0.6	77
R-54	P2A	915	5-May-11	186	3.0	6.5	181	8.2	130	22	0.5	74
R-54	P2A	915	12-Jul-11	189	3.1	6.8	56	8.3	125	22	0.5	72
R-55i	Single	510	23-Mar-11	230	5.2	5.7	-53	7.9	305	18	1.8	122
R-55i	Single	510	10-May-11	134	3.0	4.5	-98	7.5	322	18	1.6	124
R-55i	Single	510	18-Jul-11	135	3.0	3.8	-81	7.4	317	19	1.4	—
R-55	P1A	860	9-Sep-10	—	—	7.1	204	8.0	187	23	0.7	—
R-55	P1A	860	7-Feb-11	337	3.0	5.2	190	8.0	174	22	0.5	99
R-55	P1A	860	28-Apr-11	338	3.0	6.5	46	8.1	177	23	0.3	94
R-55	P1A	860	15-Jul-11	337	3.0	6.3	265	8.1	168	23	0.3	—
R-55	P2A	994	14-Sep-10	—	—	5.3	101	7.9	175	23	0.7	—
R-55	P2A	994	1-Feb-11	338	4.7	2.2	287	8.5	172	22	0.3	82
R-55	P2A	994	28-Apr-11	223	3.1	4.9	73	8.5	172	23	0.3	89
R-55	P2A	994	14-Jul-11	218	3.0	6.5	97	8.1	181	23	0.3	—
R-56	P1A	945	19-Aug-10	8065	90 (est[c])	8.0	377	7.6	127	21	0.4	—
R-56	P1A	945	3-Feb-11	312	3.6	3.1	169	7.7	145	19	0.7	80
R-56	P1A	945	10-May-11	300	3.5	5.2	104	7.9	151	21	0.4	83
R-56	P1A	945	20-Jul-11	259	3.0	5.7	136	8.0	153	22	0.3	87
R-56	P2A	1047	13-Aug-10	20300	300 (est)	8.4	346	7.6	127	18	0.2	—
R-56	P2A	1047	7-Feb-11	249	3.6	3.9	192	7.8	141	21	1.1	86
R-56	P2A	1047	10-May-11	232	3.4	4.2	97	8.2	144	21	0.9	82
R-56	P2A	1047	20-Jul-11	224	3.3	4.9	118	8.2	135	22	0.5	84
R-57	P1A	910	1-Jul-10	—	—	5.4	33	8.1	135	22	0.9	—
R-57	P1A	910	9-May-11	228	3.2	4.6	30	7.9	147	23	0.5	82

Table D-3.0-1 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purge Volume (gal.)	Purged CV	DO (mg/L)	ORP (mV)	Field pH	Specific Conductance (µS/cm)	Temperature °C	Turbidity (NTU)	Alkalinity[a] (mg/L as $CaCO_3$)
R-57	P1A	910	13-Jul-11	215	3.0	4.7	-69	7.9	134	23	0.3	—
R-57	P2A	972	25-Jun-10	—	—	2.8	192	7.8	137	22	1.8	—
R-57	P2A	972	9-May-11	170	3.3	5.9	58	7.5	145	23	0.6	82
R-57	P2A	972	13-Jul-11	160	3.1	5.7	61	7.5	121	23	0.7	—

Source: Attachment D-1 (for water-quality data); field notes (for purge volumes and casing volumes).

[a] Alkalinity measured at on-site analytical laboratory.

[b] — = Not available.

[c] est = Estimated.

Table D-3.0-2
General Inorganic Constituents in Filtered Samples and TOC

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO_4 (mg/L)	Cl (mg/L)	F (mg/L)	NO_3+NO_2-N (mg/L)	ClO_4 (µg/L)	SiO_2 (mg/L)	TDS (mg/L)	TOC (mg/L)	Alkalinity[b] (mg/L as $CaCO_3$)	Lab pH[b]
R-20	P1A	905	3-Aug-10	3.0	16	2.7	12	2.3	2.4	2.3	0.26	748[c]	0.19	72	145	1.1	63	8.4
R-20	P1A	905	20-Oct-10	4.1	14	2.5	11	2.1	2.4	2.5	0.25	< 0.26	0.17	67	127	0.9	63	8.3
R-20	P1A	905	27-Jan-11	7.9	14	2.7	12	2.3	3.1	2.5	0.24	0.12	0.19	69	122	0.6	63	8.3
R-20	P1A	905	20-Apr-11	1.0	14	2.7	13	2.4	2.7	2.5	0.22	< 0.05	0.07	71	134	0.6	67	8.4
R-20	P2A	1147	30-Jul-10	3.0	12	2.4	13	2.5	1.9	1.9	0.26	0.19	0.17	72	145	2.0	64	8.0
R-20	P2A	1147	11-Oct-10	4.6	11	2.3	13	2.5	1.7	1.8	0.22	0.24	0.21	70	147	2.5	59	8.1
R-20	P2A	1147	21-Jan-11	12.5	11	2.4	11	2.4	1.9	< 1.8	0.21	0.22	0.23	79	142	1.2	55	8.0
R-20	P2A	1147	25-Apr-11	3.0	12	2.5	14	2.9	1.9	1.9	0.29	0.23	0.19	77	137	2.5	64	7.8
R-21	Single	889	11-Aug-10	3.2	10	1.7	12	3.1	2.0	1.8	0.20	0.34	0.30	71	133	0.6	59	8.1
R-21	Single	889	11-Oct-10	3.4	10	1.7	12	3.1	2.1	1.8	0.24	0.37	0.28	77	128	< 0.4	61	8.0
R-21	Single	889	27-Jan-11	3.4	10	1.6	11	2.8	2.0	1.8	0.23	0.31	0.30	69	125	0.5	58	7.9
R-21	Single	889	19-Apr-11	3.0	10	1.8	12	3.1	2.0	1.8	0.22	0.20	0.28	73	127	0.5	57	8.0
R-23	Single	816	12-Aug-10	5.0	11	1.8	16	4.0	5.2	3.5	0.36	1.18	0.49	60	150	0.5	68	8.0
R-23	Single	816	22-Oct-10	5.8	11	1.8	17	4.1	5.3	3.6	0.36	1.37	0.44	65	141	< 1	66	8.1
R-23	Single	816	24-Jan-11	7.5	11	2.0	17	4.0	5.3	3.5	0.33	1.10	0.48	65	153	2.6	69	8.0
R-23	Single	816	18-Apr-11	4.4	11	1.9	17	4.1	5.2	3.6	0.29	1.13	0.45	60	150	1.7	67	8.0
R-23i	P1A	400	9-Aug-10	3.0	14	3.7	26	9.4	12.0	19.4	0.20	0.46	0.29	51	199	0.7	91	7.8
R-23i	P1A	400	21-Oct-10	7.7	14	3.8	27	9.6	12.7	19.4	0.19	0.56	0.28	52	195	0.7	94	8.0
R-23i	P1A	400	14-Jan-11	7.1	15	3.9	27	9.6	13.2	17.8	0.22	0.56	0.32	51	177	0.7	100	7.8
R-23i	P1A	400	28-Apr-11	4.2	14	3.7	27	9.4	4.8	3.7	0.27	0.40	0.32	51	190	0.5	98	7.4
R-23i	P2A	470	4-Aug-10	3.0	12	2.6	21	5.9	7.7	7.8	0.21	0.82	0.26	44	169	0.8	79	8.2
R-23i	P2A	470	18-Oct-10	3.4	11	2.6	20	5.6	7.7	7.9	0.19	0.88	0.25	40	147	0.7	84	8.2
R-23i	P2A	470	18-Jan-11	3.9	11	2.6	21	5.7	7.9	8.2	0.21	0.77	0.26	43	128	0.7	80	8.2

Table D-3.0-2 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO_4 (mg/L)	Cl (mg/L)	F (mg/L)	NO_3+NO_2-N (mg/L)	ClO_4 (µg/L)	SiO_2 (mg/L)	TDS (mg/L)	TOC (mg/L)	Alkalinity[b] (mg/L as $CaCO_3$)	Lab pH[b]
R-23i	P2A	470	3-May-11	3.0	12	2.4	21	5.8	7.8	7.8	0.23	0.64	0.24	41	143	1.1	77	8.1
R-23i	P3A	524	4-Aug-10	2.9	11	2.6	21	5.9	7.4	8.3	0.22	0.91	0.29	46	163	1.0	77	8.2
R-23i	P3A	524	18-Oct-10	4.0	10	2.6	20	5.6	7.5	8.3	0.19	0.93	0.25	41	143	0.7	86	8.3
R-23i	P3A	524	24-Jan-11	3.6	11	2.7	21	5.8	7.7	8.3	0.19	0.80	0.28	47	154	0.7	77	8.2
R-23i	P3A	524	18-Apr-11	3.0	11	2.7	22	6.0	7.5	8.1	0.20	0.79	0.26	41	146	0.7	77	8.0
R-32	Single	868	6-Aug-10	3.4	11	1.8	16	4.9	5.1	3.0	0.29	0.96	0.37	64	157	0.7	69	7.5
R-32	Single	868	14-Oct-10	3.7	10	1.8	16	4.7	5.3	2.9	0.26	1.02	0.37	65	148	1.3	68	7.4
R-32	Single	868	25-Jan-11	3.7	11	1.8	16	5.0	5.2	2.9	0.27	0.90	0.39	< 40	149	0.8	71	7.3
R-32	Single	868	2-May-11	3.2	11	1.8	17	5.0	5.6	3.1	0.33	0.66	0.36	67	143	0.7	69	7.6
R-37	P1A	929	5-Aug-10	2.9	16	1.9	25	5.7	9.3	4.6	0.47	0.49	0.55	57	182	0.9	98	8.1
R-37	P1A	929	12-Oct-10	3.2	15	1.7	24	5.5	9.8	4.6	0.52	0.52	0.52	52	187	1.1	95	8.1
R-37	P1A	929	21-Jan-11	5.6	15	1.9	25	5.7	9.8	4.8	0.57	0.47	0.52	60	186	0.9	101	8.1
R-37	P1A	929	3-May-11	2.8	16	1.7	26	5.8	9.5	4.6	0.51	0.38	0.45	56	177	0.9	97	8.1
R-37	P2A	1026	10-Aug-10	6.5	11	1.7	11	2.8	2.9	2.4	0.30	0.56	0.37	63	141	0.3	62	8.0
R-37	P2A	1026	14-Oct-10	4.8	11	1.8	12	2.9	2.8	2.3	0.26	0.62	0.38	69	134	0.8	57	8.1
R-37	P2A	1026	25-Jan-11	NC	12	1.7	12	2.8	2.9	2.2	0.26	0.49	0.35	< 69	139	< 1	61	8.0
R-37	P2A	1026	26-Apr-11	3.0	12	1.9	13	3.1	2.9	2.4	0.32	0.57	0.32	71	133	0.5	60	8.0
R-38	Single	821	6-Aug-10	7.0	11	1.5	12	3.5	2.9	2.5	0.29	0.58	0.39	64	152	0.4	61	7.6
R-38	Single	821	11-Oct-10	3.8	10	1.5	12	3.5	3.1	2.4	0.27	0.61	0.38	62	127	1.1	59	7.7
R-38	Single	821	27-Jan-11	3.0	11	1.6	12	3.5	2.9	2.4	0.27	0.55	0.38	68	131	0.8	62	7.5
R-38	Single	821	6-May-11	3.8	11	1.5	13	3.8	3.2	2.6	0.32	0.53	0.37	68	131	0.5	61	7.7
R-39	Single	859	12-Aug-10	3.9	12	1.5	13	3.6	3.5	2.2	0.29	0.66	0.38	66	139	0.5	61	8.1
R-39	Single	859	8-Oct-10	4.3	12	1.5	13	3.5	3.5	2.2	0.27	0.55	0.33	63	138	0.5	63	8.1
R-39	Single	859	26-Jan-11	4.7	11	1.4	12	3.4	3.0	2.2	0.27	0.59	0.37	68	135	< 1	61	8.0

Table D-3.0-2 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO_4 (mg/L)	Cl (mg/L)	F (mg/L)	NO_3+NO_2-N (mg/L)	ClO_4 (µg/L)	SiO_2 (mg/L)	TDS (mg/L)	TOC (mg/L)	Alkalinity[b] (mg/L as $CaCO_3$)	Lab pH[b]
R-39	Single	859	21-Apr-11	3.0	10	1.4	13	3.6	2.9	2.1	0.28	0.65	0.34	69	134	0.4	60	7.7
R-40i	Single	650	4-Dec-09	3.0	23	1.7	19	8.1	2.2	2.6	0.34	< 0.25	< 0.2	51	184	12.5	113	7.5
R-40i	Single	650	3-Mar-10	2.0	24	2.0	20	8.6	1.2	2.4	0.29	<0.25	< 0.2	52	189	14.5	120	7.6
R-40i	Single	650	28-Jul-10	3.5	21	1.9	19	8.3	1.3	2.5	0.24	< 0.25	< 0.2	54	91	11.9	118	7.6
R-40i	Single	650	20-Oct-10	3.8	21	1.9	19	8.3	1.2	2.4	0.22	< 0.09	< 0.2	49	164	13.5	60	7.7
R-40	P1A	752	4-Jun-10	1.3	14	1.8	22	6.4	4.8	2.2	0.37	0.09	0.08	59	162	3.0	94	8.2
R-40	P1A	752	28-Jul-10	1.4	12	1.7	22	6.8	5.5	2.2	0.28	0.11	< 0.2	55	174	0.9	102	8.2
R-40	P1A	752	20-Oct-10	1.4	13	1.9	19	6.2	4.1	2.1	0.32	0.20	0.09	55	153	3.2	94	8.4
R-40	P1A	752	21-Jan-11	1.0	14	2.0	20	7.2	4.7	2.2	0.33	< 0.25	< 0.2	55	166	1.4	105	8.5
R-40	P2A	849	27-Jul-10	4.0	11	1.5	12	3.1	2.7	2.0	0.25	0.37	0.27	72	144	0.5	60	8.0
R-40	P2A	849	19-Oct-10	4.1	11	1.6	11	3.0	2.2	1.8	0.20	< 0.49	0.29	68	136	0.3	59	7.9
R-40	P2A	849	19-Jan-11	3.0	11	1.5	11	2.9	2.1	1.9	0.22	0.36	0.29	75	133	0.5	56	7.9
R-40	P2A	849	26-Apr-11	3.0	10	1.6	11	2.9	2.2	2.0	0.26	0.36	0.26	71	133	0.5	56	7.9
R-41	P2A	965	9-Aug-10	5.0	13	1.9	15	4.0	4.6	3.1	0.34	0.66	0.37	63	144	0.5	65	8.0
R-41	P2A	965	8-Oct-10	4.1	13	1.9	15	4.0	4.6	3.1	0.30	0.56	0.42	61	167	0.4	66	8.0
R-41	P2A	965	12-Jan-11	4.7	14	2.0	15	3.9	4.5	3.0	0.31	0.58	0.40	65	132	< 1	70	8.1
R-41	P2A	965	21-Apr-11	3.4	13	2.0	16	4.2	4.6	3.0	0.34	0.69	0.38	65	147	0.4	68	7.9
R-49	P1A	845	29-Jul-10	4.1	18	1.6	12	3.6	4.5	2.7	0.24	0.64	0.32	70	155	0.9	69	8.0
R-49	P1A	845	7-Oct-10	3.5	15	1.6	12	3.5	4.6	2.8	0.29	0.46	0.30	65	146	1.3	66	8.1
R-49	P1A	845	19-Jan-11	4.4	17	1.9	13	3.8	4.4	2.8	0.26	0.56	0.31	71	145	1.2	70	8.1
R-49	P1A	845	2-May-11	3.2	15	1.9	13	3.7	4.6	2.9	0.33	0.41	0.29	69	144	0.7	65	8.0
R-49	P2A	906	29-Jul-10	4.0	11	1.5	13	3.5	3.4	2.4	0.23	0.70	0.33	71	144	0.6	58	7.9
R-49	P2A	906	7-Oct-10	3.8	9	1.4	12	3.4	3.5	2.4	0.29	0.60	0.37	68	145	0.7	56	8.0
R-49	P2A	906	26-Jan-11	3.2	10	1.5	13	3.4	3.5	2.3	0.27	0.64	0.36	69	138	< 1	60	8.0

Table D-3.0-2 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO_4 (mg/L)	Cl (mg/L)	F (mg/L)	NO_3+NO_2-N (mg/L)	ClO_4 (µg/L)	SiO_2 (mg/L)	TDS (mg/L)	TOC (mg/L)	Alkalinity[b] (mg/L as $CaCO_3$)	Lab pH[b]
R-49	P2A	906	29-Apr-11	3.1	11	1.6	13	3.7	3.8	2.5	0.31	0.57	0.35	67	130	< 1	60	8.0
R-51	P1A	915	26-Jul-10	4.4	11	1.5	12	2.8	3.0	2.0	0.26	0.34	0.28	66	131	0.4	70	8.3
R-51	P1A	915	19-Oct-10	4.8	14	1.6	11	2.8	7.2	1.9	0.15	0.34	0.29	65	139	0.5	61	8.2
R-51	P1A	915	11-Jan-11	3.0	11	1.5	12	2.7	3.2	2.0	0.26	0.25	0.28	70	127	< 1	60	8.3
R-51	P1A	915	9-May-11	3.1	11	1.3	12	2.7	3.1	2.1	0.28	0.33	0.26	72	120	0.4	58	8.2
R-51	P2A	1031	26-Jul-10	2.3	17	1.8	11	3.1	7.0	2.1	0.20	0.28	0.28	74	139	0.6	64	8.2
R-51	P2A	1031	19-Oct-10	5.8	15	1.7	11	2.8	7.0	1.9	0.15	0.36	0.30	65	142	0.6	120	8.2
R-51	P2A	1031	11-Jan-11	3.0	15	1.7	11	2.8	5.5	1.9	0.21	0.21	0.29	69	132	0.4	61	8.3
R-51	P2A	1031	9-May-11	3.0	13	1.6	11	2.8	3.3	2.0	0.22	0.27	0.26	73	126	0.5	59	8.2
R-52	P1A	1035	5-Aug-10	4.2	13	1.9	13	3.1	3.8	2.5	0.25	0.70	0.44	68	146	0.8	64	8.0
R-52	P1A	1035	12-Oct-10	3.8	13	1.9	15	3.1	4.5	2.5	0.25	0.62	0.40	62	134	1.5	66	8.5
R-52	P1A	1035	13-Jan-11	3.0	14	1.9	13	2.9	3.5	2.3	0.28	0.41	0.36	69	136	0.6	68	8.5
R-52	P1A	1035	4-May-11	3.6	14	1.8	14	3.1	3.9	2.6	0.25	0.58	0.38	67	147	0.5	66	8.4
R-52	P2A	1107	5-Aug-10	4.9	11	1.8	11	2.9	3.0	2.2	0.19	0.43	0.34	72	135	0.5	56	8.0
R-52	P2A	1107	12-Oct-10	5.5	10	1.7	11	2.9	3.0	2.1	0.20	0.45	0.33	68	128	0.6	54	8.0
R-52	P2A	1107	13-Jan-11	3.0	11	1.8	11	2.9	3.0	2.1	0.21	0.31	0.32	72	134	< 1	58	7.9
R-52	P2A	1107	4-May-11	5.8	11	1.7	11	3.0	3.0	2.2	0.19	0.39	0.31	72	150	0.4	57	7.9
R-53	P1A	849	26-Jul-10	3.1	11	1.6	11	3.2	2.0	1.8	0.27	0.27	0.21	72	137	0.8	62	7.9
R-53	P1A	849	12-Oct-10	3.9	11	1.6	10	3.0	1.9	1.8	0.23	0.38	0.28	66	129	0.7	55	7.9
R-53	P1A	849	14-Jan-11	3.0	12	1.8	10	3.0	1.9	1.8	0.25	0.34	0.28	70	123	0.4	59	8.0
R-53	P1A	849	6-May-11	3.0	11	1.5	11	3.1	2.1	1.9	0.28	0.47	0.29	70	144	0.4	57	8.0
R-53	P2A	960	26-Jul-10	4.2	11	1.6	11	3.2	1.9	1.8	0.26	0.35	0.29	75	130	< 1	58	8.1
R-53	P2A	960	12-Oct-10	3.8	10	1.7	11	3.2	1.9	1.7	0.21	0.35	0.30	68	124	0.7	55	8.1
R-53	P2A	960	13-Jan-11	3.0	10	1.8	11	3.2	2.0	1.7	0.22	0.25	0.30	74	124	< 1	57	8.0

Table D-3.0-2 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO_4 (mg/L)	Cl (mg/L)	F (mg/L)	NO_3+NO_2-N (mg/L)	ClO_4 (µg/L)	SiO_2 (mg/L)	TDS (mg/L)	TOC (mg/L)	Alkalinity[b] (mg/L as $CaCO_3$)	Lab pH[b]
R-53	P2A	960	6-May-11	3.0	10	1.9	11	3.3	2.0	1.9	0.26	0.44	0.28	74	141	0.4	57	8.0
R-54	P1A	830	27-Jul-10	3.8	19	1.8	12	4.5	1.8	2.0	0.25	0.22	0.17	70	160	7.0	83	7.3
R-54	P1A	830	13-Oct-10	4.3	19	2.0	14	5.3	1.8	1.9	0.22	0.28	0.18	71	165	2.3	55	7.2
R-54	P1A	830	14-Jan-11	3.0	18	2.1	12	5.3	1.8	1.9	0.27	0.26	0.21	70	156	1.0	87	7.2
R-54	P1A	830	4-May-11	12.0	14	1.4	10	4.1	1.9	1.9	0.20	0.33	0.25	66	141	0.6	67	7.7
R-54	P2A	915	27-Jul-10	3.7	11	1.9	12	3.0	2.1	1.9	0.25	0.39	0.28	71	132	0.7	60	8.3
R-54	P2A	915	13-Oct-10	4.0	11	2.0	13	3.1	1.9	1.8	0.20	0.46	0.28	73	135	1.0	57	8.2
R-54	P2A	915	12-Jan-11	3.0	11	2.0	12	3.1	2.0	1.9	0.22	0.29	0.29	75	134	0.4	59	8.3
R-54	P2A	915	5-May-11	3.0	11	1.7	12	3.2	2.1	2.0	0.26	0.33	0.26	73	146	0.4	60	8.1
R-55	P1A	860	9-Sep-10	—[d]	11	1.6	17	4.1	5.0	3.7	0.36	0.76	0.46	74	163	1.1	119	8.0
R-55	P1A	860	7-Feb-11	3.0	12	1.8	17	4.3	5.0	3.8	0.36	0.68	0.46	70	159	0.9	76	8.2
R-55	P1A	860	28-Apr-11	3.0	11	1.7	18	4.2	12.4	16.4	0.20	0.63	0.46	68	157	0.5	73	8.0
R-55	P2A	994	14-Sep-10	—	12	1.8	17	4.2	4.3	3.6	0.34	0.70	0.44	70	154	1.0	69	8.3
R-55	P2A	994	1-Feb-11	4.7	13	1.9	18	4.4	4.8	3.6	0.37	0.56	0.43	67	151	0.9	77	8.5
R-55	P2A	994	28-Apr-11	3.1	11	1.8	18	4.4	4.4	3.7	0.32	0.50	0.42	66	148	0.5	75	8.2
R-55i	Single	510	23-Mar-11	5.2	13	2.3	35	9.0	21.1	16.6	0.22	3.88	0.99	44	218	2.6	90	7.8
R-55i	Single	510	10-May-11	3.0	13	2.4	36	9.1	20.3	17.2	0.28	3.83	0.88	46	218	2.4	92	7.8
R-56	P1A	945	19-Aug-10	90	11	1.7	13	4.0	2.7	2.2	0.28	0.70	0.35	65	141	1.4	63	8.0
R-56	P1A	945	3-Feb-11	3.6	10	1.8	13	4.2	3.0	2.4	0.33	0.57	0.30	65	144	0.9	66	7.8
R-56	P1A	945	10-May-11	3.5	10	1.6	14	4.2	3.2	2.4	0.36	0.93	0.28	67	127	0.3	65	7.9
R-56	P2A	1047	13-Aug-10	300	11	1.7	12	3.5	2.8	2.2	0.31	0.66	0.33	64	132	0.4	60	8.0
R-56	P2A	1047	7-Feb-11	3.6	11	1.9	12	3.6	3.0	2.3	0.33	0.51	0.30	66	148	0.9	66	8.0
R-56	P2A	1047	10-May-11	3.4	12	1.9	13	3.6	3.4	2.1	0.32	0.68	0.28	68	136	< 1	62	8.0
R-57	P1A	910	1-Jul-10	—	11	1.4	13	3.3	3.2	2.5	0.30	0.61	0.34	65	137	0.5	61	8.1

Table D-3.0-2 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SO_4 (mg/L)	Cl (mg/L)	F (mg/L)	NO_3+NO_2-N (mg/L)	ClO_4 (µg/L)	SiO_2 (mg/L)	TDS (mg/L)	TOC (mg/L)	Alkalinity[b] (mg/L as $CaCO_3$)	Lab pH[b]
R-57	P1A	910	9-May-11	3.2	11	1.6	13	3.6	2.8	2.3	0.34	0.50	0.27	68	120	0.7	64	7.6
R-57	P2A	972	25-Jun-10	—	13	1.6	13	3.5	3.6	2.4	0.30	0.75	0.33	70	157	0.4	63	7.9
R-57	P2A	972	9-May-11	3.3	11	1.4	13	3.4	2.7	2.3	0.31	0.45	0.28	69	127	0.5	64	7.8

Source: Attachment D-1.

[a] Purged CVs from Table D-3.0-1.

[b] Alkalinity and pH measured at offsite analytical laboratory.

[c] — = Suspect data; see discussion of this result in Table D-4.3-1.

[d] — = Not available.

Table D-3.0-3
Trace Metals

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Filtered (µg/L)											Unfiltered (µg/L)	
					Al	Ba	Cr	Fe	Mn	Mo	Ni	Sr	U	V	Zn	Al	Fe
R-20	P1A	905	3-Aug-10	3.0	< 200	93	< 10	< 100	25	1.3	1.3	155	0.70	4.4	8	< 200	34
R-20	P1A	905	20-Oct-10	4.1	< 200	85	< 10	< 100	21	< 1.4	1.1	142	0.65	4.1	4	< 200	< 100
R-20	P1A	905	27-Jan-11	7.9	< 200	81	< 10	< 100	11	< 1.4	5.6	148	1.09	7.8	8	< 200	45
R-20	P1A	905	20-Apr-11	1.0	< 200	84	< 10	< 100	21	1.2	0.8	157	0.39	< 3.0	< 10	< 75	42
R-20	P2A	1147	30-Jul-10	3.0	< 200	173	3.3	30	66	1.5	2.7	210	0.40	3.5	< 10	< 200	50
R-20	P2A	1147	11-Oct-10	4.6	< 200	166	3.7	< 100	64	1.5	2.8	200	0.55	3.7	< 10	< 200	31
R-20	P2A	1147	21-Jan-11	12.5	70	155	2.2	< 100	39	1.5	2.0	176	0.64	5.2	< 10	82	< 100
R-20	P2A	1147	25-Apr-11	3.0	< 200	185	< 10	< 100	75	1.5	2.1	210	0.39	5.1	4	< 200	39
R-21	Single	889	11-Aug-10	3.2	< 200	14	6.5	< 100	5	1.5	0.5	47	0.37	4.7	< 10	< 200	< 100
R-21	Single	889	11-Oct-10	3.4	< 200	15	3.9	< 100	6	1.4	< 2	48	< 0.37	5.4	4	< 200	< 39
R-21	Single	889	27-Jan-11	3.4	< 200	14	< 10	37	4	< 1.5	< 2	44	0.36	5.2	< 10	< 200	< 100
R-21	Single	889	19-Apr-11	3.0	< 200	14	3.6	35	5	1.2	0.8	46	0.31	5.1	< 10	< 200	< 100
R-23	Single	816	12-Aug-10	5.0	< 200	20	3.9	< 100	< 10	1.9	< 2	80	0.51	6.1	< 10	< 200	< 100
R-23	Single	816	22-Oct-10	5.8	< 200	22	3.8	< 100	< 10	2.1	8.8	84	0.47	6.8	8	< 200	< 100
R-23	Single	816	24-Jan-11	7.5	< 200	21	3.9	< 100	< 10	1.8	1.6	80	0.49	6.1	< 10	< 200	66
R-23	Single	816	18-Apr-11	4.4	< 200	20	< 10	< 100	< 10	1.5	0.7	77	0.41	6.2	22	< 200	< 100
R-23i	P1A	400	9-Aug-10	3.0	< 200	51	4.3	< 100	< 10	0.9	0.8	155	0.78	2.8	< 10	< 200	74
R-23i	P1A	400	21-Oct-10	7.7	< 200	54	< 10	< 100	< 10	1.1	0.6	168	0.68	2.7	6	94	137
R-23i	P1A	400	14-Jan-11	7.1	< 200	55	< 10	< 100	< 10	1.2	1.1	169	0.97	3.3	5	< 136	55
R-23i	P1A	400	28-Apr-11	4.2	< 200	53	< 10	< 100	< 10	1.2	0.7	158	0.78	3.0	< 10	165	163
R-23i	P2A	470	4-Aug-10	3.0	< 200	11	< 10	< 100	< 10	1.7	0.7	101	0.74	4.2	< 10	< 200	< 100
R-23i	P2A	470	18-Oct-10	3.4	< 200	10	3.2	< 100	< 10	1.9	0.8	92	0.75	4.3	4	< 200	< 32
R-23i	P2A	470	18-Jan-11	3.9	< 200	9	< 10	< 100	< 10	1.7	0.9	93	0.78	4.3	9	< 200	< 100
R-23i	P2A	470	3-May-11	3.0	< 200	9	< 10	< 100	2	1.6	0.6	91	0.71	4.5	5	87	< 100

Table D-3.0-3 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Filtered (µg/L)											Unfiltered (µg/L)	
					Al	Ba	Cr	Fe	Mn	Mo	Ni	Sr	U	V	Zn	Al	Fe
R-23i	P3A	524	4-Aug-10	2.9	< 200	8	3.4	< 100	< 10	1.4	1.2	96	0.57	4.3	< 10	< 200	< 100
R-23i	P3A	524	18-Oct-10	4.0	< 200	8	4.4	< 100	< 10	1.6	1.2	90	0.68	4.7	< 10	< 200	< 50
R-23i	P3A	524	24-Jan-11	3.6	< 200	8	3.6	< 100	< 10	1.5	2.3	96	0.59	5.1	< 10	187	147
R-23i	P3A	524	18-Apr-11	3.0	< 200	8	< 10	< 100	< 10	1.3	1.1	91	0.55	4.7	7	< 200	< 100
R-32	Single	868	6-Aug-10	3.4	< 200	40	< 10	< 100	< 10	2.2	1.3	77	0.65	3.2	42	< 200	< 100
R-32	Single	868	14-Oct-10	3.7	< 200	41	< 10	< 100	< 10	2.2	1.1	78	0.65	2.6	44	< 200	< 100
R-32	Single	868	25-Jan-11	3.7	< 200	42	< 10	< 100	< 10	2.5	1.2	78	0.65	3.1	41	< 200	< 100
R-32	Single	868	2-May-11	3.2	< 200	41	< 10	< 100	< 10	2.1	1.4	77	0.55	3.4	37	< 200	< 100
R-37	P1A	929	5-Aug-10	2.9	< 200	10	< 10	33	7	3.7	1.1	109	1.55	5.0	< 10	< 200	76
R-37	P1A	929	12-Oct-10	3.2	< 200	9	3.0	38	4	3.6	1.1	100	1.61	4.7	< 10	< 200	32
R-37	P1A	929	21-Jan-11	5.6	< 200	9	< 10	< 100	< 10	4.1	1.5	103	1.32	4.7	9	< 200	52
R-37	P1A	929	3-May-11	2.8	90	8	< 10	< 100	< 2	3.3	1.3	100	1.41	4.8	6	89	< 100
R-37	P2A	1026	10-Aug-10	6.5	< 200	28	4.4	< 100	< 10	1.6	0.9	51	0.48	5.2	< 10	267	272
R-37	P2A	1026	14-Oct-10	4.8	< 200	30	3.5	< 100	< 10	1.6	0.8	55	0.50	5.8	< 10	111	163
R-37	P2A	1026	25-Jan-11	NC	< 200	29	3.1	< 100	< 10	1.8	0.7	53	0.46	< 5.0	< 10	< 200	30
R-37	P2A	1026	26-Apr-11	3.0	< 200	30	2.8	< 100	< 10	1.5	0.8	53	0.40	6.2	6	< 200	89
R-38	Single	821	6-Aug-10	7.0	< 200	29	< 10	< 100	< 10	1.6	3.7	50	0.40	4.0	5	< 200	< 100
R-38	Single	821	11-Oct-10	3.8	< 200	29	5.2	< 100	2	1.7	5.6	49	0.45	3.7	9	< 200	< 100
R-38	Single	821	27-Jan-11	3.0	< 200	30	< 10	< 100	2	< 1. 8	3.0	52	0.40	4.9	8	< 200	< 100
R-38	Single	821	6-May-11	3.8	< 200	29	< 10	< 100	2	1.7	3.5	51	0.44	4.7	6	< 200	< 100
R-39	Single	859	12-Aug-10	3.9	< 200	16	4.3	< 100	< 10	2.7	0.6	56	0.47	6.0	< 10	< 200	43
R-39	Single	859	8-Oct-10	4.3	< 200	15	3.8	< 100	< 10	2.4	0.6	54	0.48	5.6	< 10	189	199
R-39	Single	859	26-Jan-11	4.7	< 200	15	2.7	< 100	< 10	1.8	1.4	56	0.39	4.8	< 10	129	133
R-39	Single	859	21-Apr-11	3.0	< 200	15	5.3	< 100	< 10	1.3	1.1	56	0.30	5.9	< 10	106	70
R-40i	Single	650	4-Dec-09	3.0	< 200	28	<10	1410	372	20	0.9	100	< 0.48	< 5	< 10	< 200	1470

Table D-3.0-3 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Filtered (µg/L)											Unfiltered (µg/L)	
					Al	Ba	Cr	Fe	Mn	Mo	Ni	Sr	U	V	Zn	Al	Fe
R-40i	Single	650	3-Mar-10	2.0	< 200	30	< 6.4	1420	398	22	1.0	106	0.27	< 5	< 10	< 200	1420
R-40i	Single	650	28-Jul-10	3.5	< 200	28	< 10	1210	366	16.9	0.7	99	0.35	< 5	3	< 200	1210
R-40i	Single	650	20-Oct-10	3.8	< 200	27	3.6	1190	340	18.3	0.9	96	0.37	< 5	< 10	< 200	1190
R-40	P1A	752	4-Jun-10	1.3	< 200	29	< 10	41	48	9.3	14.8	990	1.00	4.7	13	< 200	170
R-40	P1A	752	28-Jul-10	1.4	< 200	28	< 10	< 100	10	6.4	1.3	103	1.08	2.7	6	< 200	40
R-40	P1A	752	20-Oct-10	1.4	< 200	27	4.1	< 75	4	6.7	2.4	96	1.06	3.8	5	< 200	< 95
R-40	P1A	752	21-Jan-11	1.0	< 200	29	< 10	30	24	9.0	1.7	114	1.10	2.3	8	< 200	< 100
R-40	P2A	849	27-Jul-10	4.0	< 200	25	< 10	< 100	4	2.3	0.8	54	0.32	4.7	12	< 200	126
R-40	P2A	849	19-Oct-10	4.1	< 200	23	< 10	< 35	< 10	1.8	< 2	49	0.30	5.3	7	< 200	< 125
R-40	P2A	849	19-Jan-11	3.0	< 200	25	2.3	< 100	< 10	1.4	0.9	53	0.33	5.8	5	< 200	56
R-40	P2A	849	26-Apr-11	3.0	< 200	24	< 10	< 100	< 10	1.3	0.6	50	0.29	4.8	< 10	< 200	32
R-41	P2A	965	9-Aug-10	5.0	< 200	29	4.5	< 100	6	4.3	2.9	78	0.73	6.1	4	< 200	< 100
R-41	P2A	965	8-Oct-10	4.1	537	28	3.4	< 100	3	3.3	1.8	75	0.68	5.9	< 10	< 200	< 100
R-41	P2A	965	12-Jan-11	4.7	< 200	28	2.3	< 100	< 10	3.5	1.6	78	0.56	6.2	< 10	< 200	< 100
R-41	P2A	965	21-Apr-11	3.4	< 200	27	4.1	30	< 10	2.9	2.1	75	0.39	6.8	< 10	< 200	< 100
R-49	P1A	845	29-Jul-10	4.1	< 200	22	2.7	< 100	11	2.1	1.0	70	0.89	3.7	< 10	467	238
R-49	P1A	845	7-Oct-10	3.5	< 200	20	2.8	< 100	6	2.4	1.7	58	1.26	3.9	< 10	141	52
R-49	P1A	845	19-Jan-11	4.4	< 200	21	2.2	< 100	5	2.1	1.2	62	1.07	4.1	4	76	151
R-49	P1A	845	2-May-11	3.2	< 200	20	< 10	< 100	5	2.1	0.9	58	0.88	4.8	< 10	69	35
R-49	P2A	906	29-Jul-10	4.0	< 200	21	3.4	< 100	< 10	1.4	0.6	59	0.30	4.0	< 10	< 200	< 100
R-49	P2A	906	7-Oct-10	3.8	< 200	21	3.3	< 100	< 10	1.5	1.1	55	0.35	4.5	4	< 200	< 100
R-49	P2A	906	26-Jan-11	3.2	< 200	21	2.1	< 100	< 10	1.7	0.7	59	0.36	4.1	< 10	< 200	< 100
R-49	P2A	906	29-Apr-11	3.1	< 200	21	2.2	< 100	< 10	1.5	0.8	56	0.34	4.8	< 10	< 200	39
R-51	P1A	915	26-Jul-10	4.4	< 200	25	5.2	< 100	< 10	1.3	1.8	90	0.33	5.6	20	< 200	53
R-51	P1A	915	19-Oct-10	4.8	< 200	20	< 10	< 100	< 10	1.4	< 2	53	0.33	5.0	6	< 200	68

Table D-3.0-3 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Filtered (µg/L)											Unfiltered (µg/L)	
					Al	Ba	Cr	Fe	Mn	Mo	Ni	Sr	U	V	Zn	Al	Fe
R-51	P1A	915	11-Jan-11	3.0	< 200	29	2.4	< 100	< 10	1.3	0.6	93	0.34	6.0	20	< 200	50
R-51	P1A	915	9-May-11	3.1	< 200	28	< 10	< 100	< 10	1.2	0.7	77	0.23	5.5	4	< 200	44
R-51	P2A	1031	26-Jul-10	2.3	< 200	20	3.8	32	2	1.4	0.9	58	0.39	6.2	7	< 200	93
R-51	P2A	1031	19-Oct-10	5.8	< 200	19	< 10	< 40	< 10	1.3	< 2	53	0.33	5.5	9	< 200	75
R-51	P2A	1031	11-Jan-11	3.0	< 200	20	2.2	30	< 10	1.2	< 2	54	0.37	5.8	4	< 200	56
R-51	P2A	1031	9-May-11	3.0	< 200	22	4.2	30	< 10	1.3	0.7	52	0.30	5.4	< 10	78	60
R-52	P1A	1035	5-Aug-10	4.2	< 200	28	3.2	< 100	< 10	1.5	0.6	57	0.45	5.6	41	83	64
R-52	P1A	1035	12-Oct-10	3.8	< 200	30	4.5	< 100	3	1.8	0.8	67	0.72	5.5	11	< 200	33
R-52	P1A	1035	13-Jan-11	3.0	< 200	30	< 10	< 100	< 10	2.2	1.4	67	0.75	6.6	18	< 200	40
R-52	P1A	1035	4-May-11	3.6	< 200	30	2.1	< 100	< 10	1.7	< 2	65	0.47	6.2	13	< 200	< 100
R-52	P2A	1107	5-Aug-10	4.9	< 200	28	3.5	< 100	2	1.2	0.5	50	0.36	5.8	9	< 200	< 100
R-52	P2A	1107	12-Oct-10	5.5	< 200	29	4.5	< 100	< 10	1.1	1.2	48	0.39	5.8	< 10	< 200	< 100
R-52	P2A	1107	13-Jan-11	3.0	< 200	30	< 10	< 100	< 10	< 1.5	1.2	50	0.45	6.2	< 10	< 200	< 100
R-52	P2A	1107	4-May-11	5.8	< 200	30	< 10	< 100	< 10	1.2	0.5	48	0.29	6.0	< 10	< 200	< 100
R-53	P1A	849	26-Jul-10	3.1	< 200	30	< 3.8	< 100	37	2.3	1.0	45	0.49	4.4	221	< 200	< 100
R-53	P1A	849	12-Oct-10	3.9	< 200	24	3.8	< 100	3	1.5	0.7	42	0.49	4.2	76	< 200	< 100
R-53	P1A	849	14-Jan-11	3.0	< 200	24	2.1	< 100	< 10	1.4	0.8	44	0.51	4.5	65	< 563	< 100
R-53	P1A	849	6-May-11	3.0	< 200	23	< 10	< 100	< 10	1.3	1.5	44	0.51	5.5	15	< 200	< 100
R-53	P2A	960	26-Jul-10	4.2	< 200	29	< 3.0	< 100	< 10	1.3	< 2	45	0.43	4.9	11	< 200	< 100
R-53	P2A	960	12-Oct-10	3.8	< 200	28	5.2	< 100	< 10	1.0	0.8	45	0.41	4.9	5	< 200	< 100
R-53	P2A	960	13-Jan-11	3.0	< 200	30	2.9	< 100	< 10	< 1.6	0.6	47	0.52	5.3	4	< 200	< 100
R-53	P2A	960	6-May-11	3.0	< 200	29	2.0	< 100	< 10	1.1	0.7	46	0.40	5.7	< 10	< 200	< 100
R-54	P1A	830	27-Jul-10	3.8	< 200	12	< 10	1940	216	4.0	3.1	57	0.37	1.0	25	127	2050
R-54	P1A	830	13-Oct-10	4.3	< 200	14	< 10	3850	280	3.9	3.6	66	0.53	< 5	23	< 200	4600
R-54	P1A	830	14-Jan-11	3.0	< 200	14	< 10	2650	252	3.2	2.4	64	0.58	1.4	12	< 200	2670

Table D-3.0-3 (continued)

Location	Port Name	Depth (ft bgs)	Date	Purged CV[a]	Filtered (µg/L)											Unfiltered (µg/L)	
					Al	Ba	Cr	Fe	Mn	Mo	Ni	Sr	U	V	Zn	Al	Fe
R-54	P1A	830	4-May-11	12.0	< 200	13	< 10	614	136	2.1	1.3	46	0.51	2.5	4	< 200	668
R-54	P2A	915	27-Jul-10	3.7	< 200	10	3.1	< 100	3	1.1	0.8	52	0.40	5.3	< 10	< 200	45
R-54	P2A	915	13-Oct-10	4.0	< 200	10	4.2	< 100	< 10	1.2	1.0	57	0.50	5.1	< 10	95	36
R-54	P2A	915	12-Jan-11	3.0	< 200	10	< 10	< 100	< 10	1.2	0.7	57	0.43	5.0	< 10	< 71	39
R-54	P2A	915	5-May-11	3.0	< 200	10	< 10	< 100	< 10	1.1	0.7	52	0.43	5.1	< 10	< 200	< 100
R-55i	Single	510	23-Mar-11	5.2	< 200	38	3.8	82	435	7.8	3.9	166	1.12	2.9	< 10	< 200	168
R-55i	Single	510	10-May-11	3.0	< 200	51	< 10	431	621	9.5	3.9	166	1.23	2.5	8	< 200	675
R-55	P1A	860	9-Sep-10	—[b]	< 200	36	< 10	< 100	9	1.2	2.9	73	0.62	5.7	4	< 200	< 100
R-55	P1A	860	7-Feb-11	3.0	< 200	35	2.8	36	16	1.2	1.0	73	0.64	4.9	< 10	< 200	64
R-55	P1A	860	28-Apr-11	3.0	< 200	35	< 10	< 100	5	1.1	0.9	73	0.65	5.2	< 10	< 200	< 100
R-55	P2A	994	14-Sep-10	—	< 200	31	6.5	< 100	14	1.8	< 2	73	0.61	5.5	5	< 200	41
R-55	P2A	994	1-Feb-11	4.7	< 200	29	2.0	35	2	1.4	< 2	81	0.60	4.3	< 10	< 200	58
R-55	P2A	994	28-Apr-11	3.1	< 200	32	< 10	< 100	< 10	1.3	0.9	87	0.68	< 5	< 10	< 200	< 100
R-56	P1A	945	19-Aug-10	~90	< 200	31	< 10	< 100	18	1.9	0.6	55	0.66	3.9	14	< 200	55
R-56	P1A	945	3-Feb-11	3.6	< 200	32	< 10	< 75	4	2.0	< 1.9	58	0.65	3.5	106	< 200	< 87
R-56	P1A	945	10-May-11	3.5	< 200	33	2.1	< 100	5	2.0	0.8	58	0.67	< 4.2	< 14	< 200	< 100
R-56	P2A	1047	13-Aug-10	~300	< 200	30	4.8	< 100	16	2.2	0.5	54	0.61	3.7	< 10	< 200	46
R-56	P2A	1047	7-Feb-11	3.6	< 200	29	< 10	69	< 10	2.7	0.9	54	0.66	3.9	14	< 200	103
R-56	P2A	1047	10-May-11	3.4	< 200	23	< 10	48	2	3.1	0.6	56	0.53	< 4.0	< 4	< 200	65
R-57	P1A	910	1-Jul-10	—	201	17	4.6	54	14	1.8	0.7	58	0.35	5.1	< 10	201	< 100
R-57	P1A	910	9-May-11	3.2	< 200	17	< 10	< 100	79	2.3	1.6	61	0.37	4.3	29	< 200	< 100
R-57	P2A	972	25-Jun-10	—	< 200	20	3.9	36	9	1.9	< 2	62	0.45	< 5	< 10	< 200	89
R-57	P2A	972	9-May-11	3.3	< 200	20	< 10	< 100	17	1.4	0.8	59	0.31	3.9	4	< 200	55

Source: Attachment D-1.

[a] Purged CVs from Table D-3.0-1.

[b] — = Not available.

Table D-3.0-4
Stable Isotopes

Well Port	Field QC Type	Date	$\delta^{15}N\text{-}NO_3$ (permil)	$\delta^{18}O$ (permil)	$\delta^{2}H$ (permil)
R-20 P1A, 904.6 ft	—[a]	6/21/08 3:50 PM	6.6	-11.1	-81.6
R-20 P1A, 904.6 ft	—	9/18/08 12:00 PM	—	-11.3	-80.8
R-20 P1A, 904.6 ft	—	3/10/09 10:13 AM	—	-11.3	-80.9
R-20 P1A, 904.6 ft	—	3/10/09 3:02 PM	6.3	-11.3	-81.4
R-20 P1A, 904.6 ft	—	3/10/09 9:13 PM	6.6	-11.2	-81.3
R-20 P1A, 904.6 ft	—	6/2/09 2:15 PM	5.5	-11.5	-81.4
R-20 P1A, 904.6 ft	—	9/2/09 5:30 PM	5.5	-11.2	-79.7
R-20 P1A, 904.6 ft	—	12/1/09 3:31 PM	3.7	-11.4	-82.0
R-20 P1A, 904.6 ft	—	3/13/10 1:43 PM	7.1	-11.3	-80.2
R-20 P1A, 904.6 ft	—	6/15/10 1:30 PM	6.9	-11.1	-78.4
R-20 P1A, 904.6 ft	—	10/20/10 2:05 PM	4.7	-11.3	-77.5
R-20 P1A, 904.6 ft	—	4/20/11 2:11 PM	—	-11.4	-81.0
R-20 P2A, 1147.1 ft	—	6/23/08 11:55 AM	—	-11.2	-81.0
R-20 P2A, 1147.1 ft	—	9/18/08 12:00 PM	6.3	-11.3	-79.8
R-20 P2A, 1147.1 ft	—	3/9/09 2:20 PM	6.5	-11.1	-78.5
R-20 P2A, 1147.1 ft	—	5/29/09 12:35 PM	6.6	-11.2	-80.2
R-20 P2A, 1147.1 ft	—	9/3/09 12:44 PM	—	-11.2	-81.1
R-20 P2A, 1147.1 ft	—	2/24/10 3:09 PM	16.3	-11.0	-79.8
R-20 P2A, 1147.1 ft	—	6/1/10 12:25 PM	—	-11.3	-78.1
R-20 P2A, 1147.1 ft	—	10/11/10 3:30 PM	4.7	-11.3	-79.5
R-20 P2A, 1147.1 ft	—	4/25/11 1:20 PM	—	-11.3	-79.4
R-21 Single, 888.8 ft	—	7/7/06 2:32 PM	5.2	-9.1	-80.4
R-21 Single, 888.8 ft	—	8/20/07 3:41 PM	3.5	-11.4	—
R-21 Single, 888.8 ft	—	8/14/08 12:00 PM	—	-11.1	-81.0
R-21 Single, 888.8 ft	—	8/14/08 2:55 PM	4.7	—	—
R-21 Single, 888.8 ft	—	8/18/09 1:40 PM	5.5	-11.1	-80.4
R-21 Single, 888.8 ft	—	12/4/09 2:35 PM	4.6	-10.7	-81.6
R-21 Single, 888.8 ft	—	3/12/10 3:15 PM	4.5	-11.2	-77.8
R-21 Single, 888.8 ft	—	6/11/10 12:45 PM	4.5	-11.0	-80.6
R-21 Single, 888.8 ft	—	10/11/10 12:45 PM	4.4	-11.2	-77.0
R-22 MP1A, 907.1 ft	—	3/13/01 9:20 AM	3.3	-11.0	-78.0
R-22 MP1A, 907.1 ft	—	6/19/01 2:45 PM	1.6	-10.8	-76.0
R-22 MP1A, 907.1 ft	—	11/30/01 10:15 AM	1.4	-11.0	-77.0

Table D-3.0-4 (continued)

Well Port	Field QC Type	Date	$\delta^{15}N\text{-}NO_3$ (permil)	$\delta^{18}O$ (permil)	$\delta^{2}H$ (permil)
R-22 MP1A, 907.1 ft	—	2/27/02 9:55 AM	—	-10.8	-79.0
R-22 MP1A, 907.1 ft	—	8/22/06 12:29 PM	—	-10.9	-77.5
R-22 MP2A, 962.8 ft	—	3/12/01 9:00 AM	2.6	-11.3	-78.0
R-22 MP2A, 962.8 ft	—	6/20/01 2:05 PM	0.6	-11.1	-75.0
R-22 MP2A, 962.8 ft	—	12/3/01 12:50 PM	2.7	-11.2	-77.0
R-22 MP2A, 962.8 ft	—	2/28/02 9:50 AM	5.6	-11.0	-77.0
R-22 MP2A, 962.8 ft	—	8/28/06 11:59 AM	—	-11.1	-78.5
R-22 MP2A, 962.8 ft	—	9/18/07 10:07 AM	—	-10.9	—
R-22 MP2A, 962.8 ft	—	9/16/08 9:43 AM	6.6	-11.2	-79.0
R-22 MP2A, 962.8 ft	—	2/26/09 1:30 PM	6.9	-11.0	-79.6
R-22 MP3A, 1273.5 ft	—	3/8/01 1:45 PM	-3.5	-11.2	-76.0
R-22 MP3A, 1273.5 ft	—	6/21/01 12:30 PM	0.7	-11.0	-73.0
R-22 MP3A, 1273.5 ft	—	12/4/01 12:15 PM	1.2	-10.9	-73.0
R-22 MP3A, 1273.5 ft	—	3/4/02 9:45 AM	6.4	-10.7	-78.0
R-22 MP3A, 1273.5 ft	—	8/23/06 1:35 PM	—	-10.9	-77.4
R-22 MP3A, 1273.5 ft	—	9/17/08 11:05 AM	—	-10.9	-78.3
R-22 MP3A, 1273.5 ft	—	9/17/08 11:42 AM	5.4	—	—
R-22 MP3A, 1273.5 ft	—	2/27/09 12:46 PM	6.5	-10.8	-77.1
R-22 MP4A, 1378 ft	—	3/7/01 10:15 AM	—	-11.0	-76.0
R-22 MP4A, 1378 ft	—	6/25/01 3:15 PM	2.1	-10.8	-78.0
R-22 MP4A, 1378 ft	—	12/5/01 1:40 PM	5.5	-10.5	-72.0
R-22 MP4A, 1378 ft	—	3/5/02 9:57 AM	3.7	-10.5	-74.0
R-22 MP4A, 1378 ft	FD[b]	3/5/02 9:57 AM	4.8	-10.4	-74.0
R-22 MP4A, 1378 ft	—	8/22/06 11:30 AM	—	-10.6	-76.2
R-22 MP5A, 1448.2 ft	—	3/6/01 9:45 AM	—	-11.2	-76.0
R-22 MP5A, 1448.2 ft	—	6/26/01 11:45 AM	2.5	-11.2	-80.0
R-22 MP5A, 1448.2 ft	—	12/7/01 5:00 PM	4.2	-10.7	-74.0
R-22 MP5A, 1448.2 ft	FD	12/7/01 5:00 PM	3.8	-11.0	-75.0
R-22 MP5A, 1448.2 ft	—	3/7/02 9:15 AM	—	-11.3	-77.0
R-22 MP5A, 1448.2 ft	—	8/21/06 2:59 PM	—	-10.8	-78.9
R-23 Single, 816 ft	—	8/15/06 11:40 AM	—	-10.7	-80.1
R-23 Single, 816 ft	FD	8/15/06 11:40 AM	—	-10.9	-79.9
R-23 Single, 816 ft	—	9/6/07 10:01 AM	5.8	-10.8	—
R-23 Single, 816 ft	FD	9/6/07 10:01 AM	5.7	-10.9	—
R-23 Single, 816 ft	—	9/8/08 9:35 AM	6.2	-10.5	-78.1
R-23 Single, 816 ft	—	2/25/09 2:34 PM	—	-10.6	-78.3
R-23 Single, 816 ft	—	6/4/09 3:15 PM	6.6	-10.7	-78.5
R-23 Single, 816 ft	—	9/3/09 3:45 PM	6.5	-10.5	-79.6
R-23 Single, 816 ft	—	12/9/09 11:18 AM	7.2	-10.5	-79.4

Table D-3.0-4 (continued)

Well Port	Field QC Type	Date	$\delta^{15}N\text{-}NO_3$ (permil)	$\delta^{18}O$ (permil)	$\delta^{2}H$ (permil)
R-23 Single, 816 ft	—	3/5/10 8:47 AM	6.9	-10.8	-78.1
R-23 Single, 816 ft	—	6/9/10 9:44 AM	6.8	-11.1	-80.2
R-23 Single, 816 ft	—	8/12/10 9:11 AM	—	-10.9	-78.5
R-23 Single, 816 ft	—	8/12/10 12:00 PM	5.1	—	—
R-23i P1A, 400.3 ft	—	6/16/08 1:55 PM	—	-10.6	-81.2
R-23i P1A, 400.3 ft	—	9/16/08 3:50 PM	7.1	-10.9	-79.7
R-23i P1A, 400.3 ft	—	3/3/09 1:25 PM	7.3	-10.8	-80.3
R-23i P1A, 400.3 ft	—	6/9/09 1:48 PM	5.8	-10.9	-79.5
R-23i P1A, 400.3 ft	—	9/10/09 11:25 AM	8.0	-10.6	-79.1
R-23i P1A, 400.3 ft	—	3/10/10 10:26 AM	5.5	-10.8	-79.8
R-23i P1A, 400.3 ft	—	6/15/10 11:15 AM	6.0	-10.7	-80.6
R-23i P1A, 400.3 ft	—	8/9/10 1:45 PM	5.4	-10.9	-77.6
R-23i P2A, 470.2 ft	—	12/19/07 10:35 AM	6.5	-10.6	-78.8
R-23i P2A, 470.2 ft	—	9/16/08 12:00 PM	6.4	-10.6	-78.3
R-23i P2A, 470.2 ft	—	9/8/09 4:00 PM	6.8	-10.8	-78.9
R-23i P2A, 470.2 ft	—	12/2/09 11:50 AM	7.5	-10.9	-79.7
R-23i P2A, 470.2 ft	—	3/9/10 12:15 PM	5.5	-10.8	-79.7
R-23i P2A, 470.2 ft	—	6/17/10 11:28 AM	7.1	-10.4	-76.7
R-23i P2A, 470.2 ft	—	8/4/10 11:45 AM	5.3	—	—
R-23i P2A, 470.2 ft	—	8/4/10 12:00 PM	—	-10.7	-75.1
R-23i P3A, 524 ft	—	9/15/08 12:20 PM	—	-10.8	-78.4
R-23i P3A, 524 ft	—	9/9/09 2:00 PM	6.2	-10.7	-77.8
R-23i P3A, 524 ft	—	12/1/09 1:14 PM	5.7	-10.9	-78.3
R-23i P3A, 524 ft	—	3/8/10 3:05 PM	6.2	-11.0	-78.7
R-23i P3A, 524 ft	—	6/16/10 11:52 AM	7.0	-10.5	-79.4
R-23i P3A, 524 ft	—	8/4/10 2:15 PM	5.9	-10.5	-78.2
R-32 MP1A, 870.9 ft	—	8/29/06 1:10 PM	—	-10.9	-79.0
R-32 MP3A, 976 ft	—	8/30/06 12:14 PM	—	-11.5	-80.1
R-32 Single, 867.5 ft	—	12/14/07 1:07 PM	6.0	-10.8	-78.0
R-32 Single, 867.5 ft	FD	12/14/07 1:07 PM	6.6	-10.6	-77.8
R-32 Single, 867.5 ft	—	9/8/08 1:40 PM	7.0	-10.6	-78.3
R-32 Single, 867.5 ft	FD	9/8/08 1:40 PM	6.8	-10.6	-78.6
R-32 Single, 867.5 ft	—	2/26/09 12:57 PM	—	-10.8	-79.1
R-32 Single, 867.5 ft	FD	2/26/09 12:57 PM	—	-10.8	-79.5
R-32 Single, 867.5 ft	—	6/8/09 2:40 PM	6.7	-11.0	-78.8
R-32 Single, 867.5 ft	—	8/31/09 2:00 PM	7.1	-11.0	-78.6
R-32 Single, 867.5 ft	—	12/7/09 1:55 PM	6.7	-10.7	-79.3
R-32 Single, 867.5 ft	—	3/9/10 12:27 PM	6.1	-10.9	—
R-32 Single, 867.5 ft	—	6/7/10 12:50 PM	6.5	—	-76.3

Table D-3.0-4 (continued)

Well Port	Field QC Type	Date	$\delta^{15}N\text{-}NO_3$ (permil)	$\delta^{18}O$ (permil)	$\delta^{2}H$ (permil)
R-32 Single, 867.5 ft	—	10/14/10 12:00 PM	5.3	-10.8	-79.0
R-37 P1A, 929.3 ft	—	7/13/09 5:00 AM	6.0	-11.1	-78.6
R-37 P1A, 929.3 ft	—	8/20/09 7:40 PM	7.5	-11.0	-80.7
R-37 P1A, 929.3 ft	—	11/18/09 5:40 PM	5.8	-10.9	-81.3
R-37 P1A, 929.3 ft	—	12/18/09 2:58 PM	6.4	-11.3	-79.5
R-37 P1A, 929.3 ft	—	3/2/10 1:37 PM	6.0	-11.3	-81.3
R-37 P1A, 929.3 ft	—	6/16/10 2:35 PM	7.0	-11.0	-82.1
R-37 P1A, 929.3 ft	—	10/12/10 2:45 PM	5.3	-11.2	-81.2
R-37 P2A, 1026 ft	—	6/22/09 5:25 AM	5.2	-10.9	-78.0
R-37 P2A, 1026 ft	—	11/18/09 10:52 AM	5.2	-10.7	-79.4
R-37 P2A, 1026 ft	—	12/18/09 9:22 AM	5.9	-11.3	-79.7
R-37 P2A, 1026 ft	—	3/3/10 9:06 AM	6.0	-10.9	-79.3
R-37 P2A, 1026 ft	—	6/8/10 9:40 AM	5.8	—	-78.5
R-37 P2A, 1026 ft	—	10/14/10 11:10 AM	4.1	-10.9	-77.6
R-37 P2A, 1026 ft	FD	10/14/10 11:10 AM	4.1	-10.8	-76.5
R-38 Single, 821.2 ft	—	2/6/09 12:45 PM	5.0	-11.0	-79.8
R-38 Single, 821.2 ft	—	5/1/09 11:40 AM	6.2	-11.1	-80.3
R-38 Single, 821.2 ft	—	8/21/09 11:10 AM	6.0	-11.0	-78.9
R-38 Single, 821.2 ft	—	12/17/09 12:57 PM	4.4	—	-78.0
R-38 Single, 821.2 ft	—	3/12/10 1:55 PM	4.6	-11.1	-77.5
R-38 Single, 821.2 ft	—	6/2/10 1:25 PM	5.2	-11.0	-76.9
R-38 Single, 821.2 ft	—	10/11/10 11:25 AM	4.6	-11.2	-78.8
R-39 Single, 859 ft	—	2/19/09 2:13 PM	—	-10.9	-80.0
R-39 Single, 859 ft	—	3/12/09 2:10 PM	5.8	-10.9	-79.2
R-39 Single, 859 ft	—	6/9/09 1:25 PM	5.4	-11.0	-80.6
R-39 Single, 859 ft	—	9/2/09 11:51 AM	5.2	-11.2	-77.9
R-39 Single, 859 ft	—	12/9/09 1:30 PM	5.7	-10.8	-81.5
R-39 Single, 859 ft	—	2/26/10 10:25 AM	5.5	-11.2	-80.1
R-39 Single, 859 ft	—	6/2/10 10:42 AM	5.9	-10.9	-78.0
R-39 Single, 859 ft	—	10/8/10 12:33 PM	4.5	-11.1	-79.3
R-40 P1A, 751.6 ft	—	4/21/09 8:18 AM	—	-10.7	-78.4
R-40 P1A, 751.6 ft	—	12/4/09 9:42 AM	—	-10.5	-78.9
R-40 P1A, 751.6 ft	—	2/23/10 12:00 PM	11.3	—	—
R-40 P1A, 751.6 ft	—	10/20/10 9:05 AM	8.2	-10.8	-76.6
R-40 P2A, 849.3 ft	—	9/3/09 3:02 PM	5.8	-11.1	-79.8
R-40 P2A, 849.3 ft	—	6/3/10 2:06 PM	5.2	-11.1	-79.4
R-40 P2A, 849.3 ft	—	10/19/10 12:52 PM	4.3	-10.9	-79.4
R-40 R-40i, 649.7 ft	—	6/10/09 11:33 AM	—	-10.9	-79.0
R-40 R-40i, 649.7 ft	—	8/31/09 1:10 PM	—	-10.9	-79.3

Table D-3.0-4 (continued)

Well Port	Field QC Type	Date	$\delta^{15}N\text{-}NO_3$ (permil)	$\delta^{18}O$ (permil)	$\delta^{2}H$ (permil)
R-40 R-40i, 649.7 ft	—	12/4/09 12:05 PM	—	-10.5	-80.3
R-40 R-40i, 649.7 ft	—	3/3/10 11:13 AM	—	-10.8	-79.2
R-40 R-40i, 649.7 ft	—	10/20/10 11:23 AM	—	-10.8	-78.3
R-41 P2A, 965.3 ft	—	4/2/09 7:00 AM	6.6	-10.6	-79.2
R-41 P2A, 965.3 ft	—	9/1/09 3:15 PM	5.6	-11.0	-79.2
R-41 P2A, 965.3 ft	—	12/15/09 10:10 AM	5.4	-11.5	-80.0
R-41 P2A, 965.3 ft	—	2/26/10 12:48 PM	6.3	-11.1	-80.4
R-41 P2A, 965.3 ft	—	6/9/10 10:06 AM	5.7	-11.1	-78.9
R-41 P2A, 965.3 ft	—	10/8/10 9:48 AM	5.5	-10.9	-75.6
R-41 P2A, 965.3 ft	FD	10/8/10 9:48 AM	5.4	-11.0	-76.3
R-49 P1A, 845 ft	—	6/23/09 5:45 AM	13.1	-11.1	-79.8
R-49 P1A, 845 ft	—	9/1/09 4:35 PM	3.9	-11.1	-79.5
R-49 P1A, 845 ft	—	12/7/09 1:55 PM	6.9	-10.8	-81.0
R-49 P1A, 845 ft	—	3/3/10 2:18 PM	5.0	-10.9	-79.6
R-49 P1A, 845 ft	—	6/14/10 1:56 PM	5.7	-11.1	-80.3
R-49 P1A, 845 ft	—	10/7/10 2:35 PM	5.3	-11.0	-77.6
R-49 P2A, 905.6 ft	—	6/18/09 5:50 AM	3.6	-11.2	-80.6
R-49 P2A, 905.6 ft	—	9/1/09 2:08 PM	5.8	-11.0	-80.4
R-49 P2A, 905.6 ft	—	12/9/09 11:23 AM	5.7	-10.9	-81.1
R-49 P2A, 905.6 ft	—	3/5/10 11:40 AM	5.7	-11.2	-79.8
R-49 P2A, 905.6 ft	—	6/9/10 3:13 PM	6.3	-11.0	-81.0
R-49 P2A, 905.6 ft	—	10/7/10 11:00 AM	5.6	-11.2	-77.4
R-51 P1A, 914.96 ft	—	3/8/10 6:14 AM	5.2	-10.9	-79.1
R-51 P1A, 914.96 ft	—	6/18/10 12:10 PM	5.6	-11.0	-78.3
R-51 P1A, 914.96 ft	—	7/26/10 1:40 PM	4.4	-11.2	-78.5
R-51 P1A, 914.96 ft	—	10/19/10 10:50 AM	3.6	-11.3	-80.1
R-51 P2A, 1030.96 ft	—	2/22/10 6:12 AM	5.7	-11.1	-80.0
R-51 P2A, 1030.96 ft	—	6/18/10 10:00 AM	4.6	—	—
R-51 P2A, 1030.96 ft	—	6/18/10 12:00 PM	—	-11.3	-79.1
R-51 P2A, 1030.96 ft	—	7/26/10 11:21 AM	2.8	-11.3	-81.6
R-51 P2A, 1030.96 ft	—	10/19/10 12:55 PM	1.2	-11.4	-79.5
R-52 P1A, 1035.2 ft	—	5/2/10 6:48 AM	5.8	-10.7	-77.0
R-52 P1A, 1035.2 ft	—	8/5/10 12:23 PM	—	-11.0	-78.1
R-52 P1A, 1035.2 ft	—	8/5/10 12:43 PM	5.1	—	—
R-52 P1A, 1035.2 ft	—	10/12/10 1:31 PM	4.5	-10.9	-78.8
R-52 P1A, 1035.2 ft	—	1/13/11 2:59 PM	3.5	-10.8	-77.3
R-52 P2A, 1107 ft	—	4/23/10 6:07 AM	5.5	—	—
R-52 P2A, 1107 ft	—	4/23/10 12:00 PM	—	-10.5	-79.4
R-52 P2A, 1107 ft	—	8/5/10 10:40 AM	4.6	-11.0	-77.5

Table D-3.0-4 (continued)

Well Port	Field QC Type	Date	$\delta^{15}N\text{-}NO_3$ (permil)	$\delta^{18}O$ (permil)	$\delta^{2}H$ (permil)
R-52 P2A, 1107 ft	—	10/12/10 11:34 AM	4.0	-10.8	-76.7
R-52 P2A, 1107 ft	—	1/13/11 12:26 PM	4.9	-10.8	-77.2
R-53 P1A, 849.2 ft	—	4/19/10 6:36 AM	4.6	-11.3	-82.6
R-53 P1A, 849.2 ft	—	7/26/10 1:50 PM	4.7	-11.5	-80.3
R-53 P1A, 849.2 ft	—	10/12/10 1:46 PM	3.4	-11.3	-77.9
R-53 P1A, 849.2 ft	—	1/14/11 11:05 AM	3.4	-11.1	-80.1
R-53 P2A, 959.7 ft	—	4/14/10 6:10 AM	—	-11.4	-80.5
R-53 P2A, 959.7 ft	—	4/14/10 12:00 PM	5.0	—	—
R-53 P2A, 959.7 ft	—	7/26/10 12:19 PM	4.2	-11.1	-79.8
R-53 P2A, 959.7 ft	—	10/12/10 11:55 AM	3.8	-10.9	-76.6
R-53 P2A, 959.7 ft	—	1/13/11 3:14 PM	4.3	-11.0	-78.0
R-54 P1A, 830 ft	—	2/15/10 6:06 AM	—	-11.0	-78.4
R-54 P1A, 830 ft	—	6/18/10 11:40 AM	3.9	-11.1	-79.8
R-54 P1A, 830 ft	—	7/27/10 12:21 PM	12.0	-11.2	-80.7
R-54 P1A, 830 ft	—	10/13/10 12:17 PM	6.4	-11.3	-79.3
R-54 P2A, 915 ft	—	2/21/10 6:03 AM	5.5	-11.3	-78.3
R-54 P2A, 915 ft	—	6/18/10 9:44 AM	4.8	-11.3	-78.7
R-54 P2A, 915 ft	—	7/27/10 10:43 AM	4.5	-11.3	-81.9
R-54 P2A, 915 ft	—	10/13/10 10:25 AM	3.2	-11.3	-78.4
R-55 P1A, 860 ft	—	9/9/10 6:08 AM	5.9	-9.2	-72.3
R-55 P1A, 860 ft	—	2/7/11 2:02 PM	4.9	-10.6	-77.3
R-55 P2A, 994.4 ft	—	9/14/10 6:02 AM	4.5	-10.6	-76.5
R-55 P2A, 994.4 ft	—	2/1/11 12:35 PM	6.0	-10.7	-77.0
R-56 P1A, 945 ft	—	8/19/10 6:10 AM	4.3	-11.2	-77.1
R-56 P2A, 1046.6 ft	—	8/13/10 6:15 AM	3.9	-11.1	-77.8
R-56 P2A, 1046.6 ft	—	2/7/11 12:42 PM	4.4	-11.1	-79.4
R-57 P1A, 910 ft	—	7/1/10 6:00 AM	4.2	-10.9	-77.7
R-57 P2A, 971.5 ft	—	6/25/10 6:10 AM	5.8	-11.0	-77.1

Source: Attachment D-1.

[a] — = Not applicable.

[b] FD = Field duplicate.

Table D-4.2-1
Statistical Summary of High-Explosive and Organic Compounds Detected in Groundwater Samples from TA-54 Groundwater Monitoring Network Wells for the Period Extending from Well Development to May 2011

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Dioxin Furan Detections															
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	R-23i	P3A	524	n/a[d]	3	1	0.000000745	0.000000745	0.00005	—[e]	—	—	—	—	—
	R-32	Single	867.5	n/a	4	1	0.000000706	0.000000706	0.00005	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	7	1	0.000000869	0.000000869	0.00005	—	—	—	—	—	—
	R-38	Single	821.2	n/a	6	1	0.00000147	0.00000147	0.00005	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	6	1	0.00000054	0.00000054	0.00005	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	6	1	0.000000919	0.000000919	0.00005	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	1	0.000000712	0.000000712	0.00005	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	1	0.000000996	0.000000996	0.00005	—	—	—	—	—	—
Heptachlorodibenzodioxins (Total)	R-23i	P3A	524	n/a	3	1	0.0000021	0.0000021	0.00005	—	—	—	—	—	—
	R-32	Single	867.5	n/a	4	1	0.00000186	0.00000186	0.00005	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	7	1	0.00000239	0.00000239	0.00005	—	—	—	—	—	—
	R-37	P2A	1026	n/a	6	2	0.000001375	0.00000147	0.00005	—	—	—	—	—	—
	R-38	Single	821.2	n/a	6	1	0.00000315	0.00000315	0.00005	—	—	—	—	—	—
	R-39	Single	859	n/a	8	1	0.00000258	0.00000258	0.00005	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	6	1	0.00000054	0.00000054	0.00005	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	6	1	0.00000235	0.00000235	0.00005	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	1	0.00000172	0.00000172	0.00005	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	1	0.00000101	0.00000101	0.00005	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	1	0.000000996	0.000000996	0.00005	—	—	—	—	—	—
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	R-23	Single	816	n/a	4	1	0.0000151	0.0000151	0.00005	—	—	—	—	—	—
	R-38	Single	821.2	n/a	6	1	0.00000292	0.00000292	0.00005	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	6	1	0.000000395	0.000000395	0.00005	—	—	—	—	—	—
Heptachlorodibenzofurans (Total)	R-23	Single	816	n/a	4	1	0.0000151	0.0000151	0.00005	—	—	—	—	—	—
	R-38	Single	821.2	n/a	6	1	0.00000292	0.00000292	0.00005	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	6	1	0.000000395	0.000000395	0.00005	—	—	—	—	—	—
Hexachlorodibenzofuran[1,2,3,4,7,8-]	R-23	Single	816	n/a	4	1	0.0000029	0.0000029	0.00005	—	—	—	—	—	—
Hexachlorodibenzofurans (Total)	R-23	Single	816	n/a	4	1	0.00000963	0.00000963	0.00005	—	—	—	—	—	—
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	R-20	P1A	904.6	n/a	4	1	0.00000296	0.00000296	0.00005	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	7	1	0.00000445	0.00000445	0.00005	—	—	—	—	—	—
	R-37	P2A	1026	n/a	6	1	0.00000242	0.00000242	0.00005	—	—	—	—	—	—
	R-39	Single	859	n/a	8	1	0.00000137	0.00000137	0.00005	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	4	1	0.00000245	0.00000245	0.00005	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	6	2	0.000003165	0.00000342	0.00005	—	—	—	—	—	—

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-] (continued)	R-23	Single	816	n/a	4	1	0.0000237	0.0000237	0.00005	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	5	1	0.00000088	0.00000088	0.00005	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	7	1	0.00000257	0.00000257	0.00005	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	1	0.000000618	0.000000618	0.00005	—	—	—	—	—	—
High Explosive Detections															
Amino-2,6-dinitrotoluene[4-]	R-22	MP1A	907.1	n/a	5	1	0.42	0.42	0.33	73	EPA Tap	0	36.5	0	R-22 is off-line and will undergo rehabilitation.
Amino-4,6-dinitrotoluene[2-]	R-22	MP1A	907.1	n/a	5	1	0.51	0.51	0.33	73	EPA Tap	0	36.5	0	R-22 is off-line and will undergo rehabilitation.
HMX	R-20	MP2A	1147.1	n/a	4	1	0.88	0.88	0.33	1800	EPA Tap	0	900	0	Before well rehabilitation.
Nitrobenzene	R-20	P2A	1147.1	n/a	8	1	0.154	0.154	0.33	1.2	EPA Tap	0	0.6	0	Detected once below the PQL.
	R-22	MP4A	1378	n/a	5	1	0.0196	0.0196	0.33	1.2	EPA Tap	0	0.6	0	R-22 is off-line and will undergo rehabilitation.
	R-54	P1A	830	n/a	6	1	0.124	0.124	0.33	1.2	EPA Tap	0	0.6	0	Detected once below the PQL.
RDX	R-22	MP5A	1448.2	n/a	5	1	0.34	0.34	0.33	6.1	EPA Tap	0	3.05	0	R-22 is off-line and will undergo rehabilitation.
	R-40	P2A	849.3	n/a	6	1	0.198	0.198	0.33	6.1	EPA Tap	0	3.05	0	Detected once below the PQL.
Trinitrobenzene[1,3,5-]	R-22	MP2A	962.8	n/a	16	1	0.12	0.12	0.33	1100	EPA Tap	0	550	0	R-22 is off-line and will undergo rehabilitation.
PCB Detections															
Aroclor-1242	R-23i	P1A	400.3	n/a	6	1	0.061	0.061	0.5	0.5	EPA MCL	0	0.25	0	Detected once below the PQL.
Aroclor-1254	R-20	MP3A	1330	n/a	5	1	0.11	0.11	0.5	0.5	EPA MCL	0	0.25	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-23i	P1A	400.3	n/a	6	1	0.09	0.09	0.5	0.5	EPA MCL	0	0.25	0	Detected once below the PQL.
Pesticide Detections															
BHC[beta-]	R-53	P2A	959.7	n/a	5	1	0.0108	0.0108	0.02	0.37	EPA Tap	0	0.185	0	Detected once below the PQL.
	R-55i	Single	510	n/a	2	1	0.0338	0.0338	0.02	0.37	EPA Tap	0	0.185	0	—
BHC[gamma-]	R-22	MP3A	1273.5	n/a	11	1	0.01	0.01	0.02	0.2	EPA MCL	0	0.1	0	R-22 is off-line and will undergo rehabilitation.
Chlordane[gamma-]	R-40	P1A	751.6	n/a	3	1	0.011	0.011	0.02	—	—	—	—	—	Detected once below the PQL.
DDD[4,4'-]	R-22	MP3A	1273.5	n/a	11	1	0.00918	0.00918	0.04	2.8	EPA Tap	0	1.4	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD[f]	10	1	0.00609	0.00609	0.04	2.8	EPA Tap	0	1.4	0	Detected once below the PQL.
DDE[4,4'-]	R-20	MP2A	1147.1	FD	2	1	0.00789	0.00789	0.04	2	EPA Tap	0	1	0	Before well rehabilitation.
	R-22	MP3A	1273.5	n/a	11	1	0.0199	0.0199	0.04	2	EPA Tap	0	1	0	R-22 is off-line and will undergo rehabilitation.
	R-32	MP1A	870.9	n/a	9	1	0.00578	0.00578	0.04	2	EPA Tap	0	1	0	Detected once below the PQL.
	R-37	P2A	1026	n/a	6	1	0.0904	0.0904	0.04	2	EPA Tap	0	1	0	—
DDT[4,4'-]	R-22	MP1A	907.1	n/a	6	1	0.01	0.01	0.04	2	EPA Tap	0	1	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	15	1	0.008	0.008	0.04	2	EPA Tap	0	1	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	10	2	0.0094	0.01	0.04	2	EPA Tap	0	1	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	0.01	0.01	0.04	2	EPA Tap	0	1	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	6	1	0.02	0.02	0.04	2	EPA Tap	0	1	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	0.0082	0.0082	0.04	2	EPA Tap	0	1	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	1	0.02	0.02	0.04	2	EPA Tap	0	1	0	R-22 is off-line and will undergo rehabilitation.

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
DDT[4,4'-] (continued)	R-32	MP1A	870.9	n/a	9	1	0.0148	0.0148	0.04	2	EPA Tap	0	1	0	Detected once below the PQL.
	R-37	P2A	1026	n/a	6	1	0.0523	0.0523	0.04	2	EPA Tap	0	1	0	—
Endosulfan Sulfate	R-20	MP2A	1147.1	n/a	5	1	0.0175	0.0175	0.04	—	—	—	—	—	Before well rehabilitation.
	R-23	Single	816	n/a	18	2	0.0104	0.0105	0.04	—	—	—	—	—	—
	R-38	Single	821.2	n/a	7	1	0.0365	0.0365	0.04	—	—	—	—	—	Detected once below the PQL.
Endrin Aldehyde	R-23	Single	816	n/a	17	1	0.0334	0.0334	0.04	—	—	—	—	—	Detected once below the PQL.
	R-23i	P3A	524	n/a	7	1	0.00722	0.00722	0.04	—	—	—	—	—	Detected once below the PQL.
Endrin Ketone	R-23	Single	816	n/a	18	2	0.009	0.00998	0.04	—	—	—	—	—	—
Heptachlor	R-20	P2A	1147.1	n/a	5	1	0.0135	0.0135	0.02	0.4	EPA MCL	0	0.2	0	Detected once below the PQL.
	R-40	P1A	751.6	n/a	3	1	0.0196	0.0196	0.02	0.4	EPA MCL	0	0.2	0	Detected once below the PQL.
Semivolatile Detections															
Acenaphthene	R-22	MP5A	1448.2	n/a	8	1	0.41	0.41	1	2200	EPA Tap	0	1100	0	R-22 is off-line and will undergo rehabilitation.
Acenaphthylene	R-22	MP5A	1448.2	n/a	8	1	0.4	0.4	1	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
Anthracene	R-22	MP5A	1448.2	n/a	8	1	0.36	0.36	1	11000	EPA Tap	0	5500	0	R-22 is off-line and will undergo rehabilitation.
Benzo(a)pyrene	R-22	MP5A	1448.2	n/a	8	1	0.23	0.23	1	0.2	EPA MCL	1	0.1	1	Detected once below the PQL in December 2001 from samples collected between March 2001 to February 2009.
Benzo(b)fluoranthene	R-22	MP5A	1448.2	n/a	8	1	0.4	0.4	1	0.29	EPA Tap	1	0.145	1	Detected once below the PQL in December 2001 from samples collected between March 2001 to February 2009.
	R-55	P2A	994.4	n/a	3	1	0.42	0.42	1	0.29	EPA Tap	1	0.145	1	Detected once below the PQL in first sampling event, September 2010, not detected in 2 subsequent sampling events.
Benzo(k)fluoranthene	R-22	MP5A	1448.2	n/a	8	1	0.37	0.37	1	2.9	EPA Tap	0	1.45	0	R-22 is off-line and will undergo rehabilitation.
	R-55	P2A	994.4	n/a	3	1	0.466	0.466	1	2.9	EPA Tap	0	1.45	0	Detected once below the PQL.
Benzoic Acid	R-20	MP1A	904.6	n/a	4	1	18.2	18.2	20	150000	EPA Tap	0	75000	0	Before well rehabilitation.
	R-20	P2A	1147.1	FD	5	1	15.7	15.7	20	150000	EPA Tap	0	75000	0	Detected once below the PQL.
	R-20	P2A	1147.1	n/a	15	1	15.7	15.7	20	150000	EPA Tap	0	75000	0	Detected once below the PQL.
	R-21	Single	888.8	n/a	19	1	12.5	12.5	20	150000	EPA Tap	0	75000	0	Detected once below the PQL.
	R-22	MP1A	907.1	n/a	8	3	10.47	15.9	20	150000	EPA Tap	0	75000	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	6	1	9.7	9.7	20	150000	EPA Tap	0	75000	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	1	11	11	20	150000	EPA Tap	0	75000	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	24	1	24.2	24.2	20	150000	EPA Tap	0	75000	0	—
	R-39	Single	859	n/a	11	1	20	20	20	150000	EPA Tap	0	75000	0	—
	R-54	P1A	830	n/a	6	1	14.1	14.1	20	150000	EPA Tap	0	75000	0	Detected once below the PQL.
Bis(2-ethylhexyl)phthalate	R-20	MP1A	904.6	n/a	5	1	1.5	1.5	10	6	EPA MCL	0	3	0	Before well rehabilitation.
	R-20	MP2A	1147.1	FD	2	1	1.9	1.9	10	6	EPA MCL	0	3	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	1	2.7	2.7	10	6	EPA MCL	0	3	0	Screen plugged and abandoned because of residual effects of drilling products.

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Bis(2-ethylhexyl)phthalate (continued)	R-22	MP1A	907.1	n/a	8	1	4.6	4.6	10	6	EPA MCL	0	3	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	15	3	2.38	3.9	10	6	EPA MCL	0	3	2	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	0.74	0.74	10	6	EPA MCL	0	3	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	8	1	1	1	10	6	EPA MCL	0	3	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	14	1	1.3	1.3	10	6	EPA MCL	0	3	0	Detected once below the PQL.
	R-23	Single	816	n/a	25	2	5.425	7.6	10	6	EPA MCL	1	3	2	Detected 3 times below the PQL between December 2003 and April 2011.
	R-32	MP3A	976	n/a	9	2	4	4.3	10	6	EPA MCL	0	3	2	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	8	5	3.842	4.97	10	6	EPA MCL	0	3	4	—
	R-32	Single	867.5	n/a	15	5	3.972	6	10	6	EPA MCL	1	3	4	Detected 5 times (and in the 5 field duplicates) below the PQL from December 2007 to February 2009. Not detected from June 2009 to May 2011.
	R-37	P1A	929.3	n/a	10	2	3.495	4.66	10	6	EPA MCL	0	3	1	—
	R-38	Single	821.2	FD	7	3	6.12	7.38	10	6	EPA MCL	2	3	3	See parent sample information.
	R-38	Single	821.2	n/a	12	8	8.3425	35.6	10	6	EPA MCL	3	3	7	Detected 3 times above the EPA MCL between February 2009 and May 2009.
	R-40	P1A	751.6	n/a	7	1	3.11	3.11	10	6	EPA MCL	0	3	1	Detected once below the PQL.
	R-40	R-40i	649.7	n/a	6	1	4.85	4.85	10	6	EPA MCL	0	3	1	Detected once below the PQL.
	R-54	P1A	830	n/a	6	1	11.2	11.2	10	6	EPA MCL	1	3	1	Detected once in first sample collected in February 2010. Not detected from June 2010 to may 2011.
Butylbenzylphthalate	R-22	MP5A	1448.2	n/a	8	1	9.8	9.8	10	350	EPA Tap	0	175	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	1	1.6	1.6	10	350	EPA Tap	0	175	0	Detected once below the PQL.
Chloronaphthalene[2-]	R-22	MP5A	1448.2	n/a	8	1	0.46	0.46	1	2900	EPA Tap	0	1450	0	R-22 is off-line and will undergo rehabilitation.
Chrysene	R-23	Single	816	n/a	25	1	0.295	0.295	1	29	EPA Tap	0	14.5	0	Detected once below the PQL.
Diethylphthalate	R-20	MP2A	1147.1	n/a	5	2	1.75	2	10	29000	EPA Tap	0	14500	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	1	1	1	10	29000	EPA Tap	0	14500	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	16	2	19.6	28.5	10	29000	EPA Tap	0	14500	0	—
	R-21	Single	888.8	n/a	19	1	7.38	7.38	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.
	R-22	MP5A	1448.2	n/a	8	1	1.29	1.29	10	29000	EPA Tap	0	14500	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	3	9.69	14.5	10	29000	EPA Tap	0	14500	0	—
	R-23i	P3A	524	n/a	9	2	8.185	11.7	10	29000	EPA Tap	0	14500	0	—
	R-32	Single	867.5	n/a	15	1	96.3	96.3	10	29000	EPA Tap	0	14500	0	—
	R-38	Single	821.2	n/a	12	1	13.3	13.3	10	29000	EPA Tap	0	14500	0	—
	R-39	Single	859	n/a	11	1	12.1	12.1	10	29000	EPA Tap	0	14500	0	—
	R-40	P1A	751.6	n/a	7	1	5.8	5.8	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Diethylphthalate (continued)	R-40	P2A	849.3	n/a	9	1	16.6	16.6	10	29000	EPA Tap	0	14500	0	—
	R-40	R-40i	649.7	n/a	6	1	3.04	3.04	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.
	R-41	P2A	965.3	n/a	10	1	3.07	3.07	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.
	R-51	P1A	914.96	FD	2	1	22	22	10	29000	EPA Tap	0	14500	0	—
	R-51	P2A	1031	n/a	6	1	9.47	9.47	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.
	R-53	P1A	849.2	n/a	5	1	11.7	11.7	10	29000	EPA Tap	0	14500	0	—
	R-54	P1A	830	n/a	6	3	30.9	55.4	10	29000	EPA Tap	0	14500	0	—
	R-55	P1A	860	FD	1	1	2.23	2.23	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.
	R-55	P1A	860	n/a	3	1	7.25	7.25	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.
	R-56	P1A	945	FD	1	1	3.68	3.68	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.
	R-56	P1A	945	n/a	3	1	17.6	17.6	10	29000	EPA Tap	0	14500	0	—
	R-57	P2A	971.5	n/a	2	1	8.14	8.14	10	29000	EPA Tap	0	14500	0	Detected once below the PQL.
Dioxane[1,4-]	R-23i	P1A	400.3	n/a	9	1	1.15	1.15	10	6.7	EPA Tap	0	3.35	0	Detected once below the PQL.
	R-37	P1A	929.3	FD	4	3	3.67	4.75	10	6.7	EPA Tap	0	3.35	2	—
	R-37	P1A	929.3	n/a	10	6	4.1	5.02	10	6.7	EPA Tap	0	3.35	5	—
	R-37	P2A	1026	FD	4	1	2.19	2.19	10	6.7	EPA Tap	0	3.35	0	Detected once below the PQL.
	R-37	P2A	1026	n/a	9	1	2.29	2.29	10	6.7	EPA Tap	0	3.35	0	Detected once below the PQL.
	R-38	Single	821.2	n/a	12	1	4.83	4.83	10	6.7	EPA Tap	0	3.35	1	Detected once below the PQL.
Fluoranthene	R-22	MP5A	1448.2	n/a	8	1	0.37	0.37	1	1500	EPA Tap	0	750	0	R-22 is off-line and will undergo rehabilitation.
Fluorene	R-22	MP5A	1448.2	n/a	8	1	0.41	0.41	1	1500	EPA Tap	0	750	0	R-22 is off-line and will undergo rehabilitation.
Indeno(1,2,3-cd)pyrene	R-55	P2A	994.4	n/a	3	1	0.466	0.466	1	0.29	EPA Tap	1	0.145	1	Detected once below the PQL in first sample collected in September 2010. Not detected from February to April 2011.
Methylnaphthalene[2-]	R-22	MP5A	1448.2	n/a	8	1	0.41	0.41	1	150	EPA Tap	0	75	0	R-22 is off-line and will undergo rehabilitation.
Methylphenol[4-]	R-22	MP1A	907.1	n/a	7	1	44	44	10	180	EPA Tap	0	90	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	1	210	210	10	180	EPA Tap	1	90	1	Detected once above the PQL.
	R-22	MP5A	1448.2	n/a	6	1	60	60	10	180	EPA Tap	0	90	0	R-22 is off-line and will undergo rehabilitation.
	R-54	P1A	830	FD	2	1	3.85	3.85	10	180	EPA Tap	0	90	0	Detected once below the PQL.
	R-54	P1A	830	n/a	6	1	3.32	3.32	10	180	EPA Tap	0	90	0	Detected once below the PQL.
Naphthalene	R-20	MP1A	904.6	n/a	5	1	0.24	0.24	1	30	NM GW STD	0	15	0	Before well rehabilitation.
	R-20	MP2A	1147.1	FD	2	2	0.35	0.41	1	30	NM GW STD	0	15	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	4	0.4375	0.56	1	30	NM GW STD	0	15	0	Before well rehabilitation.
Pentachlorophenol	R-22	MP5A	1448.2	n/a	8	1	6.19	6.19	10	1	EPA MCL	1	0.5	1	Detected once below the PQL.
Phenanthrene	R-22	MP3A	1273.5	n/a	15	1	0.14	0.14	1	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	8	1	0.4	0.4	1	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Phenol	R-22	MP4A	1378	n/a	7	1	32	32	10	5	NM GW STD	1	2.5	1	Detected once above the PQL.
	R-22	MP5A	1448.2	n/a	8	1	19	19	10	5	NM GW STD	1	2.5	1	Detected once above the PQL.
	R-23	Single	816	n/a	25	1	1.99	1.99	10	5	NM GW STD	0	2.5	0	Detected once below the PQL.
	R-22	MP5A	1448.2	n/a	8	1	0.49	0.49	10	1100	EPA Tap	0	550	0	R-22 is off-line and will undergo rehabilitation.
Volatile Detections															
Acetone	R-20	MP1A	904.6	FD	1	1	134	134	5	22000	EPA Tap	0	11000	0	Before well rehabilitation.
	R-20	MP1A	904.6	n/a	5	4	140.95	209	5	22000	EPA Tap	0	11000	0	Before well rehabilitation.
	R-20	P1A	904.6	n/a	21	5	25.126	85.7	5	22000	EPA Tap	0	11000	0	—
	R-20	P2A	1147.1	FD	7	1	1.42	1.42	5	22000	EPA Tap	0	11000	0	Detected once below the PQL.
	R-21	Single	888.8	n/a	21	1	2.8	2.8	5	22000	EPA Tap	0	11000	0	Detected once below the PQL.
	R-22	MP1A	907.1	n/a	12	2	7.2	13	5	22000	EPA Tap	0	11000	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	17	1	2.5	2.5	5	22000	EPA Tap	0	11000	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	5.8	5.8	5	22000	EPA Tap	0	11000	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	8	4	15.5	32	5	22000	EPA Tap	0	11000	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	22	3	11.7	16	5	22000	EPA Tap	0	11000	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	14	4	3.6925	6.9	5	22000	EPA Tap	0	11000	0	—
	R-23	Single	816	n/a	24	4	15.5325	50.8	5	22000	EPA Tap	0	11000	0	—
	R-23	Single	816	FD	14	4	3.6925	6.9	5	22000	EPA Tap	0	11000	0	—
	R-23	Single	816	n/a	24	4	15.5325	50.8	5	22000	EPA Tap	0	11000	0	—
	R-23i	P3A	524	n/a	16	1	1.33	1.33	5	22000	EPA Tap	0	11000	0	Detected once below the PQL.
	R-32	MP3A	976	n/a	9	1	2.48	2.48	5	22000	EPA Tap	0	11000	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	9	2	32.13	61.5	5	22000	EPA Tap	0	11000	0	—
	R-32	Single	867.5	n/a	15	4	15.86	52.4	5	22000	EPA Tap	0	11000	0	—
	R-37	P1A	929.3	FD	4	1	21.5	21.5	5	22000	EPA Tap	0	11000	0	—
	R-37	P1A	929.3	n/a	10	1	20.9	20.9	5	22000	EPA Tap	0	11000	0	—
	R-38	Single	821.2	FD	9	1	8.16	8.16	5	22000	EPA Tap	0	11000	0	—
	R-38	Single	821.2	n/a	15	1	6.8	6.8	5	22000	EPA Tap	0	11000	0	—
	R-52	P1A	1035.2	FD	2	1	6.54	6.54	5	22000	EPA Tap	0	11000	0	—
	R-52	P1A	1035.2	n/a	5	2	5.25	5.73	5	22000	EPA Tap	0	11000	0	—
	R-53	P1A	849.2	FD	2	1	40.3	40.3	5	22000	EPA Tap	0	11000	0	—
	R-53	P1A	849.2	n/a	5	1	39.4	39.4	5	22000	EPA Tap	0	11000	0	—
	R-54	P1A	830	n/a	6	1	8.62	8.62	5	22000	EPA Tap	0	11000	0	—
	R-55i	Single	510	FD	1	1	56.3	56.3	5	22000	EPA Tap	0	11000	0	—
	R-55i	Single	510	n/a	2	2	29.45	48.8	5	22000	EPA Tap	0	11000	0	—
Acetonitrile	R-23	Single	816	n/a	13	1	9.06	9.06	5	130	EPA Tap	0	65	0	—
	R-23i	P2A	470.2	FD	2	1	6.78	6.78	5	130	EPA Tap	0	65	0	—
	R-40	P1A	751.6	n/a	4	1	7.46	7.46	5	130	EPA Tap	0	65	0	—

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Benzene	R-38	Single	821.2	FD	9	3	9.09	23.8	1	5	EPA MCL	1	2.5	1	See parent sample information.
	R-38	Single	821.2	n/a	15	6	2.238	6.34	1	5	EPA MCL	1	2.5	1	Detected once in first sample collected in February 2009 above the MCL. Detected below the MCL in 2009. Not detected since 2009.
Butanol[1-]	R-20	P1A	904.6	n/a	8	1	16	16	50	3700	EPA Tap	0	1850	0	Detected once below the PQL.
	R-40	P1A	751.6	n/a	8	1	25	25	50	3700	EPA Tap	0	1850	0	Detected once below the PQL.
	R-40	R-40i	649.7	n/a	6	1	16	16	50	3700	EPA Tap	0	1850	0	Detected once below the PQL.
Butanone[2-]	R-20	P1A	904.6	FD	5	1	1.62	1.62	5	7100	EPA Tap	0	3550	0	Detected once below the PQL.
	R-20	P1A	904.6	n/a	21	3	1.98	2.9	5	7100	EPA Tap	0	3550	0	—
	R-22	MP4A	1378	n/a	8	1	6.9	6.9	5	7100	EPA Tap	0	3550	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	23	2	8.5	8.9	5	7100	EPA Tap	0	3550	0	R-22 is off-line and will undergo rehabilitation.
	R-40	P1A	751.6	n/a	8	1	1.87	1.87	5	7100	EPA Tap	0	3550	0	Detected once below the PQL.
	R-54	P1A	830	n/a	6	1	3.15	3.15	5	7100	EPA Tap	0	3550	0	Detected once below the PQL.
	R-55i	Single	510	n/a	2	1	2.6	2.6	5	7100	EPA Tap	0	3550	0	Detected once below the PQL.
Carbon Disulfide	R-22	MP5A	1448.2	n/a	22	1	1.98	1.98	5	1000	EPA Tap	0	500	0	R-22 is off-line and will undergo rehabilitation.
	R-38	Single	821.2	n/a	15	1	2.16	2.16	5	1000	EPA Tap	0	500	0	Detected once below the PQL.
Chloroform	R-22	MP3A	1273.5	n/a	18	1	0.94	0.94	1	80	EPA MCL	0	40	0	R-22 is off-line and will undergo rehabilitation.
Chloromethane	R-20	P1A	904.6	n/a	21	1	0.458	0.458	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-22	MP1A	907.1	FD	2	1	0.461	0.461	1	190	EPA Tap	0	95	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP1A	907.1	n/a	11	1	0.304	0.304	1	190	EPA Tap	0	95	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	23	1	0.363	0.363	1	190	EPA Tap	0	95	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	1	0.364	0.364	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-23i	P1A	400.3	FD	4	1	0.346	0.346	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-23i	P1A	400.3	n/a	14	1	0.715	0.715	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-23i	P2A	470.2	FD	5	1	0.353	0.353	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-23i	P2A	470.2	n/a	19	1	0.307	0.307	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-37	P2A	1026	n/a	9	1	0.338	0.338	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-38	Single	821.2	n/a	15	3	0.3	0.37	1	190	EPA Tap	0	95	0	—
	R-39	Single	859	FD	6	2	0.363	0.368	1	190	EPA Tap	0	95	0	—
	R-39	Single	859	n/a	11	2	0.394	0.46	1	190	EPA Tap	0	95	0	—
	R-40	R-40i	649.7	FD	2	1	0.353	0.353	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-40	R-40i	649.7	n/a	7	1	0.352	0.352	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-41	P2A	965.3	FD	5	1	0.342	0.342	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-49	P1A	845	n/a	9	1	0.463	0.463	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-52	P1A	1035.2	FD	2	1	0.33	0.33	1	190	EPA Tap	0	95	0	Detected once below the PQL.
	R-54	P1A	830	n/a	6	1	0.94	0.94	1	190	EPA Tap	0	95	0	Detected once below the PQL.

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Dichlorobenzene[1,4-]	R-22	MP2A	962.8	n/a	19	1	0.23	0.23	1	75	EPA MCL	0	37.5	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	18	1	0.21	0.21	1	75	EPA MCL	0	37.5	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	8	1	0.16	0.16	1	75	EPA MCL	0	37.5	0	R-22 is off-line and will undergo rehabilitation.
Dichloroethene[cis-1,2-]	R-20	P2A	1147.1	n/a	20	1	0.31	0.31	1	70	EPA MCL	0	35	0	Detected once below the PQL.
Diethyl Ether	R-22	MP2A	962.8	n/a	8	1	0.338	0.338	1	7300	EPA Tap	0	3650	0	R-22 is off-line and will undergo rehabilitation.
Dioxane[1,4-]	R-20	P2A	1147.1	n/a	1	1	61.4	61.4	n/a	6.7	EPA Tap	1	3.35	1	Detected once above the EPA tap screening level using EPA Method 8260. This method has been discontinued for this analyte in favor of EPA Method 8270. Not detected using EPA Method 8270 from 2009 to 2011.
Ethylbenzene	R-20	P2A	1147.1	FD	7	1	0.265	0.265	1	700	EPA MCL	0	350	0	Detected once below the PQL.
	R-20	P2A	1147.1	n/a	20	3	0.274	0.28	1	700	EPA MCL	0	350	0	—
Isopropylbenzene	R-20	MP3A	1330	n/a	5	1	0.31	0.31	1	680	EPA Tap	0	340	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P2A	1147.1	FD	7	1	0.252	0.252	1	680	EPA Tap	0	340	0	Detected once below the PQL.
	R-22	MP1A	907.1	n/a	12	6	0.737	1	1	680	EPA Tap	0	340	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	23	1	0.16	0.16	1	680	EPA Tap	0	340	0	R-22 is off-line and will undergo rehabilitation.
	R-32	Single	867.5	n/a	15	2	0.28	0.288	1	680	EPA Tap	0	340	0	—
Methyl Methacrylate	R-20	P1A	904.6	n/a	21	1	1.08	1.08	5	1400	EPA Tap	0	700	0	Detected once below the PQL.
Methyl-2-pentanone[4-]	R-20	P1A	904.6	FD	5	1	2.93	2.93	5	2000	EPA Tap	0	1000	0	Detected once below the PQL.
	R-20	P1A	904.6	n/a	21	3	3.76	5.95	5	2000	EPA Tap	0	1000	0	—
	R-54	P1A	830	n/a	6	1	5.73	5.73	5	2000	EPA Tap	0	1000	0	—
Methylene Chloride	R-22	MP1A	907.1	n/a	12	1	2.2	2.2	10	5	EPA MCL	0	2.5	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	1	0.62	0.62	10	5	EPA MCL	0	2.5	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	18	1	2.38	2.38	10	5	EPA MCL	0	2.5	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	1	4.27	4.27	10	5	EPA MCL	0	2.5	1	Detected once below the PQL.
	R-49	P2A	905.6	n/a	9	1	4.09	4.09	10	5	EPA MCL	0	2.5	1	Detected once below the PQL.
Naphthalene	R-22	MP1A	907.1	n/a	10	1	0.33	0.33	1	30	NM GW STD	0	15	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	21	1	0.656	0.656	1	30	NM GW STD	0	15	0	Detected once below the PQL.
	R-40	P1A	751.6	n/a	8	1	0.746	0.746	1	30	NM GW STD	0	15	0	Detected once below the PQL.
Styrene	R-20	P1A	904.6	n/a	21	1	0.501	0.501	1	100	EPA MCL	0	50	0	Detected once below the PQL.
Toluene	R-20	P1A	904.6	FD	5	2	56.673	113	1	750	NM GW STD	0	375	0	—
	R-20	P1A	904.6	n/a	21	11	26.62	112	1	750	NM GW STD	0	375	0	—
	R-20	P2A	1147.1	FD	7	5	6.1324	29.2	1	750	NM GW STD	0	375	0	—
	R-20	P2A	1147.1	n/a	20	10	16.1793	65.1	1	750	NM GW STD	0	375	0	—
	R-21	Single	888.8	n/a	22	1	0.5	0.5	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-22	MP1A	907.1	n/a	12	2	1.038	1.78	1	750	NM GW STD	0	375	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	8	1	0.2	0.2	1	750	NM GW STD	0	375	0	R-22 is off-line and will undergo rehabilitation.

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Toluene (continued)	R-22	MP5A	1448.2	FD	4	2	0.5335	0.79	1	750	NM GW STD	0	375	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	23	13	1.098	6.86	1	750	NM GW STD	0	375	0	R-22 is off-line and will undergo rehabilitation.
	R-23i	P1A	400.3	n/a	14	1	0.564	0.564	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-23i	P2A	470.2	FD	5	1	16	16	1	750	NM GW STD	0	375	0	—
	R-23i	P2A	470.2	n/a	19	1	14.7	14.7	1	750	NM GW STD	0	375	0	—
	R-23i	P3A	524	n/a	16	1	3.52	3.52	1	750	NM GW STD	0	375	0	—
	R-32	Single	867.5	FD	9	3	9.02	23.9	1	750	NM GW STD	0	375	0	—
	R-32	Single	867.5	n/a	15	4	7.7705	23.3	1	750	NM GW STD	0	375	0	—
	R-37	P1A	929.3	n/a	10	1	1.33	1.33	1	750	NM GW STD	0	375	0	—
	R-37	P2A	1026	n/a	9	1	0.42	0.42	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-38	Single	821.2	FD	9	3	3.57	7.06	1	750	NM GW STD	0	375	0	—
	R-38	Single	821.2	n/a	15	7	1.38	1.9	1	750	NM GW STD	0	375	0	—
	R-39	Single	859	FD	6	2	1.2175	2.1	1	750	NM GW STD	0	375	0	—
	R-39	Single	859	n/a	11	1	2.37	2.37	1	750	NM GW STD	0	375	0	—
	R-40	P1A	751.6	n/a	8	3	0.64	0.84	1	750	NM GW STD	0	375	0	—
	R-40	P2A	849.3	FD	4	1	0.27	0.27	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-40	P2A	849.3	n/a	9	2	0.279	0.29	1	750	NM GW STD	0	375	0	—
	R-40	R-40i	649.7	FD	2	2	12.2455	24.2	1	750	NM GW STD	0	375	0	—
	R-40	R-40i	649.7	n/a	7	4	7.349	23.9	1	750	NM GW STD	0	375	0	—
	R-41	P2A	965.3	n/a	10	1	7.5	7.5	1	750	NM GW STD	0	375	0	—
	R-49	P1A	845	n/a	9	1	0.298	0.298	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-49	P2A	905.6	FD	2	1	0.309	0.309	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-49	P2A	905.6	n/a	9	1	0.462	0.462	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-53	P1A	849.2	FD	2	1	0.73	0.73	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-54	P1A	830	n/a	6	1	0.27	0.27	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-55	P1A	860	n/a	3	1	0.27	0.27	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-55i	Single	510	FD	1	1	0.63	0.63	1	750	NM GW STD	0	375	0	Detected once below the PQL.
	R-55i	Single	510	n/a	2	2	1.175	1.72	1	750	NM GW STD	0	375	0	—
	R-56	P1A	945	n/a	3	1	0.81	0.81	1	750	NM GW STD	0	375	0	Detected once below the PQL.
Trichlorobenzene[1,2,3-]	R-23	Single	816	n/a	21	1	0.592	0.592	1	29	EPA Tap	0	14.5	0	Detected once below the PQL.
	R-40	P1A	751.6	n/a	8	1	0.62	0.62	1	29	EPA Tap	0	14.5	0	Detected once below the PQL.
Trichlorobenzene[1,2,4-]	R-40	P1A	751.6	n/a	8	1	0.503	0.503	1	70	EPA MCL	0	35	0	Detected once below the PQL.

Table D-4.2-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	PQL[a] (µg/L)	Standard[b] (µg/L)	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	Comment
Trichloroethene	R-20	P2A	1147.1	FD	7	6	1.54	3.04	1	5	EPA MCL	0	2.5	1	—
	R-20	P2A	1147.1	n/a	20	14	0.96	3.02	1	5	EPA MCL	0	2.5	2	—
	R-23i	P2A	470.2	FD	5	1	0.297	0.297	1	5	EPA MCL	0	2.5	0	Detected once below the PQL.
	R-23i	P2A	470.2	n/a	19	1	0.285	0.285	1	5	EPA MCL	0	2.5	0	Detected once below the PQL.
	R-40	P1A	751.6	n/a	8	2	0.635	0.81	1	5	EPA MCL	0	2.5	0	—
	R-53	P2A	959.7	n/a	5	1	0.43	0.43	1	5	EPA MCL	0	2.5	0	Detected once below the PQL.
Trimethylbenzene[1,2,4-]	R-20	MP2A	1147.1	FD	2	2	0.345	0.44	1	15	EPA Tap	0	7.5	0	—
	R-23	Single	816	n/a	25	1	0.27	0.27	1	15	EPA Tap	0	7.5	0	Detected once below the PQL.
Xylene[1,2-]	R-20	P2A	1147.1	FD	7	2	0.3795	0.419	1	1200	EPA Tap	0	600	0	—
	R-20	P2A	1147.1	n/a	20	2	0.3715	0.403	1	1200	EPA Tap	0	600	0	—
Xylene[1,3-]+Xylene[1,4-]	R-20	P2A	1147.1	FD	7	6	1.76	3.45	2	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	20	12	1.279	3.51	2	—	—	—	—	—	—
	R-23	Single	816	n/a	21	1	0.28	0.28	2	—	—	—	—	—	Detected once below the PQL.
	R-23i	P3A	524	n/a	16	1	0.289	0.289	2	—	—	—	—	—	Detected once below the PQL.

Source: Attachment D-1.

[a] PQL = Practical quantitation limit (LANL 2010, 109830, section C-4.1).

[b] Standard = Lowest applicable regulatory standard or other type of screening level.

[c] Standard Source = Reference for lowest-applicable water-quality screening level, as prescribed by the Consent Order and implemented as documented in Appendix B of the 2010 IFGMP (LANL 2010, 109830):

- EPA MCL = EPA maximum contaminant level (40 Code of Federal Regulations Part 141).
- EPA TAP SCRN LVL = EPA regional screening level for tapwater June 2011 (EPA 2011, 204336). Available online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm).
- NM GW STD = New Mexico Groundwater Human Health Standards (New Mexico Administrative Code 20.6.2).

[d] n/a = Not applicable.

[e] — = None.

[f] FD = Field duplicate.

Table D-4.2-2
Number of Sampling Events for Organic COPCs Detected at Least Twice in the Same Screened Interval

Suite	Analyte	Field QC Type	Single or Dual Screen Wells															Westbay Wells						
			R-20 P1A	R-20 P2A	R-23	R-23i P3A	R-32	R-37 P1A	R-37 P2A	R-38	R-39	R-40 P1A	R-40 P2A	R-40 R-40i	R-52 P1A	R-54 P1A	R-55i	R-20 MP1A	R-20 MP2A	R-22 MP1A	R-22 MP3A	R-22 MP4A	R-22 MP5A	R-32 MP3A
Dioxin/Furan	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	—[a]	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
Pesticides	DDT[4,4'-]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—
	Endosulfan Sulfate	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Endrin Ketone	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SVOA[b]	Benzoic Acid	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—
	Bis(2-ethylhexyl)phthalate	FD[c]	—	—	—	—	5	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	2	—	5	2	—	8	—	—	—	—	—	—	—	—	—	—	3	—	—	2
	Diethylphthalate	—	2	—	3	2	—	—	—	—	—	—	—	—	—	3	—	—	2	—	—	—	—	—
	Dioxane[1,4-]	FD	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Naphthalene	FD	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—
VOA[d]	Acetone	FD	—	—	4	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	5	—	4	—	4	—	—	—	—	—	—	—	2	—	2	4	—	2	—	4	3	—
	Benzene	FD	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Butanone[2-]	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—
	Chloromethane	FD	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—
	Ethylbenzene	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Isopropylbenzene	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—
	Methyl-2-pentanone[4-]	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Toluene	FD	2	5	—	—	3	—	—	3	2	—	—	2	—	—	—	—	—	—	—	—	2	—
		—	11	10	—	—	4	—	—	7	—	3	2	4	—	—	2	—	—	2	—	—	13	—
	Trichloroethene	FD	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	14	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—
	Trimethylbenzene[1,2,4-]	FD	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—
	Xylene[1,2-]	FD	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Xylene[1,3-]+Xylene[1,4-]	FD	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Source: Table D-4.2-1 and raw data tables in Attachment D-1.
[a] — = Not applicable.
[b] SVOA = Semivolatiles.
[c] FD = Field duplicate.
[d] VOA = Volatiles.

Table D-4.2-3
Detected and Nondetected Organic Analytes with PQLs Greater than Applicable Regulatory Standards

Suite	Analyte	Units	Standard[a]	Standard Source[b]	PQL[c]
Detected Analytes with PQLs Greater Than Standards					
SVOA[d]	Benzo(a)pyrene	µg/L	0.2	EPA MCL	1
SVOA	Benzo(b)fluoranthene	µg/L	0.29	EPA TAP SCRN LVL	1
SVOA	Bis(2-ethylhexyl)phthalate	µg/L	6	EPA MCL	10
SVOA	Dioxane[1,4-]	µg/L	6.7	EPA TAP SCRN LVL	10
SVOA	Indeno(1,2,3-cd)pyrene	µg/L	0.29	EPA TAP SCRN LVL	1
SVOA	Pentachlorophenol	µg/L	1	EPA MCL	10
SVOA	Phenol	µg/L	5	NM GW STD	10
VOA[e]	Dioxane[1,4-]	µg/L	6.7	EPA TAP SCRN LVL	10
Nondetected Analytes with PQLs Greater Than Standards					
SVOA	Atrazine	µg/L	3	EPA MCL	10
SVOA	Azobenzene	µg/L	1.3	EPA TAP SCRN LVL	10
SVOA	Benzidine	µg/L	0.00094	EPA TAP SCRN LVL	50
SVOA	Benzo(a)anthracene	µg/L	0.29	EPA TAP SCRN LVL	1
SVOA	Benzo(a)pyrene	µg/L	0.2	EPA MCL	1
SVOA	Benzo(b)fluoranthene	µg/L	0.29	EPA TAP SCRN LVL	1
SVOA	Bis(2-chloroethyl)ether	µg/L	0.12	EPA TAP SCRN LVL	10
SVOA	Bis(2-ethylhexyl)phthalate	µg/L	6	EPA MCL	10
SVOA	Chloroaniline[4-]	µg/L	3.4	EPA TAP SCRN LVL	10
SVOA	Dibenz(a,h)anthracene	µg/L	0.029	EPA TAP SCRN LVL	1
SVOA	Dichlorobenzidine[3,3'-]	µg/L	1.5	EPA TAP SCRN LVL	10
SVOA	Dinitro-2-methylphenol[4,6-]	µg/L	2.9	EPA TAP SCRN LVL	10
SVOA	Dinitrotoluene[2,4-]	µg/L	2.2	EPA TAP SCRN LVL	10
SVOA	Dioxane[1,4-]	µg/L	6.7	EPA TAP SCRN LVL	10
SVOA	Hexachlorobenzene	µg/L	1	EPA MCL	10
SVOA	Hexachlorobutadiene	µg/L	8.6	EPA TAP SCRN LVL	10
SVOA	Indeno(1,2,3-cd)pyrene	µg/L	0.29	EPA TAP SCRN LVL	1
SVOA	Nitrobenzene	µg/L	1.2	EPA TAP SCRN LVL	10
SVOA	Nitrosodiethylamine[N-]	µg/L	0.0014	EPA TAP SCRN LVL	10
SVOA	Nitrosodimethylamine[N-]	µg/L	0.0042	EPA TAP SCRN LVL	10
SVOA	Nitroso-di-n-butylamine[N-]	µg/L	0.024	EPA TAP SCRN LVL	10
SVOA	Nitroso-di-n-propylamine[N-]	µg/L	0.096	EPA TAP SCRN LVL	10
SVOA	Nitrosopyrrolidine[N-]	µg/L	0.32	EPA TAP SCRN LVL	10
SVOA	Oxybis(1-chloropropane)[2,2'-]	µg/L	3.2	EPA TAP SCRN LVL	10
SVOA	Pentachlorophenol	µg/L	1	EPA MCL	10
SVOA	Phenol	µg/L	5	NM GW STD	10
VOA	Acrolein	µg/L	0.042	EPA TAP SCRN LVL	5

Table D-4.2-3 (continued)

Suite	Analyte	Units	Standard[a]	Standard Source[b]	PQL[c]
VOA	Acrylonitrile	µg/L	0.45	EPA TAP SCRN LVL	5
VOA	Chloro-1,3-butadiene[2-]	µg/L	0.16	EPA TAP SCRN LVL	1
VOA	Dibromo-3-Chloropropane[1,2-]	µg/L	0.2	EPA MCL	1
VOA	Dibromoethane[1,2-]	µg/L	0.05	EPA MCL	1
VOA	Dioxane[1,4-]	µg/L	6.7	EPA TAP SCRN LVL	10
VOA	Hexachlorobutadiene	µg/L	8.6	EPA TAP SCRN LVL	10
VOA	Methacrylonitrile	µg/L	1	EPA TAP SCRN LVL	5
VOA	Trichloropropane[1,2,3-]	µg/L	0.0072	EPA TAP SCRN LVL	1

Source: Attachment D-1.

[a] Standard = Lowest applicable regulatory standard or other type of screening level.

[b] Standard Source = Reference for lowest-applicable water-quality screening level, as prescribed by the Consent Order and implemented as documented in Appendix B of the 2010 IFGMP (LANL 2010, 109830).

[c] PQL = Practical quantitation limit (LANL 2010, 109830, section C-4.1).

- EPA MCL = EPA maximum contaminant level (40 Code of Federal Regulations Part 141).
- EPA TAP SCRN LVL = EPA regional screening level for tapwater June 2011 (EPA 2011, 204336). Available online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm).
- NM GW STD = New Mexico Groundwater Human Health Standards (New Mexico Administrative Code 20.6.2).

[d] SVOA = Semivolatiles.

[e] VOA = Volatiles.

Table D-4.3-1
Statistical Summary of Inorganic Constituents Detected above One-Half Standard or Standard in Groundwater Samples from TA-54 Groundwater Monitoring Network Wells for the Period Extending from Well Development to May 2011

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
General Inorganic Filtered																			
Alkalinity-CO3	R-20	MP1A	904.6	n/a[d]	5	4	mg/L	3.64	6.12	1	—[e]	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	1	mg/L	3.2	3.2	1	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	P1A	904.6	n/a	13	12	mg/L	5.4958	11.9	1	—	—	—	—	—	—	—	—	—
	R-22	MP2A	962.8	n/a	12	1	mg/L	0.73	0.73	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD[f]	1	1	mg/L	2.27	2.27	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	8	8	mg/L	4.1875	8.48	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	1	mg/L	0.785	0.785	1	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	1	mg/L	1.03	1.03	1	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	4	mg/L	0.9023	1.06	1	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	1	mg/L	1.17	1.17	1	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	19	4	mg/L	1.3455	2.01	1	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	8	4	mg/L	2.4075	4.14	1	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	1	mg/L	2.09	2.09	1	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	3	mg/L	8.32	17.7	1	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	1	mg/L	2.13	2.13	1	—	—	—	—	—	—	—	—	—
Alkalinity-CO3+HCO3	R-20	MP1A	904.6	n/a	5	5	mg/L	106.2	134	1	—	—	—	—	—	156.6	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	4	mg/L	232.25	275	1	—	—	—	—	—	156.6	Regional	3	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	93.1	120	1	—	—	—	—	—	156.6	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	65.685	73.8	1	—	—	—	—	—	156.6	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	mg/L	65.1	66.2	1	—	—	—	—	—	156.6	Regional	0	—
	R-20	P2A	1147.1	n/a	16	16	mg/L	65.05	72.5	1	—	—	—	—	—	156.6	Regional	0	—
	R-21	Single	888.8	FD	3	3	mg/L	56.333	58.4	1	—	—	—	—	—	156.6	Regional	0	—
	R-21	Single	888.8	n/a	25	25	mg/L	57.76	85.8	1	—	—	—	—	—	156.6	Regional	0	—
	R-22	MP1A	907.1	n/a	5	5	mg/L	271	342	1	—	—	—	—	—	156.6	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	mg/L	65.543	84.69	1	—	—	—	—	—	156.6	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	108	108	1	—	—	—	—	—	156.6	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	12	12	mg/L	116.77	250	1	—	—	—	—	—	156.6	Regional	1	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Alkalinity-CO3+HCO3 (continued)	R-22	MP4A	1378	FD	1	1	mg/L	271	271	1	—	—	—	—	—	156.6	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	mg/L	274	304	1	—	—	—	—	—	156.6	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	214	214	1	—	—	—	—	—	156.6	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	mg/L	164.6	179	1	—	—	—	—	—	156.6	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	66.008	68.7	1	—	—	—	—	—	156.6	Regional	0	—
	R-23	Single	816	n/a	24	24	mg/L	67.6	85.8	1	—	—	—	—	—	156.6	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	mg/L	90.9	90.9	1	—	—	—	—	—	52	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	94.686	156	1	—	—	—	—	—	52	Intermediate	14	—
	R-23i	P2A	470.2	FD	2	2	mg/L	81.5	82.1	1	—	—	—	—	—	52	Intermediate	2	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	82.447	95	1	—	—	—	—	—	52	Intermediate	19	—
	R-23i	P3A	524	FD	2	2	mg/L	77.25	81.7	1	—	—	—	—	—	52	Intermediate	2	—
	R-23i	P3A	524	n/a	19	19	mg/L	75.132	85.9	1	—	—	—	—	—	52	Intermediate	19	—
	R-32	MP1A	870.9	n/a	8	8	mg/L	72.525	79.4	1	—	—	—	—	—	156.6	Regional	0	—
	R-32	MP3A	976	n/a	9	9	mg/L	58.567	61.7	1	—	—	—	—	—	156.6	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	5	5	mg/L	70.96	72.5	1	—	—	—	—	—	156.6	Regional	0	—
	R-32	Single	867.5	n/a	15	15	mg/L	69.613	72.5	1	—	—	—	—	—	156.6	Regional	0	—
	R-37	P1A	929.3	FD	1	1	mg/L	103	103	1	—	—	—	—	—	52	Intermediate	1	—
	R-37	P1A	929.3	n/a	11	11	mg/L	96.309	102	1	—	—	—	—	—	52	Intermediate	11	—
	R-37	P2A	1026	FD	1	1	mg/L	60.4	60.4	1	—	—	—	—	—	156.6	Regional	0	—
	R-37	P2A	1026	n/a	10	10	mg/L	66.87	85.8	1	—	—	—	—	—	156.6	Regional	0	—
	R-38	Single	821.2	FD	4	4	mg/L	61.05	62.3	1	—	—	—	—	—	156.6	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	60.45	62.4	1	—	—	—	—	—	156.6	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	57.4	57.4	1	—	—	—	—	—	156.6	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	59.427	63	1	—	—	—	—	—	156.6	Regional	0	—
	R-40	P1A	751.6	n/a	8	8	mg/L	97.738	105	1	—	—	—	—	—	52	Intermediate	8	—
	R-40	P2A	849.3	FD	2	2	mg/L	60.5	65.5	1	—	—	—	—	—	156.6	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	58.689	75.6	1	—	—	—	—	—	156.6	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	102.89	120	1	—	—	—	—	—	52	Intermediate	7	—
	R-41	P2A	965.3	FD	2	2	mg/L	67.2	69.3	1	—	—	—	—	—	156.6	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	69.79	80.3	1	—	—	—	—	—	156.6	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	70.278	86.9	1	—	—	—	—	—	156.6	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	57.778	59.6	1	—	—	—	—	—	156.6	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	mg/L	59.95	70	1	—	—	—	—	—	156.6	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Alkalinity-CO3+HCO3 (continued)	R-51	P2A	1031	n/a	6	6	mg/L	71.433	120	1	—	—	—	—	—	156.6	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	64.46	68.4	1	—	—	—	—	—	156.6	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	56.44	57.9	1	—	—	—	—	—	156.6	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	57.4	61.7	1	—	—	—	—	—	156.6	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	56.95	57	1	—	—	—	—	—	156.6	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	56.34	57.5	1	—	—	—	—	—	156.6	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	70.217	87.2	1	—	—	—	—	—	156.6	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	57.667	60.1	1	—	—	—	—	—	156.6	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	89.167	119	1	—	—	—	—	—	156.6	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	mg/L	73.3	76.7	1	—	—	—	—	—	156.6	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	90.7	91.9	1	—	—	—	—	—	52	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	mg/L	64.6	66	1	—	—	—	—	—	156.6	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	62.2	65.5	1	—	—	—	—	—	156.6	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	62.8	64.2	1	—	—	—	—	—	156.6	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	63.35	63.7	1	—	—	—	—	—	156.6	Regional	0	—
Alkalinity-HCO3	R-20	MP1A	904.6	n/a	4	4	mg/L	103.63	131	1	—	—	—	—	—	132.3	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	3	3	mg/L	216.33	269	1	—	—	—	—	—	132.3	Regional	2	Before well rehabilitation.
	R-20	MP3A	1330	n/a	4	4	mg/L	97.125	120	1	—	—	—	—	—	132.3	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	n/a	4	4	mg/L	63.175	85.3	1	—	—	—	—	—	132.3	Regional	0	—
	R-23	Single	816	n/a	3	3	mg/L	73.667	85.5	1	—	—	—	—	—	132.3	Regional	0	—
	R-32	MP1A	870.9	n/a	3	3	mg/L	68.233	70.5	1	—	—	—	—	—	132.3	Regional	0	—
	R-32	MP3A	976	n/a	4	4	mg/L	58.375	61.6	1	—	—	—	—	—	132.3	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
Ammonia	R-22	MP1A	907.1	n/a	4	3	mg/L	0.9067	1.06	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	4	1	mg/L	1.01	1.01	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	0.72	0.72	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	4	4	mg/L	1.1375	1.8	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	0.68	0.68	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	4	4	mg/L	0.725	1.1	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Ammonia as Nitrogen	R-20	MP1A	904.6	n/a	5	5	mg/L	0.36	0.482	0.05	—	—	—	—	—	0.05	Regional	5	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	0.6412	0.799	0.05	—	—	—	—	—	0.05	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	0.3576	0.502	0.05	—	—	—	—	—	0.05	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	8	mg/L	0.044	0.058	0.05	—	—	—	—	—	0.05	Regional	4	—
	R-20	P2A	1147.1	FD	3	1	mg/L	0.034	0.034	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-20	P2A	1147.1	n/a	13	6	mg/L	0.0572	0.101	0.05	—	—	—	—	—	0.05	Regional	2	—
	R-21	Single	888.8	n/a	22	2	mg/L	0.1765	0.331	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-22	MP1A	907.1	n/a	3	3	mg/L	0.432	0.531	0.05	—	—	—	—	—	0.05	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	7	1	mg/L	0.021	0.021	0.05	—	—	—	—	—	0.05	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	mg/L	0.1723	0.275	0.05	—	—	—	—	—	0.05	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	3	2	mg/L	0.15	0.227	0.05	—	—	—	—	—	0.05	Regional	2	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	1	mg/L	0.017	0.017	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-23	Single	816	n/a	24	1	mg/L	0.05	0.05	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-23i	P1A	400.3	n/a	14	1	mg/L	0.016	0.016	0.05	—	—	—	—	—	1.5	Intermediate	0	—
	R-23i	P2A	470.2	n/a	18	1	mg/L	0.029	0.029	0.05	—	—	—	—	—	1.5	Intermediate	0	—
	R-23i	P3A	524	FD	2	1	mg/L	0.041	0.041	0.05	—	—	—	—	—	1.5	Intermediate	0	—
	R-23i	P3A	524	n/a	16	1	mg/L	0.032	0.032	0.05	—	—	—	—	—	1.5	Intermediate	0	—
	R-32	MP1A	870.9	n/a	7	1	mg/L	0.08	0.08	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-32	MP3A	976	n/a	9	8	mg/L	0.183	0.401	0.05	—	—	—	—	—	0.05	Regional	7	Screen plugged and abandoned because of residual effects of drilling products.
	R-37	P1A	929.3	n/a	10	4	mg/L	0.0329	0.048	0.05	—	—	—	—	—	1.5	Intermediate	0	—
	R-38	Single	821.2	FD	4	1	mg/L	0.0746	0.0746	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-38	Single	821.2	n/a	10	1	mg/L	0.0197	0.0197	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-39	Single	859	n/a	11	2	mg/L	0.019	0.022	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-40	P1A	751.6	n/a	7	1	mg/L	0.018	0.018	0.05	—	—	—	—	—	1.5	Intermediate	0	—
	R-40	P2A	849.3	FD	2	1	mg/L	0.0169	0.0169	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-40	P2A	849.3	n/a	9	1	mg/L	0.046	0.046	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-40	R-40i	649.7	n/a	7	6	mg/L	0.178	0.277	0.05	—	—	—	—	—	1.5	Intermediate	0	—
	R-41	P2A	965.3	n/a	10	1	mg/L	0.075	0.075	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-49	P1A	845	n/a	9	3	mg/L	0.0533	0.0976	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-49	P2A	905.6	n/a	9	1	mg/L	0.063	0.063	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-51	P1A	914.96	n/a	6	2	mg/L	0.0326	0.0331	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-51	P2A	1031	n/a	6	3	mg/L	0.0366	0.0629	0.05	—	—	—	—	—	0.05	Regional	1	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Ammonia as Nitrogen (continued)	R-52	P1A	1035.2	n/a	5	3	mg/L	0.173	0.45	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-52	P2A	1107	n/a	5	2	mg/L	0.054	0.083	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-53	P1A	849.2	n/a	5	2	mg/L	0.046	0.0729	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-53	P2A	959.7	FD	2	1	mg/L	0.0314	0.0314	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-53	P2A	959.7	n/a	5	3	mg/L	0.0489	0.064	0.05	—	—	—	—	—	0.05	Regional	2	—
	R-54	P1A	830	n/a	6	2	mg/L	0.0405	0.046	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-54	P2A	915	n/a	6	2	mg/L	0.0415	0.067	0.05	—	—	—	—	—	0.05	Regional	1	—
	R-55	P2A	994.4	n/a	3	1	mg/L	0.04	0.04	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-55i	Single	510	n/a	2	1	mg/L	0.0438	0.0438	0.05	—	—	—	—	—	1.5	Intermediate	0	—
	R-56	P2A	1046.6	n/a	3	1	mg/L	0.0261	0.0261	0.05	—	—	—	—	—	0.05	Regional	0	—
	R-57	P1A	910	n/a	2	1	mg/L	0.042	0.042	0.05	—	—	—	—	—	0.05	Regional	0	—
Bromide	R-20	P1A	904.6	n/a	13	1	mg/L	0.102	0.102	0.2	—	—	—	—	—	0.1	Regional	1	—
	R-22	MP3A	1273.5	n/a	13	3	mg/L	0.101	0.166	0.2	—	—	—	—	—	0.1	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	2	mg/L	0.101	0.114	0.2	—	—	—	—	—	0.1	Regional	1	—
	R-23	Single	816	n/a	25	5	mg/L	0.1906	0.529	0.2	—	—	—	—	—	0.1	Regional	3	—
	R-23i	P1A	400.3	n/a	14	9	mg/L	0.1283	0.151	0.2	—	—	—	—	—	0.03	Intermediate	9	—
	R-23i	P2A	470.2	n/a	19	5	mg/L	0.0958	0.123	0.2	—	—	—	—	—	0.03	Intermediate	5	—
	R-23i	P3A	524	FD	2	1	mg/L	0.12	0.12	0.2	—	—	—	—	—	0.03	Intermediate	1	—
	R-23i	P3A	524	n/a	16	4	mg/L	0.1078	0.129	0.2	—	—	—	—	—	0.03	Intermediate	4	—
	R-32	MP1A	870.9	n/a	9	1	mg/L	0.201	0.201	0.2	—	—	—	—	—	0.1	Regional	1	—
	R-32	Single	867.5	FD	5	1	mg/L	0.089	0.089	0.2	—	—	—	—	—	0.1	Regional	0	—
	R-32	Single	867.5	n/a	15	4	mg/L	0.0901	0.125	0.2	—	—	—	—	—	0.1	Regional	1	—
	R-37	P1A	929.3	FD	1	1	mg/L	0.0783	0.0783	0.2	—	—	—	—	—	0.03	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	1	mg/L	0.0871	0.0871	0.2	—	—	—	—	—	0.03	Intermediate	1	—
	R-38	Single	821.2	FD	4	1	mg/L	0.105	0.105	0.2	—	—	—	—	—	0.1	Regional	1	—
	R-38	Single	821.2	n/a	10	1	mg/L	0.104	0.104	0.2	—	—	—	—	—	0.1	Regional	1	—
	R-39	Single	859	n/a	11	1	mg/L	0.0981	0.0981	0.2	—	—	—	—	—	0.1	Regional	0	—
	R-40	P1A	751.6	n/a	8	1	mg/L	0.0818	0.0818	0.2	—	—	—	—	—	0.03	Intermediate	1	—
	R-40	R-40i	649.7	n/a	7	1	mg/L	0.078	0.078	0.2	—	—	—	—	—	0.03	Intermediate	1	—
	R-49	P1A	845	n/a	9	1	mg/L	0.0797	0.0797	0.2	—	—	—	—	—	0.1	Regional	0	—
	R-55	P2A	994.4	n/a	3	1	mg/L	0.0855	0.0855	0.2	—	—	—	—	—	0.1	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	0.2445	0.245	0.2	—	—	—	—	—	0.03	Intermediate	2	—
	R-57	P1A	910	n/a	2	1	mg/L	0.0852	0.0852	0.2	—	—	—	—	—	0.1	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Calcium	R-20	MP1A	904.6	n/a	5	5	mg/L	3.792	4.05	0.2	—	—	—	—	—	24.88	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	39.48	43.2	0.2	—	—	—	—	—	24.88	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	14.14	21.4	0.2	—	—	—	—	—	24.88	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	11.431	13.2	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	mg/L	13.567	14.3	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-20	P2A	1147.1	n/a	14	14	mg/L	13.2	14.9	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-21	Single	888.8	FD	3	3	mg/L	11.667	11.9	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-21	Single	888.8	n/a	25	25	mg/L	11.532	12.1	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-22	MP1A	907.1	n/a	5	5	mg/L	59.76	71.7	0.2	—	—	—	—	—	24.88	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	mg/L	14.35	58.8	0.2	—	—	—	—	—	24.88	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	17.5	17.5	0.2	—	—	—	—	—	24.88	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	13	mg/L	19.177	35	0.2	—	—	—	—	—	24.88	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	44.9	44.9	0.2	—	—	—	—	—	24.88	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	mg/L	48.2	61	0.2	—	—	—	—	—	24.88	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	37.5	37.5	0.2	—	—	—	—	—	24.88	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	mg/L	35.76	37.6	0.2	—	—	—	—	—	24.88	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	16.525	17.4	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-23	Single	816	n/a	25	25	mg/L	16.804	17.9	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	mg/L	21	21	0.2	—	—	—	—	—	17.31	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	27.936	39.9	0.2	—	—	—	—	—	17.31	Intermediate	14	—
	R-23i	P2A	470.2	FD	2	2	mg/L	20.95	21.7	0.2	—	—	—	—	—	17.31	Intermediate	2	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	20.732	22.9	0.2	—	—	—	—	—	17.31	Intermediate	19	—
	R-23i	P3A	524	FD	2	2	mg/L	20.3	20.6	0.2	—	—	—	—	—	17.31	Intermediate	2	—
	R-23i	P3A	524	n/a	17	17	mg/L	20.706	21.6	0.2	—	—	—	—	—	17.31	Intermediate	17	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	16.344	16.7	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-32	MP3A	976	n/a	9	9	mg/L	11.156	11.9	0.2	—	—	—	—	—	24.88	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	16.067	16.8	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-32	Single	867.5	n/a	15	15	mg/L	16.133	17	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-37	P1A	929.3	FD	1	1	mg/L	24.5	24.5	0.2	—	—	—	—	—	17.31	Intermediate	1	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Calcium (continued)	R-37	P1A	929.3	n/a	10	10	mg/L	24.55	26.2	0.2	—	—	—	—	—	17.31	Intermediate	10	—
	R-37	P2A	1026	FD	1	1	mg/L	12.1	12.1	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-37	P2A	1026	n/a	9	9	mg/L	13.922	20.4	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-38	Single	821.2	FD	4	4	mg/L	12.35	13.1	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	12.48	13.3	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	12.2	12.2	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	12.473	13.3	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	mg/L	20.957	23.9	0.2	—	—	—	—	—	17.31	Intermediate	7	—
	R-40	P2A	849.3	FD	2	2	mg/L	11.25	11.8	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	11.289	12.5	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	18.157	20.1	0.2	—	—	—	—	—	17.31	Intermediate	5	—
	R-41	P2A	965.3	FD	2	2	mg/L	14.45	14.7	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	14.14	15.2	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	12.311	13.4	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	12.156	13	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	mg/L	11.75	12.6	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	10.8	11.5	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	13.06	14.4	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	11.1	11.5	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	10.62	11.2	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	10.85	11	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	10.8	11.3	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	10.862	13.6	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	11.667	12.5	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	17.333	17.6	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	mg/L	17.7	18	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	35.45	35.6	0.2	—	—	—	—	—	17.31	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	mg/L	13.067	13.6	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	12.2	12.7	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	13.05	13.6	0.2	—	—	—	—	—	24.88	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	12.8	12.9	0.2	—	—	—	—	—	24.88	Regional	0	—
Chloride	R-20	MP1A	904.6	n/a	5	5	mg/L	3.922	6.25	0.2	250	NM GW	0	125	0	3.57	Regional	3	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	6.704	7.53	0.2	250	NM GW	0	125	0	3.57	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	1.614	1.94	0.2	250	NM GW	0	125	0	3.57	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	2.4238	3.45	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	mg/L	1.8933	1.93	0.2	250	NM GW	0	125	0	3.57	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Chloride (continued)	R-20	P2A	1147.1	n/a	13	12	mg/L	1.985	2.3	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-21	Single	888.8	FD	3	3	mg/L	1.8567	1.96	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-21	Single	888.8	n/a	25	25	mg/L	1.83	1.98	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-22	MP1A	907.1	n/a	5	5	mg/L	4.894	10.2	0.2	250	NM GW	0	125	0	3.57	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	mg/L	2.6381	3.1	0.2	250	NM GW	0	125	0	3.57	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	4.39	4.39	0.2	250	NM GW	0	125	0	3.57	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	13	mg/L	4.2592	4.81	0.2	250	NM GW	0	125	0	3.57	Regional	12	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	7.51	7.51	0.2	250	NM GW	0	125	0	3.57	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	6	6	mg/L	7.835	8.3	0.2	250	NM GW	0	125	0	3.57	Regional	6	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	2.69	2.69	0.2	250	NM GW	0	125	0	3.57	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	6	6	mg/L	2.9333	4.2	0.2	250	NM GW	0	125	0	3.57	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	3.4967	3.82	0.2	250	NM GW	0	125	0	3.57	Regional	8	—
	R-23	Single	816	n/a	25	25	mg/L	3.6172	4	0.2	250	NM GW	0	125	0	3.57	Regional	15	—
	R-23i	P1A	400.3	FD	1	1	mg/L	6.97	6.97	0.2	250	NM GW	0	125	0	7.78	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	24.121	36.7	0.2	250	NM GW	0	125	0	7.78	Intermediate	12	—
	R-23i	P2A	470.2	FD	2	2	mg/L	7.315	8.19	0.2	250	NM GW	0	125	0	7.78	Intermediate	1	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	7.6658	8.5	0.2	250	NM GW	0	125	0	7.78	Intermediate	8	—
	R-23i	P3A	524	FD	2	2	mg/L	8.25	8.3	0.2	250	NM GW	0	125	0	7.78	Intermediate	2	—
	R-23i	P3A	524	n/a	16	16	mg/L	8.4594	9.13	0.2	250	NM GW	0	125	0	7.78	Intermediate	16	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	2.9356	3.11	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-32	MP3A	976	n/a	9	9	mg/L	2.0356	2.3	0.2	250	NM GW	0	125	0	3.57	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	5	5	mg/L	2.976	3.11	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-32	Single	867.5	n/a	15	15	mg/L	2.93	3.12	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-37	P1A	929.3	FD	1	1	mg/L	4.75	4.75	0.2	250	NM GW	0	125	0	7.78	Intermediate	0	—
	R-37	P1A	929.3	n/a	10	10	mg/L	4.437	4.75	0.2	250	NM GW	0	125	0	7.78	Intermediate	0	—
	R-37	P2A	1026	FD	1	1	mg/L	2.23	2.23	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-37	P2A	1026	n/a	9	9	mg/L	3.2944	8.49	0.2	250	NM GW	0	125	0	3.57	Regional	2	—
	R-38	Single	821.2	FD	4	4	mg/L	2.4925	2.61	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	2.487	2.8	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	2.2	2.2	0.2	250	NM GW	0	125	0	3.57	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Chloride (continued)	R-39	Single	859	n/a	11	11	mg/L	2.1818	2.3	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-40	P1A	751.6	n/a	8	8	mg/L	2.1775	2.26	0.2	250	NM GW	0	125	0	7.78	Intermediate	0	—
	R-40	P2A	849.3	FD	2	2	mg/L	1.915	2	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	1.9578	2.54	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	2.6943	3.7	0.2	250	NM GW	0	125	0	7.78	Intermediate	0	—
	R-41	P2A	965.3	FD	2	2	mg/L	3.005	3.05	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	3.153	3.75	0.2	250	NM GW	0	125	0	3.57	Regional	2	—
	R-49	P1A	845	n/a	9	9	mg/L	2.7133	2.89	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	2.5811	4.73	0.2	250	NM GW	0	125	0	3.57	Regional	1	—
	R-51	P1A	914.96	n/a	6	6	mg/L	2.09	2.62	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	2.1367	2.8	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	2.486	2.58	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	2.166	2.25	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	1.822	1.94	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	1.8	1.86	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	1.792	1.87	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	1.9333	2.04	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	1.8667	1.98	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	7.9733	16.4	0.2	250	NM GW	0	125	0	3.57	Regional	3	—
	R-55	P2A	994.4	n/a	3	3	mg/L	3.62	3.69	0.2	250	NM GW	0	125	0	3.57	Regional	2	—
	R-55i	Single	510	n/a	2	2	mg/L	16.9	17.2	0.2	250	NM GW	0	125	0	7.78	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	mg/L	2.3367	2.44	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	2.1767	2.27	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	2.415	2.5	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	2.3	2.35	0.2	250	NM GW	0	125	0	3.57	Regional	0	—
Cyanide (Total)	R-22	MP1A	907.1	n/a	1	1	mg/L	0.0047	0.0047	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	3	1	mg/L	0.0026	0.0026	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-32	MP1A	870.9	n/a	3	1	mg/L	0.0624	0.0624	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	—
Dissolved Organic Carbon	R-20	MP1A	904.6	FD	1	1	mg/L	5.7	5.7	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP1A	904.6	n/a	4	4	mg/L	5.625	7.2	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	FD	2	2	mg/L	7.65	8.5	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	4	mg/L	8.1	9	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	FD	1	1	mg/L	5.5	5.5	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Dissolved Organic Carbon (continued)	R-20	MP3A	1330	n/a	3	3	mg/L	4.6333	5.2	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	FD	2	2	mg/L	0.5	0.6	n/a	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	3	3	mg/L	0.7333	1.1	n/a	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	1	1	mg/L	8.1	8.1	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	1	1	mg/L	6.3	6.3	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	1	1	mg/L	8.4	8.4	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	1	1	mg/L	5.5	5.5	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	1	1	mg/L	0.9	0.9	n/a	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	3	3	mg/L	1.0333	1.1	n/a	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	3	3	mg/L	0.5967	0.7	n/a	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	4	4	mg/L	0.975	1.2	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Fluoride	R-20	MP1A	904.6	n/a	5	5	mg/L	0.4346	0.534	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	0.6468	0.829	0.1	1.6	NM GW	0	0.8	1	0.57	Regional	3	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	1.0656	1.31	0.1	1.6	NM GW	0	0.8	5	0.57	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	0.3065	0.469	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	mg/L	0.2477	0.263	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-20	P2A	1147.1	n/a	13	13	mg/L	0.3011	0.512	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-21	Single	888.8	FD	3	3	mg/L	0.2597	0.305	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-21	Single	888.8	n/a	25	25	mg/L	0.2859	0.473	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-22	MP1A	907.1	n/a	5	4	mg/L	0.4445	0.62	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	15	mg/L	0.3378	0.46	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	0.481	0.481	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	13	mg/L	0.5233	0.67	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	0.61	0.61	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	6	6	mg/L	0.6512	0.8	0.1	1.6	NM GW	0	0.8	1	0.57	Regional	5	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Fluoride (continued)	R-22	MP5A	1448.2	FD	1	1	mg/L	0.4	0.4	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	6	6	mg/L	0.3597	0.41	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	0.3638	0.51	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-23	Single	816	n/a	25	25	mg/L	0.3692	0.514	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	mg/L	0.252	0.252	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	0.2357	0.43	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	5	—
	R-23i	P2A	470.2	FD	2	2	mg/L	0.219	0.245	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	1	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	0.2241	0.327	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	7	—
	R-23i	P3A	524	FD	2	2	mg/L	0.218	0.244	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	1	—
	R-23i	P3A	524	n/a	16	16	mg/L	0.2379	0.391	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	8	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	0.3153	0.383	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-32	MP3A	976	n/a	9	9	mg/L	0.6586	0.974	0.1	1.6	NM GW	0	0.8	2	0.57	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	5	5	mg/L	0.3534	0.472	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-32	Single	867.5	n/a	15	15	mg/L	0.3157	0.458	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-37	P1A	929.3	FD	1	1	mg/L	0.56	0.56	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	10	mg/L	0.5765	0.735	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	10	—
	R-37	P2A	1026	FD	1	1	mg/L	0.254	0.254	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-37	P2A	1026	n/a	9	9	mg/L	0.352	0.606	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	2	—
	R-38	Single	821.2	FD	4	4	mg/L	0.295	0.319	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	0.3391	0.507	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	0.237	0.237	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	0.3043	0.465	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-40	P1A	751.6	n/a	8	7	mg/L	0.385	0.534	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	7	—
	R-40	P2A	849.3	FD	2	2	mg/L	0.3545	0.457	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	0.2832	0.465	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	0.4174	1.12	0.1	1.6	NM GW	0	0.8	1	0.23	Intermediate	6	—
	R-41	P2A	965.3	FD	2	2	mg/L	0.3045	0.305	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	0.3486	0.497	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	0.2956	0.485	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	0.2912	0.469	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	mg/L	0.2333	0.276	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	0.1985	0.217	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	0.263	0.286	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	0.1982	0.213	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Fluoride (continued)	R-53	P1A	849.2	n/a	5	5	mg/L	0.2574	0.278	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	0.2435	0.259	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	0.2322	0.26	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	0.2328	0.271	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	0.23	0.26	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	0.307	0.362	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	mg/L	0.3437	0.373	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	0.249	0.279	0.1	1.6	NM GW	0	0.8	0	0.23	Intermediate	1	—
	R-56	P1A	945	n/a	3	3	mg/L	0.3233	0.357	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	0.3223	0.333	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	0.319	0.335	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	0.3065	0.311	0.1	1.6	NM GW	0	0.8	0	0.57	Regional	0	—
Hardness	R-20	MP1A	904.6	n/a	1	1	mg/L	11.6	11.6	2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	1	1	mg/L	122	122	2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	1	1	mg/L	38.6	38.6	2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	37.469	43	2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	mg/L	44.533	46.9	2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	14	14	mg/L	43.886	49.2	2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	mg/L	41.267	42.8	2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	21	21	mg/L	41.019	42.5	2	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	1	1	mg/L	267	267	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	12	12	mg/L	47.8	50.1	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	65.9	65.9	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	9	9	mg/L	69.278	74.3	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	1	1	mg/L	119	119	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	1	1	mg/L	114	114	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	58.175	60.8	2	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	21	21	mg/L	58.333	61.3	2	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	mg/L	76.4	76.4	2	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	110.47	156	2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	mg/L	76.7	79.2	2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	75.374	83.3	2	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Hardness (continued)	R-23i	P3A	524	FD	2	2	mg/L	74.65	75.7	2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	17	17	mg/L	75.465	79.2	2	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	5	5	mg/L	61.66	62.4	2	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	5	5	mg/L	40.06	41.5	2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	59.55	63.5	2	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	mg/L	57.82	63.4	2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	mg/L	84.2	84.2	2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	mg/L	84.18	89.4	2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	mg/L	42.3	42.3	2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	mg/L	48.322	70.1	2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	mg/L	45.55	48.4	2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	mg/L	45.96	48.8	2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	mg/L	44.8	44.8	2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	mg/L	45.473	48.6	2	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	7	7	mg/L	79.171	87.6	2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	mg/L	40.15	42	2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	mg/L	40.611	46.7	2	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	76.843	85.6	2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	mg/L	52.4	53.1	2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	mg/L	51.24	54.8	2	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	mg/L	45.489	48.9	2	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	8	mg/L	44.288	47.4	2	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	mg/L	40.617	42.7	2	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	mg/L	38.833	41.4	2	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	45.04	48.5	2	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	5	mg/L	39.54	41.1	2	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	mg/L	39.2	41.2	2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	mg/L	39.9	40.6	2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	mg/L	39.8	41.7	2	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	mg/L	44.367	55.7	2	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	mg/L	41.817	43.8	2	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	mg/L	60.5	61.3	2	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	mg/L	62	63.3	2	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	mg/L	126	126	2	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	mg/L	49.7	51.5	2	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	45.167	46.3	2	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Hardness (continued)	R-57	P1A	910	n/a	2	2	mg/L	47	48.9	2	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	mg/L	46.15	46.3	2	—	—	—	—	—	—	—	—	—
Magnesium	R-20	MP1A	904.6	n/a	5	5	mg/L	0.5186	0.625	0.3	—	—	—	—	—	4.15	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	3.904	4.31	0.3	—	—	—	—	—	4.15	Regional	1	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	3.83	5.72	0.3	—	—	—	—	—	4.15	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	2.1715	2.42	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	mg/L	2.5967	2.73	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-20	P2A	1147.1	n/a	14	14	mg/L	2.6521	2.9	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-21	Single	888.8	FD	3	3	mg/L	2.9533	3.16	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-21	Single	888.8	n/a	25	25	mg/L	2.9876	3.14	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-22	MP1A	907.1	n/a	5	5	mg/L	16.24	21.3	0.3	—	—	—	—	—	4.15	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	mg/L	5.29	15.9	0.3	—	—	—	—	—	4.15	Regional	16	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	4.69	4.69	0.3	—	—	—	—	—	4.15	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	13	mg/L	5.5808	11	0.3	—	—	—	—	—	4.15	Regional	13	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	12	12	0.3	—	—	—	—	—	4.15	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	mg/L	12.598	15	0.3	—	—	—	—	—	4.15	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	6.67	6.67	0.3	—	—	—	—	—	4.15	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	mg/L	6.388	7.26	0.3	—	—	—	—	—	4.15	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	4.1092	4.36	0.3	—	—	—	—	—	4.15	Regional	2	—
	R-23	Single	816	n/a	25	25	mg/L	4.1308	4.42	0.3	—	—	—	—	—	4.15	Regional	13	—
	R-23i	P1A	400.3	FD	1	1	mg/L	5.83	5.83	0.3	—	—	—	—	—	6.12	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	9.8643	13.7	0.3	—	—	—	—	—	6.12	Intermediate	13	—
	R-23i	P2A	470.2	FD	2	2	mg/L	5.895	6.05	0.3	—	—	—	—	—	6.12	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	5.7411	6.37	0.3	—	—	—	—	—	6.12	Intermediate	1	—
	R-23i	P3A	524	FD	2	2	mg/L	5.805	5.86	0.3	—	—	—	—	—	6.12	Intermediate	0	—
	R-23i	P3A	524	n/a	17	17	mg/L	5.7724	6.12	0.3	—	—	—	—	—	6.12	Intermediate	1	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	4.9522	5.05	0.3	—	—	—	—	—	4.15	Regional	9	—
	R-32	MP3A	976	n/a	9	9	mg/L	3.23	3.6	0.3	—	—	—	—	—	4.15	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	4.7167	5.24	0.3	—	—	—	—	—	4.15	Regional	6	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Magnesium (continued)	R-32	Single	867.5	n/a	15	15	mg/L	4.7787	5.09	0.3	—	—	—	—	—	4.15	Regional	15	—
	R-37	P1A	929.3	FD	1	1	mg/L	5.61	5.61	0.3	—	—	—	—	—	6.12	Intermediate	0	—
	R-37	P1A	929.3	n/a	10	10	mg/L	5.555	5.87	0.3	—	—	—	—	—	6.12	Intermediate	0	—
	R-37	P2A	1026	FD	1	1	mg/L	2.93	2.93	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-37	P2A	1026	n/a	9	9	mg/L	3.2889	4.67	0.3	—	—	—	—	—	4.15	Regional	2	—
	R-38	Single	821.2	FD	4	4	mg/L	3.585	3.82	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	3.597	3.81	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	3.46	3.46	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	3.4736	3.74	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	mg/L	6.5143	7.19	0.3	—	—	—	—	—	6.12	Intermediate	6	—
	R-40	P2A	849.3	FD	2	2	mg/L	2.91	3.02	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	3.0167	3.76	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	7.6586	8.59	0.3	—	—	—	—	—	6.12	Intermediate	7	—
	R-41	P2A	965.3	FD	2	2	mg/L	3.95	3.98	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	3.864	4.09	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	3.5967	3.77	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	3.3811	3.59	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	mg/L	2.7333	2.86	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	2.8867	3.15	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	3.012	3.11	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	2.862	2.97	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	3.068	3.19	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	3.135	3.21	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	3.12	3.26	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	4.185	5.3	0.3	—	—	—	—	—	4.15	Regional	3	—
	R-54	P2A	915	n/a	6	6	mg/L	3.075	3.16	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	4.17	4.26	0.3	—	—	—	—	—	4.15	Regional	2	—
	R-55	P2A	994.4	n/a	3	3	mg/L	4.3333	4.44	0.3	—	—	—	—	—	4.15	Regional	3	—
	R-55i	Single	510	n/a	2	2	mg/L	9.125	9.17	0.3	—	—	—	—	—	6.12	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	mg/L	4.1367	4.24	0.3	—	—	—	—	—	4.15	Regional	2	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	3.5767	3.64	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	3.49	3.62	0.3	—	—	—	—	—	4.15	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	3.44	3.49	0.3	—	—	—	—	—	4.15	Regional	0	—
Nitrate-Nitrite as Nitrogen	R-20	P1A	904.6	n/a	13	8	mg/L	93.632	748	0.25	10	EPA MCL	1	5	1	0.89	Regional	1	The maximum nitrate result of 748 mg/L above the standard is most likely a sample that was improperly preserved with nitric acid instead of the required sulfuric acid.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Nitrate-Nitrite as Nitrogen (continued)	R-20	P2A	1147.1	FD	3	3	mg/L	0.1807	0.196	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-20	P2A	1147.1	n/a	13	11	mg/L	0.1758	0.235	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-21	Single	888.8	FD	3	3	mg/L	0.2813	0.321	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-21	Single	888.8	n/a	25	24	mg/L	0.3192	0.493	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-22	MP1A	907.1	n/a	5	2	mg/L	0.035	0.05	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	mg/L	0.7234	0.895	0.25	10	EPA MCL	0	5	0	0.89	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	0.364	0.364	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	12	12	mg/L	0.521	0.985	0.25	10	EPA MCL	0	5	0	0.89	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	2	mg/L	0.0368	0.05	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	1	mg/L	0.01	0.01	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	1.2607	1.56	0.25	10	EPA MCL	0	5	0	0.89	Regional	12	—
	R-23	Single	816	n/a	25	25	mg/L	1.1868	1.95	0.25	10	EPA MCL	0	5	0	0.89	Regional	23	—
	R-23i	P1A	400.3	FD	1	1	mg/L	0.086	0.086	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	12	mg/L	0.3208	0.56	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-23i	P2A	470.2	FD	2	2	mg/L	0.7625	0.765	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-23i	P2A	470.2	n/a	18	17	mg/L	0.7139	0.97	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-23i	P3A	524	FD	2	2	mg/L	0.8245	0.929	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-23i	P3A	524	n/a	16	16	mg/L	0.8075	0.93	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-32	MP1A	870.9	n/a	8	8	mg/L	0.7925	0.99	0.25	10	EPA MCL	0	5	0	0.89	Regional	3	—
	R-32	MP3A	976	n/a	7	2	mg/L	0.0355	0.0399	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	5	mg/L	1.1052	1.25	0.25	10	EPA MCL	0	5	0	0.89	Regional	4	—
	R-32	Single	867.5	n/a	15	15	mg/L	0.844	1.16	0.25	10	EPA MCL	0	5	0	0.89	Regional	11	—
	R-37	P1A	929.3	FD	1	1	mg/L	0.476	0.476	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-37	P1A	929.3	n/a	10	10	mg/L	0.5286	0.81	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-37	P2A	1026	FD	1	1	mg/L	0.62	0.62	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-37	P2A	1026	n/a	9	9	mg/L	0.5972	0.77	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-38	Single	821.2	FD	4	4	mg/L	0.581	0.675	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	0.5856	0.63	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	0.58	0.58	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	0.6116	0.74	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-40	P1A	751.6	n/a	7	4	mg/L	0.1473	0.203	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-40	P2A	849.3	FD	2	2	mg/L	0.377	0.388	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Nitrate-Nitrite as Nitrogen (continued)	R-40	P2A	849.3	n/a	9	8	mg/L	0.3382	0.422	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-40	R-40i	649.7	n/a	7	1	mg/L	0.082	0.082	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	0	—
	R-41	P2A	965.3	FD	2	2	mg/L	0.62	0.675	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	0.5915	0.755	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	0.5481	0.685	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	0.5729	0.76	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	mg/L	0.3317	0.407	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	0.3915	0.955	0.25	10	EPA MCL	0	5	0	0.89	Regional	1	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	0.5864	0.695	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-52	P2A	1107	n/a	5	4	mg/L	0.3953	0.447	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-53	P1A	849.2	n/a	5	4	mg/L	0.3653	0.471	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	0.293	0.346	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-53	P2A	959.7	n/a	5	4	mg/L	0.3445	0.435	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-54	P1A	830	n/a	6	5	mg/L	0.2756	0.332	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	0.3802	0.457	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	0.6873	0.76	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	mg/L	0.585	0.7	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	3.855	3.88	0.25	10	EPA MCL	0	5	0	2.41	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	mg/L	0.732	0.926	0.25	10	EPA MCL	0	5	0	0.89	Regional	1	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	0.6157	0.682	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	0.552	0.605	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	0.596	0.745	0.25	10	EPA MCL	0	5	0	0.89	Regional	0	—
Perchlorate	R-20	P1A	904.6	n/a	13	13	µg/L	0.1542	0.2	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	µg/L	0.155	0.184	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-20	P2A	1147.1	n/a	14	11	µg/L	0.1742	0.226	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-21	Single	888.8	FD	3	3	µg/L	0.278	0.292	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-21	Single	888.8	n/a	21	21	µg/L	0.281	0.317	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-22	MP1A	907.1	FD	2	2	µg/L	0.2585	0.281	0.2	4	NM GW	0	2	0	0.46	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP1A	907.1	n/a	18	15	µg/L	0.2585	0.287	0.2	4	NM GW	0	2	0	0.46	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	14	12	µg/L	0.363	0.399	0.2	4	NM GW	0	2	0	0.46	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	0.282	0.282	0.2	4	NM GW	0	2	0	0.46	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	10	8	µg/L	0.3423	0.394	0.2	4	NM GW	0	2	0	0.46	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	2	2	µg/L	0.26	0.273	0.2	4	NM GW	0	2	0	0.46	Regional	0	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Perchlorate (continued)	R-22	MP5A	1448.2	n/a	32	29	µg/L	0.281	0.319	0.2	4	NM GW	0	2	0	0.46	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	µg/L	0.4424	0.488	0.2	4	NM GW	0	2	0	0.46	Regional	3	—
	R-23	Single	816	n/a	21	21	µg/L	0.4481	0.494	0.2	4	NM GW	0	2	0	0.46	Regional	5	—
	R-23i	P1A	400.3	FD	1	1	µg/L	0.181	0.181	0.2	4	NM GW	0	2	0	0.05	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	13	µg/L	0.2295	0.323	0.2	4	NM GW	0	2	0	0.05	Intermediate	13	—
	R-23i	P2A	470.2	FD	2	2	µg/L	0.2165	0.221	0.2	4	NM GW	0	2	0	0.05	Intermediate	2	—
	R-23i	P2A	470.2	n/a	19	19	µg/L	0.2205	0.263	0.2	4	NM GW	0	2	0	0.05	Intermediate	19	—
	R-23i	P3A	524	FD	2	2	µg/L	0.2445	0.259	0.2	4	NM GW	0	2	0	0.05	Intermediate	2	—
	R-23i	P3A	524	n/a	19	19	µg/L	0.2522	0.29	0.2	4	NM GW	0	2	0	0.05	Intermediate	19	
	R-32	MP1A	870.9	n/a	5	5	µg/L	0.3002	0.316	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-32	MP3A	976	n/a	5	1	µg/L	0.0535	0.0535	0.2	4	NM GW	0	2	0	0.46	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	0.3358	0.373	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-32	Single	867.5	n/a	15	15	µg/L	0.3459	0.387	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-37	P1A	929.3	FD	1	1	µg/L	0.514	0.514	0.2	4	NM GW	0	2	0	0.05	Intermediate	1	—
	R-37	P1A	929.3	n/a	11	11	µg/L	0.5215	0.613	0.2	4	NM GW	0	2	0	0.05	Intermediate	11	—
	R-37	P2A	1026	FD	1	1	µg/L	0.347	0.347	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-37	P2A	1026	n/a	10	10	µg/L	0.3892	0.465	0.2	4	NM GW	0	2	0	0.46	Regional	3	—
	R-38	Single	821.2	FD	4	4	µg/L	0.3815	0.397	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-38	Single	821.2	n/a	10	10	µg/L	0.3577	0.387	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-39	Single	859	FD	1	1	µg/L	0.335	0.335	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-39	Single	859	n/a	11	11	µg/L	0.3448	0.379	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-40	P1A	751.6	n/a	8	5	µg/L	0.0793	0.101	0.2	4	NM GW	0	2	0	0.05	Intermediate	5	—
	R-40	P2A	849.3	FD	2	2	µg/L	0.259	0.261	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	µg/L	0.2657	0.293	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-40	R-40i	649.7	n/a	7	1	µg/L	0.142	0.142	0.2	4	NM GW	0	2	0	0.05	Intermediate	1	—
	R-41	P2A	965.3	FD	2	2	µg/L	0.382	0.385	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	µg/L	0.3796	0.421	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-49	P1A	845	n/a	9	9	µg/L	0.3069	0.353	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	µg/L	0.3464	0.367	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	µg/L	0.2785	0.292	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-51	P2A	1031	n/a	6	6	µg/L	0.2868	0.304	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	0.3894	0.441	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-52	P2A	1107	n/a	5	5	µg/L	0.3278	0.344	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	µg/L	0.2626	0.287	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-53	P2A	959.7	FD	2	2	µg/L	0.2875	0.295	0.2	4	NM GW	0	2	0	0.46	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Perchlorate (continued)	R-53	P2A	959.7	n/a	5	5	µg/L	0.2872	0.302	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-54	P1A	830	n/a	6	6	µg/L	0.2085	0.248	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-54	P2A	915	n/a	6	6	µg/L	0.2818	0.304	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-55	P1A	860	n/a	3	3	µg/L	0.4587	0.462	0.2	4	NM GW	0	2	0	0.46	Regional	1	—
	R-55	P2A	994.4	n/a	3	3	µg/L	0.4267	0.436	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-55i	Single	510	n/a	2	2	µg/L	0.9335	0.987	0.2	4	NM GW	0	2	0	0.05	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	µg/L	0.3093	0.347	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	0.3023	0.328	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-57	P1A	910	n/a	2	2	µg/L	0.307	0.341	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	µg/L	0.3035	0.331	0.2	4	NM GW	0	2	0	0.46	Regional	0	—
pH	R-20	MP1A	904.6	n/a	1	1	SU[g]	8.85	8.85	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	1	1	SU	7.63	7.63	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	1	1	SU	6.54	6.54	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	SU	8.5331	8.79	n/a	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	SU	7.9567	8.08	n/a	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	14	14	SU	7.9907	8.11	n/a	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	SU	7.8767	8.07	n/a	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	21	21	SU	8.001	8.15	n/a	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	2	2	SU	6.845	6.9	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	12	12	SU	8.035	8.33	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	SU	8.32	8.32	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	9	9	SU	8.3622	8.69	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	2	2	SU	6.965	7.23	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	SU	7.045	7.29	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	SU	7.9908	8.13	n/a	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	21	21	SU	7.989	8.16	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	SU	8.14	8.14	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	SU	7.8107	8.15	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	SU	8.02	8.07	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	SU	8.1405	8.52	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	SU	8.245	8.25	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	17	17	SU	8.1635	8.35	n/a	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
pH (continued)	R-32	MP1A	870.9	n/a	5	5	SU	8.314	8.61	n/a	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	5	5	SU	7.586	8.48	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	SU	7.5733	7.69	n/a	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	SU	7.488	7.69	n/a	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	SU	8.09	8.09	n/a	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	11	11	SU	8.06	8.15	n/a	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	SU	8.06	8.06	n/a	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	10	10	SU	8.065	8.21	n/a	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	SU	7.665	7.76	n/a	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	SU	7.723	7.94	n/a	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	SU	8.1	8.1	n/a	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	SU	7.99	8.2	n/a	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	SU	7.9788	8.48	n/a	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	SU	7.83	7.87	n/a	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	SU	7.89	8.05	n/a	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	SU	7.53	7.66	n/a	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	SU	8.08	8.12	n/a	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	SU	7.829	8.16	n/a	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	SU	8.0356	8.13	n/a	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	9	SU	8.0244	8.11	n/a	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	SU	8.1917	8.32	n/a	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	SU	8.165	8.28	n/a	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	SU	8.286	8.46	n/a	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	5	SU	7.942	7.97	n/a	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	SU	7.95	8.03	n/a	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	SU	8.035	8.07	n/a	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	SU	8.038	8.08	n/a	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	SU	7.4717	7.8	n/a	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	SU	8.1483	8.3	n/a	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	SU	8.0667	8.16	n/a	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	SU	8.3033	8.46	n/a	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	SU	7.78	7.78	n/a	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	SU	7.9133	8.01	n/a	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	SU	7.9967	8.02	n/a	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	SU	7.845	8.06	n/a	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	SU	7.855	7.91	n/a	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Orthophosphate	R-22	MP4A	1378	n/a	1	1	mg/L	0.29	0.29	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	1	1	mg/L	0.12	0.12	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
Potassium	R-20	MP1A	904.6	n/a	5	5	mg/L	3.622	3.93	0.15	—	—	—	—	—	2.63	Regional	5	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	3.942	4.17	0.15	—	—	—	—	—	2.63	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	2.61	3.14	0.15	—	—	—	—	—	2.63	Regional	2	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	2.62	2.88	0.15	—	—	—	—	—	2.63	Regional	6	—
	R-20	P2A	1147.1	FD	3	3	mg/L	2.4033	2.5	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-20	P2A	1147.1	n/a	14	14	mg/L	2.3986	2.7	0.15	—	—	—	—	—	2.63	Regional	1	—
	R-21	Single	888.8	FD	3	3	mg/L	1.6767	1.71	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-21	Single	888.8	n/a	25	25	mg/L	1.6836	1.81	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-22	MP1A	907.1	n/a	5	5	mg/L	4.168	4.68	0.15	—	—	—	—	—	2.63	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	mg/L	2.5775	3.99	0.15	—	—	—	—	—	2.63	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	6.85	6.85	0.15	—	—	—	—	—	2.63	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	13	mg/L	6.5269	9.7	0.15	—	—	—	—	—	2.63	Regional	13	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	4.75	4.75	0.15	—	—	—	—	—	2.63	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	mg/L	4.83	5.6	0.15	—	—	—	—	—	2.63	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	4.65	4.65	0.15	—	—	—	—	—	2.63	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	mg/L	4.408	5.27	0.15	—	—	—	—	—	2.63	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	1.7917	1.98	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-23	Single	816	n/a	25	25	mg/L	1.8212	1.98	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	mg/L	2.43	2.43	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	3.745	5.37	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-23i	P2A	470.2	FD	2	2	mg/L	2.58	2.59	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	2.5495	2.78	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-23i	P3A	524	FD	2	2	mg/L	2.595	2.62	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-23i	P3A	524	n/a	17	17	mg/L	2.57	2.73	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	1.7078	1.86	0.15	—	—	—	—	—	2.63	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Potassium (continued)	R-32	MP3A	976	n/a	9	9	mg/L	1.5856	1.67	0.15	—	—	—	—	—	2.63	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	1.7067	1.85	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-32	Single	867.5	n/a	15	15	mg/L	2.154	8.42	0.15	—	—	—	—	—	2.63	Regional	1	—
	R-37	P1A	929.3	FD	1	1	mg/L	1.87	1.87	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-37	P1A	929.3	n/a	10	10	mg/L	1.869	2.11	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-37	P2A	1026	FD	1	1	mg/L	1.85	1.85	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-37	P2A	1026	n/a	9	9	mg/L	1.8356	2.07	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-38	Single	821.2	FD	4	4	mg/L	1.5475	1.62	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	1.523	1.61	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	1.35	1.35	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	1.4091	1.49	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	mg/L	1.7586	1.98	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-40	P2A	849.3	FD	2	2	mg/L	1.565	1.67	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	1.5311	1.67	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	1.8314	2.1	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-41	P2A	965.3	FD	2	2	mg/L	1.925	2	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	1.861	1.99	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	1.6178	1.9	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	1.4178	1.59	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	mg/L	1.5083	1.66	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	1.725	1.79	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	1.86	1.9	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	1.71	1.82	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	1.616	1.75	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	1.745	1.79	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	1.724	1.87	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	1.62	2.07	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	1.8167	2.03	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	1.69	1.8	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	mg/L	1.81	1.84	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	2.32	2.34	0.15	—	—	—	—	—	10.03	Intermediate	0	—
	R-56	P1A	945	n/a	3	3	mg/L	1.72	1.8	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	1.81	1.88	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	1.52	1.58	0.15	—	—	—	—	—	2.63	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	1.51	1.58	0.15	—	—	—	—	—	2.63	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Silicon Dioxide	R-20	MP1A	904.6	n/a	5	5	mg/L	44.34	58.5	0.1	—	—	—	—	—	88.5	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	47.8	64.4	0.1	—	—	—	—	—	88.5	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	51.48	71.1	0.1	—	—	—	—	—	88.5	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	FD	2	2	mg/L	69.95	70.7	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-21	Single	888.8	n/a	10	10	mg/L	59.02	73.5	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-22	MP1A	907.1	n/a	3	3	mg/L	31.767	52.5	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	8	8	mg/L	57.263	71.1	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	44.8	44.8	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	6	6	mg/L	40.717	55.4	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	25.6	25.6	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	mg/L	36.633	61.6	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	22	22	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	3	3	mg/L	35.933	60.3	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	6	6	mg/L	63.983	65.7	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-23	Single	816	n/a	10	10	mg/L	55.04	64.3	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	mg/L	38.8	38.8	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-23i	P1A	400.3	n/a	1	1	mg/L	40.2	40.2	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-23i	P2A	470.2	FD	1	1	mg/L	43.3	43.3	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-23i	P2A	470.2	n/a	4	4	mg/L	41.025	42.5	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-23i	P3A	524	FD	1	1	mg/L	43.7	43.7	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-23i	P3A	524	n/a	4	4	mg/L	42.75	43.5	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	55.3	66.4	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-32	MP3A	976	n/a	9	9	mg/L	72.7	88	0.1	—	—	—	—	—	88.5	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
Sodium	R-20	MP1A	904.6	n/a	5	5	mg/L	55.12	69.6	0.2	—	—	—	—	—	24.5	Regional	5	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	86.64	101	0.2	—	—	—	—	—	24.5	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	21.46	25.2	0.2	—	—	—	—	—	24.5	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	15.969	20.2	0.2	—	—	—	—	—	24.5	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Sodium (continued)	R-20	P2A	1147.1	FD	3	3	mg/L	12.233	13.2	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-20	P2A	1147.1	n/a	14	14	mg/L	12.564	14.4	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-21	Single	888.8	FD	3	3	mg/L	10.367	10.7	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-21	Single	888.8	n/a	25	25	mg/L	10.173	11	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-22	MP1A	907.1	n/a	5	5	mg/L	23.34	25.9	0.2	—	—	—	—	—	24.5	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	mg/L	12.013	23.9	0.2	—	—	—	—	—	24.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	21.4	21.4	0.2	—	—	—	—	—	24.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	13	mg/L	23.815	54	0.2	—	—	—	—	—	24.5	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	44.9	44.9	0.2	—	—	—	—	—	24.5	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	mg/L	36.64	44.9	0.2	—	—	—	—	—	24.5	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	19	19	0.2	—	—	—	—	—	24.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	mg/L	17.28	21.7	0.2	—	—	—	—	—	24.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	11.233	12.3	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-23	Single	816	n/a	25	25	mg/L	11.156	12.1	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	mg/L	16.7	16.7	0.2	—	—	—	—	—	12.19	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	17.486	33.7	0.2	—	—	—	—	—	12.19	Intermediate	14	—
	R-23i	P2A	470.2	FD	2	2	mg/L	13.55	14.2	0.2	—	—	—	—	—	12.19	Intermediate	2	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	13.6	20.6	0.2	—	—	—	—	—	12.19	Intermediate	14	—
	R-23i	P3A	524	FD	2	2	mg/L	10.55	10.7	0.2	—	—	—	—	—	12.19	Intermediate	0	—
	R-23i	P3A	524	n/a	17	17	mg/L	10.97	12.6	0.2	—	—	—	—	—	12.19	Intermediate	1	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	11.144	11.8	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-32	MP3A	976	n/a	9	9	mg/L	10.431	11.2	0.2	—	—	—	—	—	24.5	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	10.767	11.3	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-32	Single	867.5	n/a	15	15	mg/L	13.52	51.2	0.2	—	—	—	—	—	24.5	Regional	1	—
	R-37	P1A	929.3	FD	1	1	mg/L	14.7	14.7	0.2	—	—	—	—	—	12.19	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	10	mg/L	15.51	16.5	0.2	—	—	—	—	—	12.19	Intermediate	10	—
	R-37	P2A	1026	FD	1	1	mg/L	11.6	11.6	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-37	P2A	1026	n/a	9	9	mg/L	13.056	15.9	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-38	Single	821.2	FD	4	4	mg/L	10.845	11.4	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	10.8	11.6	0.2	—	—	—	—	—	24.5	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Sodium (continued)	R-39	Single	859	FD	1	1	mg/L	11.4	11.4	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	11.091	12.2	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	mg/L	13.371	13.9	0.2	—	—	—	—	—	12.19	Intermediate	7	—
	R-40	P2A	849.3	FD	2	2	mg/L	11.4	12.1	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	11.689	16.3	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	21.2	24.1	0.2	—	—	—	—	—	12.19	Intermediate	7	—
	R-41	P2A	965.3	FD	2	2	mg/L	13.5	13.7	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	15.17	24.2	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	17.422	20.4	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	10.756	13.5	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	mg/L	12.2	14.8	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	15.033	17.1	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	13.6	15.2	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	11.5	14.1	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	11.12	11.8	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	9.925	10	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	10.48	11.9	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	17.367	19.1	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	10.567	11	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	11.5	11.8	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	mg/L	12.067	12.6	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	13.15	13.2	0.2	—	—	—	—	—	12.19	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	mg/L	10.467	10.7	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	11.5	12.4	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	11.2	11.4	0.2	—	—	—	—	—	24.5	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	11.9	12.7	0.2	—	—	—	—	—	24.5	Regional	0	—
Specific Conductance	R-20	MP1A	904.6	n/a	1	1	µS/cm	223	223	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	1	1	µS/cm	500	500	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	1	1	µS/cm	146	146	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	µS/cm	145.15	167	n/a	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µS/cm	140.67	144	n/a	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	14	14	µS/cm	140.79	154	n/a	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	µS/cm	125.67	128	n/a	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	21	21	µS/cm	125.95	136	n/a	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	1	1	µS/cm	443	443	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Specific Conductance (continued)	R-22	MP2A	962.8	n/a	12	12	µS/cm	143.83	152	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µS/cm	169	169	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	8	8	µS/cm	214.63	231	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	1	1	µS/cm	303	303	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	1	1	µS/cm	240	240	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	µS/cm	169.83	177	n/a	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	21	21	µS/cm	168.1	178	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µS/cm	232	232	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	µS/cm	307.57	452	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µS/cm	208.5	211	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	µS/cm	323.63	2070	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	µS/cm	204	205	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	17	17	µS/cm	211.65	333	n/a	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	5	5	µS/cm	165.6	177	n/a	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	5	5	µS/cm	125.8	134	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	5	5	µS/cm	164.6	171	n/a	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	µS/cm	167.13	173	n/a	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µS/cm	228	228	n/a	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	11	11	µS/cm	230.27	241	n/a	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	µS/cm	135	135	n/a	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	10	10	µS/cm	155	206	n/a	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	µS/cm	142.5	145	n/a	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	µS/cm	140.2	145	n/a	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µS/cm	132	132	n/a	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	µS/cm	137.82	147	n/a	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µS/cm	211.63	230	n/a	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	µS/cm	122	122	n/a	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	µS/cm	130.67	165	n/a	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	µS/cm	234.29	255	n/a	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	µS/cm	167	170	n/a	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	µS/cm	169	185	n/a	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	µS/cm	160.89	178	n/a	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Specific Conductance (continued)	R-49	P2A	905.6	n/a	9	9	µS/cm	136.78	144	n/a	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	µS/cm	134.67	147	n/a	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	µS/cm	144	150	n/a	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	µS/cm	149	157	n/a	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	5	µS/cm	130.6	140	n/a	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	µS/cm	125.4	129	n/a	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	µS/cm	122.5	127	n/a	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	µS/cm	120.6	125	n/a	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	µS/cm	159.67	182	n/a	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	µS/cm	126.83	132	n/a	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	µS/cm	172.33	174	n/a	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	µS/cm	173	174	n/a	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	µS/cm	308.5	315	n/a	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	µS/cm	144	149	n/a	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	µS/cm	139.67	142	n/a	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	µS/cm	139.5	140	n/a	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µS/cm	141.5	142	n/a	—	—	—	—	—	—	—	—	—
Sulfate	R-20	MP1A	904.6	n/a	5	4	mg/L	3.015	3.76	0.4	600	NM GW	0	300	0	7.2	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	1	mg/L	1.04	1.04	0.4	600	NM GW	0	300	0	7.2	Regional	0	Before well rehabilitation.
	R-20	P1A	904.6	n/a	13	13	mg/L	2.6085	3.38	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	mg/L	1.82	1.84	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-20	P2A	1147.1	n/a	13	13	mg/L	2	2.96	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-21	Single	888.8	FD	3	3	mg/L	2.2067	2.56	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-21	Single	888.8	n/a	25	25	mg/L	2.094	2.5	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-22	MP1A	907.1	n/a	5	3	mg/L	0.3173	0.352	0.4	600	NM GW	0	300	0	7.2	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	mg/L	3.4469	4.21	0.4	600	NM GW	0	300	0	7.2	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	9.09	9.09	0.4	600	NM GW	0	300	0	7.2	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	13	mg/L	12.387	31	0.4	600	NM GW	0	300	0	7.2	Regional	6	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	1.12	1.12	0.4	600	NM GW	0	300	0	7.2	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	6	4	mg/L	1.1375	2.04	0.4	600	NM GW	0	300	0	7.2	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	0.59	0.59	0.4	600	NM GW	0	300	0	7.2	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	6	3	mg/L	0.5797	0.709	0.4	600	NM GW	0	300	0	7.2	Regional	0	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Sulfate (continued)	R-23	Single	816	FD	12	12	mg/L	5.1492	5.54	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-23	Single	816	n/a	25	25	mg/L	5.4008	7.22	0.4	600	NM GW	0	300	0	7.2	Regional	1	—
	R-23i	P1A	400.3	FD	1	1	mg/L	9.02	9.02	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	13.675	27.5	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-23i	P2A	470.2	FD	2	2	mg/L	7.365	7.51	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	8.1953	13.1	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-23i	P3A	524	FD	2	2	mg/L	7.595	7.7	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-23i	P3A	524	n/a	16	16	mg/L	7.5925	8.27	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	5.64	7.29	0.4	600	NM GW	0	300	0	7.2	Regional	1	—
	R-32	MP3A	976	n/a	9	9	mg/L	1.7311	2.4	0.4	600	NM GW	0	300	0	7.2	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	5	5	mg/L	4.988	5.26	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-32	Single	867.5	n/a	15	15	mg/L	5.106	5.61	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-37	P1A	929.3	FD	1	1	mg/L	9.8	9.8	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-37	P1A	929.3	n/a	10	10	mg/L	9.464	10.3	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-37	P2A	1026	FD	1	1	mg/L	2.76	2.76	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-37	P2A	1026	n/a	9	9	mg/L	4.1178	7.86	0.4	600	NM GW	0	300	0	7.2	Regional	1	—
	R-38	Single	821.2	FD	4	4	mg/L	2.9625	3.18	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	2.962	3.15	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	3.18	3.18	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	3.13	3.54	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-40	P1A	751.6	n/a	8	8	mg/L	4.7388	5.69	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-40	P2A	849.3	FD	2	2	mg/L	2.805	3.45	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	3.2044	6.27	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	2.81	8.07	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-41	P2A	965.3	FD	2	2	mg/L	4.615	4.67	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	4.952	6.53	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	5.0589	7.89	0.4	600	NM GW	0	300	0	7.2	Regional	1	—
	R-49	P2A	905.6	n/a	9	9	mg/L	3.8011	7.22	0.4	600	NM GW	0	300	0	7.2	Regional	1	—
	R-51	P1A	914.96	n/a	6	6	mg/L	4.24	7.18	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	5.6383	7	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	4.034	4.52	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	3.352	4.82	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	1.928	2.06	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	1.955	2	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	1.97	2.11	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	2	2.36	0.4	600	NM GW	0	300	0	7.2	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Sulfate (continued)	R-54	P2A	915	n/a	6	6	mg/L	2.0283	2.19	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	7.4867	12.4	0.4	600	NM GW	0	300	0	7.2	Regional	1	—
	R-55	P2A	994.4	n/a	3	3	mg/L	4.5	4.8	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	20.7	21.1	0.4	600	NM GW	0	300	0	40.03	Intermediate	0	—
	R-56	P1A	945	n/a	3	3	mg/L	2.9867	3.23	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	3.0367	3.41	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	2.985	3.21	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	3.125	3.56	0.4	600	NM GW	0	300	0	7.2	Regional	0	—
Total Dissolved Solids	R-20	MP1A	904.6	n/a	1	1	mg/L	227	227	n/a	1000	NM GW	0	500	0	191.68	Regional	1	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	1	1	mg/L	578	578	n/a	1000	NM GW	0	500	1	191.68	Regional	1	Before well rehabilitation.
	R-20	MP3A	1330	n/a	1	1	mg/L	208	208	n/a	1000	NM GW	0	500	0	191.68	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	138.77	149	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	mg/L	150.33	157	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-20	P2A	1147.1	n/a	14	14	mg/L	145.14	156	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-21	Single	888.8	FD	4	4	mg/L	126.5	129	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-21	Single	888.8	n/a	23	23	mg/L	136.35	268	n/a	1000	NM GW	0	500	0	191.68	Regional	1	—
	R-22	MP1A	907.1	n/a	4	4	mg/L	370.5	401	n/a	1000	NM GW	0	500	0	191.68	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	17	17	mg/L	136.12	170	n/a	1000	NM GW	0	500	0	191.68	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	173	173	n/a	1000	NM GW	0	500	0	191.68	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	12	mg/L	158.42	181	n/a	1000	NM GW	0	500	0	191.68	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	4	4	mg/L	270.75	348	n/a	1000	NM GW	0	500	0	191.68	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	3	3	mg/L	220.67	240	n/a	1000	NM GW	0	500	0	191.68	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	14	14	mg/L	347.57	2900	n/a	1000	NM GW	1	500	1	191.68	Regional	1	Maximum result may be an outlier (see text.)
	R-23	Single	816	n/a	23	23	mg/L	145.78	166	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	mg/L	153	153	n/a	1000	NM GW	0	500	0	127	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	210.21	271	n/a	1000	NM GW	0	500	0	127	Intermediate	14	—
	R-23i	P2A	470.2	FD	2	2	mg/L	142.5	146	n/a	1000	NM GW	0	500	0	127	Intermediate	2	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	148.95	169	n/a	1000	NM GW	0	500	0	127	Intermediate	19	—
	R-23i	P3A	524	FD	2	2	mg/L	144.5	145	n/a	1000	NM GW	0	500	0	127	Intermediate	2	—
	R-23i	P3A	524	n/a	17	17	mg/L	147.47	163	n/a	1000	NM GW	0	500	0	127	Intermediate	17	—
	R-32	MP1A	870.9	n/a	7	7	mg/L	155.14	178	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Total Dissolved Solids (continued)	R-32	MP3A	976	n/a	7	7	mg/L	148.14	157	n/a	1000	NM GW	0	500	0	191.68	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	5	5	mg/L	144.8	150	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-32	Single	867.5	n/a	15	15	mg/L	146.93	161	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-37	P1A	929.3	FD	1	1	mg/L	183	183	n/a	1000	NM GW	0	500	0	127	Intermediate	1	—
	R-37	P1A	929.3	n/a	11	11	mg/L	175.18	187	n/a	1000	NM GW	0	500	0	127	Intermediate	11	—
	R-37	P2A	1026	FD	1	1	mg/L	129	129	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-37	P2A	1026	n/a	10	10	mg/L	140.3	145	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-38	Single	821.2	FD	4	4	mg/L	133.5	147	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	137.7	152	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	115	115	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	133.27	144	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-40	P1A	751.6	n/a	8	8	mg/L	162.88	174	n/a	1000	NM GW	0	500	0	127	Intermediate	8	—
	R-40	P2A	849.3	FD	2	2	mg/L	134	140	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	141.33	158	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	162	191	n/a	1000	NM GW	0	500	0	127	Intermediate	6	—
	R-41	P2A	965.3	FD	2	2	mg/L	150.5	151	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	148.7	167	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	149.78	163	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	148.56	222	n/a	1000	NM GW	0	500	0	191.68	Regional	1	—
	R-51	P1A	914.96	n/a	6	6	mg/L	129.33	139	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	140.5	153	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	139.4	147	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	143.4	170	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	132.4	144	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	141	156	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	131	141	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	148.67	165	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	135.33	146	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	159.67	163	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	mg/L	151	154	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	218	218	n/a	1000	NM GW	0	500	0	127	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	mg/L	137.33	144	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	138.67	148	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	128.5	137	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	142	157	n/a	1000	NM GW	0	500	0	191.68	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Total Kjeldahl Nitrogen	R-20	MP1A	904.6	n/a	5	5	mg/L	0.5802	1.01	0.1	—	—	—	—	—	0.1	Regional	5	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	1.145	2.33	0.1	—	—	—	—	—	0.1	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	0.7364	1.8	0.1	—	—	—	—	—	0.1	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	n/a	9	3	mg/L	0.1493	0.344	0.1	—	—	—	—	—	0.1	Regional	1	—
	R-22	MP1A	907.1	n/a	5	5	mg/L	1.1788	1.62	0.1	—	—	—	—	—	0.1	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	8	4	mg/L	0.215	0.28	0.1	—	—	—	—	—	0.1	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	0.91	0.91	0.1	—	—	—	—	—	0.1	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	9	8	mg/L	0.6553	1.7	0.1	—	—	—	—	—	0.1	Regional	6	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	1.02	1.02	0.1	—	—	—	—	—	0.1	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	4	mg/L	1.5325	2.3	0.1	—	—	—	—	—	0.1	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	1.11	1.11	0.1	—	—	—	—	—	0.1	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	mg/L	1.133	1.9	0.1	—	—	—	—	—	0.1	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	6	1	mg/L	0.01	0.01	0.1	—	—	—	—	—	0.1	Regional	0	—
	R-23	Single	816	n/a	10	6	mg/L	0.2122	0.475	0.1	—	—	—	—	—	0.1	Regional	5	—
	R-32	MP1A	870.9	n/a	7	4	mg/L	0.2565	0.52	0.1	—	—	—	—	—	0.1	Regional	3	—
	R-32	MP3A	976	n/a	9	9	mg/L	0.3732	1.05	0.1	—	—	—	—	—	0.1	Regional	6	Screen plugged and abandoned because of residual effects of drilling products.
Total Organic Carbon	R-22	MP2A	962.8	n/a	1	1	mg/L	0.29	0.29	1	—	—	—	—	—	0.46	Regional	0	R-22 is off-line and will undergo rehabilitation.
Total Phosphate as Phosphorus	R-20	MP1A	904.6	n/a	5	5	mg/L	0.283	0.403	0.05	—	—	—	—	—	0.16	Regional	5	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	0.6418	0.693	0.05	—	—	—	—	—	0.16	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	1.3458	1.94	0.05	—	—	—	—	—	0.16	Regional	4	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	7	mg/L	0.0859	0.249	0.05	—	—	—	—	—	0.16	Regional	1	—
	R-20	P2A	1147.1	n/a	13	5	mg/L	0.6618	2.95	0.05	—	—	—	—	—	0.16	Regional	2	—
	R-21	Single	888.8	n/a	24	7	mg/L	0.1063	0.277	0.05	—	—	—	—	—	0.16	Regional	1	—
	R-22	MP1A	907.1	n/a	3	1	mg/L	0.15	0.15	0.05	—	—	—	—	—	0.16	Regional	0	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Total Phosphate as Phosphorus (continued)	R-22	MP2A	962.8	n/a	14	4	mg/L	0.103	0.257	0.05	—	—	—	—	—	0.16	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	10	4	mg/L	0.053	0.11	0.05	—	—	—	—	—	0.16	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	1	mg/L	0.14	0.14	0.05	—	—	—	—	—	0.16	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	0.18	0.18	0.05	—	—	—	—	—	0.16	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	3	2	mg/L	0.1	0.18	0.05	—	—	—	—	—	0.16	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	1	mg/L	0.151	0.151	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-23	Single	816	n/a	25	5	mg/L	0.0804	0.132	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-23i	P1A	400.3	n/a	14	4	mg/L	0.1773	0.434	0.05	—	—	—	—	—	0.08	Intermediate	3	—
	R-23i	P2A	470.2	FD	2	1	mg/L	0.035	0.035	0.05	—	—	—	—	—	0.08	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	6	mg/L	0.1055	0.194	0.05	—	—	—	—	—	0.08	Intermediate	3	—
	R-23i	P3A	524	n/a	14	4	mg/L	0.0523	0.105	0.05	—	—	—	—	—	0.08	Intermediate	1	—
	R-32	MP1A	870.9	n/a	9	2	mg/L	0.0325	0.046	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-32	MP3A	976	n/a	9	9	mg/L	2.0456	3.16	0.05	—	—	—	—	—	0.16	Regional	9	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	1	mg/L	0.032	0.032	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-32	Single	867.5	n/a	15	5	mg/L	0.0892	0.259	0.05	—	—	—	—	—	0.16	Regional	1	—
	R-37	P1A	929.3	n/a	10	2	mg/L	0.0325	0.034	0.05	—	—	—	—	—	0.08	Intermediate	0	—
	R-37	P2A	1026	n/a	9	1	mg/L	0.0381	0.0381	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-38	Single	821.2	FD	4	1	mg/L	0.034	0.034	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-38	Single	821.2	n/a	10	2	mg/L	0.128	0.211	0.05	—	—	—	—	—	0.16	Regional	1	—
	R-39	Single	859	n/a	11	4	mg/L	0.043	0.064	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-40	P1A	751.6	n/a	7	2	mg/L	0.049	0.053	0.05	—	—	—	—	—	0.08	Intermediate	0	—
	R-40	P2A	849.3	n/a	9	1	mg/L	0.029	0.029	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-40	R-40i	649.7	n/a	7	4	mg/L	0.074	0.116	0.05	—	—	—	—	—	0.08	Intermediate	2	—
	R-41	P2A	965.3	n/a	10	3	mg/L	0.0609	0.116	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-49	P1A	845	n/a	9	2	mg/L	0.058	0.065	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-49	P2A	905.6	n/a	9	3	mg/L	0.0543	0.076	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-52	P1A	1035.2	n/a	5	2	mg/L	0.0375	0.044	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-52	P2A	1107	n/a	5	2	mg/L	0.068	0.108	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-53	P1A	849.2	n/a	5	1	mg/L	0.038	0.038	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-54	P1A	830	n/a	6	2	mg/L	0.0415	0.049	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-54	P2A	915	n/a	6	2	mg/L	0.026	0.037	0.05	—	—	—	—	—	0.16	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Total Phosphate as Phosphorus (continued)	R-55	P1A	860	n/a	3	1	mg/L	0.064	0.064	0.05	—	—	—	—	—	0.16	Regional	0	—
	R-56	P1A	945	n/a	3	1	mg/L	0.033	0.033	0.05	—	—	—	—	—	0.16	Regional	0	—
General Inorganic Not Filtered																			
Alkalinity-CO3	R-22	MP3A	1273.5	n/a	5	5	mg/L	5.03	9.23	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	1	mg/L	0.879	0.879	1	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	2	1	mg/L	0.733	0.733	1	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	2	2	mg/L	2.49	3.04	1	—	—	—	—	—	—	—	—	—
Alkalinity-CO3+HCO3	R-21	Single	888.8	FD	1	1	mg/L	58.4	58.4	1	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	2	2	mg/L	58.45	58.5	1	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	3	3	mg/L	190.67	289	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	5	5	mg/L	65.72	75.7	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	5	5	mg/L	131.52	280	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	mg/L	233.67	248	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	mg/L	141	147	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	2	mg/L	68.1	68.7	1	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	2	2	mg/L	68.35	68.7	1	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	2	2	mg/L	73.05	74	1	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	2	2	mg/L	57.4	58.1	1	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Alkalinity-HCO3	R-22	MP1A	907.1	n/a	3	3	mg/L	190.67	289	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	3	3	mg/L	67.5	75.3	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	3	3	mg/L	148.63	271	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	mg/L	233	247	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	mg/L	140	146	1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
Ammonia as Nitrogen	R-20	MP1A	904.6	n/a	4	4	mg/L	0.3498	0.451	0.05	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	4	mg/L	0.6565	0.772	0.05	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	4	4	mg/L	0.3695	0.484	0.05	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Ammonia as Nitrogen (continued)	R-22	MP1A	907.1	n/a	2	2	mg/L	0.935	1.05	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	3	1	mg/L	0.021	0.021	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	2	2	mg/L	0.56	0.72	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	mg/L	0.4445	0.54	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	1	mg/L	0.089	0.089	0.05	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	5	2	mg/L	0.0365	0.043	0.05	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	5	1	mg/L	0.105	0.105	0.05	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	6	5	mg/L	0.2232	0.375	0.05	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Calcium	R-20	MP1A	904.6	n/a	5	5	mg/L	3.506	3.93	0.2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	36.52	43.3	0.2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	14.08	20.9	0.2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	11.4	12.8	0.2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	mg/L	13.3	14.3	0.2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	mg/L	13.162	15	0.2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	mg/L	11.6	11.8	0.2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	25	mg/L	11.58	12.6	0.2	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	7	mg/L	66.586	74.9	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	19	mg/L	11.179	11.9	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	17.1	17.1	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	16	mg/L	17.103	33	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	43.3	43.3	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	mg/L	42.829	55	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	37.3	37.3	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	mg/L	35.243	39	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	16.558	17	0.2	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	25	mg/L	16.856	17.7	0.2	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Calcium (continued)	R-23i	P1A	400.3	FD	1	1	mg/L	21.7	21.7	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	28.107	40.5	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	mg/L	20.55	21.3	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	20.732	23.2	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	mg/L	20.15	20.5	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	16	mg/L	22.025	39.7	0.2	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	16.411	17.2	0.2	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	9	mg/L	10.978	11.7	0.2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	16.133	16.5	0.2	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	mg/L	16.307	18.4	0.2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	mg/L	25	25	0.2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	mg/L	24.72	26.4	0.2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	mg/L	11.8	11.8	0.2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	mg/L	14.144	21.4	0.2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	mg/L	12.525	13	0.2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	mg/L	12.62	13.3	0.2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	mg/L	12.4	12.4	0.2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	mg/L	12.764	14.6	0.2	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	mg/L	21.25	24.6	0.2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	mg/L	11.15	11.4	0.2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	mg/L	11.378	12.5	0.2	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	18.143	19.6	0.2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	mg/L	14.65	15.1	0.2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	mg/L	13.956	15.9	0.2	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	mg/L	13.156	15.9	0.2	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	9	mg/L	12.389	13.9	0.2	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	mg/L	11.8	12.6	0.2	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	mg/L	10.717	11.4	0.2	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	13.22	14.6	0.2	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	5	mg/L	11.14	11.4	0.2	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	mg/L	10.566	11.2	0.2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	mg/L	10.95	11.2	0.2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	mg/L	10.58	11.3	0.2	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	mg/L	11.352	14.6	0.2	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	mg/L	11.55	12.3	0.2	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	mg/L	17.467	17.8	0.2	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Calcium (continued)	R-55	P2A	994.4	n/a	3	3	mg/L	17.6	18.2	0.2	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	mg/L	35	35.8	0.2	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	mg/L	12.633	13.4	0.2	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	12.2	12.5	0.2	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	mg/L	12.9	13.3	0.2	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	mg/L	12.9	13.3	0.2	—	—	—	—	—	—	—	—	—
Chemical Oxygen Demand	R-22	MP3A	1273.5	n/a	1	1	mg/L	3.17	3.17	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	1	1	mg/L	21.5	21.5	n/a	—	—	—	—	—	—	—	—	—
Chloride	R-21	Single	888.8	FD	1	1	mg/L	1.97	1.97	0.2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	2	2	mg/L	1.93	1.98	0.2	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	3	3	mg/L	3.8367	4.1	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	5	5	mg/L	2.622	2.7	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	5	5	mg/L	4.458	4.66	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	mg/L	8.4233	9.08	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	mg/L	2.915	2.97	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	2	mg/L	3.715	3.74	0.2	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	2	2	mg/L	3.73	3.76	0.2	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	2	2	mg/L	2.845	2.86	0.2	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	2	2	mg/L	1.95	1.97	0.2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Cyanide (Total)	R-20	MP1A	904.6	n/a	4	1	mg/L	0.0031	0.0031	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	2	mg/L	0.0043	0.0055	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	4	1	mg/L	0.0068	0.0068	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-22	MP1A	907.1	n/a	7	1	mg/L	0.0024	0.0024	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	14	1	mg/L	0.0025	0.0025	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	12	1	mg/L	0.0019	0.0019	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	0.0053	0.0053	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	3	mg/L	0.0057	0.0111	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Cyanide (Total) (continued)	R-23	Single	816	FD	10	1	mg/L	0.004	0.004	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	—
	R-23i	P2A	470.2	n/a	13	1	mg/L	0.0048	0.0048	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	—
	R-23i	P3A	524	FD	2	1	mg/L	0.002	0.002	0.005	0.2	EPA MCL	0	0.1	0	—	—	—	—
Fluoride	R-21	Single	888.8	FD	1	1	mg/L	0.303	0.303	0.1	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	2	2	mg/L	0.2835	0.303	0.1	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	3	3	mg/L	0.3053	0.361	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	5	5	mg/L	0.288	0.314	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	5	5	mg/L	0.4518	0.479	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	mg/L	0.602	0.628	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	mg/L	0.293	0.302	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	2	mg/L	0.3765	0.383	0.1	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	2	2	mg/L	0.38	0.388	0.1	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	2	2	mg/L	0.3	0.335	0.1	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	2	2	mg/L	0.5555	0.618	0.1	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Hardness	R-20	MP1A	904.6	n/a	1	1	mg/L	11.2	11.2	2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	1	1	mg/L	105	105	2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	1	1	mg/L	37.3	37.3	2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	37.385	41.5	2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	mg/L	43.767	47.4	2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	mg/L	43.731	50	2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	mg/L	40.367	41.5	2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	21	21	mg/L	41.295	45.2	2	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	4	4	mg/L	264.75	277	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	15	15	mg/L	47.373	50.1	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	64.6	64.6	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	12	12	mg/L	61.192	74.5	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	4	4	mg/L	137	157	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Hardness (continued)	R-22	MP5A	1448.2	n/a	3	3	mg/L	109	111	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	58.217	60	2	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	21	21	mg/L	58.705	61.6	2	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	mg/L	79.4	79.4	2	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	111.21	159	2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	mg/L	75.3	77.4	2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	75.395	84.5	2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	mg/L	73.8	75.3	2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	16	mg/L	79.981	138	2	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	5	5	mg/L	61.38	64.3	2	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	5	5	mg/L	39.4	39.9	2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	59.35	61	2	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	mg/L	60.613	66.7	2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	mg/L	86.2	86.2	2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	mg/L	84.96	90.9	2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	mg/L	41.3	41.3	2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	mg/L	49.056	73	2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	mg/L	46.275	48.3	2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	mg/L	46.55	49.4	2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	mg/L	45.8	45.8	2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	mg/L	46.473	52.8	2	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	mg/L	80.038	89.5	2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	mg/L	39.7	40.3	2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	mg/L	41.144	48	2	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	76.871	83.5	2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	mg/L	52.9	54.5	2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	mg/L	50.51	57.4	2	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	mg/L	48.933	60.4	2	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	9	mg/L	45.1	50.5	2	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	mg/L	40.9	43.7	2	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	mg/L	38.467	41.2	2	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	45.92	49.1	2	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	5	mg/L	39.68	40.5	2	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	mg/L	39.1	41	2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	mg/L	40.6	41.5	2	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Hardness (continued)	R-53	P2A	959.7	n/a	5	5	mg/L	39.04	41.8	2	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	mg/L	46.4	59.7	2	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	mg/L	41.517	43.2	2	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	mg/L	61.167	62.2	2	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	mg/L	61.833	64	2	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	mg/L	124.5	127	2	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	mg/L	46.9	50.9	2	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	45.333	46.8	2	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	mg/L	46.3	47.9	2	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	mg/L	46.45	47.4	2	—	—	—	—	—	—	—	—	—
Magnesium	R-20	MP1A	904.6	n/a	5	5	mg/L	0.467	0.549	0.3	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	3.826	4.32	0.3	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	3.788	5.54	0.3	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	2.1623	2.34	0.3	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	mg/L	2.5767	2.81	0.3	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	mg/L	2.6446	3.07	0.3	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	mg/L	2.94	3	0.3	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	25	mg/L	3.0024	3.32	0.3	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	7	mg/L	18.557	21.8	0.3	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	19	mg/L	4.6211	5.13	0.3	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	4.65	4.65	0.3	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	16	mg/L	5.0763	11	0.3	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	11.5	11.5	0.3	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	mg/L	11.391	14	0.3	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	5.82	5.82	0.3	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	mg/L	6.0229	6.37	0.3	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	4.1133	4.27	0.3	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	25	mg/L	4.1708	4.63	0.3	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	mg/L	6.14	6.14	0.3	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	9.99	14.1	0.3	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Magnesium (continued)	R-23i	P2A	470.2	FD	2	2	mg/L	5.82	5.9	0.3	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	5.7342	6.44	0.3	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	mg/L	5.715	5.86	0.3	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	16	mg/L	6.07	9.54	0.3	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	4.9644	5.2	0.3	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	9	mg/L	3.1956	3.39	0.3	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	4.6367	4.84	0.3	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	mg/L	4.832	5.07	0.3	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	mg/L	5.78	5.78	0.3	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	mg/L	5.639	6.05	0.3	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	mg/L	2.87	2.87	0.3	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	mg/L	3.3444	4.77	0.3	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	mg/L	3.645	3.84	0.3	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	mg/L	3.654	3.95	0.3	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	mg/L	3.59	3.59	0.3	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	mg/L	3.5527	3.99	0.3	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	mg/L	6.555	7.5	0.3	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	mg/L	2.88	2.88	0.3	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	mg/L	3.09	4.08	0.3	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	7.6614	8.38	0.3	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	mg/L	3.975	4.09	0.3	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	mg/L	3.808	4.28	0.3	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	mg/L	3.9067	5.04	0.3	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	9	mg/L	3.4322	3.83	0.3	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	mg/L	2.7783	2.95	0.3	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	mg/L	2.8467	3.08	0.3	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	3.154	3.52	0.3	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	5	mg/L	2.884	2.94	0.3	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	mg/L	3.09	3.22	0.3	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	mg/L	3.195	3.27	0.3	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	mg/L	3.062	3.3	0.3	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	mg/L	4.38	5.66	0.3	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	mg/L	3.0817	3.27	0.3	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	mg/L	4.2433	4.36	0.3	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	mg/L	4.3233	4.47	0.3	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	mg/L	8.95	9.09	0.3	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Magnesium (continued)	R-56	P1A	945	n/a	3	3	mg/L	3.7267	4.24	0.3	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	3.5933	3.76	0.3	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	mg/L	3.42	3.53	0.3	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	mg/L	3.46	3.47	0.3	—	—	—	—	—	—	—	—	—
Nitrate-Nitrite as Nitrogen	R-21	Single	888.8	FD	1	1	mg/L	0.301	0.301	0.25	10	EPA MCL	0	5	0	—	—	—	—
	R-21	Single	888.8	n/a	6	6	mg/L	0.3175	0.39	0.25	10	EPA MCL	0	5	0	—	—	—	—
	R-22	MP2A	962.8	n/a	5	5	mg/L	0.686	0.781	0.25	10	EPA MCL	0	5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	5	5	mg/L	0.463	0.641	0.25	10	EPA MCL	0	5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	2	mg/L	1.425	1.47	0.25	10	EPA MCL	0	5	0	—	—	—	—
	R-23	Single	816	n/a	6	6	mg/L	1.0717	1.47	0.25	10	EPA MCL	0	5	0	—	—	—	—
	R-32	MP1A	870.9	n/a	6	6	mg/L	0.6527	1	0.25	10	EPA MCL	0	5	0	—	—	—	—
	R-32	MP3A	976	n/a	3	1	mg/L	0.0304	0.0304	0.25	10	EPA MCL	0	5	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Perchlorate	R-21	Single	888.8	n/a	4	4	µg/L	0.2688	0.299	0.2	4	NM GW	0	2	0	0.05	Regional	4	—
	R-22	MP2A	962.8	n/a	1	1	µg/L	0.317	0.317	0.2	4	NM GW	0	2	0	0.05	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	1	1	µg/L	0.205	0.205	0.2	4	NM GW	0	2	0	0.05	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	4	4	µg/L	0.3318	0.409	0.2	4	NM GW	0	2	0	0.05	Regional	4	—
	R-32	MP1A	870.9	n/a	4	4	µg/L	0.2668	0.315	0.2	4	NM GW	0	2	0	0.05	Regional	4	—
pH	R-21	Single	888.8	FD	1	1	SU	8.08	8.08	n/a	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	2	2	SU	8.005	8.13	n/a	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	3	3	SU	6.7967	6.99	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	5	5	SU	7.878	8.09	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	5	5	SU	8.62	8.91	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	SU	7.26	7.6	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	SU	7.485	7.52	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	2	SU	8.01	8.19	n/a	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	2	2	SU	8.055	8.06	n/a	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	2	2	SU	8.415	8.51	n/a	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	2	2	SU	7.29	7.31	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Potassium	R-20	MP1A	904.6	n/a	5	5	mg/L	3.544	3.82	0.15	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	3.79	3.98	0.15	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	2.608	3.13	0.15	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	2.5954	2.94	0.15	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	mg/L	2.3967	2.51	0.15	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	mg/L	2.4092	2.65	0.15	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	mg/L	1.62	1.64	0.15	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	25	mg/L	1.688	1.82	0.15	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	7	mg/L	4.38	4.66	0.15	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	19	mg/L	2.5316	3.2	0.15	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	6.85	6.85	0.15	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	16	mg/L	6.39	10	0.15	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	4.59	4.59	0.15	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	mg/L	4.6071	5.7	0.15	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	4.53	4.53	0.15	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	mg/L	4.4229	5.07	0.15	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	1.8208	2.18	0.15	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	25	mg/L	1.842	2.03	0.15	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	mg/L	2.47	2.47	0.15	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	3.7929	5.51	0.15	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	mg/L	2.58	2.6	0.15	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	2.5821	3.06	0.15	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	mg/L	2.57	2.6	0.15	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	16	mg/L	2.6631	3.95	0.15	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	1.6944	1.76	0.15	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	9	mg/L	1.5567	1.64	0.15	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	1.6833	1.78	0.15	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	mg/L	1.7187	1.85	0.15	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	mg/L	1.89	1.89	0.15	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Potassium (continued)	R-37	P1A	929.3	n/a	10	10	mg/L	1.891	2.17	0.15	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	mg/L	1.83	1.83	0.15	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	mg/L	1.87	2.14	0.15	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	mg/L	1.585	1.66	0.15	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	mg/L	1.541	1.64	0.15	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	mg/L	1.4	1.4	0.15	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	mg/L	1.4618	1.9	0.15	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	mg/L	1.77	2.05	0.15	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	mg/L	1.525	1.57	0.15	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	mg/L	1.5656	1.69	0.15	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	1.8671	2.19	0.15	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	mg/L	1.985	2	0.15	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	mg/L	1.7098	2.06	0.15	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	mg/L	1.7844	2.33	0.15	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	9	mg/L	1.4467	1.66	0.15	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	mg/L	1.525	1.63	0.15	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	mg/L	1.6817	1.78	0.15	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	1.876	1.95	0.15	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	5	mg/L	1.708	1.83	0.15	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	mg/L	1.612	1.7	0.15	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	mg/L	1.775	1.81	0.15	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	mg/L	1.668	1.77	0.15	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	mg/L	1.805	2.07	0.15	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	mg/L	1.83	2.02	0.15	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	mg/L	1.7033	1.79	0.15	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	mg/L	1.84	1.94	0.15	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	mg/L	2.32	2.4	0.15	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	mg/L	1.55	1.81	0.15	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	1.79	1.98	0.15	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	mg/L	1.465	1.52	0.15	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	mg/L	1.475	1.53	0.15	—	—	—	—	—	—	—	—	—
Silicon Dioxide	R-20	MP1A	904.6	n/a	5	5	mg/L	44.44	56.3	0.1	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	51.26	68.2	0.1	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	50.64	70.2	0.1	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	FD	2	2	mg/L	70.5	70.6	0.1	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	7	7	mg/L	52.443	72.1	0.1	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Silicon Dioxide (continued)	R-22	MP1A	907.1	n/a	6	6	mg/L	42.433	57.2	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	8	8	mg/L	58.55	70.5	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	44.5	44.5	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	7	7	mg/L	37.457	55.6	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	25.9	25.9	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	6	6	mg/L	49.467	64.2	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	22.3	22.3	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	mg/L	42.64	59.2	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	3	3	mg/L	64.433	66	0.1	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	7	7	mg/L	52.171	65.4	0.1	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	7	7	mg/L	54.143	68.1	0.1	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	7	7	mg/L	70	84.3	0.1	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Sodium	R-20	MP1A	904.6	n/a	5	5	mg/L	54.28	65.6	0.2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	mg/L	81.16	99.8	0.2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	mg/L	21.64	25.9	0.2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	mg/L	15.838	20.7	0.2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	mg/L	12.133	13	0.2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	mg/L	12.485	13.9	0.2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	mg/L	9.9033	10.2	0.2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	25	mg/L	10.173	11	0.2	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	7	mg/L	24.486	26.2	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	19	mg/L	11.179	12.6	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	mg/L	21.5	21.5	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	16	mg/L	23.919	60	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	42.9	42.9	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Sodium (continued)	R-22	MP4A	1378	n/a	7	7	mg/L	45.257	55.7	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	18.7	18.7	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	mg/L	17.786	20.7	0.2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	mg/L	11.283	11.8	0.2	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	25	mg/L	11.256	12	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	mg/L	15.4	15.4	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	mg/L	17.336	32.7	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	mg/L	13.7	14	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	mg/L	60.616	903	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	mg/L	10.55	10.9	0.2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	16	mg/L	11.036	13.1	0.2	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	9	mg/L	11.111	11.6	0.2	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	9	mg/L	10.45	11.2	0.2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	10.717	11	0.2	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	mg/L	10.913	11.4	0.2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	mg/L	14.7	14.7	0.2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	mg/L	15.59	16.6	0.2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	mg/L	11.2	11.2	0.2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	mg/L	13.133	16.2	0.2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	mg/L	10.975	11.3	0.2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	mg/L	10.94	11.8	0.2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	mg/L	10.9	10.9	0.2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	mg/L	11.216	14.1	0.2	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	mg/L	13.45	14.7	0.2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	mg/L	10.9	11.5	0.2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	mg/L	11.789	15.8	0.2	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	21.157	23.4	0.2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	mg/L	13.75	13.9	0.2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	mg/L	13.92	18.6	0.2	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	mg/L	17.333	21.1	0.2	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	9	mg/L	10.976	13.8	0.2	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	mg/L	12.183	14.8	0.2	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	mg/L	14.783	17	0.2	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	13.56	14.4	0.2	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Sodium (continued)	R-52	P2A	1107	n/a	5	5	mg/L	11.42	13.6	0.2	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	mg/L	11.1	11.6	0.2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	mg/L	10.125	10.3	0.2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	mg/L	10.19	11.5	0.2	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	mg/L	17.367	19.7	0.2	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	mg/L	10.462	10.9	0.2	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	mg/L	11.533	12	0.2	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	mg/L	11.933	12.7	0.2	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	mg/L	12.9	13.2	0.2	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	mg/L	10.41	10.8	0.2	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	mg/L	11.367	11.7	0.2	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	mg/L	11	11.2	0.2	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	mg/L	11.95	12.6	0.2	—	—	—	—	—	—	—	—	—
Specific Conductance	R-21	Single	888.8	FD	1	1	µS/cm	123	123	n/a	—	—	—	—	—	287.21	Regional	0	—
	R-21	Single	888.8	n/a	2	2	µS/cm	125	126	n/a	—	—	—	—	—	287.21	Regional	0	—
	R-22	MP1A	907.1	n/a	3	3	µS/cm	562	627	n/a	—	—	—	—	—	287.21	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	5	5	µS/cm	143.4	150	n/a	—	—	—	—	—	287.21	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	5	5	µS/cm	209.6	224	n/a	—	—	—	—	—	287.21	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	µS/cm	445.67	478	n/a	—	—	—	—	—	287.21	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	µS/cm	287	306	n/a	—	—	—	—	—	287.21	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	2	µS/cm	169.5	171	n/a	—	—	—	—	—	287.21	Regional	0	—
	R-23	Single	816	n/a	2	2	µS/cm	170	170	n/a	—	—	—	—	—	287.21	Regional	0	—
	R-32	MP1A	870.9	n/a	2	2	µS/cm	195	219	n/a	—	—	—	—	—	287.21	Regional	0	—
	R-32	MP3A	976	n/a	2	2	µS/cm	128	130	n/a	—	—	—	—	—	287.21	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
Sulfate	R-21	Single	888.8	FD	1	1	mg/L	2.51	2.51	0.4	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	2	2	mg/L	2.36	2.54	0.4	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	3	2	mg/L	0.408	0.428	0.4	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	5	5	mg/L	3.37	3.51	0.4	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	5	5	mg/L	6.55	7.53	0.4	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Sulfate (continued)	R-22	MP4A	1378	n/a	3	3	mg/L	1.38	1.67	0.4	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	mg/L	0.5775	0.688	0.4	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	2	2	mg/L	5.41	5.47	0.4	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	2	2	mg/L	5.43	5.49	0.4	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	2	2	mg/L	4.88	5	0.4	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	2	2	mg/L	1.455	1.61	0.4	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Suspended Sediment Concentration	R-20	MP1A	904.6	n/a	1	1	mg/L	8	8	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	1	1	mg/L	1.2	1.2	n/a	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	1	1	mg/L	4	4	n/a	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-22	MP1A	907.1	n/a	2	2	mg/L	40.85	47	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	3	1	mg/L	1.6	1.6	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	3	1	mg/L	0.4	0.4	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	2	2	mg/L	7.75	11.5	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	1	1	mg/L	1.03	1.03	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	1	1	mg/L	7.2	7.2	n/a	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	1	1	mg/L	1000	1000	n/a	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	1	1	mg/L	2.4	2.4	n/a	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	2	2	mg/L	4.6	4.8	n/a	—	—	—	—	—	—	—	—	—
Total Kjeldahl Nitrogen	R-20	MP1A	904.6	n/a	4	4	mg/L	0.5665	0.729	0.1	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	4	mg/L	1.5135	3.55	0.1	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	4	4	mg/L	1.2913	3.54	0.1	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	14	3	mg/L	0.0403	0.057	0.1	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	14	2	mg/L	0.109	0.182	0.1	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	23	5	mg/L	0.135	0.425	0.1	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	3	3	mg/L	0.3447	0.483	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	7	4	mg/L	0.1655	0.283	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	24	6	mg/L	0.2053	0.596	0.1	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Total Kjeldahl Nitrogen (continued)	R-23i	P1A	400.3	FD	1	1	mg/L	0.175	0.175	0.1	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	1	mg/L	0.111	0.111	0.1	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	18	2	mg/L	0.077	0.08	0.1	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	15	2	mg/L	0.054	0.054	0.1	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	8	3	mg/L	1.4457	3.98	0.1	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	8	7	mg/L	0.4321	1.2	0.1	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	n/a	15	1	mg/L	0.031	0.031	0.1	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	11	1	mg/L	0.045	0.045	0.1	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	1	mg/L	2.51	2.51	0.1	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	6	2	mg/L	0.1075	0.173	0.1	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	1	mg/L	0.062	0.062	0.1	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	5	mg/L	0.1838	0.34	0.1	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	1	mg/L	0.035	0.035	0.1	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	3	mg/L	0.2987	0.747	0.1	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	1	mg/L	0.033	0.033	0.1	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	2	mg/L	0.0625	0.079	0.1	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	1	mg/L	0.16	0.16	0.1	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	1	mg/L	0.048	0.048	0.1	—	—	—	—	—	—	—	—	—
Total Organic Carbon	R-20	MP1A	904.6	FD	1	1	mg/L	16.2	16.2	1	—	—	—	—	—	0.33	Regional	1	Before well rehabilitation.
	R-20	MP1A	904.6	n/a	4	4	mg/L	19.15	32.4	1	—	—	—	—	—	0.33	Regional	4	Before well rehabilitation.
	R-20	MP2A	1147.1	FD	2	2	mg/L	38.15	39.4	1	—	—	—	—	—	0.33	Regional	2	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	4	mg/L	42.85	51.7	1	—	—	—	—	—	0.33	Regional	4	Before well rehabilitation.
	R-20	MP3A	1330	FD	1	1	mg/L	5.02	5.02	1	—	—	—	—	—	0.33	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	MP3A	1330	n/a	4	4	mg/L	3.4725	5.13	1	—	—	—	—	—	0.33	Regional	4	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	12	11	mg/L	1.1706	3.51	1	—	—	—	—	—	0.33	Regional	11	—
	R-20	P2A	1147.1	FD	3	3	mg/L	2.1767	2.23	1	—	—	—	—	—	0.33	Regional	3	—
	R-20	P2A	1147.1	n/a	12	10	mg/L	1.956	2.53	1	—	—	—	—	—	0.33	Regional	10	—
	R-21	Single	888.8	FD	4	1	mg/L	0.431	0.431	1	—	—	—	—	—	0.33	Regional	1	—
	R-21	Single	888.8	n/a	24	15	mg/L	0.5659	0.792	1	—	—	—	—	—	0.33	Regional	15	—
	R-22	MP1A	907.1	n/a	6	6	mg/L	7.5017	11	1	—	—	—	—	—	0.33	Regional	6	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	17	11	mg/L	0.5047	0.885	1	—	—	—	—	—	0.33	Regional	8	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Total Organic Carbon (continued)	R-22	MP3A	1273.5	n/a	13	12	mg/L	1.6674	4.11	1	—	—	—	—	—	0.33	Regional	11	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	mg/L	18	18	1	—	—	—	—	—	0.33	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	6	mg/L	18.5	23	1	—	—	—	—	—	0.33	Regional	6	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	mg/L	4.98	4.98	1	—	—	—	—	—	0.33	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	6	6	mg/L	5.69	13	1	—	—	—	—	—	0.33	Regional	6	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	9	mg/L	1.1248	2.44	1	—	—	—	—	—	0.33	Regional	9	—
	R-23	Single	816	n/a	23	18	mg/L	1.1202	2.62	1	—	—	—	—	—	0.33	Regional	18	—
	R-23i	P1A	400.3	FD	1	1	mg/L	1.58	1.58	1	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	13	13	mg/L	1.0176	2.01	1	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	1	mg/L	0.853	0.853	1	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	18	16	mg/L	1.0334	1.71	1	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	1	mg/L	0.762	0.762	1	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	15	13	mg/L	0.9438	1.72	1	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	7	5	mg/L	0.4374	0.495	1	—	—	—	—	—	0.33	Regional	5	—
	R-32	MP3A	976	n/a	7	6	mg/L	0.6457	0.757	1	—	—	—	—	—	0.33	Regional	6	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	mg/L	1.891	4.87	1	—	—	—	—	—	0.33	Regional	6	—
	R-32	Single	867.5	n/a	14	14	mg/L	1.3045	4.3	1	—	—	—	—	—	0.33	Regional	14	—
	R-37	P1A	929.3	FD	1	1	mg/L	0.841	0.841	1	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	mg/L	0.8778	1.31	1	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	mg/L	0.784	0.784	1	—	—	—	—	—	0.33	Regional	1	—
	R-37	P2A	1026	n/a	9	6	mg/L	0.5222	0.771	1	—	—	—	—	—	0.33	Regional	6	—
	R-38	Single	821.2	FD	4	4	mg/L	0.59	0.703	1	—	—	—	—	—	0.33	Regional	4	—
	R-38	Single	821.2	n/a	10	10	mg/L	0.7243	1.44	1	—	—	—	—	—	0.33	Regional	10	—
	R-39	Single	859	n/a	10	5	mg/L	0.4868	0.724	1	—	—	—	—	—	0.33	Regional	5	—
	R-40	P1A	751.6	n/a	6	6	mg/L	2.0735	3.24	1	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	1	mg/L	0.539	0.539	1	—	—	—	—	—	0.33	Regional	1	—
	R-40	P2A	849.3	n/a	8	8	mg/L	0.6664	1.6	1	—	—	—	—	—	0.33	Regional	8	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	11.954	14.7	1	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	9	4	mg/L	0.6123	0.895	1	—	—	—	—	—	0.33	Regional	4	—
	R-49	P1A	845	n/a	8	8	mg/L	1.3626	3.54	1	—	—	—	—	—	0.33	Regional	8	—
	R-49	P2A	905.6	n/a	8	3	mg/L	0.665	0.738	1	—	—	—	—	—	0.33	Regional	3	—
	R-51	P1A	914.96	n/a	6	5	mg/L	0.488	0.702	1	—	—	—	—	—	0.33	Regional	5	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Total Organic Carbon (continued)	R-51	P2A	1031	n/a	6	6	mg/L	0.6232	0.953	1	—	—	—	—	—	0.33	Regional	6	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	0.7656	1.52	1	—	—	—	—	—	0.33	Regional	5	—
	R-52	P2A	1107	n/a	5	4	mg/L	0.4628	0.586	1	—	—	—	—	—	0.33	Regional	4	—
	R-53	P1A	849.2	n/a	5	5	mg/L	0.5424	0.847	1	—	—	—	—	—	0.33	Regional	5	—
	R-53	P2A	959.7	FD	2	1	mg/L	0.366	0.366	1	—	—	—	—	—	0.33	Regional	1	—
	R-53	P2A	959.7	n/a	5	2	mg/L	0.557	0.746	1	—	—	—	—	—	0.33	Regional	2	—
	R-54	P1A	830	n/a	6	6	mg/L	2.1873	7.02	1	—	—	—	—	—	0.33	Regional	6	—
	R-54	P2A	915	n/a	6	6	mg/L	0.6097	0.961	1	—	—	—	—	—	0.33	Regional	6	—
	R-55	P1A	860	n/a	3	3	mg/L	0.8397	1.11	1	—	—	—	—	—	0.33	Regional	3	—
	R-55	P2A	994.4	n/a	3	1	mg/L	0.464	0.464	1	—	—	—	—	—	0.33	Regional	1	—
	R-55i	Single	510	n/a	2	2	mg/L	2.51	2.64	1	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	mg/L	0.885	1.44	1	—	—	—	—	—	0.33	Regional	3	—
	R-56	P2A	1046.6	n/a	3	2	mg/L	0.653	0.933	1	—	—	—	—	—	0.33	Regional	2	—
	R-57	P1A	910	n/a	2	2	mg/L	0.5825	0.693	1	—	—	—	—	—	0.33	Regional	2	—
	R-57	P2A	971.5	n/a	2	2	mg/L	0.445	0.537	1	—	—	—	—	—	0.33	Regional	2	—
Total Phosphate as Phosphorus	R-20	MP1A	904.6	n/a	4	4	mg/L	0.2783	0.316	0.05	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	4	mg/L	0.807	0.823	0.05	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	4	4	mg/L	1.9125	2.08	0.05	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	n/a	6	2	mg/L	0.067	0.121	0.05	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	3	3	mg/L	0.1723	0.233	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	5	2	mg/L	0.028	0.037	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	3	3	mg/L	0.1477	0.157	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	1	mg/L	0.03	0.03	0.05	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-32	MP1A	870.9	n/a	6	1	mg/L	0.061	0.061	0.05	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	6	6	mg/L	1.9967	2.86	0.05	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
Total Suspended Solids	R-22	MP1A	907.1	n/a	2	2	mg/L	51.8	53.6	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	2	2	mg/L	7.4	8.4	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	1	1	mg/L	3.4	3.4	n/a	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23i	P2A	470.2	FD	1	1	mg/L	6	6	n/a	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Filtered Metals																			
Aluminum	R-20	MP1A	904.6	n/a	5	3	µg/L	49.067	64.9	200	5000	NM GW	0	2500	0	68	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	1	µg/L	28.4	28.4	200	5000	NM GW	0	2500	0	68	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	34.58	75.6	200	5000	NM GW	0	2500	0	68	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P2A	1147.1	n/a	14	1	µg/L	70.4	70.4	200	5000	NM GW	0	2500	0	68	Regional	1	—
	R-22	MP5A	1448.2	n/a	5	1	µg/L	175	175	200	5000	NM GW	0	2500	0	68	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	24	3	µg/L	79.333	168	200	5000	NM GW	0	2500	0	68	Regional	1	—
	R-23i	P3A	524	n/a	17	1	µg/L	173	173	200	5000	NM GW	0	2500	0	1065.84	Intermediate	0	—
	R-32	MP1A	870.9	n/a	7	1	µg/L	15.6	15.6	200	5000	NM GW	0	2500	0	68	Regional	0	—
	R-32	Single	867.5	n/a	15	1	µg/L	6850	6850	200	5000	NM GW	1	2500	1	68	Regional	1	The reanalysis of the one detected result exceeding the NM GW standard was not detected. The 6850 µg/L result is therefore suspect.
	R-37	P1A	929.3	n/a	10	1	µg/L	89.6	89.6	200	5000	NM GW	0	2500	0	1065.84	Intermediate	0	—
	R-40	R-40i	649.7	n/a	7	1	µg/L	76.1	76.1	200	5000	NM GW	0	2500	0	1065.84	Intermediate	0	—
	R-41	P2A	965.3	n/a	10	2	µg/L	350	537	200	5000	NM GW	0	2500	0	68	Regional	2	—
	R-49	P1A	845	n/a	9	1	µg/L	331	331	200	5000	NM GW	0	2500	0	68	Regional	1	—
	R-51	P2A	1031	n/a	6	1	µg/L	283	283	200	5000	NM GW	0	2500	0	68	Regional	1	—
	R-53	P1A	849.2	n/a	5	1	µg/L	109	109	200	5000	NM GW	0	2500	0	68	Regional	1	—
	R-54	P1A	830	n/a	6	1	µg/L	87.3	87.3	200	5000	NM GW	0	2500	0	68	Regional	1	—
	R-57	P1A	910	n/a	2	1	µg/L	201	201	200	5000	NM GW	0	2500	0	68	Regional	1	—
Antimony	R-22	MP3A	1273.5	n/a	13	1	µg/L	1.29	1.29	2	6	EPA MCL	0	3	0	1	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	1	µg/L	0.22	0.22	2	6	EPA MCL	0	3	0	1	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	1	µg/L	0.48	0.48	2	6	EPA MCL	0	3	0	1	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-38	Single	821.2	n/a	10	4	µg/L	0.7095	0.823	2	6	EPA MCL	0	3	0	1	Regional	0	—
	R-40	P1A	751.6	n/a	7	5	µg/L	4.49	9.26	2	6	EPA MCL	2	3	3	0.5	Intermediate	5	The 2 results above the EPA MCL were collected on 10/20/2010. There were not results above the MCL before this sampling event, or after this sampling event.
	R-53	P1A	849.2	n/a	5	1	µg/L	0.56	0.56	2	6	EPA MCL	0	3	0	1	Regional	0	—
Arsenic	R-20	MP1A	904.6	n/a	5	2	µg/L	5.515	5.6	5	10	EPA MCL	0	5	2	10	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	1	µg/L	2.96	2.96	5	10	EPA MCL	0	5	0	10	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	4	µg/L	9.21	10.6	5	10	EPA MCL	1	5	4	10	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Arsenic (continued)	R-20	P1A	904.6	n/a	13	3	µg/L	2.2267	3.32	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-21	Single	888.8	n/a	25	7	µg/L	2.3086	3.63	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-22	MP3A	1273.5	n/a	13	4	µg/L	2.325	3.4	5	10	EPA MCL	0	5	0	10	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	3	µg/L	2.4667	3.6	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-23	Single	816	n/a	25	4	µg/L	3.4475	6.79	5	10	EPA MCL	0	5	1	10	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	µg/L	4.5	4.5	5	10	EPA MCL	0	5	0	4.32	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	3	µg/L	3.4933	4.7	5	10	EPA MCL	0	5	0	4.32	Intermediate	1	—
	R-23i	P2A	470.2	n/a	19	5	µg/L	2.176	2.7	5	10	EPA MCL	0	5	0	4.32	Intermediate	0	—
	R-23i	P3A	524	FD	2	1	µg/L	1.8	1.8	5	10	EPA MCL	0	5	0	4.32	Intermediate	0	—
	R-23i	P3A	524	n/a	17	5	µg/L	2.488	5.36	5	10	EPA MCL	0	5	1	4.32	Intermediate	1	—
	R-32	MP3A	976	n/a	9	3	µg/L	3.5	6.7	5	10	EPA MCL	0	5	1	10	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	n/a	15	1	µg/L	1.77	1.77	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-37	P1A	929.3	n/a	10	4	µg/L	2.25	3.15	5	10	EPA MCL	0	5	0	4.32	Intermediate	0	—
	R-37	P2A	1026	n/a	9	2	µg/L	2.255	2.28	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-38	Single	821.2	FD	4	1	µg/L	3.08	3.08	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-38	Single	821.2	n/a	10	1	µg/L	2.7	2.7	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-39	Single	859	n/a	11	1	µg/L	1.86	1.86	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-40	P1A	751.6	n/a	7	2	µg/L	2.935	3.38	5	10	EPA MCL	0	5	0	4.32	Intermediate	0	—
	R-40	R-40i	649.7	n/a	7	3	µg/L	2.85	3.75	5	10	EPA MCL	0	5	0	4.32	Intermediate	0	—
	R-49	P1A	845	n/a	9	4	µg/L	2.3875	3.45	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-49	P2A	905.6	n/a	9	1	µg/L	4.89	4.89	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-51	P1A	914.96	n/a	6	1	µg/L	1.67	1.67	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-51	P2A	1031	n/a	6	1	µg/L	2.41	2.41	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-52	P1A	1035.2	n/a	5	2	µg/L	2.385	2.59	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-52	P2A	1107	n/a	5	1	µg/L	2.35	2.35	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-53	P1A	849.2	n/a	5	1	µg/L	3.19	3.19	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-54	P1A	830	n/a	6	2	µg/L	2.81	2.83	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-54	P2A	915	n/a	6	2	µg/L	2.525	3.01	5	10	EPA MCL	0	5	0	10	Regional	0	—
	R-55i	Single	510	n/a	2	1	µg/L	2.11	2.11	5	10	EPA MCL	0	5	0	4.32	Intermediate	0	—
Barium	R-20	MP1A	904.6	n/a	5	5	µg/L	26.34	31.4	5	1000	NM GW	0	500	0	56.83	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	220.2	253	5	1000	NM GW	0	500	0	56.83	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	91.26	108	5	1000	NM GW	0	500	0	56.83	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	µg/L	76.7	92.7	5	1000	NM GW	0	500	0	56.83	Regional	13	—
	R-20	P2A	1147.1	FD	3	3	µg/L	182	188	5	1000	NM GW	0	500	0	56.83	Regional	3	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Barium (continued)	R-20	P2A	1147.1	n/a	14	14	µg/L	157.71	202	5	1000	NM GW	0	500	0	56.83	Regional	14	—
	R-21	Single	888.8	FD	3	3	µg/L	13.8	14	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-21	Single	888.8	n/a	25	25	µg/L	14	15.6	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-22	MP1A	907.1	n/a	5	5	µg/L	171.8	198	5	1000	NM GW	0	500	0	56.83	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	14	µg/L	25.464	171	5	1000	NM GW	0	500	0	56.83	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	150	150	5	1000	NM GW	0	500	0	56.83	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	12	µg/L	143.2	175	5	1000	NM GW	0	500	0	56.83	Regional	12	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	314	314	5	1000	NM GW	0	500	0	56.83	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	µg/L	319.2	360	5	1000	NM GW	0	500	0	56.83	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	142	142	5	1000	NM GW	0	500	0	56.83	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	µg/L	130.8	144	5	1000	NM GW	0	500	0	56.83	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	µg/L	22.542	26.8	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-23	Single	816	n/a	25	25	µg/L	24.016	37.8	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	µg/L	9.2	9.2	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	14	µg/L	51.364	77.6	5	1000	NM GW	0	500	0	71.83	Intermediate	1	—
	R-23i	P2A	470.2	FD	2	2	µg/L	7.805	8.5	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	19	µg/L	8.5958	12.2	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-23i	P3A	524	FD	2	2	µg/L	8.935	9.6	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-23i	P3A	524	n/a	17	17	µg/L	9.4041	17.5	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-32	MP1A	870.9	n/a	9	9	µg/L	63.367	85.4	5	1000	NM GW	0	500	0	56.83	Regional	5	—
	R-32	MP3A	976	n/a	9	9	µg/L	81.711	93.4	5	1000	NM GW	0	500	0	56.83	Regional	9	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	45.517	49	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-32	Single	867.5	n/a	15	15	µg/L	44.38	64.7	5	1000	NM GW	0	500	0	56.83	Regional	1	—
	R-37	P1A	929.3	FD	1	1	µg/L	9.05	9.05	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-37	P1A	929.3	n/a	10	10	µg/L	13.512	30.8	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-37	P2A	1026	FD	1	1	µg/L	30.4	30.4	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-37	P2A	1026	n/a	9	9	µg/L	31.144	35.8	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-38	Single	821.2	FD	4	4	µg/L	29.4	30.7	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-38	Single	821.2	n/a	10	10	µg/L	30.13	33	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-39	Single	859	FD	1	1	µg/L	16.2	16.2	5	1000	NM GW	0	500	0	56.83	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Barium (continued)	R-39	Single	859	n/a	11	11	µg/L	15.982	18.2	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	µg/L	31.5	37.8	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-40	P2A	849.3	FD	2	2	µg/L	23.3	25	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	µg/L	24.322	31.3	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	25.229	29.8	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-41	P2A	965.3	FD	2	2	µg/L	28.9	29.6	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	µg/L	31.29	47	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-49	P1A	845	n/a	9	9	µg/L	28.756	42.4	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	µg/L	22.678	36	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	µg/L	25.167	28.7	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-51	P2A	1031	n/a	6	6	µg/L	20.75	24.2	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	28.92	30.3	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-52	P2A	1107	n/a	5	5	µg/L	27.6	29.8	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	µg/L	25.4	30	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-53	P2A	959.7	FD	2	2	µg/L	28.75	28.8	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	µg/L	28.56	29.5	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-54	P1A	830	n/a	6	6	µg/L	12.733	14.3	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-54	P2A	915	n/a	6	6	µg/L	11.812	19.9	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-55	P1A	860	n/a	3	3	µg/L	35.3	36.1	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	µg/L	30.7	32.1	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-55i	Single	510	n/a	2	2	µg/L	44.25	51	5	1000	NM GW	0	500	0	71.83	Intermediate	0	—
	R-56	P1A	945	n/a	3	3	µg/L	31.833	32.5	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	27.367	30	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-57	P1A	910	n/a	2	2	µg/L	17.1	17.4	5	1000	NM GW	0	500	0	56.83	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	µg/L	19.75	20	5	1000	NM GW	0	500	0	56.83	Regional	0	—
Beryllium	R-20	MP3A	1330	n/a	5	1	µg/L	3.9	3.9	0.5	4	EPA MCL	0	2	1	1	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
	R-22	MP3A	1273.5	n/a	13	1	µg/L	1.63	1.63	0.5	4	EPA MCL	0	2	0	1	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	1	µg/L	1.6	1.6	0.5	4	EPA MCL	0	2	0	1	Regional	1	—
	R-38	Single	821.2	FD	4	1	µg/L	1.53	1.53	0.5	4	EPA MCL	0	2	0	1	Regional	1	—
Boron	R-20	MP1A	904.6	n/a	5	4	µg/L	40.175	59.4	50	750	NM GW	0	375	0	38.77	Regional	1	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	88.94	97.1	50	750	NM GW	0	375	0	38.77	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	4	µg/L	34.65	38.1	50	750	NM GW	0	375	0	38.77	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	8	µg/L	15.65	20	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-20	P2A	1147.1	FD	3	1	µg/L	20.5	20.5	50	750	NM GW	0	375	0	38.77	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Boron (continued)	R-20	P2A	1147.1	n/a	14	6	µg/L	19.3	29.3	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-21	Single	888.8	FD	3	2	µg/L	12.65	13	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-21	Single	888.8	n/a	25	12	µg/L	14.083	22.8	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-22	MP1A	907.1	n/a	5	1	µg/L	30.9	30.9	50	750	NM GW	0	375	0	38.77	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	9	µg/L	12.278	14.4	50	750	NM GW	0	375	0	38.77	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	30.3	30.3	50	750	NM GW	0	375	0	38.77	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	9	µg/L	23.989	46	50	750	NM GW	0	375	0	38.77	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	95.7	95.7	50	750	NM GW	0	375	0	38.77	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	3	µg/L	95.067	97.3	50	750	NM GW	0	375	0	38.77	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	1	µg/L	34.4	34.4	50	750	NM GW	0	375	0	38.77	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	7	µg/L	13.5	15.6	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-23	Single	816	n/a	25	18	µg/L	14.708	18.7	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	µg/L	17.1	17.1	50	750	NM GW	0	375	0	15.12	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	9	µg/L	15.978	21.2	50	750	NM GW	0	375	0	15.12	Intermediate	6	—
	R-23i	P2A	470.2	FD	2	2	µg/L	17.35	18.3	50	750	NM GW	0	375	0	15.12	Intermediate	2	—
	R-23i	P2A	470.2	n/a	19	15	µg/L	17.153	23.6	50	750	NM GW	0	375	0	15.12	Intermediate	14	—
	R-23i	P3A	524	FD	2	1	µg/L	15.2	15.2	50	750	NM GW	0	375	0	15.12	Intermediate	1	—
	R-23i	P3A	524	n/a	17	14	µg/L	16.807	20	50	750	NM GW	0	375	0	15.12	Intermediate	11	—
	R-32	MP1A	870.9	n/a	9	6	µg/L	12.87	15.4	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-32	MP3A	976	n/a	9	8	µg/L	14.45	16.4	50	750	NM GW	0	375	0	38.77	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	4	µg/L	15.775	18.5	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-32	Single	867.5	n/a	15	6	µg/L	24.783	64.4	50	750	NM GW	0	375	0	38.77	Regional	1	—
	R-37	P1A	929.3	FD	1	1	µg/L	30.6	30.6	50	750	NM GW	0	375	0	15.12	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	10	µg/L	28.06	34	50	750	NM GW	0	375	0	15.12	Intermediate	10	—
	R-37	P2A	1026	n/a	9	4	µg/L	16.275	21.6	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-39	Single	859	n/a	11	1	µg/L	15.1	15.1	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	µg/L	18.086	21.2	50	750	NM GW	0	375	0	15.12	Intermediate	7	—
	R-40	R-40i	649.7	n/a	7	6	µg/L	18.083	20.3	50	750	NM GW	0	375	0	15.12	Intermediate	6	—
	R-41	P2A	965.3	FD	2	1	µg/L	15.2	15.2	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-41	P2A	965.3	n/a	10	6	µg/L	19.483	24.7	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-49	P1A	845	n/a	9	7	µg/L	19.014	34.8	50	750	NM GW	0	375	0	38.77	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Boron (continued)	R-49	P2A	905.6	n/a	9	1	µg/L	11.4	11.4	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-51	P1A	914.96	n/a	6	2	µg/L	17.2	18.2	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-51	P2A	1031	n/a	6	1	µg/L	16.3	16.3	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-52	P1A	1035.2	n/a	5	2	µg/L	16.95	17.5	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-52	P2A	1107	n/a	5	1	µg/L	17.1	17.1	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-54	P1A	830	n/a	6	4	µg/L	16.675	19	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-54	P2A	915	n/a	6	1	µg/L	15.9	15.9	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-55	P1A	860	n/a	3	3	µg/L	19.7	21.1	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	µg/L	20.433	21.4	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-55i	Single	510	n/a	2	2	µg/L	17.7	18.6	50	750	NM GW	0	375	0	15.12	Intermediate	2	—
	R-56	P1A	945	n/a	3	1	µg/L	15	15	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-56	P2A	1046.6	n/a	3	1	µg/L	16.1	16.1	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-57	P1A	910	n/a	2	1	µg/L	15.8	15.8	50	750	NM GW	0	375	0	38.77	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	µg/L	17.7	20	50	750	NM GW	0	375	0	38.77	Regional	0	—
Cadmium	R-22	MP3A	1273.5	n/a	13	1	µg/L	1.18	1.18	1	5	EPA MCL	0	2.5	0	1	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-32	MP1A	870.9	n/a	9	1	µg/L	0.06	0.06	1	5	EPA MCL	0	2.5	0	1	Regional	0	—
Chromium	R-20	MP1A	904.6	n/a	5	1	µg/L	0.63	0.63	5	50	NM GW	0	25	0	5.75	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	2	µg/L	0.805	0.85	5	50	NM GW	0	25	0	5.75	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	4	µg/L	1.82	3.7	5	50	NM GW	0	25	0	5.75	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	4	µg/L	3.1825	4.5	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-20	P2A	1147.1	FD	3	2	µg/L	3.21	3.73	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-20	P2A	1147.1	n/a	14	8	µg/L	3.02	3.85	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-21	Single	888.8	FD	3	2	µg/L	2.15	2.7	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-21	Single	888.8	n/a	25	17	µg/L	3.4882	6.45	5	50	NM GW	0	25	0	5.75	Regional	1	—
	R-22	MP1A	907.1	n/a	5	1	µg/L	1.8	1.8	5	50	NM GW	0	25	0	5.75	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	9	µg/L	3.0556	3.9	5	50	NM GW	0	25	0	5.75	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	2.3	2.3	5	50	NM GW	0	25	0	5.75	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	7	µg/L	4.1429	7	5	50	NM GW	0	25	0	5.75	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	5.88	5.88	5	50	NM GW	0	25	0	5.75	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	10	µg/L	2.966	4.66	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-23	Single	816	n/a	25	18	µg/L	2.8161	5.11	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	µg/L	1.2	1.2	5	50	NM GW	0	25	0	1	Intermediate	1	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Chromium (continued)	R-23i	P1A	400.3	n/a	14	3	µg/L	2.7267	4.28	5	50	NM GW	0	25	0	1	Intermediate	3	—
	R-23i	P2A	470.2	n/a	19	5	µg/L	3.07	3.9	5	50	NM GW	0	25	0	1	Intermediate	5	—
	R-23i	P3A	524	FD	2	2	µg/L	2.765	4.43	5	50	NM GW	0	25	0	1	Intermediate	2	—
	R-23i	P3A	524	n/a	17	7	µg/L	2.9043	4.39	5	50	NM GW	0	25	0	1	Intermediate	7	—
	R-32	MP1A	870.9	n/a	9	1	µg/L	1.9	1.9	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-32	MP3A	976	n/a	9	2	µg/L	1.85	2.4	5	50	NM GW	0	25	0	5.75	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	3	µg/L	2.5667	3.5	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-32	Single	867.5	n/a	14	3	µg/L	3.97	5.18	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-37	P1A	929.3	n/a	10	2	µg/L	3.08	3.14	5	50	NM GW	0	25	0	1	Intermediate	2	—
	R-37	P2A	1026	FD	1	1	µg/L	3.54	3.54	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-37	P2A	1026	n/a	9	6	µg/L	3.3183	4.36	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-38	Single	821.2	FD	4	2	µg/L	3.845	4.48	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-38	Single	821.2	n/a	10	6	µg/L	4.7333	6.77	5	50	NM GW	0	25	0	5.75	Regional	1	—
	R-39	Single	859	FD	1	1	µg/L	2.54	2.54	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-39	Single	859	n/a	11	7	µg/L	3.4157	4.33	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-40	P1A	751.6	n/a	7	1	µg/L	4.05	4.05	5	50	NM GW	0	25	0	1	Intermediate	1	—
	R-40	P2A	849.3	n/a	9	4	µg/L	3.47	5	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-40	R-40i	649.7	n/a	7	2	µg/L	2.765	3.63	5	50	NM GW	0	25	0	1	Intermediate	2	—
	R-41	P2A	965.3	FD	2	2	µg/L	4.66	5.35	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-41	P2A	965.3	n/a	11	7	µg/L	3.5757	5.7	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-49	P1A	845	n/a	9	6	µg/L	3.0867	4.17	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-49	P2A	905.6	n/a	9	7	µg/L	3.2129	4.58	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-51	P1A	914.96	n/a	6	3	µg/L	3.9	5.2	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-51	P2A	1031	n/a	6	5	µg/L	3.564	4.37	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-52	P1A	1035.2	n/a	5	4	µg/L	3.6775	4.82	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-52	P2A	1107	n/a	5	3	µg/L	4.5333	5.66	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-53	P1A	849.2	n/a	5	2	µg/L	2.93	3.79	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-53	P2A	959.7	FD	2	1	µg/L	2.61	2.61	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-53	P2A	959.7	n/a	5	3	µg/L	3.38	5.23	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-54	P1A	830	n/a	6	2	µg/L	7.045	11.1	5	50	NM GW	0	25	0	5.75	Regional	1	—
	R-54	P2A	915	n/a	6	3	µg/L	3.75	4.15	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-55	P1A	860	n/a	3	1	µg/L	2.76	2.76	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-55	P2A	994.4	n/a	3	2	µg/L	4.25	6.47	5	50	NM GW	0	25	0	5.75	Regional	1	—
	R-55i	Single	510	n/a	2	1	µg/L	3.81	3.81	5	50	NM GW	0	25	0	1	Intermediate	1	—
	R-56	P1A	945	n/a	3	1	µg/L	2.05	2.05	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-56	P2A	1046.6	n/a	3	1	µg/L	4.83	4.83	5	50	NM GW	0	25	0	5.75	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Chromium (continued)	R-57	P1A	910	n/a	2	1	µg/L	4.55	4.55	5	50	NM GW	0	25	0	5.75	Regional	0	—
	R-57	P2A	971.5	n/a	2	1	µg/L	3.86	3.86	5	50	NM GW	0	25	0	5.75	Regional	0	—
Chromium hexavalent ion	R-23i	P2A	470.2	FD	1	1	µg/L	0.3	0.3	10	50	NM GW	0	25	0	—	—	—	—
	R-23i	P2A	470.2	n/a	1	1	µg/L	0.3	0.3	10	50	NM GW	0	25	0	—	—	—	—
	R-23i	P3A	524	n/a	1	1	µg/L	0.7	0.7	10	50	NM GW	0	25	0	—	—	—	—
Cobalt	R-20	MP1A	904.6	n/a	5	1	µg/L	3.3	3.3	5	50	NM GW	0	25	0	0.5	Regional	1	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	2	µg/L	3.9	4	5	50	NM GW	0	25	0	0.5	Regional	2	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P2A	1147.1	n/a	14	1	µg/L	1	1	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-21	Single	888.8	n/a	25	1	µg/L	5.7	5.7	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-22	MP2A	962.8	n/a	16	1	µg/L	2.7	2.7	5	50	NM GW	0	25	0	0.5	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	1	µg/L	1.6	1.6	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-23i	P1A	400.3	n/a	14	1	µg/L	1.1	1.1	5	50	NM GW	0	25	0	0.5	Intermediate	1	—
	R-23i	P3A	524	n/a	17	1	µg/L	1.05	1.05	5	50	NM GW	0	25	0	0.5	Intermediate	1	—
	R-32	MP1A	870.9	n/a	9	4	µg/L	2.2625	3.9	5	50	NM GW	0	25	0	0.5	Regional	4	—
	R-32	MP3A	976	n/a	9	5	µg/L	2.678	4.05	5	50	NM GW	0	25	0	0.5	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	n/a	15	1	µg/L	2.17	2.17	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-37	P1A	929.3	n/a	10	1	µg/L	1.17	1.17	5	50	NM GW	0	25	0	0.5	Intermediate	1	—
	R-38	Single	821.2	FD	4	1	µg/L	1.12	1.12	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-38	Single	821.2	n/a	10	3	µg/L	1.4867	2.14	5	50	NM GW	0	25	0	0.5	Regional	3	—
	R-40	P1A	751.6	n/a	7	2	µg/L	1.94	2.69	5	50	NM GW	0	25	0	0.5	Intermediate	2	—
	R-40	P2A	849.3	n/a	9	1	µg/L	1.01	1.01	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-40	R-40i	649.7	n/a	7	1	µg/L	1.01	1.01	5	50	NM GW	0	25	0	0.5	Intermediate	1	—
	R-41	P2A	965.3	n/a	10	2	µg/L	1.43	1.59	5	50	NM GW	0	25	0	0.5	Regional	2	—
	R-49	P1A	845	n/a	9	1	µg/L	1.24	1.24	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-49	P2A	905.6	n/a	9	1	µg/L	1.02	1.02	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-52	P1A	1035.2	n/a	5	1	µg/L	1.03	1.03	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-52	P2A	1107	n/a	5	1	µg/L	1.62	1.62	5	50	NM GW	0	25	0	0.5	Regional	1	—
	R-54	P1A	830	n/a	6	5	µg/L	2.044	3.08	5	50	NM GW	0	25	0	0.5	Regional	5	—
	R-55i	Single	510	n/a	2	1	µg/L	1.26	1.26	5	50	NM GW	0	25	0	0.5	Intermediate	1	—
Copper	R-20	MP2A	1147.1	n/a	5	1	µg/L	2.8	2.8	10	1000	NM GW	0	500	0	3	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	1	µg/L	15.6	15.6	10	1000	NM GW	0	500	0	3	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	n/a	24	1	µg/L	7.57	7.57	10	1000	NM GW	0	500	0	3	Regional	1	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Copper (continued)	R-23	Single	816	FD	11	1	µg/L	27.4	27.4	10	1000	NM GW	0	500	0	3	Regional	1	—
	R-32	MP1A	870.9	n/a	5	1	µg/L	1.4	1.4	10	1000	NM GW	0	500	0	3	Regional	0	—
	R-32	MP3A	976	n/a	7	1	µg/L	2.95	2.95	10	1000	NM GW	0	500	0	3	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	n/a	15	1	µg/L	3.58	3.58	10	1000	NM GW	0	500	0	3	Regional	1	—
	R-37	P1A	929.3	n/a	10	1	µg/L	8.28	8.28	10	1000	NM GW	0	500	0	5.32	Intermediate	1	—
	R-39	Single	859	n/a	11	1	µg/L	4	4	10	1000	NM GW	0	500	0	3	Regional	1	—
	R-40	P1A	751.6	n/a	7	2	µg/L	3.32	3.33	10	1000	NM GW	0	500	0	5.32	Intermediate	0	—
	R-40	R-40i	649.7	n/a	7	2	µg/L	11.85	14	10	1000	NM GW	0	500	0	5.32	Intermediate	2	—
Iron	R-20	MP1A	904.6	n/a	5	4	µg/L	115.48	123	100	1000	NM GW	0	500	0	21	Regional	4	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	245.4	495	100	1000	NM GW	0	500	0	21	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	7116	9450	100	1000	NM GW	5	500	5	21	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	3	µg/L	73.567	120	100	1000	NM GW	0	500	0	21	Regional	3	—
	R-20	P2A	1147.1	FD	3	2	µg/L	35.2	35.7	100	1000	NM GW	0	500	0	21	Regional	2	—
	R-20	P2A	1147.1	n/a	14	9	µg/L	51.411	103	100	1000	NM GW	0	500	0	21	Regional	9	—
	R-21	Single	888.8	FD	3	1	µg/L	27.9	27.9	100	1000	NM GW	0	500	0	21	Regional	1	—
	R-21	Single	888.8	n/a	25	8	µg/L	25.275	36.7	100	1000	NM GW	0	500	0	21	Regional	5	—
	R-22	MP1A	907.1	n/a	7	7	µg/L	10447	14900	100	1000	NM GW	7	500	7	21	Regional	7	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	1	µg/L	7840	7840	100	1000	NM GW	1	500	1	21	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	22.7	22.7	100	1000	NM GW	0	500	0	21	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	3	µg/L	91.7	200	100	1000	NM GW	0	500	0	21	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	2390	2390	100	1000	NM GW	1	500	1	21	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	µg/L	3445.4	5700	100	1000	NM GW	4	500	5	21	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	2200	2200	100	1000	NM GW	1	500	1	21	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	µg/L	2042.7	4300	100	1000	NM GW	4	500	4	21	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	3	µg/L	47.5	74	100	1000	NM GW	0	500	0	21	Regional	3	—
	R-23	Single	816	n/a	25	3	µg/L	71.333	169	100	1000	NM GW	0	500	0	21	Regional	2	—
	R-23i	P1A	400.3	FD	1	1	µg/L	26.5	26.5	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	1	µg/L	72	72	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—
	R-23i	P2A	470.2	FD	2	1	µg/L	24.2	24.2	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Iron (continued)	R-23i	P2A	470.2	n/a	19	5	µg/L	67.22	116	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—
	R-23i	P3A	524	FD	2	1	µg/L	55.6	55.6	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—
	R-23i	P3A	524	n/a	17	3	µg/L	118.67	211	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—
	R-32	MP1A	870.9	n/a	9	3	µg/L	55.6	121	100	1000	NM GW	0	500	0	21	Regional	2	—
	R-32	MP3A	976	n/a	9	9	µg/L	658.33	1070	100	1000	NM GW	2	500	6	21	Regional	9	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	3	µg/L	87.733	143	100	1000	NM GW	0	500	0	21	Regional	3	—
	R-32	Single	867.5	n/a	15	5	µg/L	833.58	3850	100	1000	NM GW	1	500	1	21	Regional	5	The result above the NM groundwater standard is suspect because the unfiltered sample taken at the same time was nondetect.
	R-37	P1A	929.3	n/a	10	2	µg/L	35.45	37.9	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—
	R-38	Single	821.2	n/a	10	1	µg/L	107	107	100	1000	NM GW	0	500	0	21	Regional	1	—
	R-40	P1A	751.6	n/a	7	5	µg/L	71.18	201	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—
	R-40	P2A	849.3	n/a	9	2	µg/L	92.2	140	100	1000	NM GW	0	500	0	21	Regional	2	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	1094.4	1420	100	1000	NM GW	5	500	6	839.99	Intermediate	6	Results above the NM groundwater standard may be attributed to reducing condition at this screen (see text).
	R-41	P2A	965.3	n/a	10	2	µg/L	73.05	116	100	1000	NM GW	0	500	0	21	Regional	2	—
	R-49	P1A	845	n/a	9	1	µg/L	78.5	78.5	100	1000	NM GW	0	500	0	21	Regional	1	—
	R-51	P2A	1031	n/a	6	3	µg/L	118.5	271	100	1000	NM GW	0	500	0	21	Regional	3	—
	R-52	P2A	1107	n/a	5	1	µg/L	68.1	68.1	100	1000	NM GW	0	500	0	21	Regional	1	—
	R-54	P1A	830	n/a	6	6	µg/L	1548	3850	100	1000	NM GW	3	500	4	21	Regional	6	Iron was detected above the NM groundwater standard in 3 of the 6 samples at this screen.
	R-55	P1A	860	n/a	3	1	µg/L	36.1	36.1	100	1000	NM GW	0	500	0	21	Regional	1	—
	R-55	P2A	994.4	n/a	3	1	µg/L	35.4	35.4	100	1000	NM GW	0	500	0	21	Regional	1	—
	R-55i	Single	510	n/a	2	2	µg/L	256.65	431	100	1000	NM GW	0	500	0	839.99	Intermediate	0	—
	R-56	P2A	1046.6	n/a	3	2	µg/L	58.55	69.3	100	1000	NM GW	0	500	0	21	Regional	2	—
	R-57	P1A	910	n/a	2	1	µg/L	54	54	100	1000	NM GW	0	500	0	21	Regional	1	—
	R-57	P2A	971.5	n/a	2	1	µg/L	35.8	35.8	100	1000	NM GW	0	500	0	21	Regional	1	—
Lead	R-20	MP1A	904.6	n/a	5	4	µg/L	0.6725	0.84	2	15	EPA MCL	0	7.5	0	1.83	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	2	µg/L	0.0855	0.089	2	15	EPA MCL	0	7.5	0	1.83	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	2	µg/L	0.1475	0.17	2	15	EPA MCL	0	7.5	0	1.83	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	n/a	25	2	µg/L	0.1065	0.123	2	15	EPA MCL	0	7.5	0	1.83	Regional	0	—
	R-22	MP3A	1273.5	n/a	13	1	µg/L	19.7	19.7	2	15	EPA MCL	1	7.5	1	1.83	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	4	µg/L	1.365	2.04	2	15	EPA MCL	0	7.5	0	1.83	Regional	1	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Lead (continued)	R-32	MP3A	976	n/a	9	3	µg/L	0.337	0.441	2	15	EPA MCL	0	7.5	0	1.83	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-40	P1A	751.6	n/a	7	1	µg/L	0.885	0.885	2	15	EPA MCL	0	7.5	0	0.5	Intermediate	1	—
	R-54	P1A	830	n/a	6	1	µg/L	0.918	0.918	2	15	EPA MCL	0	7.5	0	1.83	Regional	0	—
Manganese	R-20	MP1A	904.6	n/a	5	5	µg/L	18.68	28.5	10	200	NM GW	0	100	0	2.94	Regional	5	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	356.6	382	10	200	NM GW	5	100	5	2.94	Regional	5	Detected above NM groundwater standard before well rehabilitation. Results were below New Mexico groundwater standard after well rehabilitation
	R-20	MP3A	1330	n/a	5	5	µg/L	764	1050	10	200	NM GW	5	100	5	2.94	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	µg/L	19.015	27.5	10	200	NM GW	0	100	0	2.94	Regional	13	—
	R-20	P2A	1147.1	FD	3	3	µg/L	68.1	69.3	10	200	NM GW	0	100	0	2.94	Regional	3	—
	R-20	P2A	1147.1	n/a	14	14	µg/L	64.543	78.4	10	200	NM GW	0	100	0	2.94	Regional	14	—
	R-21	Single	888.8	FD	3	3	µg/L	8.7667	10.4	10	200	NM GW	0	100	0	2.94	Regional	3	—
	R-21	Single	888.8	n/a	25	25	µg/L	7.6492	18.2	10	200	NM GW	0	100	0	2.94	Regional	25	—
	R-22	MP1A	907.1	n/a	7	7	µg/L	3365.7	4410	10	200	NM GW	7	100	7	2.94	Regional	7	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	4	µg/L	860.78	3430	10	200	NM GW	1	100	1	2.94	Regional	3	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	4	µg/L	63.325	200	10	200	NM GW	1	100	1	2.94	Regional	4	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	1230	1230	10	200	NM GW	1	100	1	2.94	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	µg/L	1244.4	1600	10	200	NM GW	5	100	5	2.94	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	534	534	10	200	NM GW	1	100	1	2.94	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	µg/L	537	630	10	200	NM GW	5	100	5	2.94	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	2	µg/L	2.86	3.2	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-23	Single	816	n/a	25	6	µg/L	41.193	207	10	200	NM GW	1	100	1	2.94	Regional	5	The one result above the NM groundwater standard was detected in the first sampling event, December 2003.
	R-23i	P1A	400.3	FD	1	1	µg/L	6.2	6.2	10	200	NM GW	0	100	0	2	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	5	µg/L	13.56	44.8	10	200	NM GW	0	100	0	2	Intermediate	5	—
	R-23i	P2A	470.2	FD	2	1	µg/L	18.2	18.2	10	200	NM GW	0	100	0	2	Intermediate	1	—
	R-23i	P2A	470.2	n/a	19	6	µg/L	6.85	18.4	10	200	NM GW	0	100	0	2	Intermediate	6	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Manganese (continued)	R-23i	P3A	524	n/a	17	2	µg/L	9.725	13.7	10	200	NM GW	0	100	0	2	Intermediate	2	—
	R-32	MP1A	870.9	n/a	9	6	µg/L	23.467	73.8	10	200	NM GW	0	100	0	2.94	Regional	5	—
	R-32	MP3A	976	n/a	9	9	µg/L	1774.4	2120	10	200	NM GW	9	100	9	2.94	Regional	9	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	9.3667	20.4	10	200	NM GW	0	100	0	2.94	Regional	6	—
	R-32	Single	867.5	n/a	15	12	µg/L	8.0817	19.7	10	200	NM GW	0	100	0	2.94	Regional	10	—
	R-37	P1A	929.3	n/a	10	5	µg/L	5.152	7.47	10	200	NM GW	0	100	0	2	Intermediate	5	—
	R-37	P2A	1026	n/a	9	3	µg/L	3.1067	4.7	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-38	Single	821.2	FD	4	2	µg/L	3.35	4.65	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-38	Single	821.2	n/a	10	9	µg/L	6.5567	14.4	10	200	NM GW	0	100	0	2.94	Regional	6	—
	R-39	Single	859	n/a	11	3	µg/L	3.5167	6.5	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-40	P1A	751.6	n/a	7	7	µg/L	93.664	400	10	200	NM GW	1	100	2	2	Intermediate	7	One result was detected above the NM groundwater standard in December 2009.
	R-40	P2A	849.3	n/a	9	4	µg/L	29.133	104	10	200	NM GW	0	100	1	2.94	Regional	4	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	300.57	398	10	200	NM GW	6	100	7	2	Intermediate	7	Consistently detected above NM groundwater standard at this port.
	R-41	P2A	965.3	FD	2	2	µg/L	4.83	6.83	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-41	P2A	965.3	n/a	10	8	µg/L	18.69	55.3	10	200	NM GW	0	100	0	2.94	Regional	7	—
	R-49	P1A	845	n/a	9	9	µg/L	10.098	27.1	10	200	NM GW	0	100	0	2.94	Regional	8	—
	R-49	P2A	905.6	n/a	9	2	µg/L	3.205	4.09	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-51	P1A	914.96	n/a	6	1	µg/L	7.24	7.24	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-51	P2A	1031	n/a	6	3	µg/L	5.8033	12.2	10	200	NM GW	0	100	0	2.94	Regional	2	—
	R-52	P1A	1035.2	n/a	5	2	µg/L	3.94	5.18	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-52	P2A	1107	n/a	5	2	µg/L	8.435	14.5	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-53	P1A	849.2	n/a	5	2	µg/L	20.21	37.1	10	200	NM GW	0	100	0	2.94	Regional	2	—
	R-53	P2A	959.7	n/a	5	1	µg/L	6.31	6.31	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-54	P1A	830	n/a	6	6	µg/L	167.72	280	10	200	NM GW	3	100	4	2.94	Regional	6	Detected above the NM groundwater standard in 3 of the 6 samples at this screen.
	R-54	P2A	915	n/a	6	3	µg/L	4.0433	6.95	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-55	P1A	860	n/a	3	3	µg/L	9.96	16.2	10	200	NM GW	0	100	0	2.94	Regional	3	—
	R-55	P2A	994.4	n/a	3	2	µg/L	7.945	13.6	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-55i	Single	510	n/a	2	2	µg/L	528	621	10	200	NM GW	2	100	2	2	Intermediate	2	Consistently detected above NM groundwater standard at this port.
	R-56	P1A	945	n/a	3	3	µg/L	8.7367	17.6	10	200	NM GW	0	100	0	2.94	Regional	3	—
	R-56	P2A	1046.6	n/a	3	2	µg/L	9.215	16.3	10	200	NM GW	0	100	0	2.94	Regional	1	—
	R-57	P1A	910	n/a	2	2	µg/L	46.15	78.6	10	200	NM GW	0	100	0	2.94	Regional	2	—
	R-57	P2A	971.5	n/a	2	2	µg/L	12.96	16.5	10	200	NM GW	0	100	0	2.94	Regional	2	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Mercury	R-22	MP2A	962.8	n/a	16	1	µg/L	0.079	0.079	0.2	2	EPA MCL	0	1	0	0.07	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	1	µg/L	0.0715	0.0715	0.2	2	EPA MCL	0	1	0	0.07	Regional	1	—
	R-32	MP3A	976	n/a	9	1	µg/L	0.53	0.53	0.2	2	EPA MCL	0	1	0	0.07	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
Molybdenum	R-20	MP1A	904.6	n/a	5	5	µg/L	14.1	27.7	0.5	1000	NM GW	0	500	0	2	Regional	5	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	5.35	7.4	0.5	1000	NM GW	0	500	0	2	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	21.26	31.3	0.5	1000	NM GW	0	500	0	2	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	10	µg/L	1.425	1.8	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	µg/L	1.7733	2	0.5	1000	NM GW	0	500	0	2	Regional	1	—
	R-20	P2A	1147.1	n/a	14	14	µg/L	1.6586	1.98	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-21	Single	888.8	FD	3	2	µg/L	2.45	3.7	0.5	1000	NM GW	0	500	0	2	Regional	1	—
	R-21	Single	888.8	n/a	25	20	µg/L	1.9465	3.85	0.5	1000	NM GW	0	500	0	2	Regional	8	—
	R-22	MP1A	907.1	n/a	5	5	µg/L	27.92	40	0.5	1000	NM GW	0	500	0	2	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	5	µg/L	6.04	24.8	0.5	1000	NM GW	0	500	0	2	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	3.4	3.4	0.5	1000	NM GW	0	500	0	2	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	8	µg/L	7.5613	16	0.5	1000	NM GW	0	500	0	2	Regional	7	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	10.3	10.3	0.5	1000	NM GW	0	500	0	2	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	µg/L	18.98	42	0.5	1000	NM GW	0	500	0	2	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	28.8	28.8	0.5	1000	NM GW	0	500	0	2	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	µg/L	24.16	30.8	0.5	1000	NM GW	0	500	0	2	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	5	µg/L	1.692	1.99	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-23	Single	816	n/a	25	17	µg/L	1.6294	2.12	0.5	1000	NM GW	0	500	0	2	Regional	1	—
	R-23i	P1A	400.3	n/a	14	12	µg/L	3.1681	23.4	0.5	1000	NM GW	0	500	0	2	Intermediate	2	—
	R-23i	P2A	470.2	FD	2	2	µg/L	1.96	2	0.5	1000	NM GW	0	500	0	2	Intermediate	1	—
	R-23i	P2A	470.2	n/a	19	15	µg/L	2.3353	4	0.5	1000	NM GW	0	500	0	2	Intermediate	10	—
	R-23i	P3A	524	FD	2	1	µg/L	2.3	2.3	0.5	1000	NM GW	0	500	0	2	Intermediate	1	—
	R-23i	P3A	524	n/a	17	14	µg/L	1.5807	2.5	0.5	1000	NM GW	0	500	0	2	Intermediate	2	—
	R-32	MP1A	870.9	n/a	9	7	µg/L	2.8371	3.5	0.5	1000	NM GW	0	500	0	2	Regional	7	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Molybdenum (continued)	R-32	MP3A	976	n/a	9	6	µg/L	2.1983	3.7	0.5	1000	NM GW	0	500	0	2	Regional	2	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	2.2667	2.5	0.5	1000	NM GW	0	500	0	2	Regional	6	—
	R-32	Single	867.5	n/a	15	15	µg/L	2.2607	3.1	0.5	1000	NM GW	0	500	0	2	Regional	15	—
	R-37	P1A	929.3	FD	1	1	µg/L	4.12	4.12	0.5	1000	NM GW	0	500	0	2	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	10	µg/L	3.742	4.34	0.5	1000	NM GW	0	500	0	2	Intermediate	10	—
	R-37	P2A	1026	FD	1	1	µg/L	1.63	1.63	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-37	P2A	1026	n/a	9	9	µg/L	2.1133	3.17	0.5	1000	NM GW	0	500	0	2	Regional	4	—
	R-38	Single	821.2	FD	4	3	µg/L	1.6833	1.73	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-38	Single	821.2	n/a	10	9	µg/L	1.9333	2.9	0.5	1000	NM GW	0	500	0	2	Regional	2	—
	R-39	Single	859	FD	1	1	µg/L	1.82	1.82	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-39	Single	859	n/a	11	11	µg/L	1.8855	2.71	0.5	1000	NM GW	0	500	0	2	Regional	4	—
	R-40	P1A	751.6	n/a	7	7	µg/L	9.1343	12.9	0.5	1000	NM GW	0	500	0	2	Intermediate	7	—
	R-40	P2A	849.3	FD	2	2	µg/L	2.465	3.67	0.5	1000	NM GW	0	500	0	2	Regional	1	—
	R-40	P2A	849.3	n/a	9	9	µg/L	3.0122	6.1	0.5	1000	NM GW	0	500	0	2	Regional	6	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	17.3	22	0.5	1000	NM GW	0	500	0	2	Intermediate	7	—
	R-41	P2A	965.3	FD	2	2	µg/L	3.9	4.09	0.5	1000	NM GW	0	500	0	2	Regional	2	—
	R-41	P2A	965.3	n/a	10	10	µg/L	4.826	8.69	0.5	1000	NM GW	0	500	0	2	Regional	10	—
	R-49	P1A	845	n/a	9	9	µg/L	2.9956	5.93	0.5	1000	NM GW	0	500	0	2	Regional	9	—
	R-49	P2A	905.6	n/a	9	8	µg/L	1.4825	1.66	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	µg/L	1.32	1.44	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-51	P2A	1031	n/a	6	6	µg/L	1.2533	1.39	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	1.758	2.23	0.5	1000	NM GW	0	500	0	2	Regional	1	—
	R-52	P2A	1107	n/a	5	4	µg/L	1.23	1.36	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	µg/L	1.552	2.29	0.5	1000	NM GW	0	500	0	2	Regional	1	—
	R-53	P2A	959.7	FD	2	1	µg/L	1.12	1.12	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-53	P2A	959.7	n/a	5	4	µg/L	1.239	1.59	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-54	P1A	830	n/a	6	6	µg/L	3.4467	5.1	0.5	1000	NM GW	0	500	0	2	Regional	6	—
	R-54	P2A	915	n/a	6	6	µg/L	1.115	1.17	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-55	P1A	860	n/a	3	2	µg/L	1.11	1.15	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	µg/L	1.49	1.76	0.5	1000	NM GW	0	500	0	2	Regional	0	—
	R-55i	Single	510	n/a	2	2	µg/L	8.63	9.5	0.5	1000	NM GW	0	500	0	2	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	µg/L	1.9433	2.01	0.5	1000	NM GW	0	500	0	2	Regional	1	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	2.6733	3.14	0.5	1000	NM GW	0	500	0	2	Regional	3	—
	R-57	P1A	910	n/a	2	2	µg/L	2.08	2.33	0.5	1000	NM GW	0	500	0	2	Regional	1	—
	R-57	P2A	971.5	n/a	2	2	µg/L	1.655	1.89	0.5	1000	NM GW	0	500	0	2	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Nickel	R-20	MP1A	904.6	n/a	5	1	µg/L	0.7	0.7	2	200	NM GW	0	100	0	3.09	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	3	µg/L	5.5333	12.1	2	200	NM GW	0	100	0	3.09	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	12	µg/L	1.6551	5.63	2	200	NM GW	0	100	0	3.09	Regional	1	—
	R-20	P2A	1147.1	FD	3	3	µg/L	2.9667	3.31	2	200	NM GW	0	100	0	3.09	Regional	1	—
	R-20	P2A	1147.1	n/a	14	13	µg/L	2.4858	3.71	2	200	NM GW	0	100	0	3.09	Regional	4	—
	R-21	Single	888.8	FD	3	3	µg/L	3.1467	8.3	2	200	NM GW	0	100	0	3.09	Regional	1	—
	R-21	Single	888.8	n/a	25	14	µg/L	0.796	2.7	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-22	MP1A	907.1	n/a	5	2	µg/L	17.4	24.8	2	200	NM GW	0	100	0	3.09	Regional	2	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	5	µg/L	1.284	3.7	2	200	NM GW	0	100	0	3.09	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	1.5	1.5	2	200	NM GW	0	100	0	3.09	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	9	µg/L	1.4211	1.9	2	200	NM GW	0	100	0	3.09	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	1	µg/L	2.6	2.6	2	200	NM GW	0	100	0	3.09	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	1	µg/L	2.5	2.5	2	200	NM GW	0	100	0	3.09	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	5	µg/L	0.7004	1	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-23	Single	816	n/a	24	13	µg/L	1.3768	8.79	2	200	NM GW	0	100	0	3.09	Regional	1	—
	R-23i	P1A	400.3	FD	1	1	µg/L	1.3	1.3	2	200	NM GW	0	100	0	1	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	13	µg/L	1.1161	3.5	2	200	NM GW	0	100	0	1	Intermediate	5	—
	R-23i	P2A	470.2	FD	2	2	µg/L	0.79	0.89	2	200	NM GW	0	100	0	1	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	18	µg/L	0.9483	1.8	2	200	NM GW	0	100	0	1	Intermediate	7	—
	R-23i	P3A	524	FD	2	2	µg/L	1.545	1.8	2	200	NM GW	0	100	0	1	Intermediate	2	—
	R-23i	P3A	524	n/a	17	15	µg/L	1.1409	2.5	2	200	NM GW	0	100	0	1	Intermediate	7	—
	R-32	MP1A	870.9	n/a	9	4	µg/L	1.18	2.3	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-32	MP3A	976	n/a	9	6	µg/L	1.23	2.1	2	200	NM GW	0	100	0	3.09	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	3.0167	6	2	200	NM GW	0	100	0	3.09	Regional	2	—
	R-32	Single	867.5	n/a	15	14	µg/L	2.0243	5.6	2	200	NM GW	0	100	0	3.09	Regional	2	—
	R-37	P1A	929.3	FD	1	1	µg/L	1.51	1.51	2	200	NM GW	0	100	0	1	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	10	µg/L	1.2123	1.51	2	200	NM GW	0	100	0	1	Intermediate	9	—
	R-37	P2A	1026	FD	1	1	µg/L	0.771	0.771	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-37	P2A	1026	n/a	9	8	µg/L	0.8791	1.27	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-38	Single	821.2	FD	4	4	µg/L	4.78	8.91	2	200	NM GW	0	100	0	3.09	Regional	3	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Nickel (continued)	R-38	Single	821.2	n/a	10	10	µg/L	10.549	27.5	2	200	NM GW	0	100	0	3.09	Regional	9	—
	R-39	Single	859	FD	1	1	µg/L	0.751	0.751	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-39	Single	859	n/a	11	10	µg/L	0.9508	2.1	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	µg/L	12.421	49.8	2	200	NM GW	0	100	0	1	Intermediate	7	—
	R-40	P2A	849.3	FD	2	2	µg/L	0.9815	1.43	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-40	P2A	849.3	n/a	9	8	µg/L	1.4714	3.84	2	200	NM GW	0	100	0	3.09	Regional	1	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	0.9411	1.17	2	200	NM GW	0	100	0	1	Intermediate	2	—
	R-41	P2A	965.3	FD	2	2	µg/L	2.535	2.99	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	µg/L	2.0538	3.26	2	200	NM GW	0	100	0	3.09	Regional	1	—
	R-49	P1A	845	n/a	9	9	µg/L	1.4459	2.31	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-49	P2A	905.6	n/a	9	6	µg/L	0.7182	1.05	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-51	P1A	914.96	n/a	6	3	µg/L	1.0357	1.84	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-51	P2A	1031	n/a	6	4	µg/L	0.6685	0.861	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-52	P1A	1035.2	n/a	5	3	µg/L	0.9313	1.35	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-52	P2A	1107	n/a	5	5	µg/L	0.8734	1.24	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-53	P1A	849.2	n/a	5	4	µg/L	1.0095	1.49	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-53	P2A	959.7	FD	2	2	µg/L	0.627	0.732	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-53	P2A	959.7	n/a	5	3	µg/L	0.6987	0.821	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-54	P1A	830	n/a	6	6	µg/L	3.2883	8.3	2	200	NM GW	0	100	0	3.09	Regional	3	—
	R-54	P2A	915	n/a	6	4	µg/L	0.7963	1.01	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-55	P1A	860	n/a	3	3	µg/L	1.615	2.94	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-55	P2A	994.4	n/a	3	1	µg/L	0.906	0.906	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-55i	Single	510	n/a	2	2	µg/L	3.88	3.9	2	200	NM GW	0	100	0	1	Intermediate	2	—
	R-56	P1A	945	n/a	3	2	µg/L	0.717	0.828	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	0.6793	0.909	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-57	P1A	910	n/a	2	2	µg/L	1.149	1.62	2	200	NM GW	0	100	0	3.09	Regional	0	—
	R-57	P2A	971.5	n/a	2	1	µg/L	0.763	0.763	2	200	NM GW	0	100	0	3.09	Regional	0	—
Selenium	R-20	MP1A	904.6	n/a	5	1	µg/L	3.3	3.3	5	50	EPA MCL	0	25	0	6	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	1	µg/L	3.5	3.5	5	50	EPA MCL	0	25	0	6	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-22	MP2A	962.8	n/a	16	1	µg/L	1.1	1.1	5	50	EPA MCL	0	25	0	6	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	1	µg/L	1	1	5	50	EPA MCL	0	25	0	6	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	2	µg/L	1.935	2.6	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-23	Single	816	n/a	25	3	µg/L	2.22	4.2	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-23i	P1A	400.3	n/a	14	1	µg/L	1.55	1.55	5	50	EPA MCL	0	25	0	6	Intermediate	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Selenium (continued)	R-23i	P2A	470.2	n/a	19	1	µg/L	1.16	1.16	5	50	EPA MCL	0	25	0	6	Intermediate	0	—
	R-32	MP1A	870.9	n/a	9	2	µg/L	2.8	4.5	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-32	Single	867.5	FD	6	1	µg/L	1.2	1.2	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-32	Single	867.5	n/a	15	2	µg/L	1.37	1.56	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-37	P1A	929.3	n/a	10	1	µg/L	1.25	1.25	5	50	EPA MCL	0	25	0	6	Intermediate	0	—
	R-49	P2A	905.6	n/a	9	1	µg/L	1.58	1.58	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-55i	Single	510	n/a	2	1	µg/L	2.91	2.91	5	50	EPA MCL	0	25	0	6	Intermediate	0	—
Silicon	R-22	MP1A	907.1	n/a	2	2	µg/L	14000	16000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	2	2	µg/L	31000	32000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	2	2	µg/L	21500	27000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	2	2	µg/L	18500	21000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	µg/L	23000	23000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
Silicon Dioxide	R-20	P1A	904.6	n/a	13	13	mg/L	69.046	71.8	0.1	—	—	—	—	—	88.5	Regional	0	—
Silicon Dioxide	R-20	P2A	1147.1	FD	3	3	mg/L	74.767	76.1	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-20	P2A	1147.1	n/a	14	14	mg/L	74.307	79	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-21	Single	888.8	FD	1	1	mg/L	73.3	73.3	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-21	Single	888.8	n/a	15	15	mg/L	70.927	77.3	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-22	MP2A	962.8	n/a	6	6	mg/L	65.917	68.6	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	3	3	mg/L	56.533	58.4	0.1	—	—	—	—	—	88.5	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	6	6	mg/L	62.817	64	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-23	Single	816	n/a	15	15	mg/L	63.84	69.9	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-23i	P1A	400.3	n/a	13	13	mg/L	50.162	54.9	0.1	—	—	—	—	—	50.72	Intermediate	9	—
	R-23i	P2A	470.2	FD	1	1	mg/L	42.4	42.4	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-23i	P2A	470.2	n/a	15	15	mg/L	41.173	44.2	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-23i	P3A	524	FD	1	1	mg/L	41.6	41.6	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-23i	P3A	524	n/a	13	13	mg/L	43.492	46.9	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-32	Single	867.5	FD	6	6	mg/L	63.533	67.6	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-32	Single	867.5	n/a	15	14	mg/L	64.843	69.6	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-37	P1A	929.3	FD	1	1	mg/L	60.1	60.1	0.1	—	—	—	—	—	50.72	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	10	mg/L	53.88	60.1	0.1	—	—	—	—	—	50.72	Intermediate	8	—
	R-37	P2A	1026	FD	1	1	mg/L	69.8	69.8	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-37	P2A	1026	n/a	9	8	mg/L	64.588	71.5	0.1	—	—	—	—	—	88.5	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Silicon Dioxide (continued)	R-38	Single	821.2	FD	4	4	mg/L	66.6	70.3	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-38	Single	821.2	n/a	10	10	mg/L	66.6	69.4	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-39	Single	859	FD	1	1	mg/L	67.6	67.6	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-39	Single	859	n/a	11	11	mg/L	67.373	72.5	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-40	P1A	751.6	n/a	8	8	mg/L	55.713	58.9	0.1	—	—	—	—	—	50.72	Intermediate	8	—
	R-40	P2A	849.3	FD	2	2	mg/L	71.65	74.3	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	mg/L	69.2	75.2	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	mg/L	53.186	62.2	0.1	—	—	—	—	—	50.72	Intermediate	5	—
	R-41	P2A	965.3	FD	2	2	mg/L	63.05	64.7	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	mg/L	62.93	64.8	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-49	P1A	845	n/a	9	9	mg/L	69.2	73.1	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	mg/L	68.244	71	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	mg/L	68.583	72.3	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-51	P2A	1031	n/a	6	6	mg/L	70.583	73.6	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	mg/L	68.46	76	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-52	P2A	1107	n/a	5	5	mg/L	70.36	71.9	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	mg/L	69.72	71.9	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-53	P2A	959.7	FD	2	2	mg/L	72.55	72.8	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	mg/L	72.48	75.3	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-54	P1A	830	n/a	6	6	mg/L	69.967	72.1	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-54	P2A	915	n/a	6	6	mg/L	72.317	74.7	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-55	P1A	860	n/a	3	3	mg/L	70.4	73.5	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	mg/L	67.267	69.8	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-55i	Single	510	n/a	2	2	mg/L	45.1	46.2	0.1	—	—	—	—	—	50.72	Intermediate	0	—
	R-56	P1A	945	n/a	3	2	mg/L	65.05	65.3	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-56	P2A	1046.6	n/a	3	2	mg/L	65.15	65.9	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-57	P1A	910	n/a	2	2	mg/L	66.45	68	0.1	—	—	—	—	—	88.5	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	mg/L	69.55	70	0.1	—	—	—	—	—	88.5	Regional	0	—
Silver	R-20	MP3A	1330	n/a	5	1	µg/L	0.92	0.92	1	50	NM GW	0	25	0	1	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
Strontium	R-20	MP1A	904.6	n/a	5	5	µg/L	39.32	42.2	5	22000	EPA Tap	0	11000	0	540	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	1912	2070	5	22000	EPA Tap	0	11000	0	540	Regional	5	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	131	191	5	22000	EPA Tap	0	11000	0	540	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	µg/L	139.54	157	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	µg/L	222.67	231	5	22000	EPA Tap	0	11000	0	540	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Strontium (continued)	R-20	P2A	1147.1	n/a	14	14	µg/L	207.43	232	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-21	Single	888.8	FD	3	3	µg/L	44.867	45.6	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-21	Single	888.8	n/a	25	25	µg/L	45.14	48.3	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-22	MP1A	907.1	n/a	5	5	µg/L	313.2	366	5	22000	EPA Tap	0	11000	0	540	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	16	16	µg/L	67.444	311	5	22000	EPA Tap	0	11000	0	540	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	634	634	5	22000	EPA Tap	0	11000	0	540	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	13	µg/L	561.77	940	5	22000	EPA Tap	0	11000	0	540	Regional	7	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	960	960	5	22000	EPA Tap	0	11000	0	540	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	5	5	µg/L	936	1100	5	22000	EPA Tap	0	11000	0	540	Regional	5	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	312	312	5	22000	EPA Tap	0	11000	0	540	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	5	5	µg/L	287.4	312	5	22000	EPA Tap	0	11000	0	540	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	µg/L	80.767	83	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-23	Single	816	n/a	25	25	µg/L	81.428	88	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	µg/L	97.3	97.3	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	14	µg/L	164.96	254	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	13	—
	R-23i	P2A	470.2	FD	2	2	µg/L	94.45	96.3	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	19	µg/L	95.295	111	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-23i	P3A	524	FD	2	2	µg/L	93.3	95.4	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-23i	P3A	524	n/a	17	17	µg/L	96.371	113	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-32	MP1A	870.9	n/a	9	9	µg/L	84.056	90.8	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-32	MP3A	976	n/a	9	9	µg/L	101.12	109	5	22000	EPA Tap	0	11000	0	540	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	82.35	93	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-32	Single	867.5	n/a	15	15	µg/L	77.307	90.5	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-37	P1A	929.3	FD	1	1	µg/L	103	103	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-37	P1A	929.3	n/a	10	10	µg/L	102.96	109	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-37	P2A	1026	FD	1	1	µg/L	54.7	54.7	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-37	P2A	1026	n/a	9	9	µg/L	63.044	94.6	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-38	Single	821.2	FD	4	4	µg/L	51.275	53.2	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-38	Single	821.2	n/a	10	10	µg/L	51.25	53.9	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-39	Single	859	FD	1	1	µg/L	54.9	54.9	5	22000	EPA Tap	0	11000	0	540	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Strontium (continued)	R-39	Single	859	n/a	11	11	µg/L	55.655	60.7	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	µg/L	102.46	114	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-40	P2A	849.3	FD	2	2	µg/L	50.8	51.6	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	µg/L	52.978	68.8	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	94.814	106	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	0	—
	R-41	P2A	965.3	FD	2	2	µg/L	76.65	77.4	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	µg/L	75.12	81.7	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-49	P1A	845	n/a	9	9	µg/L	74.978	107	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-49	P2A	905.6	n/a	9	9	µg/L	57.356	65.9	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	µg/L	81.5	98.3	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-51	P2A	1031	n/a	6	6	µg/L	54.15	57.9	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	62.36	67.4	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-52	P2A	1107	n/a	5	5	µg/L	48.84	49.7	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	µg/L	44.66	48.3	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-53	P2A	959.7	FD	2	2	µg/L	45.8	46.5	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	µg/L	45.72	46.9	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-54	P1A	830	n/a	6	6	µg/L	54.233	66.1	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-54	P2A	915	n/a	6	6	µg/L	53.117	56.6	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-55	P1A	860	n/a	3	3	µg/L	72.967	73.4	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	µg/L	80.233	86.6	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-55i	Single	510	n/a	2	2	µg/L	166	166	5	22000	EPA Tap	0	11000	0	154.76	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	µg/L	57.033	58	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	54.4	55.6	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-57	P1A	910	n/a	2	2	µg/L	59.9	61.4	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	µg/L	60.45	61.7	5	22000	EPA Tap	0	11000	0	540	Regional	0	—
Thallium	R-20	MP1A	904.6	n/a	5	3	µg/L	0.2767	0.42	1	2	EPA MCL	0	1	0	1	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	2	µg/L	0.309	0.33	1	2	EPA MCL	0	1	0	1	Regional	0	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	3	µg/L	0.236	0.41	1	2	EPA MCL	0	1	0	1	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	3	µg/L	0.4333	0.5	1	2	EPA MCL	0	1	0	1	Regional	0	—
	R-20	P2A	1147.1	n/a	14	1	µg/L	0.4	0.4	1	2	EPA MCL	0	1	0	1	Regional	0	—
	R-21	Single	888.8	n/a	25	6	µg/L	0.5335	0.83	1	2	EPA MCL	0	1	0	1	Regional	0	—
	R-22	MP3A	1273.5	n/a	13	2	µg/L	0.525	0.62	1	2	EPA MCL	0	1	0	1	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	4	µg/L	0.413	0.57	1	2	EPA MCL	0	1	0	1	Regional	0	—
	R-23i	P1A	400.3	n/a	14	2	µg/L	0.415	0.47	1	2	EPA MCL	0	1	0	1	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	2	µg/L	0.53	0.65	1	2	EPA MCL	0	1	0	1	Intermediate	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Thallium (continued)	R-32	MP1A	870.9	n/a	9	3	µg/L	0.3753	0.53	1	2	EPA MCL	0	1	0	1	Regional	0	—
	R-32	MP3A	976	n/a	9	3	µg/L	0.3707	0.442	1	2	EPA MCL	0	1	0	1	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	n/a	15	1	µg/L	0.47	0.47	1	2	EPA MCL	0	1	0	1	Regional	0	—
	R-40	P2A	849.3	n/a	9	1	µg/L	0.557	0.557	1	2	EPA MCL	0	1	0	1	Regional	0	—
	R-49	P1A	845	n/a	9	1	µg/L	0.328	0.328	1	2	EPA MCL	0	1	0	1	Regional	0	—
	R-52	P1A	1035.2	n/a	5	1	µg/L	0.338	0.338	1	2	EPA MCL	0	1	0	1	Regional	0	—
Tin	R-20	P1A	904.6	n/a	13	1	µg/L	3.86	3.86	10	22000	EPA Tap	0	11000	0	3.26	Regional	1	—
	R-23i	P1A	400.3	FD	1	1	µg/L	2.6	2.6	10	22000	EPA Tap	0	11000	0	3.26	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	1	µg/L	4.03	4.03	10	22000	EPA Tap	0	11000	0	3.26	Intermediate	1	—
	R-32	Single	867.5	n/a	15	2	µg/L	9.205	15.5	10	22000	EPA Tap	0	11000	0	3.26	Regional	1	—
	R-37	P1A	929.3	n/a	10	1	µg/L	3.48	3.48	10	22000	EPA Tap	0	11000	0	3.26	Intermediate	1	—
	R-37	P2A	1026	n/a	9	1	µg/L	3.65	3.65	10	22000	EPA Tap	0	11000	0	3.26	Regional	1	—
	R-39	Single	859	n/a	11	1	µg/L	5.96	5.96	10	22000	EPA Tap	0	11000	0	3.26	Regional	1	—
	R-49	P1A	845	n/a	9	1	µg/L	3.74	3.74	10	22000	EPA Tap	0	11000	0	3.26	Regional	1	—
	R-49	P2A	905.6	n/a	9	1	µg/L	5.68	5.68	10	22000	EPA Tap	0	11000	0	3.26	Regional	1	—
Uranium	R-20	MP1A	904.6	n/a	5	4	µg/L	0.1413	0.16	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	0.0954	0.175	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	Before well rehabilitation.
	R-20	P1A	904.6	n/a	13	11	µg/L	0.6927	1.09	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	µg/L	0.542	0.615	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-20	P2A	1147.1	n/a	14	13	µg/L	0.5873	0.69	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-21	Single	888.8	FD	3	2	µg/L	0.345	0.36	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-21	Single	888.8	n/a	25	22	µg/L	0.3634	0.61	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-22	MP1A	907.1	n/a	4	2	µg/L	0.095	0.14	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	15	11	µg/L	0.3809	0.47	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	3.8	3.8	0.2	30	EPA MCL	0	15	0	1.9	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	12	12	µg/L	4.0433	15.2	0.2	30	EPA MCL	0	15	1	1.9	Regional	11	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	0.28	0.28	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	4	2	µg/L	0.21	0.29	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	4	1	µg/L	0.16	0.16	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	10	µg/L	0.4853	0.533	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-23	Single	816	n/a	25	21	µg/L	0.528	0.802	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Uranium (continued)	R-23i	P1A	400.3	FD	1	1	µg/L	1.4	1.4	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	12	µg/L	2.4348	18.9	0.2	30	EPA MCL	0	15	1	0.72	Intermediate	10	—
	R-23i	P2A	470.2	FD	2	2	µg/L	0.943	0.98	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	2	—
	R-23i	P2A	470.2	n/a	19	18	µg/L	1.0252	1.7	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	17	—
	R-23i	P3A	524	FD	2	1	µg/L	0.55	0.55	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	0	—
	R-23i	P3A	524	n/a	17	15	µg/L	0.6601	1.1	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	3	—
	R-32	MP1A	870.9	n/a	9	9	µg/L	1.0767	1.8	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-32	MP3A	976	n/a	9	8	µg/L	0.2005	0.56	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	0.7883	0.89	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-32	Single	867.5	n/a	15	14	µg/L	0.7296	0.88	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-37	P1A	929.3	FD	1	1	µg/L	1.32	1.32	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	10	µg/L	1.558	1.84	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	10	—
	R-37	P2A	1026	FD	1	1	µg/L	0.497	0.497	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-37	P2A	1026	n/a	9	9	µg/L	0.7297	1.75	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-38	Single	821.2	FD	4	4	µg/L	0.401	0.427	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-38	Single	821.2	n/a	10	10	µg/L	0.4235	0.556	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-39	Single	859	FD	1	1	µg/L	0.413	0.413	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-39	Single	859	n/a	11	10	µg/L	0.4161	0.478	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-40	P1A	751.6	n/a	7	7	µg/L	0.9651	1.1	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	7	—
	R-40	P2A	849.3	FD	2	2	µg/L	0.3185	0.354	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-40	P2A	849.3	n/a	9	9	µg/L	0.3323	0.49	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-40	R-40i	649.7	n/a	7	6	µg/L	0.5045	0.96	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	1	—
	R-41	P2A	965.3	FD	2	2	µg/L	0.6275	0.648	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	µg/L	0.7577	1.29	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-49	P1A	845	n/a	9	9	µg/L	1.162	1.47	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-49	P2A	905.6	n/a	9	8	µg/L	0.3719	0.553	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	µg/L	0.3395	0.5	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-51	P2A	1031	n/a	6	6	µg/L	0.3848	0.551	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	0.558	0.751	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-52	P2A	1107	n/a	5	4	µg/L	0.372	0.45	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	µg/L	0.4806	0.509	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-53	P2A	959.7	FD	2	2	µg/L	0.429	0.452	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	µg/L	0.4718	0.595	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-54	P1A	830	n/a	6	6	µg/L	0.5465	0.682	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-54	P2A	915	n/a	6	5	µg/L	0.433	0.503	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-55	P1A	860	n/a	3	3	µg/L	0.6357	0.645	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Uranium (continued)	R-55	P2A	994.4	n/a	3	3	µg/L	0.6307	0.683	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-55i	Single	510	n/a	2	2	µg/L	1.175	1.23	0.2	30	EPA MCL	0	15	0	0.72	Intermediate	2	—
	R-56	P1A	945	n/a	3	3	µg/L	0.6597	0.666	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	0.5977	0.66	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-57	P1A	910	n/a	2	1	µg/L	0.372	0.372	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	µg/L	0.3825	0.454	0.2	30	EPA MCL	0	15	0	1.9	Regional	0	—
Vanadium	R-20	MP3A	1330	n/a	5	1	µg/L	3.9	3.9	5	180	EPA Tap	0	90	0	13.41	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	12	µg/L	4.6708	7.76	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-20	P2A	1147.1	FD	3	3	µg/L	3.0733	3.45	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-20	P2A	1147.1	n/a	14	9	µg/L	4.3133	5.24	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-21	Single	888.8	FD	3	2	µg/L	5.35	5.4	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-21	Single	888.8	n/a	25	23	µg/L	5.1783	6.4	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-22	MP2A	962.8	n/a	16	10	µg/L	4.929	5.6	5	180	EPA Tap	0	90	0	13.41	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	6.1	6.1	5	180	EPA Tap	0	90	0	13.41	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	9	µg/L	7.2667	8.7	5	180	EPA Tap	0	90	0	13.41	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	µg/L	6.375	7.4	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-23	Single	816	n/a	25	24	µg/L	6.4421	8.1	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-23i	P1A	400.3	FD	1	1	µg/L	4.2	4.2	5	180	EPA Tap	0	90	0	4.91	Intermediate	0	—
	R-23i	P1A	400.3	n/a	14	11	µg/L	3.2873	5.5	5	180	EPA Tap	0	90	0	4.91	Intermediate	1	—
	R-23i	P2A	470.2	FD	2	2	µg/L	4.715	5.53	5	180	EPA Tap	0	90	0	4.91	Intermediate	1	—
	R-23i	P2A	470.2	n/a	19	18	µg/L	4.6522	6.03	5	180	EPA Tap	0	90	0	4.91	Intermediate	6	—
	R-23i	P3A	524	FD	2	1	µg/L	4.73	4.73	5	180	EPA Tap	0	90	0	4.91	Intermediate	0	—
	R-23i	P3A	524	n/a	17	16	µg/L	5.2925	8	5	180	EPA Tap	0	90	0	4.91	Intermediate	9	—
	R-32	MP1A	870.9	n/a	9	6	µg/L	4.0667	5.5	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-32	MP3A	976	n/a	9	3	µg/L	1.9	2.6	5	180	EPA Tap	0	90	0	13.41	Regional	0	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	4	µg/L	3.6	4.1	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-32	Single	867.5	n/a	15	13	µg/L	3.5146	4.39	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-37	P1A	929.3	FD	1	1	µg/L	4.71	4.71	5	180	EPA Tap	0	90	0	4.91	Intermediate	0	—
	R-37	P1A	929.3	n/a	10	10	µg/L	5.093	5.95	5	180	EPA Tap	0	90	0	4.91	Intermediate	5	—
	R-37	P2A	1026	FD	1	1	µg/L	5.77	5.77	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-37	P2A	1026	n/a	9	8	µg/L	5.9	6.44	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-38	Single	821.2	FD	4	4	µg/L	4.4275	4.96	5	180	EPA Tap	0	90	0	13.41	Regional	0	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Vanadium (continued)	R-38	Single	821.2	n/a	10	9	µg/L	4.2911	4.86	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-39	Single	859	FD	1	1	µg/L	4.95	4.95	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-39	Single	859	n/a	11	10	µg/L	5.531	6.13	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-40	P1A	751.6	n/a	7	6	µg/L	2.88	4.69	5	180	EPA Tap	0	90	0	4.91	Intermediate	0	—
	R-40	P2A	849.3	FD	2	1	µg/L	5.2	5.2	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-40	P2A	849.3	n/a	9	8	µg/L	4.5675	5.81	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-41	P2A	965.3	FD	2	2	µg/L	5.82	5.83	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-41	P2A	965.3	n/a	10	10	µg/L	6.232	6.81	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-49	P1A	845	n/a	9	9	µg/L	4.42	5.96	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-49	P2A	905.6	n/a	9	8	µg/L	4.6775	5.39	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-51	P1A	914.96	n/a	6	6	µg/L	5.6667	6.33	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-51	P2A	1031	n/a	6	6	µg/L	5.7217	6.53	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	6.08	6.61	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-52	P2A	1107	n/a	5	5	µg/L	6.046	6.3	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-53	P1A	849.2	n/a	5	5	µg/L	4.626	5.48	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-53	P2A	959.7	FD	2	2	µg/L	5.45	5.47	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-53	P2A	959.7	n/a	5	5	µg/L	5.144	5.7	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-54	P1A	830	n/a	6	5	µg/L	2.466	4.22	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-54	P2A	915	n/a	6	6	µg/L	5.1817	5.66	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-55	P1A	860	n/a	3	3	µg/L	5.2367	5.65	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-55	P2A	994.4	n/a	3	3	µg/L	4.9433	5.54	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-55i	Single	510	n/a	2	1	µg/L	2.91	2.91	5	180	EPA Tap	0	90	0	4.91	Intermediate	0	—
	R-56	P1A	945	n/a	3	2	µg/L	3.68	3.91	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-56	P2A	1046.6	n/a	3	2	µg/L	3.81	3.88	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-57	P1A	910	n/a	2	2	µg/L	4.665	5.06	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
	R-57	P2A	971.5	n/a	2	2	µg/L	4.475	5.04	5	180	EPA Tap	0	90	0	13.41	Regional	0	—
Zinc	R-20	MP2A	1147.1	n/a	4	2	µg/L	30.82	59.5	10	10000	NM GW	0	5000	0	3.89	Regional	1	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	4	µg/L	8.1075	13.1	10	10000	NM GW	0	5000	0	3.89	Regional	3	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	9	µg/L	7.1011	19.4	10	10000	NM GW	0	5000	0	3.89	Regional	6	—
	R-20	P2A	1147.1	n/a	14	5	µg/L	4.126	8.1	10	10000	NM GW	0	5000	0	3.89	Regional	2	—
	R-21	Single	888.8	n/a	25	7	µg/L	5.9043	7.81	10	10000	NM GW	0	5000	0	3.89	Regional	6	—
	R-22	MP2A	962.8	n/a	16	4	µg/L	5.3	11	10	10000	NM GW	0	5000	0	3.89	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	2.9	2.9	10	10000	NM GW	0	5000	0	3.89	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	4	µg/L	14.825	51	10	10000	NM GW	0	5000	0	3.89	Regional	1	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Zinc (continued)	R-22	MP4A	1378	n/a	5	1	µg/L	12.3	12.3	10	10000	NM GW	0	5000	0	3.89	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	1	µg/L	16.1	16.1	10	10000	NM GW	0	5000	0	3.89	Regional	1	—
	R-23	Single	816	n/a	25	9	µg/L	10.981	30.5	10	10000	NM GW	0	5000	0	3.89	Regional	6	—
	R-23i	P1A	400.3	FD	1	1	µg/L	3.6	3.6	10	10000	NM GW	0	5000	0	2	Intermediate	1	—
	R-23i	P1A	400.3	n/a	14	10	µg/L	8.719	21.2	10	10000	NM GW	0	5000	0	2	Intermediate	10	—
	R-23i	P2A	470.2	FD	2	2	µg/L	13.565	22.6	10	10000	NM GW	0	5000	0	2	Intermediate	2	—
	R-23i	P2A	470.2	n/a	19	12	µg/L	7.0875	31.3	10	10000	NM GW	0	5000	0	2	Intermediate	12	—
	R-23i	P3A	524	n/a	17	5	µg/L	4.354	7	10	10000	NM GW	0	5000	0	2	Intermediate	5	—
	R-32	MP1A	870.9	n/a	9	5	µg/L	6.14	9.6	10	10000	NM GW	0	5000	0	3.89	Regional	4	—
	R-32	MP3A	976	n/a	9	6	µg/L	6.9817	11.2	10	10000	NM GW	0	5000	0	3.89	Regional	5	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	65	103	10	10000	NM GW	0	5000	0	3.89	Regional	6	—
	R-32	Single	867.5	n/a	15	15	µg/L	47.48	102	10	10000	NM GW	0	5000	0	3.89	Regional	15	—
	R-37	P1A	929.3	FD	1	1	µg/L	9.35	9.35	10	10000	NM GW	0	5000	0	2	Intermediate	1	—
	R-37	P1A	929.3	n/a	10	7	µg/L	26.654	115	10	10000	NM GW	0	5000	0	2	Intermediate	7	—
	R-37	P2A	1026	n/a	9	4	µg/L	7.78	12.8	10	10000	NM GW	0	5000	0	3.89	Regional	4	—
	R-38	Single	821.2	FD	4	4	µg/L	8.0575	12.8	10	10000	NM GW	0	5000	0	3.89	Regional	4	—
	R-38	Single	821.2	n/a	10	9	µg/L	21.446	69	10	10000	NM GW	0	5000	0	3.89	Regional	9	—
	R-39	Single	859	FD	1	1	µg/L	3.5	3.5	10	10000	NM GW	0	5000	0	3.89	Regional	0	—
	R-39	Single	859	n/a	11	6	µg/L	12.925	28.1	10	10000	NM GW	0	5000	0	3.89	Regional	5	—
	R-40	P1A	751.6	n/a	7	7	µg/L	143.39	909	10	10000	NM GW	0	5000	0	2	Intermediate	7	—
	R-40	P2A	849.3	FD	2	1	µg/L	5.5	5.5	10	10000	NM GW	0	5000	0	3.89	Regional	1	—
	R-40	P2A	849.3	n/a	9	8	µg/L	26.615	158	10	10000	NM GW	0	5000	0	3.89	Regional	7	—
	R-40	R-40i	649.7	n/a	7	3	µg/L	116.52	343	10	10000	NM GW	0	5000	0	2	Intermediate	3	—
	R-41	P2A	965.3	n/a	10	2	µg/L	4.805	5.38	10	10000	NM GW	0	5000	0	3.89	Regional	2	—
	R-49	P1A	845	n/a	9	3	µg/L	7.2167	9.47	10	10000	NM GW	0	5000	0	3.89	Regional	3	—
	R-49	P2A	905.6	n/a	9	3	µg/L	3.4	4.15	10	10000	NM GW	0	5000	0	3.89	Regional	2	—
	R-51	P1A	914.96	n/a	6	6	µg/L	14.415	32.4	10	10000	NM GW	0	5000	0	3.89	Regional	5	—
	R-51	P2A	1031	n/a	6	4	µg/L	5.905	8.73	10	10000	NM GW	0	5000	0	3.89	Regional	3	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	17.256	40.6	10	10000	NM GW	0	5000	0	3.89	Regional	5	—
	R-52	P2A	1107	n/a	5	1	µg/L	8.61	8.61	10	10000	NM GW	0	5000	0	3.89	Regional	1	—
	R-53	P1A	849.2	n/a	5	4	µg/L	94.35	221	10	10000	NM GW	0	5000	0	3.89	Regional	4	—
	R-53	P2A	959.7	FD	2	1	µg/L	3.8	3.8	10	10000	NM GW	0	5000	0	3.89	Regional	0	—
	R-53	P2A	959.7	n/a	5	3	µg/L	6.66	10.5	10	10000	NM GW	0	5000	0	3.89	Regional	3	—
	R-54	P1A	830	n/a	6	6	µg/L	22.328	60.5	10	10000	NM GW	0	5000	0	3.89	Regional	5	—
	R-55	P1A	860	n/a	3	1	µg/L	4.05	4.05	10	10000	NM GW	0	5000	0	3.89	Regional	1	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Zinc (continued)	R-55	P2A	994.4	n/a	3	1	µg/L	4.84	4.84	10	10000	NM GW	0	5000	0	3.89	Regional	1	—
	R-55i	Single	510	n/a	2	1	µg/L	10.4	10.4	10	10000	NM GW	0	5000	0	2	Intermediate	1	—
	R-56	P1A	945	n/a	3	2	µg/L	60	106	10	10000	NM GW	0	5000	0	3.89	Regional	2	—
	R-56	P2A	1046.6	n/a	3	1	µg/L	14.1	14.1	10	10000	NM GW	0	5000	0	3.89	Regional	1	—
	R-57	P1A	910	n/a	2	1	µg/L	29.2	29.2	10	10000	NM GW	0	5000	0	3.89	Regional	1	—
	R-57	P2A	971.5	n/a	2	1	µg/L	4.31	4.31	10	10000	NM GW	0	5000	0	3.89	Regional	1	—
Not Filtered Metals																			
Aluminum	R-20	MP1A	904.6	n/a	5	3	µg/L	69.033	110	200	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	4	1	µg/L	45.8	45.8	200	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	4	µg/L	45.425	104	200	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P2A	1147.1	FD	3	1	µg/L	417	417	200	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	3	µg/L	123.63	216	200	—	—	—	—	—	—	—	—	—
	R-22	MP2A	962.8	n/a	18	1	µg/L	48.7	48.7	200	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	3	µg/L	25.533	37.5	200	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	2	µg/L	34.25	53.2	200	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	6	1	µg/L	43.3	43.3	200	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	24	3	µg/L	45.4	69.6	200	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	10	µg/L	307.88	1050	200	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	1	µg/L	654	654	200	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	2	µg/L	382.8	679	200	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	3	µg/L	2123.3	6080	200	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	8	1	µg/L	20.3	20.3	200	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	1	µg/L	23.3	23.3	200	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-37	P1A	929.3	n/a	10	2	µg/L	126.15	163	200	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	245	245	200	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	7	µg/L	170.51	267	200	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	157	157	200	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	7	µg/L	170.27	261	200	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	1	µg/L	85.3	85.3	200	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	4	µg/L	330.68	901	200	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	2	µg/L	406.5	711	200	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	3	µg/L	270	361	200	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Aluminum (continued)	R-49	P1A	845	n/a	9	9	µg/L	785.69	3020	200	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	3	µg/L	198.1	424	200	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	2	µg/L	1386.4	2690	200	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	1	µg/L	118	118	200	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	1	µg/L	69.1	69.1	200	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	1	µg/L	374	374	200	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	4	µg/L	511.28	1710	200	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	1	µg/L	78.7	78.7	200	—	—	—	—	—	—	—	—	—
Antimony	R-22	MP2A	962.8	n/a	19	1	µg/L	3.7	3.7	2	6	EPA MCL	0	3	1	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	1	µg/L	0.28	0.28	2	6	EPA MCL	0	3	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	1	µg/L	1.51	1.51	2	6	EPA MCL	0	3	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-37	P1A	929.3	n/a	10	1	µg/L	0.506	0.506	2	6	EPA MCL	0	3	0	—	—	—	—
	R-38	Single	821.2	FD	4	1	µg/L	0.561	0.561	2	6	EPA MCL	0	3	0	—	—	—	—
	R-38	Single	821.2	n/a	10	5	µg/L	0.7554	0.916	2	6	EPA MCL	0	3	0	—	—	—	—
	R-40	P1A	751.6	n/a	8	5	µg/L	4.2724	8.94	2	6	EPA MCL	2	3	2	—	—	—	Antimony was detected above the EPA MCL standard in 2 of the 8 samples at this screen.
	R-49	P1A	845	n/a	9	1	µg/L	0.509	0.509	2	6	EPA MCL	0	3	0	—	—	—	—
	R-53	P1A	849.2	n/a	5	1	µg/L	0.506	0.506	2	6	EPA MCL	0	3	0	—	—	—	—
Arsenic	R-20	MP1A	904.6	n/a	5	3	µg/L	4.2867	5.06	5	10	EPA MCL	0	5	1	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	1	µg/L	4.03	4.03	5	10	EPA MCL	0	5	0	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	3	µg/L	6.7333	8.2	5	10	EPA MCL	0	5	3	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	2	µg/L	2.835	3.25	5	10	EPA MCL	0	5	0	—	—	—	—
	R-20	P2A	1147.1	n/a	13	1	µg/L	1.8	1.8	5	10	EPA MCL	0	5	0	—	—	—	—
	R-21	Single	888.8	n/a	25	7	µg/L	2.1814	3.71	5	10	EPA MCL	0	5	0	—	—	—	—
	R-22	MP2A	962.8	n/a	19	1	µg/L	1.5	1.5	5	10	EPA MCL	0	5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	5	µg/L	3.058	4.99	5	10	EPA MCL	0	5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	3	µg/L	3.0233	3.61	5	10	EPA MCL	0	5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	1	µg/L	2.51	2.51	5	10	EPA MCL	0	5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	3	µg/L	2.5667	3.2	5	10	EPA MCL	0	5	0	—	—	—	—
	R-23	Single	816	n/a	25	4	µg/L	2.3475	2.9	5	10	EPA MCL	0	5	0	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Arsenic (continued)	R-23i	P1A	400.3	FD	1	1	µg/L	4.4	4.4	5	10	EPA MCL	0	5	0	—	—	—	—
	R-23i	P1A	400.3	n/a	14	4	µg/L	3.685	4.9	5	10	EPA MCL	0	5	0	—	—	—	—
	R-23i	P2A	470.2	n/a	19	7	µg/L	2.1929	3.03	5	10	EPA MCL	0	5	0	—	—	—	—
	R-23i	P3A	524	FD	2	1	µg/L	1.8	1.8	5	10	EPA MCL	0	5	0	—	—	—	—
	R-23i	P3A	524	n/a	16	6	µg/L	2.6217	3.84	5	10	EPA MCL	0	5	0	—	—	—	—
	R-32	MP3A	976	n/a	9	1	µg/L	2	2	5	10	EPA MCL	0	5	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	2	µg/L	1.6	1.6	5	10	EPA MCL	0	5	0	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	2.17	2.17	5	10	EPA MCL	0	5	0	—	—	—	—
	R-37	P1A	929.3	n/a	10	3	µg/L	3.02	3.94	5	10	EPA MCL	0	5	0	—	—	—	—
	R-37	P2A	1026	n/a	9	1	µg/L	1.97	1.97	5	10	EPA MCL	0	5	0	—	—	—	—
	R-38	Single	821.2	FD	4	1	µg/L	3.38	3.38	5	10	EPA MCL	0	5	0	—	—	—	—
	R-38	Single	821.2	n/a	10	2	µg/L	2.615	2.93	5	10	EPA MCL	0	5	0	—	—	—	—
	R-39	Single	859	n/a	11	1	µg/L	2.14	2.14	5	10	EPA MCL	0	5	0	—	—	—	—
	R-40	P1A	751.6	n/a	8	1	µg/L	2.27	2.27	5	10	EPA MCL	0	5	0	—	—	—	—
	R-40	P2A	849.3	n/a	9	1	µg/L	1.95	1.95	5	10	EPA MCL	0	5	0	—	—	—	—
	R-40	R-40i	649.7	n/a	7	3	µg/L	3.1267	4.07	5	10	EPA MCL	0	5	0	—	—	—	—
	R-41	P2A	965.3	n/a	10	1	µg/L	1.53	1.53	5	10	EPA MCL	0	5	0	—	—	—	—
	R-49	P1A	845	n/a	9	3	µg/L	3.22	3.91	5	10	EPA MCL	0	5	0	—	—	—	—
	R-49	P2A	905.6	n/a	9	1	µg/L	3.34	3.34	5	10	EPA MCL	0	5	0	—	—	—	—
	R-51	P1A	914.96	n/a	6	2	µg/L	2.17	2.78	5	10	EPA MCL	0	5	0	—	—	—	—
	R-51	P2A	1031	n/a	6	1	µg/L	4.18	4.18	5	10	EPA MCL	0	5	0	—	—	—	—
	R-52	P2A	1107	n/a	5	1	µg/L	2.44	2.44	5	10	EPA MCL	0	5	0	—	—	—	—
	R-54	P1A	830	n/a	6	3	µg/L	1.9467	2.44	5	10	EPA MCL	0	5	0	—	—	—	—
	R-54	P2A	915	n/a	6	2	µg/L	2.515	2.77	5	10	EPA MCL	0	5	0	—	—	—	—
Barium	R-20	MP1A	904.6	n/a	5	5	µg/L	24.96	29.6	5	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	215	261	5	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	106.56	153	5	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	µg/L	77.2	90.5	5	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µg/L	180	185	5	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	µg/L	156.77	199	5	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	µg/L	13.6	13.7	5	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	25	µg/L	14.06	15.7	5	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	7	µg/L	217.71	239	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Barium (continued)	R-22	MP2A	962.8	n/a	19	17	µg/L	14.276	16.7	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	149	149	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	15	µg/L	128.22	187	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	337	337	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	µg/L	343.71	362	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	143	143	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	µg/L	132.86	141	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	µg/L	24.633	32.9	5	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	25	µg/L	25.784	39.9	5	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	7.9	7.9	5	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	µg/L	54.279	87.8	5	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µg/L	9.31	10.5	5	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	µg/L	8.9832	12.6	5	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	µg/L	9.025	9.7	5	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	16	µg/L	13.039	64.3	5	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	9	µg/L	64.089	86.5	5	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	9	µg/L	81.1	92	5	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	45.783	49.6	5	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	µg/L	43.253	50.6	5	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	9.5	9.5	5	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	µg/L	13.913	32	5	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	32.9	32.9	5	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	µg/L	32.578	37.7	5	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	µg/L	29.8	30.6	5	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	µg/L	30.73	34.1	5	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	17.6	17.6	5	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	µg/L	18.473	31.7	5	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µg/L	31.663	39.1	5	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	µg/L	23.15	23.9	5	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	µg/L	25.367	34.2	5	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	25.757	29.3	5	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Barium (continued)	R-41	P2A	965.3	FD	2	2	µg/L	29.1	29.4	5	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	µg/L	26.444	35.7	5	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	µg/L	44.533	121	5	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	9	µg/L	23.156	36.5	5	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	µg/L	25.517	27.7	5	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	µg/L	21.217	26.5	5	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	30.1	31.8	5	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	5	µg/L	27.64	30.3	5	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	µg/L	25.06	28.8	5	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	µg/L	29.45	29.6	5	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	µg/L	28.18	30	5	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	µg/L	22.683	66	5	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	µg/L	12.152	19.4	5	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	µg/L	36.233	36.9	5	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	µg/L	30.833	32	5	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	µg/L	45.75	52.9	5	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	µg/L	27.5	33.6	5	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	27.633	30.6	5	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	µg/L	17.1	17.5	5	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µg/L	20.05	20.1	5	—	—	—	—	—	—	—	—	—
Beryllium	R-23i	P3A	524	n/a	16	1	µg/L	1.4	1.4	0.5	4	EPA MCL	0	2	0	—	—	—	—
Boron	R-20	MP1A	904.6	n/a	5	4	µg/L	39	51.7	50	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	82.72	94.9	50	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	4	µg/L	32.5	35.4	50	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	8	µg/L	15.7	21.8	50	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	1	µg/L	20.6	20.6	50	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	6	µg/L	18.033	24.5	50	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	2	µg/L	11.2	12.2	50	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	14	µg/L	13.369	18.9	50	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	4	µg/L	34.45	42.5	50	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	10	µg/L	13.13	19.3	50	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	30.5	30.5	50	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	12	µg/L	27.483	51	50	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Boron (continued)	R-22	MP4A	1378	FD	1	1	µg/L	93.9	93.9	50	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	µg/L	102.54	115	50	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	3	µg/L	35.733	45.3	50	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	6	µg/L	13.75	15.6	50	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	17	µg/L	13.82	18.2	50	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	17.2	17.2	50	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	9	µg/L	16.344	20.7	50	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µg/L	16.85	17.8	50	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	15	µg/L	20.6	63.9	50	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	µg/L	15.05	15.5	50	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	14	µg/L	16.907	23	50	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	7	µg/L	12.076	17.3	50	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	8	µg/L	13.45	15.1	50	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	3	µg/L	15.533	17.4	50	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	4	µg/L	16.925	19.4	50	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	30.6	30.6	50	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	µg/L	28.38	35.3	50	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	5	µg/L	16.42	22.7	50	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	1	µg/L	17.5	17.5	50	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µg/L	17.963	22.7	50	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	6	µg/L	17.317	21.9	50	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	1	µg/L	15	15	50	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	5	µg/L	19.7	20.7	50	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	6	µg/L	20.317	35.5	50	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	2	µg/L	13.85	15	50	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	1	µg/L	16.9	16.9	50	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	1	µg/L	16.2	16.2	50	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	2	µg/L	16.85	18.5	50	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	1	µg/L	18.2	18.2	50	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	1	µg/L	15.1	15.1	50	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	4	µg/L	18.85	22.9	50	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	1	µg/L	16.7	16.7	50	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	µg/L	19.867	20.9	50	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	µg/L	21.133	23.1	50	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Boron (continued)	R-55i	Single	510	n/a	2	2	µg/L	18.7	19	50	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	2	µg/L	16.1	16.2	50	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	1	µg/L	15.6	15.6	50	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	1	µg/L	16.9	16.9	50	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µg/L	16.45	17.8	50	—	—	—	—	—	—	—	—	—
Cadmium	R-23	Single	816	FD	12	1	µg/L	0.159	0.159	1	5	EPA MCL	0	2.5	0	—	—	—	—
	R-23	Single	816	n/a	25	2	µg/L	0.167	0.224	1	5	EPA MCL	0	2.5	0	—	—	—	—
	R-23i	P3A	524	n/a	16	1	µg/L	0.36	0.36	1	5	EPA MCL	0	2.5	0	—	—	—	—
Chromium	R-20	MP1A	904.6	n/a	5	1	µg/L	1.4	1.4	5	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	3	µg/L	4.8967	9.49	5	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	3	µg/L	4.93	6.5	5	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	6	µg/L	3.32	4.9	5	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	2	µg/L	5.64	7.73	5	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	10	µg/L	3.735	5.9	5	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	1	µg/L	2.8	2.8	5	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	16	µg/L	3.3306	5.25	5	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	2	µg/L	16.245	31.4	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	10	µg/L	6.949	20.1	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	14.6	14.6	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	11	µg/L	10.357	47	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	1	µg/L	5.24	5.24	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	1	µg/L	2.23	2.23	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	10	µg/L	3.659	5.35	5	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	20	µg/L	4.8369	20.1	5	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	1.5	1.5	5	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	9	µg/L	5.8478	18	5	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	4	µg/L	2.5375	4.05	5	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	µg/L	2.73	3.86	5	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	10	µg/L	11.075	82.4	5	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	4	µg/L	7.384	24.3	5	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Chromium (continued)	R-32	MP3A	976	n/a	9	4	µg/L	5.6	10.4	5	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	4	µg/L	5.15	9.6	5	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	8	µg/L	3.94	6.14	5	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	3	µg/L	3.1733	3.35	5	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	35.6	35.6	5	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	5	µg/L	7.942	21.5	5	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	1	µg/L	4.67	4.67	5	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	7	µg/L	6.7229	11.9	5	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	2.75	2.75	5	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	7	µg/L	3.6329	4.57	5	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	3	µg/L	4.6967	5.55	5	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	5	µg/L	3.722	5.45	5	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	2	µg/L	2.48	2.66	5	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	µg/L	4.27	4.96	5	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	7	µg/L	4.1771	6.66	5	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	7	µg/L	4.3471	7.82	5	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	6	µg/L	3.4633	4.89	5	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	3	µg/L	3.7433	4.27	5	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	5	µg/L	3.518	4.64	5	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	4	µg/L	3.875	4.9	5	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	3	µg/L	4.5933	6.32	5	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	3	µg/L	2.7633	3.8	5	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	µg/L	2.5	2.75	5	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	3	µg/L	3.4733	5.4	5	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	2	µg/L	73.25	143	5	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	4	µg/L	3.595	4.42	5	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	2	µg/L	3.045	3.21	5	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	2	µg/L	4.43	6.43	5	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	1	µg/L	5.32	5.32	5	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	1	µg/L	5.55	5.55	5	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	µg/L	3.54	4.85	5	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	1	µg/L	3.8	3.8	5	—	—	—	—	—	—	—	—	—
Cobalt	R-20	MP1A	904.6	n/a	5	1	µg/L	0.898	0.898	5	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-22	MP1A	907.1	n/a	7	1	µg/L	1.3	1.3	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Cobalt (continued)	R-22	MP4A	1378	n/a	7	1	µg/L	0.709	0.709	5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	1	µg/L	1.9	1.9	5	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	1	µg/L	1.04	1.04	5	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	2	µg/L	1.06	1.49	5	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-40	P1A	751.6	n/a	8	1	µg/L	1.42	1.42	5	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	3	µg/L	2.0167	2.66	5	—	—	—	—	—	—	—	—	—
Copper	R-20	MP1A	904.6	n/a	5	1	µg/L	1.4	1.4	10	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	2	µg/L	2.55	3.2	10	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-21	Single	888.8	n/a	24	1	µg/L	13.1	13.1	10	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	6	2	µg/L	2.7	3.4	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	13	1	µg/L	4.11	4.11	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	1	µg/L	3.03	3.03	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	11	1	µg/L	3.2	3.2	10	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	23	1	µg/L	3.16	3.16	10	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	13	4	µg/L	3.5375	4.03	10	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	18	1	µg/L	3.1	3.1	10	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	15	1	µg/L	25	25	10	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	7	1	µg/L	1.98	1.98	10	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	n/a	15	2	µg/L	5.15	6.61	10	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	1	µg/L	15.4	15.4	10	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	1	µg/L	6.4	6.4	10	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	2	µg/L	7.815	8.93	10	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	5	µg/L	8.312	13.5	10	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	1	µg/L	14	14	10	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	2	µg/L	11.37	15	10	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	1	µg/L	3.24	3.24	10	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	1	µg/L	10.2	10.2	10	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	1	µg/L	16.2	16.2	10	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	1	µg/L	4.27	4.27	10	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Iron	R-20	MP1A	904.6	n/a	5	4	µg/L	126	143	100	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	4	µg/L	1006.5	1090	100	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	8830	12900	100	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	7	µg/L	60.329	181	100	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µg/L	111.37	252	100	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	12	µg/L	61.717	152	100	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	1	µg/L	21.1	21.1	100	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	9	µg/L	28.744	48.9	100	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	8	8	µg/L	17063	21500	100	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	3	µg/L	66.167	114	100	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	162	162	100	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	8	µg/L	119.58	320	100	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	4850	4850	100	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	µg/L	4912.9	8300	100	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	2420	2420	100	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	µg/L	2424.3	5200	100	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	11	µg/L	52.818	125	100	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	17	µg/L	82.565	327	100	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	80.4	80.4	100	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	12	µg/L	267.11	1090	100	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	1	µg/L	666	666	100	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	5	µg/L	243.68	667	100	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	1	µg/L	112	112	100	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	8	µg/L	1172.1	8890	100	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	3	µg/L	59.967	138	100	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	9	µg/L	685	1090	100	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	4	µg/L	144.38	280	100	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	8	µg/L	108.85	250	100	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	7	µg/L	77.371	229	100	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Iron (continued)	R-37	P2A	1026	FD	1	1	µg/L	328	328	100	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	8	µg/L	158.33	272	100	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	3	µg/L	122.83	265	100	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	127	127	100	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	µg/L	107.36	199	100	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	6	µg/L	360.22	1050	100	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	µg/L	65.2	98.4	100	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	8	µg/L	193.79	612	100	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	1168.9	1470	100	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	4	µg/L	200.58	398	100	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	µg/L	387.63	1510	100	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	2	µg/L	37.1	39.4	100	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	4	µg/L	50.45	55.1	100	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	5	µg/L	156.38	478	100	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	4	µg/L	364.4	1320	100	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	1	µg/L	118	118	100	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	1	µg/L	227	227	100	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	1	µg/L	184	184	100	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	µg/L	2016.5	4600	100	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	4	µg/L	44.05	55.3	100	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	1	µg/L	64.3	64.3	100	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	2	µg/L	49.35	57.6	100	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	µg/L	421.5	675	100	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	1	µg/L	55.1	55.1	100	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	71.533	103	100	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µg/L	72.05	89.3	100	—	—	—	—	—	—	—	—	—
Lead	R-20	MP1A	904.6	n/a	5	5	µg/L	0.7012	0.946	2	15	EPA MCL	0	7.5	0	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	3	µg/L	0.2047	0.224	2	15	EPA MCL	0	7.5	0	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	3	µg/L	0.1577	0.223	2	15	EPA MCL	0	7.5	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	1	µg/L	0.51	0.51	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-20	P2A	1147.1	FD	3	2	µg/L	5.8435	10.8	2	15	EPA MCL	0	7.5	1	—	—	—	—
	R-20	P2A	1147.1	n/a	13	1	µg/L	0.569	0.569	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-21	Single	888.8	n/a	25	2	µg/L	0.117	0.137	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-22	MP1A	907.1	n/a	7	2	µg/L	0.11	0.117	2	15	EPA MCL	0	7.5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Lead (continued)	R-22	MP3A	1273.5	n/a	16	1	µg/L	0.073	0.073	2	15	EPA MCL	0	7.5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	2	µg/L	0.097	0.104	2	15	EPA MCL	0	7.5	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	7	µg/L	1.2514	2.2	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-23	Single	816	n/a	25	17	µg/L	2.1155	14.2	2	15	EPA MCL	0	7.5	1	—	—	—	—
	R-23i	P1A	400.3	n/a	14	4	µg/L	1.0443	1.47	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-23i	P3A	524	n/a	16	1	µg/L	21.9	21.9	2	15	EPA MCL	1	7.5	1	—	—	—	Lead was detected during the first sampling event in October 2006 above the EPA MCL and has not been detected after the first sampling event.
	R-32	MP3A	976	n/a	9	3	µg/L	0.4067	0.46	2	15	EPA MCL	0	7.5	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	1	µg/L	0.53	0.53	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-32	Single	867.5	n/a	15	1	µg/L	0.51	0.51	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-37	P1A	929.3	n/a	10	1	µg/L	1.78	1.78	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-38	Single	821.2	n/a	10	1	µg/L	0.83	0.83	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-40	P1A	751.6	n/a	8	3	µg/L	1.4597	2.68	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-40	P2A	849.3	n/a	9	1	µg/L	0.9	0.9	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-40	R-40i	649.7	n/a	7	1	µg/L	0.61	0.61	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-41	P2A	965.3	n/a	10	1	µg/L	0.539	0.539	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-49	P1A	845	n/a	9	8	µg/L	2.6198	8.85	2	15	EPA MCL	0	7.5	1	—	—	—	—
	R-51	P1A	914.96	n/a	6	1	µg/L	0.98	0.98	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-52	P1A	1035.2	n/a	5	1	µg/L	0.698	0.698	2	15	EPA MCL	0	7.5	0	—	—	—	—
	R-54	P1A	830	n/a	6	2	µg/L	5.178	9.8	2	15	EPA MCL	0	7.5	1	—	—	—	—
Manganese	R-20	MP1A	904.6	n/a	5	5	µg/L	15.14	20.5	10	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	346.2	388	10	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	777.4	1120	10	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	µg/L	19.854	31.4	10	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µg/L	68.133	72	10	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	µg/L	63.608	80.7	10	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	µg/L	7.9	10	10	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	25	µg/L	7.1356	11.7	10	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	8	8	µg/L	3470	4320	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	12	µg/L	5.2625	20.5	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Manganese (continued)	R-22	MP3A	1273.5	FD	1	1	µg/L	5.7	5.7	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	10	µg/L	27.571	160	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	1390	1390	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	µg/L	1025.9	1600	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	449	449	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	µg/L	509.14	650	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	µg/L	64.967	383	10	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	25	µg/L	65.392	604	10	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	2.6	2.6	10	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	µg/L	22.408	77.4	10	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	1	µg/L	18.8	18.8	10	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	6	µg/L	9.6333	19.2	10	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	3	µg/L	153.73	453	10	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	5	µg/L	25.4	72.5	10	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	9	µg/L	1770	2170	10	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	11.25	22.9	10	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	11	µg/L	7.42	21.9	10	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	28.4	28.4	10	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	8	µg/L	27.048	81.3	10	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	5	5	10	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	5	µg/L	4.584	6.44	10	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	1	µg/L	4.66	4.66	10	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	9	µg/L	6.3611	13.6	10	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	6.94	6.94	10	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	µg/L	6.9582	19.1	10	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µg/L	88.291	383	10	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	1	µg/L	2.53	2.53	10	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	5	µg/L	25.344	108	10	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	303	392	10	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	µg/L	5.28	7.12	10	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	8	µg/L	10.918	50.9	10	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	µg/L	18.95	51.4	10	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Manganese (continued)	R-49	P2A	905.6	n/a	9	1	µg/L	4.26	4.26	10	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	2	µg/L	5.1	7.7	10	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	4	µg/L	7.0325	18.3	10	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	1	µg/L	13.4	13.4	10	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	2	µg/L	6.88	11.7	10	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	2	µg/L	19.615	36.2	10	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	1	µg/L	6.14	6.14	10	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	µg/L	173.38	306	10	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	2	µg/L	4.49	6.37	10	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	3	µg/L	10.24	16.5	10	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	2	µg/L	7.925	13.6	10	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	µg/L	525	644	10	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	µg/L	12.94	19.8	10	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	1	µg/L	16.5	16.5	10	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	µg/L	46.3	79.2	10	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µg/L	14.34	19	10	—	—	—	—	—	—	—	—	—
Mercury	R-20	P2A	1147.1	n/a	13	1	µg/L	0.29	0.29	0.2	2	EPA MCL	0	1	0	0.2	Regional	1	—
	R-22	MP3A	1273.5	n/a	16	2	µg/L	0.4485	0.84	0.2	2	EPA MCL	0	1	0	0.2	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-23i	P1A	400.3	n/a	14	1	µg/L	0.096	0.096	0.2	2	EPA MCL	0	1	0	0.06	Intermediate	1	—
	R-23i	P3A	524	n/a	16	1	µg/L	0.13	0.13	0.2	2	EPA MCL	0	1	0	0.06	Intermediate	1	—
	R-32	MP3A	976	n/a	9	1	µg/L	0.32	0.32	0.2	2	EPA MCL	0	1	0	0.2	Regional	1	Screen plugged and abandoned because of residual effects of drilling products.
Molybdenum	R-20	MP1A	904.6	n/a	5	5	µg/L	12.8	22.6	0.5	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	5.362	6.1	0.5	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	20.42	30.8	0.5	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	10	µg/L	1.427	1.9	0.5	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µg/L	1.8	2.01	0.5	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	µg/L	1.6677	2.02	0.5	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	20	µg/L	1.851	3.67	0.5	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	7	µg/L	24.286	32	0.5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	7	µg/L	1.6371	1.9	0.5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	5	5	0.5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Molybdenum (continued)	R-22	MP3A	1273.5	n/a	16	12	µg/L	7.7317	22	0.5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	10.6	10.6	0.5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	µg/L	9.76	23	0.5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	26.3	26.3	0.5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	µg/L	22.9	28	0.5	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	4	µg/L	1.73	2.07	0.5	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	16	µg/L	1.6625	2.09	0.5	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	12	µg/L	3.6842	28.8	0.5	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µg/L	2.35	2.5	0.5	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	16	µg/L	2.1806	3.4	0.5	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	1	µg/L	2	2	0.5	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	12	µg/L	1.515	2.2	0.5	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	5	µg/L	2.882	3.31	0.5	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	5	µg/L	1.974	2.67	0.5	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	2.4	2.8	0.5	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	µg/L	2.2713	2.6	0.5	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	4.19	4.19	0.5	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	µg/L	3.701	4.22	0.5	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	1.84	1.84	0.5	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	µg/L	2.1756	3.2	0.5	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	3	µg/L	1.6833	1.73	0.5	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	9	µg/L	1.9622	3	0.5	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	1.61	1.61	0.5	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	11	µg/L	2.1045	4.98	0.5	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µg/L	9.1913	14.4	0.5	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	µg/L	2.56	3.76	0.5	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	µg/L	2.9689	6.1	0.5	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	17.5	21.8	0.5	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	µg/L	3.65	3.97	0.5	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	µg/L	3.866	7.4	0.5	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	µg/L	2.9167	5.64	0.5	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	8	µg/L	1.4438	1.59	0.5	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Molybdenum (continued)	R-51	P1A	914.96	n/a	6	6	µg/L	1.3917	1.54	0.5	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	µg/L	1.2767	1.39	0.5	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	1.746	2.29	0.5	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	4	µg/L	1.2025	1.34	0.5	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	µg/L	1.528	2.22	0.5	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	1	µg/L	1.03	1.03	0.5	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	4	µg/L	1.22	1.53	0.5	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	µg/L	3.81	7.53	0.5	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	6	µg/L	1.1302	1.2	0.5	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	2	µg/L	1.135	1.23	0.5	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	µg/L	1.52	1.8	0.5	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	µg/L	8.4	9.41	0.5	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	3	µg/L	1.7867	1.99	0.5	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	2.71	3.11	0.5	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	µg/L	2.085	2.28	0.5	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µg/L	1.7	1.81	0.5	—	—	—	—	—	—	—	—	—
Nickel	R-20	MP1A	904.6	n/a	5	2	µg/L	1.125	1.5	2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	1	µg/L	3.5	3.5	2	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	3	µg/L	6.7667	12.8	2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	12	µg/L	1.8097	5.93	2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µg/L	3.4167	4.53	2	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	12	µg/L	2.7328	3.9	2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	FD	3	3	µg/L	0.57	0.61	2	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	11	µg/L	0.6112	0.88	2	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	5	µg/L	23.06	31.5	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	9	µg/L	2.1383	7.7	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	2.2	2.2	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	11	µg/L	5.0936	27	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	6	µg/L	4.5467	7.01	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	2	µg/L	8.45	14.8	2	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	10	µg/L	1.3833	3.77	2	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	20	µg/L	2.1495	9.4	2	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Nickel (continued)	R-23i	P1A	400.3	FD	1	1	µg/L	1.2	1.2	2	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	13	µg/L	1.8014	5.18	2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µg/L	0.8575	0.91	2	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	µg/L	1.2312	5.8	2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	2	µg/L	1.585	1.9	2	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	15	µg/L	3.5746	36.3	2	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	6	µg/L	3.155	11.4	2	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	6	µg/L	3.65	6.9	2	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	3.55	7	2	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	14	µg/L	2.3671	6.5	2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	1.97	1.97	2	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	µg/L	1.3264	1.84	2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	15.6	15.6	2	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	9	µg/L	2.1506	9.65	2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	µg/L	4.81	8.77	2	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	10	µg/L	11.64	30.1	2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	0.904	0.904	2	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	10	µg/L	1.1475	3.28	2	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µg/L	14.59	76.9	2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	2	µg/L	1.0975	1.59	2	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	8	µg/L	1.0878	1.8	2	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	1.0036	1.4	2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	2	µg/L	2.425	2.72	2	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	µg/L	1.8781	2.85	2	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	9	µg/L	2.1127	6.24	2	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	4	µg/L	0.6638	0.732	2	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	4	µg/L	0.7415	0.993	2	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	6	µg/L	0.695	0.901	2	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	4	µg/L	0.6808	0.859	2	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	4	µg/L	0.7655	1.26	2	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	4	µg/L	0.9595	1.46	2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	2	µg/L	0.5995	0.647	2	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	2	µg/L	0.766	0.801	2	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	µg/L	10.043	49.4	2	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	4	µg/L	0.7345	1.06	2	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	2	µg/L	0.9575	0.958	2	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Nickel (continued)	R-55	P2A	994.4	n/a	3	2	µg/L	0.8605	1.19	2	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	2	µg/L	3.945	4.04	2	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	2	µg/L	0.7885	1.01	2	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	0.7043	0.839	2	—	—	—	—	—	—	—	—	—
	R-57	P1A	910	n/a	2	2	µg/L	1.074	1.54	2	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	1	µg/L	0.887	0.887	2	—	—	—	—	—	—	—	—	—
Selenium	R-20	MP1A	904.6	n/a	5	2	µg/L	5.035	5.3	5	50	EPA MCL	0	25	0	6	Regional	0	Before well rehabilitation.
	R-22	MP2A	962.8	n/a	19	2	µg/L	2.985	4.87	5	50	EPA MCL	0	25	0	6	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	3	µg/L	1.3667	1.6	5	50	EPA MCL	0	25	0	6	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	1	µg/L	2.6	2.6	5	50	EPA MCL	0	25	0	6	Regional	0	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	1	µg/L	1.03	1.03	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-23	Single	816	n/a	25	3	µg/L	2.3867	4.35	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-23i	P1A	400.3	n/a	14	1	µg/L	1.44	1.44	5	50	EPA MCL	0	25	0	6	Intermediate	0	—
	R-23i	P2A	470.2	n/a	19	2	µg/L	1.14	1.27	5	50	EPA MCL	0	25	0	6	Intermediate	0	—
	R-23i	P3A	524	n/a	16	1	µg/L	1.03	1.03	5	50	EPA MCL	0	25	0	6	Intermediate	0	—
	R-32	MP1A	870.9	n/a	9	2	µg/L	2.25	3.4	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-32	Single	867.5	n/a	15	2	µg/L	1.445	1.75	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-37	P1A	929.3	n/a	10	1	µg/L	1.53	1.53	5	50	EPA MCL	0	25	0	6	Intermediate	0	—
	R-38	Single	821.2	n/a	10	1	µg/L	1.19	1.19	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-49	P1A	845	n/a	9	1	µg/L	1.07	1.07	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-49	P2A	905.6	n/a	9	1	µg/L	1.17	1.17	5	50	EPA MCL	0	25	0	6	Regional	0	—
	R-55i	Single	510	n/a	2	1	µg/L	2.85	2.85	5	50	EPA MCL	0	25	0	6	Intermediate	0	—
Silicon	R-22	MP1A	907.1	n/a	1	1	µg/L	16000	16000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	2	2	µg/L	30500	31000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	2	2	µg/L	22500	28000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	1	1	µg/L	22000	22000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	2	2	µg/L	23500	25000	0.1	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
Silicon Dioxide	R-53	P2A	959.7	n/a	1	1	mg/L	73.3	73.3	0.1	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Silver	R-22	MP2A	962.8	n/a	19	1	µg/L	2.3	2.3	1	—	—	—	—	—	2	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	1	µg/L	2.77	2.77	1	—	—	—	—	—	2	Regional	1	R-22 is off-line and will undergo rehabilitation.
	R-54	P1A	830	n/a	6	1	µg/L	0.764	0.764	1	—	—	—	—	—	2	Regional	0	—
Strontium	R-20	MP1A	904.6	n/a	5	5	µg/L	35.12	40.4	5	22000	EPA Tap	0	11000	0	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	1710	2070	5	22000	EPA Tap	0	11000	0	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	5	µg/L	130.5	191	5	22000	EPA Tap	0	11000	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	13	µg/L	138.85	152	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µg/L	218	228	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-20	P2A	1147.1	n/a	13	13	µg/L	206.85	230	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-21	Single	888.8	FD	3	3	µg/L	44.067	45	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-21	Single	888.8	n/a	25	25	µg/L	45.28	49.6	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-22	MP1A	907.1	n/a	7	7	µg/L	351	394	5	22000	EPA Tap	0	11000	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	19	µg/L	50.621	55.5	5	22000	EPA Tap	0	11000	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	633	633	5	22000	EPA Tap	0	11000	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	16	µg/L	542.13	1000	5	22000	EPA Tap	0	11000	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	933	933	5	22000	EPA Tap	0	11000	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	7	µg/L	885.29	1100	5	22000	EPA Tap	0	11000	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	FD	1	1	µg/L	327	327	5	22000	EPA Tap	0	11000	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	7	µg/L	287.57	330	5	22000	EPA Tap	0	11000	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	12	µg/L	80.708	84.1	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23	Single	816	n/a	25	25	µg/L	81.772	86.6	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	94.9	94.9	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23i	P1A	400.3	n/a	14	14	µg/L	165.61	256	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µg/L	94.85	98.4	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23i	P2A	470.2	n/a	19	19	µg/L	96.342	113	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23i	P3A	524	FD	2	2	µg/L	91.5	93.7	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23i	P3A	524	n/a	16	16	µg/L	101.03	176	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-32	MP1A	870.9	n/a	9	9	µg/L	84.656	91.1	5	22000	EPA Tap	0	11000	0	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Strontium (continued)	R-32	MP3A	976	n/a	9	9	µg/L	99.689	106	5	22000	EPA Tap	0	11000	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	81.35	91	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-32	Single	867.5	n/a	15	15	µg/L	79.46	90.8	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	105	105	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	µg/L	103.77	108	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	53.6	53.6	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-37	P2A	1026	n/a	9	9	µg/L	63.967	99.1	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-38	Single	821.2	FD	4	4	µg/L	51.975	53.4	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-38	Single	821.2	n/a	10	10	µg/L	51.98	55.3	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	55.2	55.2	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-39	Single	859	n/a	11	11	µg/L	58.155	79.6	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µg/L	103.15	117	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-40	P2A	849.3	FD	2	2	µg/L	49.7	49.8	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	µg/L	53.589	68.8	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-40	R-40i	649.7	n/a	7	7	µg/L	94.771	104	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-41	P2A	965.3	FD	2	2	µg/L	77.25	77.3	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	µg/L	73.38	80.6	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-49	P1A	845	n/a	9	9	µg/L	83.067	118	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-49	P2A	905.6	n/a	9	9	µg/L	58.522	67.3	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	µg/L	82.783	101	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-51	P2A	1031	n/a	6	6	µg/L	53.783	57.7	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	63.22	68.6	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-52	P2A	1107	n/a	5	5	µg/L	49.14	50.7	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	µg/L	44.46	47.7	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-53	P2A	959.7	FD	2	2	µg/L	46.35	46.8	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	µg/L	45	46.9	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-54	P1A	830	n/a	6	6	µg/L	60.283	80.7	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-54	P2A	915	n/a	6	6	µg/L	52.667	55.6	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-55	P1A	860	n/a	3	3	µg/L	73.633	74.8	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	µg/L	79.933	84.5	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-55i	Single	510	n/a	2	2	µg/L	163.5	167	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-56	P1A	945	n/a	3	3	µg/L	54.8	58.1	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	54.567	55.5	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-57	P1A	910	n/a	2	2	µg/L	58.6	59.8	5	22000	EPA Tap	0	11000	0	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µg/L	61.15	61.4	5	22000	EPA Tap	0	11000	0	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Thallium	R-20	MP1A	904.6	n/a	5	1	µg/L	0.082	0.082	1	2	EPA MCL	0	1	0	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	1	µg/L	0.026	0.026	1	2	EPA MCL	0	1	0	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	2	µg/L	0.0675	0.092	1	2	EPA MCL	0	1	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	2	µg/L	0.405	0.41	1	2	EPA MCL	0	1	0	—	—	—	—
	R-20	P2A	1147.1	n/a	13	2	µg/L	0.415	0.43	1	2	EPA MCL	0	1	0	—	—	—	—
	R-21	Single	888.8	FD	3	1	µg/L	0.4	0.4	1	2	EPA MCL	0	1	0	—	—	—	—
	R-21	Single	888.8	n/a	25	3	µg/L	0.6913	1.56	1	2	EPA MCL	0	1	1	—	—	—	—
	R-22	MP2A	962.8	n/a	19	3	µg/L	0.4263	0.53	1	2	EPA MCL	0	1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	3	µg/L	0.5083	0.52	1	2	EPA MCL	0	1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	1	µg/L	0.526	0.526	1	2	EPA MCL	0	1	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	n/a	25	1	µg/L	0.052	0.052	1	2	EPA MCL	0	1	0	—	—	—	—
	R-23i	P2A	470.2	n/a	19	4	µg/L	0.4353	0.538	1	2	EPA MCL	0	1	0	—	—	—	—
	R-23i	P3A	524	n/a	16	1	µg/L	0.47	0.47	1	2	EPA MCL	0	1	0	—	—	—	—
	R-32	MP1A	870.9	n/a	9	1	µg/L	0.05	0.05	1	2	EPA MCL	0	1	0	—	—	—	—
	R-32	Single	867.5	n/a	15	1	µg/L	0.4	0.4	1	2	EPA MCL	0	1	0	—	—	—	—
	R-37	P1A	929.3	n/a	10	1	µg/L	0.581	0.581	1	2	EPA MCL	0	1	0	—	—	—	—
	R-38	Single	821.2	n/a	10	2	µg/L	0.359	0.41	1	2	EPA MCL	0	1	0	—	—	—	—
	R-40	R-40i	649.7	n/a	7	2	µg/L	0.391	0.435	1	2	EPA MCL	0	1	0	—	—	—	—
	R-49	P1A	845	n/a	9	1	µg/L	0.469	0.469	1	2	EPA MCL	0	1	0	—	—	—	—
	R-54	P1A	830	n/a	6	1	µg/L	0.575	0.575	1	2	EPA MCL	0	1	0	—	—	—	—
Tin	R-23	Single	816	FD	12	2	µg/L	3.33	3.56	10	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23	Single	816	n/a	21	2	µg/L	2.86	3.02	10	22000	EPA Tap	0	11000	0	—	—	—	—
	R-23i	P1A	400.3	n/a	14	1	µg/L	4.22	4.22	10	22000	EPA Tap	0	11000	0	—	—	—	—
	R-32	Single	867.5	n/a	15	1	µg/L	3.46	3.46	10	22000	EPA Tap	0	11000	0	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	2.84	2.84	10	22000	EPA Tap	0	11000	0	—	—	—	—
	R-37	P1A	929.3	n/a	10	1	µg/L	3.19	3.19	10	22000	EPA Tap	0	11000	0	—	—	—	—
	R-37	P2A	1026	n/a	9	1	µg/L	3.53	3.53	10	22000	EPA Tap	0	11000	0	—	—	—	—
	R-49	P2A	905.6	n/a	9	1	µg/L	4.69	4.69	10	22000	EPA Tap	0	11000	0	—	—	—	—
	R-51	P1A	914.96	n/a	6	1	µg/L	7.72	7.72	10	22000	EPA Tap	0	11000	0	—	—	—	—
Uranium	R-20	MP1A	904.6	n/a	5	4	µg/L	0.1498	0.18	0.2	30	EPA MCL	0	15	0	—	—	—	Before well rehabilitation.
	R-20	MP2A	1147.1	n/a	5	5	µg/L	0.1168	0.18	0.2	30	EPA MCL	0	15	0	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	1	µg/L	0.021	0.021	0.2	30	EPA MCL	0	15	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Uranium (continued)	R-20	P1A	904.6	n/a	13	11	µg/L	0.6811	1.09	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µg/L	0.5587	0.669	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-20	P2A	1147.1	n/a	13	12	µg/L	0.5913	0.76	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-21	Single	888.8	FD	3	3	µg/L	0.32	0.35	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-21	Single	888.8	n/a	25	21	µg/L	0.3618	0.568	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-22	MP1A	907.1	n/a	6	3	µg/L	0.131	0.197	0.2	30	EPA MCL	0	15	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	18	15	µg/L	0.3645	0.43	0.2	30	EPA MCL	0	15	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	3.6	3.6	0.2	30	EPA MCL	0	15	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	15	15	µg/L	3.2413	16	0.2	30	EPA MCL	0	15	1	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	FD	1	1	µg/L	0.32	0.32	0.2	30	EPA MCL	0	15	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	6	3	µg/L	0.1833	0.26	0.2	30	EPA MCL	0	15	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	6	2	µg/L	0.1335	0.14	0.2	30	EPA MCL	0	15	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	10	µg/L	0.4825	0.52	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-23	Single	816	n/a	25	21	µg/L	0.527	0.854	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	1.3	1.3	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-23i	P1A	400.3	n/a	14	13	µg/L	2.6462	22.7	0.2	30	EPA MCL	0	15	1	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µg/L	0.9415	1	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-23i	P2A	470.2	n/a	19	18	µg/L	1.0594	1.7	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-23i	P3A	524	FD	2	1	µg/L	0.56	0.56	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-23i	P3A	524	n/a	16	14	µg/L	0.9103	4.6	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-32	MP1A	870.9	n/a	9	9	µg/L	1.04	1.7	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-32	MP3A	976	n/a	9	8	µg/L	0.1699	0.51	0.2	30	EPA MCL	0	15	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	6	µg/L	0.8117	0.87	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-32	Single	867.5	n/a	15	14	µg/L	0.7568	0.912	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	1.34	1.34	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	µg/L	1.578	1.87	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	0.522	0.522	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-37	P2A	1026	n/a	9	9	µg/L	0.7517	1.8	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-38	Single	821.2	FD	4	4	µg/L	0.408	0.454	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-38	Single	821.2	n/a	10	10	µg/L	0.4359	0.614	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	0.458	0.458	0.2	30	EPA MCL	0	15	0	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Uranium (continued)	R-39	Single	859	n/a	11	10	µg/L	0.469	0.67	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µg/L	1.0684	1.44	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-40	P2A	849.3	FD	2	2	µg/L	0.3705	0.428	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	µg/L	0.4028	0.87	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-40	R-40i	649.7	n/a	7	6	µg/L	0.5347	1.1	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-41	P2A	965.3	FD	2	2	µg/L	0.62	0.645	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	µg/L	0.6618	1.2	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-49	P1A	845	n/a	9	9	µg/L	1.9978	4.59	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-49	P2A	905.6	n/a	9	8	µg/L	0.3691	0.541	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	µg/L	0.3458	0.515	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-51	P2A	1031	n/a	6	6	µg/L	0.4153	0.602	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	0.6282	0.89	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-52	P2A	1107	n/a	5	4	µg/L	0.3718	0.446	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	µg/L	0.4958	0.554	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-53	P2A	959.7	FD	2	2	µg/L	0.4395	0.483	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	µg/L	0.5302	0.708	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-54	P1A	830	n/a	6	6	µg/L	1.0058	3.25	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-54	P2A	915	n/a	6	6	µg/L	0.4562	0.526	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-55	P1A	860	n/a	3	3	µg/L	0.6607	0.673	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	µg/L	0.6373	0.682	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-55i	Single	510	n/a	2	2	µg/L	1.11	1.15	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-56	P1A	945	n/a	3	3	µg/L	0.599	0.647	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-56	P2A	1046.6	n/a	3	3	µg/L	0.6053	0.656	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-57	P1A	910	n/a	2	1	µg/L	0.366	0.366	0.2	30	EPA MCL	0	15	0	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µg/L	0.3885	0.454	0.2	30	EPA MCL	0	15	0	—	—	—	—
Vanadium	R-20	MP3A	1330	n/a	5	1	µg/L	0.753	0.753	5	180	EPA Tap	0	90	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	12	µg/L	4.6117	7.56	5	180	EPA Tap	0	90	0	—	—	—	—
	R-20	P2A	1147.1	FD	3	3	µg/L	3.1633	3.33	5	180	EPA Tap	0	90	0	—	—	—	—
	R-20	P2A	1147.1	n/a	13	9	µg/L	4.2011	5.15	5	180	EPA Tap	0	90	0	—	—	—	—
	R-21	Single	888.8	FD	3	2	µg/L	5.35	5.5	5	180	EPA Tap	0	90	0	—	—	—	—
	R-21	Single	888.8	n/a	25	22	µg/L	5.1686	6	5	180	EPA Tap	0	90	0	—	—	—	—
	R-22	MP2A	962.8	n/a	19	13	µg/L	5.0169	6.1	5	180	EPA Tap	0	90	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	5.6	5.6	5	180	EPA Tap	0	90	0	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	10	µg/L	6.56	9.1	5	180	EPA Tap	0	90	0	—	—	—	R-22 is off-line and will undergo rehabilitation.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Vanadium (continued)	R-23	Single	816	FD	12	12	µg/L	6.4483	7.6	5	180	EPA Tap	0	90	0	—	—	—	—
	R-23	Single	816	n/a	25	25	µg/L	6.542	7.56	5	180	EPA Tap	0	90	0	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	3.9	3.9	5	180	EPA Tap	0	90	0	—	—	—	—
	R-23i	P1A	400.3	n/a	14	11	µg/L	3.2818	4.3	5	180	EPA Tap	0	90	0	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µg/L	4.875	5.35	5	180	EPA Tap	0	90	0	—	—	—	—
	R-23i	P2A	470.2	n/a	19	18	µg/L	4.5556	5.64	5	180	EPA Tap	0	90	0	—	—	—	—
	R-23i	P3A	524	FD	2	1	µg/L	4.89	4.89	5	180	EPA Tap	0	90	0	—	—	—	—
	R-23i	P3A	524	n/a	16	15	µg/L	6.6613	25.1	5	180	EPA Tap	0	90	0	—	—	—	—
	R-32	MP1A	870.9	n/a	9	6	µg/L	3.7833	5	5	180	EPA Tap	0	90	0	—	—	—	—
	R-32	MP3A	976	n/a	9	2	µg/L	2.05	2.1	5	180	EPA Tap	0	90	0	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-32	Single	867.5	FD	6	4	µg/L	3.5	3.9	5	180	EPA Tap	0	90	0	—	—	—	—
	R-32	Single	867.5	n/a	15	13	µg/L	3.5662	4.12	5	180	EPA Tap	0	90	0	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	4.84	4.84	5	180	EPA Tap	0	90	0	—	—	—	—
	R-37	P1A	929.3	n/a	10	10	µg/L	5.012	6.26	5	180	EPA Tap	0	90	0	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	6.07	6.07	5	180	EPA Tap	0	90	0	—	—	—	—
	R-37	P2A	1026	n/a	9	8	µg/L	6.0238	6.62	5	180	EPA Tap	0	90	0	—	—	—	—
	R-38	Single	821.2	FD	4	4	µg/L	4.4575	4.94	5	180	EPA Tap	0	90	0	—	—	—	—
	R-38	Single	821.2	n/a	10	9	µg/L	4.4733	5.01	5	180	EPA Tap	0	90	0	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	5.13	5.13	5	180	EPA Tap	0	90	0	—	—	—	—
	R-39	Single	859	n/a	11	9	µg/L	5.7511	6.27	5	180	EPA Tap	0	90	0	—	—	—	—
	R-40	P1A	751.6	n/a	8	7	µg/L	3.0857	4.4	5	180	EPA Tap	0	90	0	—	—	—	—
	R-40	P2A	849.3	FD	2	1	µg/L	4.8	4.8	5	180	EPA Tap	0	90	0	—	—	—	—
	R-40	P2A	849.3	n/a	9	8	µg/L	4.5825	5.57	5	180	EPA Tap	0	90	0	—	—	—	—
	R-40	R-40i	649.7	n/a	7	1	µg/L	1.5	1.5	5	180	EPA Tap	0	90	0	—	—	—	—
	R-41	P2A	965.3	FD	2	2	µg/L	5.71	5.85	5	180	EPA Tap	0	90	0	—	—	—	—
	R-41	P2A	965.3	n/a	10	10	µg/L	5.786	7.19	5	180	EPA Tap	0	90	0	—	—	—	—
	R-49	P1A	845	n/a	9	9	µg/L	4.6367	6.47	5	180	EPA Tap	0	90	0	—	—	—	—
	R-49	P2A	905.6	n/a	9	8	µg/L	4.7925	5.66	5	180	EPA Tap	0	90	0	—	—	—	—
	R-51	P1A	914.96	n/a	6	6	µg/L	5.79	6.38	5	180	EPA Tap	0	90	0	—	—	—	—
	R-51	P2A	1031	n/a	6	6	µg/L	5.545	5.97	5	180	EPA Tap	0	90	0	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	6.124	6.88	5	180	EPA Tap	0	90	0	—	—	—	—
	R-52	P2A	1107	n/a	5	5	µg/L	5.944	6.09	5	180	EPA Tap	0	90	0	—	—	—	—
	R-53	P1A	849.2	n/a	5	5	µg/L	4.546	5.2	5	180	EPA Tap	0	90	0	—	—	—	—
	R-53	P2A	959.7	FD	2	2	µg/L	5.2	5.52	5	180	EPA Tap	0	90	0	—	—	—	—
	R-53	P2A	959.7	n/a	5	5	µg/L	5.27	6.5	5	180	EPA Tap	0	90	0	—	—	—	—
	R-54	P1A	830	n/a	6	5	µg/L	2.658	4.18	5	180	EPA Tap	0	90	0	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Vanadium (continued)	R-54	P2A	915	n/a	6	6	µg/L	5.1833	5.64	5	180	EPA Tap	0	90	0	—	—	—	—
	R-55	P1A	860	n/a	3	3	µg/L	5.4033	5.79	5	180	EPA Tap	0	90	0	—	—	—	—
	R-55	P2A	994.4	n/a	3	3	µg/L	5.22	5.56	5	180	EPA Tap	0	90	0	—	—	—	—
	R-55i	Single	510	n/a	2	1	µg/L	3.28	3.28	5	180	EPA Tap	0	90	0	—	—	—	—
	R-56	P1A	945	n/a	3	2	µg/L	3.75	3.92	5	180	EPA Tap	0	90	0	—	—	—	—
	R-56	P2A	1046.6	n/a	3	2	µg/L	3.515	3.77	5	180	EPA Tap	0	90	0	—	—	—	—
	R-57	P1A	910	n/a	2	2	µg/L	4.735	4.93	5	180	EPA Tap	0	90	0	—	—	—	—
	R-57	P2A	971.5	n/a	2	2	µg/L	4.78	5.03	5	180	EPA Tap	0	90	0	—	—	—	—
Zinc	R-20	MP2A	1147.1	n/a	5	3	µg/L	6.94	12.6	10	—	—	—	—	—	—	—	—	Before well rehabilitation.
	R-20	MP3A	1330	n/a	5	4	µg/L	14.15	22	10	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.
	R-20	P1A	904.6	n/a	13	10	µg/L	11.5	40.3	10	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	FD	3	1	µg/L	23.7	23.7	10	—	—	—	—	—	—	—	—	—
	R-20	P2A	1147.1	n/a	13	8	µg/L	6.85	16.2	10	—	—	—	—	—	—	—	—	—
	R-21	Single	888.8	n/a	25	5	µg/L	6.882	16	10	—	—	—	—	—	—	—	—	—
	R-22	MP1A	907.1	n/a	7	1	µg/L	6.55	6.55	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP2A	962.8	n/a	19	6	µg/L	4.3783	9.2	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	FD	1	1	µg/L	5.8	5.8	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP3A	1273.5	n/a	16	7	µg/L	6.12	17.8	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP4A	1378	n/a	7	2	µg/L	9.685	14.9	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-22	MP5A	1448.2	n/a	7	4	µg/L	5.425	10	10	—	—	—	—	—	—	—	—	R-22 is off-line and will undergo rehabilitation.
	R-23	Single	816	FD	12	2	µg/L	3.15	3.7	10	—	—	—	—	—	—	—	—	—
	R-23	Single	816	n/a	25	10	µg/L	9.651	40.1	10	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	FD	1	1	µg/L	3.2	3.2	10	—	—	—	—	—	—	—	—	—
	R-23i	P1A	400.3	n/a	14	11	µg/L	15.598	29.2	10	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	FD	2	2	µg/L	24.74	43.1	10	—	—	—	—	—	—	—	—	—
	R-23i	P2A	470.2	n/a	19	13	µg/L	8.1723	42.2	10	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	FD	2	1	µg/L	3.56	3.56	10	—	—	—	—	—	—	—	—	—
	R-23i	P3A	524	n/a	16	5	µg/L	55.04	262	10	—	—	—	—	—	—	—	—	—
	R-32	MP1A	870.9	n/a	9	5	µg/L	6.22	8.6	10	—	—	—	—	—	—	—	—	—
	R-32	MP3A	976	n/a	9	6	µg/L	10.513	18.8	10	—	—	—	—	—	—	—	—	Screen plugged and abandoned because of residual effects of drilling products.

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Zinc (continued)	R-32	Single	867.5	FD	6	6	µg/L	83.167	134	10	—	—	—	—	—	—	—	—	—
	R-32	Single	867.5	n/a	15	15	µg/L	56.987	128	10	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	FD	1	1	µg/L	12.8	12.8	10	—	—	—	—	—	—	—	—	—
	R-37	P1A	929.3	n/a	10	8	µg/L	32.16	154	10	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	FD	1	1	µg/L	16.2	16.2	10	—	—	—	—	—	—	—	—	—
	R-37	P2A	1026	n/a	9	8	µg/L	10.639	19.5	10	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	FD	4	4	µg/L	9.545	14.3	10	—	—	—	—	—	—	—	—	—
	R-38	Single	821.2	n/a	10	9	µg/L	26.233	86.5	10	—	—	—	—	—	—	—	—	—
	R-39	Single	859	FD	1	1	µg/L	15.4	15.4	10	—	—	—	—	—	—	—	—	—
	R-39	Single	859	n/a	11	10	µg/L	22.47	52.6	10	—	—	—	—	—	—	—	—	—
	R-40	P1A	751.6	n/a	8	8	µg/L	148.15	978	10	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	FD	2	1	µg/L	18.4	18.4	10	—	—	—	—	—	—	—	—	—
	R-40	P2A	849.3	n/a	9	9	µg/L	38.439	171	10	—	—	—	—	—	—	—	—	—
	R-40	R-40i	649.7	n/a	7	5	µg/L	75.244	341	10	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	FD	2	1	µg/L	4.19	4.19	10	—	—	—	—	—	—	—	—	—
	R-41	P2A	965.3	n/a	10	4	µg/L	9.195	19.2	10	—	—	—	—	—	—	—	—	—
	R-49	P1A	845	n/a	9	7	µg/L	11.351	18.4	10	—	—	—	—	—	—	—	—	—
	R-49	P2A	905.6	n/a	9	1	µg/L	4.17	4.17	10	—	—	—	—	—	—	—	—	—
	R-51	P1A	914.96	n/a	6	5	µg/L	19.228	34	10	—	—	—	—	—	—	—	—	—
	R-51	P2A	1031	n/a	6	4	µg/L	7.51	12.5	10	—	—	—	—	—	—	—	—	—
	R-52	P1A	1035.2	n/a	5	5	µg/L	22.84	47	10	—	—	—	—	—	—	—	—	—
	R-52	P2A	1107	n/a	5	1	µg/L	8.54	8.54	10	—	—	—	—	—	—	—	—	—
	R-53	P1A	849.2	n/a	5	4	µg/L	93.35	207	10	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	FD	2	1	µg/L	5.2	5.2	10	—	—	—	—	—	—	—	—	—
	R-53	P2A	959.7	n/a	5	4	µg/L	6.1975	10.1	10	—	—	—	—	—	—	—	—	—
	R-54	P1A	830	n/a	6	6	µg/L	46.195	186	10	—	—	—	—	—	—	—	—	—
	R-54	P2A	915	n/a	6	1	µg/L	3.38	3.38	10	—	—	—	—	—	—	—	—	—
	R-55	P1A	860	n/a	3	2	µg/L	4.5	5.27	10	—	—	—	—	—	—	—	—	—
	R-55	P2A	994.4	n/a	3	2	µg/L	4.48	5.23	10	—	—	—	—	—	—	—	—	—
	R-55i	Single	510	n/a	2	1	µg/L	21.9	21.9	10	—	—	—	—	—	—	—	—	—
	R-56	P1A	945	n/a	3	2	µg/L	61.3	109	10	—	—	—	—	—	—	—	—	—
	R-56	P2A	1046.6	n/a	3	1	µg/L	15.4	15.4	10	—	—	—	—	—	—	—	—	—

Table D-4.3-1 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field QC Type	Number of Analyses	Number of Detects	Units	Average Detected Concentration	Maximum Detected Concentration	PQL[a]	Standard[b]	Standard Source[c]	Value > Standard	1/2 Standard	Value > 1/2 Standard	BV	BV Type	Value > BV	Comment
Zinc (continued)	R-57	P1A	910	n/a	2	2	µg/L	7.79	9.34	10	—	—	—	—	—	—	—	—	—
	R-57	P2A	971.5	n/a	2	1	µg/L	4.99	4.99	10	—	—	—	—	—	—	—	—	—

Source: Attachment D-1.

[a] PQL = Practical quantitation limit (LANL 2010, 109830, section C-4.1).

[b] Standard = Lowest applicable regulatory standard or other type of screening level.

[c] Standard Source = Reference for lowest-applicable water-quality screening level, as prescribed by the Consent Order and implemented as documented in Appendix B of the 2010 IFGMP (LANL 2010, 109830):

- EPA MCL = EPA maximum contaminant level (40 Code of Federal Regulations Part 141).
- EPA TAP SCRN LVL = EPA regional screening level for tapwater June 2011 (EPA 2011, 204336). Available online at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm).
- NM GW STD = New Mexico Groundwater Human Health Standards (New Mexico Administrative Code 20.6.2).

[d] n/a = Not applicable.

[e] — = None.

[f] FD = Field duplicate.

[g] SU = Standard Unit.

Table D-4.3-2
Number of Sampling Events for Inorganic Constituents Detected Above ½-Standard at Least Twice in the Same Screened Interval

Suite	Analyte	Single or Dual Screen Wells				Westbay Wells						
		R-40 40i port	R-40 P1A	R-54 P1A	R-55i	R-20 MP1A	R-20 MP2A	R-20 MP3A	R-22 MP1A	R-22 MP4A	R-22 MP5A	R-32 MP3A
Filtered General Inorganic	Fluoride	—*	—	—	—	—	—	5	—	—	—	2
Filtered Metals	Antimony	—	3	—	—	—	—	—	—	—	—	—
	Arsenic	—	—	—	—	2	—	4	—	—	—	—
	Iron	6	—	4	—	—	—	5	7	5	4	6
	Manganese	7	2	4	2	—	5	5	7	5	5	9
Not Filtered Metals	Antimony	—	2	—	—	—	—	—	—	—	—	—
	Arsenic	—	—	—	—	—	—	3	—	—	—	—

Source: Table D-4.3-1 and raw data tables in Attachment D-1.
*— = No events.

Table D-4.3-3
Statistical Summary of Radionuclides Detected in
TA-54 Groundwater Monitoring Wells, Extending from Well Completion to May 2011

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Americium-241	R-23i	P2A	470.2	F[a]	n/a[b]	11	1	0.0554	0.0554
	R-22	MP1A	907.1	UF[c]	n/a	6	1	0.00648	0.00648
	R-22	MP2A	962.8	UF	n/a	18	1	0.00705	0.00705
	R-22	MP3A	1273.5	UF	n/a	14	1	0.03	0.03
	R-22	MP4A	1378	UF	n/a	6	1	0.011	0.011
	R-22	MP5A	1448.2	UF	n/a	6	1	0.0228	0.0228
	R-23i	P2A	470.2	UF	n/a	16	1	0.0458	0.0458
Gross alpha	R-20	MP1A	904.6	F	n/a	1	1	5.37	5.37
	R-22	MP3A	1273.5	F	FD[d]	1	1	2.69	2.69
	R-22	MP3A	1273.5	F	n/a	7	5	2.756	3.12
	R-23	Single	816	F	n/a	8	2	0.869	0.891
	R-23i	P2A	470.2	F	n/a	6	1	2.3	2.3
	R-37	P1A	929.3	F	n/a	1	1	2.91	2.91
	R-20	MP2A	1147.1	UF	n/a	1	1	2.11	2.11
	R-20	P1A	904.6	UF	n/a	4	1	13.5	13.5
	R-22	MP1A	907.1	UF	n/a	6	2	2.845	3.55
	R-22	MP2A	962.8	UF	n/a	10	1	1.69	1.69
	R-22	MP3A	1273.5	UF	FD	1	1	3.27	3.27
	R-22	MP3A	1273.5	UF	n/a	9	6	2.555	3.75
	R-22	MP4A	1378	UF	n/a	4	1	2.54	2.54
	R-23	Single	816	UF	FD	8	1	0.793	0.793
	R-23	Single	816	UF	n/a	10	1	3.41	3.41
	R-23i	P1A	400.3	UF	n/a	8	1	3.38	3.38
	R-23i	P2A	470.2	UF	n/a	11	2	2.78	3.5
	R-23i	P3A	524	UF	n/a	11	1	17	17
	R-32	MP1A	870.9	UF	n/a	5	1	2.26	2.26
	R-32	MP3A	976	UF	n/a	5	2	0.9685	1.43
	R-37	P1A	929.3	UF	n/a	7	2	4.405	4.44
	R-49	P1A	845	UF	n/a	9	7	5.73857	14
	R-49	P2A	905.6	UF	n/a	9	1	3.94	3.94
	R-54	P1A	830	UF	n/a	6	1	11	11
Gross beta	R-20	MP1A	904.6	F	n/a	1	1	8.67	8.67
	R-20	MP2A	1147.1	F	n/a	1	1	5.89	5.89
	R-20	P1A	904.6	F	n/a	2	2	4.4	7.37
	R-21	Single	888.8	F	n/a	5	1	10.4	10.4

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Gross beta (continued)	R-22	MP1A	907.1	F	n/a	1	1	7.95	7.95
	R-22	MP2A	962.8	F	n/a	7	4	3.9025	4.81
	R-22	MP3A	1273.5	F	FD	1	1	7.89	7.89
	R-22	MP3A	1273.5	F	n/a	7	7	15.6086	71
	R-22	MP4A	1378	F	n/a	1	1	4.18	4.18
	R-22	MP5A	1448.2	F	n/a	1	1	5.65	5.65
	R-23	Single	816	F	FD	6	2	3.095	3.2
	R-23	Single	816	F	n/a	8	3	2.74	3.29
	R-23i	P1A	400.3	F	n/a	3	2	4.84	5.2
	R-23i	P2A	470.2	F	n/a	6	2	4.1	4.75
	R-23i	P3A	524	F	n/a	6	4	3.875	4.68
	R-32	MP1A	870.9	F	n/a	5	4	2.3575	3.05
	R-32	MP3A	976	F	n/a	5	3	3.80333	4.08
	R-32	Single	867.5	F	n/a	2	2	4.755	6.34
	R-38	Single	821.2	F	n/a	1	1	5.26	5.26
	R-39	Single	859	F	n/a	2	1	6.7	6.7
	R-40	P1A	751.6	F	n/a	1	1	1.09	1.09
	R-40	R-40i	649.7	F	n/a	2	1	2	2
	R-41	P2A	965.3	F	n/a	2	2	2.615	2.83
	R-20	MP1A	904.6	UF	n/a	1	1	3.06	3.06
	R-20	MP2A	1147.1	UF	n/a	1	1	5.62	5.62
	R-20	MP3A	1330	UF	n/a	1	1	3.61	3.61
	R-20	P1A	904.6	UF	n/a	4	4	4.605	9.55
	R-20	P2A	1147.1	UF	FD	1	1	4.35	4.35
	R-20	P2A	1147.1	UF	n/a	5	4	3.6575	5.84
	R-21	Single	888.8	UF	n/a	7	2	3.93	4.57
	R-22	MP1A	907.1	UF	n/a	6	6	7.22167	10.3
	R-22	MP2A	962.8	UF	n/a	10	6	2.59167	3.73
	R-22	MP3A	1273.5	UF	FD	1	1	9.87	9.87
	R-22	MP3A	1273.5	UF	n/a	9	8	6.9125	8.67
	R-22	MP4A	1378	UF	n/a	4	3	4.58333	5.03
	R-22	MP5A	1448.2	UF	n/a	3	3	5.05667	5.66
	R-23	Single	816	UF	FD	8	1	2.6	2.6
	R-23	Single	816	UF	n/a	10	4	3.185	4.04
	R-23i	P1A	400.3	UF	n/a	8	7	3.55286	5.12
	R-23i	P2A	470.2	UF	FD	2	1	2.74	2.74

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Gross beta (continued)	R-23i	P2A	470.2	UF	n/a	11	2	3.195	3.6
	R-23i	P3A	524	UF	n/a	11	5	8.426	24.8
	R-32	MP1A	870.9	UF	n/a	5	2	2.11	2.17
	R-32	MP3A	976	UF	n/a	5	1	4.57	4.57
	R-32	Single	867.5	UF	n/a	4	2	2.18	2.36
	R-37	P1A	929.3	UF	n/a	7	3	3.69667	4.41
	R-38	Single	821.2	UF	n/a	6	2	3.165	3.55
	R-39	Single	859	UF	n/a	7	2	2.8	3.65
	R-40	P1A	751.6	UF	n/a	6	3	18.26	45.4
	R-40	P2A	849.3	UF	n/a	6	1	4.3	4.3
	R-40	R-40i	649.7	UF	n/a	5	2	3.51	3.94
	R-41	P2A	965.3	UF	n/a	7	4	2.9275	3.35
	R-49	P1A	845	UF	n/a	9	6	4.66333	8.13
	R-51	P1A	914.96	UF	n/a	6	1	2.97	2.97
	R-51	P2A	1031	UF	n/a	6	2	3.46	3.47
	R-52	P1A	1035.2	UF	n/a	5	3	2.94	3.1
	R-53	P2A	959.7	UF	FD	2	1	3.45	3.45
	R-53	P2A	959.7	UF	n/a	5	1	3.34	3.34
	R-54	P1A	830	UF	n/a	6	2	3.29	3.57
	R-54	P2A	915	UF	n/a	6	1	7.86	7.86
	R-55	P1A	860	UF	n/a	3	2	2.945	3.22
	R-55	P2A	994.4	UF	n/a	3	1	5.65	5.65
	R-56	P1A	945	UF	n/a	3	1	3.97	3.97
	R-56	P2A	1046.6	UF	n/a	3	1	3.32	3.32
Gross gamma	R-20	P2A	1147.1	F	n/a	2	1	75.3	75.3
	R-23i	P2A	470.2	F	FD	2	1	85	85
	R-20	P1A	904.6	UF	n/a	5	1	77.5	77.5
	R-20	P2A	1147.1	UF	FD	1	1	10.8	10.8
	R-21	Single	888.8	UF	n/a	11	1	114	114
	R-22	MP1A	907.1	UF	n/a	6	1	251	251
	R-23i	P2A	470.2	UF	FD	2	1	86.1	86.1
	R-23i	P3A	524	UF	n/a	13	1	51.3	51.3
	R-37	P1A	929.3	UF	n/a	7	1	6.32	6.32
	R-38	Single	821.2	UF	n/a	7	1	50.1	50.1
	R-40	P2A	849.3	UF	n/a	6	1	75.3	75.3
	R-49	P2A	905.6	UF	n/a	8	1	12.4	12.4

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Gross gamma (continued)	R-51	P2A	1031	UF	n/a	5	3	61.9333	97.4
	R-52	P1A	1035.2	UF	n/a	4	1	21.6	21.6
	R-54	P2A	915	UF	n/a	5	1	12.9	12.9
	R-57	P2A	971.5	UF	n/a	1	1	50.1	50.1
Plutonium-238	R-22	MP1A	907.1	UF	n/a	7	1	-0.004	-0.004
	R-22	MP2A	962.8	UF	n/a	19	1	0.00072	0.00072
	R-22	MP3A	1273.5	UF	n/a	15	1	0.00564	0.00564
	R-22	MP4A	1378	UF	FD	1	1	0.04	0.04
	R-22	MP4A	1378	UF	n/a	7	1	0.00369	0.00369
	R-22	MP5A	1448.2	UF	n/a	7	1	0.00916	0.00916
Plutonium-239/240	R-20	MP1A	904.6	UF	n/a	5	1	0.0443	0.0443
	R-20	MP3A	1330	UF	n/a	5	1	0.06	0.06
	R-22	MP1A	907.1	UF	n/a	7	1	0.012	0.012
	R-22	MP2A	962.8	UF	n/a	19	1	0.00627	0.00627
	R-22	MP3A	1273.5	UF	n/a	15	1	0.0254	0.0254
	R-22	MP4A	1378	UF	n/a	7	1	0.00369	0.00369
	R-22	MP5A	1448.2	UF	n/a	7	1	0.0061	0.0061
Potassium-40	R-22	MP2A	962.8	UF	n/a	17	1	66.4	66.4
	R-22	MP5A	1448.2	UF	FD	1	1	54.29	54.29
	R-32	MP1A	870.9	UF	n/a	7	1	46	46
Radium-226	R-22	MP1A	907.1	F	n/a	2	1	1.53	1.53
	R-20	P2A	1147.1	UF	n/a	3	2	0.8345	1.11
	R-21	Single	888.8	UF	n/a	5	1	0.679	0.679
	R-22	MP1A	907.1	UF	n/a	6	4	0.69475	0.848
	R-22	MP2A	962.8	UF	n/a	6	2	0.5225	0.648
	R-22	MP3A	1273.5	UF	n/a	5	2	0.5285	0.655
	R-22	MP4A	1378	UF	n/a	5	3	0.783	0.949
	R-22	MP5A	1448.2	UF	n/a	4	2	0.3985	0.442
	R-23	Single	816	UF	n/a	5	1	1.1	1.1
	R-23i	P1A	400.3	UF	n/a	5	2	0.7775	0.906
	R-23i	P2A	470.2	UF	n/a	5	1	1.35	1.35
	R-23i	P3A	524	UF	n/a	4	2	0.7945	0.932
	R-32	Single	867.5	UF	FD	2	1	1.2	1.2
	R-39	Single	859	UF	n/a	4	1	0.469	0.469

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Radium-228	R-22	MP1A	907.1	F	n/a	2	2	1.64	1.99
	R-20	P1A	904.6	UF	n/a	3	2	0.674	0.776
	R-22	MP1A	907.1	UF	n/a	3	3	3.43	4.45
	R-22	MP3A	1273.5	UF	n/a	2	1	0.696	0.696
	R-22	MP4A	1378	UF	n/a	2	1	2	2
Radium-228 (continued)	R-22	MP5A	1448.2	UF	n/a	2	1	1.19	1.19
	R-23	Single	816	UF	n/a	5	1	0.599	0.599
	R-23i	P1A	400.3	UF	n/a	5	3	1.25467	1.88
	R-23i	P3A	524	UF	n/a	4	1	1.14	1.14
	R-32	Single	867.5	UF	FD	2	1	0.93	0.93
	R-37	P1A	929.3	UF	n/a	3	1	3.05	3.05
	R-37	P2A	1026	UF	n/a	3	1	1.37	1.37
	R-38	Single	821.2	UF	n/a	3	1	1.34	1.34
	R-39	Single	859	UF	n/a	4	1	0.722	0.722
	R-40	R-40i	649.7	UF	n/a	2	1	1.71	1.71
	R-49	P1A	845	UF	n/a	2	1	1.57	1.57
	R-49	P2A	905.6	UF	n/a	2	1	0.717	0.717
Strontium-90	R-22	MP2A	962.8	F	n/a	13	1	0.7	0.7
	R-22	MP4A	1378	F	n/a	2	1	0.8	0.8
	R-20	MP1A	904.6	UF	n/a	5	1	0.229	0.229
	R-20	MP2A	1147.1	UF	n/a	6	1	0.237	0.237
	R-20	MP3A	1330	UF	n/a	6	1	4.15	4.15
	R-23i	P3A	524	UF	n/a	13	1	0.612	0.612
	R-37	P1A	929.3	UF	n/a	7	1	1.65	1.65
Technetium-99	R-22	MP3A	1273.5	UF	n/a	7	1	4.9	4.9
	R-22	MP5A	1448.2	UF	n/a	6	1	4.3	4.3
Thorium-228	R-22	MP1A	907.1	UF	n/a	4	2	0.1655	0.189
	R-22	MP5A	1448.2	UF	n/a	2	1	0.0492	0.0492
	R-49	P1A	845	UF	n/a	1	1	0.172	0.172
	R-22	MP1A	907.1	UF	n/a	4	1	0.0606	0.0606
	R-22	MP3A	1273.5	UF	n/a	3	2	0.1174	0.198
	R-22	MP4A	1378	UF	n/a	3	1	0.0724	0.0724
	R-49	P1A	845	UF	n/a	1	1	0.267	0.267
Thorium-232	R-49	P1A	845	UF	n/a	1	1	0.238	0.238

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Tritium	R-20	MP2A	1147.1	UF	n/a	5	1	7.40776	7.40776
	R-20	MP3A	1330	UF	n/a	5	1	1.97966	1.97966
	R-21	Single	888.8	UF	n/a	23	1	4.56599	4.56599
	R-22	MP1A	907.1	UF	n/a	26	19	30.3112	523
	R-22	MP2A	962.8	UF	n/a	22	3	25.6019	76.8
	R-22	MP3A	1273.5	UF	n/a	22	4	0.53237	1.24527
	R-22	MP4A	1378	UF	FD	1	1	582.4	582.4
	R-22	MP4A	1378	UF	n/a	22	2	0.16	0.44
Tritium (continued)	R-22	MP5A	1448.2	UF	FD	3	1	16.67	16.67
	R-22	MP5A	1448.2	UF	n/a	56	17	9.4308	18.49
	R-23	Single	816	UF	FD	12	3	1.69229	3.60809
	R-23	Single	816	UF	n/a	21	2	2.283	3.67195
	R-23i	P1A	400.3	UF	FD	2	1	22.2552	22.2552
	R-23i	P1A	400.3	UF	n/a	13	12	168.683	302
	R-23i	P2A	470.2	UF	FD	3	2	26.4221	29.3756
	R-23i	P2A	470.2	UF	n/a	18	13	36.6399	162
	R-23i	P3A	524	UF	FD	3	2	34.6281	34.8037
	R-23i	P3A	524	UF	n/a	20	17	32.7433	37.6774
	R-32	MP3A	976	UF	n/a	8	2	2.05949	2.84177
	R-37	P1A	929.3	UF	FD	1	1	27.2044	27.2044
	R-37	P1A	929.3	UF	n/a	9	9	32.8382	51.2477
	R-37	P2A	1026	UF	n/a	9	3	14.145	24.4265
	R-38	Single	821.2	UF	n/a	9	1	40.5511	40.5511
	R-39	Single	859	UF	n/a	11	1	4.40634	4.40634
	R-40	P1A	751.6	UF	n/a	8	1	17.1464	17.1464
	R-40	R-40i	649.7	UF	n/a	7	1	4.56599	4.56599
	R-41	P2A	965.3	UF	FD	2	1	3.92739	3.92739
	R-41	P2A	965.3	UF	n/a	10	1	6.25828	6.25828
	R-49	P1A	845	UF	n/a	9	1	3.38458	3.38458
	R-52	P1A	1035.2	UF	n/a	4	1	5.97091	5.97091
	R-53	P1A	849.2	UF	n/a	4	1	9.54707	9.54707
	R-55	P1A	860	UF	n/a	3	1	4.24669	4.24669
	R-55	P2A	994.4	UF	n/a	3	1	3.09721	3.09721
	R-56	P1A	945	UF	n/a	2	2	3.08125	3.35265
	R-56	P2A	1046.6	UF	n/a	2	1	3.44844	3.44844

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Uranium-234	R-20	MP2A	1147.1	F	n/a	1	1	0.216	0.216
	R-20	P1A	904.6	F	n/a	2	2	0.431	0.476
	R-20	P2A	1147.1	F	n/a	2	2	0.3065	0.335
	R-21	Single	888.8	F	FD	1	1	0.238	0.238
	R-21	Single	888.8	F	n/a	6	6	0.21733	0.276
	R-22	MP1A	907.1	F	FD	2	2	0.538	0.586
	R-22	MP1A	907.1	F	n/a	5	3	0.51367	0.605
	R-22	MP2A	962.8	F	n/a	13	13	0.25262	0.29
	R-22	MP3A	1273.5	F	FD	1	1	2.01	2.01
	R-22	MP3A	1273.5	F	n/a	10	10	1.943	7.6
	R-22	MP4A	1378	F	n/a	2	2	0.0995	0.1
	R-22	MP5A	1448.2	F	n/a	2	1	0.107	0.107
	R-23	Single	816	F	FD	6	6	0.386	0.443
	R-23	Single	816	F	n/a	13	13	0.37892	0.498
	R-23i	P1A	400.3	F	FD	1	1	0.738	0.738
	R-23i	P1A	400.3	F	n/a	6	6	2.57883	12.4
	R-23i	P2A	470.2	F	FD	2	2	0.5525	0.64
	R-23i	P2A	470.2	F	n/a	11	11	0.68891	1.09
	R-23i	P3A	524	F	n/a	8	8	0.4485	0.842
	R-32	MP1A	870.9	F	n/a	5	5	0.5634	0.622
	R-32	MP3A	976	F	n/a	5	4	0.17068	0.273
	R-32	Single	867.5	F	FD	6	6	0.50117	0.577
	R-32	Single	867.5	F	n/a	7	7	0.51171	0.547
	R-37	P1A	929.3	F	n/a	1	1	1.02	1.02
	R-37	P2A	1026	F	n/a	1	1	0.62	0.62
	R-38	Single	821.2	F	n/a	2	2	0.3185	0.319
	R-39	Single	859	F	n/a	3	3	0.292	0.334
	R-40	P1A	751.6	F	n/a	1	1	0.612	0.612
	R-40	P2A	849.3	F	n/a	1	1	0.466	0.466
	R-40	R-40i	649.7	F	n/a	2	2	0.409	0.552
	R-41	P2A	965.3	F	n/a	2	2	1.133	1.39
	R-49	P1A	845	F	n/a	1	1	0.553	0.553
	R-49	P2A	905.6	F	n/a	1	1	0.448	0.448
	R-20	MP1A	904.6	UF	n/a	5	2	0.1435	0.168
	R-20	MP2A	1147.1	UF	n/a	5	3	0.1379	0.229
	R-20	P1A	904.6	UF	n/a	5	5	0.4332	0.555

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Uranium-234 (continued)	R-20	P2A	1147.1	UF	FD	1	1	0.272	0.272
	R-20	P2A	1147.1	UF	n/a	5	5	0.2446	0.309
	R-21	Single	888.8	UF	FD	1	1	0.261	0.261
	R-21	Single	888.8	UF	n/a	13	13	0.23562	0.294
	R-22	MP1A	907.1	UF	n/a	8	4	0.06925	0.124
	R-22	MP2A	962.8	UF	n/a	18	18	0.27522	0.34
	R-22	MP3A	1273.5	UF	FD	1	1	2.1	2.1
	R-22	MP3A	1273.5	UF	n/a	15	15	1.6608	7.8
	R-22	MP4A	1378	UF	FD	1	1	0.13	0.13
	R-22	MP4A	1378	UF	n/a	7	5	0.08936	0.0991
	R-22	MP5A	1448.2	UF	FD	1	1	0.04	0.04
	R-22	MP5A	1448.2	UF	n/a	7	5	0.1058	0.14
	R-23	Single	816	UF	FD	8	8	0.37	0.439
	R-23	Single	816	UF	n/a	20	20	0.39185	0.706
	R-23i	P1A	400.3	UF	FD	1	1	0.68	0.68
	R-23i	P1A	400.3	UF	n/a	11	11	1.66273	13.1
	R-23i	P2A	470.2	UF	FD	2	2	0.652	0.683
	R-23i	P2A	470.2	UF	n/a	16	16	0.65113	1.1
	R-23i	P3A	524	UF	FD	1	1	0.4	0.4
	R-23i	P3A	524	UF	n/a	13	13	0.50354	1.61
	R-32	MP1A	870.9	UF	n/a	9	9	0.67467	1.03
	R-32	MP3A	976	UF	n/a	9	4	0.08908	0.131
	R-32	Single	867.5	UF	FD	6	6	0.514	0.542
	R-32	Single	867.5	UF	n/a	10	10	0.4978	0.577
	R-37	P1A	929.3	UF	n/a	7	7	1.14086	1.38
	R-37	P2A	1026	UF	n/a	6	6	0.59217	1.05
	R-38	Single	821.2	UF	FD	2	2	0.2875	0.293
	R-38	Single	821.2	UF	n/a	7	7	0.28229	0.331
	R-39	Single	859	UF	FD	1	1	0.266	0.266
	R-39	Single	859	UF	n/a	8	8	0.31675	0.456
	R-40	P1A	751.6	UF	n/a	4	4	0.84025	0.961
	R-40	P2A	849.3	UF	FD	1	1	0.33	0.33
	R-40	P2A	849.3	UF	n/a	6	6	0.32	0.482
	R-40	R-40i	649.7	UF	n/a	5	5	0.3284	0.515
	R-41	P2A	965.3	UF	FD	1	1	0.449	0.449
	R-41	P2A	965.3	UF	n/a	7	7	0.70786	1.36

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Uranium-234 (continued)	R-49	P1A	845	UF	n/a	9	9	1.17289	2.17
	R-49	P2A	905.6	UF	n/a	9	9	0.30733	0.664
	R-51	P1A	914.96	UF	n/a	6	6	0.234	0.379
	R-51	P2A	1031	UF	n/a	6	6	0.26117	0.392
	R-52	P1A	1035.2	UF	n/a	5	5	0.3704	0.429
	R-52	P2A	1107	UF	n/a	5	5	0.2716	0.335
	R-53	P1A	849.2	UF	n/a	5	5	0.3064	0.376
	R-53	P2A	959.7	UF	FD	2	2	0.2745	0.321
	R-53	P2A	959.7	UF	n/a	5	5	0.2866	0.443
	R-54	P1A	830	UF	n/a	6	6	0.50733	1.15
	R-54	P2A	915	UF	n/a	6	6	0.30133	0.363
	R-55	P1A	860	UF	n/a	3	2	0.463	0.485
	R-55	P2A	994.4	UF	n/a	3	3	0.389	0.445
	R-55i	Single	510	UF	n/a	2	2	0.6665	0.672
	R-56	P1A	945	UF	n/a	3	3	0.41433	0.442
	R-56	P2A	1046.6	UF	n/a	3	3	0.381	0.437
	R-57	P1A	910	UF	n/a	2	2	0.272	0.321
	R-57	P2A	971.5	UF	n/a	2	2	0.256	0.295
Uranium-235/236	R-22	MP2A	962.8	F	n/a	13	1	0.0472	0.0472
	R-22	MP3A	1273.5	F	FD	1	1	0.0956	0.0956
	R-22	MP3A	1273.5	F	n/a	10	6	0.11448	0.26
	R-23	Single	816	F	n/a	13	1	0.0336	0.0336
	R-23i	P1A	400.3	F	FD	1	1	0.0471	0.0471
	R-23i	P1A	400.3	F	n/a	6	3	0.14377	0.285
	R-23i	P2A	470.2	F	FD	2	1	0.039	0.039
	R-23i	P2A	470.2	F	n/a	11	3	0.04273	0.0464
	R-32	MP1A	870.9	F	n/a	5	2	0.0474	0.0612
	R-32	Single	867.5	F	FD	6	1	0.0291	0.0291
	R-32	Single	867.5	F	n/a	7	2	0.04025	0.0471
	R-20	P1A	904.6	UF	n/a	5	1	0.0399	0.0399
	R-21	Single	888.8	UF	n/a	13	2	0.04475	0.054
	R-22	MP2A	962.8	UF	n/a	19	1	0.0447	0.0447
	R-22	MP3A	1273.5	UF	n/a	16	10	0.08259	0.28
	R-23	Single	816	UF	n/a	20	2	0.03765	0.0439
	R-23i	P1A	400.3	UF	n/a	11	2	0.2583	0.473
	R-23i	P2A	470.2	UF	FD	2	1	0.061	0.061

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Uranium-235/236 (continued)	R-23i	P2A	470.2	UF	n/a	16	2	0.05265	0.0548
	R-32	MP1A	870.9	UF	n/a	9	4	0.06355	0.119
	R-32	Single	867.5	UF	n/a	10	2	0.0378	0.0391
	R-37	P1A	929.3	UF	n/a	7	1	0.0548	0.0548
	R-41	P2A	965.3	UF	n/a	7	1	0.0334	0.0334
	R-49	P1A	845	UF	n/a	9	2	0.0918	0.129
	R-49	P2A	905.6	UF	n/a	9	1	0.0589	0.0589
	R-52	P1A	1035.2	UF	n/a	5	1	0.0321	0.0321
	R-52	P2A	1107	UF	n/a	5	1	0.0258	0.0258
	R-54	P1A	830	UF	n/a	6	1	0.0462	0.0462
	R-55	P1A	860	UF	n/a	3	1	0.036	0.036
	R-56	P2A	1046.6	UF	n/a	3	2	0.0298	0.0303
Uranium-238	R-20	MP2A	1147.1	F	n/a	1	1	0.207	0.207
	R-20	P1A	904.6	F	n/a	2	2	0.2655	0.301
	R-20	P2A	1147.1	F	n/a	2	2	0.187	0.195
	R-21	Single	888.8	F	FD	1	1	0.104	0.104
	R-21	Single	888.8	F	n/a	6	6	0.1148	0.144
	R-22	MP1A	907.1	F	FD	2	2	0.3025	0.356
	R-22	MP1A	907.1	F	n/a	5	3	0.27833	0.338
	R-22	MP2A	962.8	F	n/a	13	13	0.12644	0.173
	R-22	MP3A	1273.5	F	FD	1	1	1.14	1.14
	R-22	MP3A	1273.5	F	n/a	10	10	1.1736	4.92
	R-23	Single	816	F	FD	6	6	0.17317	0.247
	R-23	Single	816	F	n/a	13	13	0.17454	0.227
	R-23i	P1A	400.3	F	FD	1	1	0.406	0.406
	R-23i	P1A	400.3	F	n/a	6	6	1.2765	5.86
	R-23i	P2A	470.2	F	FD	2	2	0.312	0.323
	R-23i	P2A	470.2	F	n/a	11	11	0.38227	0.632
	R-23i	P3A	524	F	n/a	8	8	0.2105	0.387
	R-32	MP1A	870.9	F	n/a	5	5	0.2742	0.289
	R-32	MP3A	976	F	n/a	5	3	0.14333	0.185
	R-32	Single	867.5	F	FD	6	6	0.24833	0.261
	R-32	Single	867.5	F	n/a	7	7	0.22943	0.263
	R-37	P1A	929.3	F	n/a	1	1	0.47	0.47
	R-37	P2A	1026	F	n/a	1	1	0.28	0.28
	R-38	Single	821.2	F	n/a	2	2	0.1445	0.152

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Uranium-238 (continued)	R-39	Single	859	F	n/a	3	3	0.119	0.136
	R-40	P1A	751.6	F	n/a	1	1	0.248	0.248
	R-40	P2A	849.3	F	n/a	1	1	0.15	0.15
	R-40	R-40i	649.7	F	n/a	2	2	0.1758	0.253
	R-41	P2A	965.3	F	n/a	2	2	0.3915	0.417
	R-49	P1A	845	F	n/a	1	1	0.257	0.257
	R-49	P2A	905.6	F	n/a	1	1	0.164	0.164
	R-20	MP1A	904.6	UF	n/a	5	3	0.07473	0.084
	R-20	MP2A	1147.1	UF	n/a	5	2	0.10925	0.161
	R-20	P1A	904.6	UF	n/a	5	5	0.2154	0.265
	R-20	P2A	1147.1	UF	FD	1	1	0.116	0.116
	R-20	P2A	1147.1	UF	n/a	5	5	0.1768	0.205
	R-21	Single	888.8	UF	FD	1	1	0.171	0.171
	R-21	Single	888.8	UF	n/a	13	12	0.11174	0.147
	R-22	MP2A	962.8	UF	n/a	18	17	0.11826	0.15
	R-22	MP3A	1273.5	UF	FD	1	1	1.31	1.31
	R-22	MP3A	1273.5	UF	n/a	15	15	0.9964	5.31
	R-22	MP4A	1378	UF	FD	1	1	0.05	0.05
	R-22	MP4A	1378	UF	n/a	7	3	0.05303	0.0735
	R-22	MP5A	1448.2	UF	FD	1	1	0.02	0.02
	R-22	MP5A	1448.2	UF	n/a	7	2	0.0516	0.0532
	R-23	Single	816	UF	FD	8	8	0.16763	0.196
	R-23	Single	816	UF	n/a	20	20	0.1727	0.3
	R-23i	P1A	400.3	UF	FD	1	1	0.358	0.358
	R-23i	P1A	400.3	UF	n/a	11	11	0.83618	6.35
	R-23i	P2A	470.2	UF	FD	2	2	0.3	0.317
	R-23i	P2A	470.2	UF	n/a	16	16	0.34781	0.582
	R-23i	P3A	524	UF	FD	1	1	0.175	0.175
	R-23i	P3A	524	UF	n/a	13	13	0.27162	1.03
	R-32	MP1A	870.9	UF	n/a	9	9	0.33911	0.528
	R-32	MP3A	976	UF	n/a	9	3	0.04847	0.0614
	R-32	Single	867.5	UF	FD	6	6	0.23417	0.293
	R-32	Single	867.5	UF	n/a	10	10	0.2284	0.289
	R-37	P1A	929.3	UF	n/a	7	7	0.48114	0.56
	R-37	P2A	1026	UF	n/a	6	6	0.2595	0.482
	R-38	Single	821.2	UF	FD	2	2	0.134	0.135

Table D-4.3-3 (continued)

Analyte	Well	Port Name	Port Depth (ft)	Field Prep	Field QC Type	Number of Analyses	Number of Detects	Average Detected Activity (pCi/L)	Maximum Detected Activity (pCi/L)
Uranium-238 (continued)	R-38	Single	821.2	UF	n/a	7	7	0.13029	0.159
	R-39	Single	859	UF	FD	1	1	0.147	0.147
	R-39	Single	859	UF	n/a	8	8	0.15113	0.261
	R-40	P1A	751.6	UF	n/a	4	4	0.36025	0.423
	R-40	P2A	849.3	UF	FD	1	1	0.128	0.128
	R-40	P2A	849.3	UF	n/a	6	6	0.1495	0.278
	R-40	R-40i	649.7	UF	n/a	5	5	0.1724	0.262
	R-41	P2A	965.3	UF	FD	1	1	0.189	0.189
	R-41	P2A	965.3	UF	n/a	7	7	0.30057	0.61
	R-49	P1A	845	UF	n/a	9	9	0.63222	1.53
	R-49	P2A	905.6	UF	n/a	9	9	0.1521	0.399
	R-51	P1A	914.96	UF	n/a	6	6	0.1039	0.14
	R-51	P2A	1031	UF	n/a	6	6	0.13972	0.274
	R-52	P1A	1035.2	UF	n/a	5	5	0.1908	0.294
	R-52	P2A	1107	UF	n/a	5	5	0.12358	0.143
	R-53	P1A	849.2	UF	n/a	5	5	0.1574	0.181
	R-53	P2A	959.7	UF	FD	2	2	0.1145	0.135
	R-53	P2A	959.7	UF	n/a	5	5	0.15762	0.289
	R-54	P1A	830	UF	n/a	6	6	0.33183	1.2
	R-54	P2A	915	UF	n/a	6	6	0.1445	0.172
	R-55	P1A	860	UF	n/a	3	2	0.1945	0.213
	R-55	P2A	994.4	UF	n/a	3	3	0.209	0.239
	R-55i	Single	510	UF	n/a	2	2	0.3015	0.314
	R-56	P1A	945	UF	n/a	3	3	0.20367	0.216
	R-56	P2A	1046.6	UF	n/a	3	3	0.194	0.215
	R-57	P1A	910	UF	n/a	2	2	0.1355	0.145
	R-57	P2A	971.5	UF	n/a	2	2	0.124	0.128

Source: Attachment D-1.

[a] F = Filtered.

[b] n/a = Not applicable.

[c] UF= Unfitered.

[d] FD = Field duplicate.

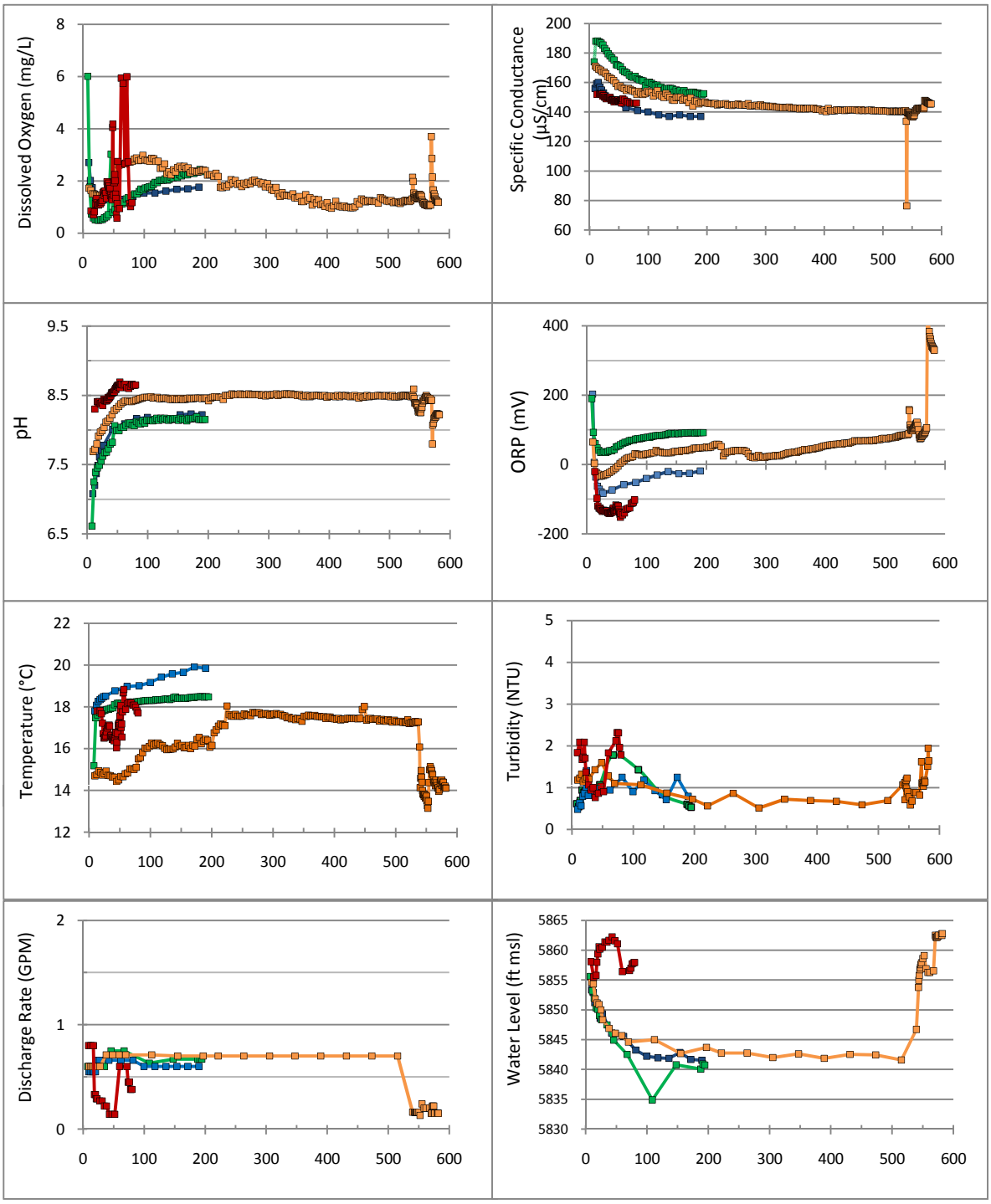
Attachment D-1

Analytical Suites and Results and Analytical Reports
(on DVDs included with this document)

Attachment D-2

Geochemical Trend Plots for
Technical Area 54 Monitoring Network Wells

R-20 screen 1 (port P1A), port depth 905 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R20-1. **Time-series plots of field parameters monitored during purging of R-20 screen 1 (port P1A)**

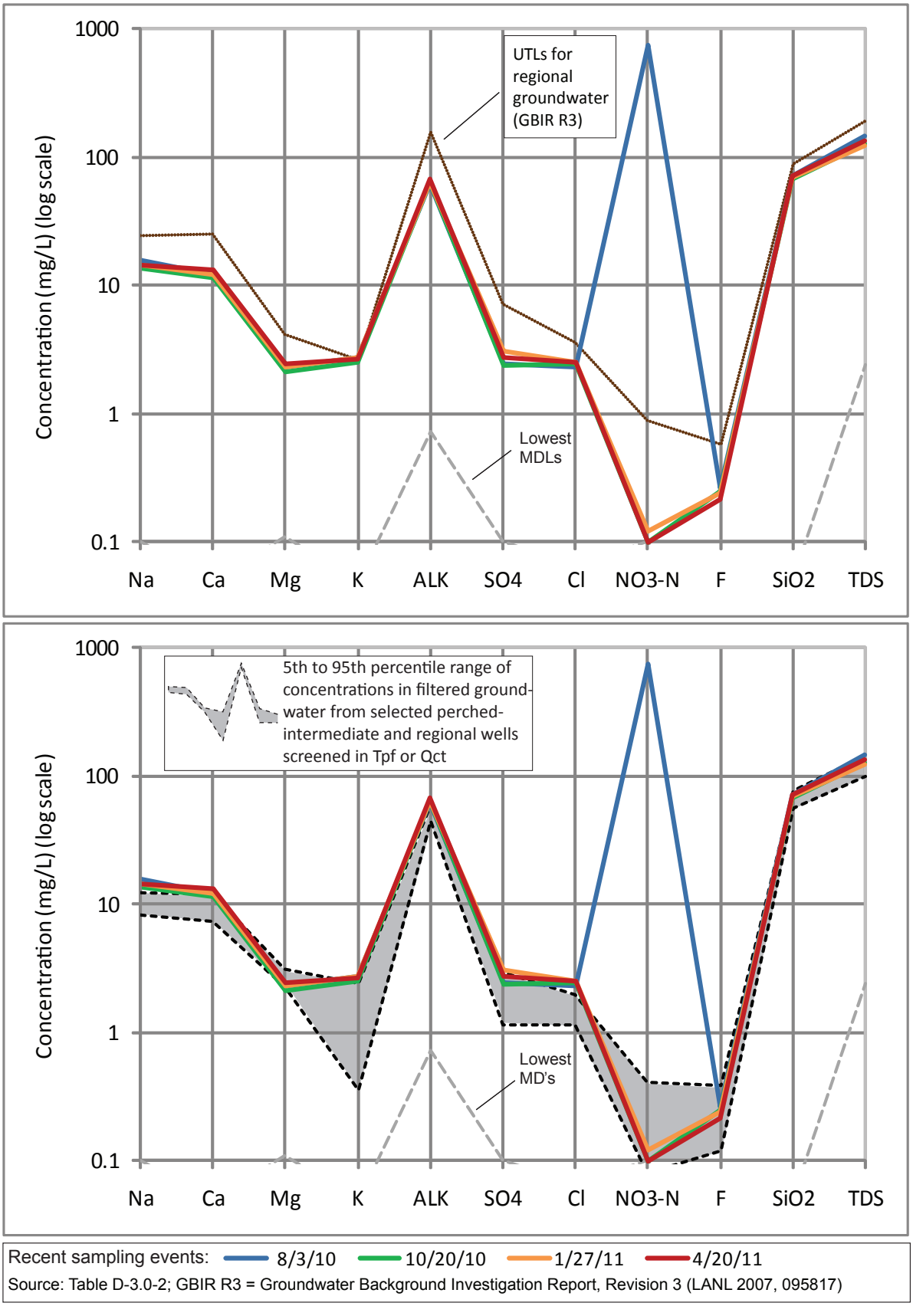


Figure D2-R20-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-20 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

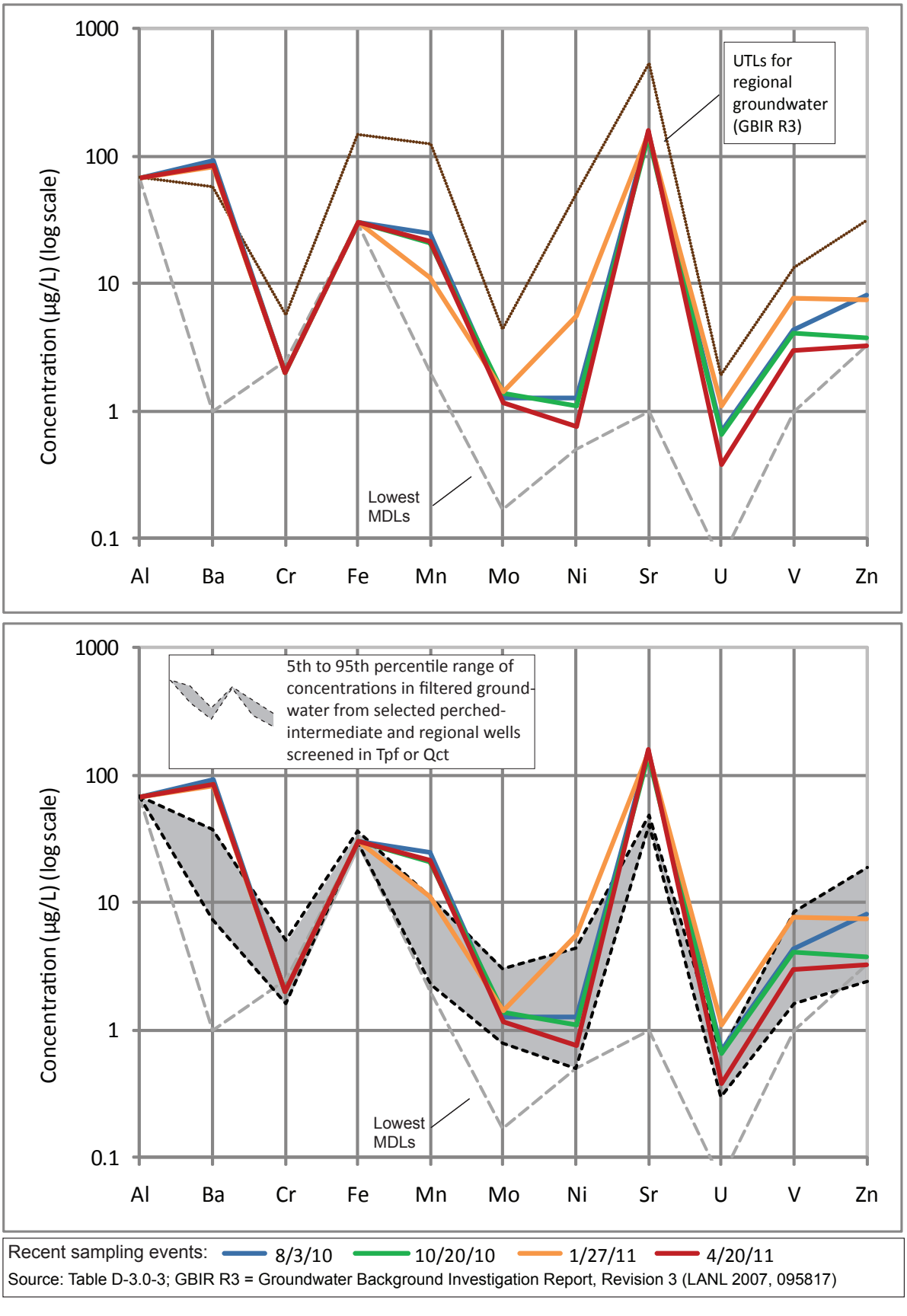
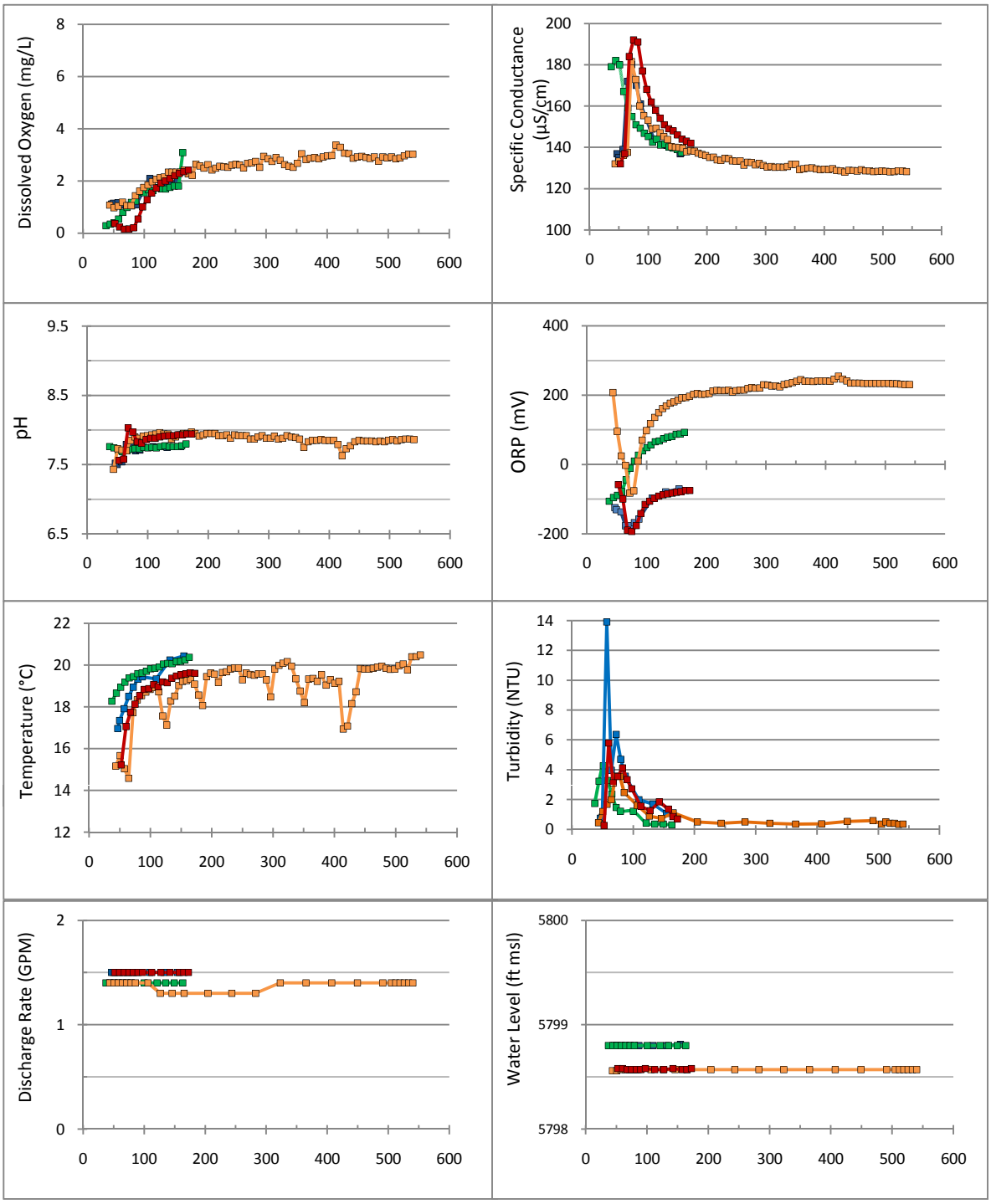


Figure D2-R20-3. Concentrations of trace metals in filtered groundwater from well R-20 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows"background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-20 screen 2 (port P2A), port depth 1147 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R20-4. Time-series plots of field parameters monitored during purging of R-20 screen 2 (port P2A)

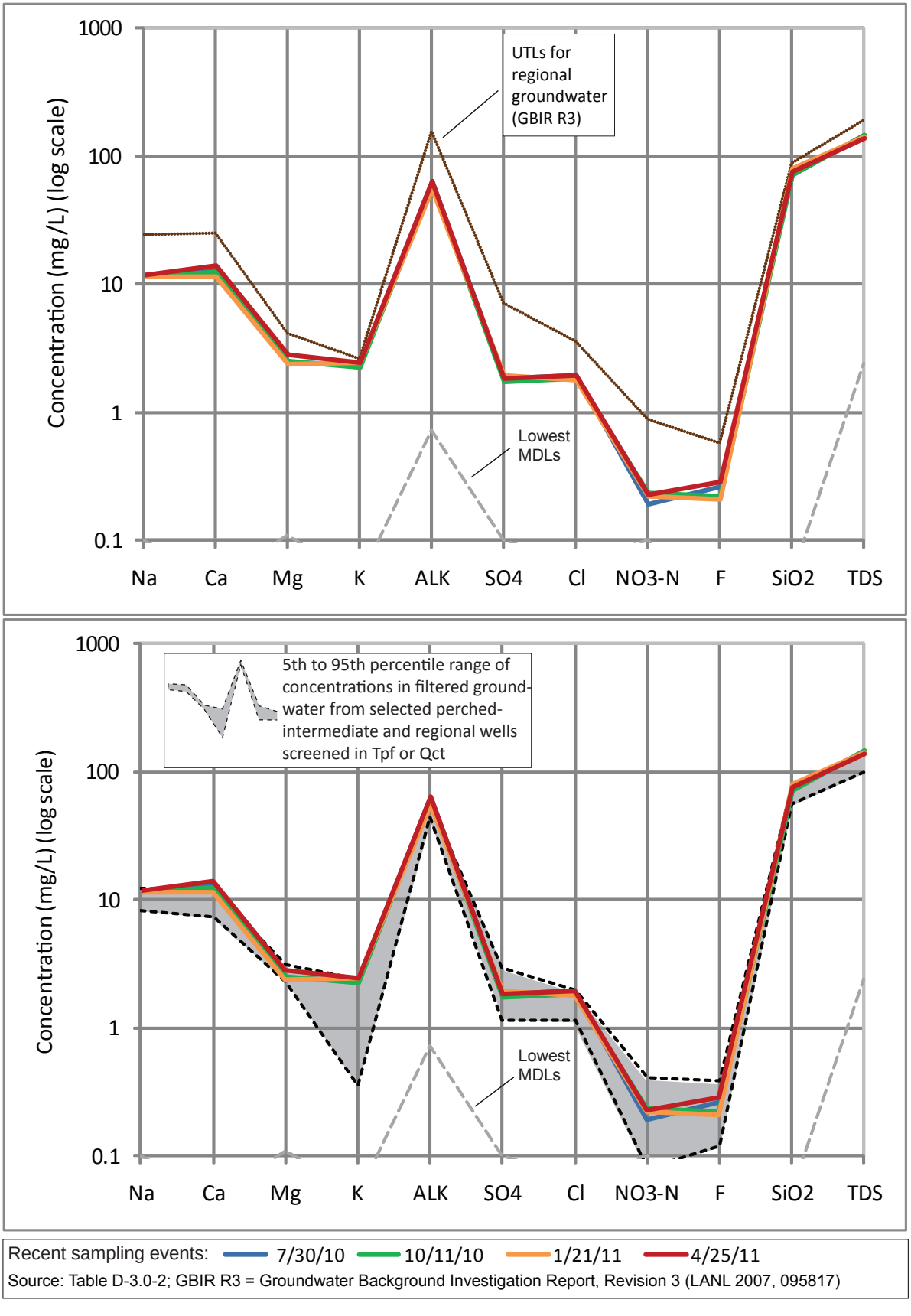


Figure D2-R20-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-20 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

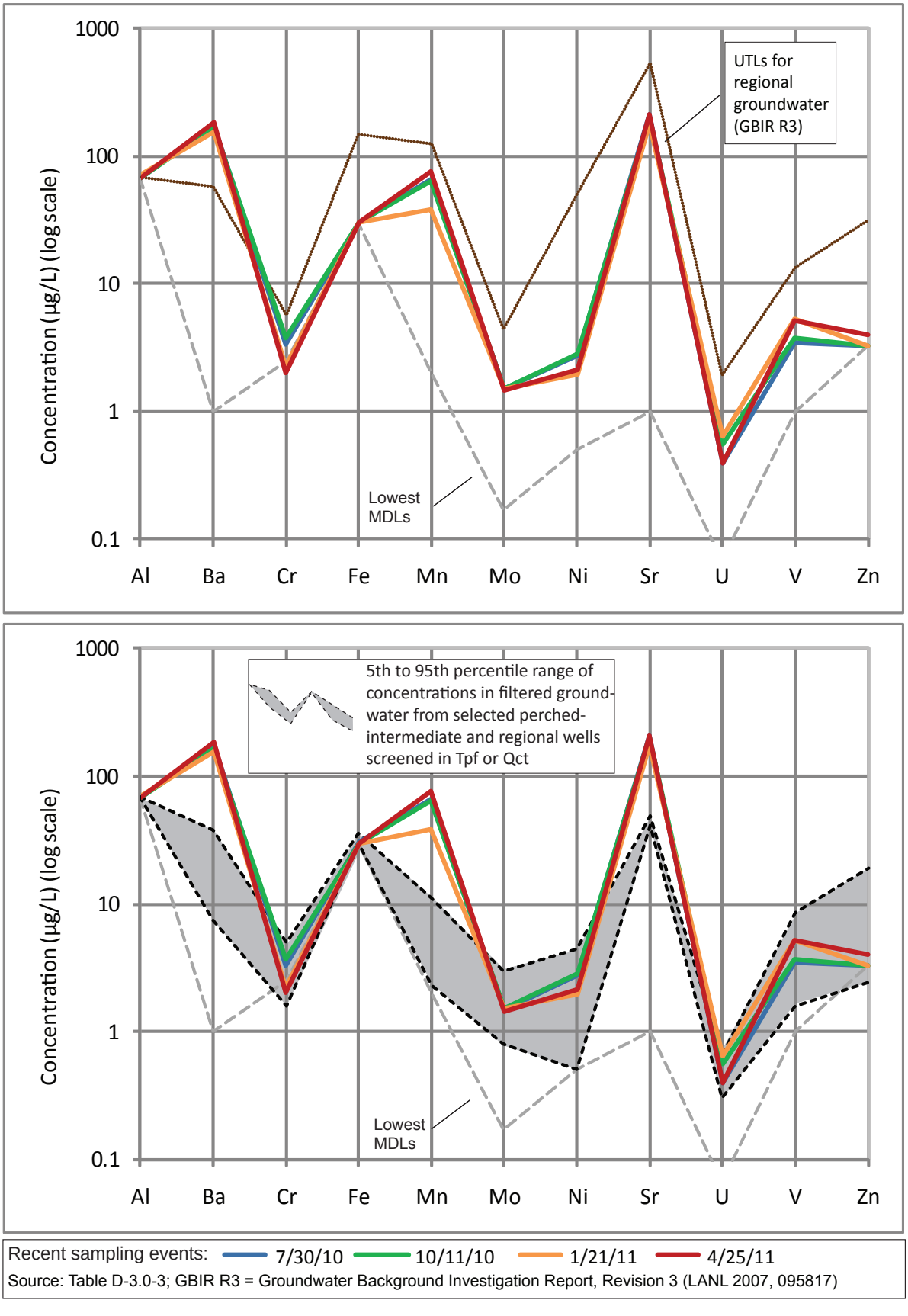
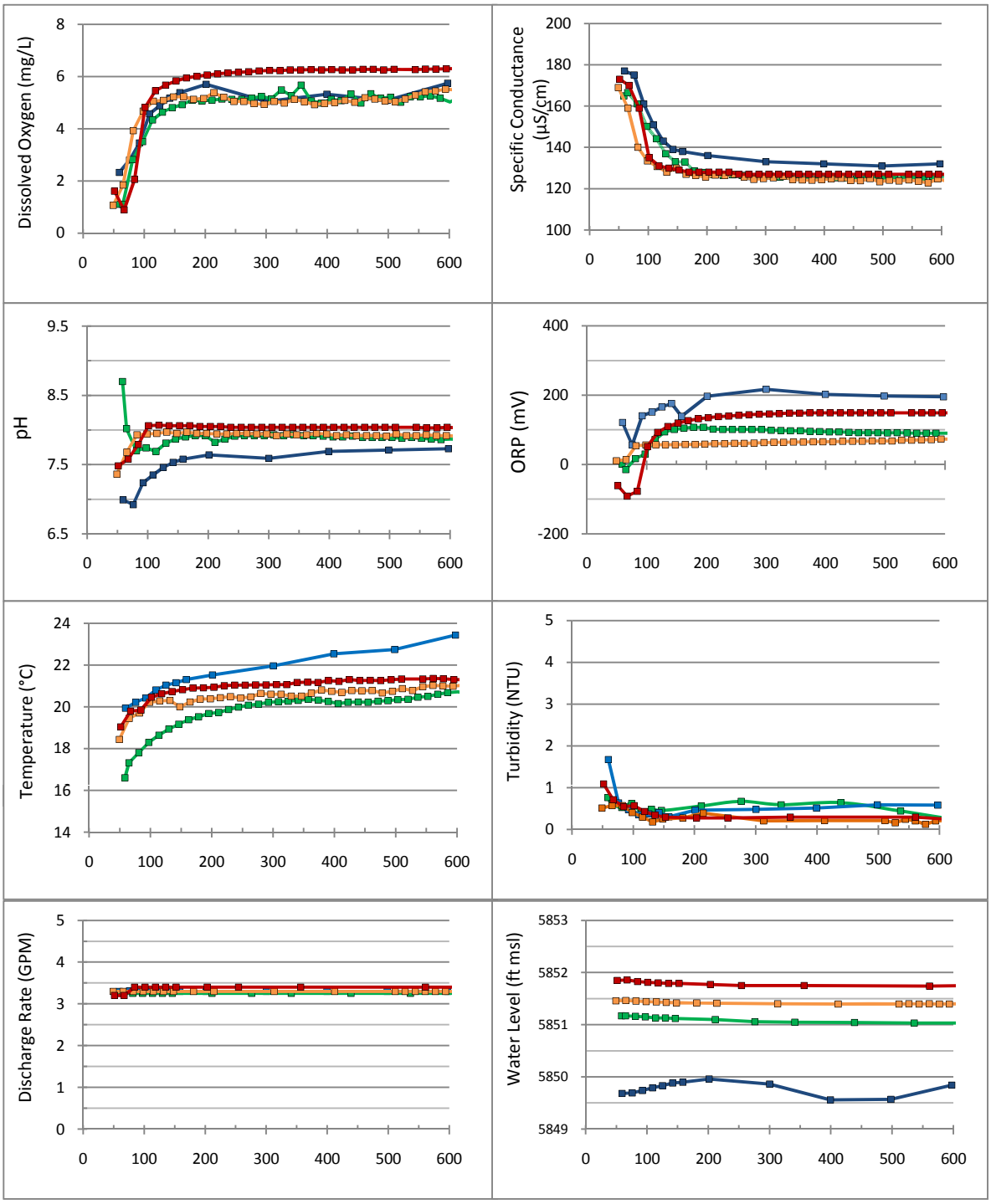


Figure D2-R20-6. Concentrations of trace metals in filtered groundwater from well R-20 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater. Lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-21 (single screen), port depth 889 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R21-1. Time-series plots of field parameters monitored during purging of R-21 (single screen)

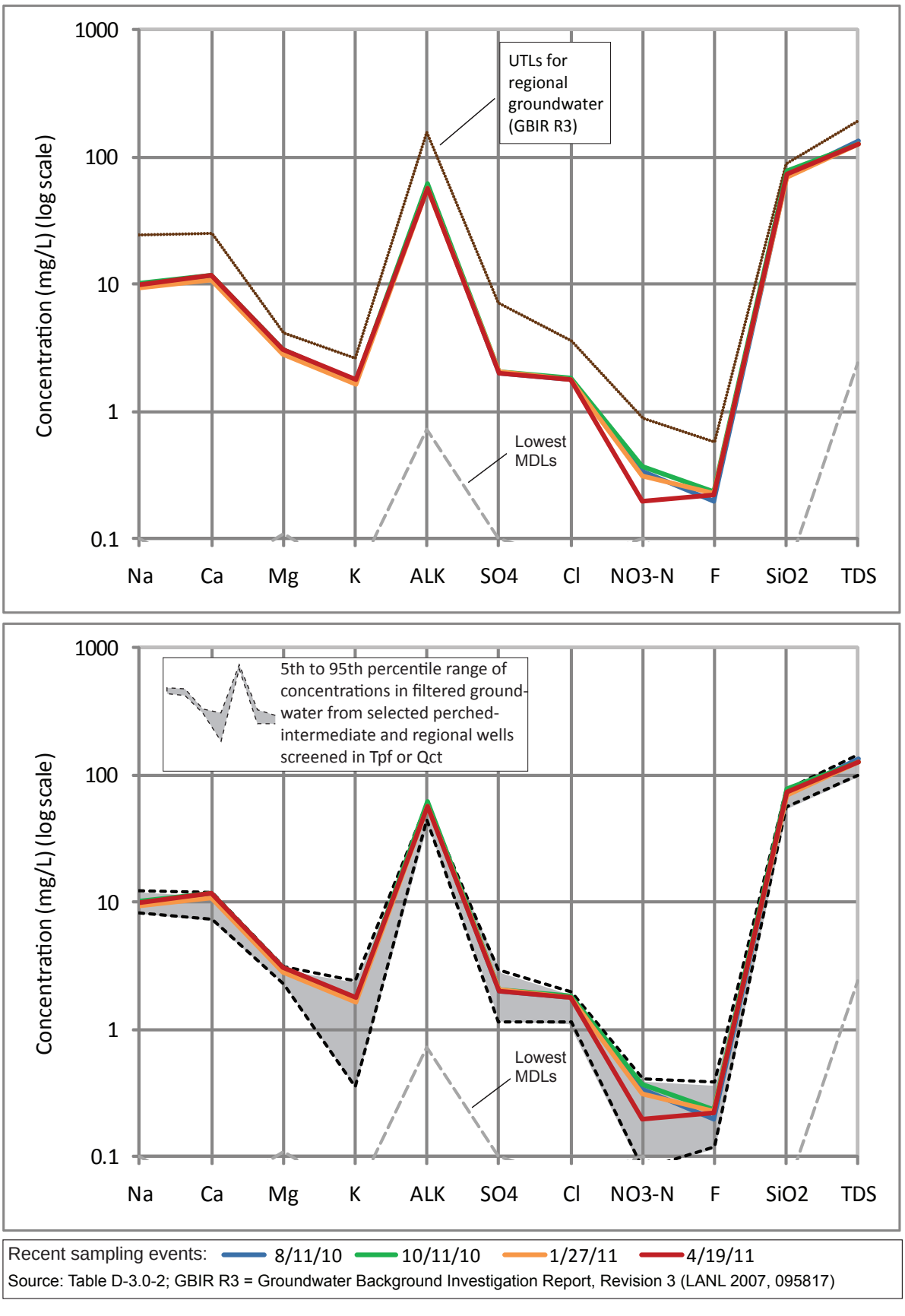


Figure D2-R21-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-21 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

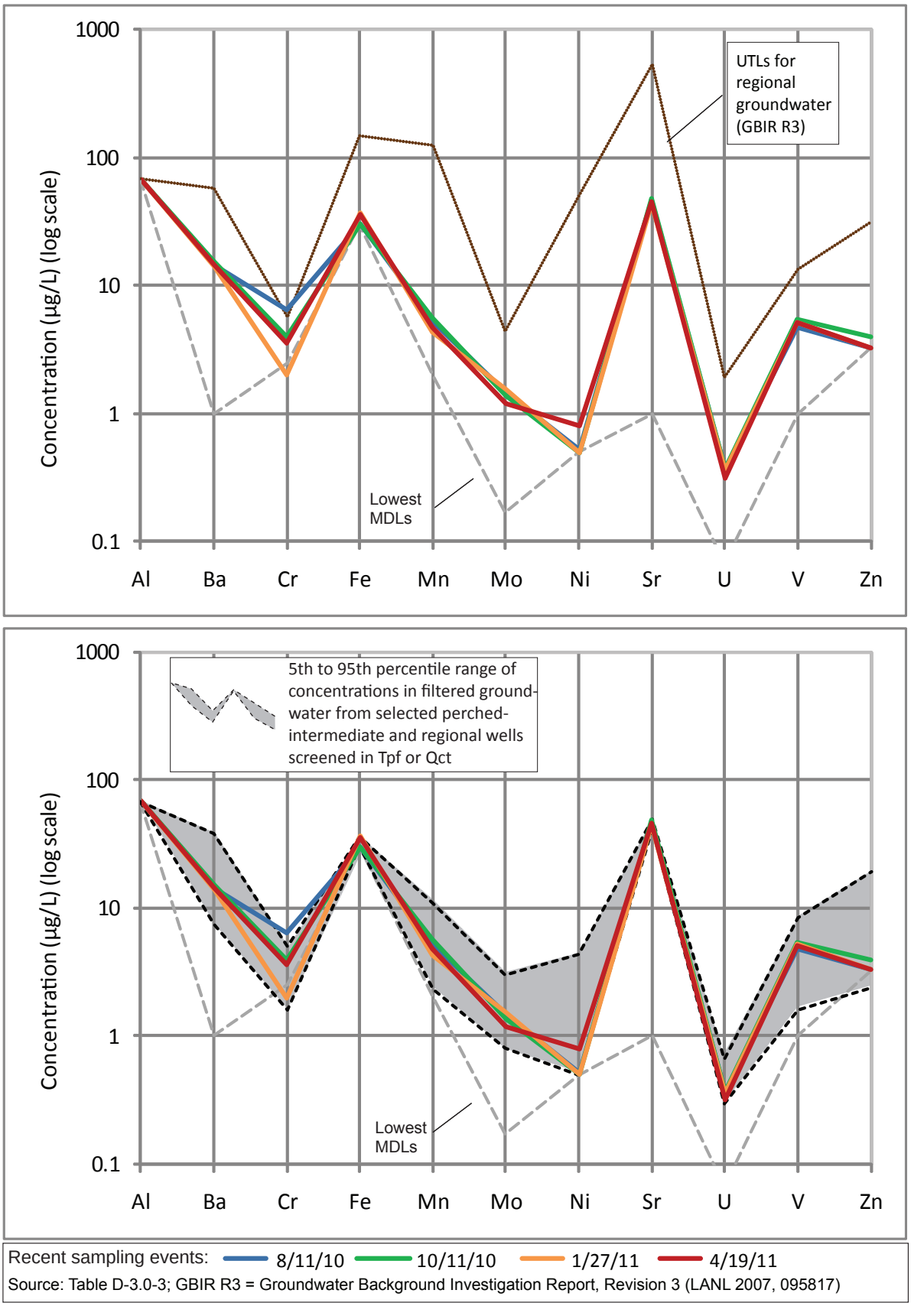


Figure D2-R21-3. Concentrations of trace metals in filtered groundwater from well R-21 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater. Lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

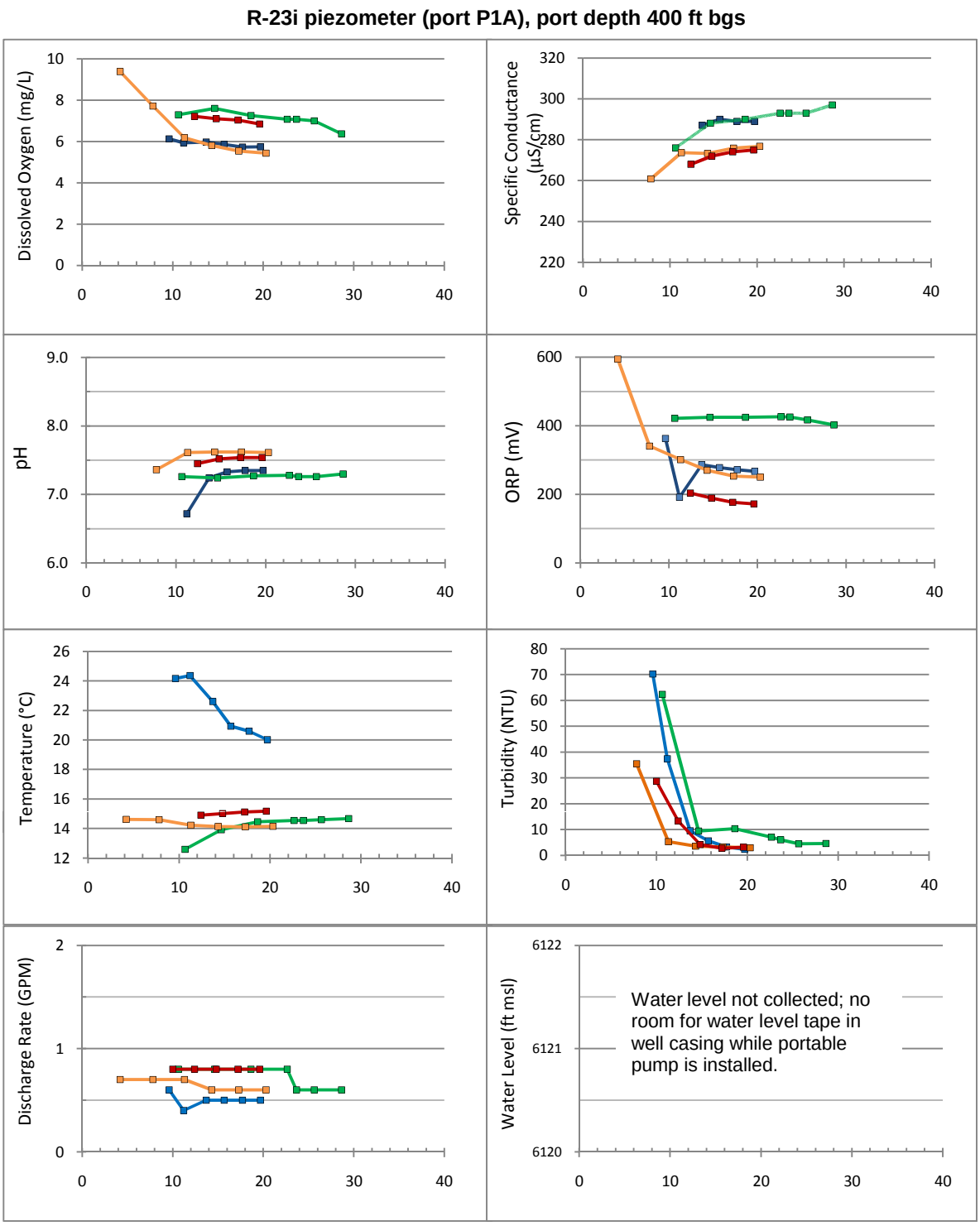


Figure D2-R23i-1. Time-series plots of field parameters monitored during purging of R-23i piezometer

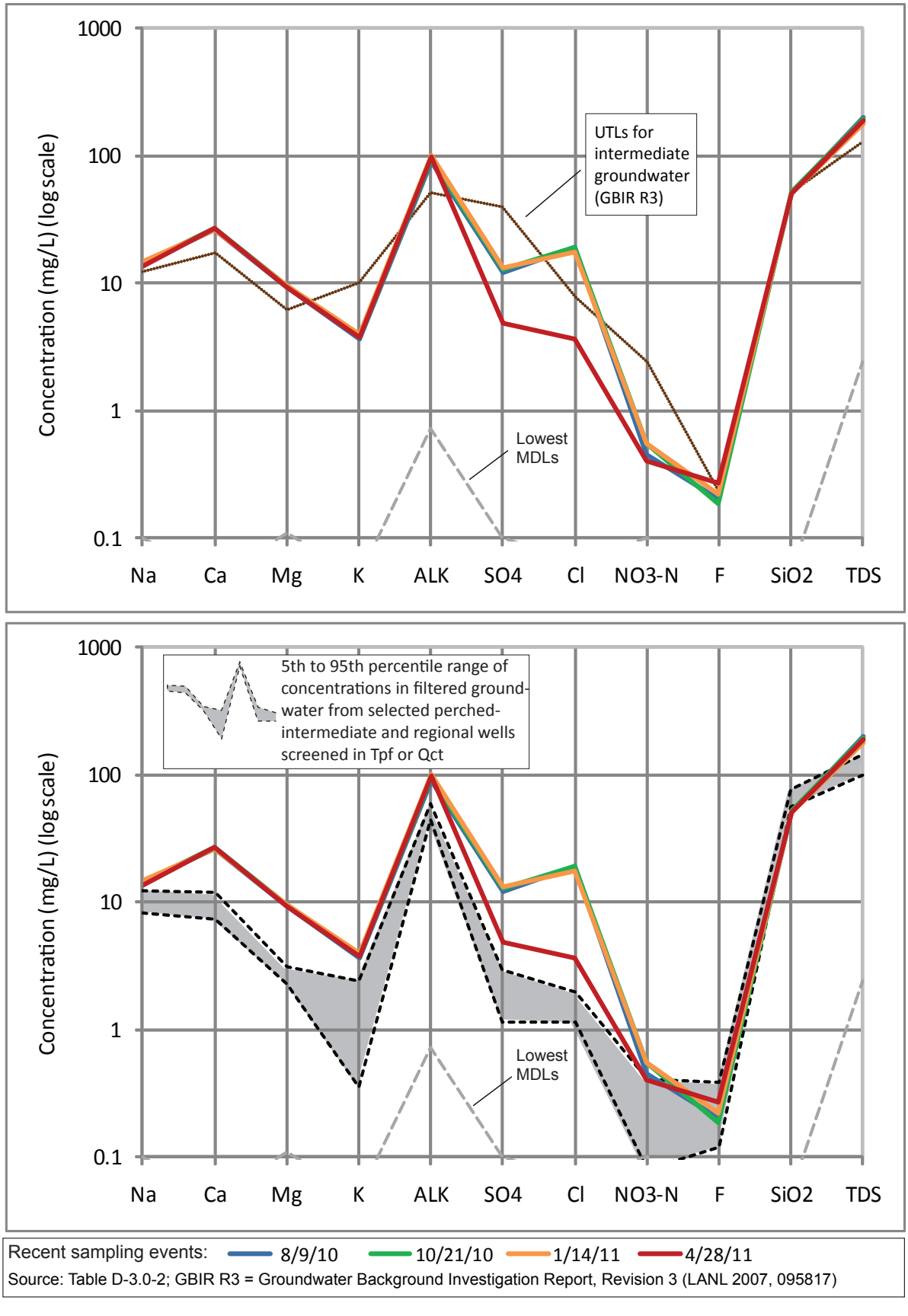


Figure D2-R23i-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-23i screen 1 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

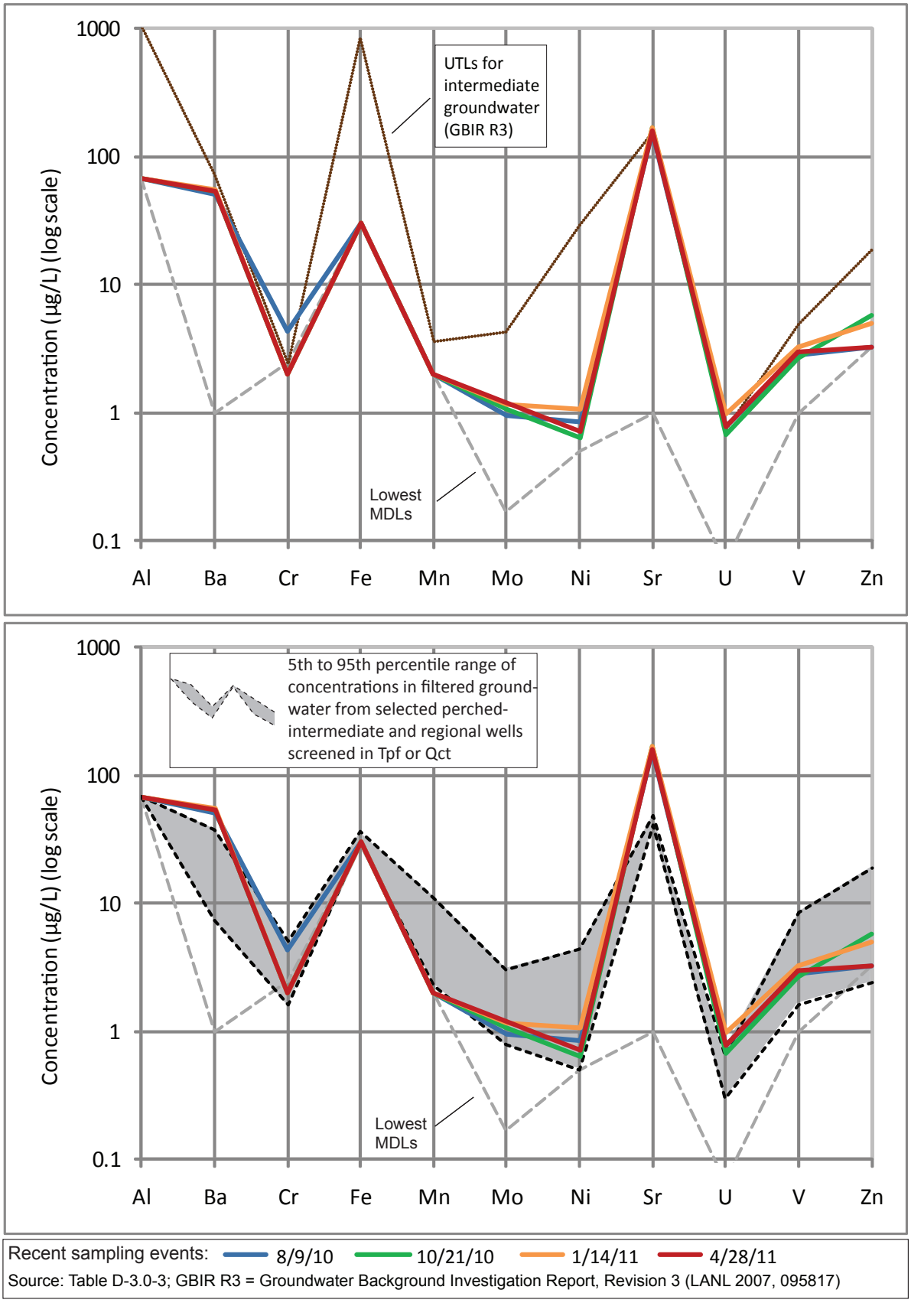


Figure D2-R23i-3. Concentrations of trace metals in filtered groundwater from well R-23i screen 1 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-23i screen 1 (port P2A), port depth 470 ft bgs

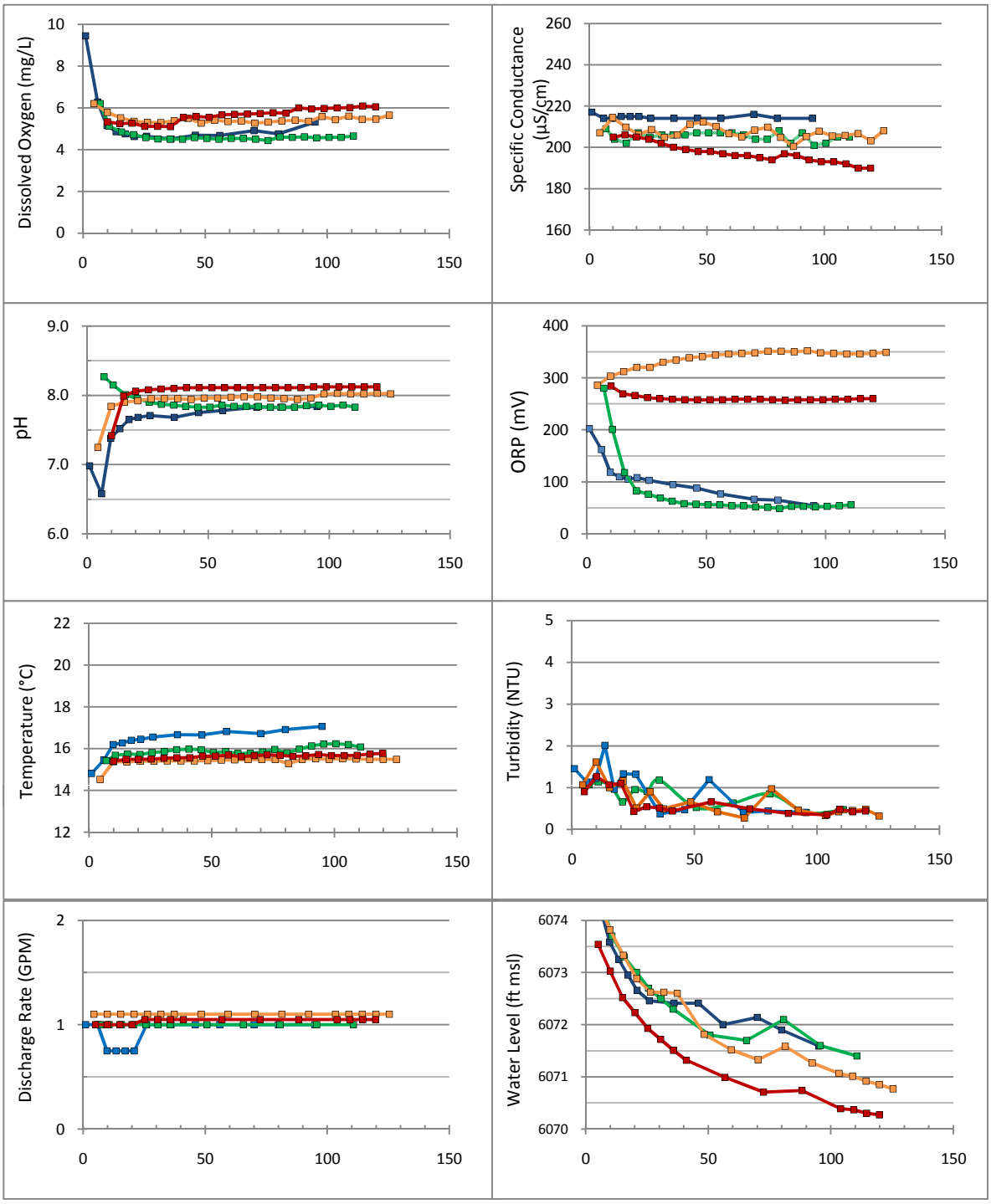


Figure D2-R23i-4. Time-series plots of field parameters monitored during purging of R-23i screen 1 (port P2A)

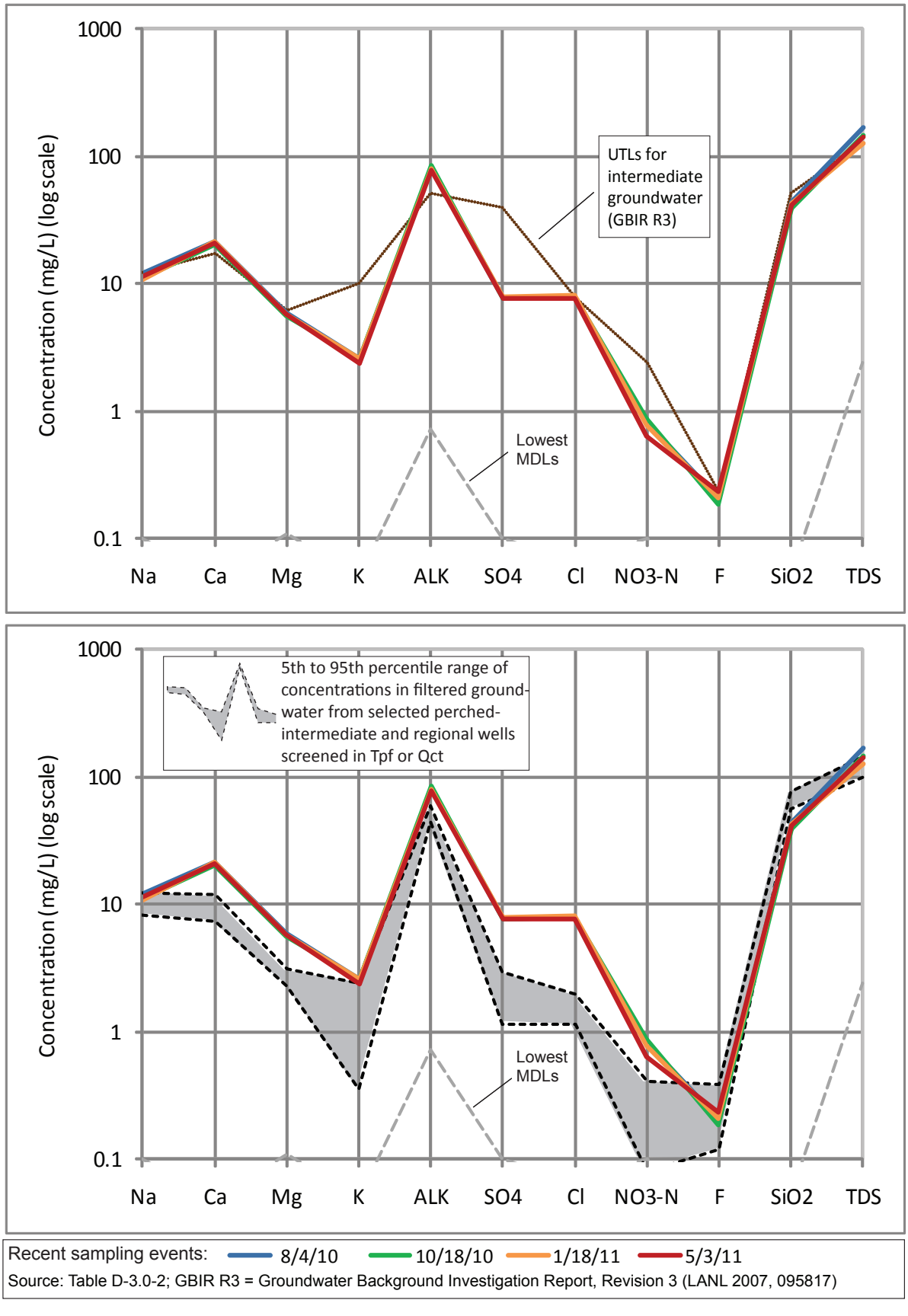


Figure D2-R23i-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-23i screen 2 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

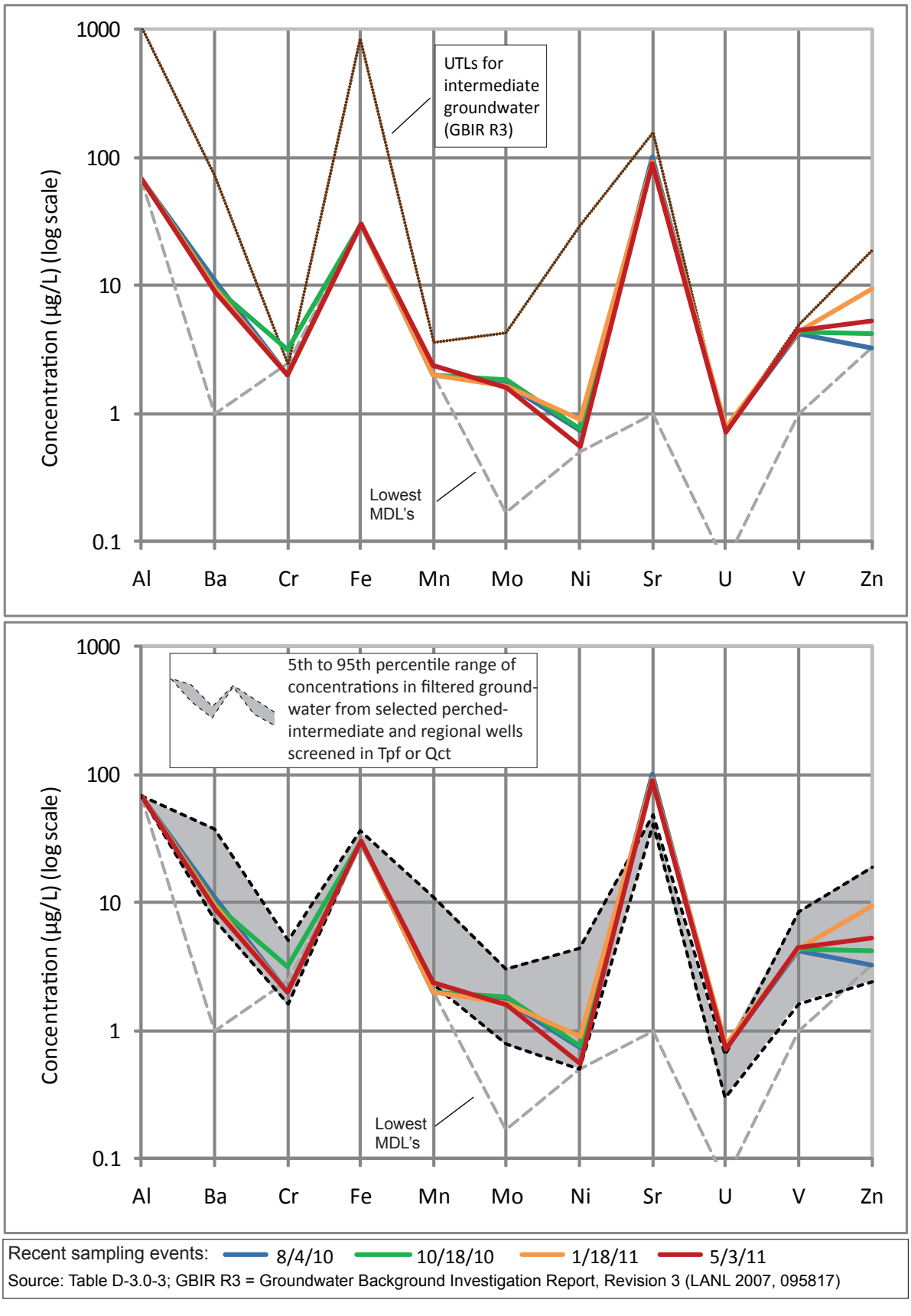


Figure D2-R23i-6. Concentrations of trace metals in filtered groundwater from well R-23i screen 2 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

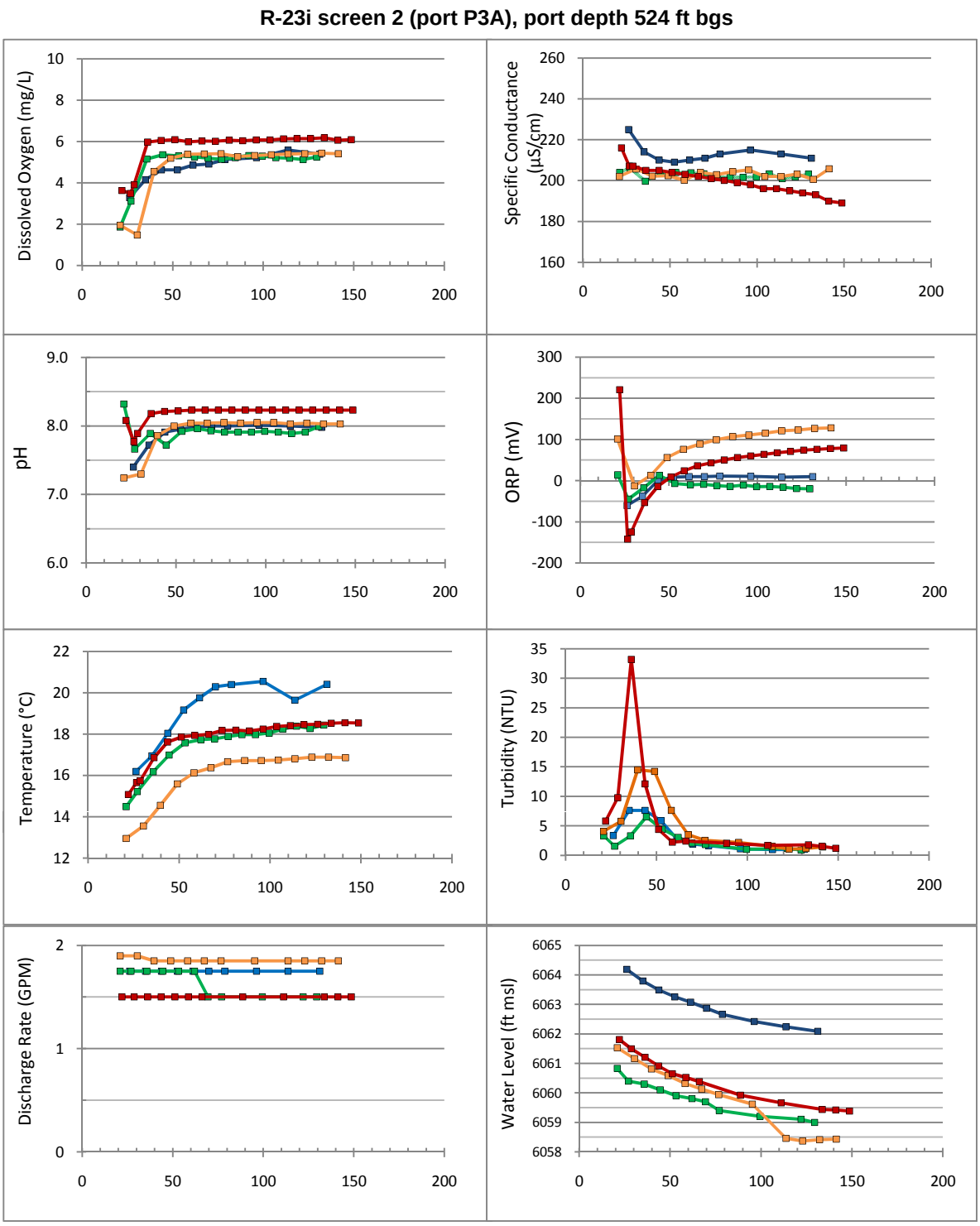


Figure D2-R23i-7. Time-series plots of field parameters monitored during purging of R-23i screen 2 (port P3A)

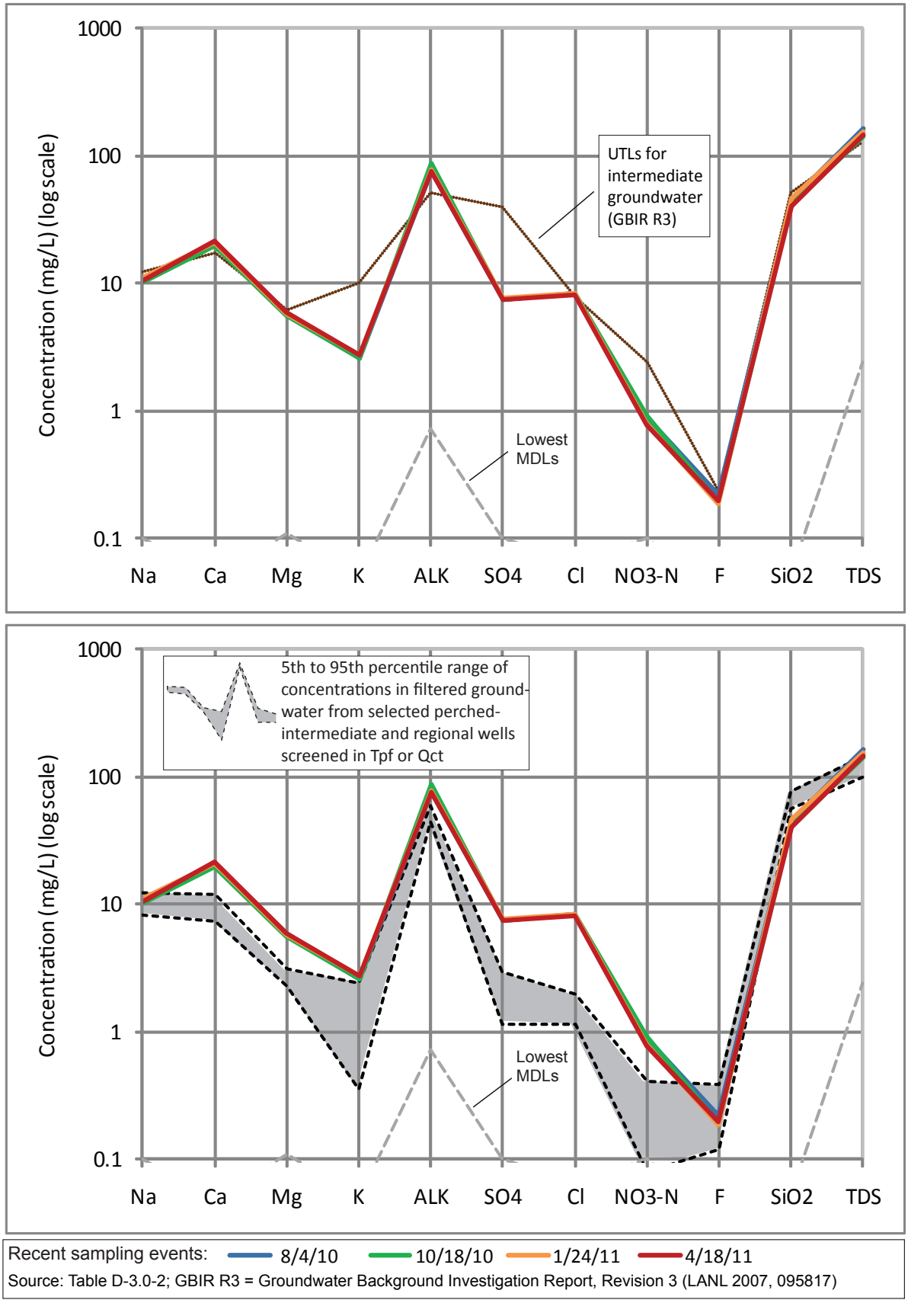


Figure D2-R-23i-8. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-23i screen 3 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

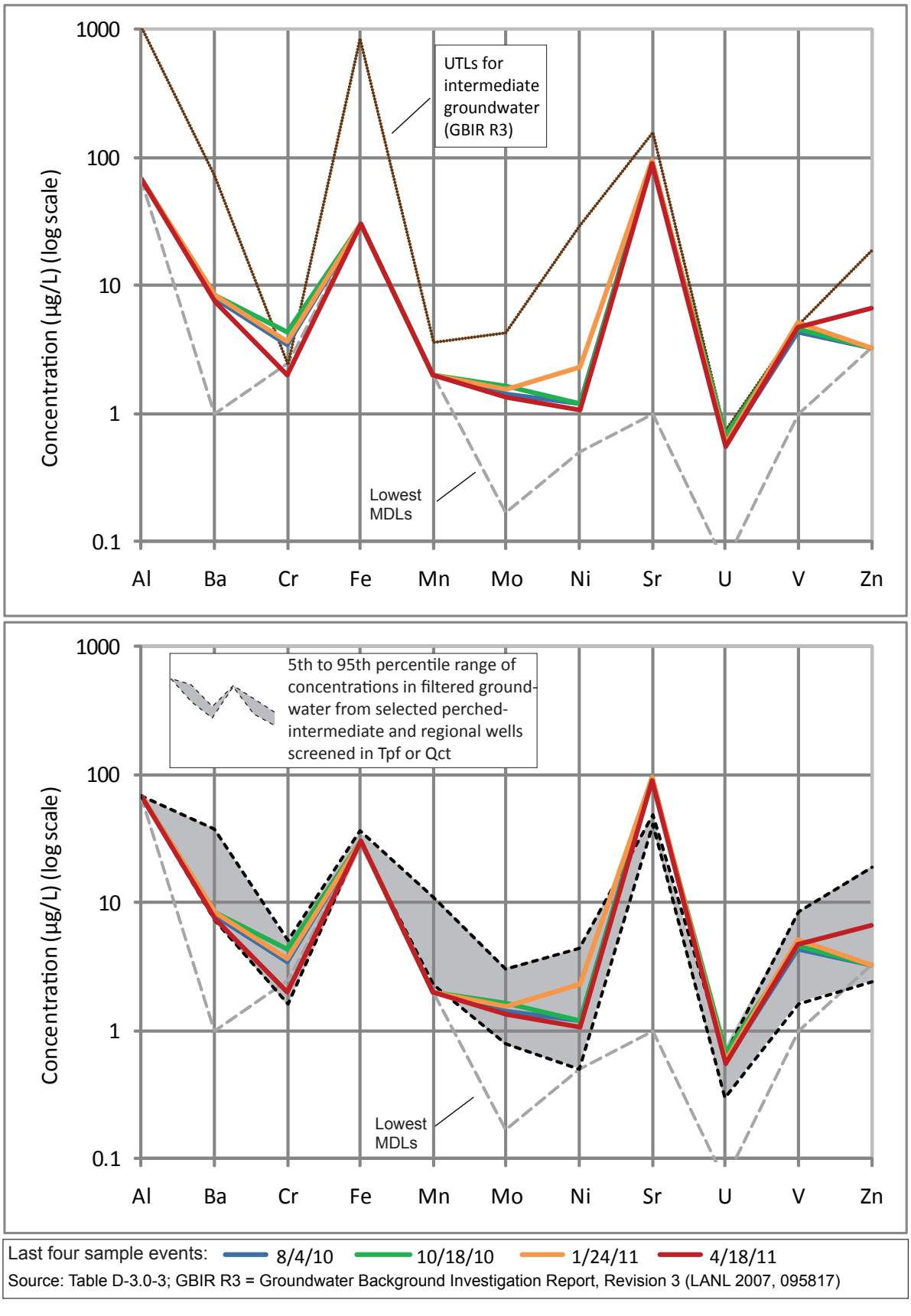
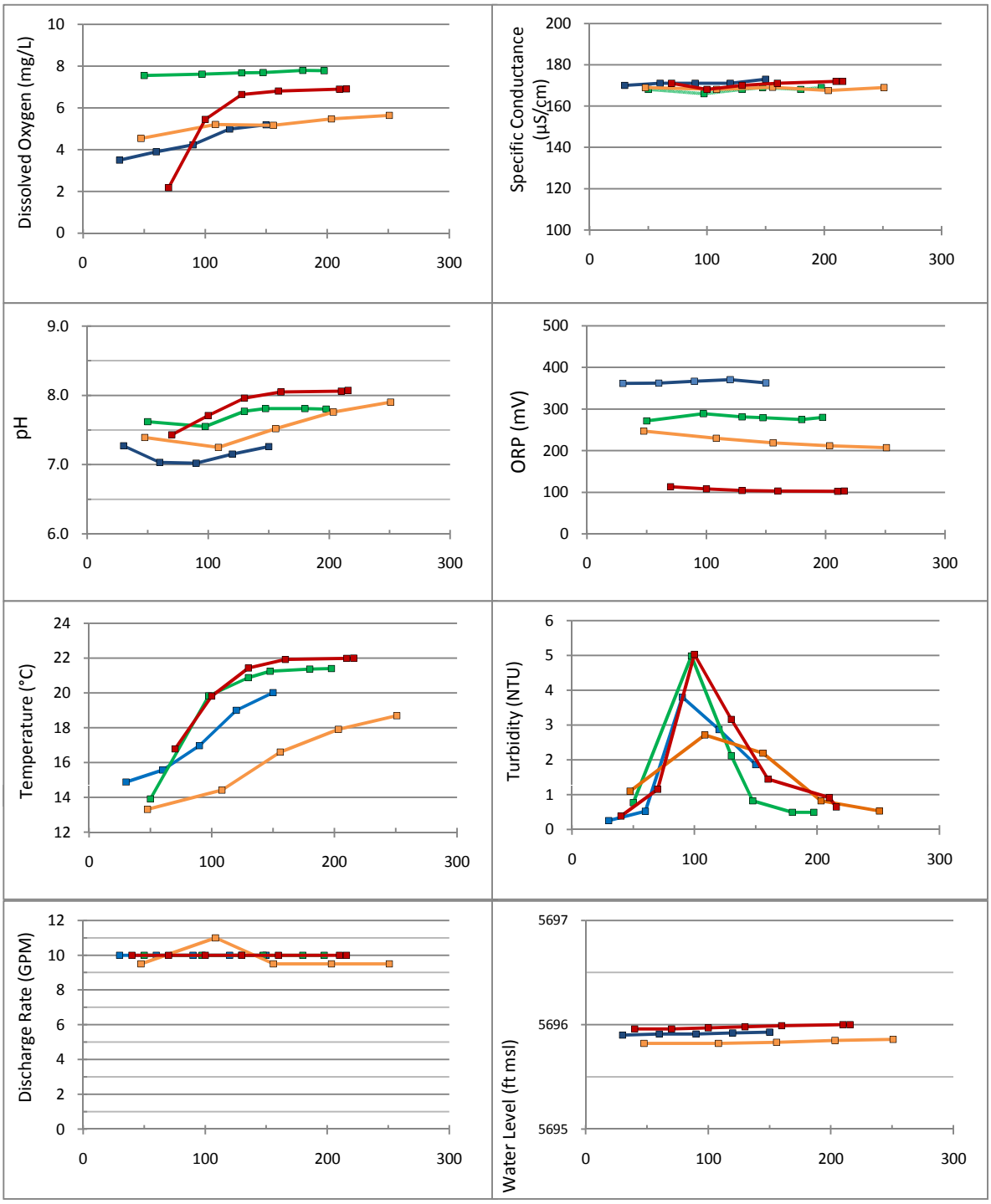


Figure D2-R23i-9. Concentrations of trace metals in filtered groundwater from well R-23i screen 3 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-23 (single screen), port depth 816 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R23-1. Time-series plots of field parameters monitored during purging of R-23 (single screen)

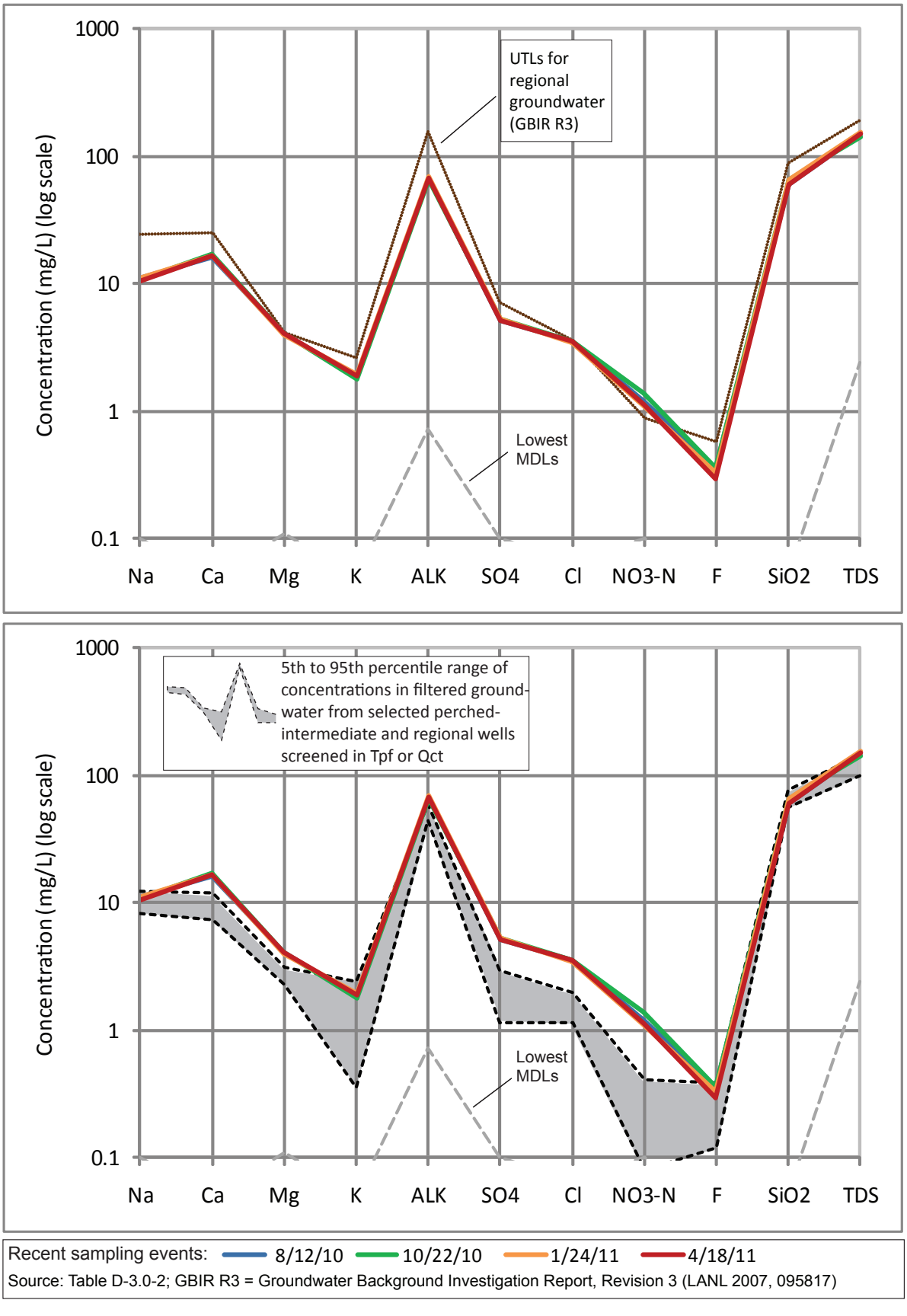


Figure D2-R23-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-23 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

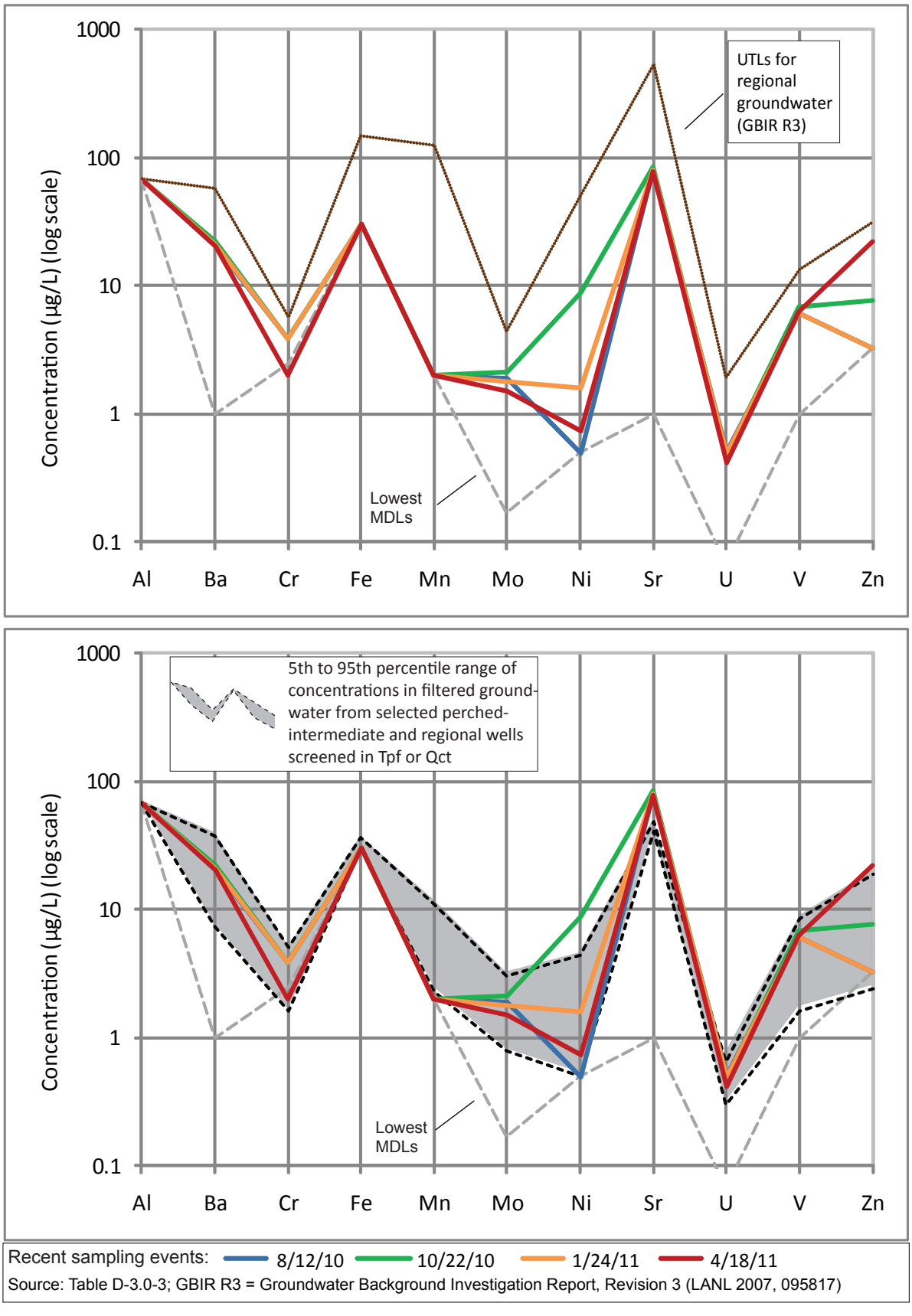
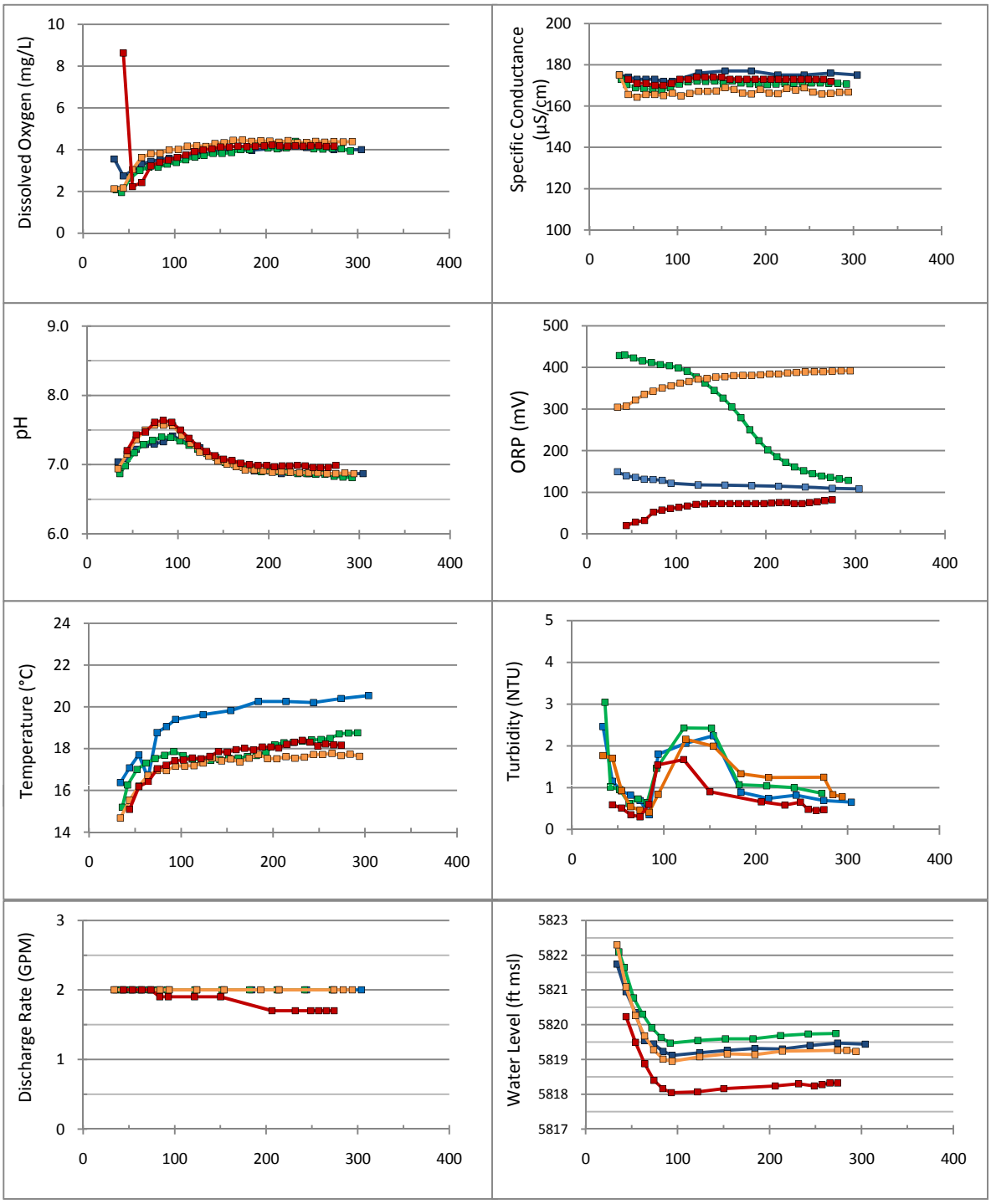


Figure D2-R23-3. Concentrations of trace metals in filtered groundwater from well R-23 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-32 (single screen), port depth 868 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R32-1. Time-series plots of field parameters monitored during purging of R-32 (single screen)

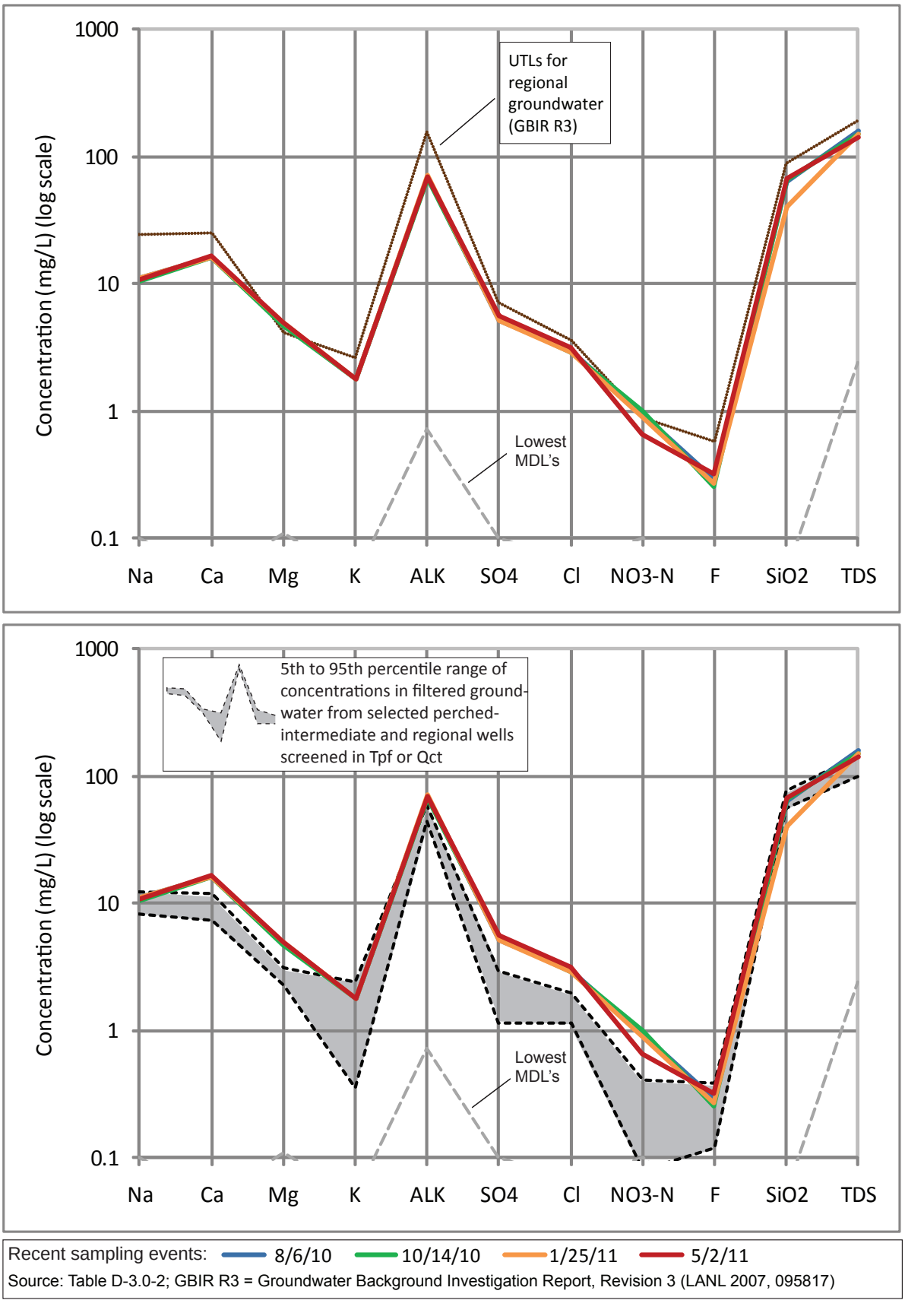


Figure D2-R32-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-32 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

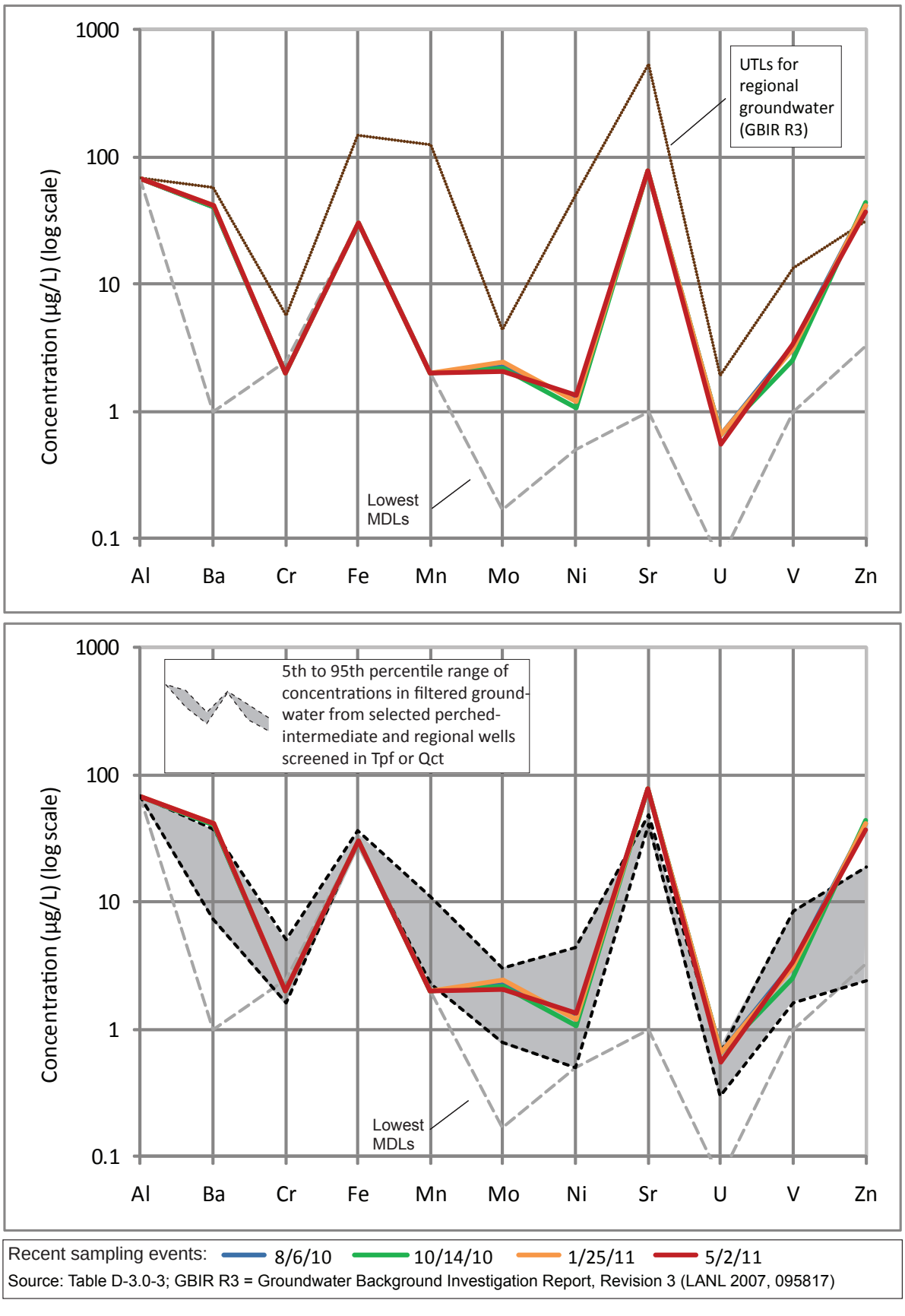
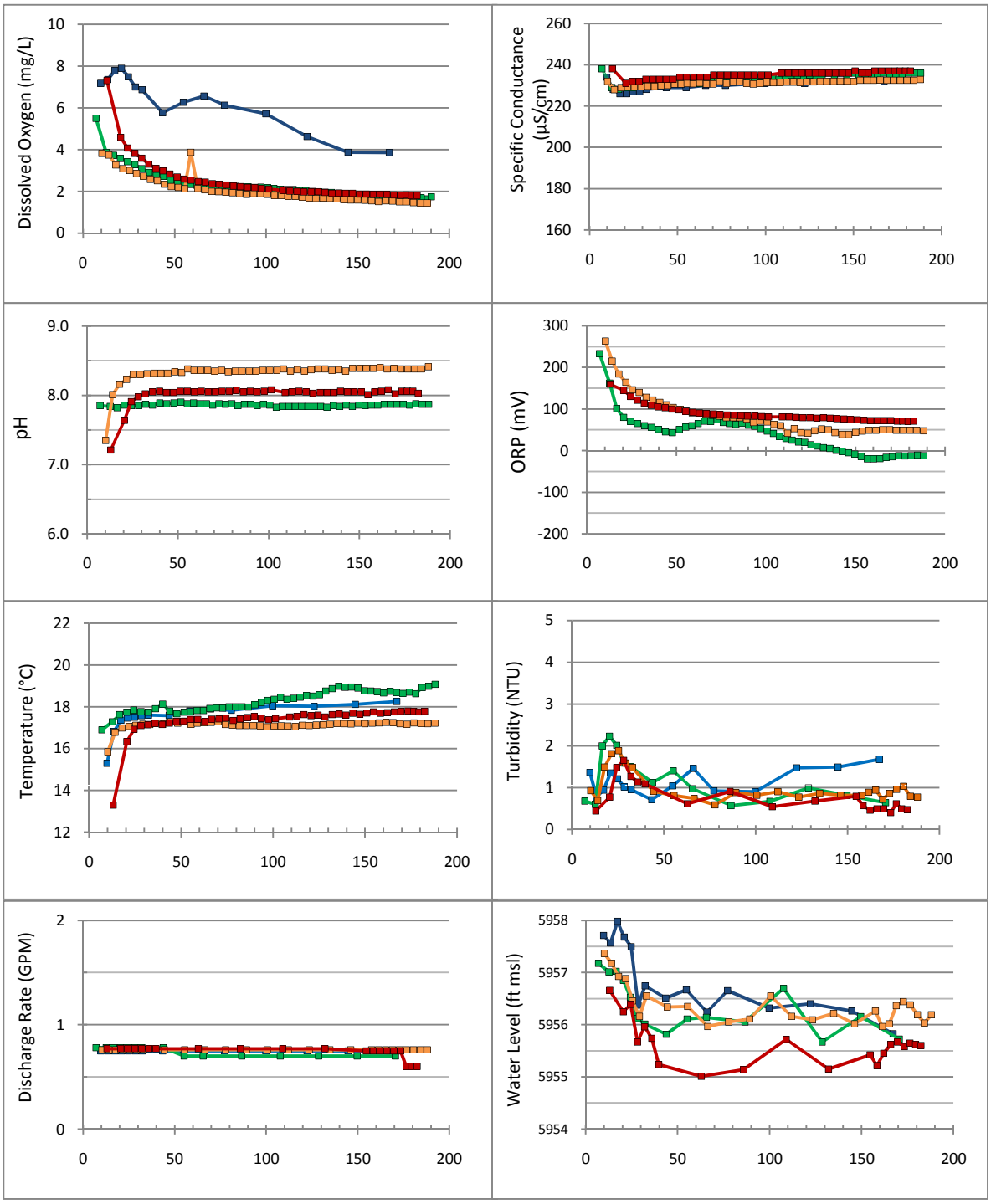


Figure D2-R32-3. Concentrations of trace metals in filtered groundwater from well R-32 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater. Lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-37 screen 1 (port P1A), port depth 929 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R37-1. Time-series plots of field parameters monitored during purging of R-37 screen 1 (port P1A)

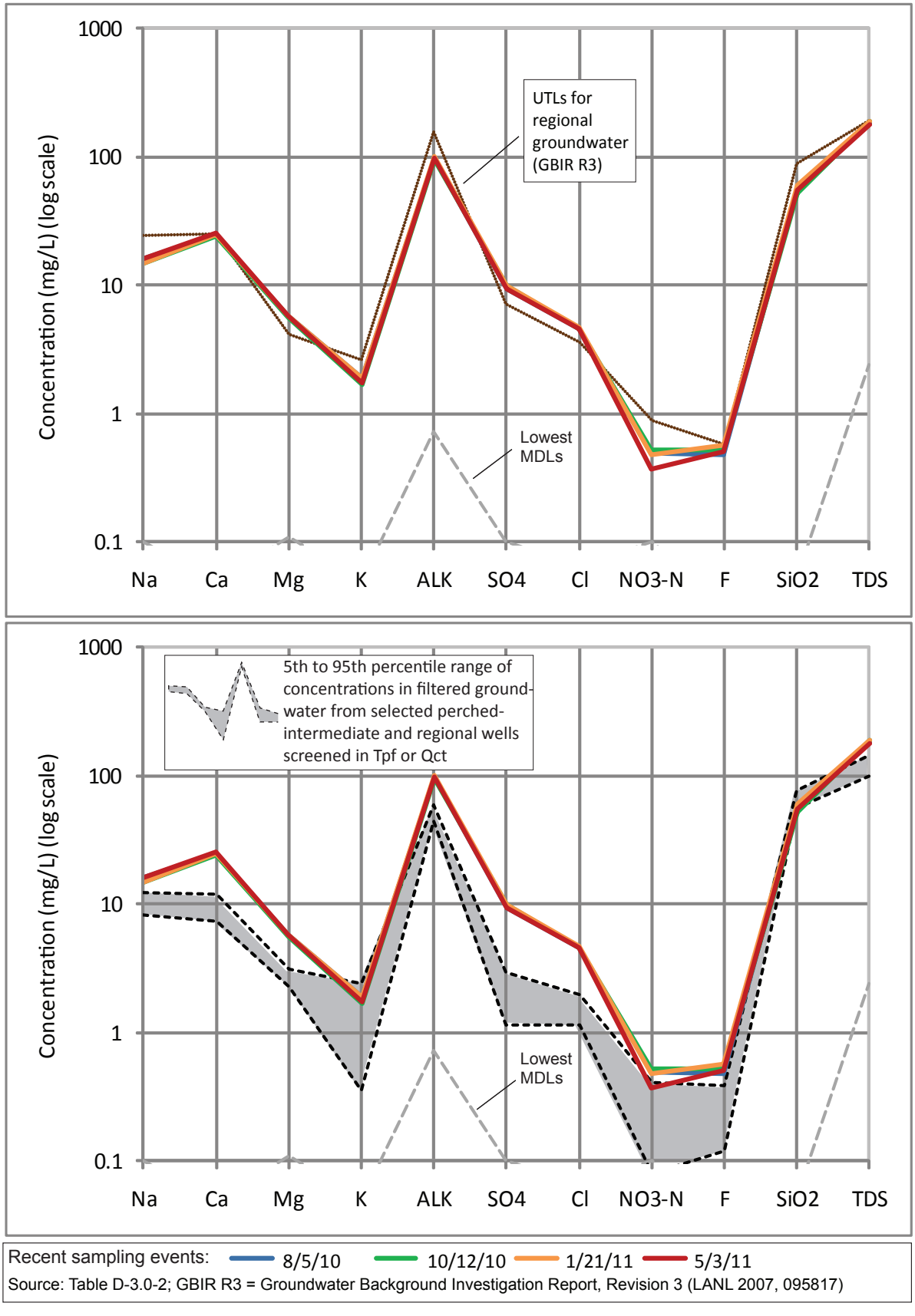


Figure D2-R37-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-37 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

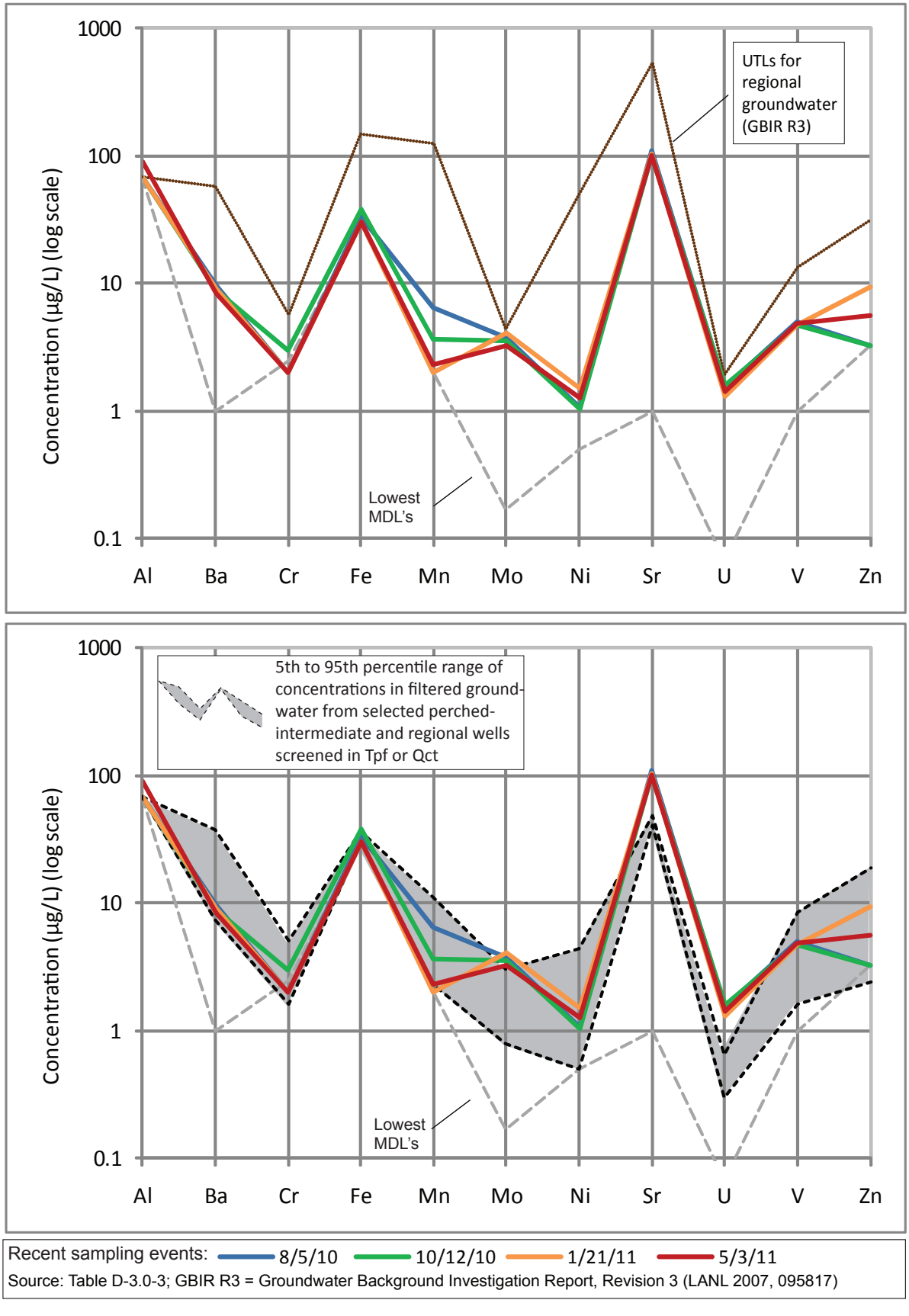


Figure D2-R37-3. Concentrations of trace metals in filtered groundwater from well R-37 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

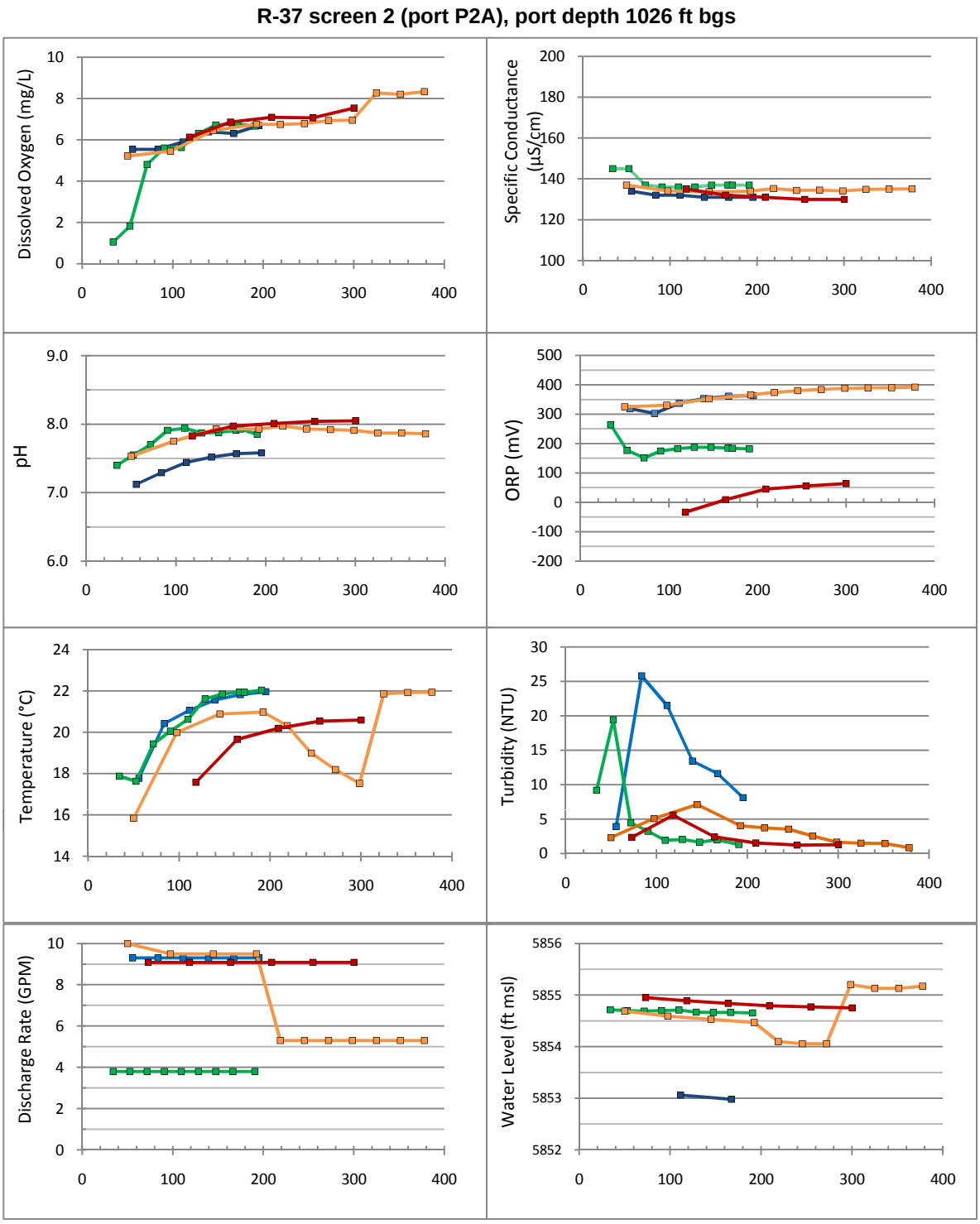


Figure D2-R37-4. **Time-series plots of field parameters monitored during purging of R-37 screen 2 (port P2A)**

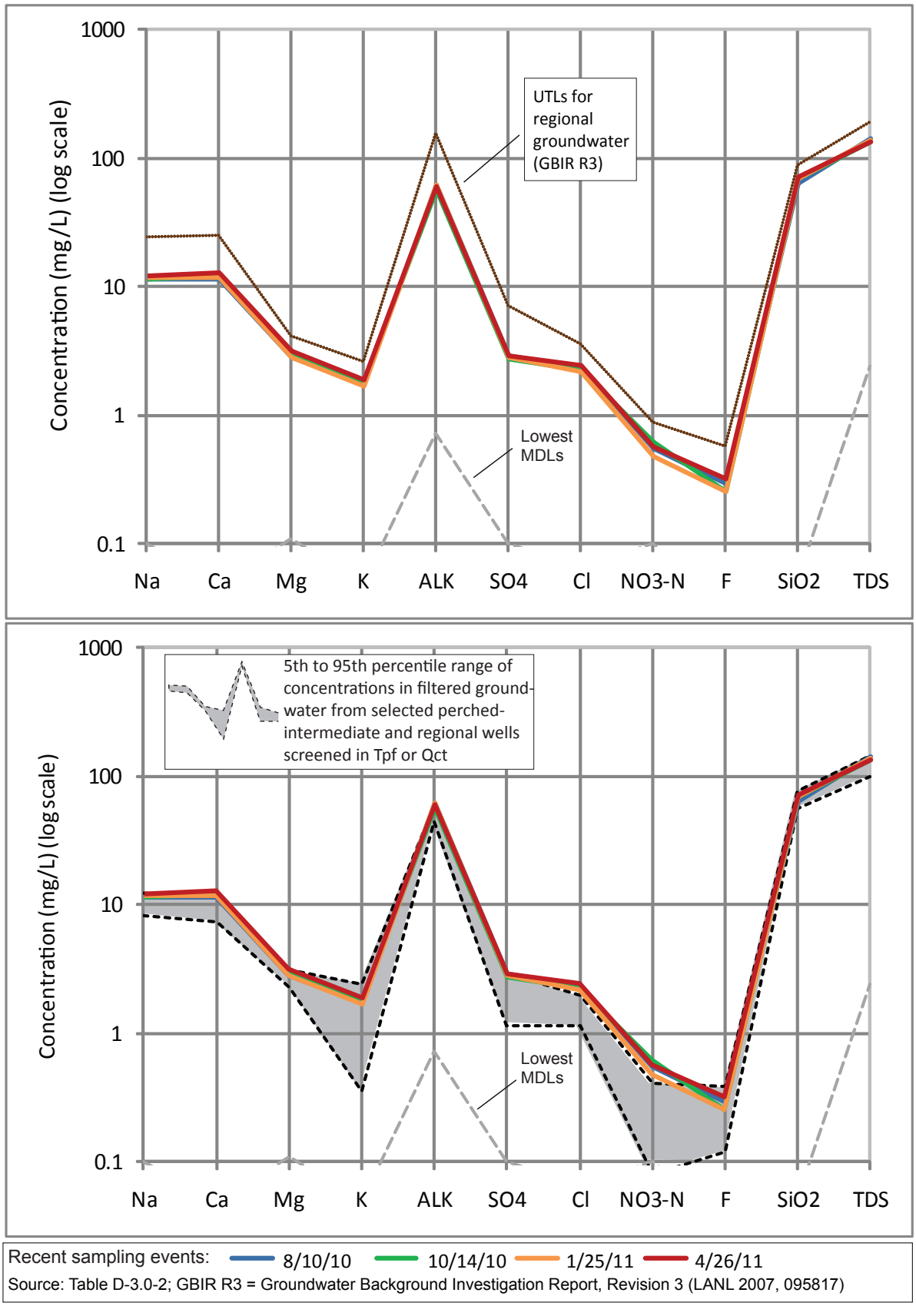


Figure D2-R37-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-37 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

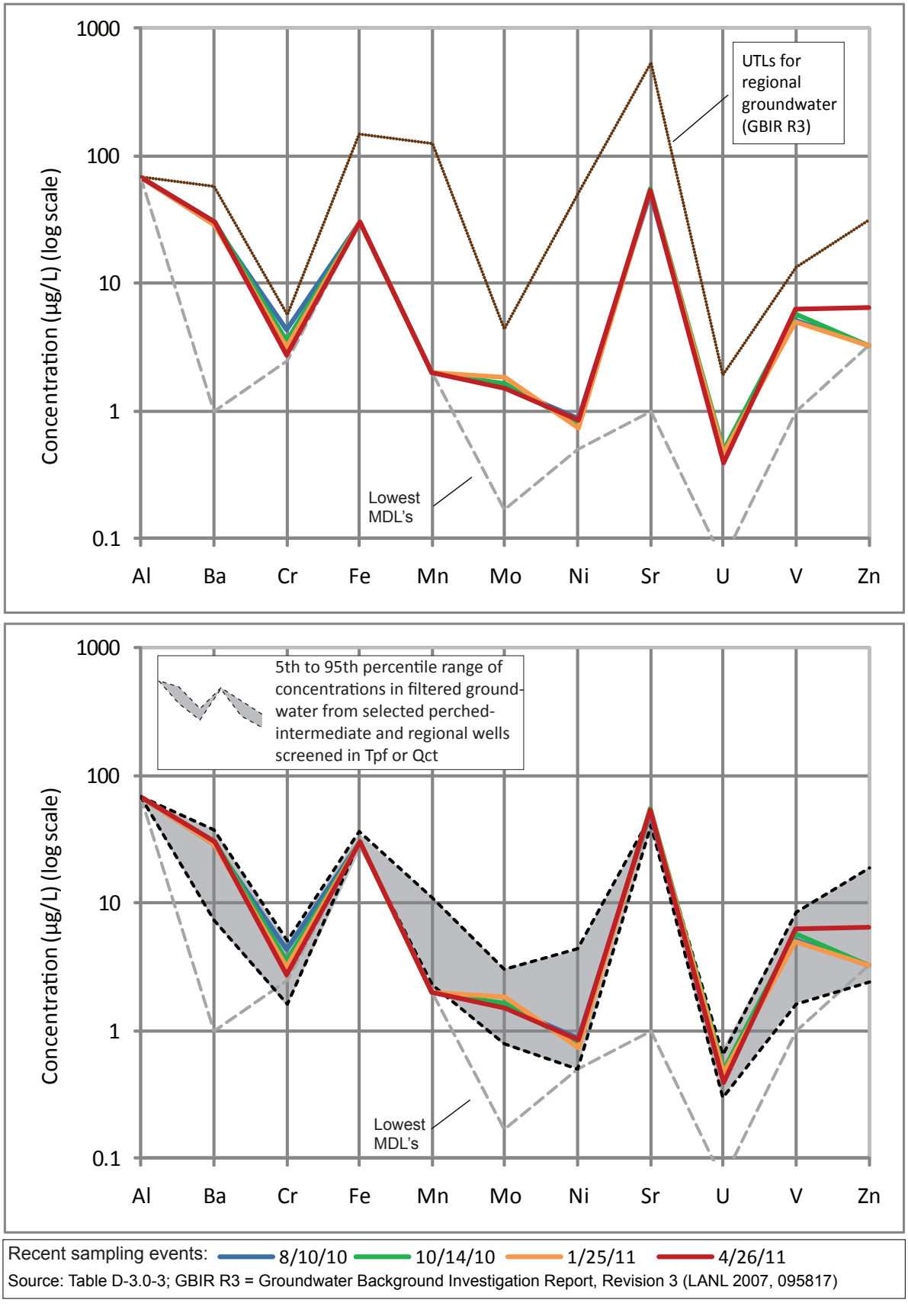
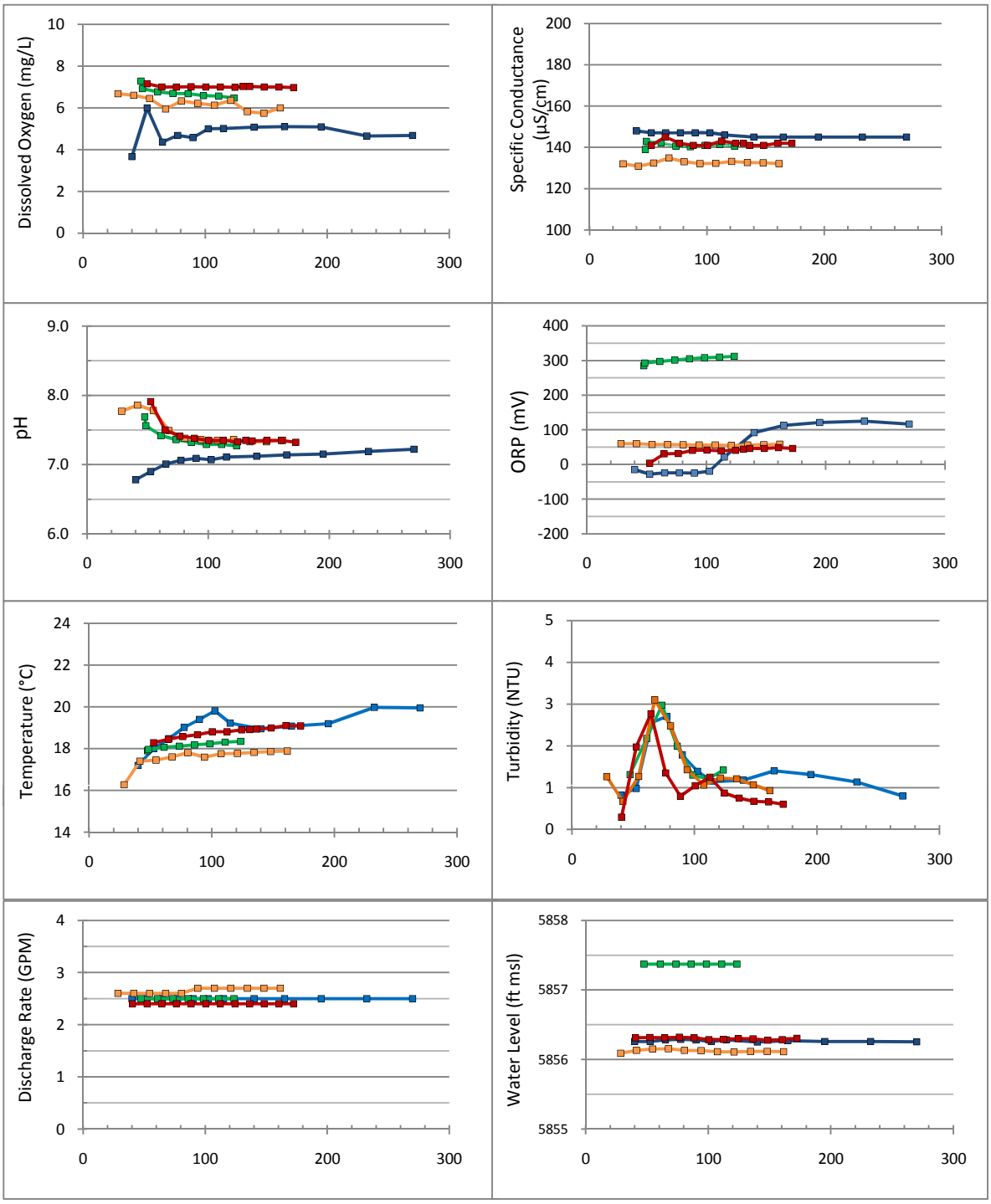


Figure D2-R37-6. Concentrations of trace metals in filtered groundwater from well R-37 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-38 (single screen), port depth 821 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R38-1. Time-series plots of field parameters monitored during purging of R-38 (single screen)

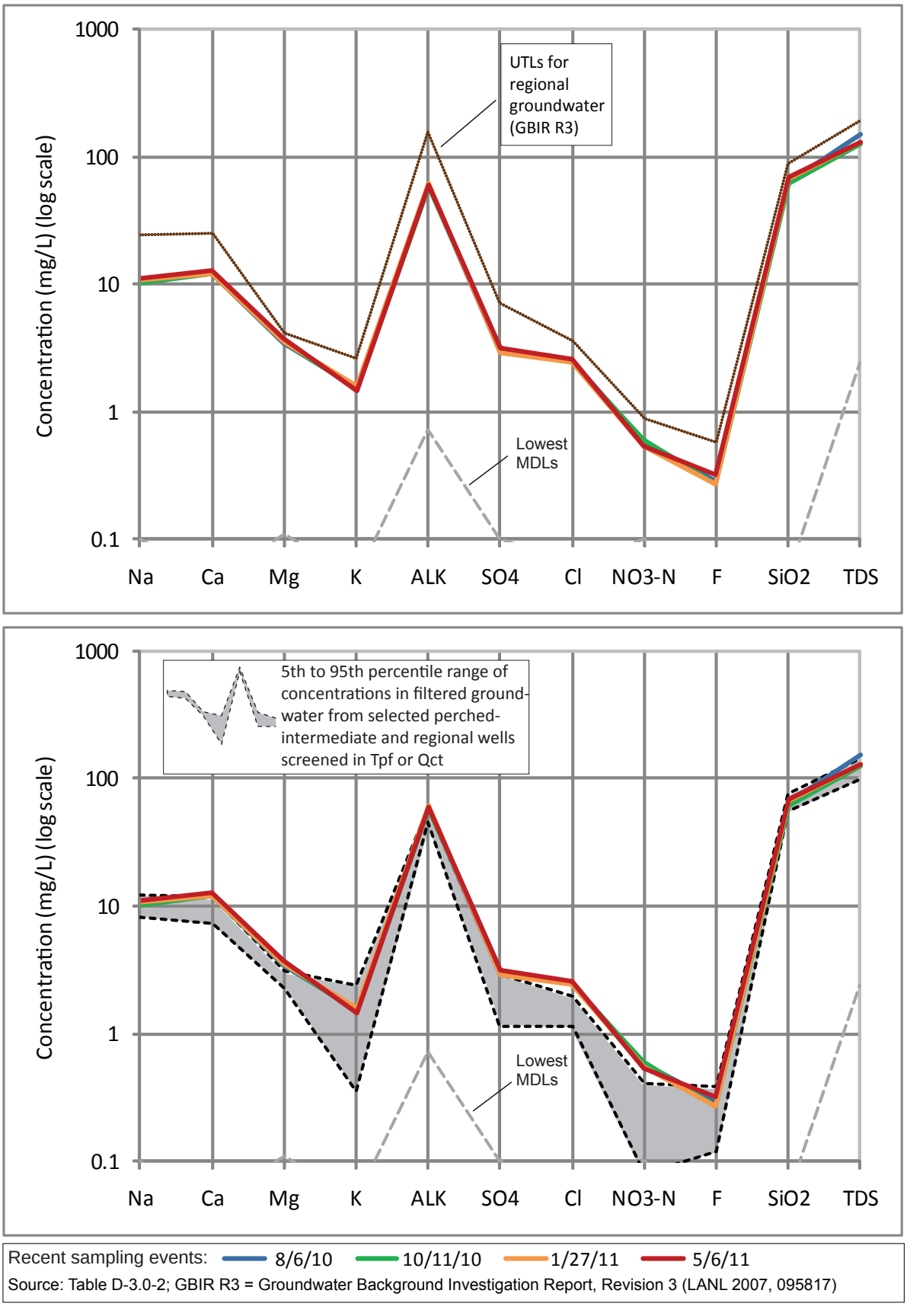


Figure D2-R38-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-38 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

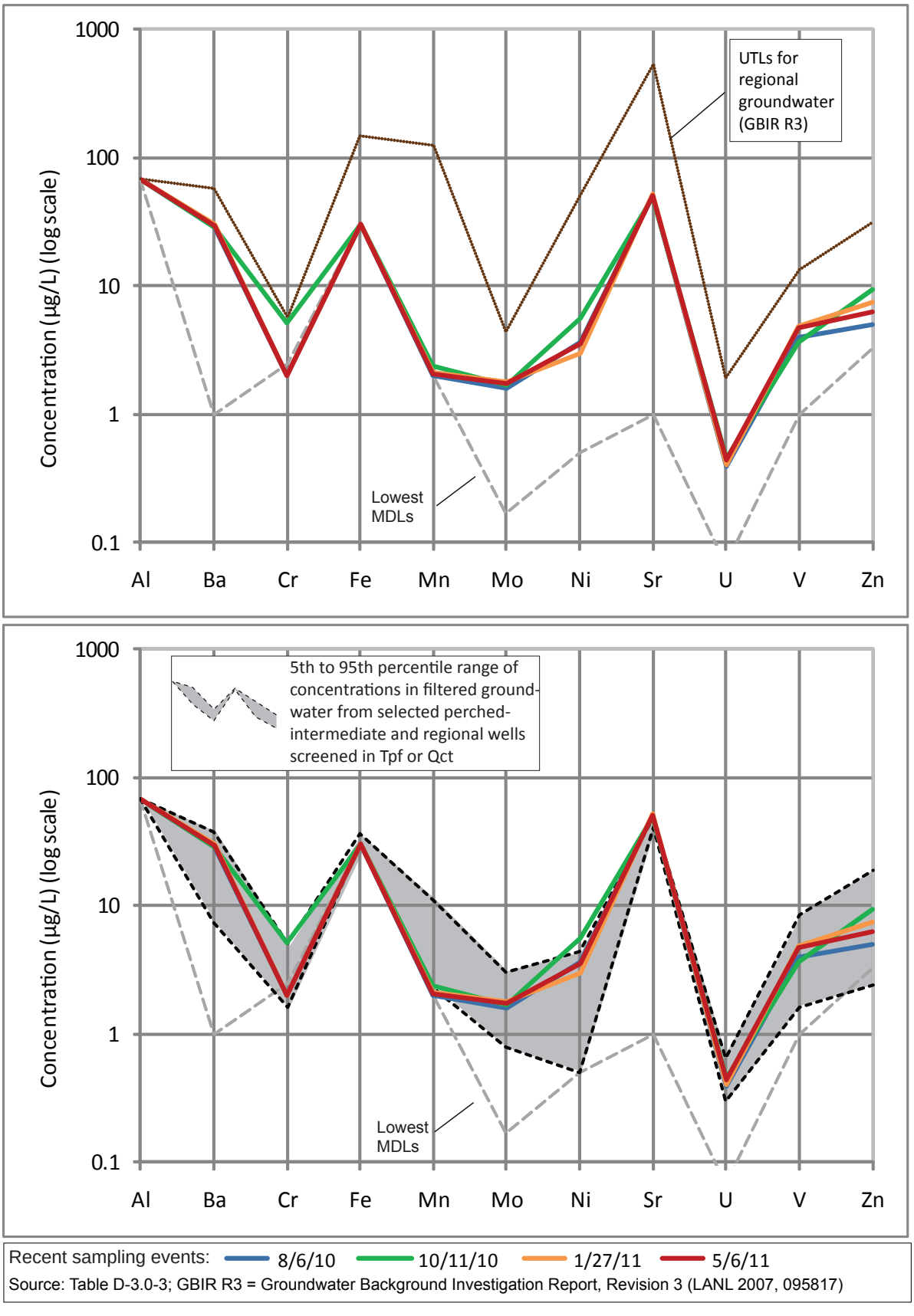
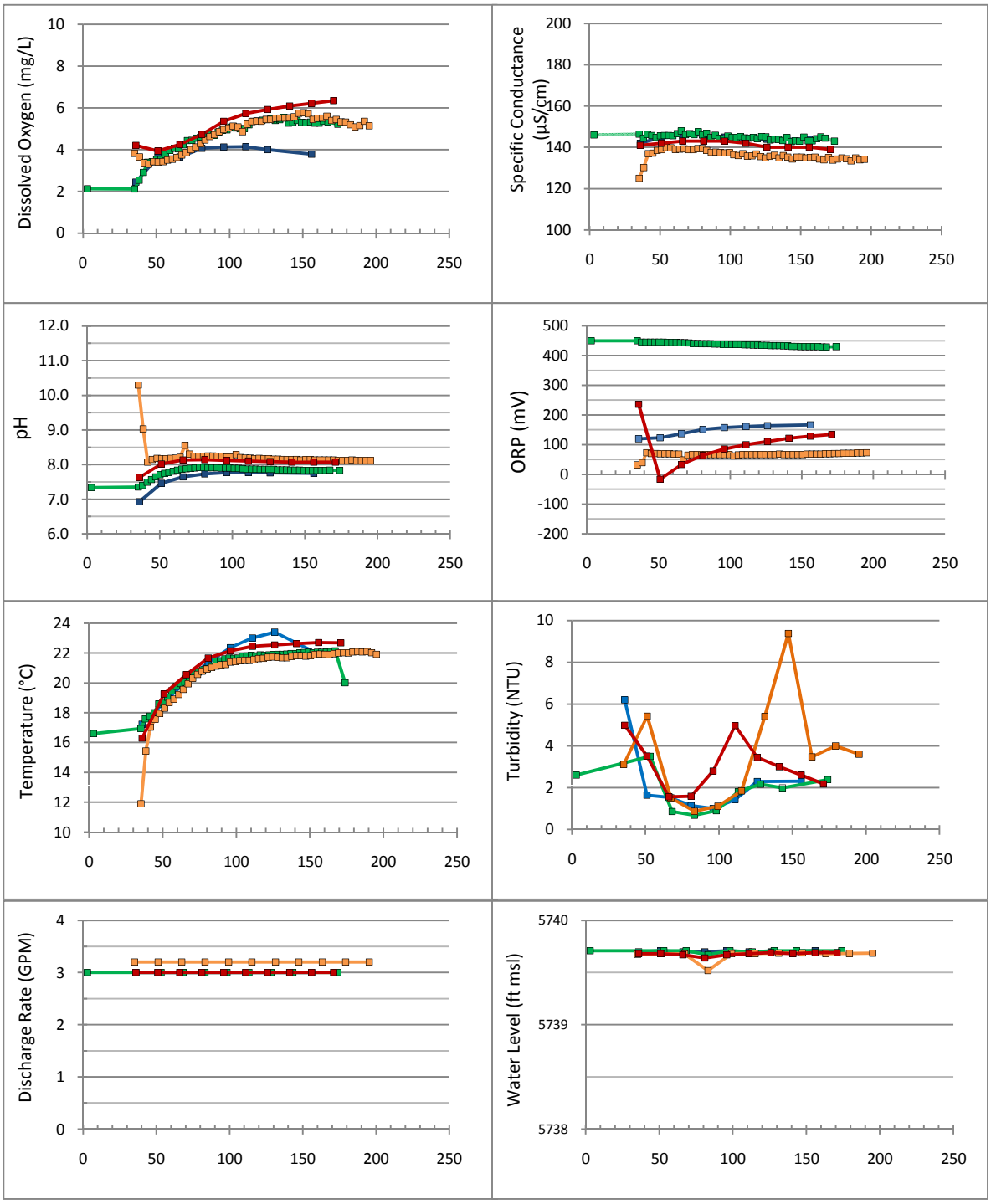


Figure D2-R38-3. Concentrations of trace metals in filtered groundwater from well R-38 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater. Lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-39 (single screen), port depth 859 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R39-1. Time-series plots of field parameters monitored during purging of R-39 (single screen)

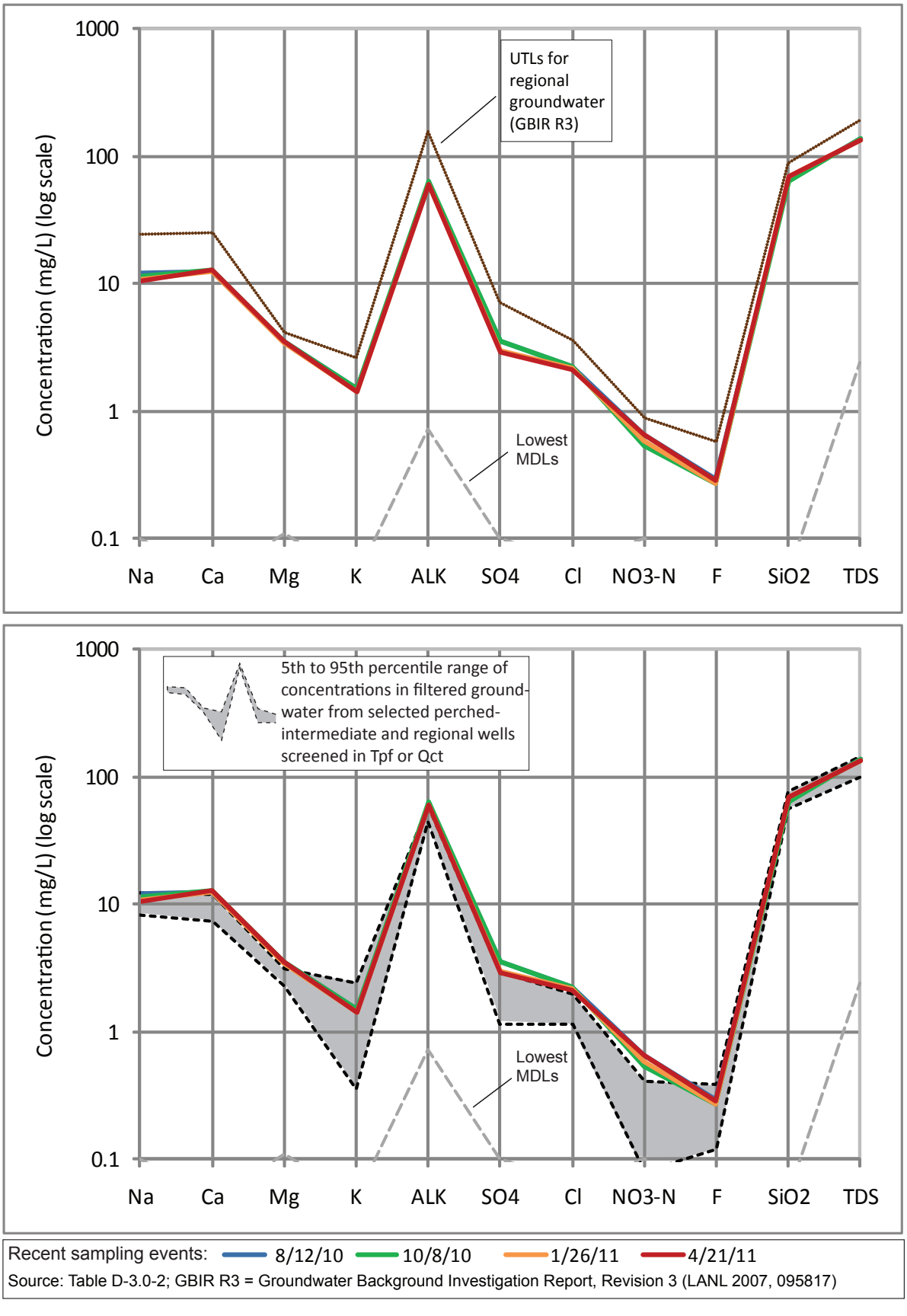


Figure D2-R39-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-39 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

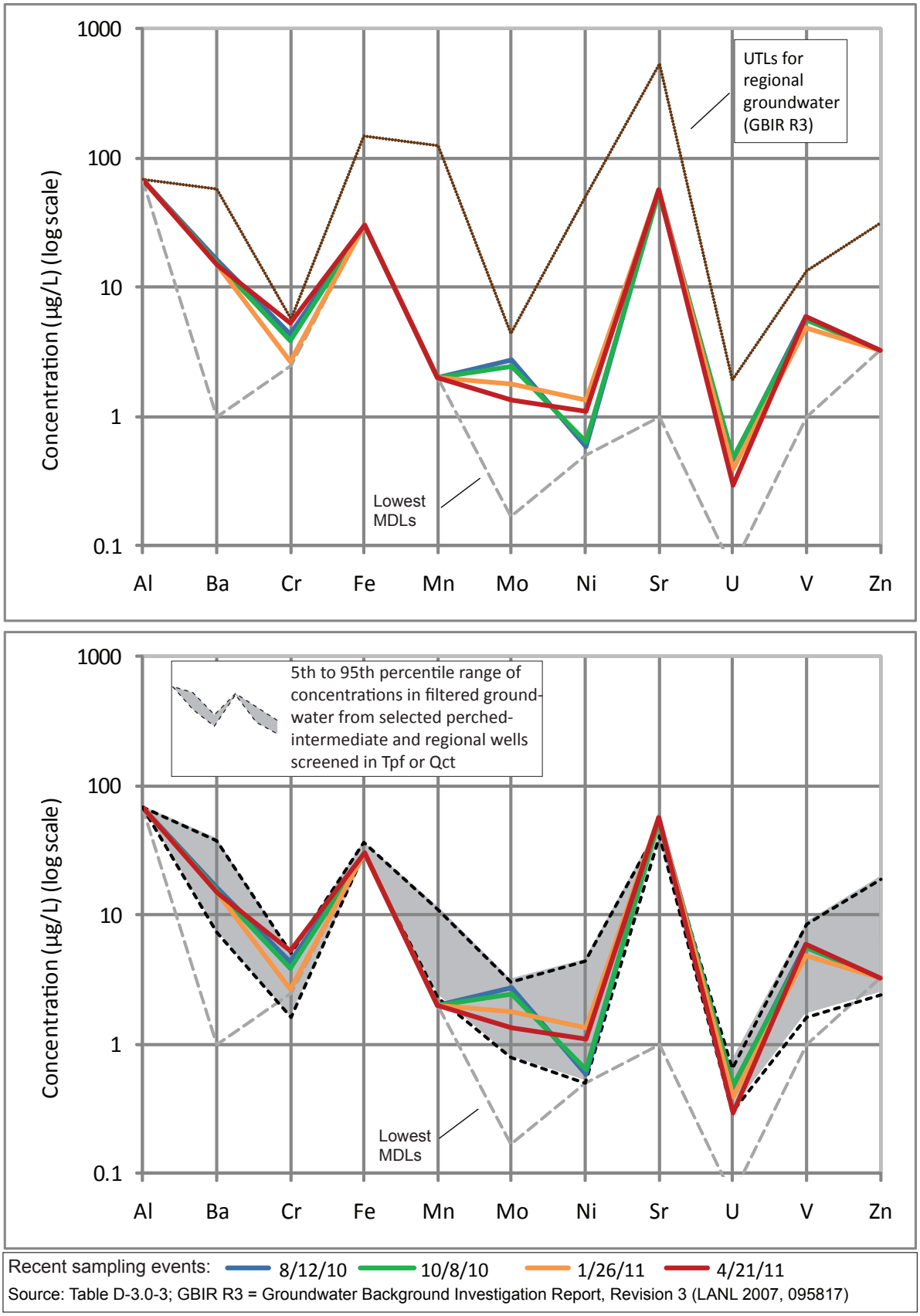


Figure D2-R39-3. Concentrations of trace metals in filtered groundwater from well R-39 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-40i, port depth 650 ft bgs

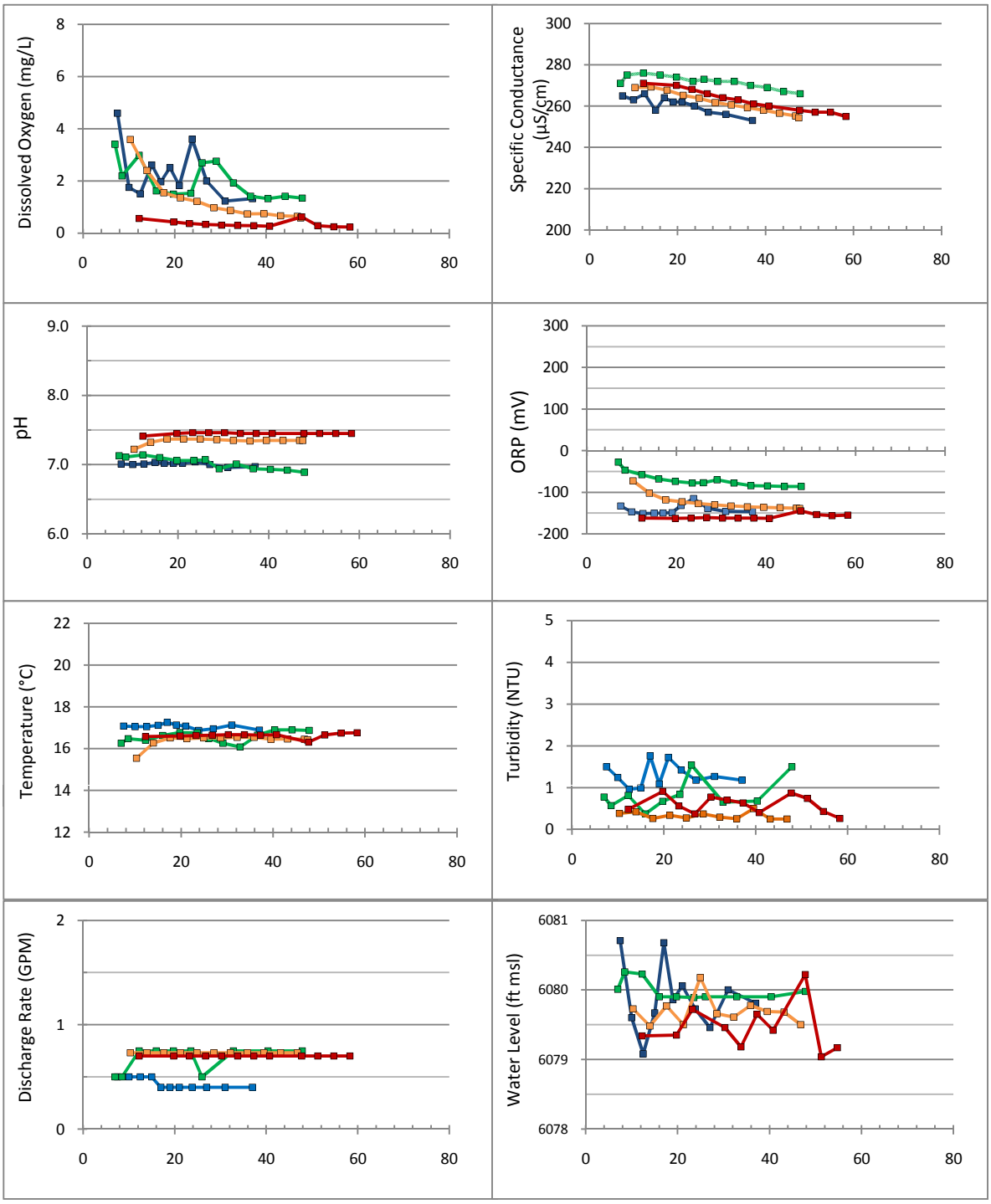


Figure D2-R40i-1. Time-series plots of field parameters monitored during purging of R-40i

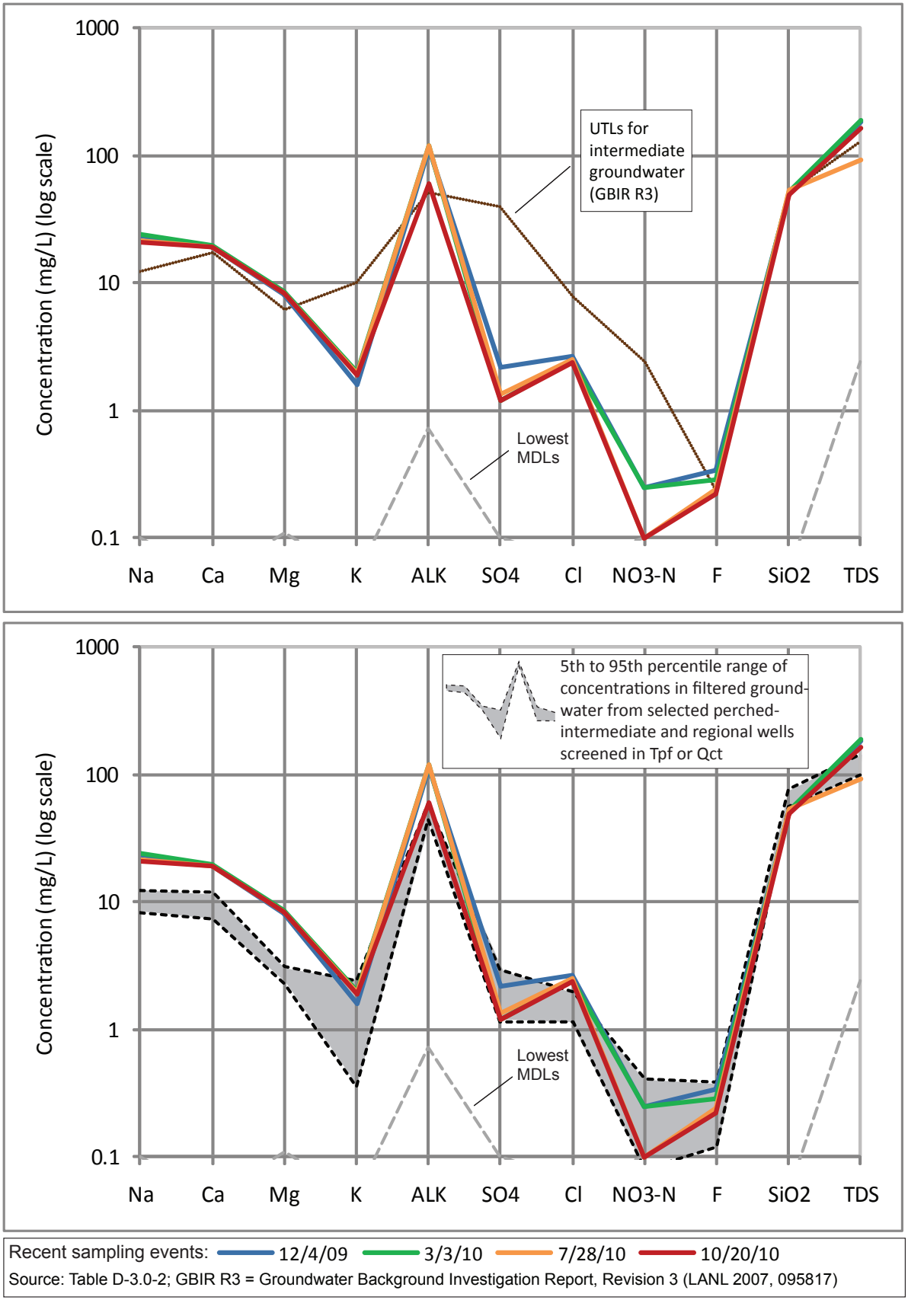


Figure D2-R40i-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-40i for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

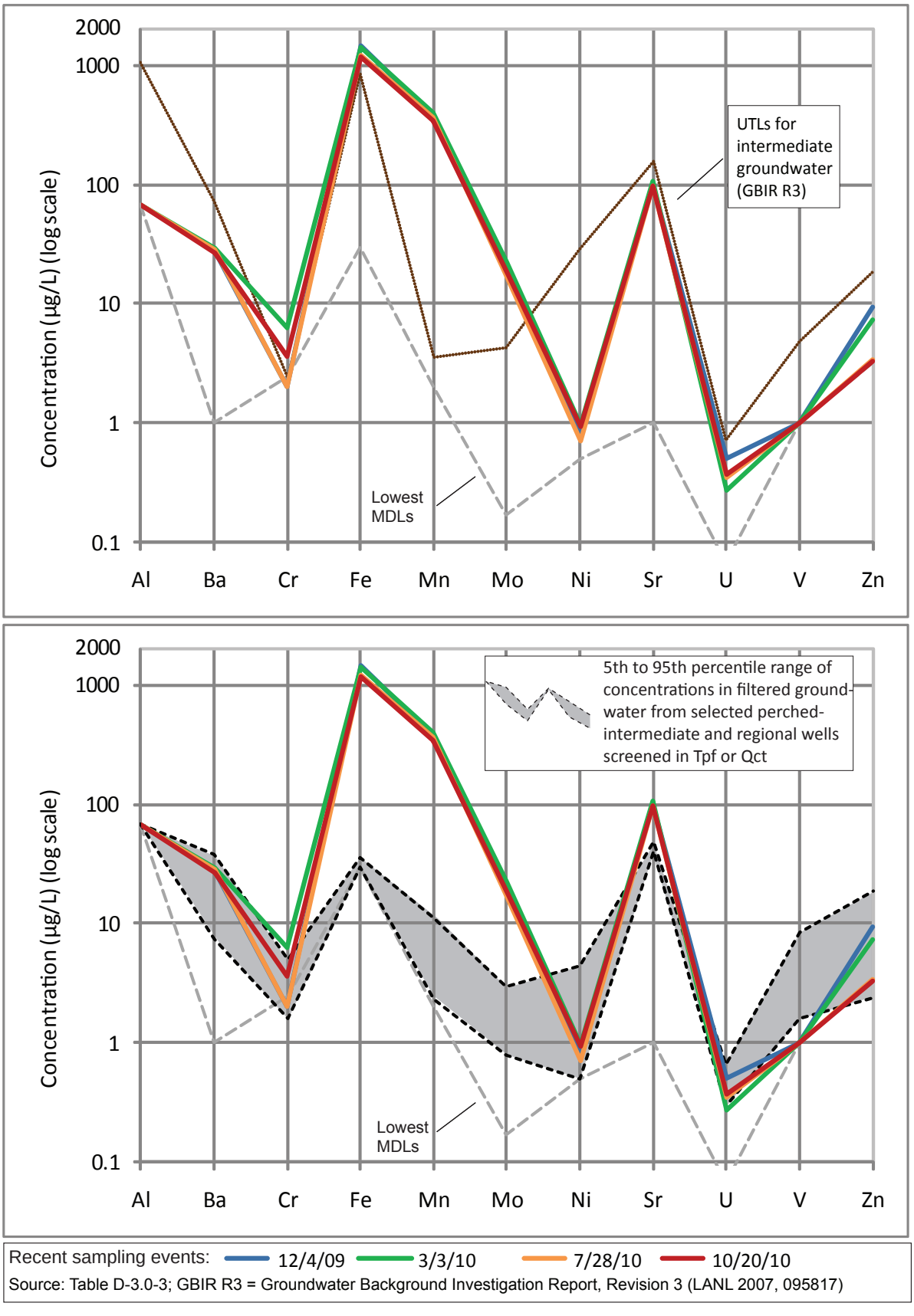
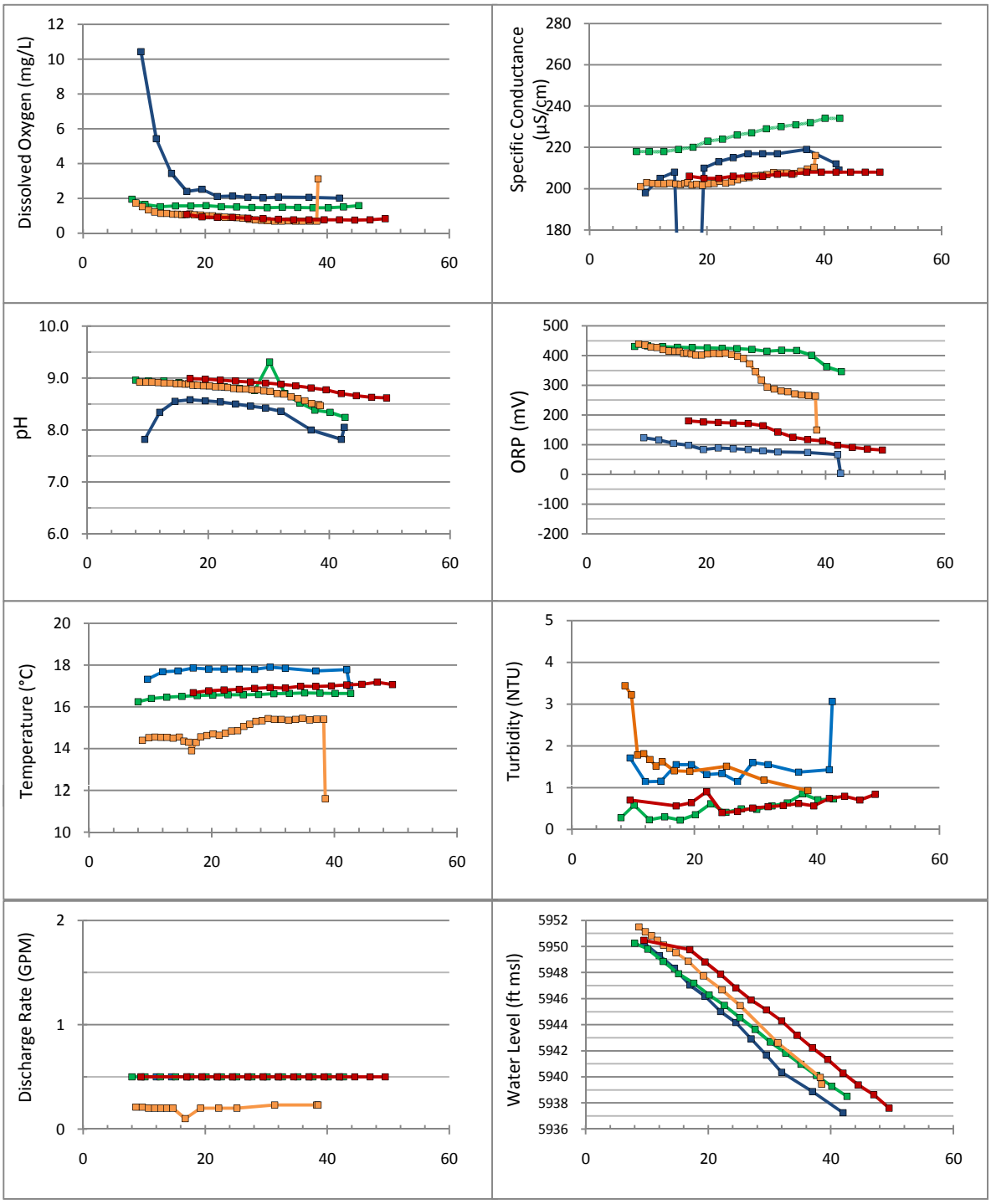


Figure D2-R40i-3. Concentrations of trace metals in filtered groundwater from well R-40i for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-40 screen 1 (port P1A), port depth 752 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R40-1. **Time-series plots of field parameters monitored during purging of R-40 screen 1 (port P1A)**

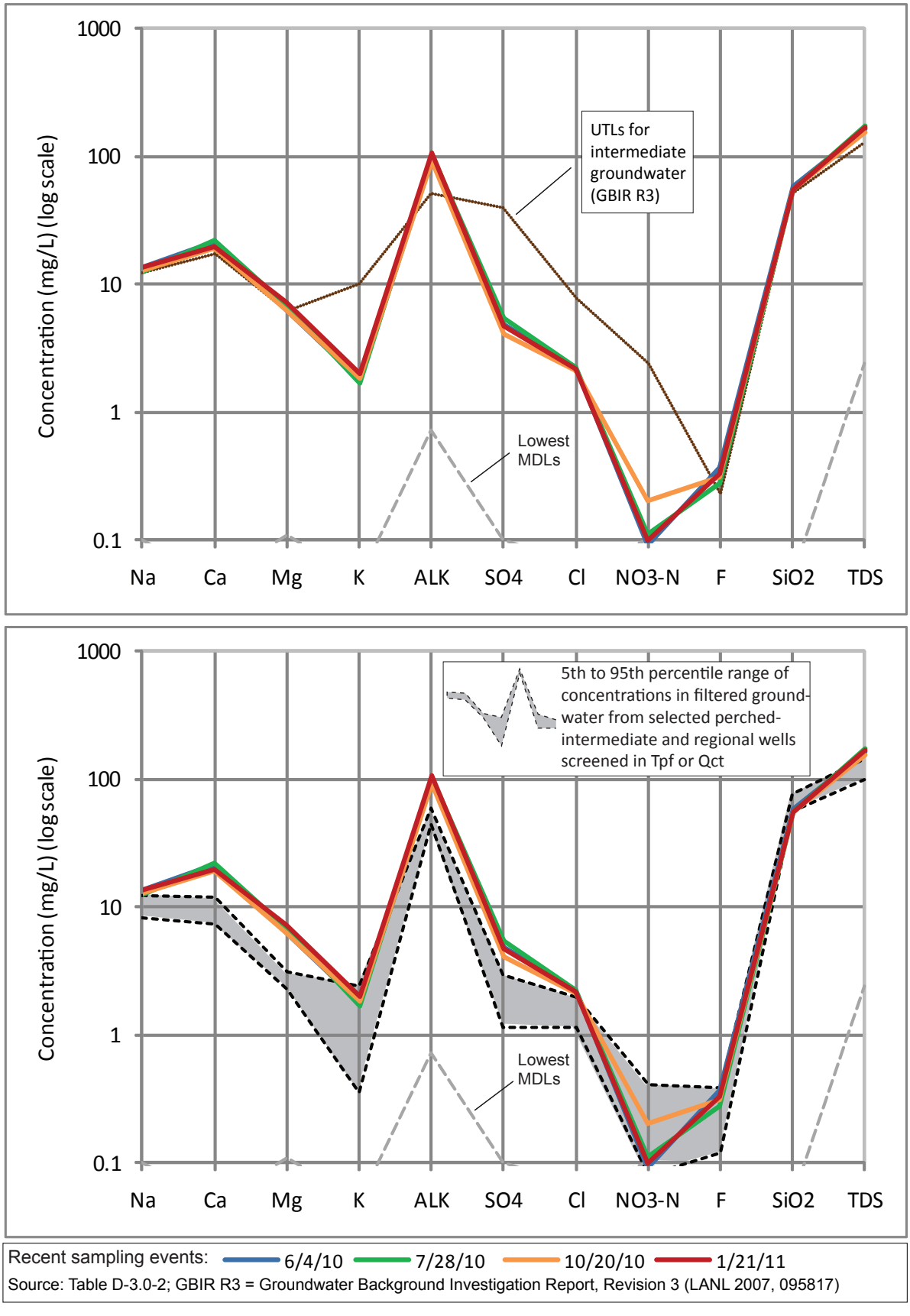


Figure D2-R40-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-40 screen 1 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

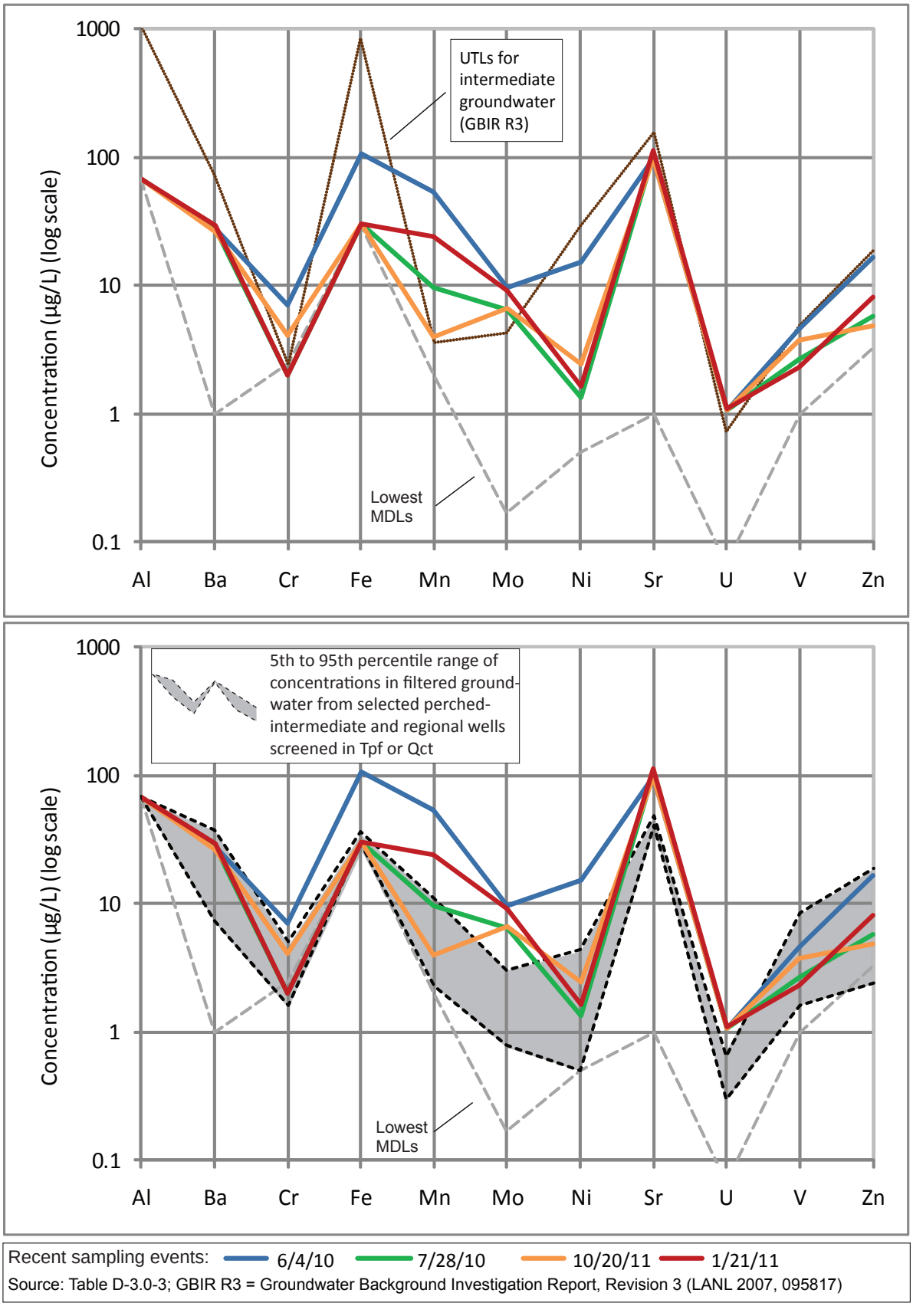


Figure D2-R40-3. Concentrations of trace metals in filtered groundwater from well R-40 screen 1 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

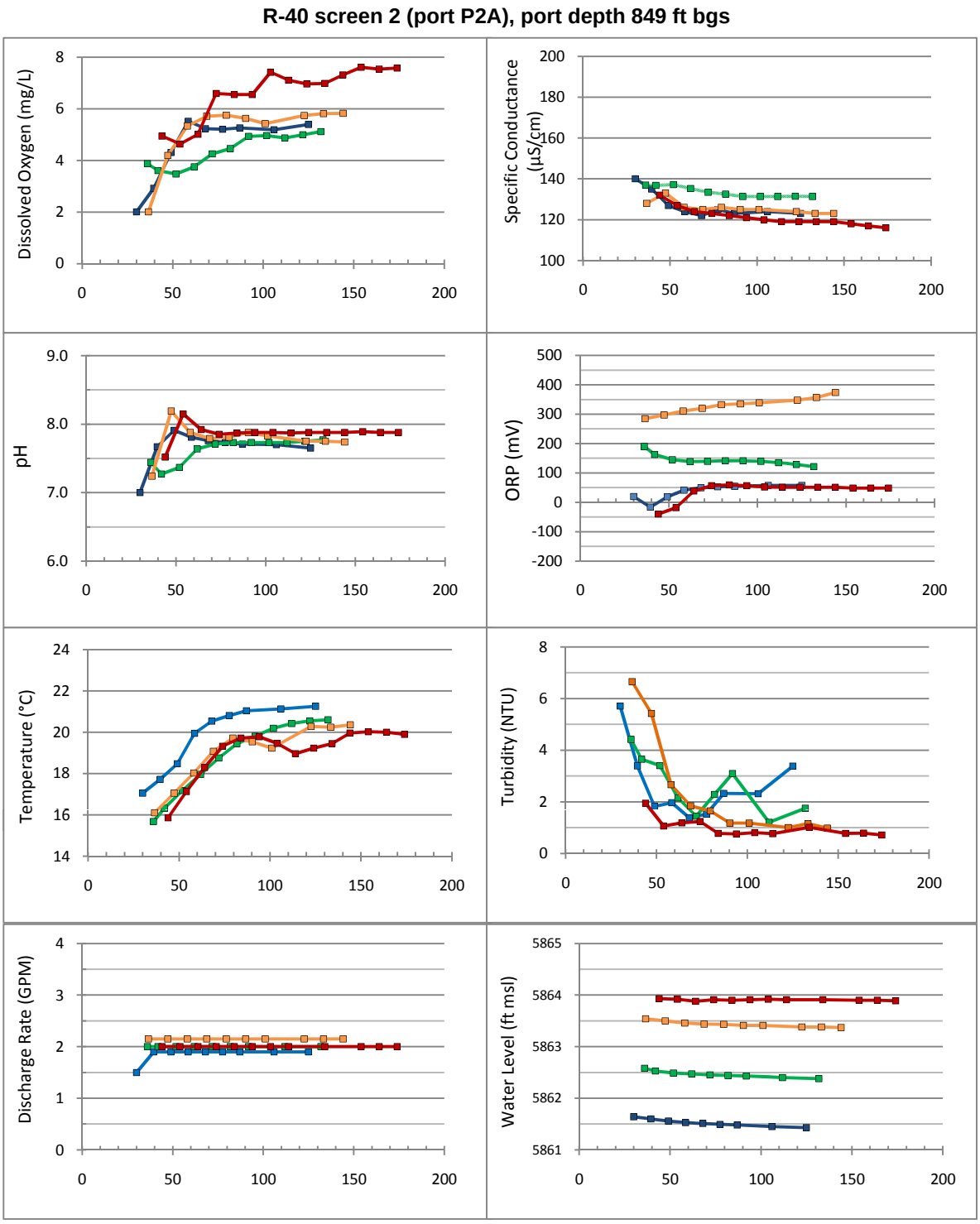


Figure D2-R40-4. **Time-series plots of field parameters monitored during purging of R-40 screen 2 (port P2A)**

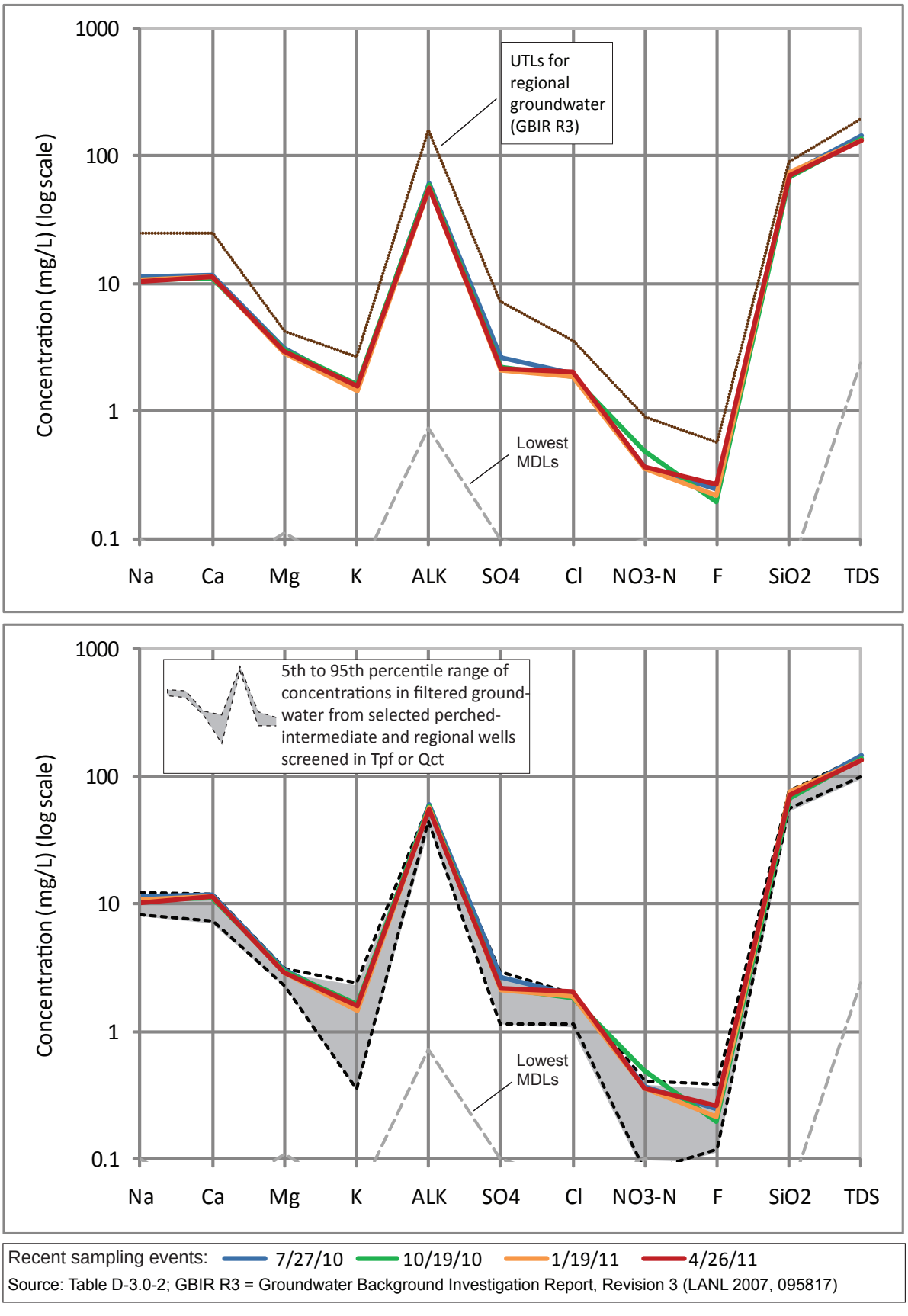


Figure D2-R40-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-40 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

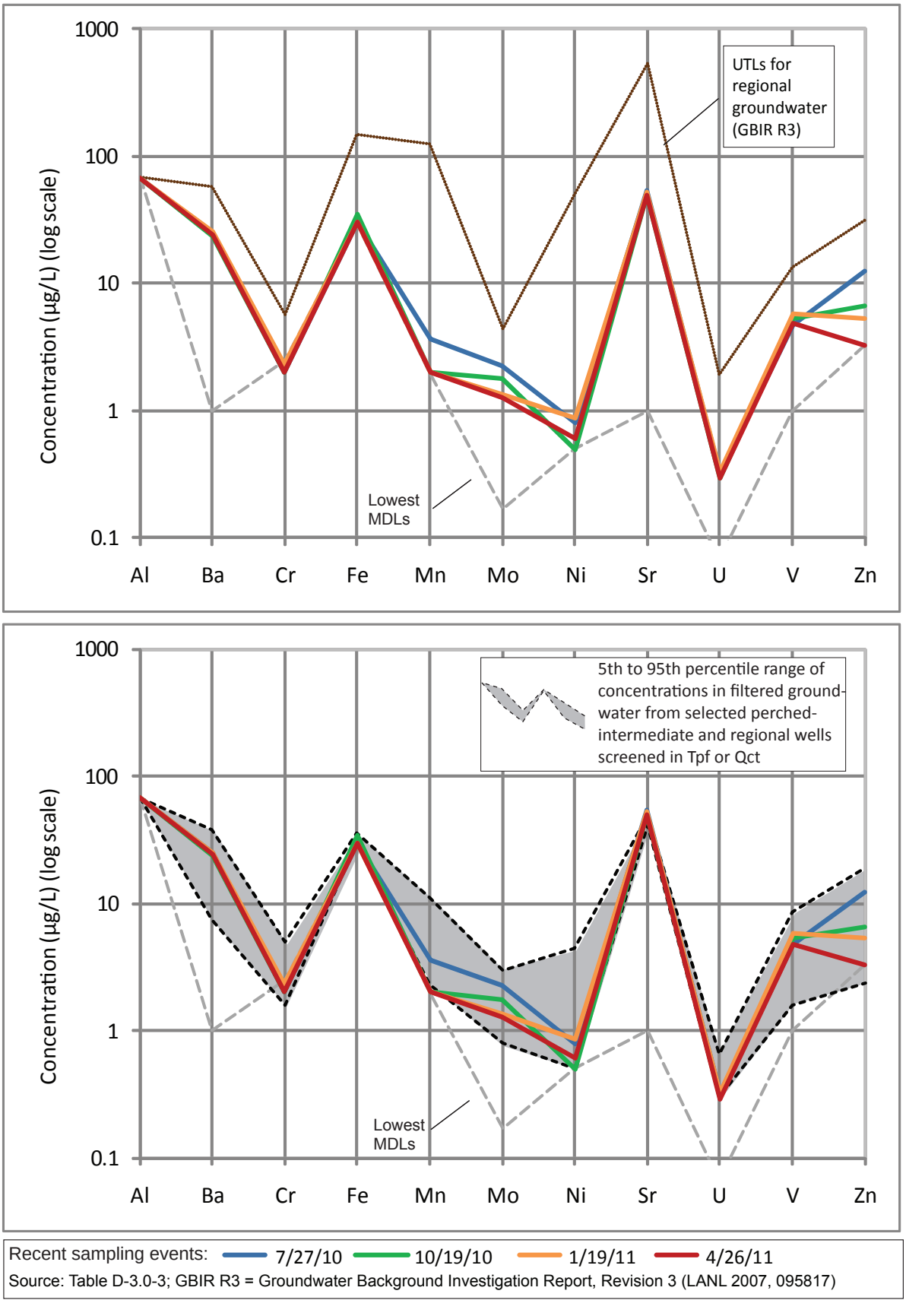


Figure D2-R40-6. Concentrations of trace metals in filtered groundwater from well R-40 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater. Lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-41 screen 2 (port P2A), port depth 965 ft bgs

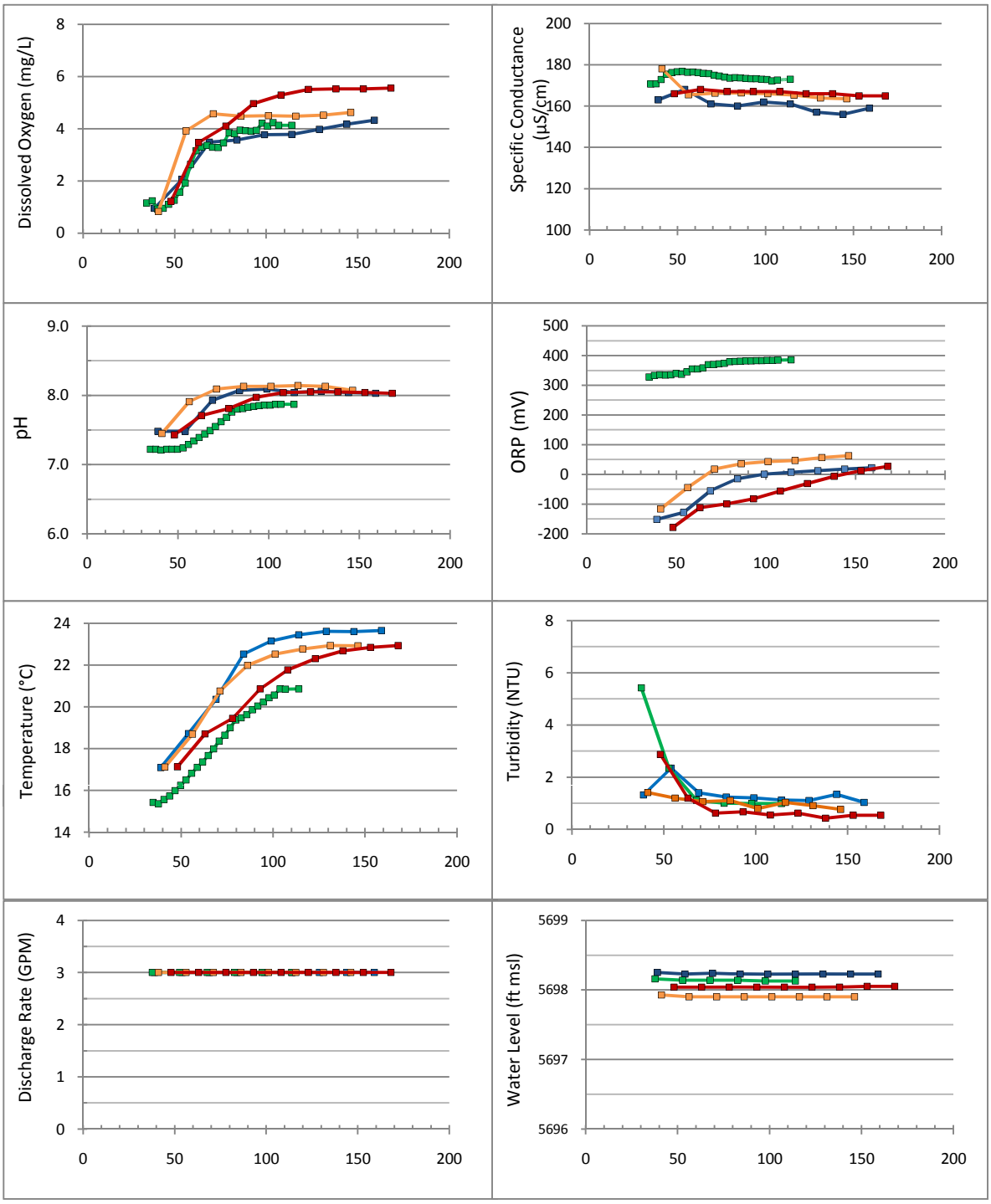


Figure D2-R41-1. **Time-series plots of field parameters monitored during purging of R-41 screen 2 (port P2A)**

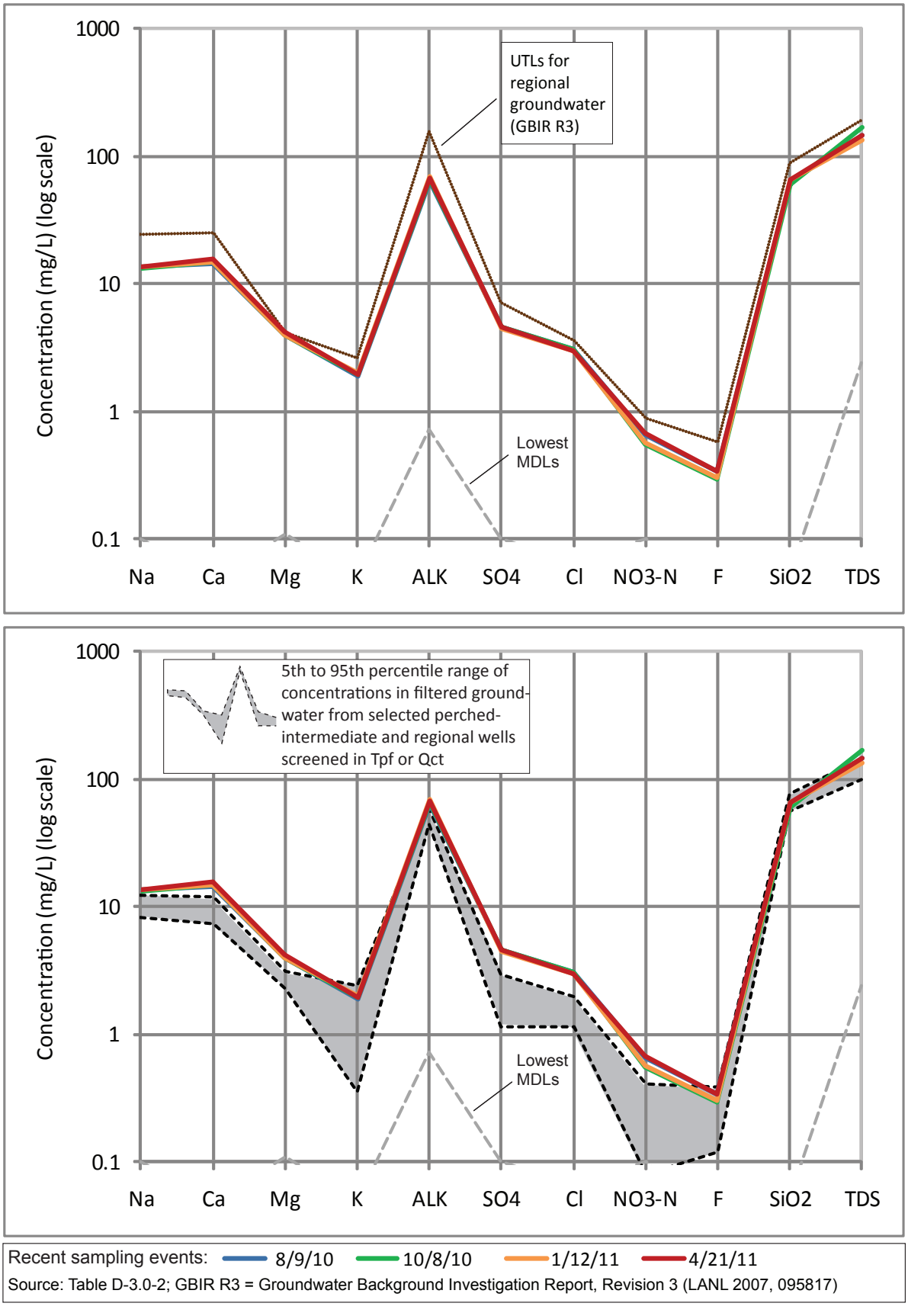


Figure D2-R41-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-41 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

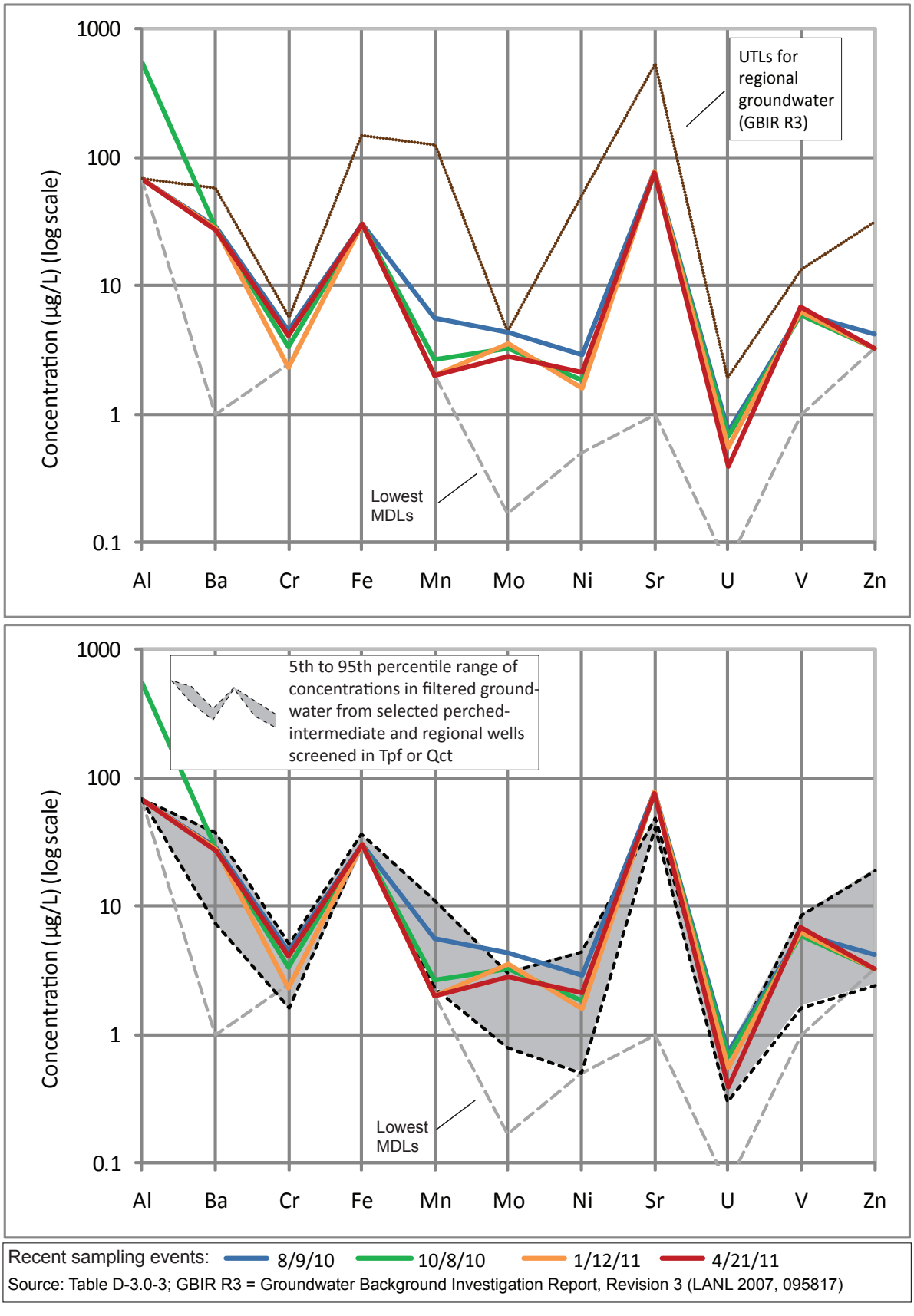


Figure D2-R41-3. Concentrations of trace metals in filtered groundwater from well R-41 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

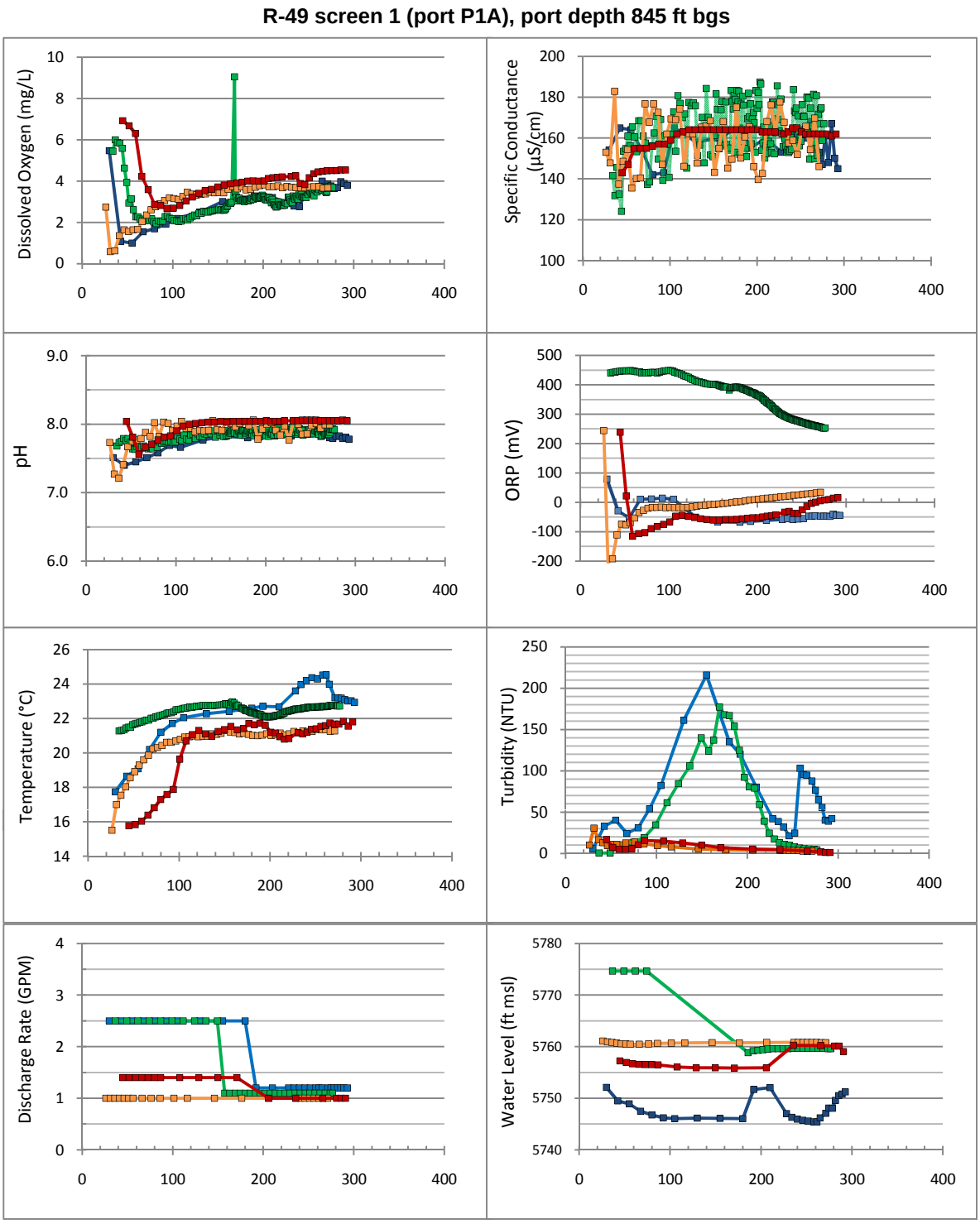


Figure D2-R49-1. **Time-series plots of field parameters monitored during purging of R-49 screen 1 (port P1A)**

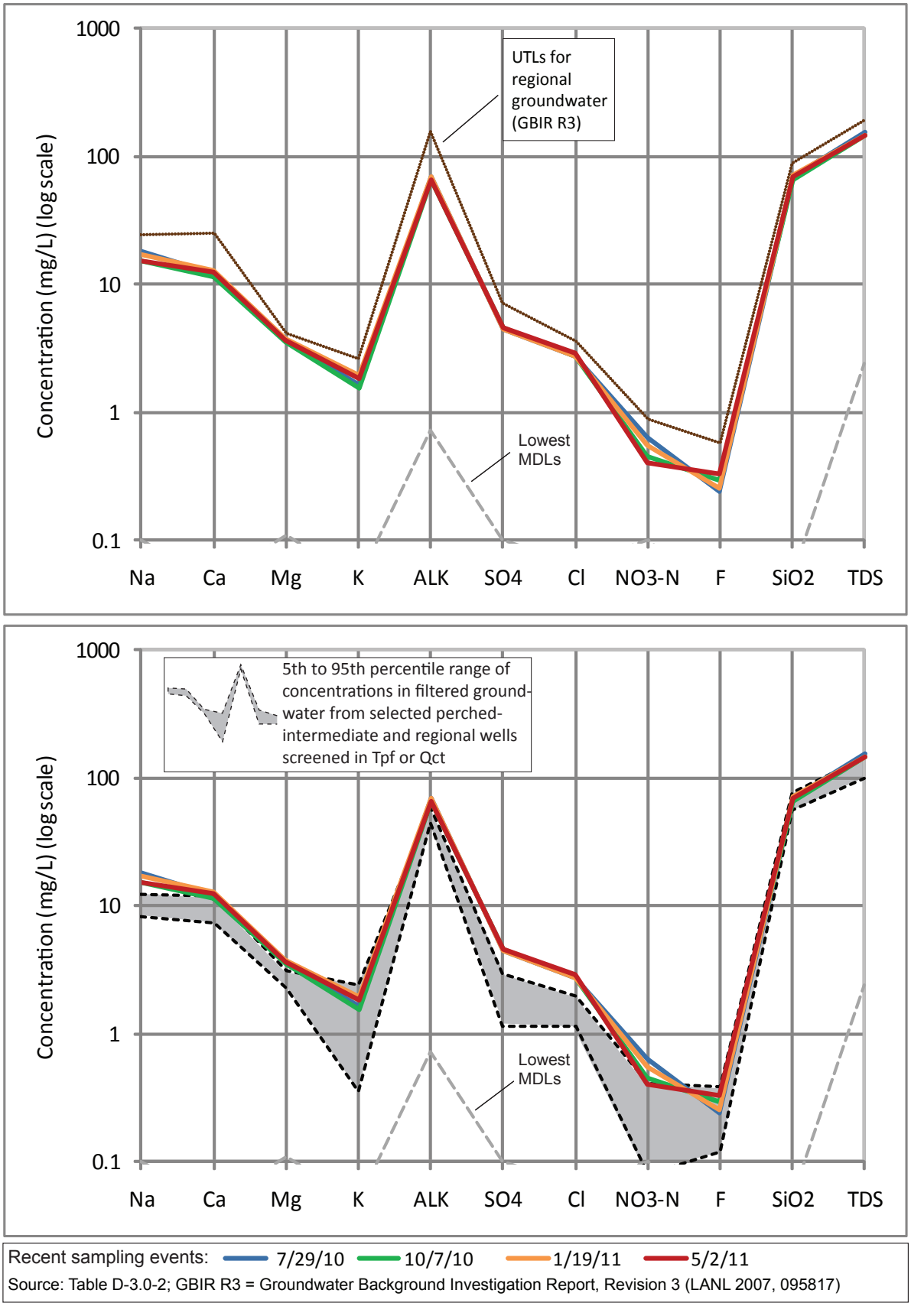


Figure D2-R49-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-49 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

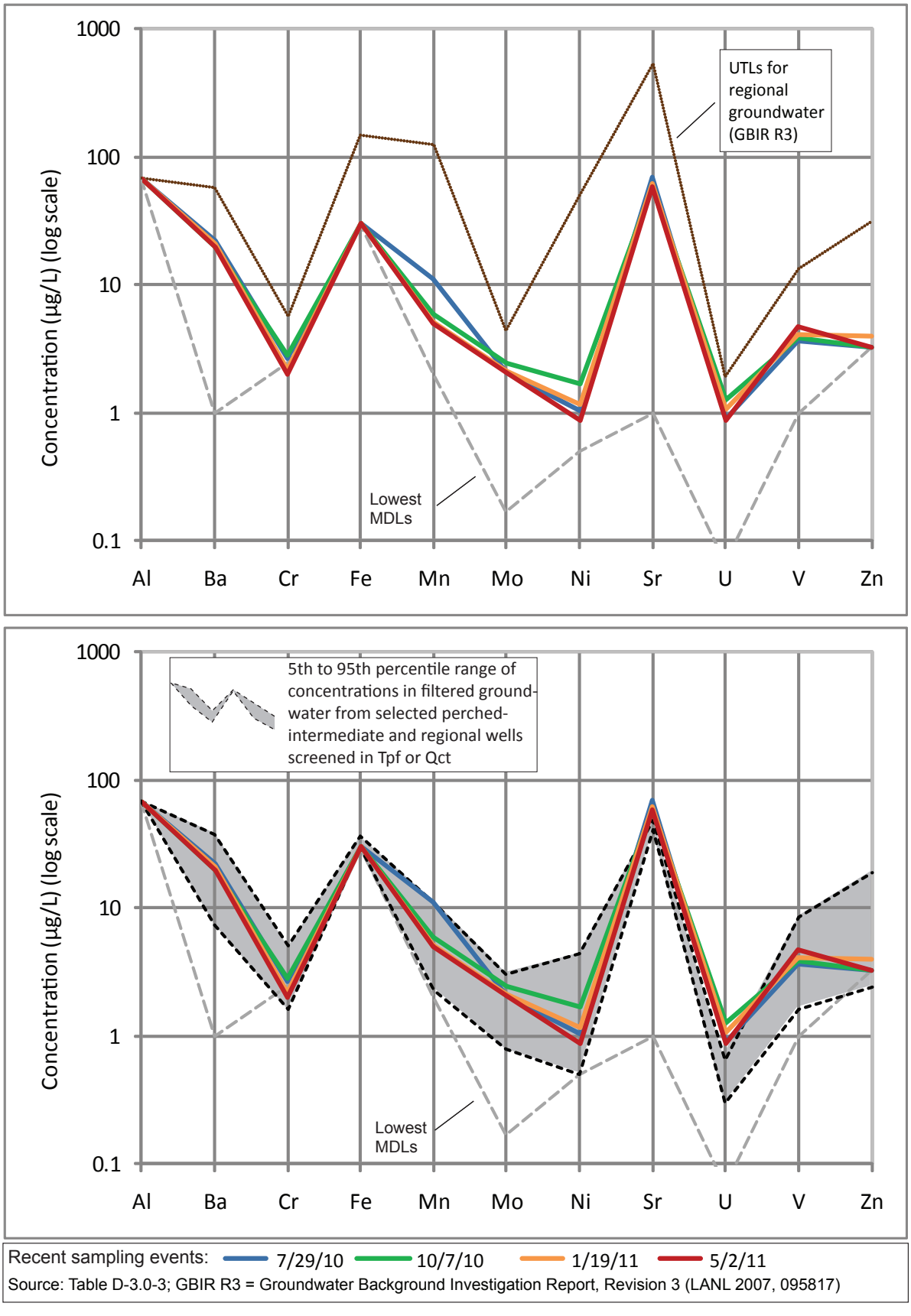
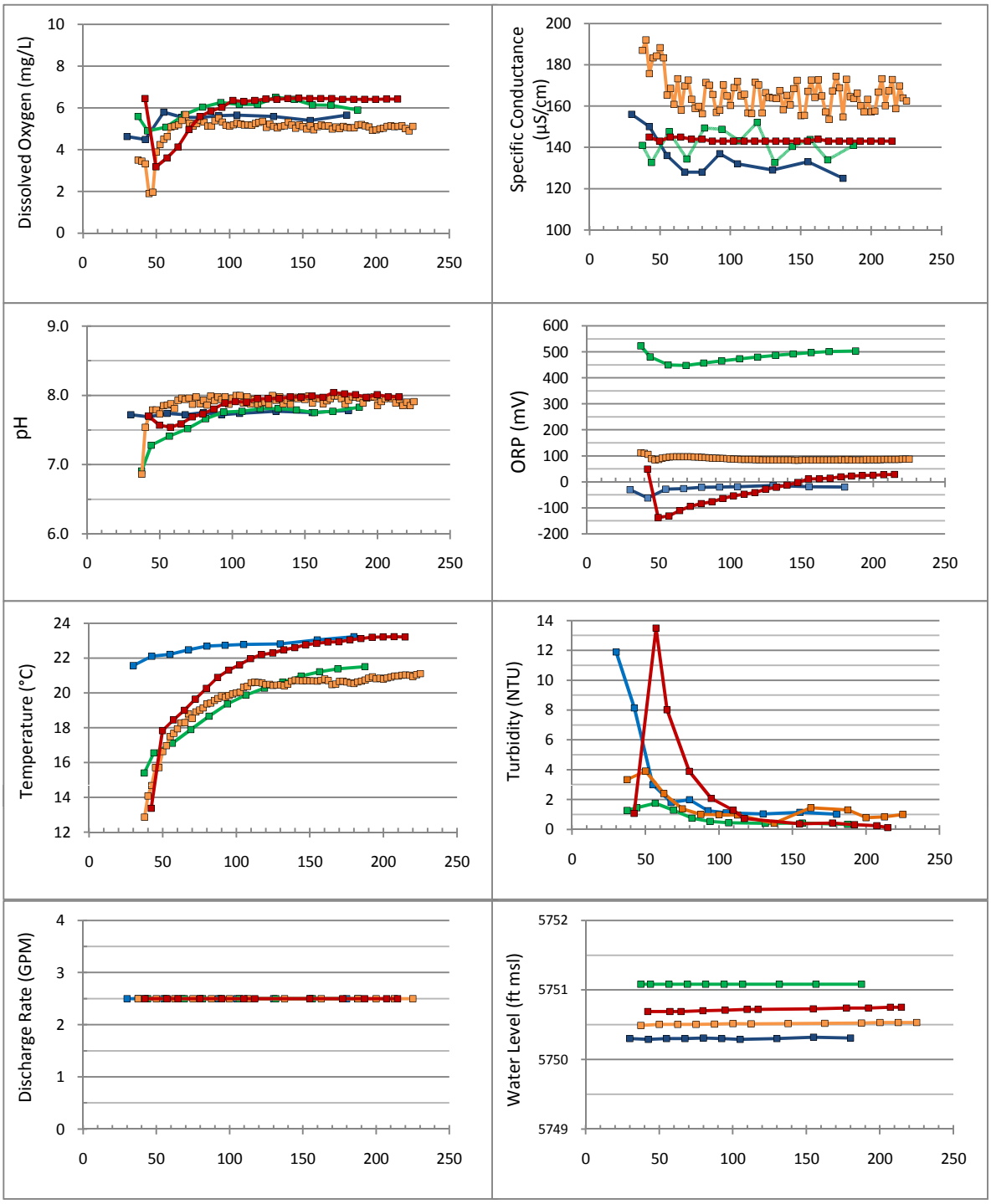


Figure D2-R49-3. Concentrations of trace metals in filtered groundwater from well R-49 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-49 screen 2 (port P2A), port depth 906 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R49-4. **Time-series plots of field parameters monitored during purging of R-49 screen 2 (port P2A)**

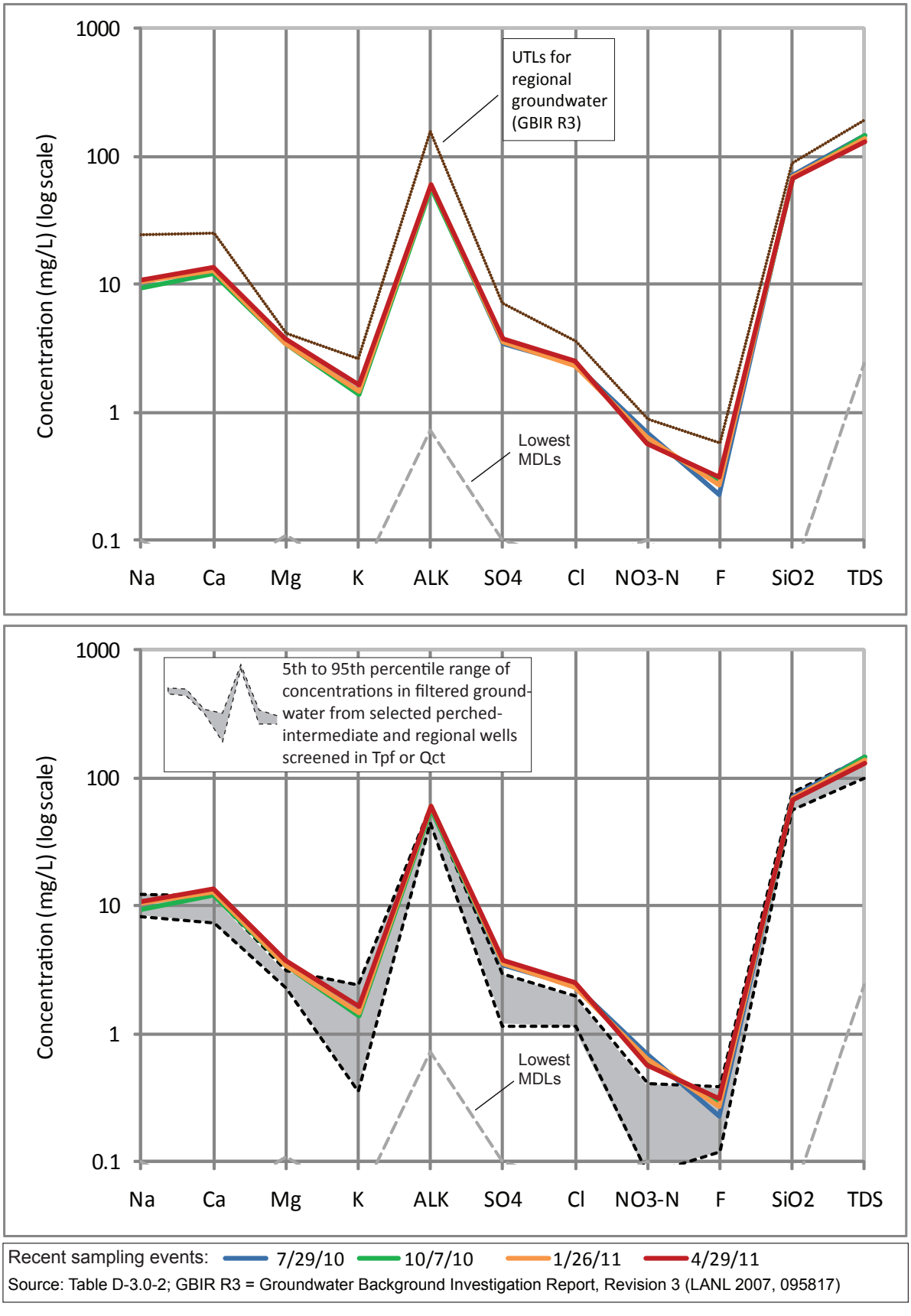


Figure D2-R49-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-49 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

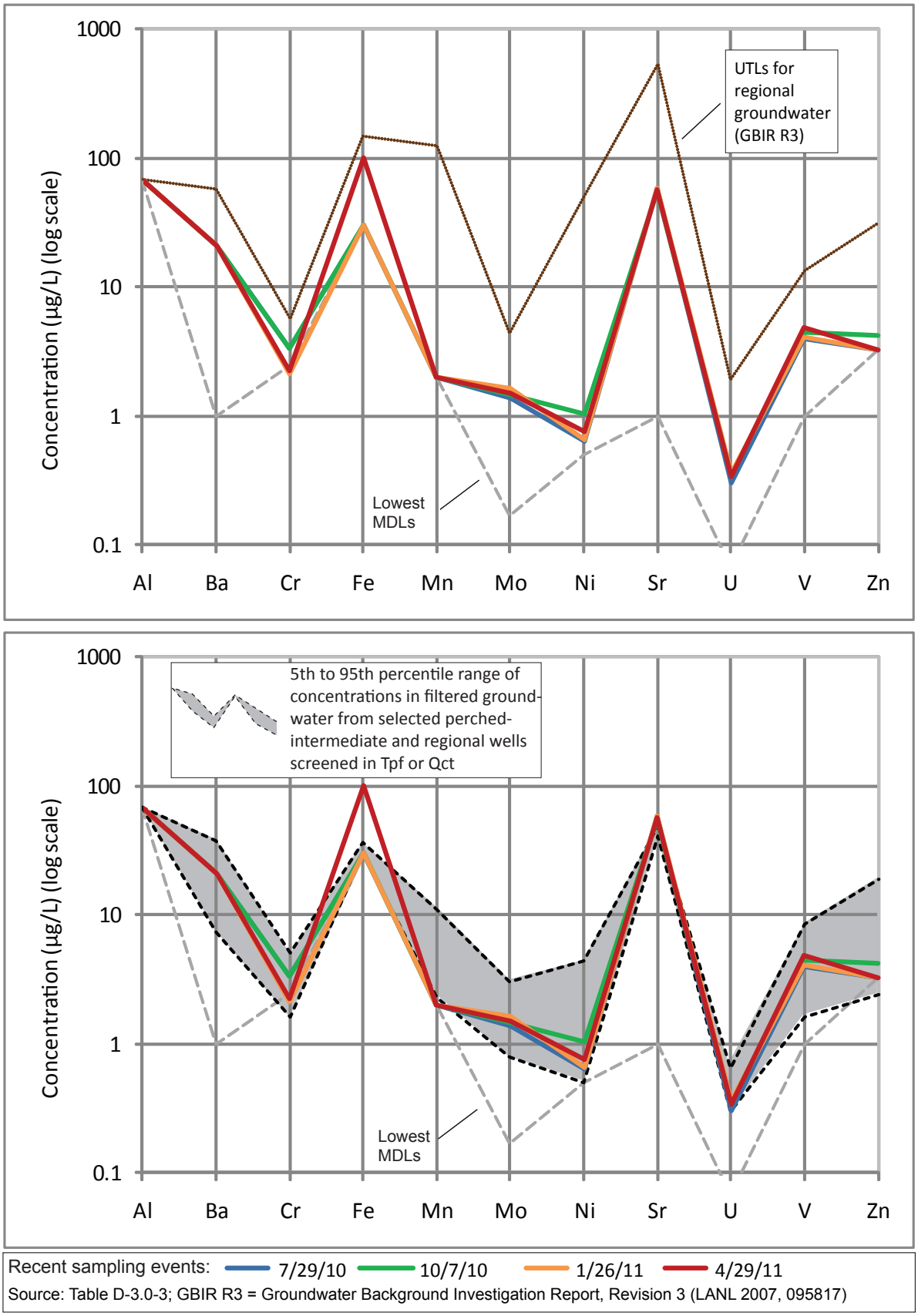


Figure D2-R49-6. Concentrations of trace metals in filtered groundwater from well R-49 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-51 screen 1 (port P1A), port depth 915 ft bgs

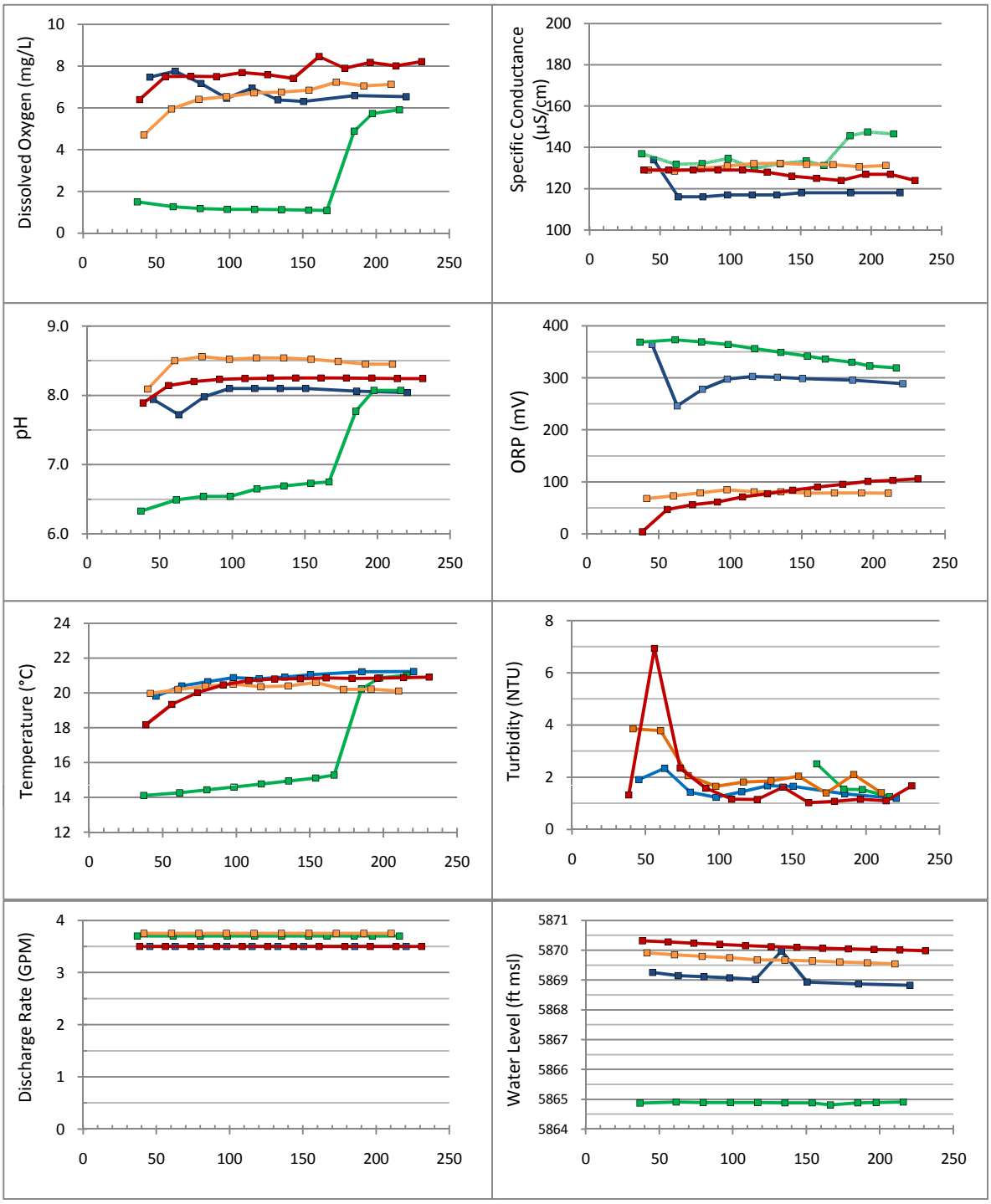


Figure D2-R51-1. Time-series plots of field parameters monitored during purging of R-51 screen 1 (port P1A)

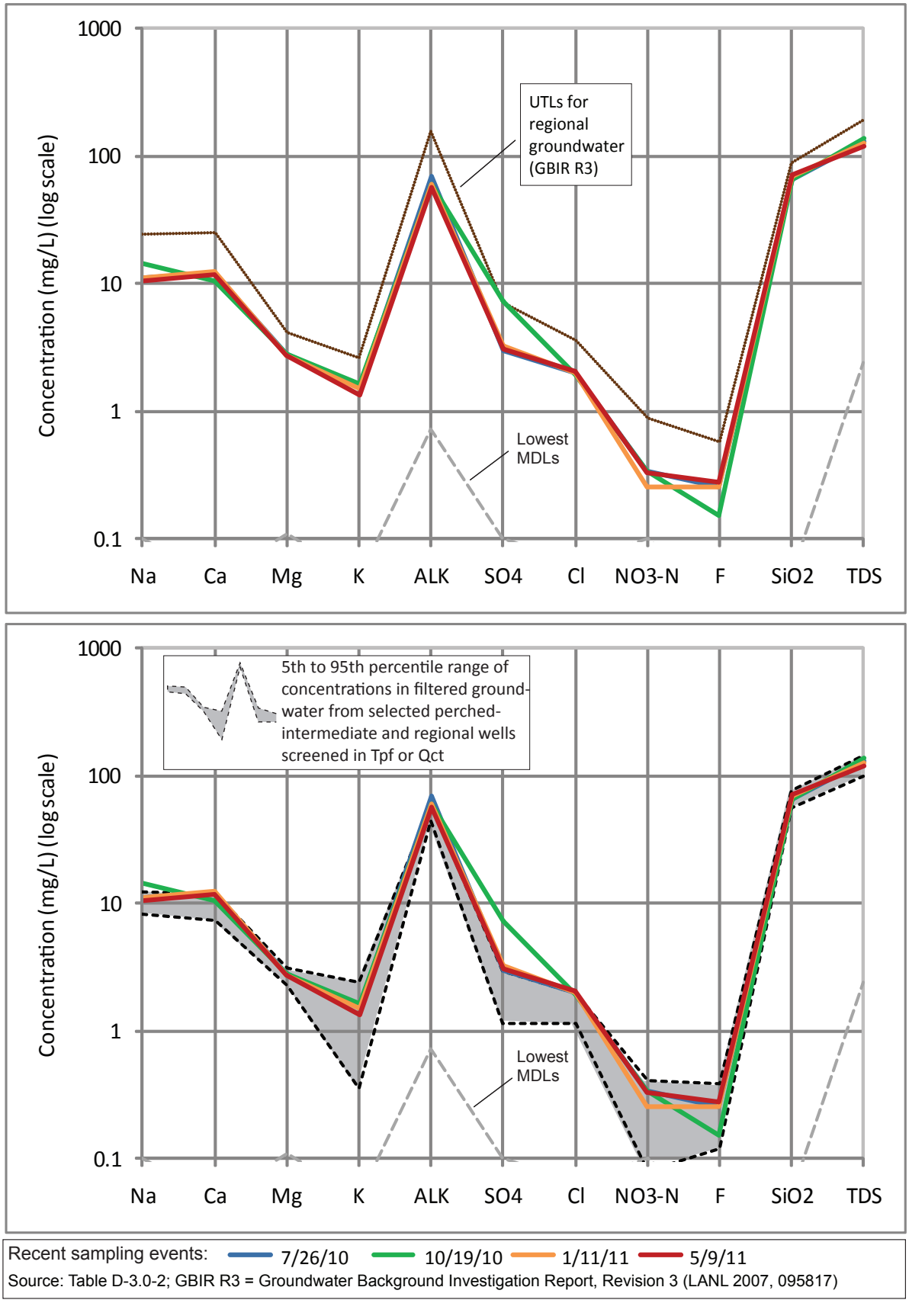


Figure D2-R51-3. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-51 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

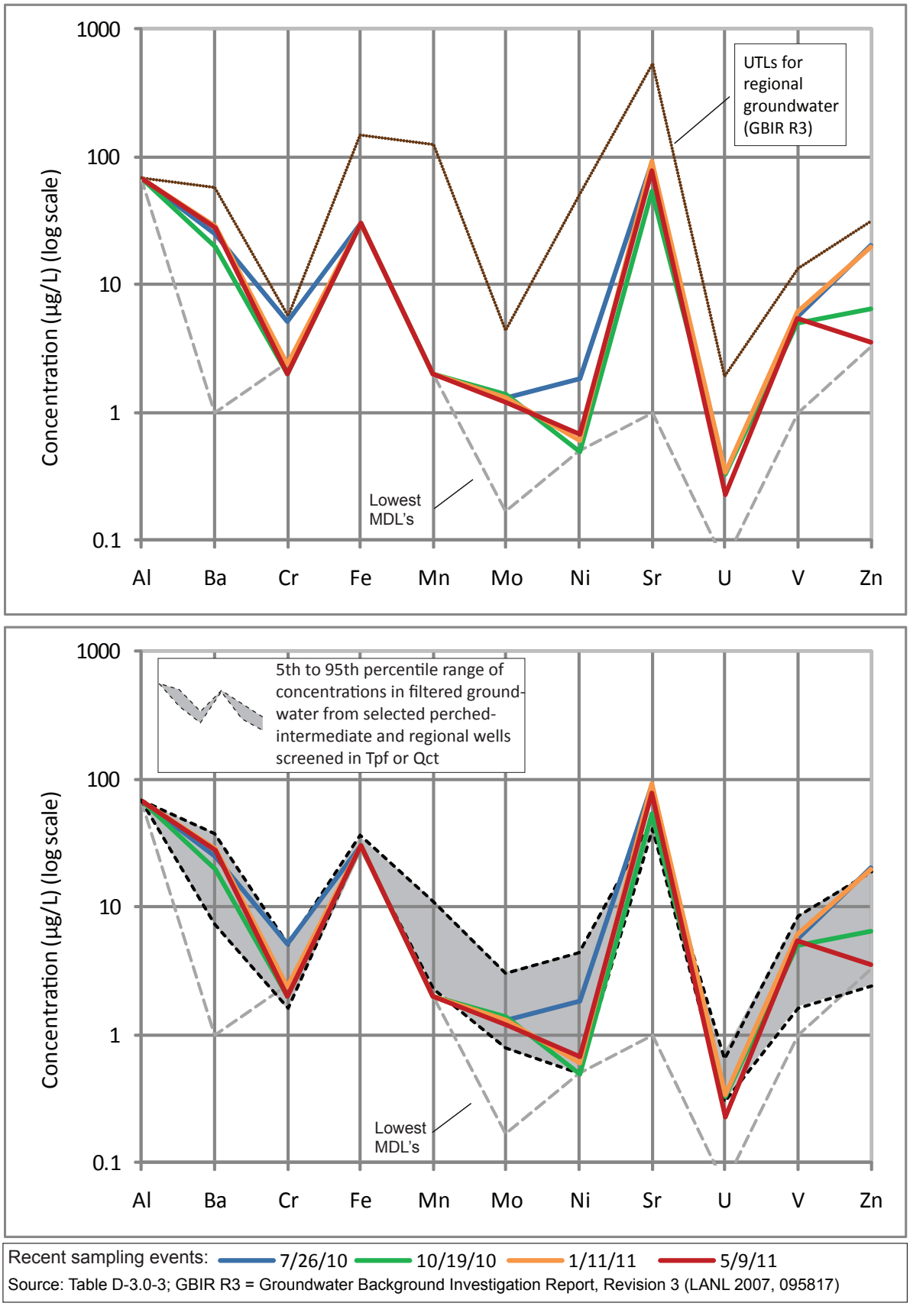


Figure D2-R51-3. Concentrations of trace metals in filtered groundwater from well R-51 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-51 screen 2 (port P2A), port depth 1031 ft bgs

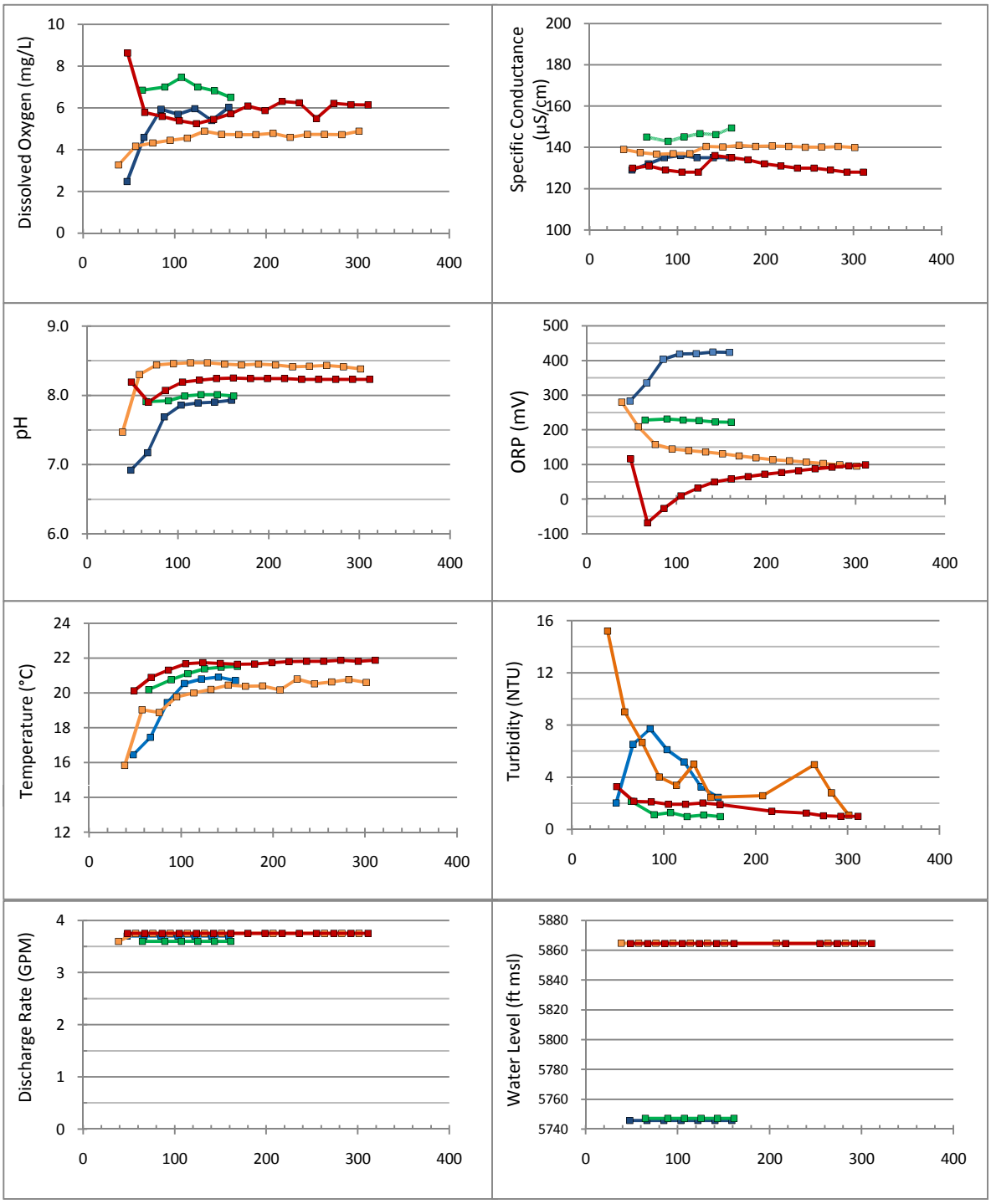


Figure D2-R51-4. **Time-series plots of field parameters monitored during purging of R-51 screen 2 (port P2A)**

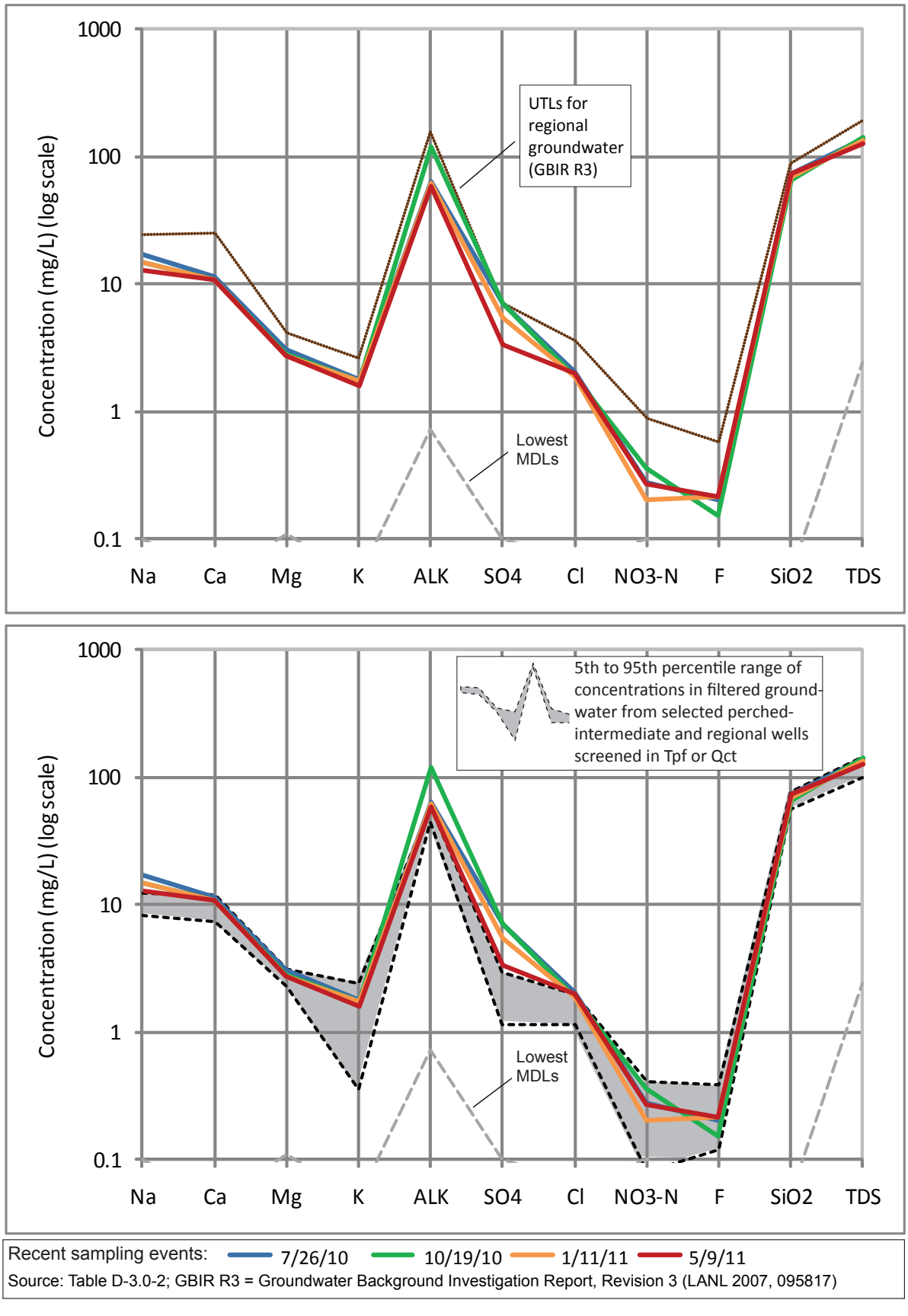


Figure D2-R51-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-51 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

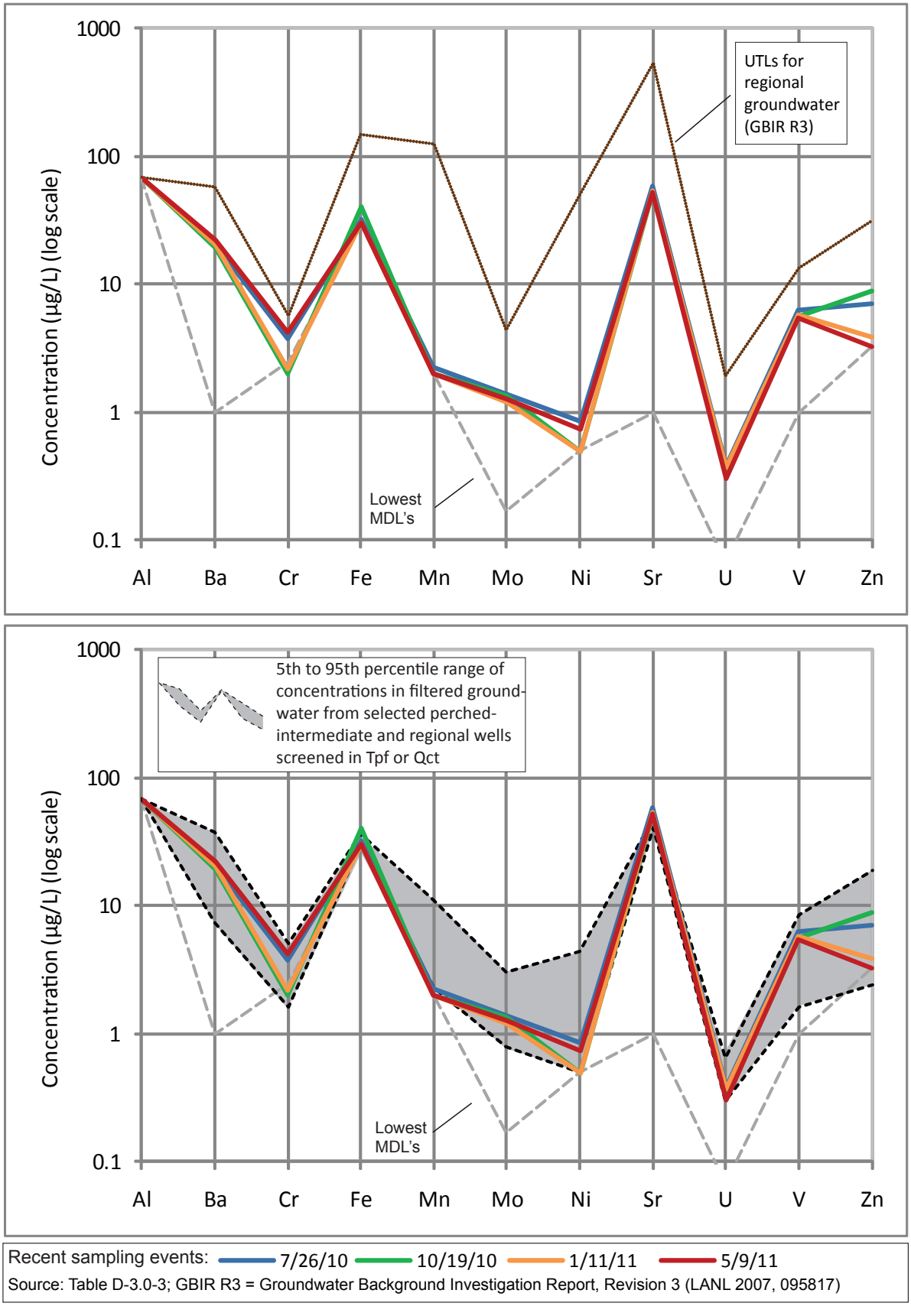


Figure D2-R51-6. Concentrations of trace metals in filtered groundwater from well R-51 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-52 screen 1 (port P1A), port depth 1035 ft bgs

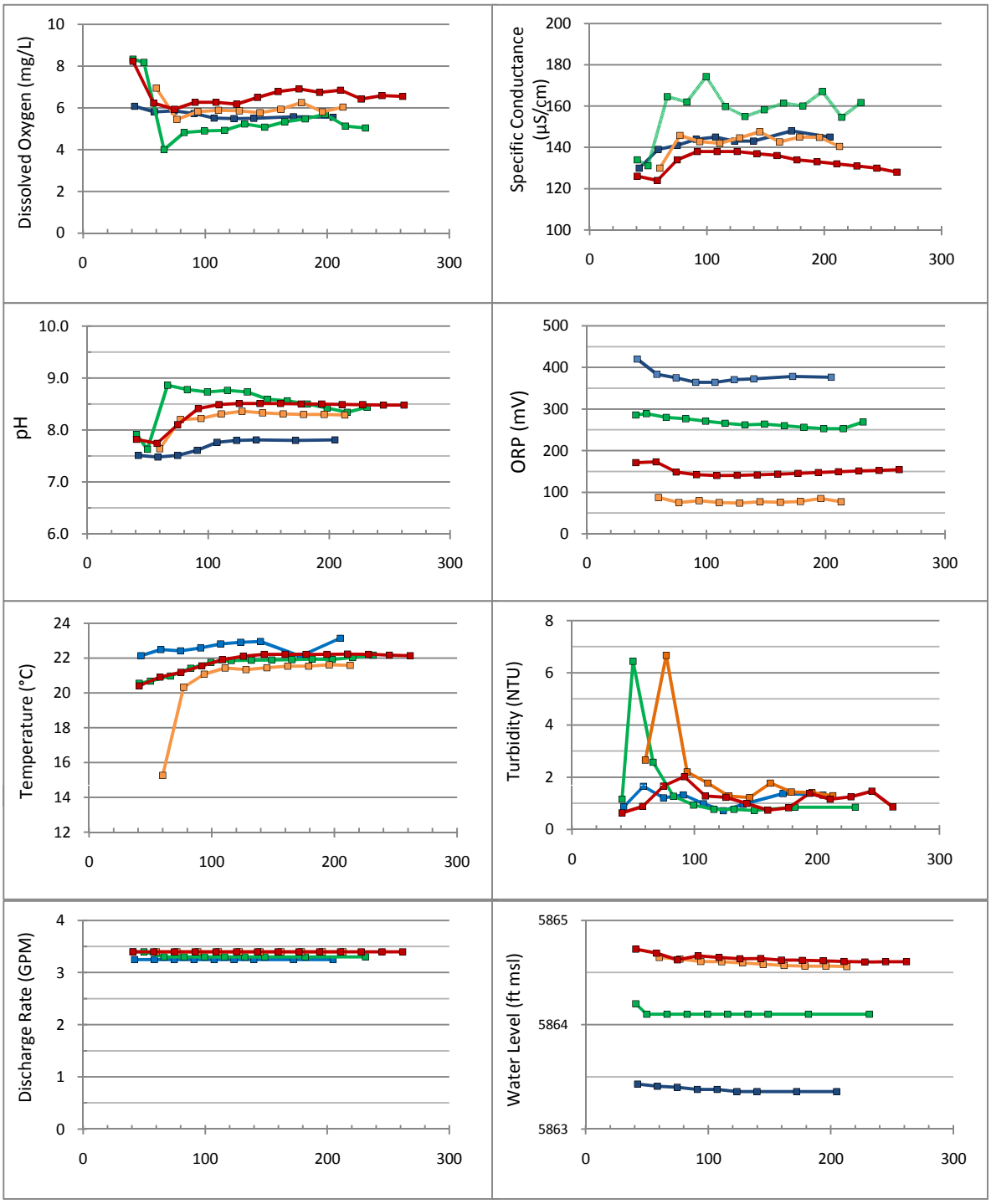


Figure D2-R52-1. **Time-series plots of field parameters monitored during purging of R-52 screen 1 (port P1A)**

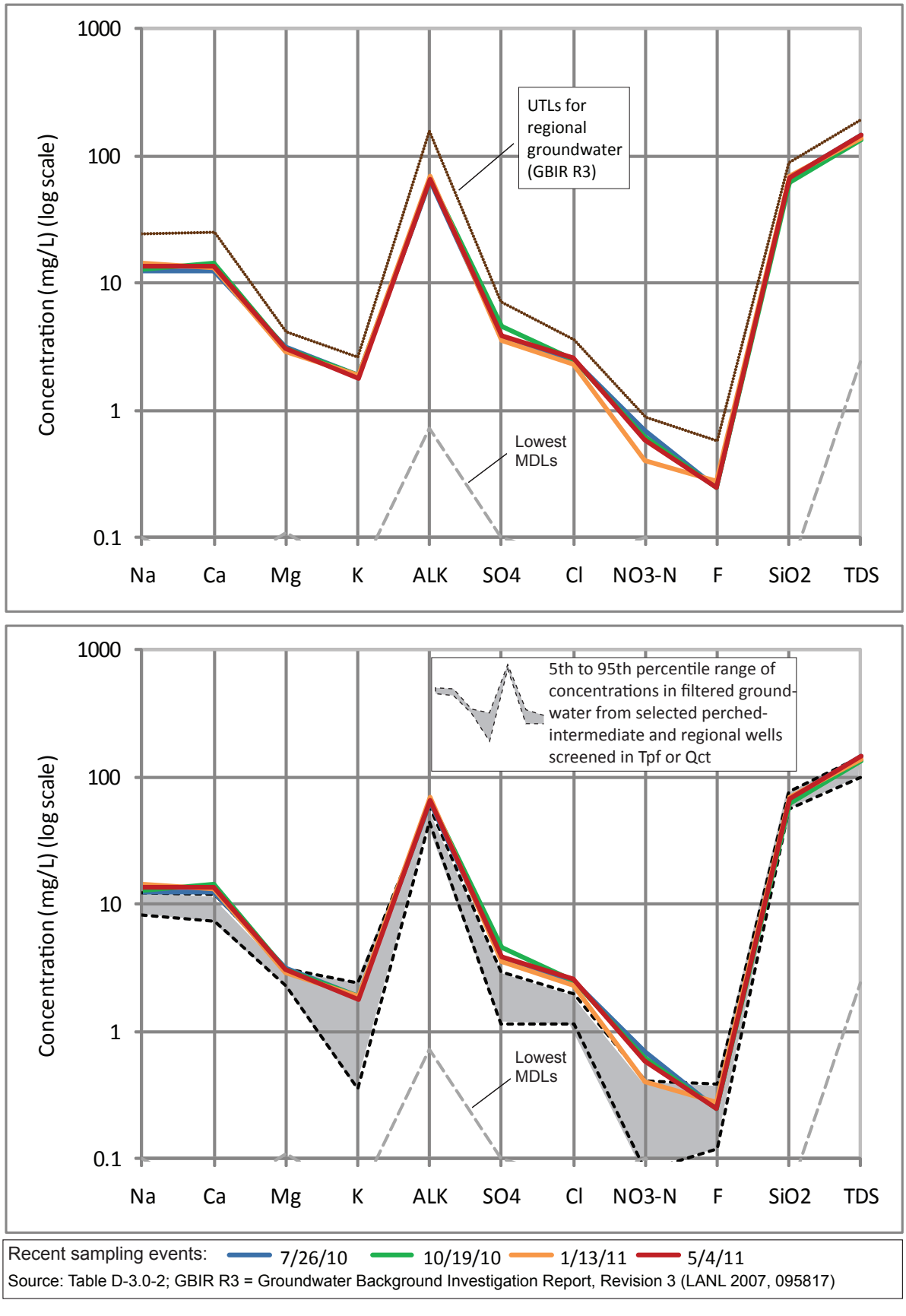


Figure D2-R52-3. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-52 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

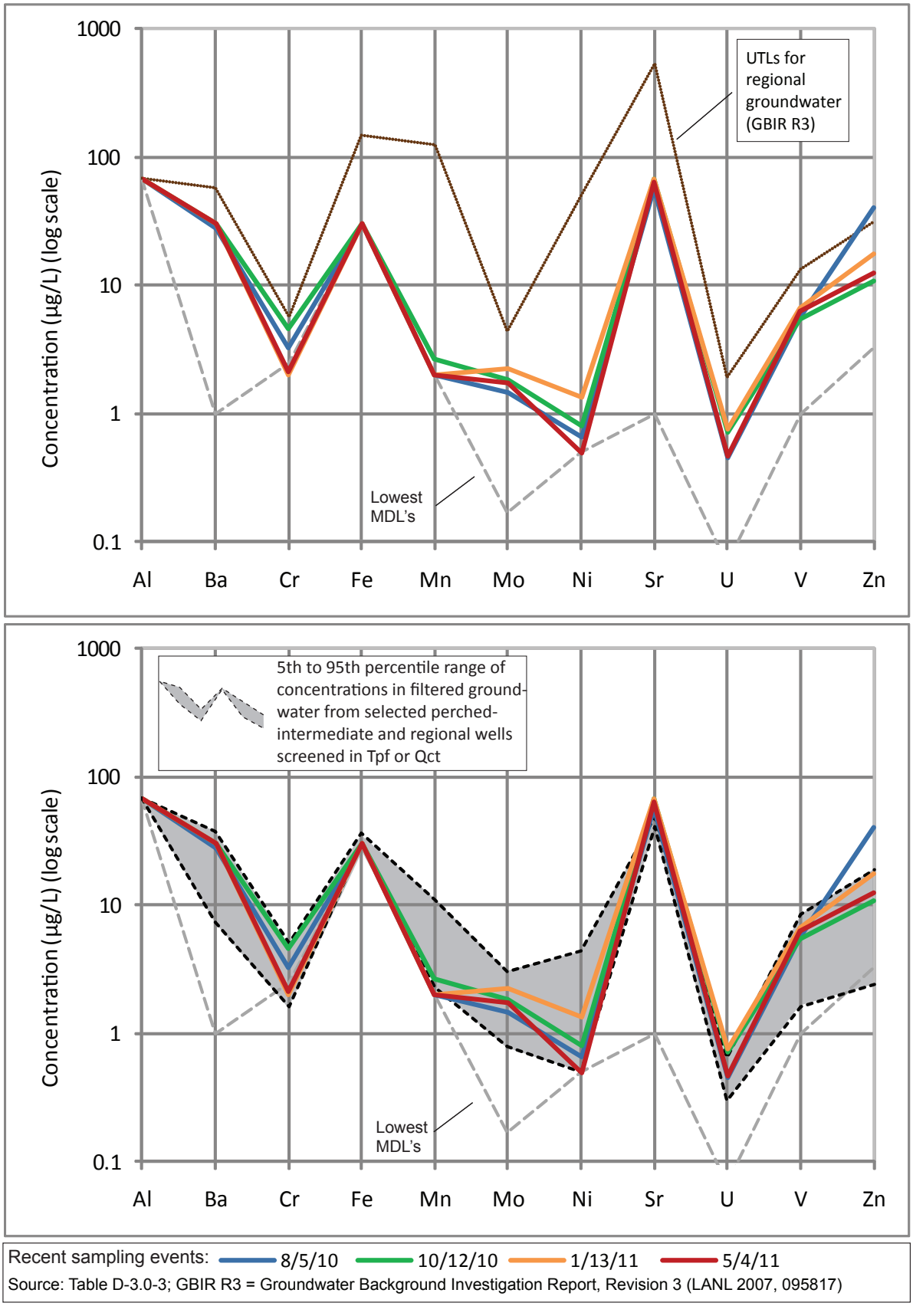


Figure D2-R52-3. Concentrations of trace metals in filtered groundwater from well R-52 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-52 screen 2 (port P2A), port depth 1107 ft bgs

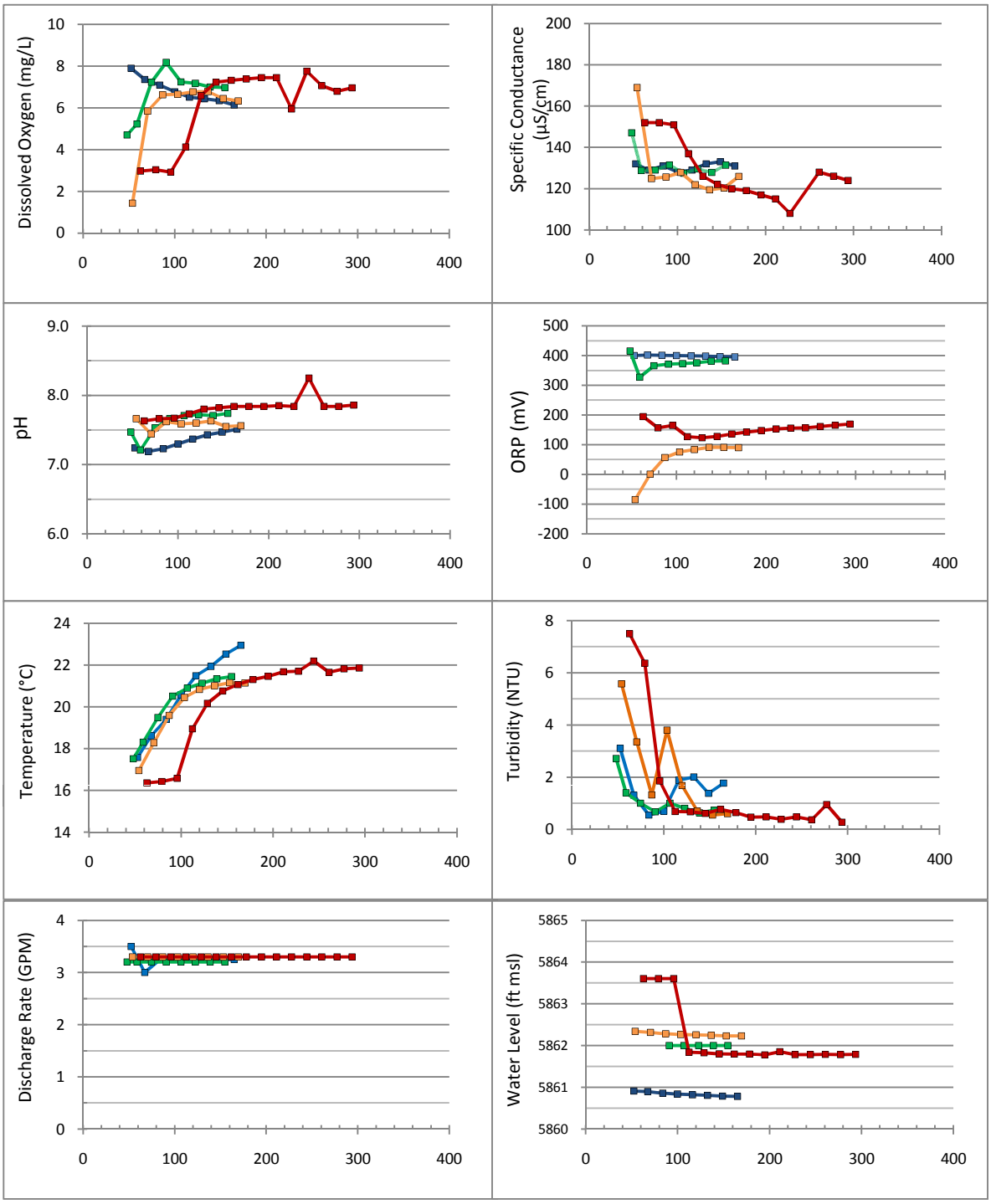


Figure D2-R52-4. **Time-series plots of field parameters monitored during purging of R-52 screen 2 (port P2A)**

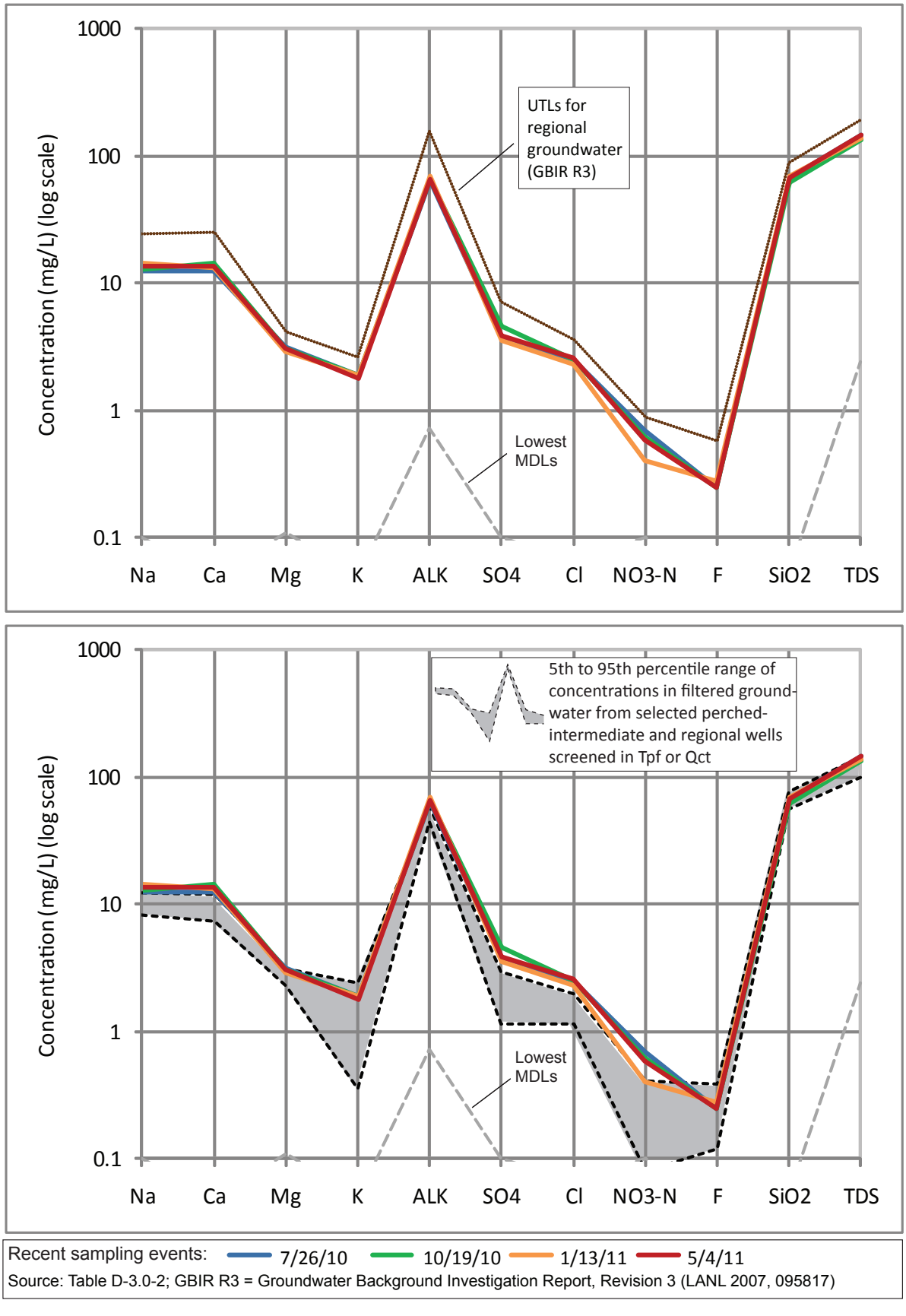


Figure D2-R52-3. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-52 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

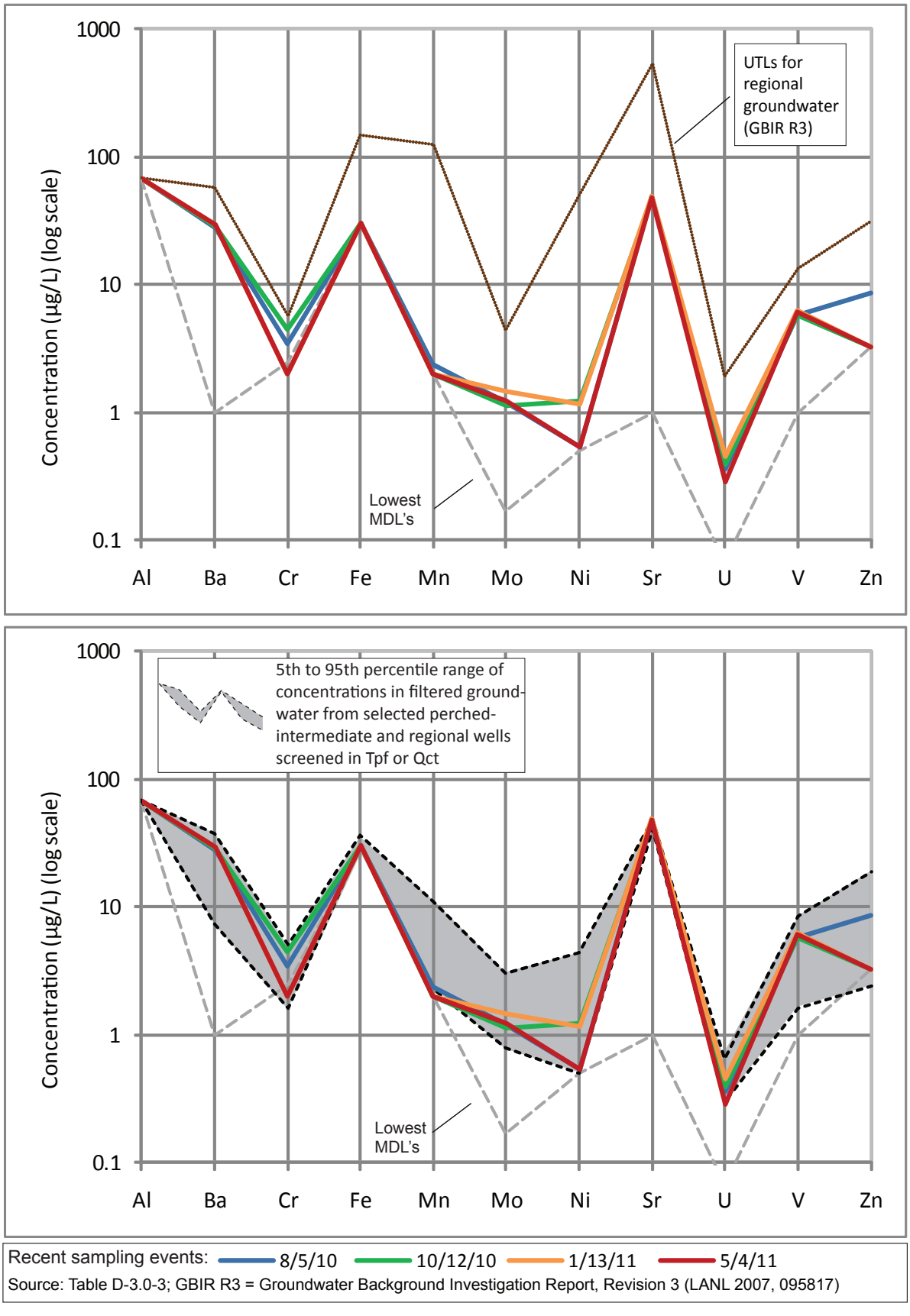


Figure D2-R52-6. Concentrations of trace metals in filtered groundwater from well R-52 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-53 screen 1 (port P1A), port depth 849 ft bgs

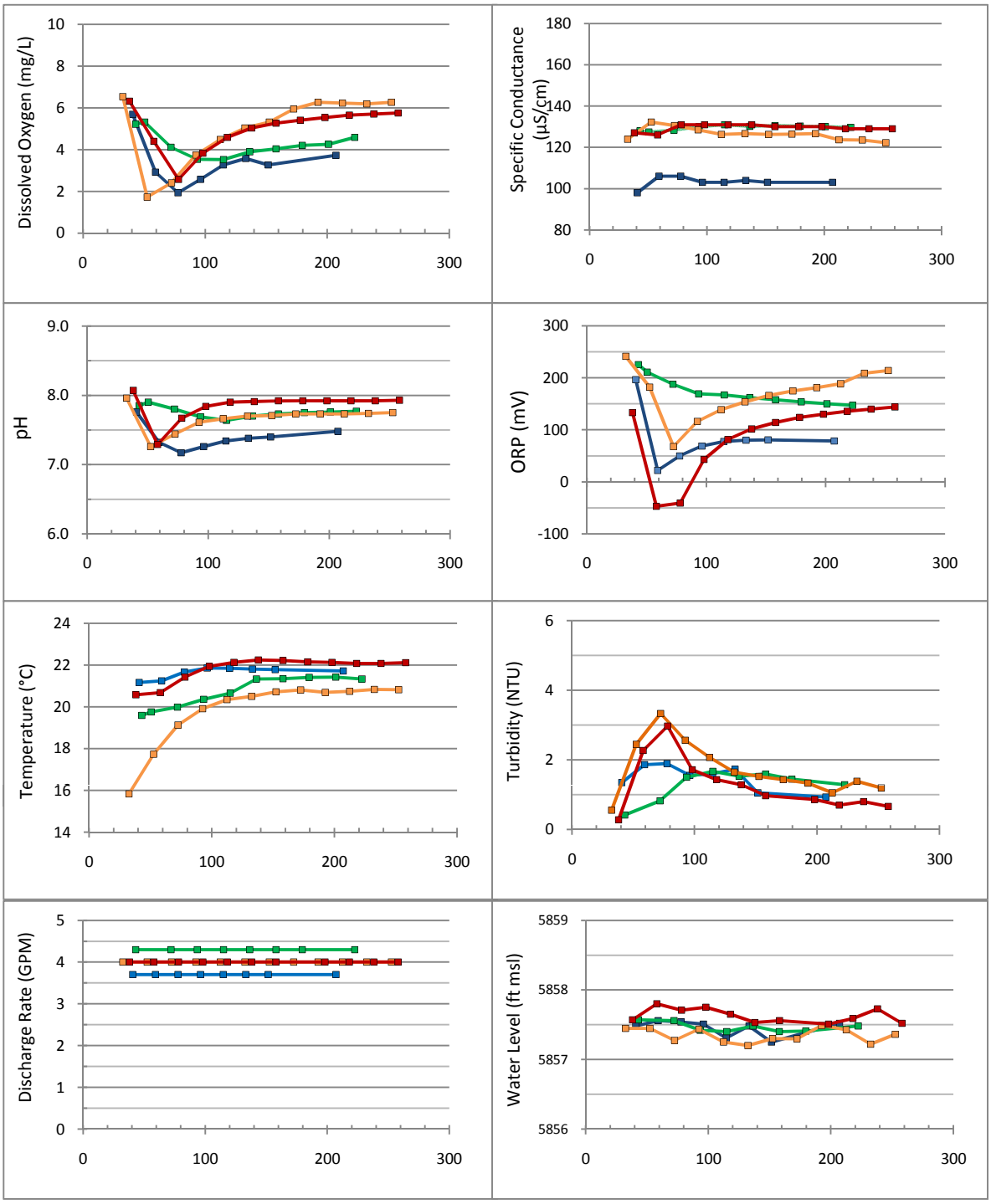


Figure D2-R53-1. **Time-series plots of field parameters monitored during purging of R-53 screen 1 (port P1A)**

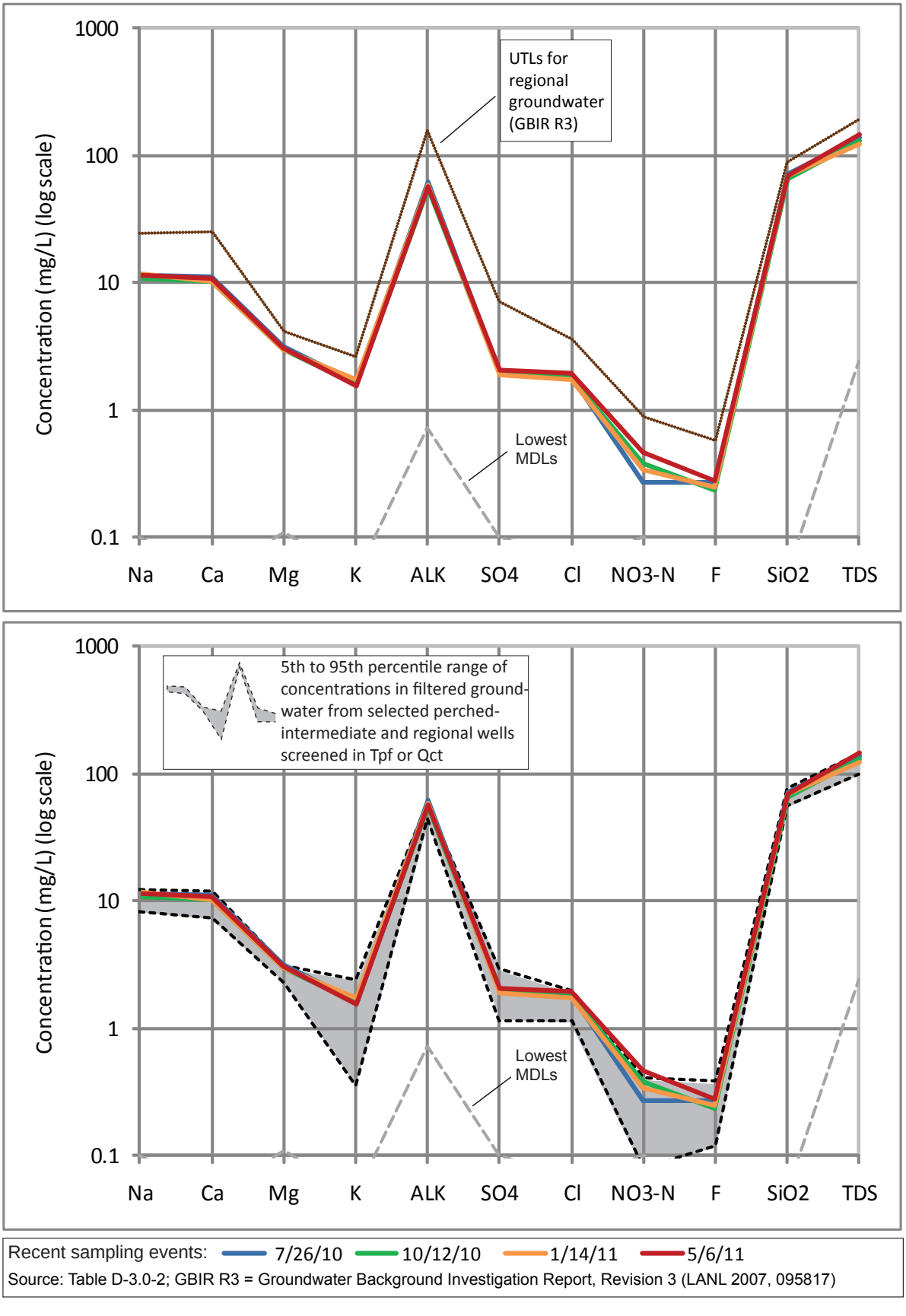


Figure D2-R53-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-53 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

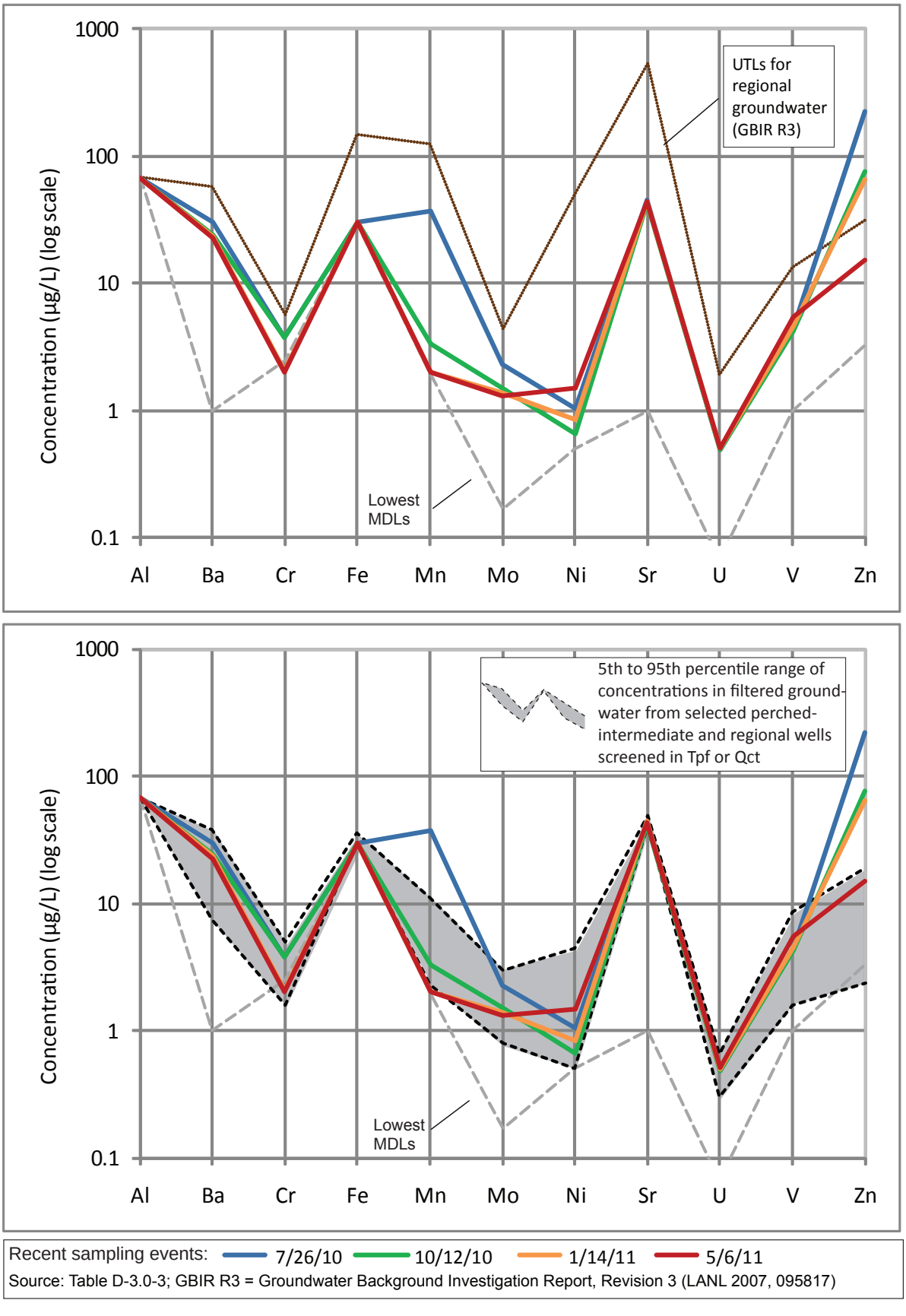


Figure D2-R53-3. Concentrations of trace metals in filtered groundwater from well R-53 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

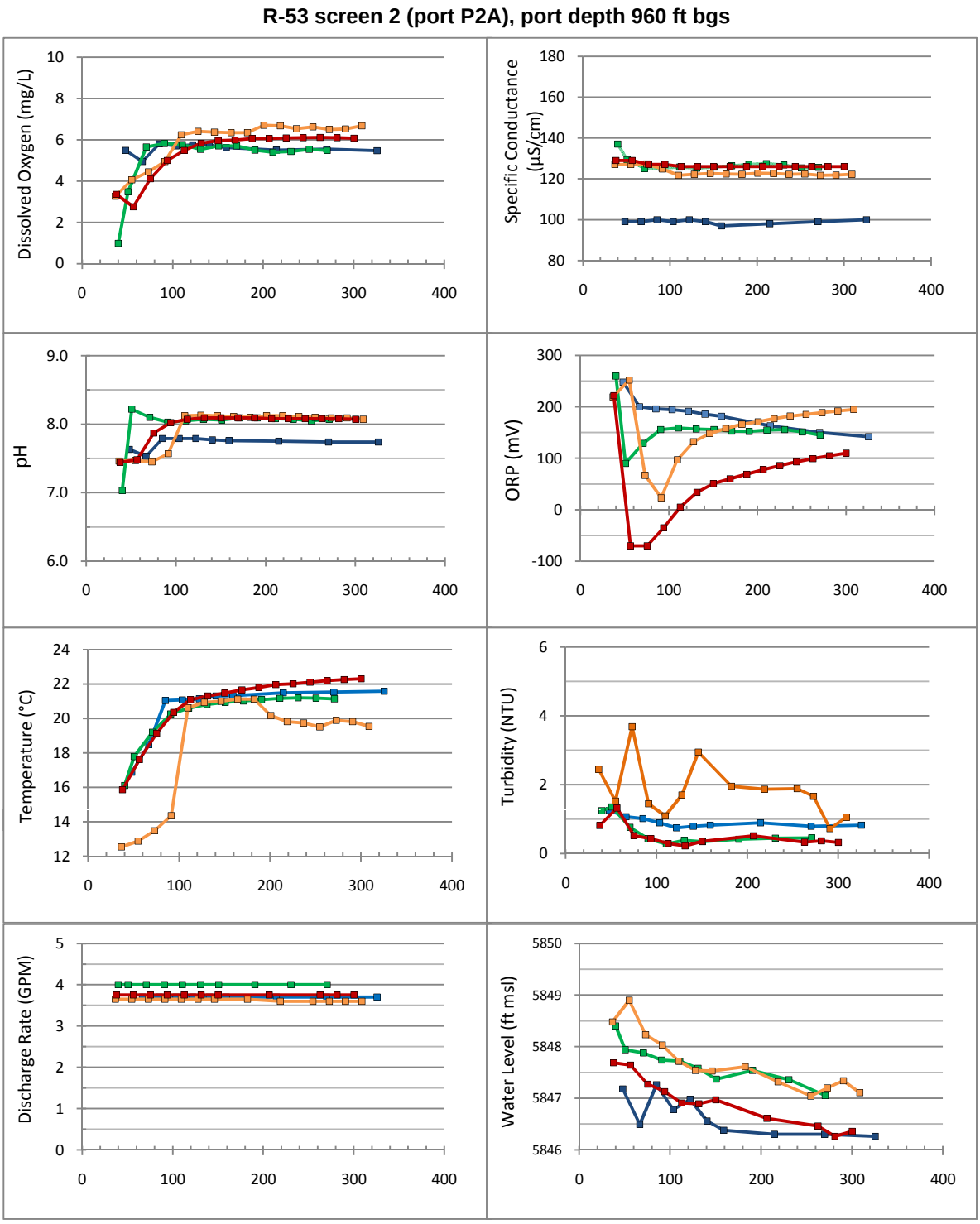


Figure D2-R53-4. **Time-series plots of field parameters monitored during purging of R-53 screen 2 (port P2A)**

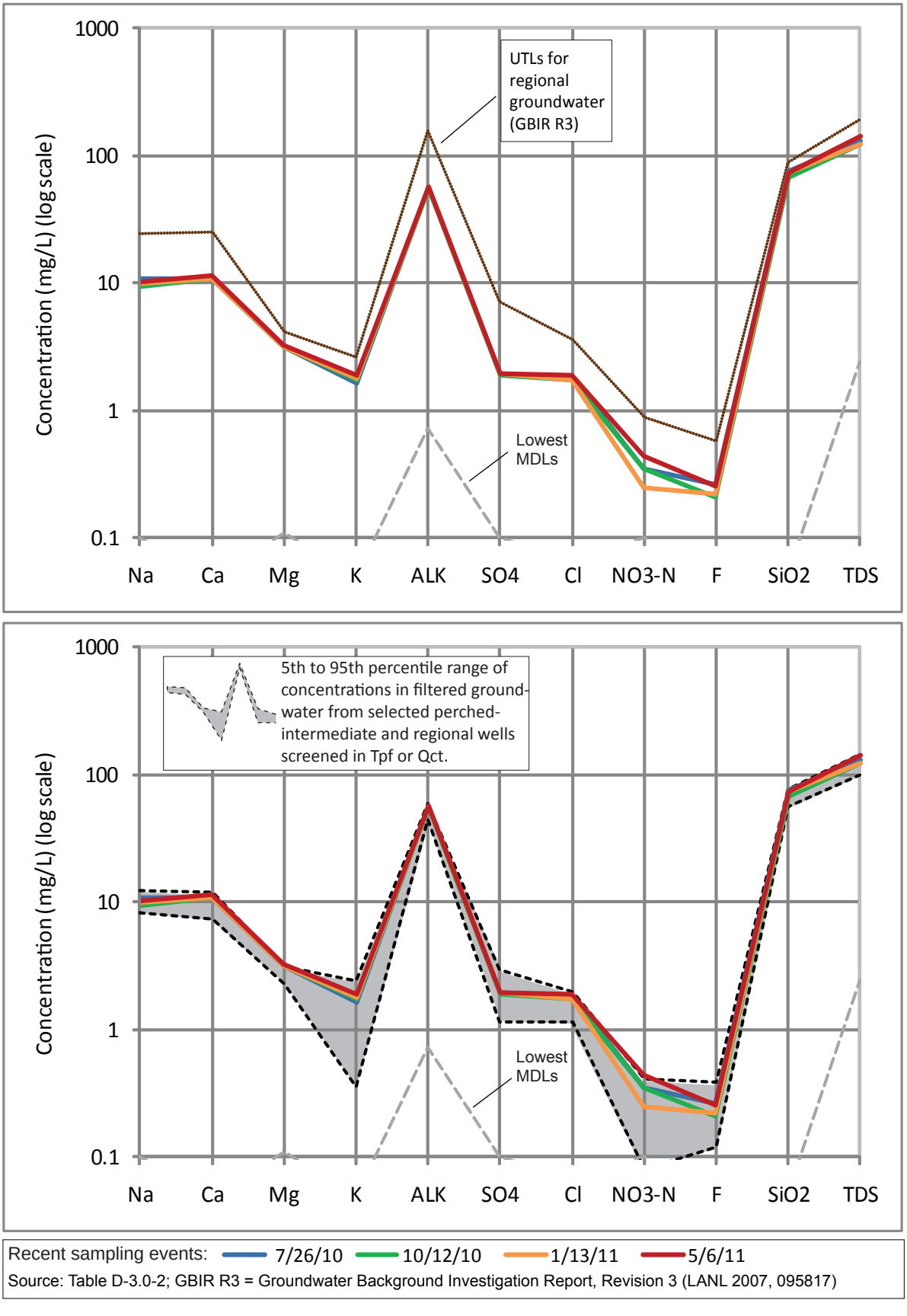


Figure D2-R53-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-53 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

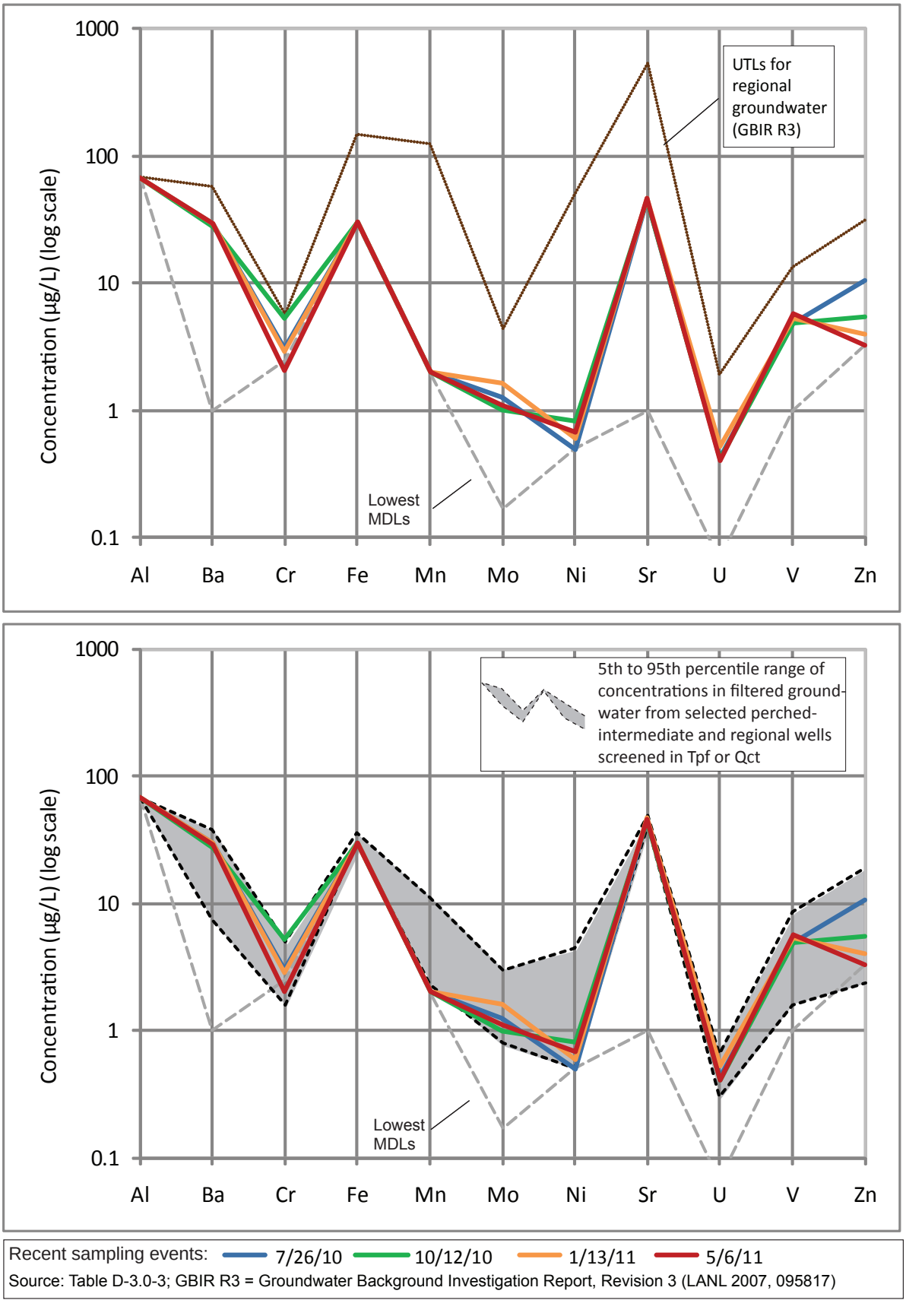
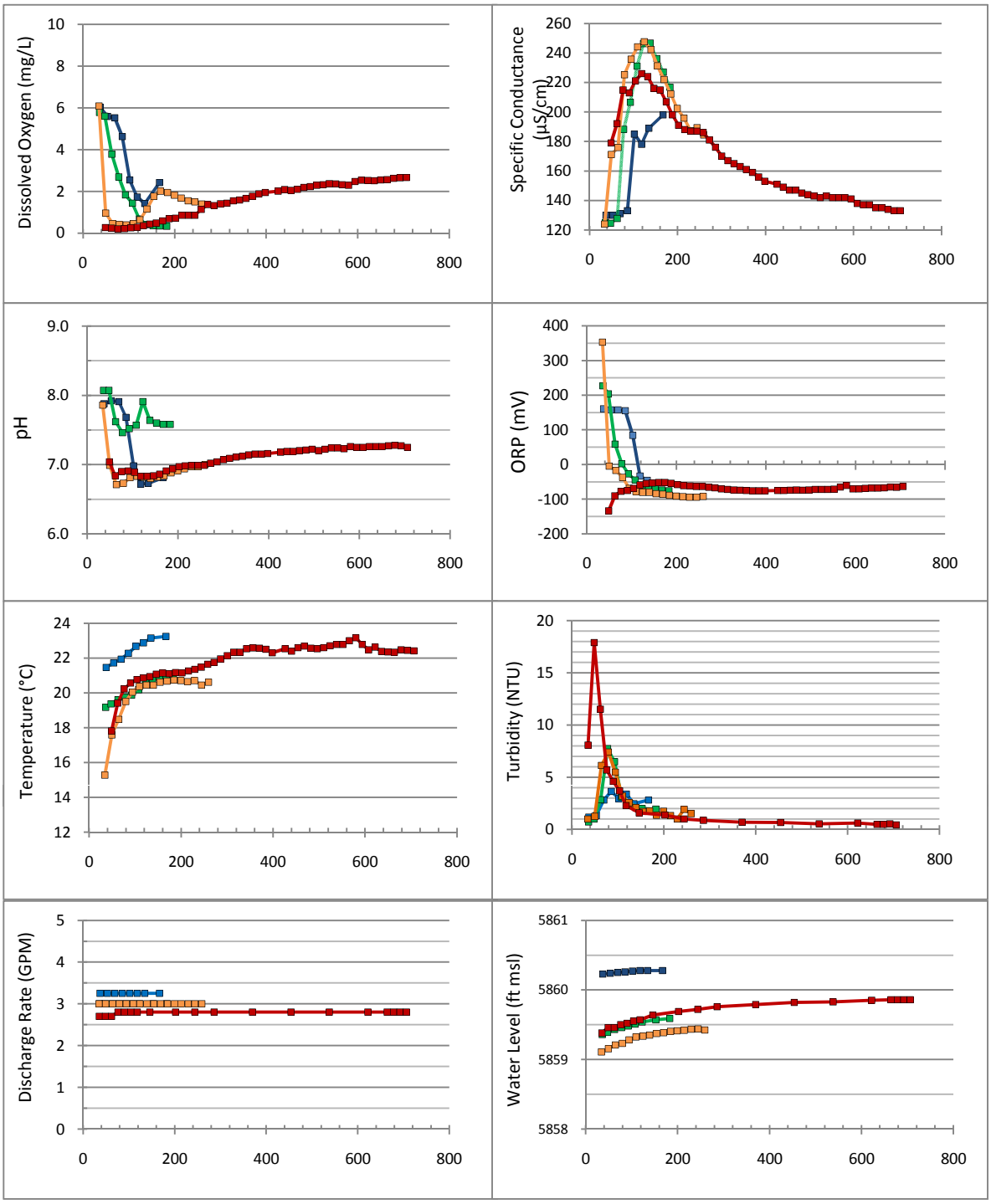


Figure D2-R53-6. Concentrations of trace metals in filtered groundwater from well R-53 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-54 screen 1 (port P1A), port depth 830 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R54-1. **Time-series plots of field parameters monitored during purging of R-54 screen 1 (port P1A)**

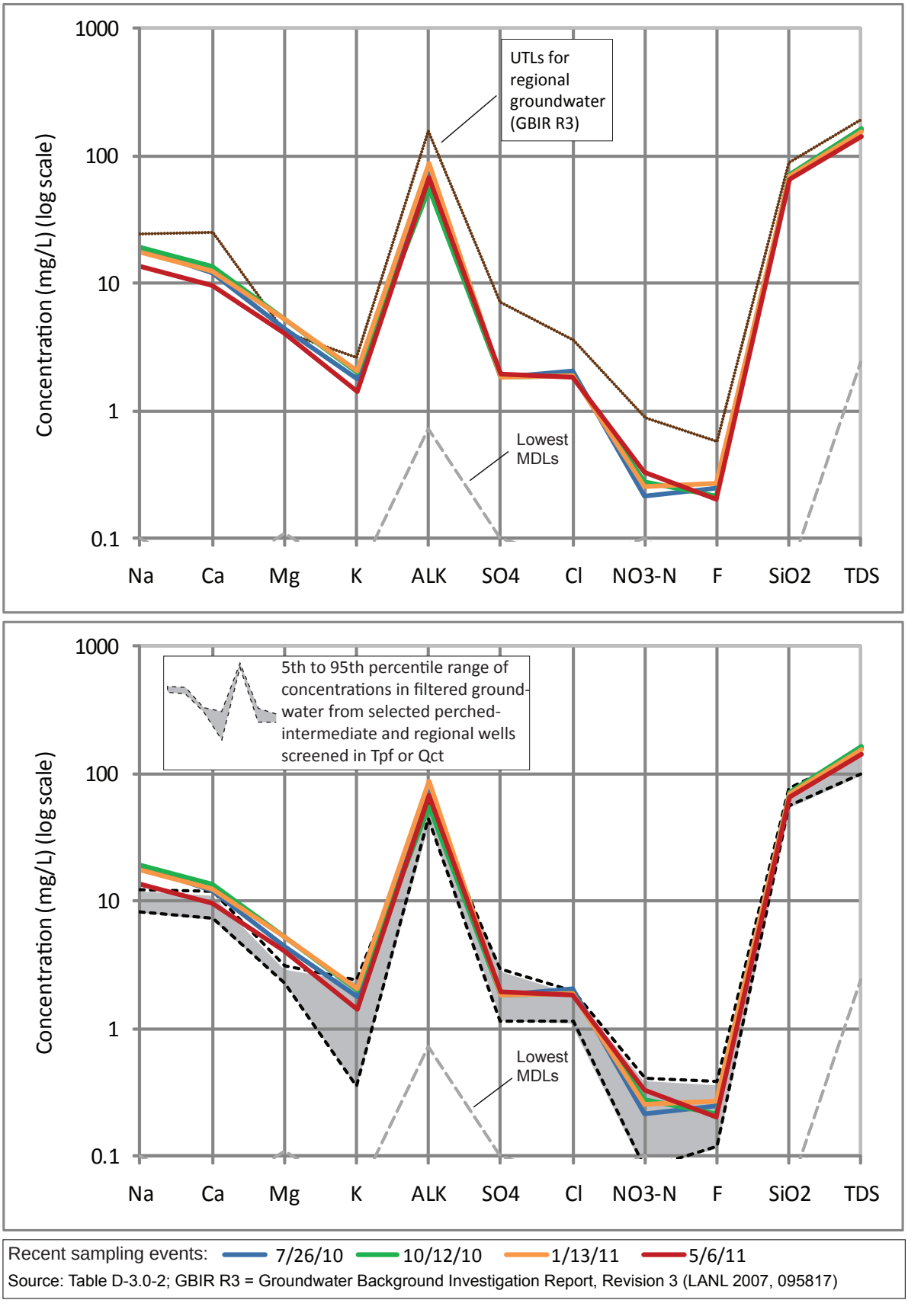


Figure D2-R54-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-54 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

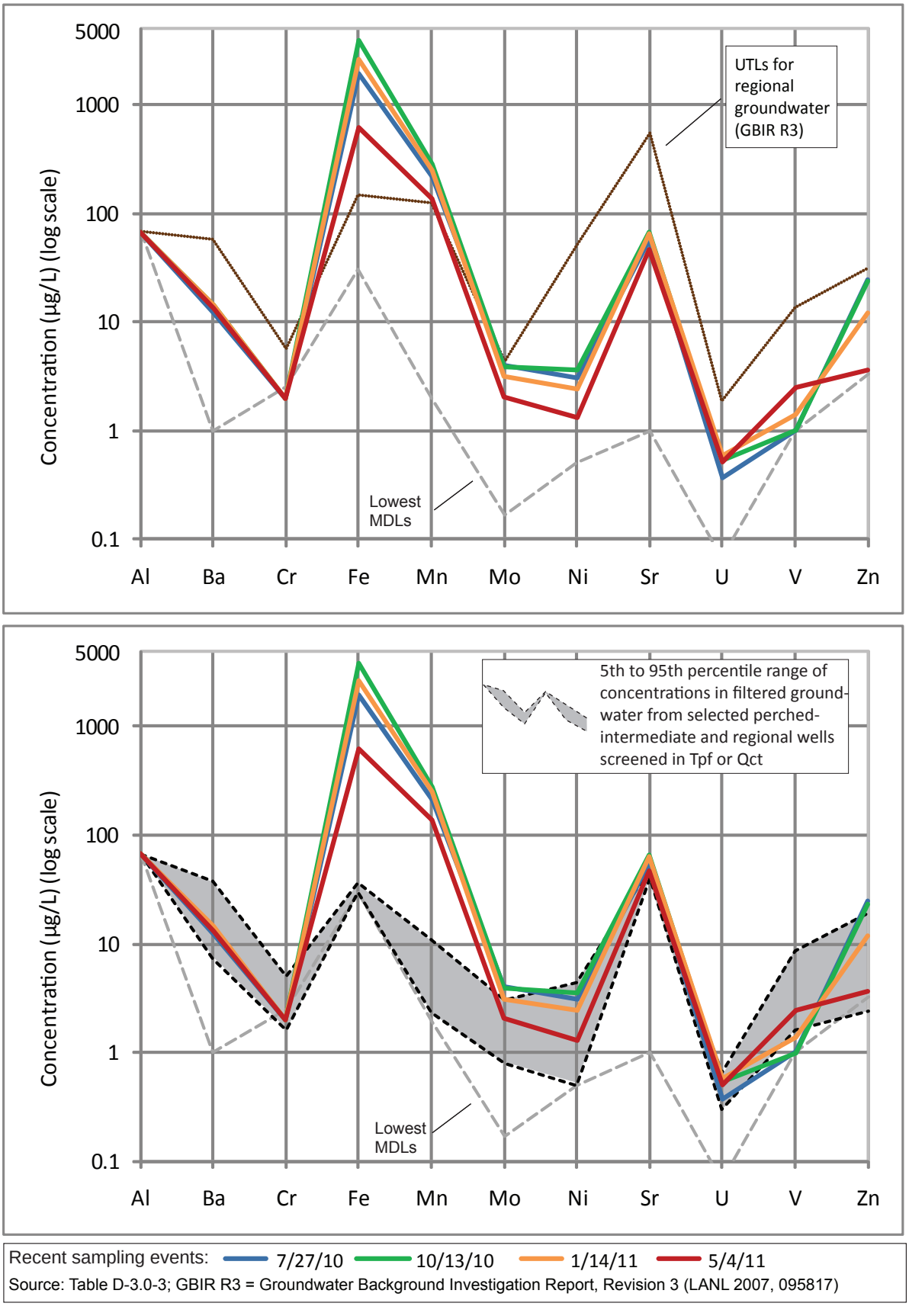


Figure D2-R54-3. Concentrations of trace metals in filtered groundwater from well R-54 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater. Lower graph shows"background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-54 screen 2 (port P2A), port depth 915 ft bgs

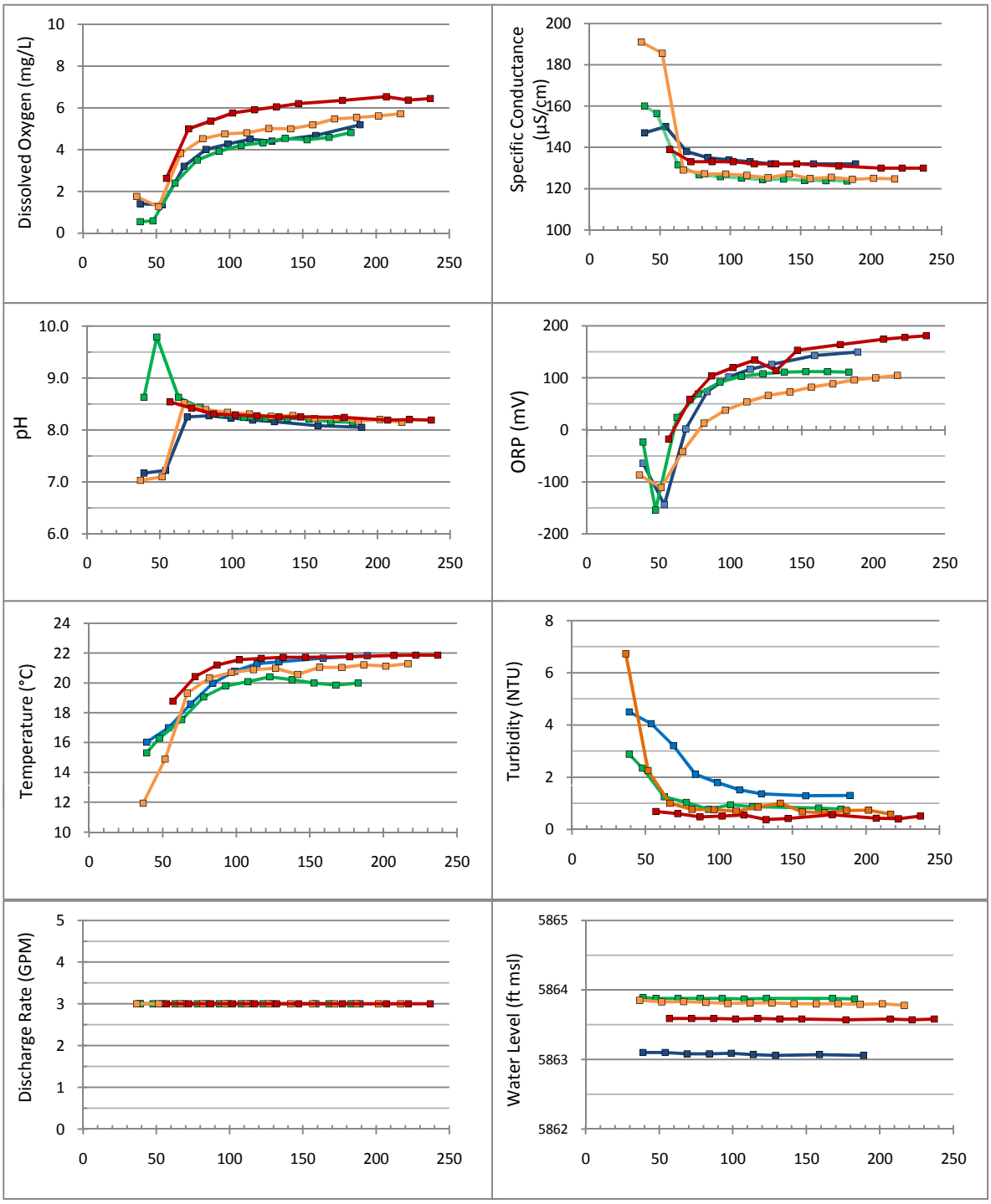


Figure D2-R54-4. **Time-series plots of field parameters monitored during purging of R-54 screen 2 (port P2A)**

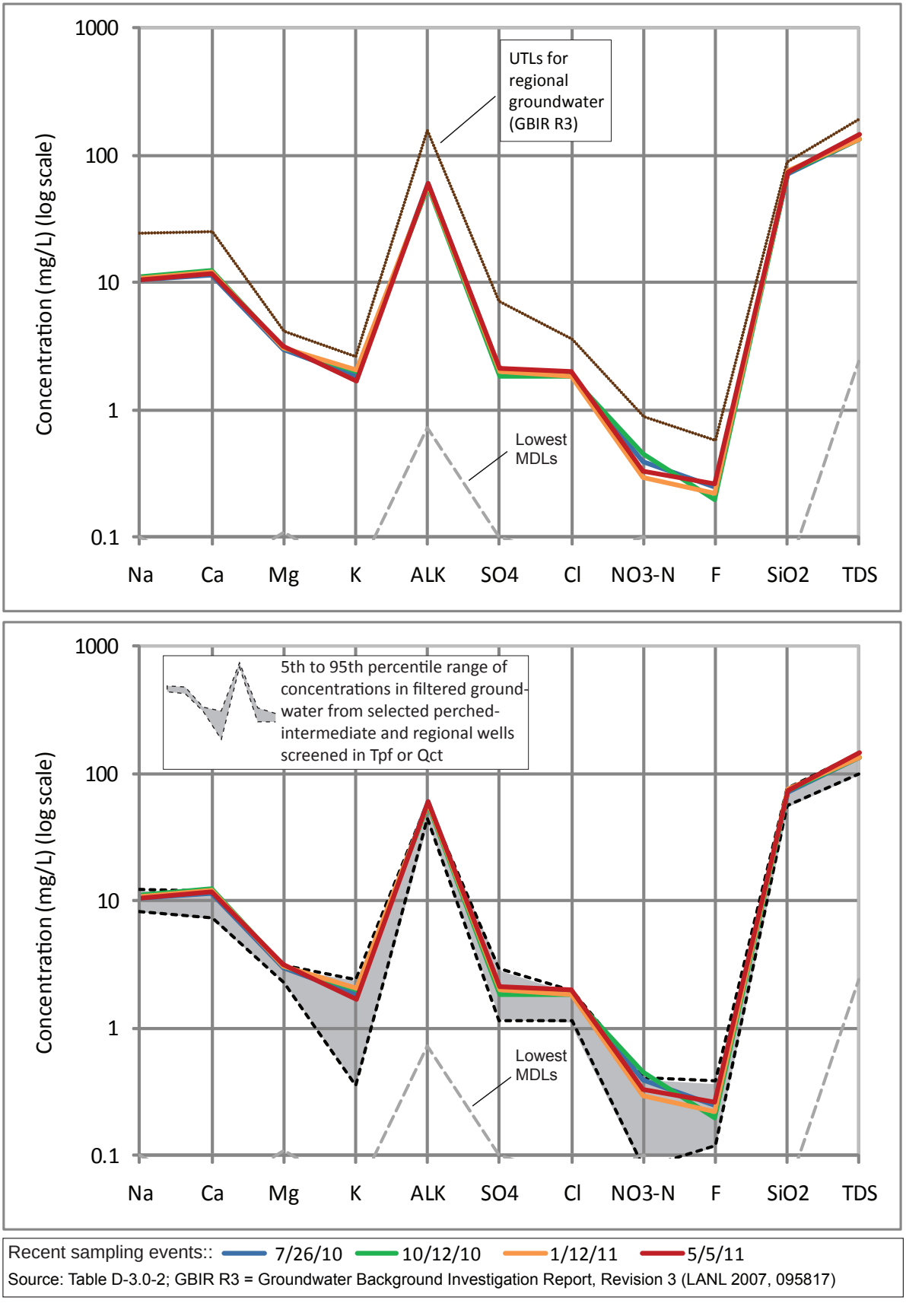


Figure D2-R54-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-54 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

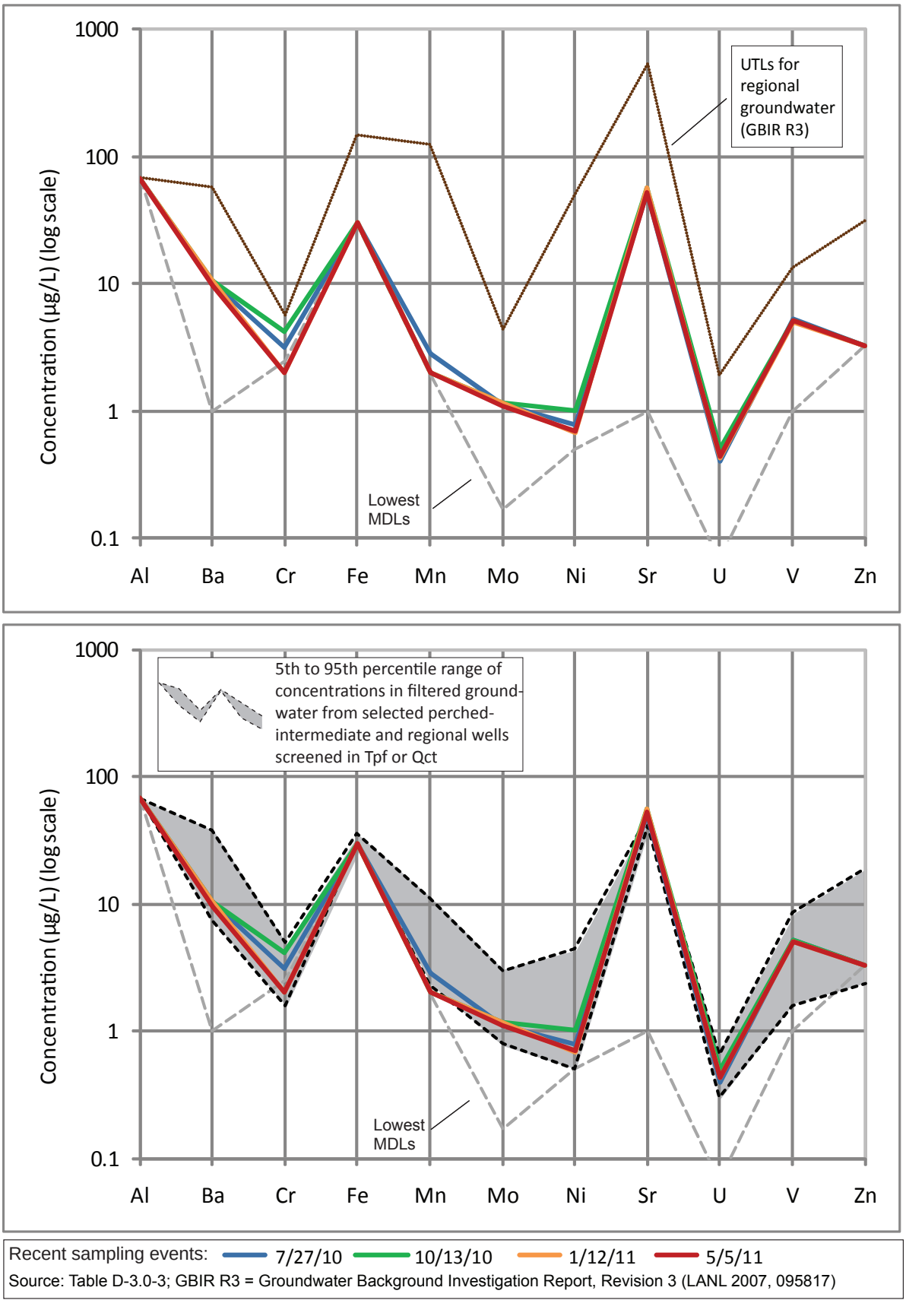
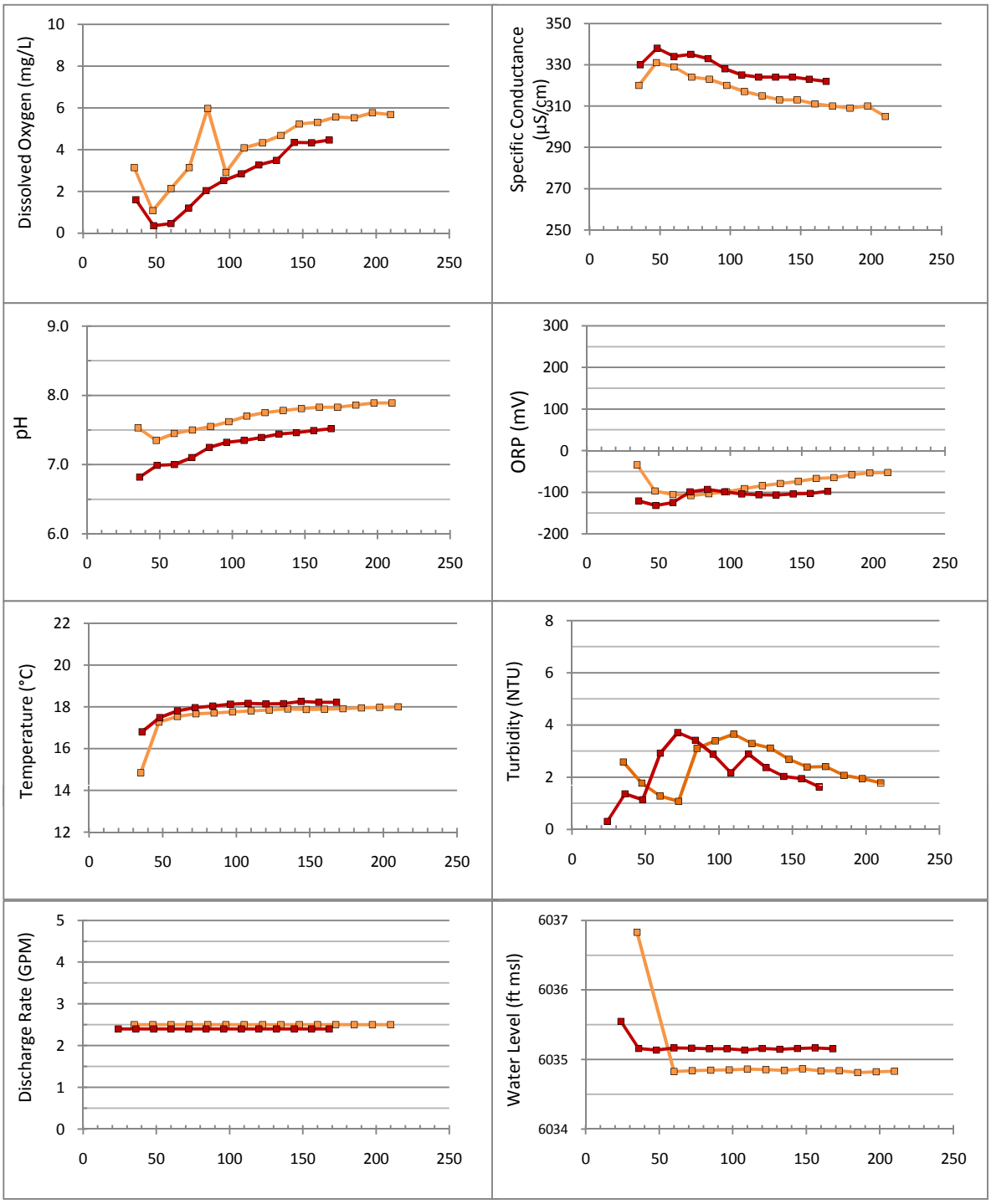


Figure D2-R54-6. Concentrations of trace metals in filtered groundwater from well R-54 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater. Lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-55i (single screen), port depth 510 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R55i-1. Time-series plots of field parameters monitored during purging of R-55i (single screen)

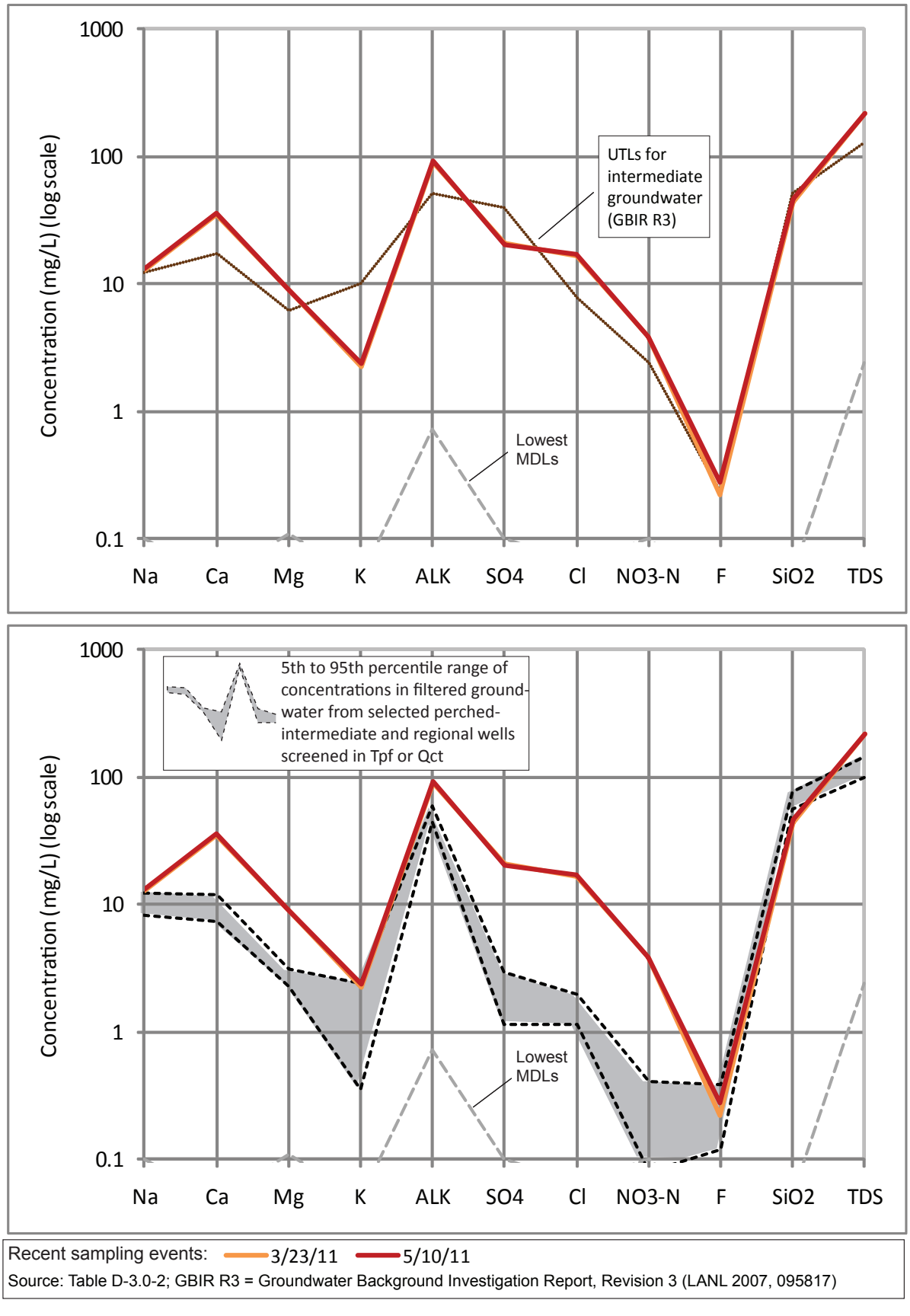


Figure D2-R-55i-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-55i screen 1 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

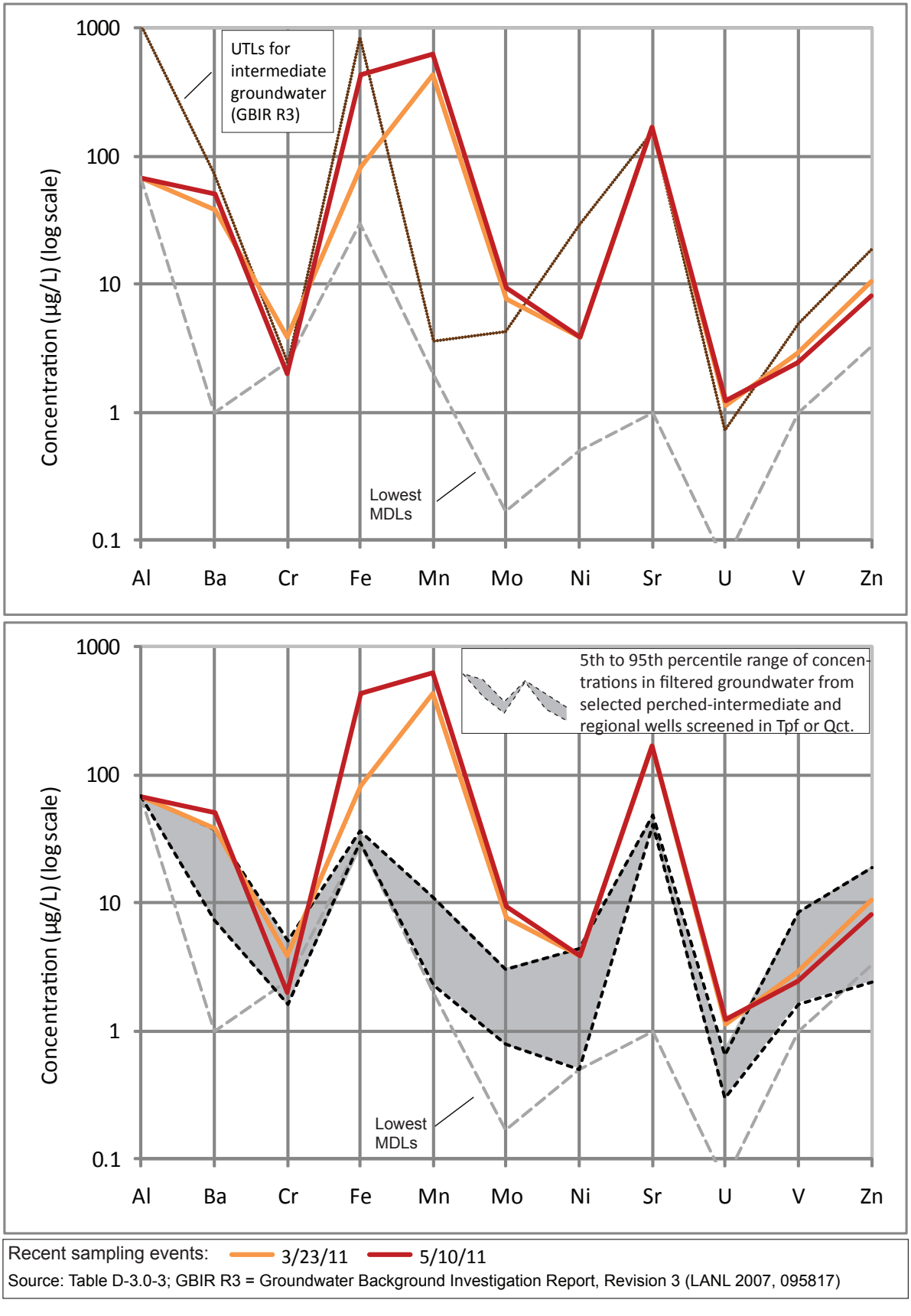


Figure D2-R55i-3. Concentrations of trace metals in filtered groundwater from well R-55i screen 1 for recent sampling events. Upper graph shows UTLs for intermediate groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-55 screen 1 (port P1A), port depth 860 ft bgs

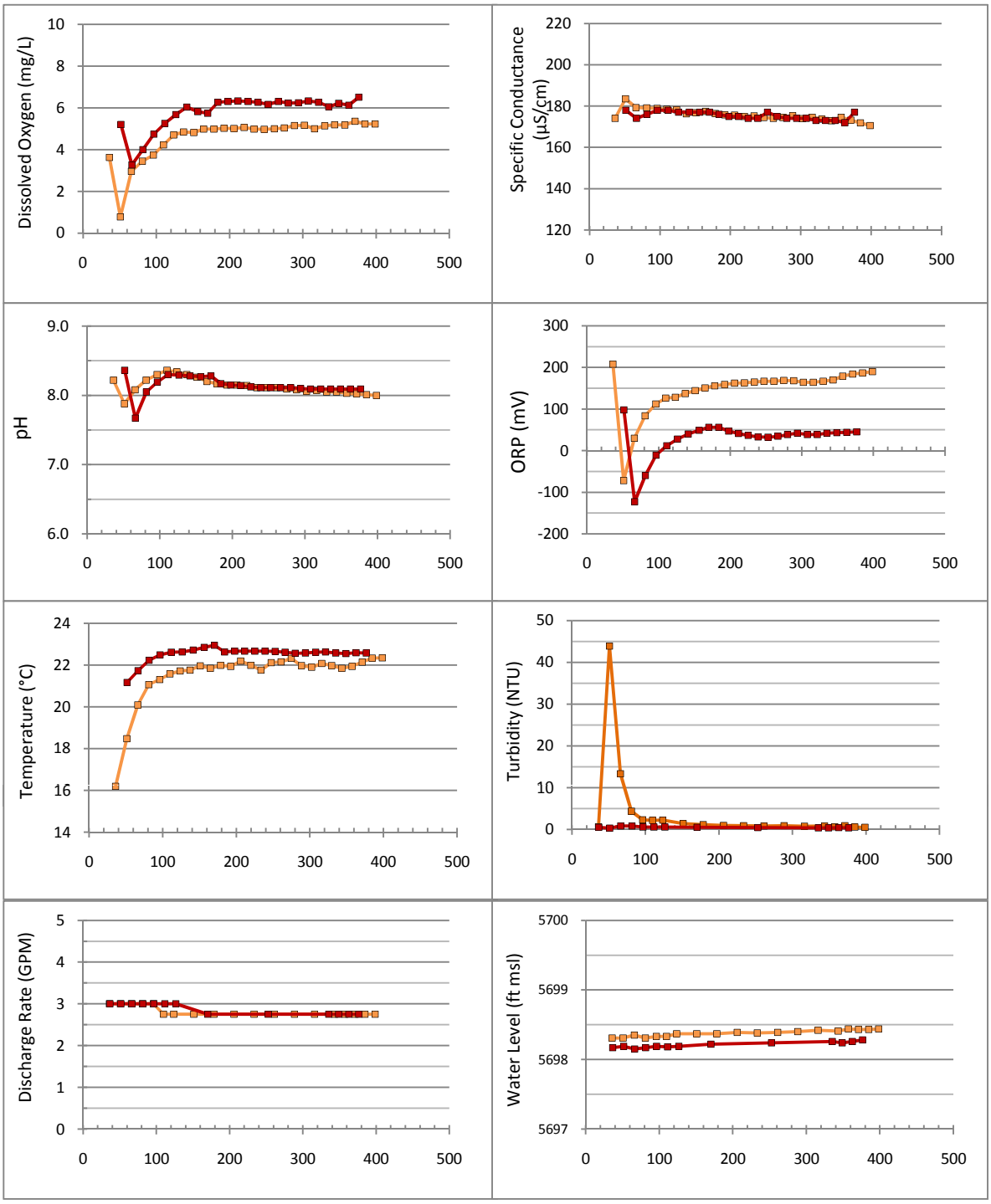


Figure D2-R55-1. Time-series plots of field parameters monitored during purging of R-55 screen 1 (port P1A)

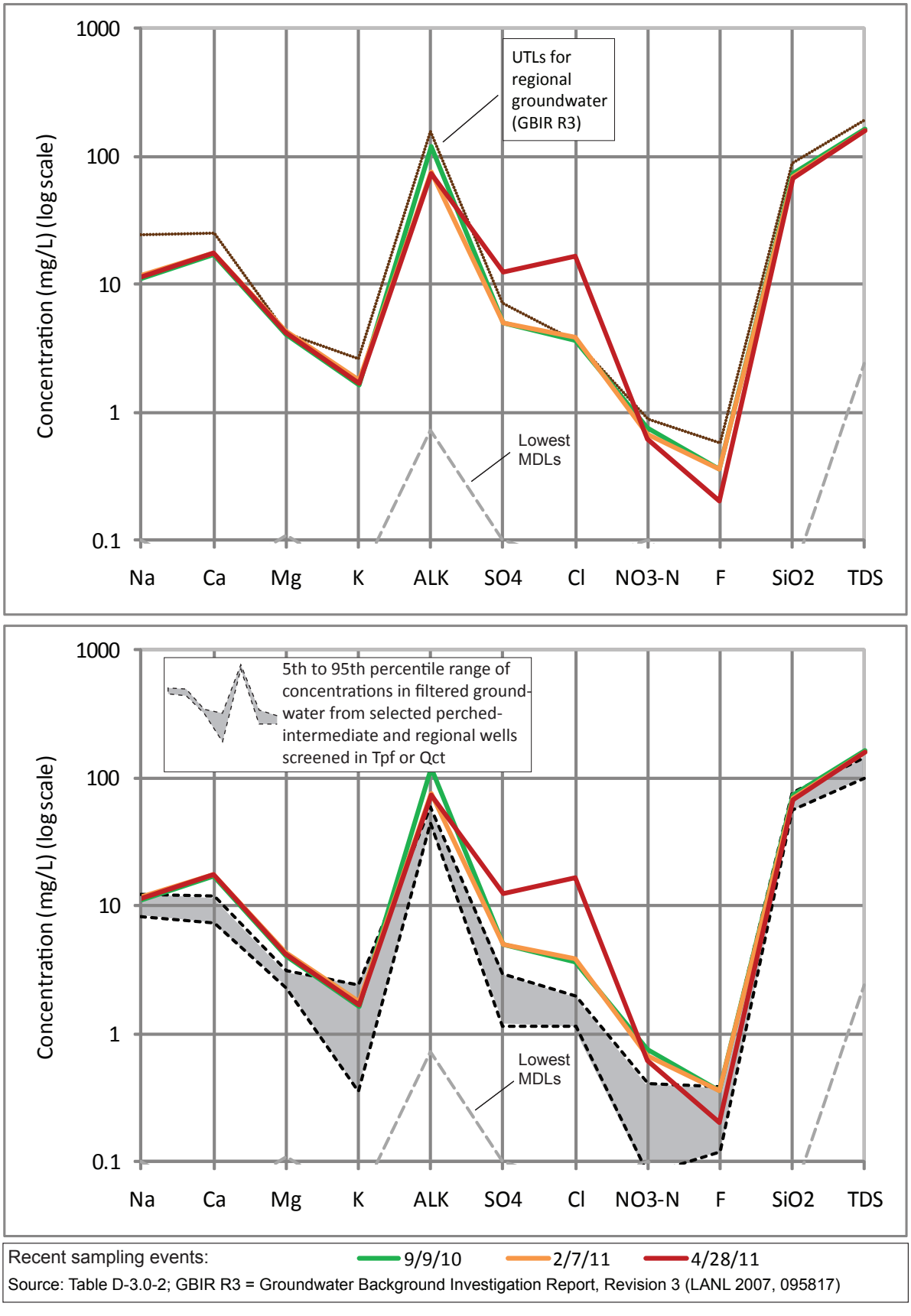


Figure D2-R55-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-55 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

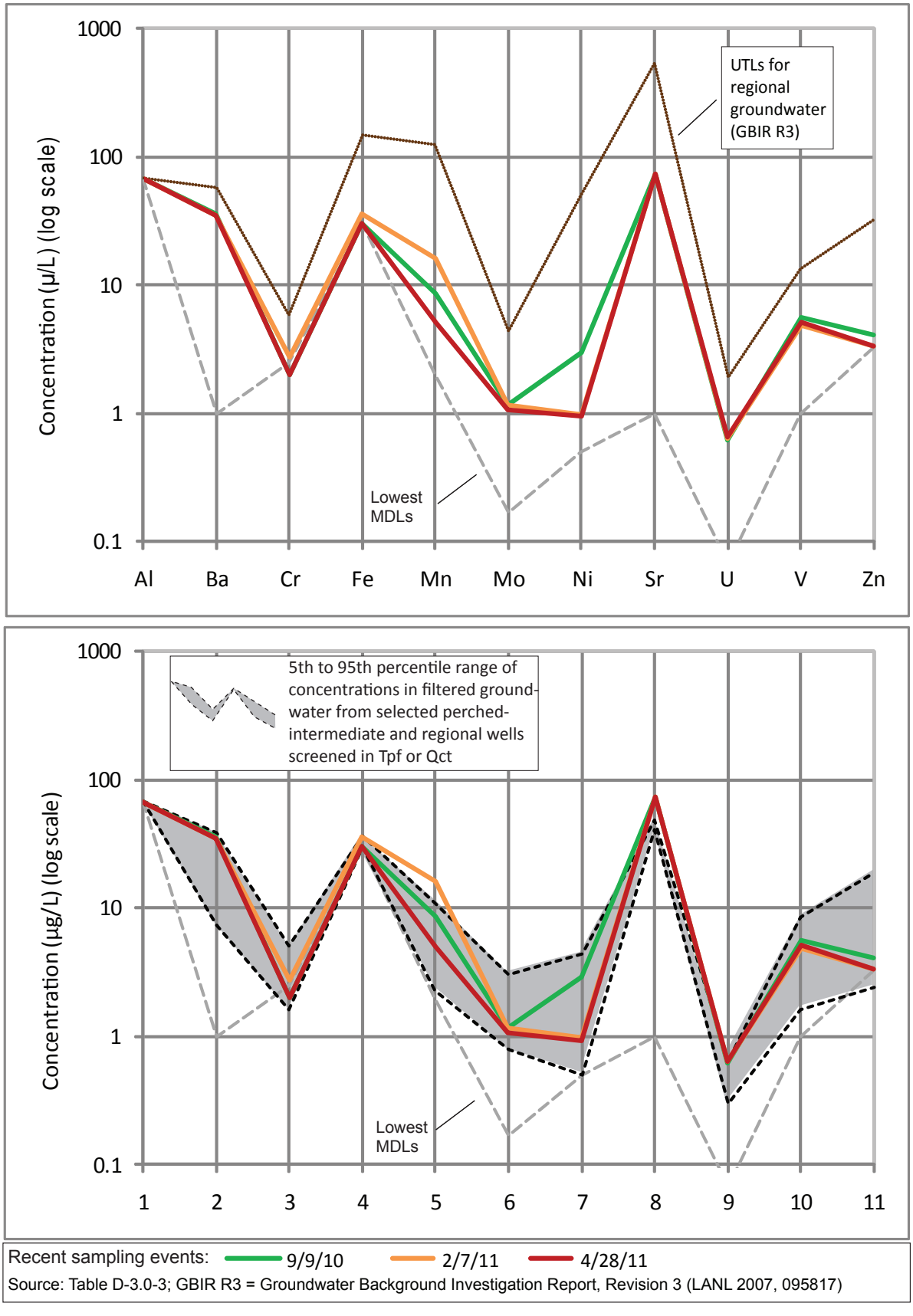
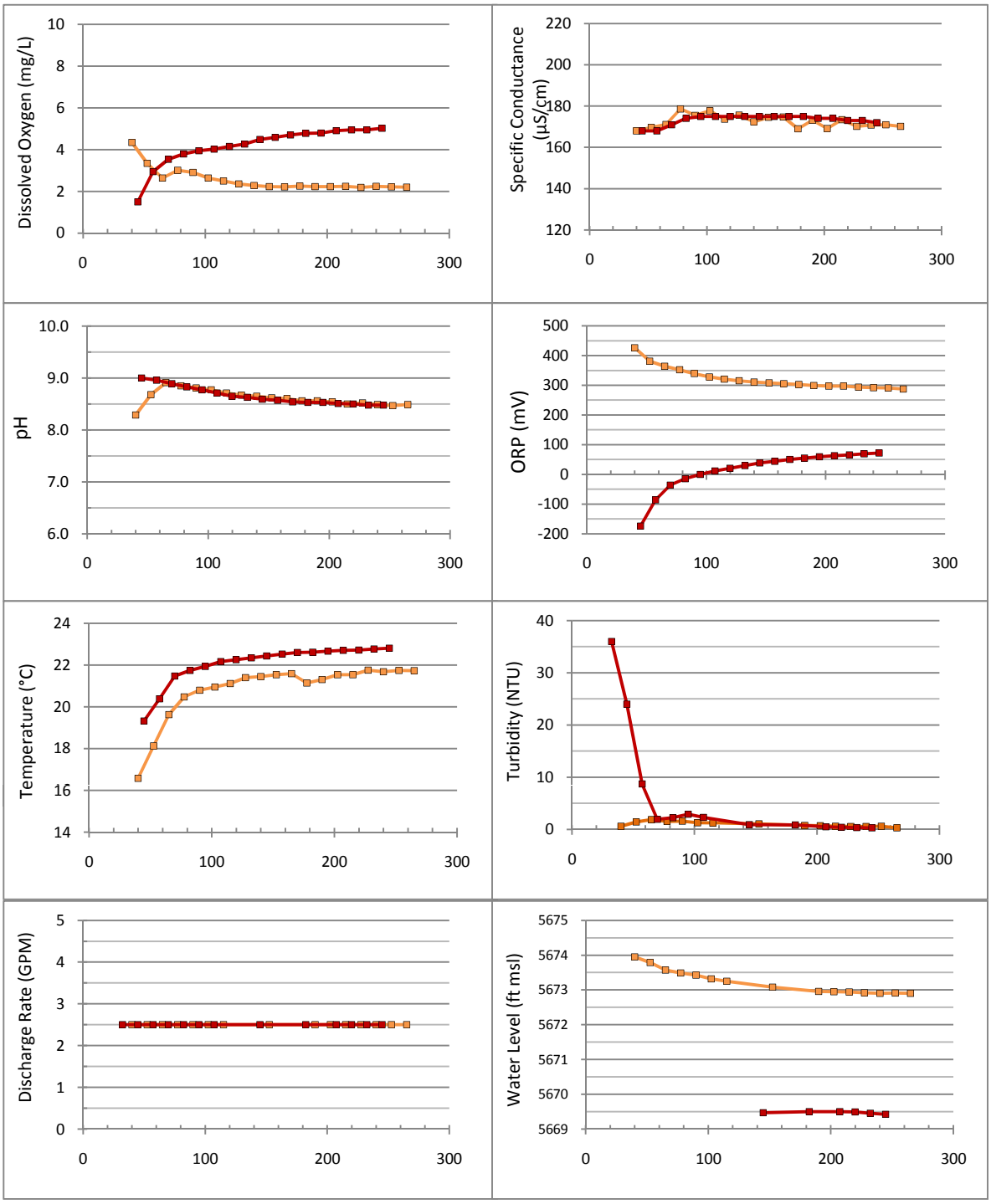


Figure D2-R55-3. Concentrations of trace metals in filtered groundwater from well R-55 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-55 screen 2 (port P2A), port depth 994 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R55-4. **Time-series plots of field parameters monitored during purging of R-55 screen 2 (port P2A)**

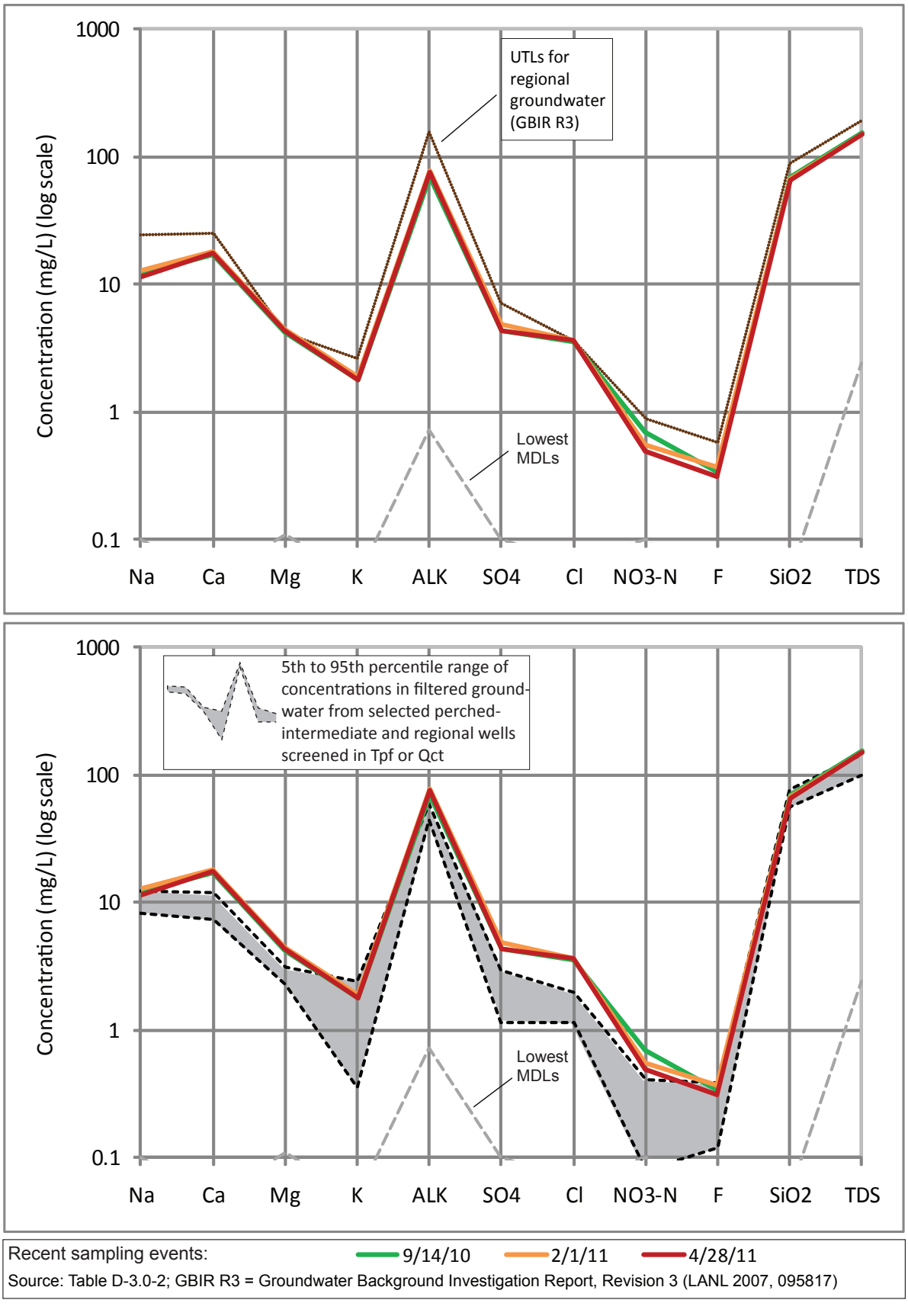


Figure D2-R55-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-55 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

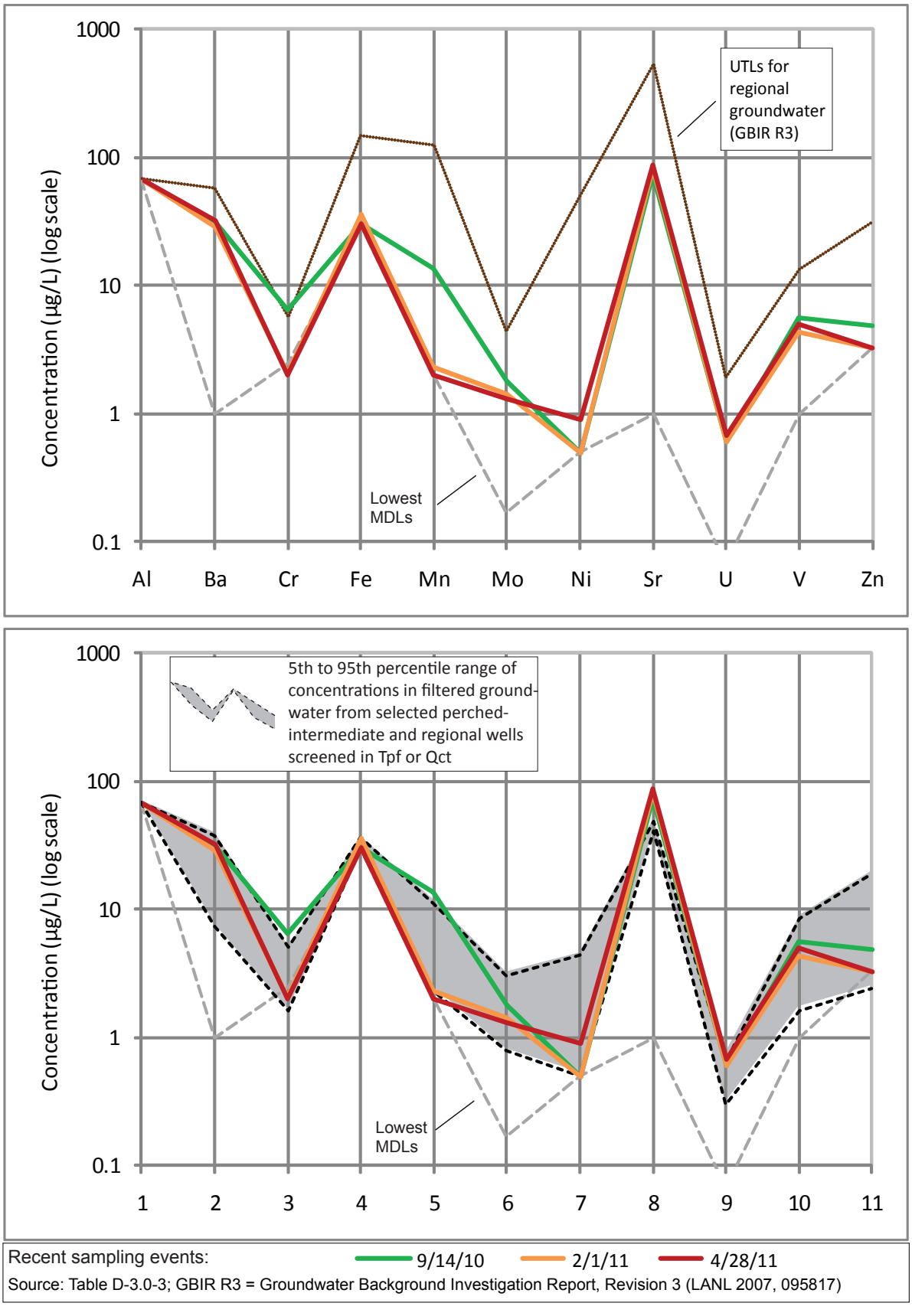
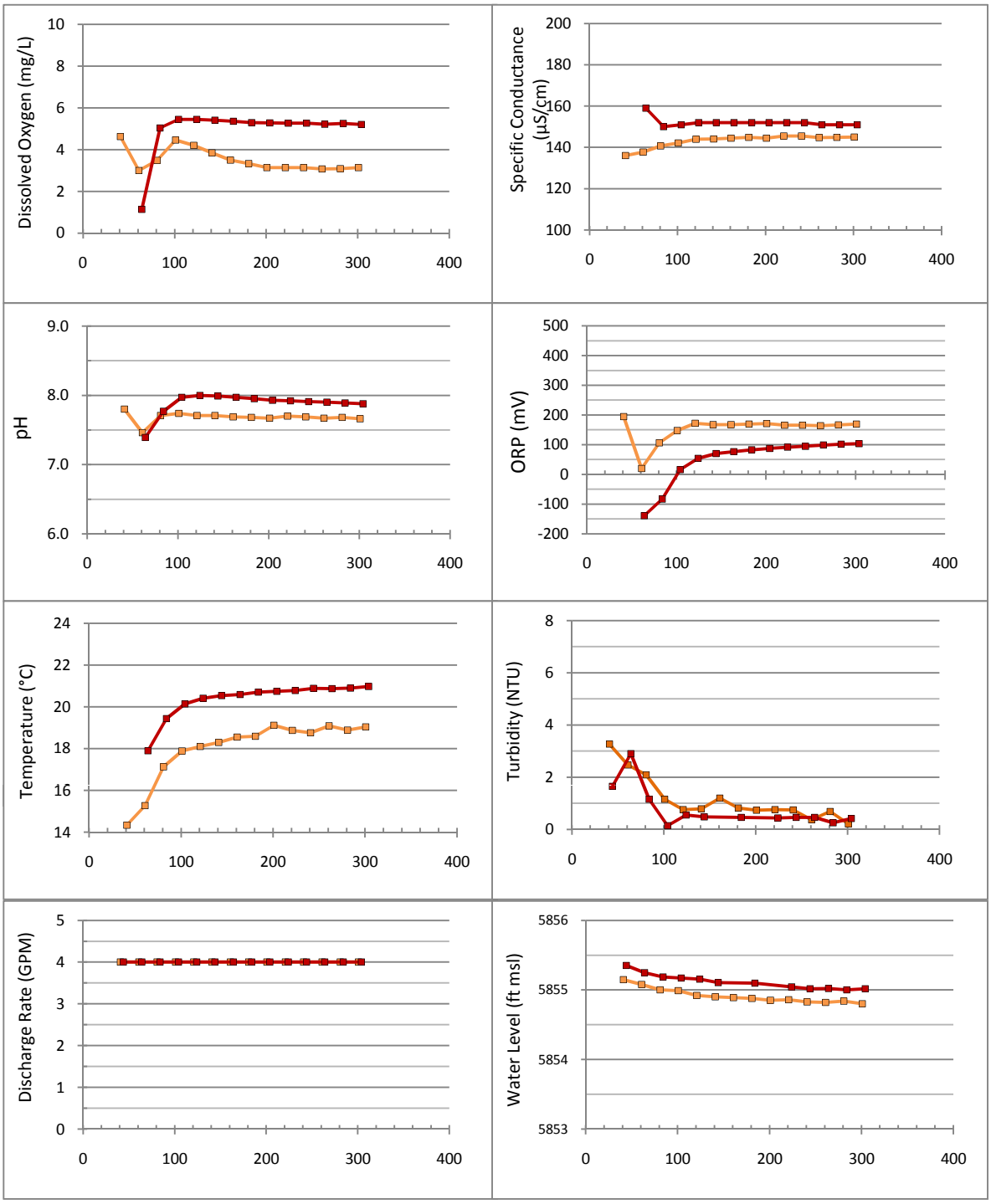


Figure D2-R55-6. Concentrations of trace metals in filtered groundwater from well R-55 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-56 screen 1 (port P1A), port depth 945 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R56-1. **Time-series plots of field parameters monitored during purging of R-56 screen 1 (port P1A)**

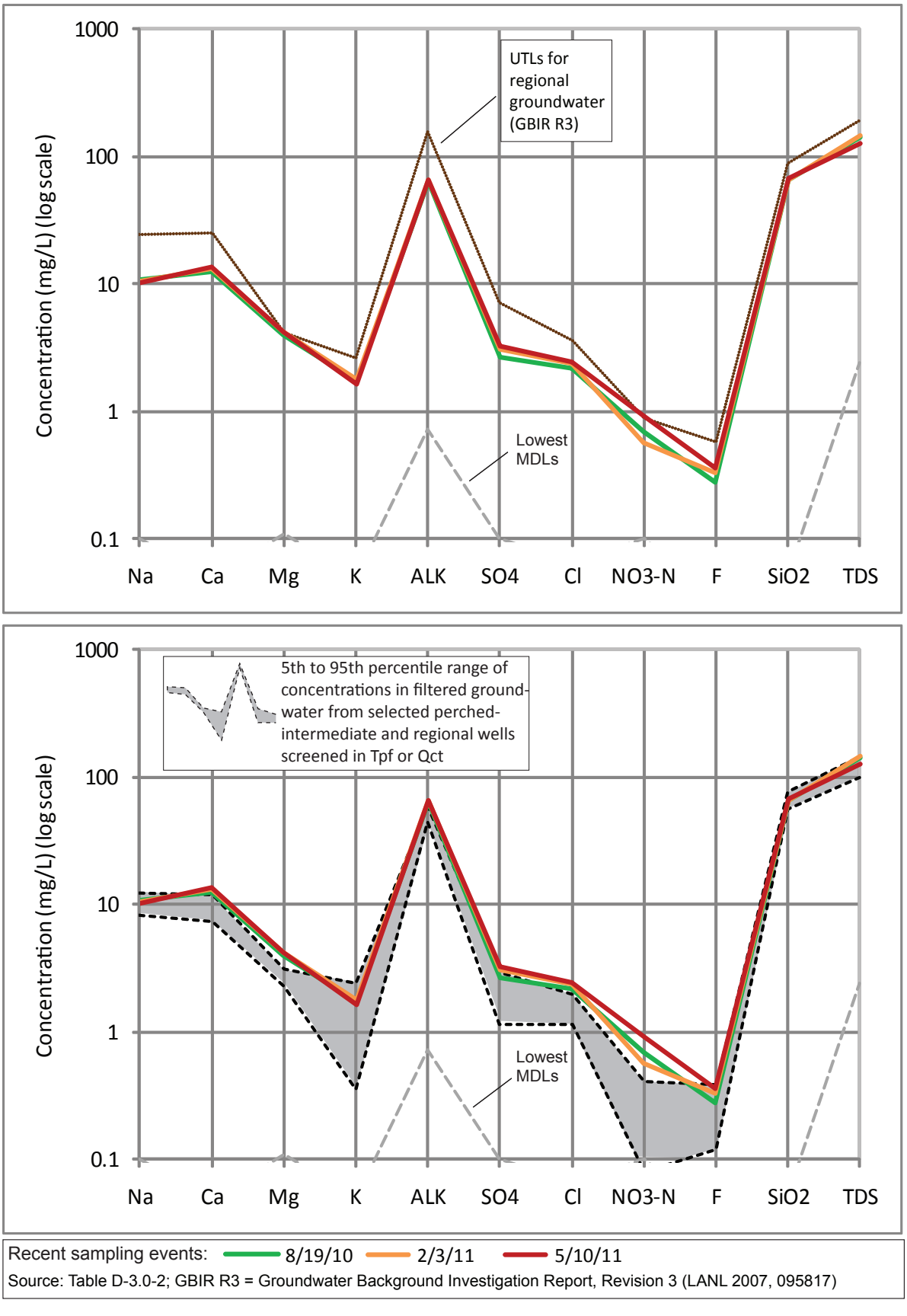


Figure D2-R56-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-56 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

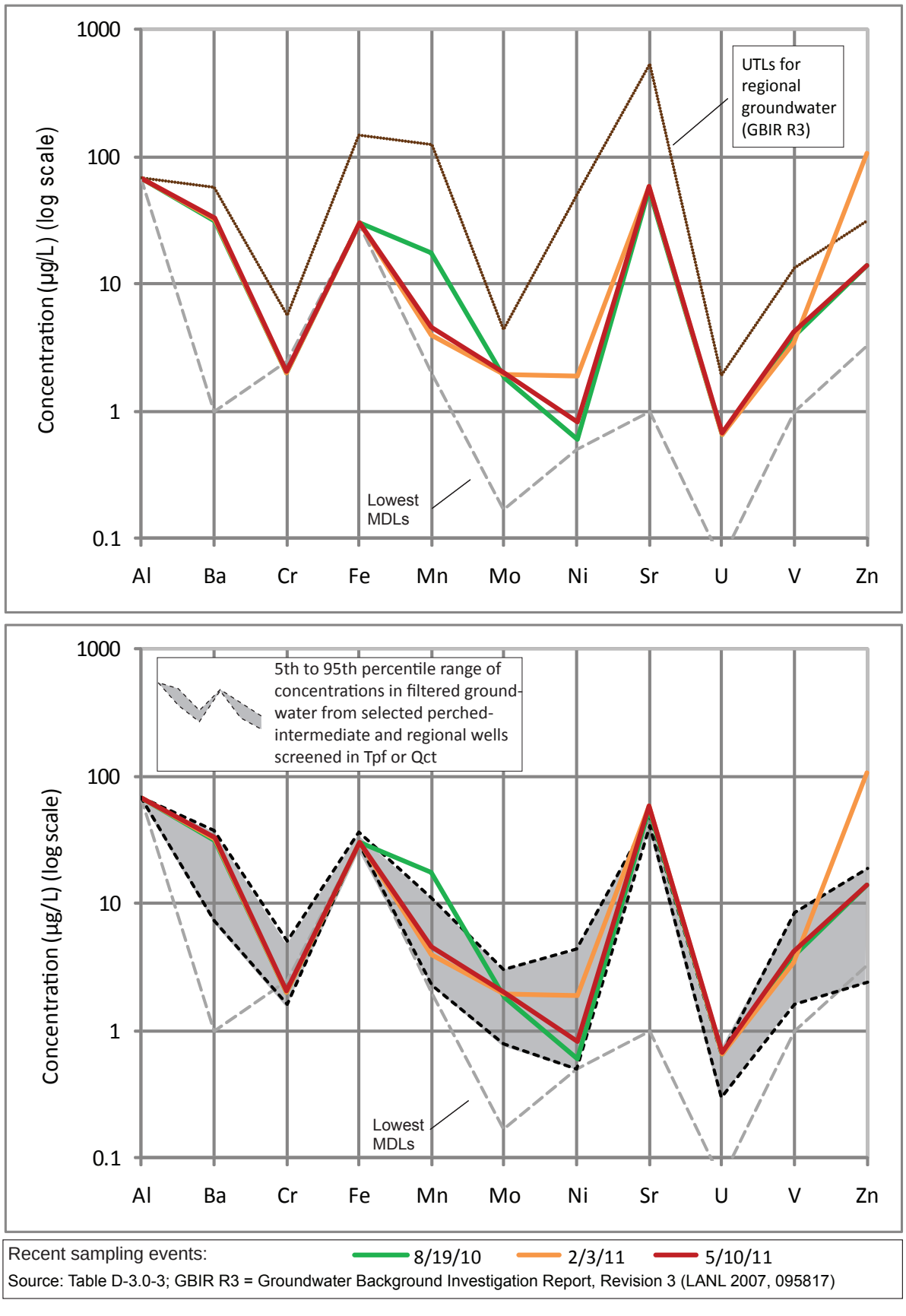


Figure D2-R56-3. Concentrations of trace metals in filtered groundwater from well R-56 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

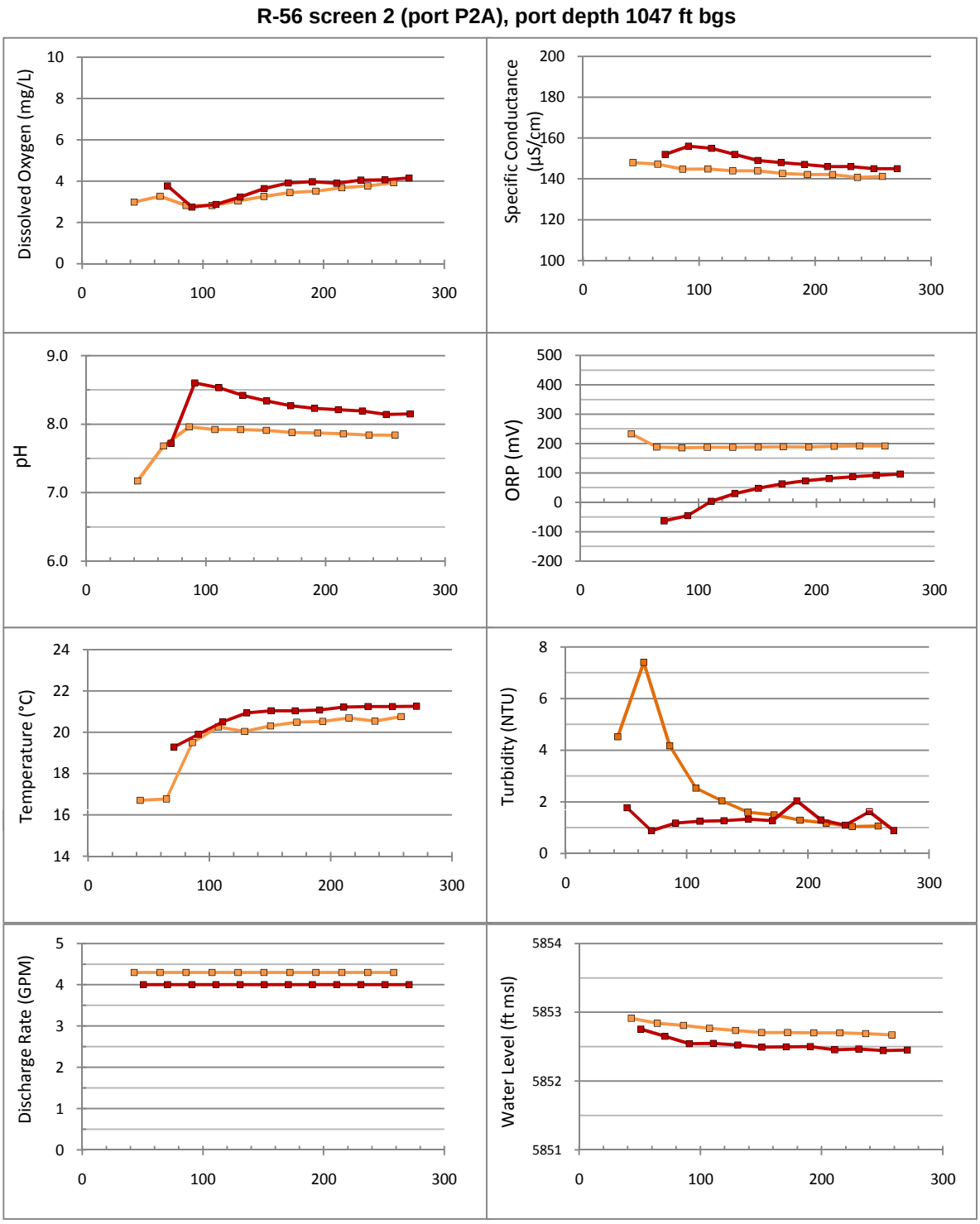


Figure D2-R56-4. **Time-series plots of field parameters monitored during purging of R-56 screen 2 (port P2A)**

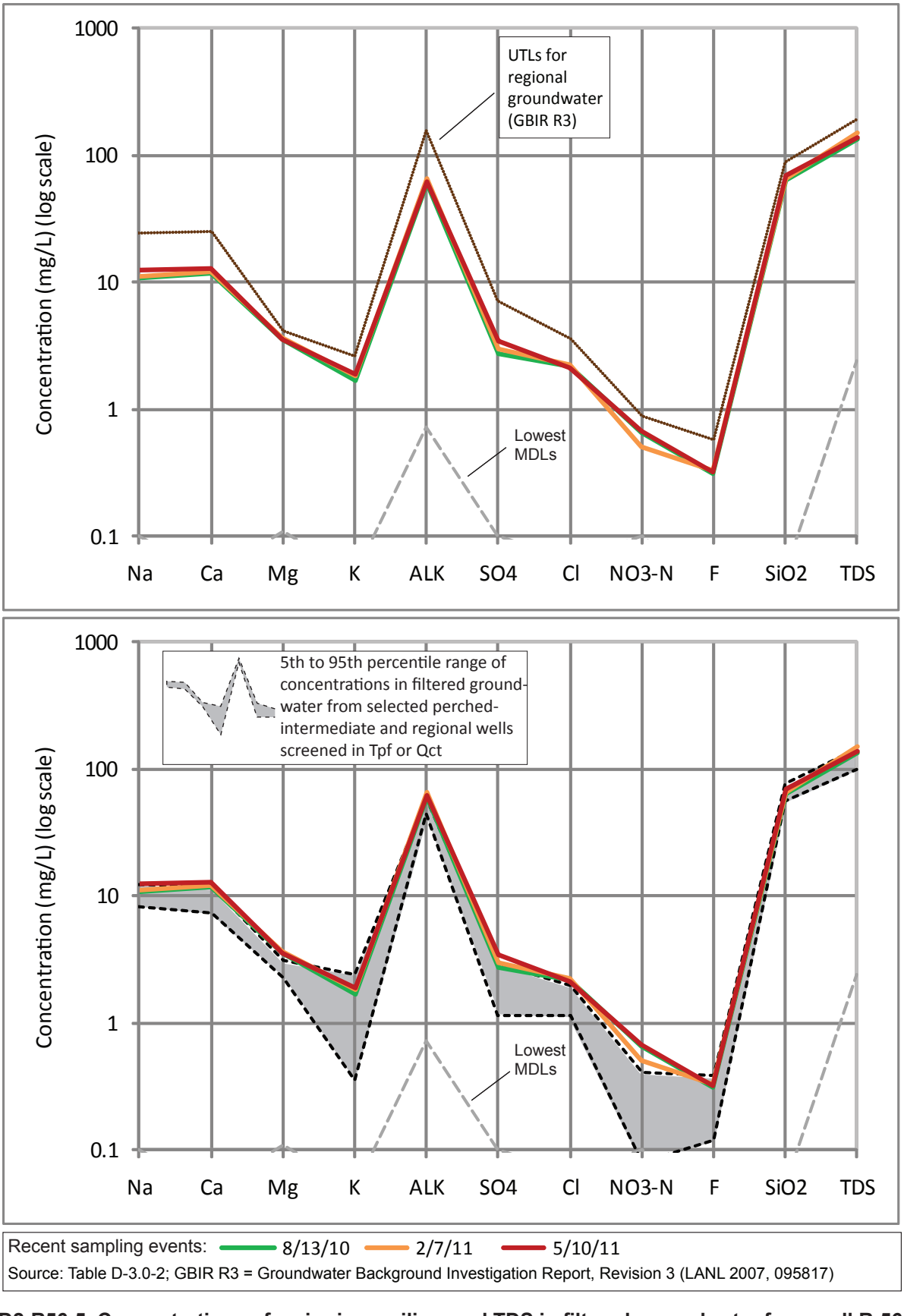


Figure D2-R56-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-56 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011,201564).

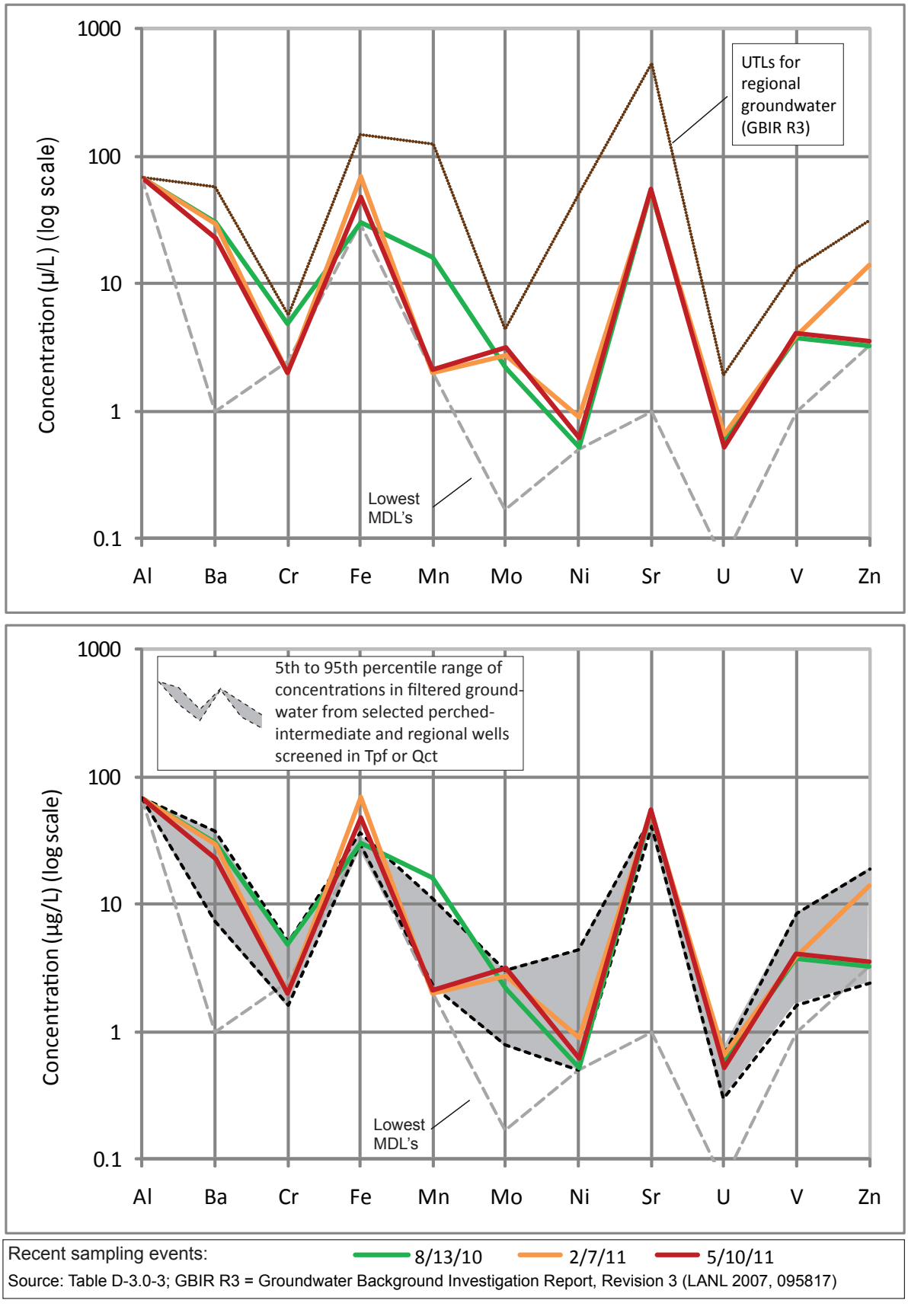
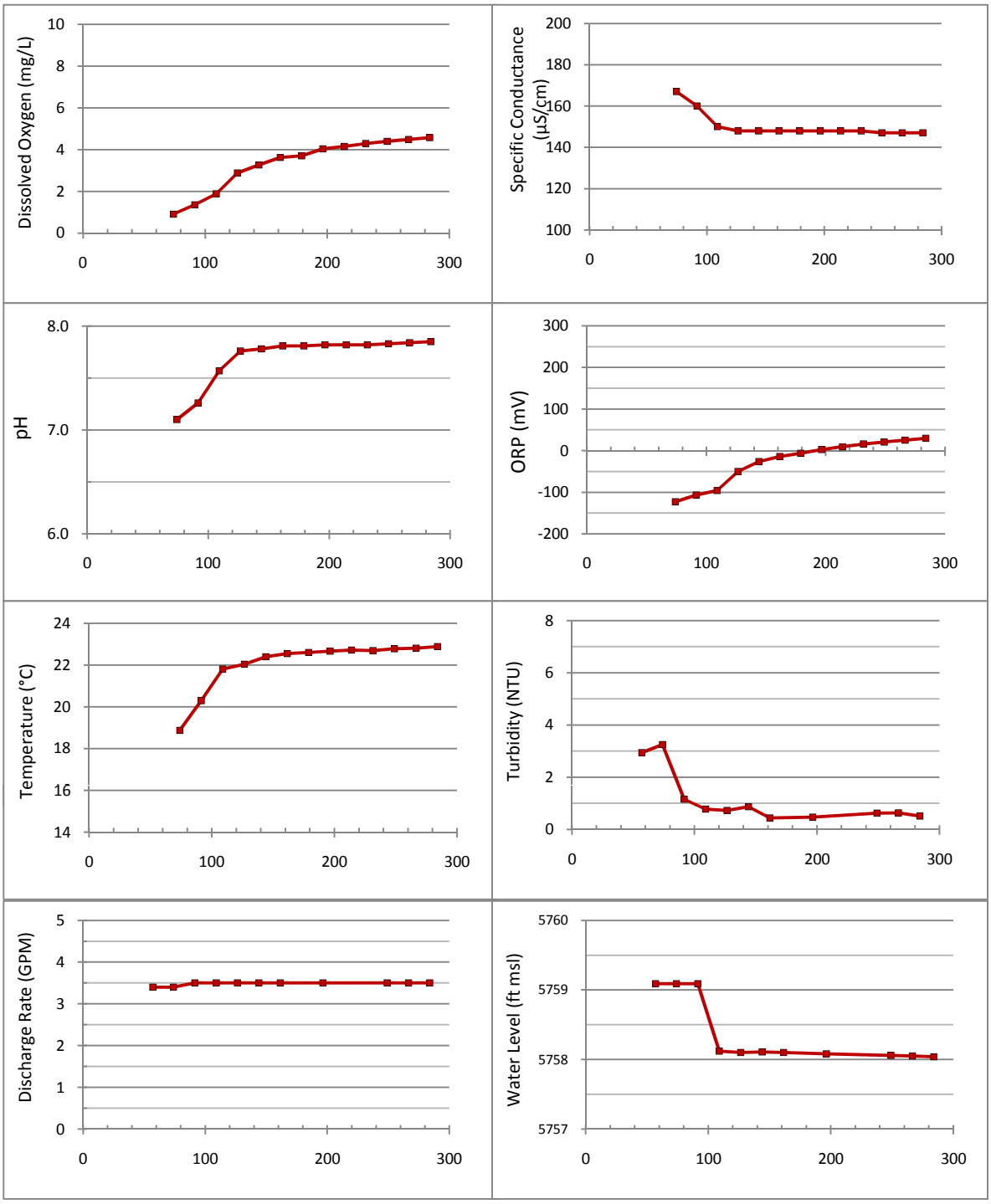


Figure D2-R56-6. Concentrations of trace metals in filtered groundwater from well R-56 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-57 screen 1 (port P1A), port depth 910 ft bgs



x-axis = cumulative volume purged (gals.), including drop pipe

Figure D2-R57-1. Time-series plots of field parameters monitored during purging of R-57 screen 1 (port P1A)

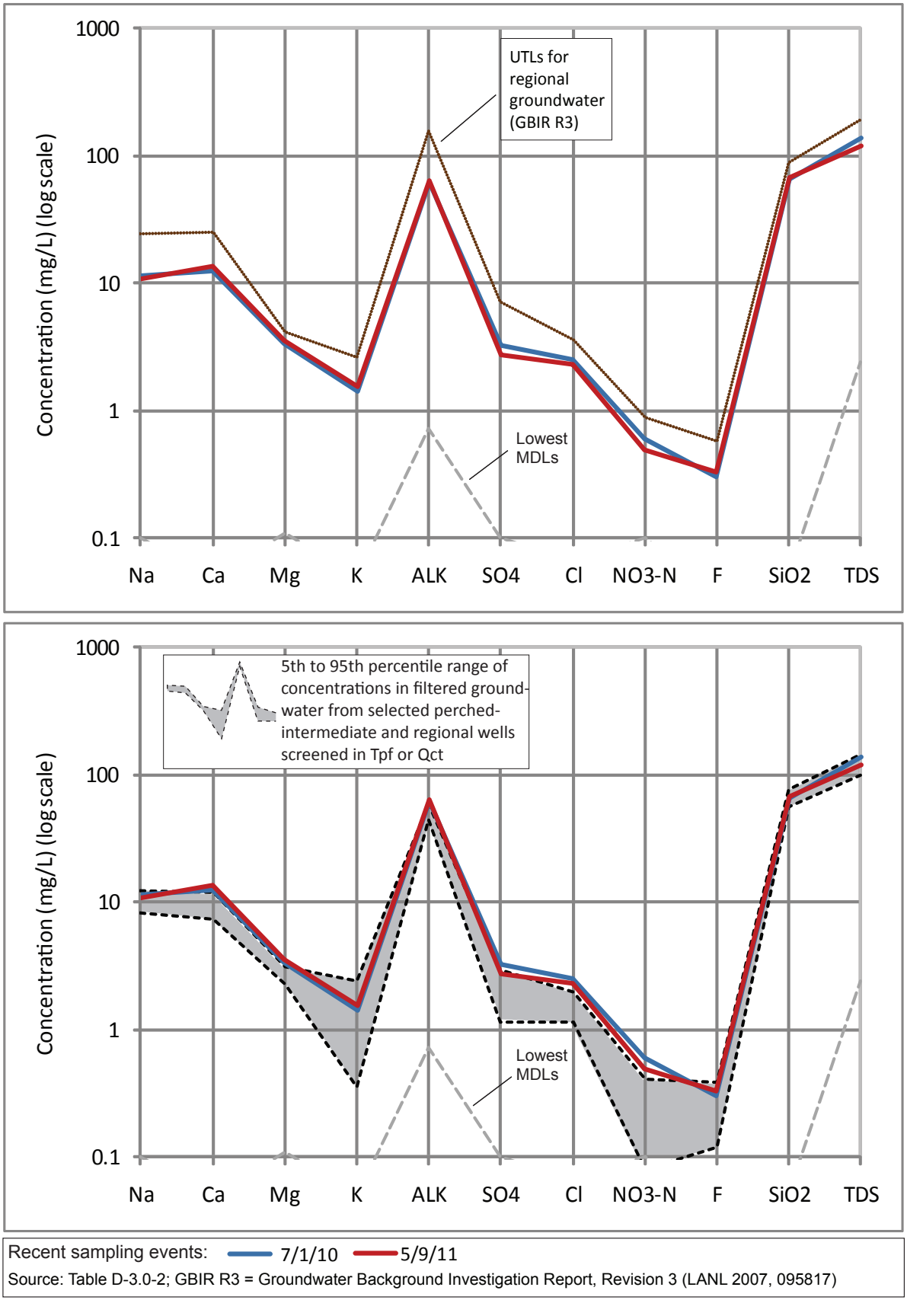


Figure D2-R57-2. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-57 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

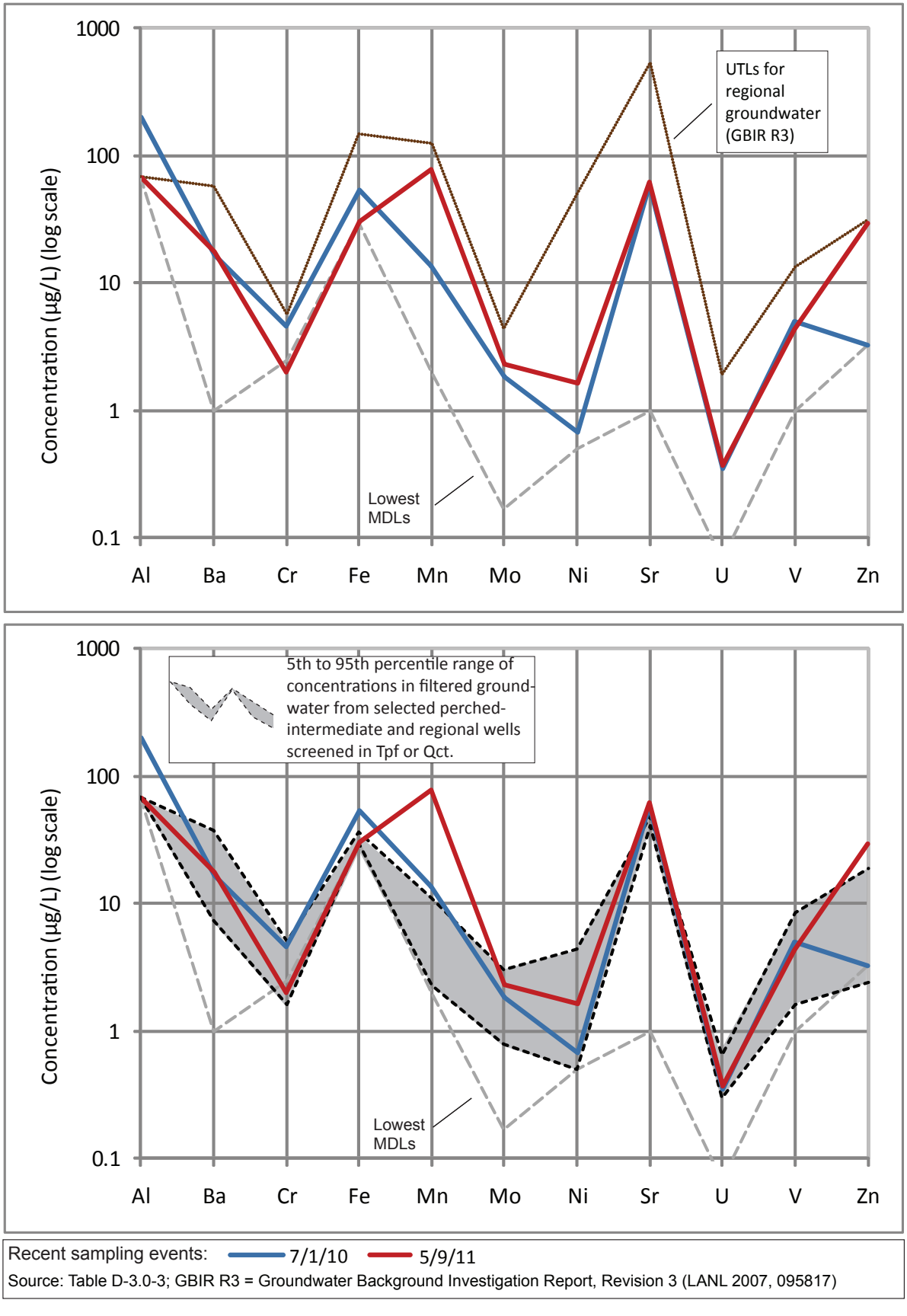


Figure D2-R57-3. Concentrations of trace metals in filtered groundwater from well R-57 screen 1 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

R-57 screen 2 (port P2A), port depth 972 ft bgs

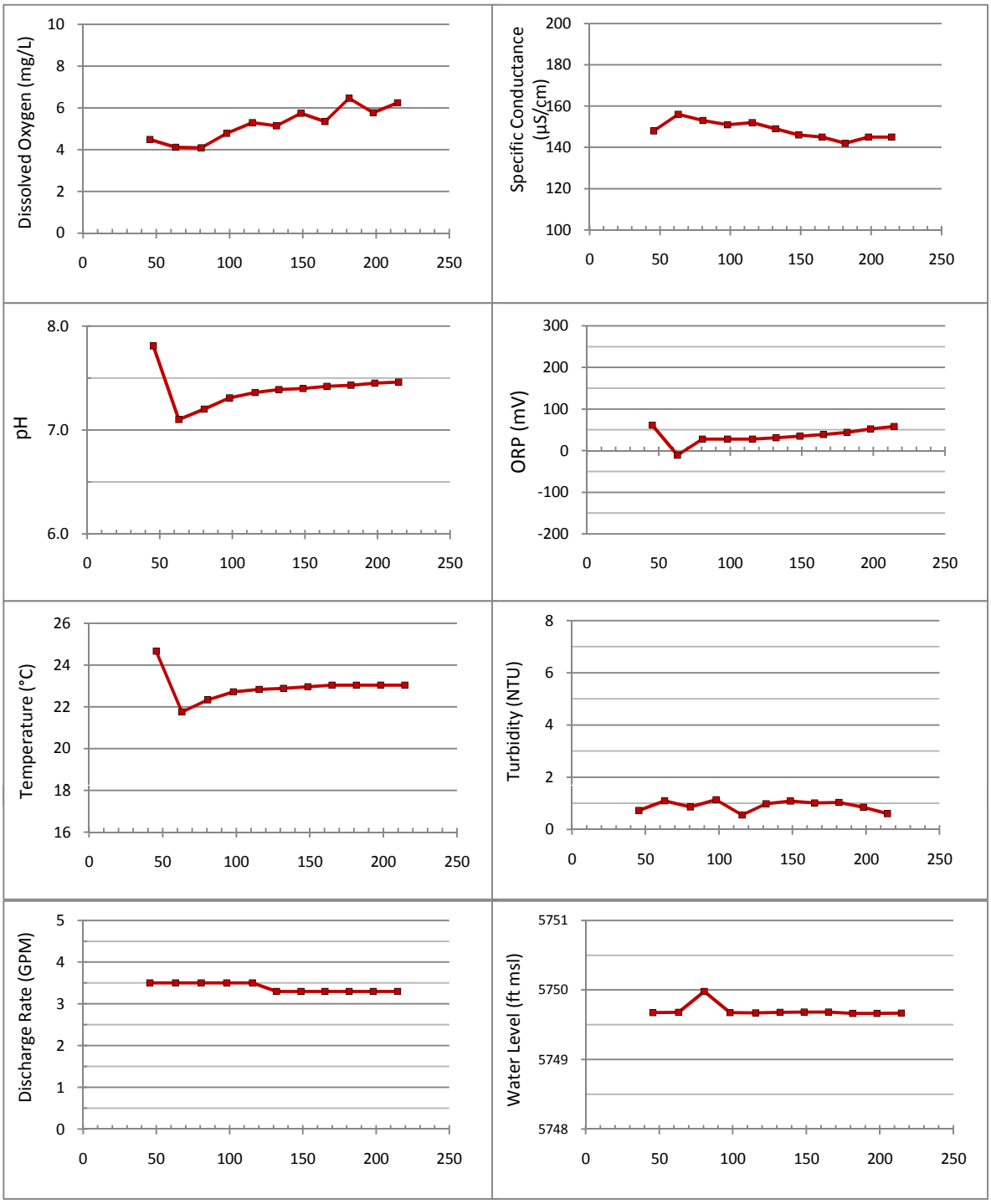


Figure D2-R57-4. Time-series plots of field parameters monitored during purging of R-57 screen 2 (port P2A)

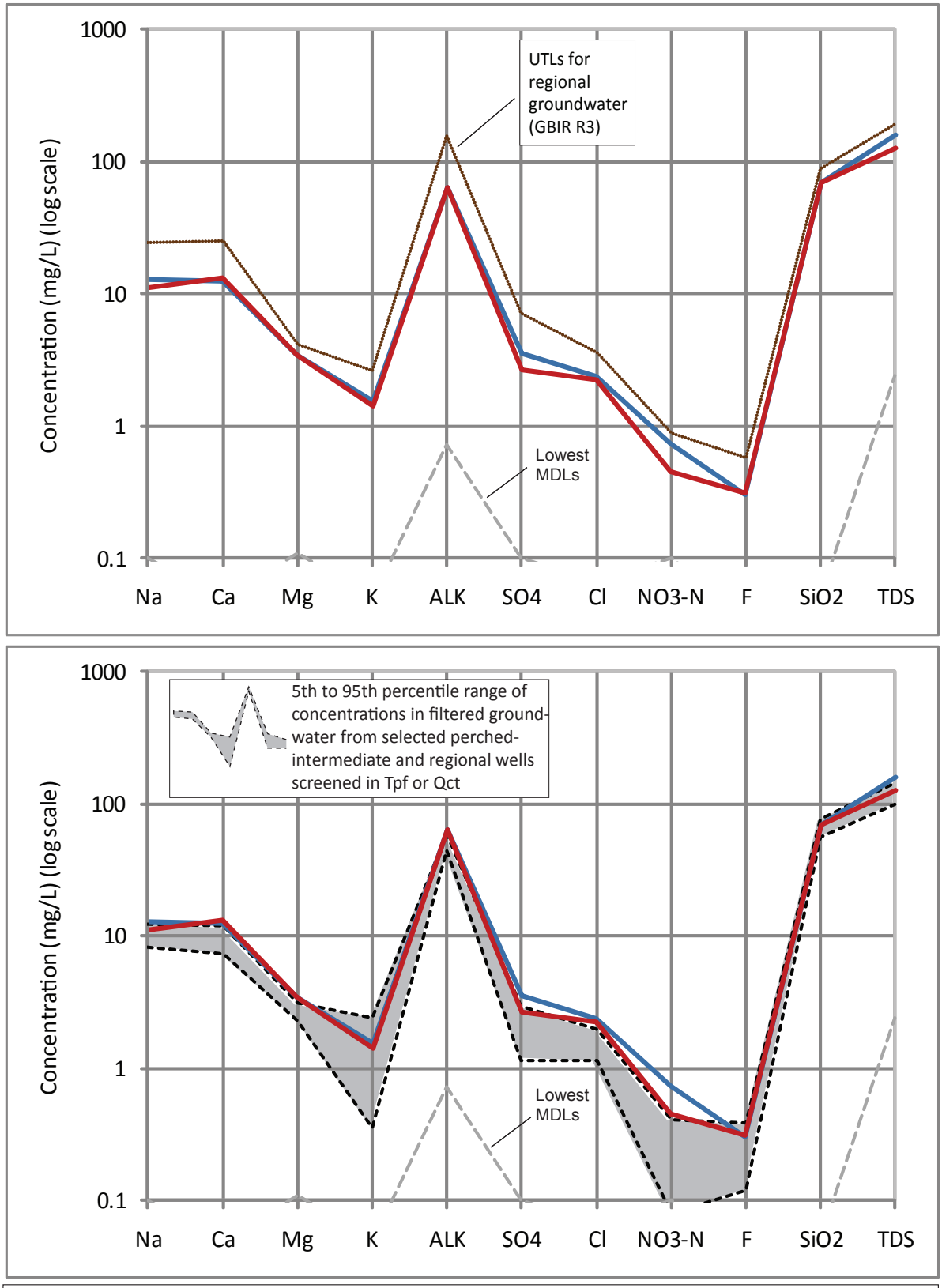


Figure D2-R57-5. Concentrations of major ions, silica, and TDS in filtered groundwater from well R-57 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background"values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

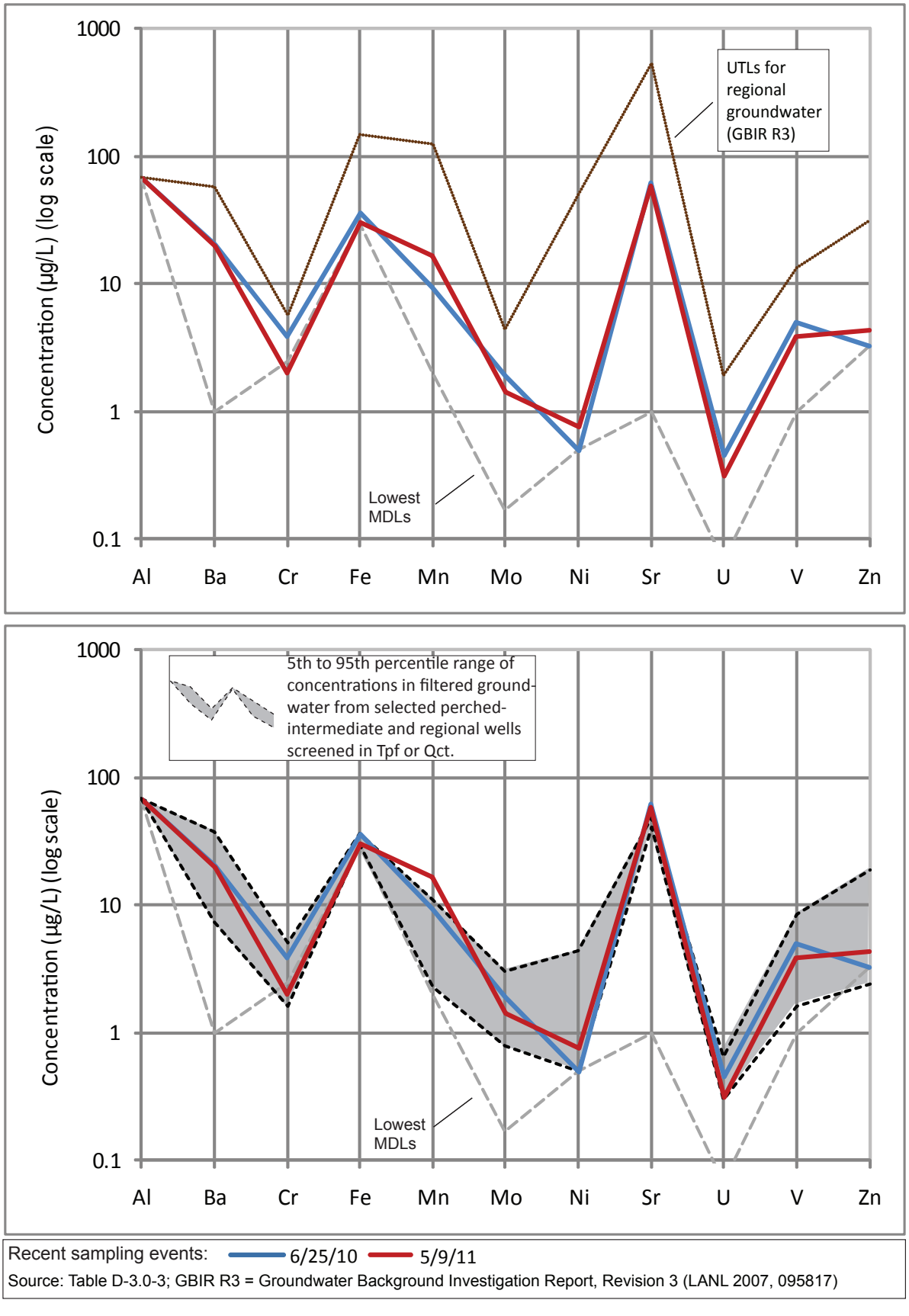


Figure D2-R57-6. Concentrations of trace metals in filtered groundwater from well R-57 screen 2 for recent sampling events. Upper graph shows UTLs for regional groundwater; lower graph shows "background" values for wells screened in Tpf (Puye Formation) or Qct (Cerro Toledo Formation) (LANL 2011, 201564).

Appendix E

Technical Area 54 Geology and
Material Disposal Area H Regional Aquifer Hydrology

E-1.0 INTRODUCTION

This appendix discusses the sitewide geology and hydrology of Technical Area 54 (TA-54) at Los Alamos National Laboratory (LANL or the Laboratory). Section E-2.0 discusses the site geology, including the stratigraphy of TA-54 (section E-2.1), seismic hazards (section E-2.2), and cliff retreat (section E-2.3). Section E-3.0 discusses the regional aquifer hydrology of the area. It includes information on the regional aquifer monitoring wells near Material Disposal Area (MDA) H (section E-3.1), summarizes hydrogeologic information collected at monitoring wells (section E-3.2), presents interpretations of regional aquifer water-table maps (section E-3.3), and presents interpretations of the regional aquifer monitoring network (section 3.4).

E-2.0 GEOLOGY

The sitewide geology for TA-54 is discussed in this appendix. More site-specific descriptions of geology are presented in the approved investigation work plans for MDAs G and L (LANL 2004, 087624; LANL 2004, 087833; LANL 2006, 094673). Upper vadose-zone geology in the vicinity of the MDAs was characterized through borehole logging discussed in various investigation reports (LANL 2005, 090513; LANL 2006, 091888; LANL 2007, 096409). Additional information about vadose-zone and regional-aquifer geology around TA-54 was collected during the installation of deep wells to monitor perched-intermediate and regional groundwater. These groundwater-monitoring wells included R-20, R-21, R-22, R-23, R-23i, R-32, R-37, R-38, R-39, R-40, R-40i, R-41, R-49, R-51, R-52, R-53, R-54, R-55, R-55i, R-56, and R-57. Collectively, the investigations described above confirm that the sitewide geology for TA-54 is consistent with the regional geology described by Broxton and Vaniman (1995, 049726, pp. 8–19).

E-2.1 Stratigraphy of TA-54

The stratigraphy in the vicinity of TA-54 includes ignimbrites of the Tshirege and Otowi Members of the Quaternary Bandelier Tuff (including interbedded sedimentary deposits of the Cerro Toledo Formation); volcanic and sedimentary deposits of the Pliocene Cerros del Rio volcanic series; fanglomerate, riverine, and lacustrine deposits of the Pliocene Puye Formation; Jemez-derived fanglomerate and pumice-rich alluvial fan deposits of Miocene age; and riverine deposits of the Miocene Chamita Formation. The distribution and thickness of geologic units vary from west to east across the TA-54 site. Figure E-2.1-1 shows the locations of intermediate and regional monitoring wells in the vicinity of TA-54 and the locations of geologic cross-sections for the site. Figures E-2.1-2 through E-2.1-8 are geologic cross-sections for TA-54 based on a geologic framework model that incorporates geologic controls from wells, boreholes, and outcrops at the site.

Bandelier Tuff

The Bandelier Tuff has two members, each consisting of a basal pumice fall overlain by a petrologically related succession of ash-flow tuffs (Bailey et al. 1969, 021498). The lower Bandelier Tuff includes the Otowi Member and its basal pumice fall deposit, the Guaje Pumice Bed. The upper Bandelier Tuff is made up of the Tshirege Member and its basal pumice fall, the Tsankawi Pumice Bed. The Cerro Toledo Formation is a volcaniclastic deposit of sediment and tephra between the Otowi and Tshirege Members.

The following description of Bandelier Tuff uses the term *welding* to distinguish between tuff that is less compacted (or noncompacted) and porous (nonwelded) as opposed to tuff that is more compacted, dense (welded), and less porous. In the field, the degree of welding in tuff is quantified by the degree of flattening of pumice fragments (a higher degree of flattening and elongation equals a higher degree of

welding). Petrographically, welded tuff shows adhesion (welding) of pumice and ash, but nonwelded tuff does not. The term *devitrified* is applied to tuff whose volcanic glass has crystallized to a fine-grained mineral assemblage of alkali feldspar and silica polymorphs (quartz, cristobalite, and tridymite).

Tshirege Member (Qbt)

The Tshirege Member of the Bandelier Tuff is a compound cooling unit that resulted from several successive ash-flow deposits separated by periods of inactivity that allowed for partial cooling before subsequent tuffs within the Member were deposited (Smith and Bailey 1966, 021584; Broxton and Reneau 1995, 049726). Because of the episodic depositional history of the tuff, physical properties such as density, porosity, degree of welding, fracture content, and mineralogy vary both vertically and laterally within the member. These variations in tuff properties are used to subdivide the Tshirege Member into mappable units that reflect localized emplacement temperature, thickness, gas content, and composition of the tuff deposits (Broxton and Reneau 1995, 049726). The Tshirege Member thins eastward across TA-54 where the deposits overlapped a paleotopographic highland formed by older Cerros del Rio volcanic centers (Broxton and Reneau 1995, 049726, pp. 8–19; Broxton and Reneau 1996, 055429). The Tshirege Member is 235 ft (72 m) thick in the west near MDA H and 128 ft (39 m) thick in the east near MDA G.

Tshirege Member Unit 2 (Qbt 2)

Unit 2 of the Tshirege Member of the Bandelier Tuff forms the caprock of Mesita del Buey and is the host unit for most disposal pits and shafts at TA-54. The thickness of unit 2 varies from 36 to 65 ft (11 to 19.8 m). Where exposed, unit 2 forms a medium brown, vertical cliff that stands out in marked contrast to the slope-forming, lighter colored tuffs below. It is a moderately welded ash-flow tuff composed of crystal-rich, devitrified pumice fragments in a matrix of ash, shards, and phenocrysts (primarily sanidine and quartz). Vapor-phase crystallization of flattened shards and pumices is extensive in this unit.

Unit 2 is extensively fractured as a result of contraction during postdepositional cooling. High-angle cooling-joint fractures are visible on mesa edges and on the walls of pits. In general, the fractures dissipate at the bottom of unit 2. On average, fractures in unit 2 are nearly vertical. At MDA G, Purtymun et al. (1978, 005728) measured an average fracture spacing of 3 to 5.6 ft (0.9 to 1.7 m), and Purtymun and Kennedy (1971, 004798) cite a maximum aperture of 2 in. (51 mm). Reneau and Vaniman (1998, 063135) mapped the walls of Pit 39 at MDA G and measured average fracture spacing of 3.2 to 4.2 ft (1.0 to 1.3 m) and average apertures of 0.12 to 0.21 in. (3.1 to 5.3 mm) (with a maximum of 3.9 in. [10 cm]). The fractures are often filled with clays, calcite, and fine detritus to a depth of about 10 ft (3 m); smectites are the dominant clay minerals present. Smectites are known for their tendency to swell when water is present and for their ability to strongly bind certain elements, properties that have implications for the transport of metals and radionuclides in fractures. Opal and calcite may be found throughout the fractured length, usually associated with the presence of tree and plant roots (live and decomposed); the presence of both the minerals and the roots indicates moisture at depth in fractures (Reneau and Vaniman 1998, 063135).

The base of unit 2 is marked by a series of thin (less than 3.9-in.- [10-cm-] thick) discontinuous, stratified, crystal-rich and fines-depleted sandy surge deposits. Cross beds and planar bedding structures are often observed in these deposits.

Tshirege Member Unit 1v (Qbt 1v)

Tshirege Member unit 1v is a light-colored vapor-phase-altered cooling unit underlying unit 2. This unit forms generally sloping outcrops, which contrast with the near-vertical cliffs of unit 2. Unit 1v is further subdivided into units 1v(u) and 1v(c).

Unit 1v(u). The uppermost portion of unit 1v is devitrified and vapor-phase-altered ash-fall and ash-flow tuff; it is designated unit 1v(u), where *u* signifies upper. This unit thins eastward across TA-54, ranging in thickness from 100 ft (30 m) near MDA H to 25 ft (8 m) on the east side of MDA G. Unit 1v(u) is nonwelded at its base and becomes partly welded in its interior. Only the more prominent cooling fractures originating in unit 2 continue into the more welded upper section of unit 1v(u), but these die out in the lower, less consolidated section. More typically, fractures in unit 2 do not extend into unit 1v(u).

Unit 1v(c). Beneath unit 1v(u) is unit 1v(c), where *c* stands for colonnade, named for the columnar jointing visible in cliffs formed by this unit. Unit 1v(c) is an orange-brown nonwelded, devitrified ash-flow tuff at its base and top; it becomes slightly more welded in its interior. Unit 1v(c) varies in thickness from 6 to 15 ft (1.8 to 3 m) at TA-54. The basal contact of unit 1 v(c) is marked by a rapid vertical change (within 0.7 ft [0.2 m]) from devitrified (crystallized) matrix in unit 1 v(c) to vitric (glassy) matrix in the underlying unit 1g. In many outcrops, the transition from devitrified to vitric rock matrix forms a prominent erosional recess termed the *vapor-phase notch*; at other locations this transition is marked by a prominent bench. No depositional break is associated with the vapor-phase notch, indicating that this mineralogic transition developed within the interior of the cooling ash-flow sheet after the tuffs were deposited.

Tshirege Member Unit 1g (Qbt 1g)

Unit 1g is a white to tan vitric, pumiceous, nonwelded ash-flow tuff. This unit thins eastward across TA-54, ranging in thickness from 100 ft (30 m) near MDA H to 50 ft (16 m) on the east side of MDA G. Few fractures are observed in the outcrops of this unit where exposed in nearby areas, and the weathered cliff faces have a distinctive Swiss-cheese appearance because of the softness of the tuff. The uppermost 5 to 20 ft (1.5 to 6.1 m) of unit 1g are discolored by oxidation, possibly by development of ferric oxyhydroxides. This portion of unit 1g is resistant to erosion, helping to preserve the vapor-phase notch in the outcrops. A pumice-poor surge deposit forms the base of unit 1g locally.

Tsankawi Pumice Bed (Qbtt)

The Tsankawi Pumice Bed is the basal fall deposit of the Tshirege Member of the Bandelier Tuff. It is a stratified, fines-depleted deposit of gravel-sized vitric pumice and quartz and sanidine crystals. The maximum thickness of the Tsankawi Pumice Bed is 2 ft (0.6 m). Despite being thin, this pumice-fall unit was uniformly deposited throughout the area and is expected to be laterally continuous.

Pueblo Canyon Member, Cerro Toledo Formation (Qct)

Sedimentary deposits of the Cerro Toledo Formation are commonly referred to as the Cerro Toledo interval in other Laboratory reports (e.g., Broxton and Reneau 1995, 049726). However, these deposits were recently incorporated into the newly revised Cerro Toledo Formation, consisting of extrusive volcanic domes, lava flows, tephras, and sedimentary rocks that record landscape evolution in the time interval between the Tshirege and Otowi Members of the Bandelier Tuff (Gardner et al. 2010, 204421). The newly defined Pueblo Canyon Member of the Cerro Toledo Formation is stratigraphically equivalent to the deposits identified as the Cerro Toledo interval in previous reports. At TA-54, the Cerro Toledo Formation represents channelized fluvial deposits that consist of thin beds of tuffaceous sandstone, siltstone, and ash and pumice falls. It also includes localized dacitic gravel- and cobble-rich fluvial

deposits eroded from Tschicoma Formation exposed in the eastern Jemez Mountains. This unit reaches a maximum thickness of 55 ft (17 m) at well R-56, but because it fills channels eroded into the top of the Otowi Member, its thickness is variable and these deposits are absent in many areas of TA-54.

Otowi Member (Qbo)

The Otowi Member lacks the welding and crystallization zonation found in the Tshirege Member, and it is treated as a single, relatively homogeneous lithologic unit. The Otowi Member is a white to tan, pumiceous, nonwelded ash-flow tuff. The unit is characterized by fully inflated vitric pumices whose supporting tubular structures have not collapsed as a result of welding. The pumices are supported by a matrix of poorly sorted ash, glass shards, broken pumice fragments, phenocrysts (primarily sanidine and quartz), perlite clasts, and volcanic lithics. Otowi ash-flow tuffs thin eastward against a paleotopographic high formed by Cerros del Rio volcanics near White Rock. These tuffs are continuous under TA-54, but unit thicknesses decrease eastwards, ranging between 250 ft (76 m) near MDA H to 45 ft (14 m) on the east side of MDA G.

Guaje Pumice Bed (Qbog)

The Guaje Pumice Bed (Qbog) is the basal fall deposit of the Otowi Member. It is a stratified, fines-depleted deposit of gravel-sized vitric pumice and quartz and sanidine crystals. Borehole data indicate that the thickness of this unit at TA-54 ranges between 5 ft (1.5 m) and 19 ft (5.8 m). This pumice-fall unit was deposited throughout the area and is expected to be laterally continuous. It is potentially important for vadose zone flow and transport because higher moisture content and zones of saturation occur within this unit at other areas of the Laboratory beneath wet canyons (e.g., Los Alamos Canyon). Site investigations in the vicinity of TA-54 indicate that saturated conditions occur in the Guaje Pumice Bed only at well R-51 (Figure E-2.1-3).

Cerros del Rio Volcanic Series (Tb4, Tvt2b)

Basaltic rocks of the Cerros del Rio volcanic field crop out primarily in White Rock Canyon and east of the Rio Grande in the Caja del Rio (Griggs and Hem 1964, 092516; Smith et al. 1970, 009752; Kelley 1978, 011659; Sawyer et al. 2007, 106130). The northwest part of the volcanic field extends beneath the Pajarito Plateau where it is covered by thick deposits of Bandelier Tuff (Dransfield and Gardner 1985, 006612; Broxton and Reneau 1996, 055429). Cerros del Rio volcanic rocks interfinger with the upper Puye Formation west of the Rio Grande and unconformably overlie the Tesuque Formation east of the river. Discontinuous thin beds of fine-grained cemented sandstone and siltstone (possible paleosols or eolian deposits) and coarse-grained volcanic colluvium occur at the top of the Cerros del Rio volcanics. Sediments directly beneath or between individual lava flows show varying degrees of cementation and mineralogic alteration because of thermal contact metamorphism.

At TA-54, the Cerros del Rio volcanic series is a thick sequence of stacked lava flows that are separated by interflow breccias, cinder or scoria zones, volcaniclastic and riverine sediments, phreatomagmatic deposits, and lake-bed deposits. The lava flows generally have massive interiors made up of dense, variably fractured impermeable rock. Cuttings samples of lavas and related deposits were analyzed by X-ray fluorescence for major and trace elements to aid in the correlation of lavas from borehole to borehole. The lava flows range in composition from basalt to dacite, with the more silicic rock types (dacites) occurring at the base of the volcanic pile (oldest units) and less evolved flows (tholeiites and alkali basalts) at the top (youngest units) (Figure E-2.1-9). The more mafic portions of the Cerros del Rio volcanic series (compositions ranging from basalt through trachyandesite in Figure E-2.1-9) are labeled Tb4 on the geologic cross-sections (Figures E-2.1-2 to E-2.1-8). Dacite lavas form a compositionally

distinct volcanic feature near the east end of TA-54 and are labeled Tvt2b on the cross-sections (Figures E-2.1-2 and E-2.1-8).

The dacite lavas at the east end of TA-54 were likely erupted from a small dome and flow complex. Dacite flows of similar age occur at other locations beneath the Pajarito Plateau (Samuels et al. 2007, 204422) and at Tetilla Peak and Montoso Arroyo in the Caja del Rio (Sawyer et al. 2007, 106130). These dacite lavas are similar in composition to Tschicoma lavas exposed in the Jemez Mountain volcanic field (JMVF), but they are slightly younger and lack the coarse-grained, abundant phenocrysts that characterize the Tschicoma Formation. The dacite lavas of the Pajarito Plateau closely overlap the age and distribution of mafic lavas of the Cerros del Rio volcanic field (CdRVF), but their compositions are more evolved than the basalts that make up most of the volcanic field. Thus, dacites of the Pajarito Plateau differ in significant ways from dominant rock types found in both JMVF and CdRVF, and they probably reflect a transitional style of magmatism that developed in the region between these adjacent, concurrently active volcanic fields (Samuels et al. 2007, 204422). Because of their temporal and spatial overlap, they are included in the Cerros del Rio volcanic series in this report.

The Cerros del Rio volcanic series thickens eastward, ranging from about 300 ft (91 m) near MDA H to about 775 ft (236 m) near the east end of MDA G. The thickest deposits generally coincide with a south-southwest-draining paleovalley that is defined by structure contours at the base of the unit (Figure E-2.1-10). An isolated occurrence of anomalously thick (983 ft [300 m]) Cerros del Rio volcanic deposits occurs at well R-22; this anomalous occurrence is discussed below.

The Cerros del Rio volcanic series was erupted primarily between 2.8 and 2.3 million years ago (Ma) (WoldeGabriel et al. 1996, 054427; WoldeGabriel et al. 2001, 092523; Sawyer et al. 2007, 106130). Overlapping $^{40}Ar/^{39}Ar$ ages of 2.40±0.09 and 2.50±0.33 were obtained for dacite and overlying tholeiite lavas, respectively, at well R-22.

Rapid lateral facies variations of the volcanic rocks and their intercalated deposits are common in this unit. These variations reflect dynamic landscape processes associated with the rapid growth of overlapping volcanoes and eruption of lava flows onto a basin floor that included the ancestral Rio Grande floodplain and the western alluvial slope of the Española basin. The thickest volcanic deposits overlie Totavi Lentil (Tpt) riverine deposits in the vicinity of MDA G and to the east. The presence of phreatomagmatic deposits within the volcanic sequence indicates that erupting magmas frequently interacted explosively with the ancestral Rio Grande and its saturated flood plain sediments. Lavas flowing into low-lying areas periodically blocked the ancestral Rio Grande, causing lake sediment (lacustrine) deposits to form behind temporary lava dams. Riverine deposits intercalated within the volcanic sequence mark the changing course of the ancestral Rio Grande in response to the continuously evolving basin-floor topography. These intercalated riverine deposits are associated with temporary river channels, and the deposits are probably not laterally continuous.

The presence of volcanic vents in the vicinity of TA-54 is inferred from the presence of thick cinder and phreatomagmatic deposits that commonly accumulate near their source vents as well as subdued exposures of an eroded cinder cone south of R-23 in TA-36. Cinder deposits more than 50 ft (16 m) thick occur in wells R-20, R-21, R-22, R-34, R-39, R-41, R-49, R-53, R-54, R-55, and R-56. These cinder deposits range in composition from basalt to dacite, indicating multiple vents are in the vicinity. Thick (>25 ft [>7.6 m]) basaltic phreatomagmatic deposits occur in wells R-38, R-41, R-49, R-55, and R-57, suggesting maar volcanoes are located near the east end of MDA G. Additionally, the top of Cerros del Rio volcanics form a broad paleotopographic high area east and north of TA-54 (Figures E-2.1-2, E-2.1-3, E-2.1-6, and E-2.1-11). This paleotopographic high likely represents a constructional highland formed by coalescing volcanic vents, including the dacite dome and flow complex (Tvt2b) that was buried by subsequent basaltic lavas (Tb4) near the east end of MDA G (Figures E-2.1-2, E-2.1-8, and E-2.1-11).

Well R-22 may have intersected a volcanic vent conduit of unknown morphology that fed the upper tholeiitic lavas at the east end of TA-54. All other wells at the east end of TA-54 (e.g., R-23, R-39, R-41, R-55, R-49, and R-57) show a consistent volcanic stratigraphy in which basaltic lavas (tholeiite and alkali basalt) overlie more evolved lava types (trachyandesite and dacite). Well R-22 is the only location where tholeiites are found beneath dacite lavas. The lowermost tholeiites at R-22 occur 213 ft (65 m) deeper than the base of the volcanic pile (dacite lava) and 785 ft (239 m) deeper than tholeiites at R-57, located only 215 ft (66 m) to the west. It is possible that the deep tholeiites at R-22 represent older lavas filling a deep, narrow paleocanyon, but such a canyon would have been cut into poorly consolidated riverine sediments that were unlikely to support such a steep-walled feature. Moreover, other closely spaced boreholes in the vicinity do not intersect any igneous lithologies this deep, as would be expected if there were a lava-filled canyon with lateral extent. The alternative interpretation is that R-22 was drilled through an obliquely oriented vent conduit related to the upper tholeiitic lavas. Chemical compositions of the shallow and deep tholeiites at R-22 are similar; these similarities permit, but do not prove, a relationship between the two. Because other lines of evidence suggest volcanic vents occur in the area (see discussion above), cross-sections through well R-22 show the interpretation that well R-22 intersected a volcanic conduit that feeds the upper tholeiite lava flows (Figures E-2.1-2 and E-2.1-8).

The Cerros del Rio volcanic series is largely in the vadose zone at TA-54. However, the base of these volcanic deposits extends more than 150 ft beneath the regional water table in the vicinity of MDA G where lavas pooled in a south-southwest-draining paleovalley (Figures E-2.1-2, E-2.1-10, and E-2.1-12). Under unsaturated and saturated conditions, groundwater flow in lava interiors is impacted by fractures, with properties of groundwater flow and contaminant transport (direction, magnitude, etc.) influenced by fracture aperture, fracture density, fracture orientation, fracture connectivity, and fracture-filling materials. Groundwater flow and contaminant transport are also impacted by porous flow through interflow zones made up of highly permeable breccias, cinder and scoria deposits, and sedimentary deposits. The nonfractured volcanic rocks and clay-filled fractured zones are expected to have low saturated permeability. Zones with significant connected and open fractures, interflow zones, and possible lava tubes are expected to have higher saturated permeability and low matrix porosity, a combination of properties that can lead to fast travel times.

Puye Formation (Tpf and Tpt)

The Pliocene Puye Formation is subdivided into three interfingering facies: fanglomerate, lacustrine beds, and Totavi Lentil riverine deposits. Fanglomerate and Totavi riverine deposits are the dominant facies of the Puye Formation at TA-54. Lacustrine beds are relatively minor components of the Puye Formation at TA-54, and they (along with other intercalated sedimentary deposits) are included in the Cerros del Rio volcanic series where they are interbedded with thick lava flows. Fanglomerate and lacustrine beds are labeled Tpf and the Totavi Lentil is labeled Tpt on the geologic cross-sections (Figures E-2.1-2 through E-2.1-8).

The fanglomerate facies of the Puye Formation was deposited as broad, coalescing alluvial fans shed eastward from the JMVF into the western Española basin (Griggs and Hem 1964, 092516; Bailey at el. 1969, 021498). The sources for these alluvial-fan deposits were large overlapping dacite to low-silica rhyolite dome complexes of the Tschicoma Formation that formed the eastern part of the Jemez Mountains between about 3 and 5 Ma (Broxton et al. 2007, 106121). The fanglomerates are a heterogeneous assemblage of clast- to matrix-supported conglomerates, with associated gravels and lithic sandstones. The coarsest parts of the deposits contain subangular to subrounded boulders and cobbles of lava and tuff in a poorly sorted matrix of ash, silts, and sands. Debris flow deposits are common throughout the unit. Thin ash- and pumice-fall deposits of dacitic to rhyolitic composition are

interbedded with the conglomerates and gravels. At TA-54, the fanglomerate facies thins eastward; it is >263 ft (>80 m) thick at well R-52 and is absent on the east side of MDA G.

During the early Pliocene, before the development of the Cerros del Rio volcanic field, the distal parts of Puye alluvial fans merged with ancestral Rio Grande axial river sediments (Totavi Lentil) that were being deposited over a basin floor that was at least 3 to 6 km wide. As a result, fanglomerate and riverine deposits are interbedded in the vicinity of MDA G and eastwards. The early Pliocene Totavi riverine deposits consist of poorly consolidated conglomerate containing well-rounded cobbles and gravels of Precambrian quartzite, granite, and pegmatite with subrounded to subangular cobbles and boulders of silicic to intermediate and rarer basaltic volcanic rocks. Precambrian clasts commonly make up >80% of the clasts in the deposits. These deposits also contain subordinate subangular to subrounded clasts of intermediate volcanic rocks derived from the JMVF in some horizons. Loose, well-sorted, fine to coarse quartz and microcline sands occur as lenses within the conglomerate. The Totavi deposits are up to 203 ft (62 m) thick and formed deposits primarily beneath MDA G and to the east. The ancestral Rio Grande flowed north to south so it is expected that Totavi deposits contain stacked channel sands and gravels with the same orientation and with length-to-width dimensions on the order of 0.5 to 3 km and 50 m, respectively. This may cause large-scale anisotropy of flow and transport properties within the unit, with preferential flow along permeable channel deposits. Totavi deposits west of MDA G are much thinner (<40 ft [12 m]), or they are highly mixed with Puye fanglomerate; the deposits in this area probably represent an area of overlap between the western alluvial slope and the basin floor.

During the late Pliocene, the eastern Jemez Mountains remained structurally high and continued to supply sediment to Puye alluvial fans in the western Española basin. However, the onset of Cerros del Rio volcanism had three major effects on the Puye depositional patterns: (1) concurrent sedimentation and volcanism led to interfingering of Puye and Cerros del Rio deposits, (2) growth of a constructional volcanic highlands on the basin floor provided an eastern source of volcaniclastic sediments for the Puye Formation and blocked the eastern migration of alluvial fans from the Jemez Mountains, and (3) Totavi Lentil deposition became more restricted in areal distribution, and areas of deposition frequently shifted in response to damming and diversion of the Rio Grande by lava flows.

Miocene Jemez Alluvial Fan Deposits (Tjfp)

Unnamed Miocene Jemez alluvial fan deposits generally include a lower fanglomerate and an upper subunit of pumiceous sands and gravels at the Laboratory (Broxton and Vaniman 2005, 090038). Only the upper pumiceous subunit was encountered in boreholes at TA-54. The pumiceous sediments are 115 ft (35 m) thick at well R-20 and pinch out eastward, probably in the vicinity of MDA L.

Although their deposits are not as coarse, these Miocene rocks share similarities with the overlying Pliocene Puye Formation in that they are interpreted as alluvial fans shed eastward from the JMVF into the western Española basin (Broxton and Vaniman 2005, 090038). However, there appears to be a significant unconformity that represents a 2-million-year hiatus in deposition between these two alluvial-fan sequences. A poorly developed, oxidized paleosol occurs at the top of the Miocene sediments at core hole SCI-2, located 1.4 mi (2.3 km) north of TA-54, but the lateral extent and continuity of this paleosol is not known because of limited data. Formation microimager geophysical logs collected at R-20 indicate that bedding in the upper pumiceous sediments dips towards the south-southwest, possibly indicating postdepositional tilting of the Miocene units before the Puye Formation was deposited.

The Miocene sediments in the vicinity of TA-54 consist of well-bedded horizons of light-colored reworked pumiceous sands and subordinate gravels of rhyolite and dacite. Deposits typically contain up to 30% subangular to rounded vitric rhyolite pumice admixed with 70% to 90% ash and lithic sands. Some intervals contain as much as 90% subangular to angular pumice that represent primary fall deposits or

reworked deposits that underwent minimal transport. Pumice clasts are characterized by sparse phenocrysts that include quartz, sanidine, plagioclase, biotite, and pyroxene. Seven pumice samples collected from boreholes across the Pajarito Plateau yielded $^{40}Ar/^{39}Ar$ feldspar ages ranging between 6.44 ± 0.46 Ma and 7.50 ± 0.30 Ma. The ages overlap the 6.01 ± 0.05 to 7.1 ± 0.2 Ma ages reported for the Bearhead Rhyolite in outcrops southwest of the Pajarito Plateau (Justet and Spell 2001, 093391). Microprobe analyses of glass and whole rock analyses of pumices closely match the chemistry of the Bearhead Rhyolite.

These pumiceous deposits are entirely within the regional aquifer and should have relatively high permeability where they occur beneath the western part of TA-54. Individual beds are made up of relatively uniform, well-sorted lithologies. Heterogeneity in this unit is primarily associated with bedding. The south-southwest dip of these deposits may cause some preferential groundwater flow towards the east-southeast along the strike of bedding. However, beneath TA-54, these beds are too deep in the regional aquifer for preferential flow to be a concern and these beds are thin to absent beneath much of the site.

Chamita Formation (Tcar)

The Miocene Chamita Formation of the Santa Fe Group is made up of basin-floor axial river deposits consisting of the Hernandez and Vallito Members. The Hernandez Member represents ancestral Rio Chama deposits, and the Vallito Member represents ancestral Rio Grande deposits. These south-flowing river systems merged in the vicinity of Buckman Mesa (Koning et al. 2007, 106122), and the separate members are grouped at the formation level in the vicinity of TA-54. The Chamita Formation is >1285 ft (391 m) thick at well PM-2 and >559 ft (170 m) thick at well R-16. Most water-supply wells on the Pajarito Plateau are completed in this formation. The Chamita Formation ranges in age between 6 and 13 Ma. The upper part of the formation overlaps in age with Miocene Jemez alluvial fan deposits, and it is likely that alluvial fan and axial river sediments interfinger along the western margin of the basin floor. The Chamita Formation is overlain by Miocene pumiceous alluvial fan deposits at well R-20 and by riverine deposits of the Totavi Lentil at well R-57.

The Chamita Formation consists of fine- to coarse-grained quartz sands and silty sands with minor microcline and felsic to intermediate volcanics, fine- to coarse-grained volcanic lithic sands, and sandy and silty gravels dominated by well-rounded felsic to intermediate volcanics and 1% to 3% Precambrian quartzite. Some gravel deposits also contain subangular to subrounded intermediate volcanic clasts that probably represent input of sediment from tributary streams draining the Miocene JMVF. These stratified deposits are variably cemented by calcite with poorly to noncemented sands and gravels intercalated with cemented sandstones.

The Chamita Formation is entirely within the regional aquifer at TA-54. These rocks should have relatively good permeability characteristics because they contain relatively abundant, sorted coarse-grained channel fills. Intercalated silt-rich sands and gravels are likely to be less transmissive than clean channel sands and gravels, providing vertical stratification and hydraulic compartmentalization. Because of their accumulation as axial deposits in a north-to-south-flowing river, these sediments probably contain north-to south-oriented stacked channel sands and gravels with long length to width dimensions similar to the Totavi Lentil. This characteristic may cause large-scale anisotropy of flow and transport properties of the aquifer medium with preferential north-to-south orientation.

Basaltic lava flows are intercalated within the Chamita Formation at wells PM-2 and R-22. These basalts are deep within the regional aquifer and show varying degrees of alteration of groundmass minerals and phenocrysts, with fractures that appear to be at least partly sealed by smectite. Alteration minerals typically include smectite; calcite may also occur. At well PM-2, upper and lower basalt flows are 52 ft

(16 m) and 94 ft (29 m) thick, respectively. At well R-22, the basalt sequence is 68 ft (21 m) thick. The basalt at R-22 yielded a $^{40}Ar/^{39}Ar$ age of 8.97±0.11 Ma. The basalts at PM-2 occur at greater depths than the R-22 basalt. Assuming they are correlative, these basalts appear to have a westward component of dip. In age and composition, these lavas appear to be related to those near the top of the regional aquifer at R-9 and R-12, to the north, suggesting that there may also be a southern component of dip with net dip of these lavas to the southwest.

E-2.2 Seismic Hazards

A seismic hazard evaluation was conducted at several sites around the Laboratory to estimate ground motion from possible earthquakes (tectonics) (Wong et al. 1995, 070097). The objective was to determine the seismic hazard criteria for designing new nuclear facilities. The evaluation led to the conclusion that within 100 yr an earthquake with a magnitude of 6 or greater is considered likely to occur in the Pajarito fault system.

While TA-54 was not included in the study, its geology is similar to two of the sites evaluated at TA-18 and TA-46. Results of the study were applied in the safety analysis report for MDA G, which includes the Laboratory's radioactive waste disposal facility (Benchmark Environmental Corporation 1995, 063300). Such an earthquake was determined not to pose a hazard to waste buried below the surface at MDA G.

Small-scale faults have been documented in the disposal pits and in cliff outcrops at MDA G (Reneau et al. 1998, 063497; Schultz and Kelley 2009, 111231). However, these faults have small displacements (less than 1 ft [30 cm] of offset on Tshirege subunits), they lack lateral continuity (they cannot be traced across mesas or to other canyon exposures), they do not show movement in Holocene time, and they do not have clear connections to other major regional faults. Therefore, these small faults are not considered a seismic hazard to MDA G or neighboring facilities. Based on the data from published geologic studies at and around TA-54, aerial reconnaissance of the area within a 5-mi radius of MDA G, an analysis of aerial photographs, and field reconnaissance of lineaments and contact elevations, Schultz and Kelley (2009, 111231) concluded that no faults with Holocene displacement are present at MDA G.

E-2.3 Cliff Retreat

The MDAs at TA-54 are located on Mesita del Buey next to Pajarito Canyon and Cañada del Buey, and cliff retreat is a primary process by which the canyon walls erode. Siting of disposal pits at MDA G included a 50-ft setback from the mesa edges to avoid the possibility of exposure of waste by cliff retreat (Purtymun and Kennedy 1971, 004798; Rogers 1977, 005707). Geomorphic studies at DP and Pajarito Mesas indicate that mass wasting and cliff retreat on the Pajarito Plateau occur by detachment of fracture-bounded blocks in relatively small rockfalls along shallow canyons, similar to those bordering Mesita del Buey at MDA G (Broxton and Eller 1995, 058207; Reneau and Raymond 1995, 054709). Larger-scale mass wasting involving landsliding along canyon walls only occurs where canyons are deeper, including Los Alamos Canyon next to DP Mesa and Pajarito Canyon next to Pajarito Mesa. Using various lines of evidence, including the size of fracture-bounded blocks and long-term evolution of the canyons and assuming a 10,000-yr period of interest, the studies at DP and Pajarito Mesas supported the use of a 50-ft setback from mesa edges for shallow canyons like those that exist next to MDA G (Broxton and Eller 1995, 058207; Reneau and Raymond 1995, 054709). Larger setbacks were recommended next to deeper canyons where larger-scale mass wasting occurs.

E-3.0 HYDROLOGY

The regional aquifer beneath the Pajarito Plateau occurs at depths between 1200 ft (366 m) along the western edge of the Pajarito Plateau and about 600 ft (183 m) along the eastern edge. Beneath MDA H, the regional water-table elevation is approximately 5870 ft above mean sea level (amsl) or approximately 900 ft (300 m) below the ground surface.

As with the conditions observed elsewhere beneath the Pajarito Plateau, the regional aquifer beneath MDA H is a complex heterogeneous system that includes deep, predominantly confined and shallow, predominantly unconfined zones. There are no lithologic observations that demonstrate the existence of clearly defined aquitards or confining layers that provide hydraulic separation between the deep and shallow zones of the regional aquifer. However, the vertical hydraulic stratification of the regional aquifer has been observed at numerous aquifer locations where there are deep and shallow monitoring well screens. The vertical hydraulic stratification is indicated by (1) pronounced vertical differences in hydraulic heads and (2) a lack of vertical propagation of pumping drawdown caused by pumping tests and municipal water supply pumping. The vertical stratification of the regional aquifer is also demonstrated by the PM-2 spinner test (LANL 2009, 106939, Appendix J). The vertical hydraulic separation is most likely caused by pronounced vertical aquifer anisotropy; that is, the lateral permeability is substantially higher than the vertical permeability. The anisotropy is probably caused by the depositional layering of the hydrostratigraphic units. Based on the existing observations, the degree of hydraulic communication between these zones is (1) relatively poor and (2) spatially variable, depending on local hydrogeologic conditions and hydrostratigraphy. The poor hydraulic communication between the two zones does not preclude the possibility that some contaminant migration may occur between the shallow and deep zones. Between the two zones, the hydraulic gradient has a downward vertical component because of water supply pumping in the deep zone, creating the possibility that downward contaminant flow may occur along “hydraulic windows,” although these flows have not been directly observed.

E-3.1 Regional Aquifer Wells Near MDA H

Information about the hydrogeological properties of the regional aquifer can be obtained by analyzing the ambient water-level transients and pumping drawdowns observed at the monitoring wells near MDA H. The aquifer properties are important to evaluate groundwater flow and contaminant transport in the regional aquifer. The hydrogeological conditions at the monitoring wells are important to take into account in evaluating monitoring-well capabilities for characterizing regional groundwater flow and to detect potential contaminants originating from MDA H. Drawdown data are collected during the pumping tests (up to 24 h long) conducted at each of the monitoring wells. Drawdown data are also obtained as a result of the water-supply pumping at the municipal wells on the Pajarito Plateau; the transient analysis of water-supply pumping effects is computationally intensive but allows for a cost-effective estimation of the effective large-scale properties of the aquifer (Harp and Vesselinov 2010, 111220). The analysis of the water-table drawdowns caused by water-supply pumping also allows for the evaluation of the impact of the water-supply pumping on the regional groundwater flow directions. This is important because MDA H is located near two of the water-supply wells on the Pajarito Plateau: PM-4 (~2250 ft to the north-northwest) and PM-2 (~1750 ft to the south) (Figure E-2.1-1).

Hydrogeologic information obtained from the regional and intermediate water-supply and monitoring wells next to MDA H (PM-2, PM-4, R-51, R-52, R-40, R-40i, and R-37; Figure E-2.1-1) is summarized below and in Tables E-3.1-1 through E-3.1-4.

E-3.1.1 Water-Supply Wells

PM-2

PM-2 was completed in 1965 within the Puye Formation and Santa Fe Group (Figure E-2.1-1). The screen is placed about 130 ft beneath the regional water table. During pumping, the drawdown at the well is about 70 ft. The existing water-level data suggest PM-2 pumps a deep confined section of the regional aquifer, and the intensive pumping does not cause long-term decline of the aquifer hydraulic pressures. The water level at PM-2 seems to be recovering since 2004, from ~5840 ft in 2004 to ~5855 ft in 2008. PM-2 has not actively operated since 2007 because of maintenance and repairs, and up-to-date information about the water level is not available. The regional water table at R-40 screen 2 is ~5866 ft, about 10 ft higher than the PM-2 water level was in 2008. The head difference suggests a degree of hydraulic separation between the deep and shallow aquifer sections tapped by PM-2 and R-40 screen 2, respectively. The water level at R-40 screen 2 responds to PM-2 pumping with drawdown of about 2 ft and to PM-4 pumping with drawdown less than 1 ft. Taking into account the short lateral distance between PM-2 and R-40 and the substantial difference in the PM-2 (70 ft) and the R-40 (2 ft) drawdowns suggests vertical aquifer stratification. The PM-2 spinner test (LANL 2009, 106939, Appendix J) demonstrated that water is extracted from the upper section of the louvers. PM-2 pumping is detected in many monitoring wells. The zone of influence for PM-2 seems to extend preferentially to the north; R-28 and other wells near Sandia Canyon are impacted by PM-2 pumping (LANL 2009, 107453), potentially because of structures or heterogeneities in the regional aquifer. For example, highly permeable channels with north-south orientation observed within the Puye Formation may cause permeability anisotropy that could impact the predominant direction of drawdown propagation. PM-2 is expected to be actively used as a water supply well again starting in September 2011.

PM-4

PM-4 is located on Mesita del Buey about midway between supply wells PM-2 and PM-5 (Figure E-2.1-1). PM-4 was completed in 1981 within the Puye Formation and Santa Fe Group. The screen is placed about 120 ft beneath the regional water table. During pumping, the drawdown at the well is about 70 ft. The existing water-level data suggest PM-4 pumps a deep confined section of the regional aquifer that is hydraulically connected with the aquifer zone pumped at PM-2; hydraulic cross-communication occurs between the two wells during pumping. The water-level elevation was steady at ~5840 ft from 2004 to 2008. However, in 2009, water levels declined steadily in PM-4, reaching ~5828 ft because of active pumping of PM-4 since use of PM-2 ceased in 2007. It is expected that the PM-4 water levels will recover when the pumping is reduced. PM-4 pumping is detected in many monitoring wells. There are no observations of the elevation of the regional water table in monitoring wells near PM-4. It is expected that the elevation of the regional water table is higher than the water level observed in the water-supply well because of vertical hydraulic disconnection and head differences between the deep and shallow aquifer zones observed elsewhere. The analyses of the regional water table (section E-3.3) suggest its elevation is about ~5865 ft at PM-4 or about 10 to 30 ft higher than the water level observed at PM-2.

E-3.1.2 Monitoring Wells

R-51

R-51 is screened within sands and gravels of the Puye Formation (Figure E-2.1-3). Screen 1 is 10 ft long (from 915 to 925 ft [below ground surface [bgs]), and screen 2 is 10 ft long (from 1031 to 1041 ft bgs). The zone above screen 1 from 905 to 915 ft was silt rich and presumably low in hydraulic conductivity. As such, this zone was expected to provide hydraulic confinement of the screen 1 zone. The composite

water level during well installation was 890.62 ft bgs (5869.38 ft amsl). When the screen zones were isolated, the water level in screen 1 rose 0.80 ft (889.82 ft bgs; 5870.18 ft amsl), and the head in screen 2 declined 0.83 ft (891.45 ft bgs; 5868.55 ft amsl). The vertical component of the hydraulic gradient at R-51 is on the order of 0.016 (Table E-3.1-3).

The silt-rich sediments above screen 1 suggest locally confined conditions; consistently, screen 1 has a high barometric efficiency of around 100% (Table E-3.1-4), demonstrating a lack of response to atmospheric pressure fluctuations (i.e., potentially confined conditions). Screen 2, on the other hand, is more affected than screen 1 by atmospheric pressure fluctuations. It has a barometric efficiency less than 100% (Table E-3.1-4); this suggests unconfined or partially confined conditions because of a pneumatic connection of the screen with the atmosphere. The differences in the barometric response of the two screens are unusual; most of the wells on the Pajarito Plateau have increasing or no change in the barometric efficiency with depth (e.g., R-49, R-50, R-53, and R-55). Wells with decreasing barometric efficiency with depth in the TA-54 area are R-51, R-20, R-54, and R-32. The cause of this anomalous behavior is unclear. It suggests that the hydrostratigraphic units in the lower screens are pneumatically connected with the atmosphere through a pathway that is not strictly vertical and bypasses the upper well screens. For example, hydrostratigraphic units screened by the deep screens might be pneumatically connected with the atmosphere to the northeast of the wells; it is also possible that the propagation of the atmospheric pressures into the subsurface is related to Pajarito Canyon and aquifer heterogeneity. R-51, R-20, R-54, and R-32 are located along the canyon bottom.

Screen 1 produced 4.1 gallons per minute (gpm) for 60 min with 4.56 ft of drawdown for a short-term specific capacity of 0.9 gpm/ft. Analysis of the screen 1 pumping tests suggests a hydraulic conductivity of 16 ft/d.

Screen 2 produced 21.1 gpm for 1440 min with 77.7 ft of drawdown for a specific capacity of 0.27 gpm/ft. Analysis of the screen 2 pumping tests suggests a hydraulic conductivity of 3.5 ft/d.

Pumping screen 1 had no discernable effect on water levels in screen 2, whereas pumping screen 2 caused about 0.08 ft of drawdown in screen 1. Both screen zones showed evidence of pumping influence from water-supply well PM-4 (Table E-3.1-2). R-51 screen 2 responded to trial pumping of PM-2 in late May and early June 2010, but there was no apparent response at screen 1.

R-52

Both screens in R-52 lie within sands and gravels of the Puye Formation (Figure E-2.1-3). Screen 1 is 20.5 ft long (from 1035.2 to 1055.7 ft bgs), and screen 2 is 10 ft long (from 1107 to 1117 ft bgs). The composite water level during well installation was 1017.96 ft bgs (5865.08 ft amsl). After the screen zones were isolated by packers, the water level in screen 1 rose 0.60 ft (1017.36 ft bgs; 5865.68 ft amsl), and the water level in screen 2 declined 1.18 ft (1019.14 ft bgs; 5863.90 ft amsl). The vertical component of the hydraulic gradient at R-52 is on the order of 0.03 (Table E-3.1-3). The barometric efficiency is about 100% for both well screens (Table E-3.1-4); the screen aquifer zones do not respond to atmospheric pressure fluctuations.

Screen 1 produced 3.6 gpm for 885 min with 1.4 ft of drawdown for a specific capacity of 2.6 gpm/ft. Analysis of the screen 1 pumping tests estimates an average hydraulic conductivity value of 18.9 ft/d.

Screen 2 produced 7.9 gpm for 1440 min with 7.64 ft of drawdown for a specific capacity of 1.03 gpm/ft. Analysis of the screen 2 pumping tests suggests a near-well hydraulic conductivity of 26.2 ft/d and a hydraulic conductivity over a broader area of 19.3 ft/d.

Pumping screen 1 at 4.2 gpm for 1440 min caused about 0.1 ft of drawdown in screen 2. Pumping screen 2 at 10.8 gpm caused more than 0.2 ft of drawdown in screen 1. There was no discernable effect to pumping either of the R-52 screens in R-37 screen 2 located just over 1100 ft away.

Aerated groundwater was produced from both screens 1 and 2 during the pumping tests, which complicated the pumping test execution and interpretation.

Both screen zones showed evidence of pumping influence from water-supply well PM-4 (Table E-3.1-2). Response to water-supply well PM-2 pumping is also expected, but PM-2 has not been actively used for water supply since R-51 was installed.

R-40 and R-40i

The combination of R-40 and R-40i constitutes a multiple-well completion that includes screens 1 and 2 in well R-40 and R-40i, which is a 3-in. slotted schedule 80 polyvinyl chloride well installed in the annulus outside the R-40 well casing (LANL 2009, 106432). R-40 screen 1 is completed in a perched zone in Cerros del Rio basalt, and screen 2 is completed in the regional aquifer in the Puye Formation. Screen 1 is 33.5 ft long (751.6 to 785.1 ft bgs), and the water level is approximately 763 ft bgs, 5955 ft amsl. Screen 2 is 20.8 ft long (849.2 to 870 ft bgs), and the water level is approximately 853 ft bgs; because of transients, the water level varies between approximately 5864 and 5866 ft amsl. The top of screen 2 lies within a transition zone separating overlying basalt-rich sediments from underlying basalt-free sediments, with the bottom of the screen extending into the basalt-free sediments. Well R-40i is set in an upper perched zone within Cerros del Rio basalt and is composed of 19.3-ft slotted pipe (649.7 to 669 ft bgs). At the time of well completion, the water level for screen R-40i was 9.4 ft above the top of the screen at 640.3 ft bgs, 6077.7 ft amsl.

The difference in the water levels in screens 1 and 2 is approximately 93 ft. The vertical gradient between the two screens is close to unity, suggesting that there is a zone of unsaturated groundwater conditions between the screens. The difference in the water levels in screen 1 and R-40i is approximately 121 ft. Again, the vertical gradient between the two screens is close to unity, suggesting a zone of unsaturated groundwater conditions between the screens. None of the pumping tests affected water levels in any of the other R-40/R-40i well screens or at nearby monitoring well R-20. The three screens at R-40 are within hydraulically distinct zones of saturation.

During the aquifer pump test, groundwater flow into R-40 screen 1 was on the order of just 12 gpd. This suggests extremely low permeability of the screened interval (less than 0.1 ft/d). More recently, sampling of this screen has been problematic because of rapid drawdown and slow recovery.

The water-level data in R-40 screen 2 indicates a barometric efficiency of 100% (Table E-3.1-4). Hydraulic conductivity is estimated to be 4.4 ft/d.

Transients in the water-level data demonstrate that screen 2 responds to water-supply pumping at PM-2 and PM-4 (Table E-3.1-2).

The water levels in screen R-40i responded to atmospheric pressure changes with a barometric efficiency of 33% and an average lag time of 5 h. This type of barometric response is expected for a screen completed in a perched zone of saturation that appears to be unconfined and in pneumatic connection with the atmosphere. Hydraulic conductivity is estimated to be 118 ft/d. At a distance from the well, effective average hydraulic conductivity is approximately 22 ft/d. Late drawdown and recovery data showed boundary effects potentially because of limited lateral extent of the perched zone.

R-37

R-37 is a dual-screen well with screen 1 placed in a perched-intermediate zone and screen 2 placed in the regional aquifer. Screen 1 is 20.7 ft long and straddles the base of Cerros del Rio lavas and volcaniclastic sediments of the Puye Formation that were derived from local Cerros del Rio volcanics (from 929.3 to 950 ft bgs). The contact between the lava and sediment is 933 ft bgs. The water level in screen 1 is approximately 909 ft bgs (5961 ft amsl). Screen 2 is within dacitic gravels of the Puye Formation about 14 ft below the regional water table. It has a length of 20.68 ft (from 1025.96 to 1046.64 ft bgs). During well construction, the water level was 1009.6 ft bgs (5860 ft amsl), about 103 ft deeper than the perched groundwater level in screen 1.

Screen 1 shows a lower barometric efficiency (62%), which is expected for a screen completed in a perched zone of saturation that appears to be unconfined and in pneumatic connection with the atmosphere. Screen 2 showed a barometric efficiency of near 100% (Table E-3.1-4); the screen aquifer zone does not respond to atmospheric pressure fluctuations and is pneumatically disconnected from the atmosphere.

The screen 1 response to a pumping test is complex and difficult to interpret. Much of the data are affected by wellbore storage. Late-time data indicate the possibility that the pumping water level had fallen below the contributing zones. Linear recovery response suggests the possibility that much of the production to screen 1 may come from lavas above the top of the screen. The base of lava flows are commonly fractured and brecciated, possibly providing good zones for water storage. Screen 1 produces 0.81 gpm with 34.5 ft of drawdown after 1 d of pumping for a specific capacity of 0.0235 gpm/ft.

Screen 2 produces 12.5 gpm with 4.0 ft of drawdown after 1 d of pumping for a specific capacity of 3.13 gpm/ft. Drawdown and recovery data analyses of the pumping test data produce consistent results, indicating an average hydraulic conductivity value for screen 2 of 21.4 ft/d. Late pumping and recovery data from screen 2 show steady flattening over time, consistent with continued vertical growth of the cone of depression into deeper aquifer sediments.

Transients in the water-level data collected so far demonstrate that screen 2 responds to water-supply pumping at PM-4 (Table E-3.1-2). During trial pumping of PM-2 in late May and early June 2010, screen 2 showed a slight response of about 0.1 ft; additional response is expected to routine pumping of PM-2.

E-3.2 Summary of Hydrogeological Information Collected at the Intermediate and Regional Monitoring Wells

Table E-3.1-1 presents information about the regional monitoring wells near MDA H related to estimated hydraulic conductivity based on conducted pumping tests during well development, hydrodynamic conditions at the screens (unconfined, partially confined, or confined), and the submergence of the uppermost screen below the regional water table. Most of the monitoring wells near MDA H appear to be either unconfined or partially confined.

Table E-3.1-2 summarizes the information regarding the water-level transients observed in the regional monitoring wells near TA-54 and whether these transients are related to the water-supply pumping. When a sufficient amount of data is available, the water-level transients are analyzed to evaluate the large-scale aquifer properties (transmissivity and specific storage, Table E-3.1-2). For many of the newer regional wells in the TA-54 monitoring network, the period of record for pumping rates and water levels is not sufficient to analyze the transients. Hydraulic properties could not be estimated based on PM-2 pumping for water-level transients at R-51, R-52, R-40, and R-37 because PM-2 was not actively used for water supply during the period of water-level observation. PM-2 has not been actively used since most of the

new regional monitoring wells were completed. However, Los Alamos County plans to bring the well back online in the fall of 2011 and potentially replace it near the current location of PM-2.

Table E-3.1-3 summarizes the estimated vertical component of the hydraulic gradient at the monitoring wells with more than one screen near TA-54. The highest values for the vertical component of the hydraulic gradient are observed at R-20, R-49, R-57, and R-22. Well R-20 is located close to PM-2, and its water levels have been strongly impacted by the water-supply pumping; therefore, the high value is probably caused by the water-supply pumping.

Table E-3.1-4 presents information regarding barometric efficiency of the monitoring well screens near MDA H based on a comparison of the hourly water-level data with the barometric pressure changes. Screens with barometric efficiency less than 100% are not confined. The table also discusses the potential impacts of Earth-tide effects on the regional water levels. Most of the screens near MDA H are not impacted by Earth-tide effects and are expected to be unconfined (except R-20 screen 2 and possibly R-20 screen 3; Table E-3.1-4).

Hydrogeologic data suggest that the screened regional-aquifer zones at the monitoring wells around MDA H are either unconfined or partially confined. This finding suggests that the upper well screens and the regional water table are potentially hydraulically connected, and they are good monitoring locations.

The perched zones near MDA H probably result from local infiltration along the canyon floors along Pajarito Canyon, Cañada del Buey, or even Mortandad Canyon to the north. There may also be a component caused by the lateral propagation of large-scale mountain-front aquifer recharge occurring to the west of MDA H. It is not known if the perched-intermediate zones observed at R-40 screen 1, R-51, R-37 screen 1, and R-52 are laterally connected and extend beneath MDA H, as illustrated in Figures E-2.1-3 and E-2.1-4. Such a connection is considered possible given the substantial thickness of the perched zones and their relative high groundwater capacity. The direction of the groundwater flow in the perched zones is not known; it is potentially to the northwest based on the observed perched water levels in R-40i (~6077 ft) and R-37 (~5963 ft). The water levels monitored in R-40i and R-37 appear to be steady over the existing observation period (since the summer of 2009) with small seasonal transients (less than 0.4 ft) that may suggest active groundwater recharge. These perched zones are expected to discharge into the regional aquifer somewhere downgradient from MDA H. The perched zones at R-40 and R-52 have substantially higher water levels than the regional water table (~120 ft). Nevertheless, the small vertical distance between the perched and regional zones (~80 ft) brings into question the level of saturation of the subsurface media between the zones. The perched zones are expected to discharge into the regional aquifer somewhere downgradient of R-40 and R-52. This discharge may affect the shape of the regional water table.

E-3.3 Regional Aquifer Water-Table Maps

Groundwater flow directions and fluxes that control contaminant transport in the aquifer are generally dictated by the shape of the regional water table (Freeze and Cherry 1979, 088742, Chapter 5; Vesselinov 2005, 090040). The general shape of the regional water table beneath the Laboratory is predominantly controlled by the areas of regional recharge to the west (the flanks of Sierra de los Valles and the Pajarito fault zone) and discharge to the east (the Rio Grande and the White Rock Canyon Springs). The structure of the regional phreatic flow is also expected to be impacted by (1) local infiltration zones (e.g., beneath wet canyons), (2) heterogeneity and anisotropy in the aquifer properties, and (3) discharge zones (water-supply wells and springs).

Information about the elevation of the regional water table is provided by existing data from monitoring wells (water levels) and selected springs (e.g., the White Rock Canyon Springs; discharge elevations of

the springs are applied as an estimate of the local elevation of the regional water table). Well data are predominantly applied to map the elevation of the regional water table; spring discharge elevations are used in the vicinity of White Rock Canyon to provide additional constraints on the water-table elevation. The analyses do not include the water levels observed at the water-supply wells (such as PM-2 and PM-4 near MDA H). Existing hydrogeological information suggests the elevation of the regional water table is higher than the water level observed in the water-supply well because of vertical hydraulic disconnection and head differences between the deep and shallow aquifer zones observed elsewhere.

Water-table elevations under the Pajarito Plateau vary in time because of transient effects that include pumping of the water-supply wells and large- and small-scale variability in aquifer recharge. In general, water-level maps are representative of specific periods of time. The interpretation of water-level data not representative of the same time period is a source of uncertainty in the mapping process. Differences in the depths of screen placements and local hydrogeologic conditions also complicate the interpretation of the water-level data. In addition, up to a month (depending on the local hydrogeological conditions) is required for the water levels in the recently drilled wells to equilibrate after they are disturbed by drilling, development, and pump testing.

The process of water-table contouring is theoretically constrained by conformity rules (Freeze and Cherry 1979, 088742): (1) the contour lines should be perpendicular to the flow paths and (2) the length and the width of the flownet cells formed by the contour lines between two adjacent flow paths should have the same ratios. These rules are theoretically valid only for the case of two-dimensional (lateral) groundwater flow in a uniform, isotropic aquifer with no recharge/discharge sources within flownet cells. Deviations from the conformity rules are caused by three-dimensional flow effects, aquifer heterogeneity and anisotropy, as well as recharge/discharge sources within flownet cells. Here, the regional water-table maps are contoured by attempting to satisfy four goals simultaneously: (1) to match the water-level data at the monitoring wells, (2) to account for issues of data representativeness (confined versus unconfined hydrodynamic conditions at the screens, submergence of the screen below the regional water table, water-level transients, etc.), (3) to preserve flownet conformity, and (4) to account for conceptual models of groundwater flow in the regional aquifer. Because of the existing uncertainties in the data and knowledge about the site, a series of alternative conceptual-model assumptions pertaining to the regional groundwater flow have been evaluated. The actual contouring is performed using a combination of manual and automated techniques; the automated contouring is performed using the minimum curvature method.

The water-table map of the regional aquifer beneath the Pajarito Plateau is presented in Figure E-3.3-1. The map is based on monthly averaged water-level data from February 2011 observed in the shallowest screens in all the regional monitoring wells. The map includes the data collected at the recently installed regional wells near MDA H. The R-41 screen 2 water level is not taken into account, assuming that it is an anomalous observation caused by a localized hydrogeologic feature that is hydraulically disconnected from the rest of the aquifer near the western end of MDA G. As a result, the R-41 water level is not expected to affect the large-scale structure of the groundwater flow in the regional aquifer, as presented in Figure E-3.3-1. The R-41 water level is not expected to influence groundwater flow directions beneath MDA H.

The groundwater flow in the regional aquifer beneath MDA H is predominantly from southwest to northeast. The direction of the potential contaminant transport in the regional aquifer is expected to follow the hydraulic gradients along the regional water table. The regional water table is observed within the Puye Formation sediments.

The structure of the regional aquifer flow beneath MDA H is represented in greater detail by a series of water-table (piezometric) maps presented in Figures E-3.3-2 through E-3.3-4. The maps are based on

monthly averaged regional-aquifer water-level data from February 2011; water-level contours in Figures E-3.3-1 and E-3.3-2 are equivalent. The contours in Figures E-3.3-1 and E-3.3-2 are based on the water levels from the uppermost screens in the regional aquifer; the maps represent the general structure of the groundwater flow along the regional water table (applied water-level data are presented in Figure E-3.3-2). The water-level contour map in Figure E-3.3-3 incorporates information from the deeper screens in the regional aquifer at the monitoring wells with more than one screen (applied water-level data are presented in Figure E-3.3-3). Figure E-3.3-3 attempts to estimate the structure of the groundwater flow about 100 ft (the average distance between the shallow and deep screens in the regional wells; Table E-3.1-1) below the regional water table based on the available information.

The water-level contour maps in Figures E-3.3-2 and E-3.3-3 are somewhat similar; a comparison of the contours is presented in Figure E-3.3-4. The general directions and hydraulic gradients of the groundwater flow in the shallow and deep sections of the regional aquifer appear to be similar as well. The major differences in the groundwater flow structures in the shallow and deep zones are near R-51 and R-52. Both the shallow and the deep screens of the monitoring wells around MDA H respond to the water-supply pumping (R-51, R-52, R-40, and R-37; Table E-3.1-2) at PM-2 and PM-4. These wells predominantly cause the observed transients in the water levels in both the shallow and deep sections of the regional aquifer. The pumping effects are smaller in the shallow screens than in the deep screens. Regardless of the differences in the water levels and the pumping effects, the general directions and hydraulic gradients of the groundwater flow in the shallow and deep sections of the regional aquifer appear to be similar. The differences in the water-levels contours (Figure E-3.3-4) are expected to be predominantly caused by the water-supply pumping; it is feasible that the differences are also influenced by aquifer heterogeneity and regional aquifer recharge. It is important to emphasize that well PM-2 has not actively been used for water supply since the summer of 2007, and the observed pumping fluctuations in the water levels are because of pumping of PM-4 only. It is expected that use of PM-2 will start again in the fall of 2011.

The northeastward direction of the regional groundwater flow beneath MDA H (Figures E-3.3-1, E-3.3-2, and E-3.3-3) may indicate a complex three-dimensional flow structure in the aquifer that is potentially influenced by hydrostratigraphy, aquifer recharge, and/or water-supply pumping in the deep sections of the regional aquifer. Local infiltration and aquifer recharge along Pajarito Canyon south of MDA H, and/or the lateral propagation of large-scale mountain-front aquifer recharge occurring to the west of MDA H, may cause the northeastern groundwater flow direction in the regional aquifer beneath MDA H. This conceptual model is supported by the existing perched zones in the area near MDA H. It is also plausible the shape of the regional water table near wells R-40, R-20, and R-54 is influenced by previous water-supply pumping in PM-2. The presence of the low-permeability Cerros del Rio lavas (Tb4) below the regional water table in the area to the east of MDA H, beneath MDA G, may act as a hydrogeologic barrier that diverts flow northeastward in the R-40 area (Figures E-3.3-2 and E-3.3-3). The distribution of hydrostratigraphic units at the regional water table and the estimated thickness of the Cerros del Rio lavas beneath the regional water table are presented in Figure E-2.1-12. The relatively lower water levels and flat hydraulic gradients in the area north of R-38 are potentially caused by flow through highly permeable Puye Formation sediments (as indicated by the pumping test results from wells R-28, R-11, R-13, R-44, and R-45). The three-dimensional structure of the groundwater flow may also be influenced by the general trends of (1) decreased thickness of the Puye Formation at the top of the regional aquifer and (2) decreased depth of the Santa Fe Group sediments below the regional water table in the area between R-37 and R-34 (LANL 2009, 106939, Figure O-4.0-1).

E-3.4 Regional Aquifer Monitoring Network

The regional monitoring well network around MDA H includes a series of wells for detection of potential contaminants reaching the regional aquifer in an area of considerable hydrogeologic complexity (Figures E-3.3-1, E-3.3-2, and E-3.3-3). The existing monitoring wells are located both upgradient (R-51) and downgradient (R-52 and R-37). Well R-40 may also be considered a potential downgradient well because it is located between MDA H and PM-2, and it provides the ability to detect contaminants that may be drawn toward PM-2 by water-supply pumping. The monitoring network includes single-screen (R-37 and R-40) and two-screen (R-51 and R-52) regional wells. In the two-screen wells, the upper screen is placed as close to the water table as possible to monitor the first arrival of contaminants in the aquifer, and the lower screen is placed in deep permeable aquifer sediments to monitor the primary groundwater pathways downgradient of the facility. All the monitoring wells located downgradient of MDA H are screened in sections of the regional aquifer that appear to be the best locations for monitoring potential contaminants.

Hydrogeologic data also suggest all the regional aquifer zones screened at the regional monitoring wells around MDA H are either unconfined or partially confined (Table E-3.1-1). This means that the upper well screens and the regional water table are potentially hydraulically connected. The barometric pressure responses of the monitoring screens (barometric efficiency less than 100%) demonstrate a connection between the screens and the vadose zone (i.e., the screens are not confined [Table E-3.1-4]). Most of the screens near MDA H are not impacted by Earth-tide effects and therefore are expected to be unconfined as well (Table E-3.1-4).

Taking into account the flow directions in the regional aquifer (Figures E-3.3-2 and E-3.3-3), an additional regional aquifer monitoring well east-southeast of MDA H is recommended to ensure adequate monitoring in the regional aquifer to support long-term performance monitoring. Because of potential perched-intermediate zones in this area, an additional well in the perched zone, if identified, is also recommended. The addition of these new groundwater monitoring wells will be included as part of the corrective measures implementation plan. Groundwater monitoring of the regional aquifer will be conducted in accordance with requirements in the Laboratory's Hazardous Waste Facility Permit.

E-4.0 REFERENCES

The following list includes all documents cited in this appendix. 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 New Mexico Environment Department 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.

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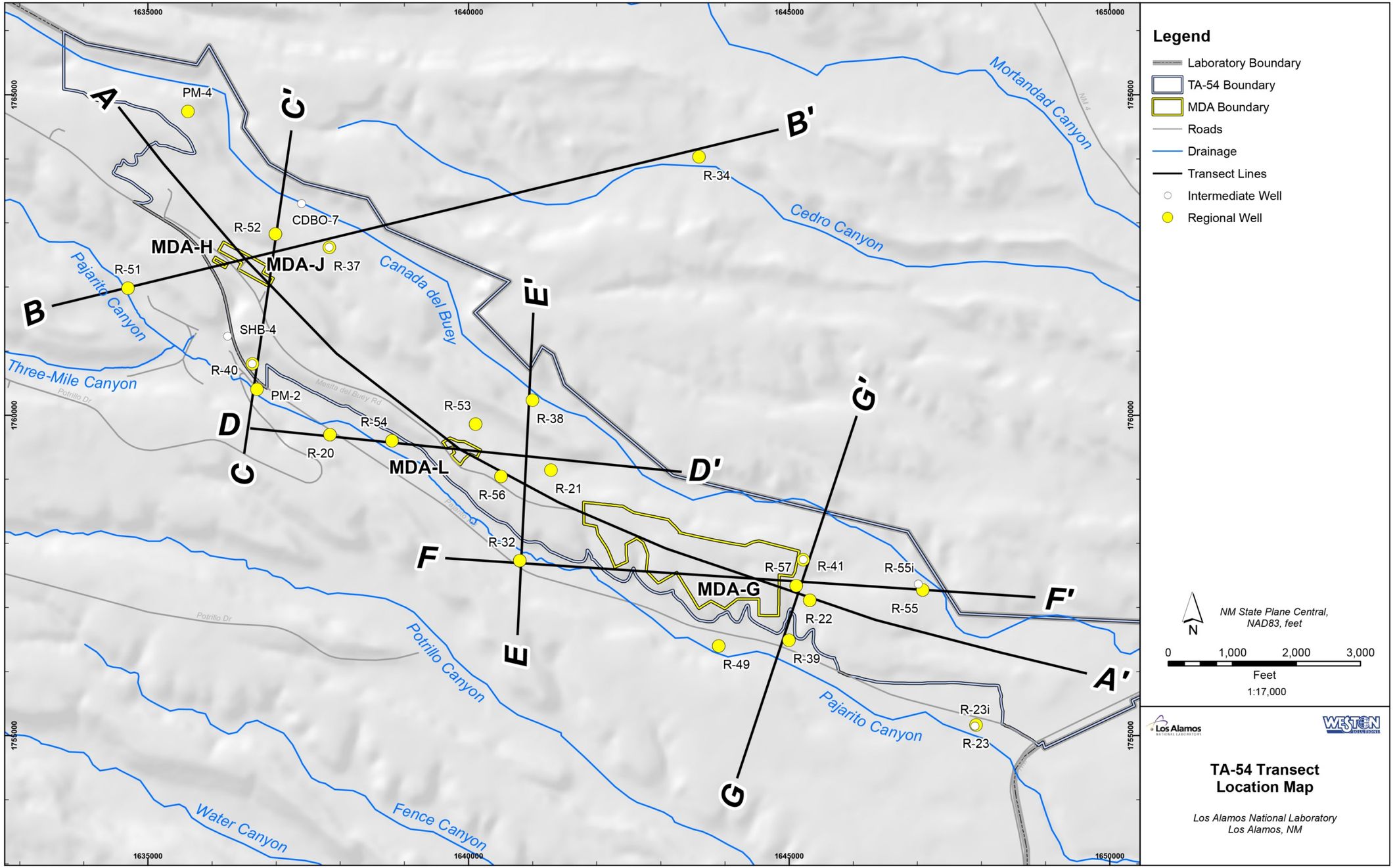
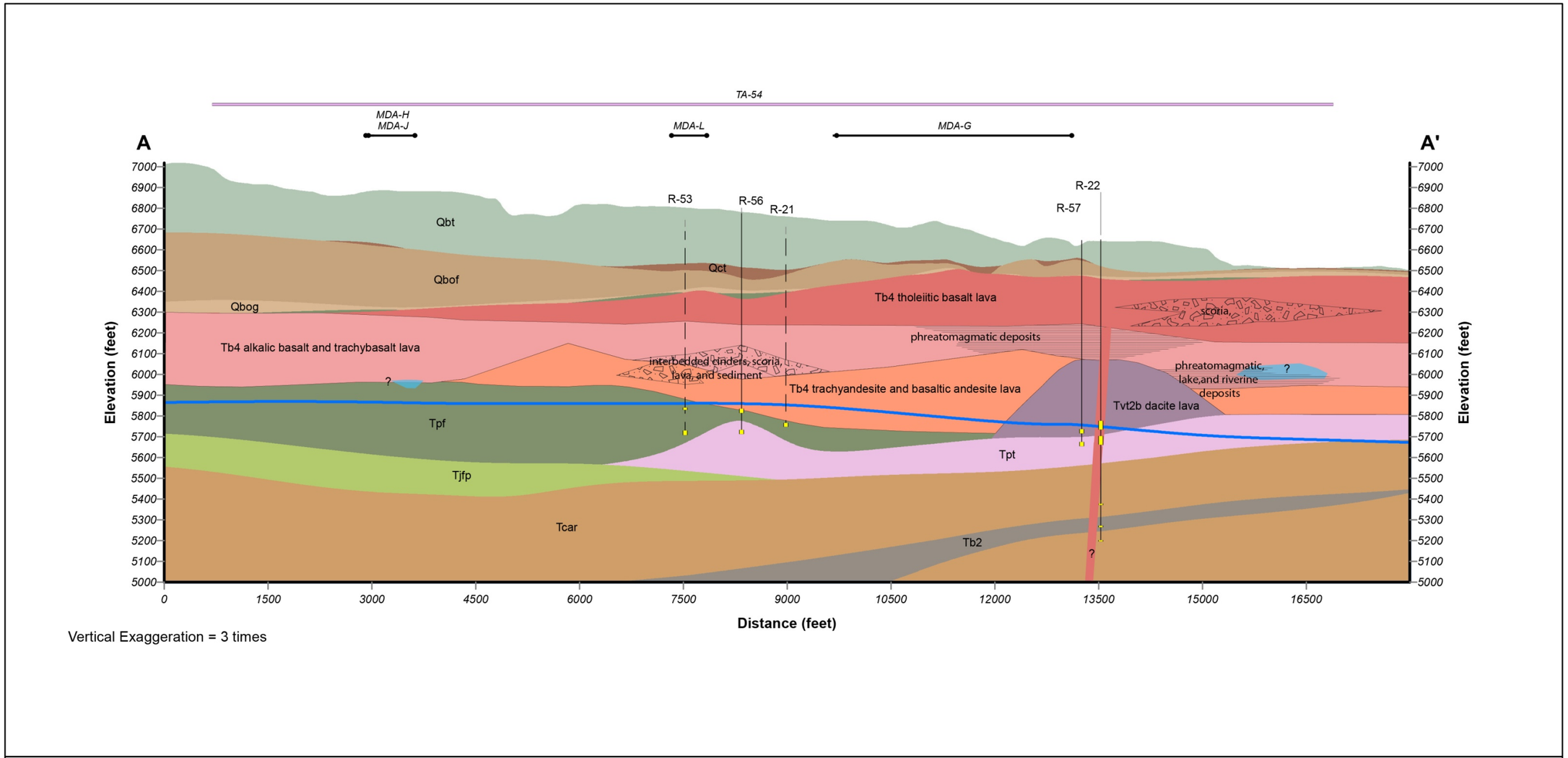


Figure E-2.1-1 Location of regional and intermediate wells in the vicinity of TA-54 and the lines of section for geologic cross-sections shown in Figures E-2.1-2 through E-2.1-8



Legend

- Material Disposal Area
- Technical Area
- Regional Water Table
- Intermediate Well Screen
- Regional Well Screen
- Perched Groundwater

Offset from Section (feet)

- < 500
- 500 - 1000
- 1000 - 2250

Geologic Unit

- Qbt - Tshirege Member, Bandelier Tuff
- Qct - Cerro Toledo Formation
- Qbof - Otowi Member, Bandelier Tuff
- Qbog - Guaje Pumice Bed
- Tb4 - Cerros del Rio Volcanic Series, basalt
- Tvt2b - Cerros del Rio Volcanic Series, dacite
- Tpf - Puye Formation, fanglomerate
- Tpt - Puye Fm, Totavi Lentil
- Tjfp - Miocene pumiceous sediments (Bearhead equivalent)
- Tcar - Chamita Formation
- Tb2 - Miocene Basalt

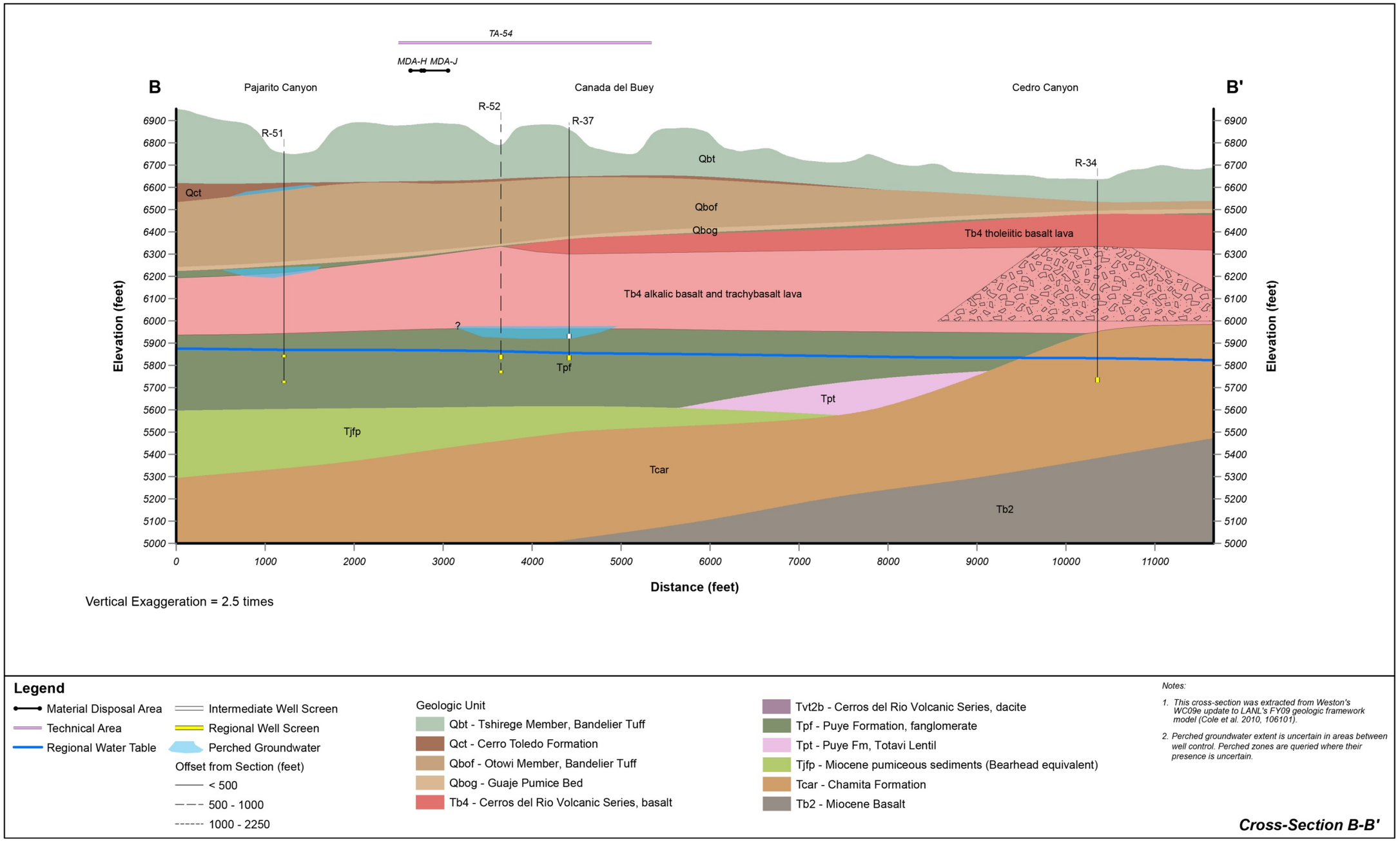
Notes:

1. *This cross-section was extracted from Weston's WC09e update to LANL's FY09 geologic framework model (Cole et al. 2010, 106101).*
2. *Perched groundwater extent is uncertain in areas between well control. Perched zones are queried where their presence is uncertain.*

Cross-Section A-A'

Note: See Figure E-2.1-1 for location of cross-section.

Figure E-2.1-2 Northwest to southeast geologic cross-section A-A' along the axis of Mesita del Buey



Legend

- Material Disposal Area
- Technical Area
- Regional Water Table
- Intermediate Well Screen
- Regional Well Screen
- Perched Groundwater

Offset from Section (feet)

- < 500
- 500 - 1000
- 1000 - 2250

Geologic Unit

- Qbt - Tshirege Member, Bandelier Tuff
- Qct - Cerro Toledo Formation
- Qbof - Otowi Member, Bandelier Tuff
- Qbog - Guaje Pumice Bed
- Tb4 - Cerros del Rio Volcanic Series, basalt
- Tvt2b - Cerros del Rio Volcanic Series, dacite
- Tpf - Puye Formation, fanglomerate
- Tpt - Puye Fm, Totavi Lentil
- Tjfp - Miocene pumiceous sediments (Bearhead equivalent)
- Tcar - Chamita Formation
- Tb2 - Miocene Basalt

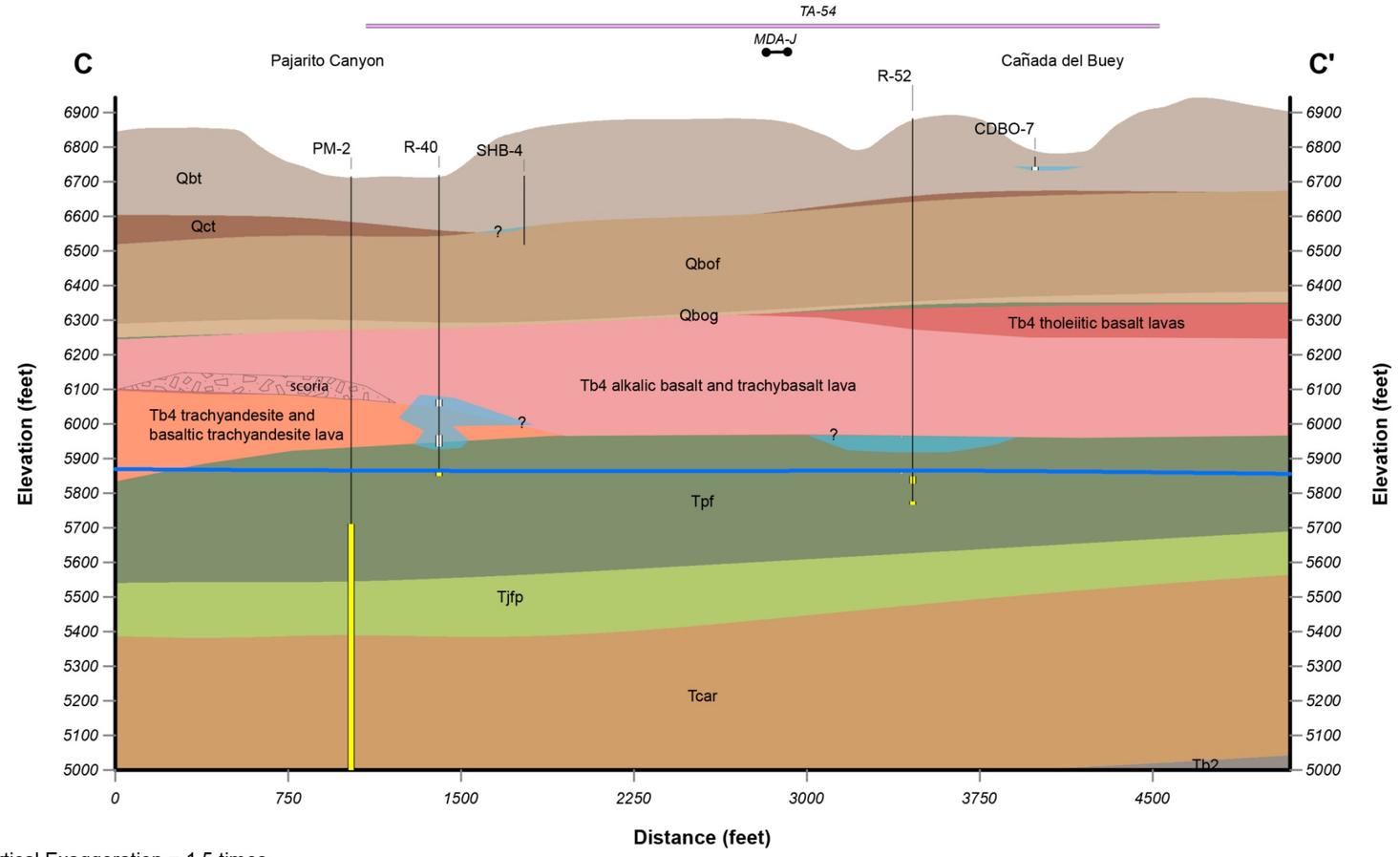
Notes:

1. *This cross-section was extracted from Weston's WC09e update to LANL's FY09 geologic framework model (Cole et al. 2010, 106101).*
2. *Perched groundwater extent is uncertain in areas between well control. Perched zones are queried where their presence is uncertain.*

Cross-Section B-B'

Note: See Figure E-2.1-1 for location of cross-section.

Figure E-2.1-3 Southwest to northeast geologic cross-section B-B' through MDA H



Vertical Exaggeration = 1.5 times

Legend

- Material Disposal Area
- Technical Area
- Regional Water Table
- Intermediate Well Screen
- Regional Well Screen
- Perched Groundwater

Offset from Section (feet)

- < 500
- 500 - 1000
- 1000 - 2500

Geologic Unit

- Qbt - Tshirege Member, Bandelier Tuff
- Qct - Cerro Toledo Formation
- Qbof - Otowi Member, Bandelier Tuff
- Qbog - Guaje Pumice Bed
- Tb4 - Cerros del Rio Volcanic Series, tholeiitic
- Tb4 - Cerros del Rio Volcanic Series, alkalic basalt and trachybasalt
- Tb4 - Cerros del Rio Volcanic Series, trachyandesite and basaltic trachyandesite
- Tvt2b - Cerros del Rio Volcanic Series, dacite
- Tpf - Puye Formation, fanglomerate
- Tpt - Puye Fm, Totavi Lentil
- Tjfp - Miocene pumiceous sediments (Bearhead equivalent)
- Tcar - Chamita Formation
- Tb2 - Miocene Basalt

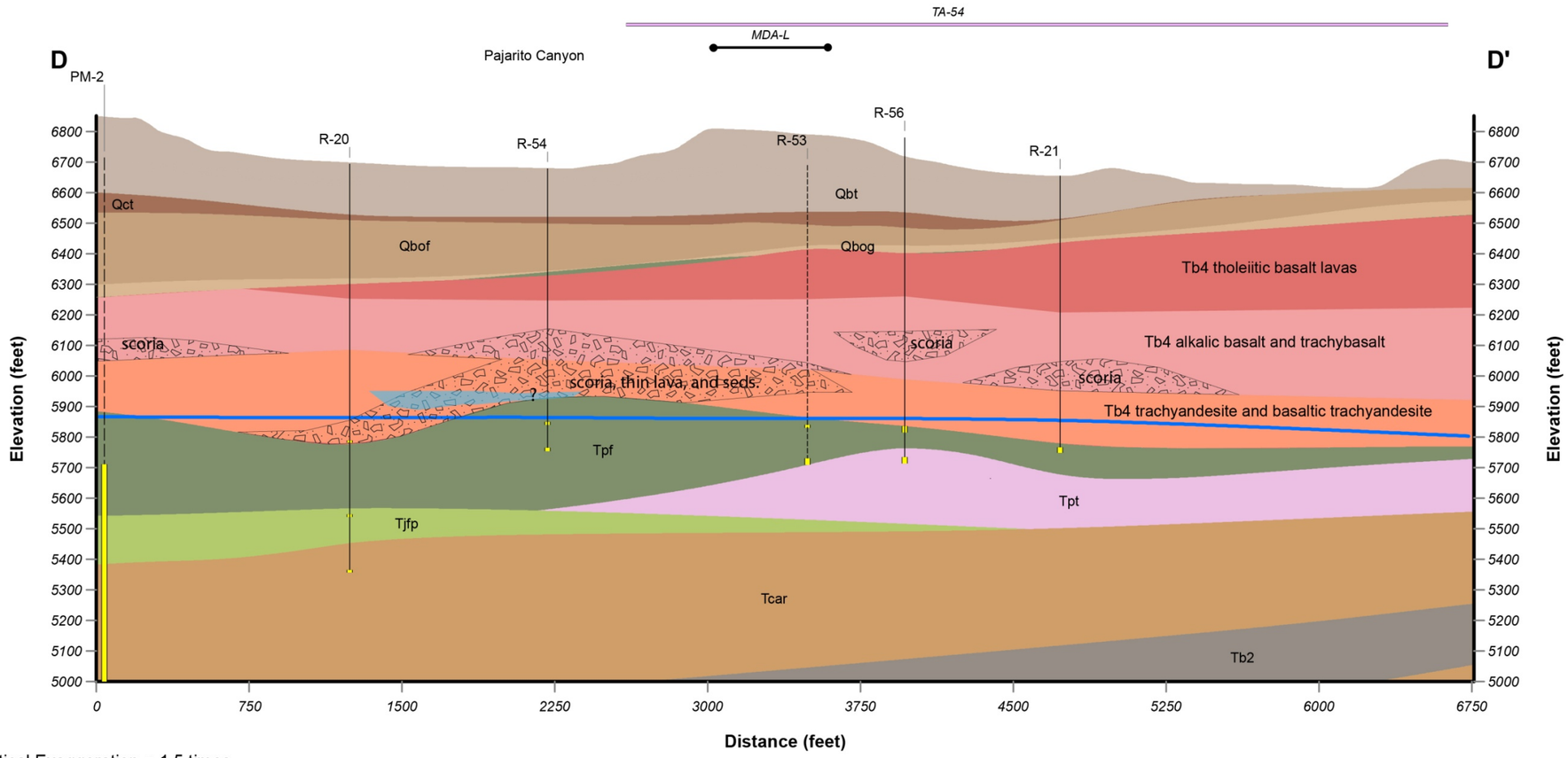
Notes:

1. *This cross-section was extracted from Weston's WC09e update to LANL's FY09 geologic framework model (Cole et al. 2010, 106101).*
2. *Perched groundwater extent is uncertain in areas between well control. Perched zones are queried where their presence is uncertain.*

Cross-Section C-C'

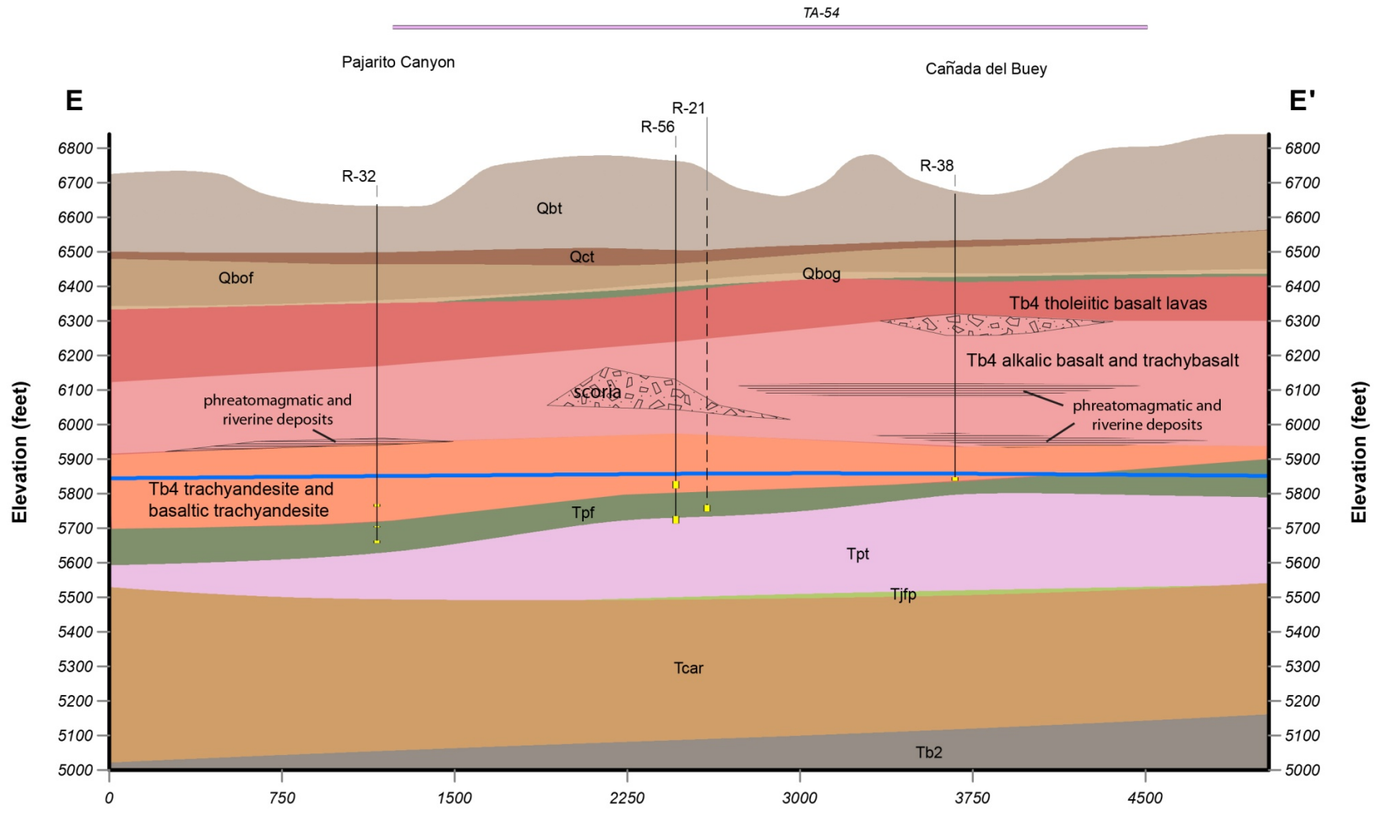
Note: See Figure E-2.1-1 for location of cross-section.

Figure E-2.1-4 South to north geologic cross-section C-C' near MDA H



Note: See Figure E-2.1-1 for location of cross-section.

Figure E-2.1-5 West to east geologic cross-section D-D' through MDA L



Legend

- Material Disposal Area
- Technical Area
- Regional Water Table
- Intermediate Well Screen
- Regional Well Screen
- Perched Groundwater

Offset from Section (feet)

- < 500
- 500 - 1000
- 1000 - 2500

Geologic Unit

- Qbt - Tshirege Member, Bandelier Tuff
- Qct - Cerro Toledo Formation
- Qbof - Otowi Member, Bandelier Tuff
- Qbog - Guaje Pumice Bed
- Tb4 - Cerros del Rio Volcanic Series, tholeiitic
- Tb4 - Cerros del Rio Volcanic Series, alkalic basalt and trachybasalt
- Tb4 - Cerros del Rio Volcanic Series, trachyandesite and basaltic trachyandesite
- Tvt2b - Cerros del Rio Volcanic Series, dacite
- Tpf - Puye Formation, fanglomerate
- Tpt - Puye Fm, Totavi Lentil
- Tjfp - Miocene pumiceous sediments (Bearhead equivalent)
- Tcar - Chamita Formation
- Tb2 - Miocene Basalt

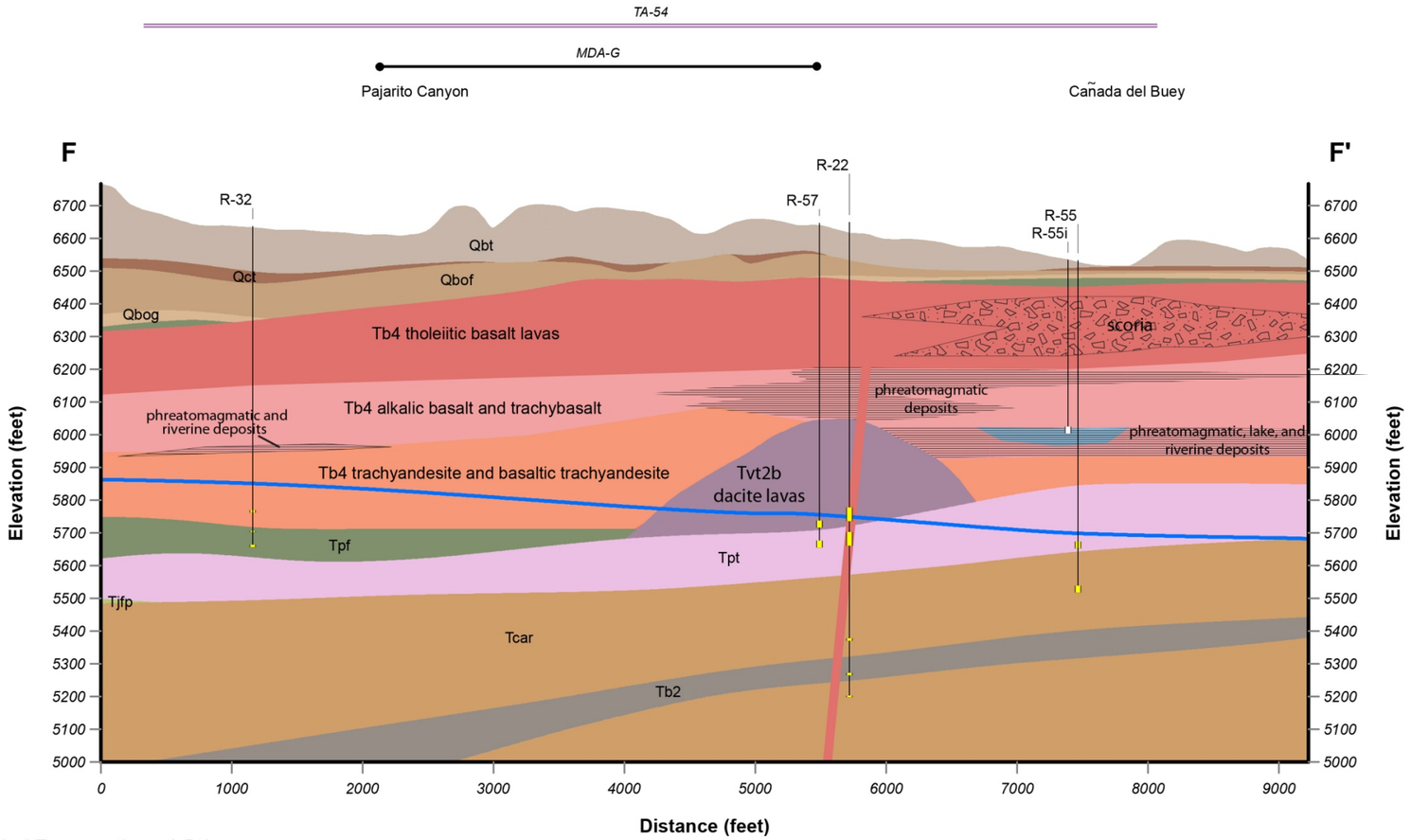
Notes:

1. *This cross-section was extracted from Weston's WC09e update to LANL's FY09 geologic framework model (Cole et al. 2010, 106101).*
2. *Perched groundwater extent is uncertain in areas between well control. Perched zones are queried where their presence is uncertain.*

Cross-Section E-E'

Note: See Figure E-2.1-1 for location of cross-section.

Figure E-2.1-6 South to north geologic cross-section E-E' through the area between MDAs G and L



Legend

- Material Disposal Area
- Technical Area
- Regional Water Table
- Intermediate Well Screen
- Regional Well Screen
- Perched Groundwater

Offset from Section (feet)

- < 500
- 500 - 1000
- 1000 - 2500

Geologic Unit

- Qbt - Tshirege Member, Bandelier Tuff
- Qct - Cerro Toledo Formation
- Qbof - Otowi Member, Bandelier Tuff
- Qbog - Guaje Pumice Bed
- Tb4 - Cerros del Rio Volcanic Series, tholeiitic
- Tb4 - Cerros del Rio Volcanic Series, alkalic basalt and trachybasalt
- Tb4 - Cerros del Rio Volcanic Series, trachyandesite and basaltic trachyandesite
- Tvt2b - Cerros del Rio Volcanic Series, dacite
- Tpf - Puye Formation, fanglomerate
- Tpt - Puye Fm, Totavi Lentil
- Tjfp - Miocene pumiceous sediments (Bearhead equivalent)
- Tcar - Chamita Formation
- Tb2 - Miocene Basalt

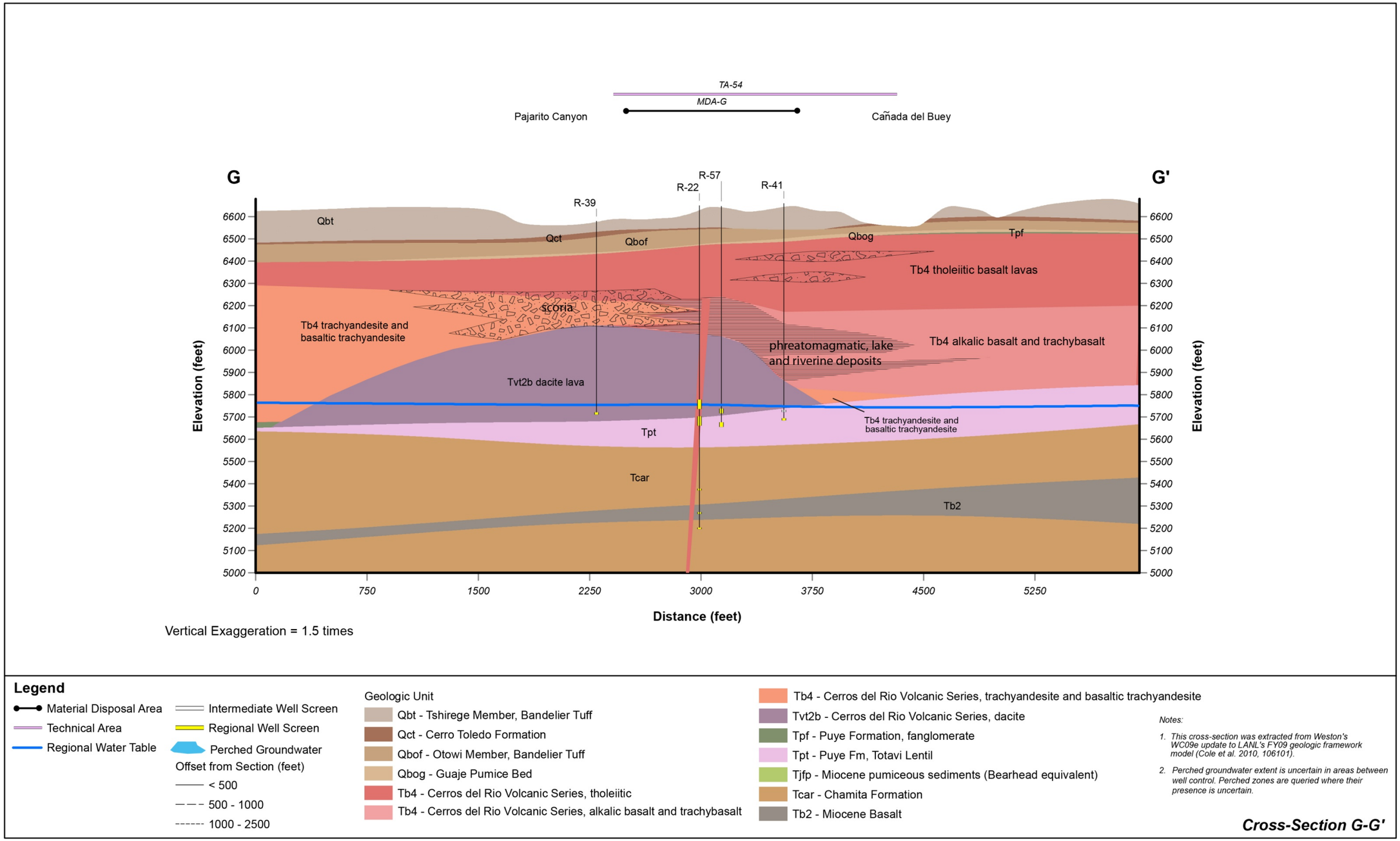
Notes:

1. *This cross-section was extracted from Weston's WC09e update to LANL's FY09 geologic framework model (Cole et al. 2010, 106101).*
2. *Perched groundwater extent is uncertain in areas between well control. Perched zones are queried where their presence is uncertain.*

Cross-Section F-F'

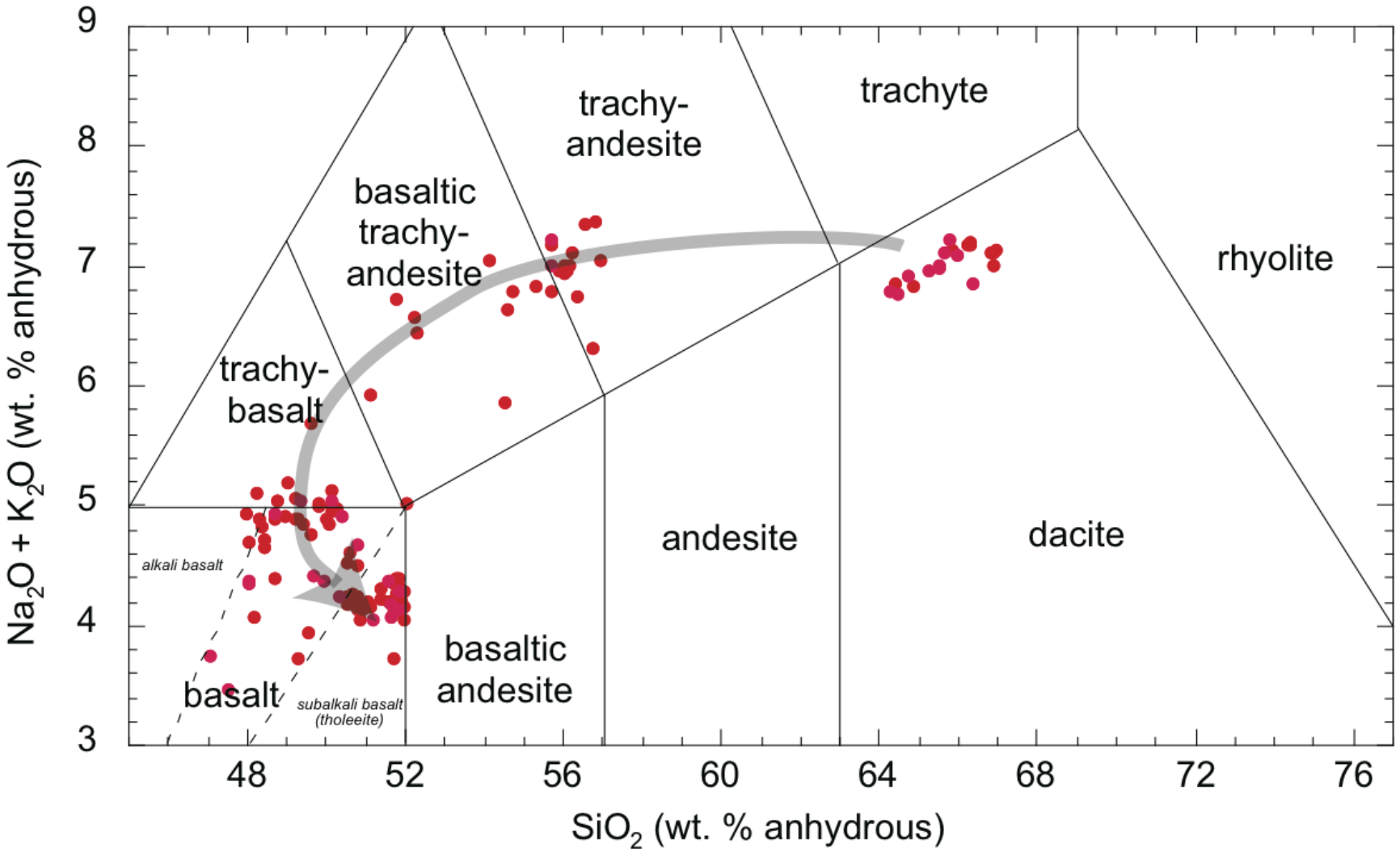
Note: See Figure E-2.1-1 for location of cross-section.

Figure E-2.1-7 West to east geologic cross-section F-F' through MDA G



Note: See Figure E-2.1-1 for location of cross-section.

Figure E-2.1-8 Southwest to northeast geologic cross-section G-G' through MDA G



Notes: Gray arrow shows the eruption sequence from oldest to youngest rocks. Rocks with basalt through trachyandesite compositions are designated Tb4 in the discussion and cross-sections; dacite compositions are designated as Tvt2b.

Figure E-2.1-9 Alkali-silica diagram showing chemical classification of Cerros del Rio volcanic rocks in the vicinity of TA-54

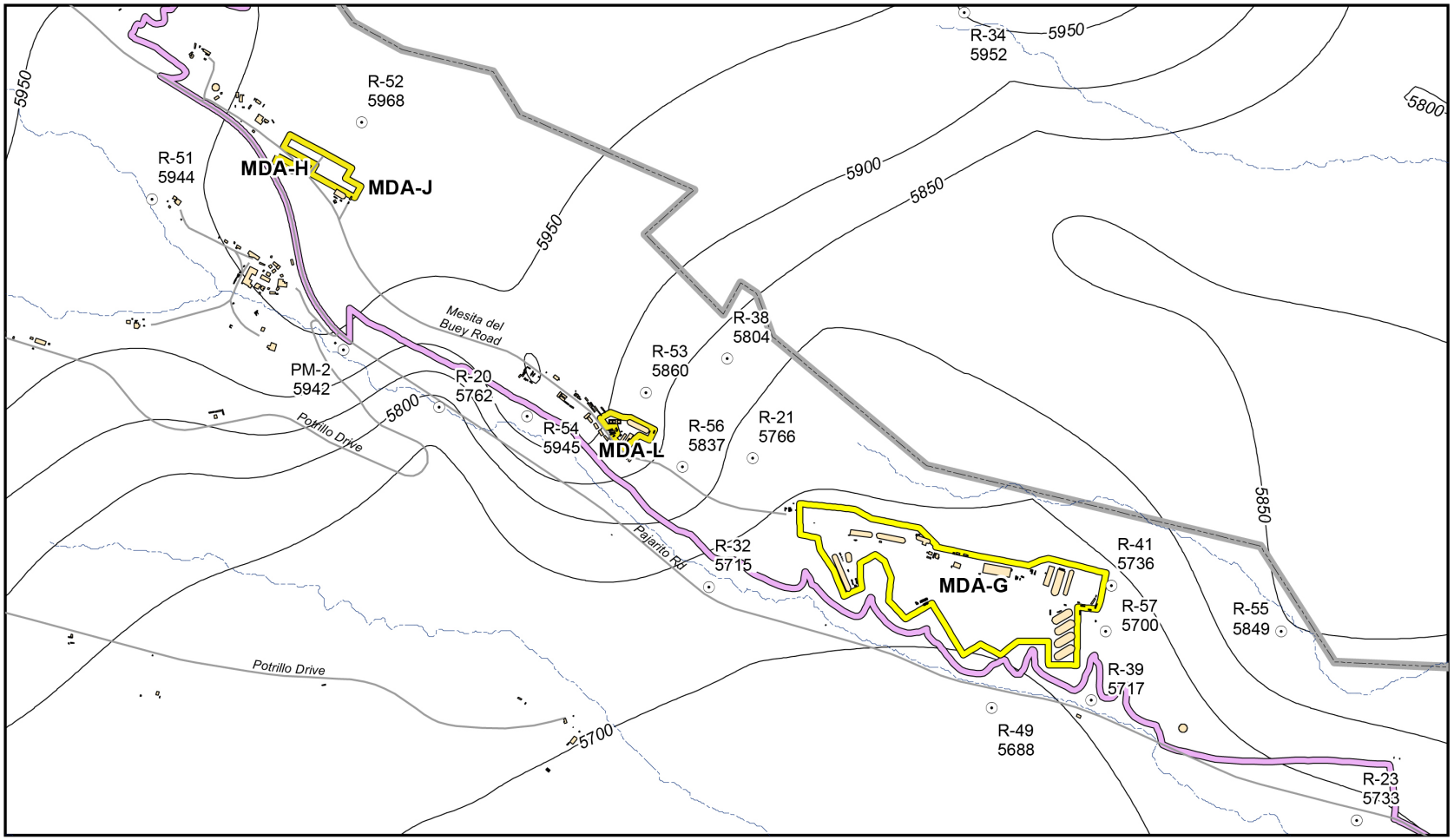


Figure E-2.1-10 Structure contour map for the base of Cerros del Rio volcanic rocks in the vicinity of TA-54

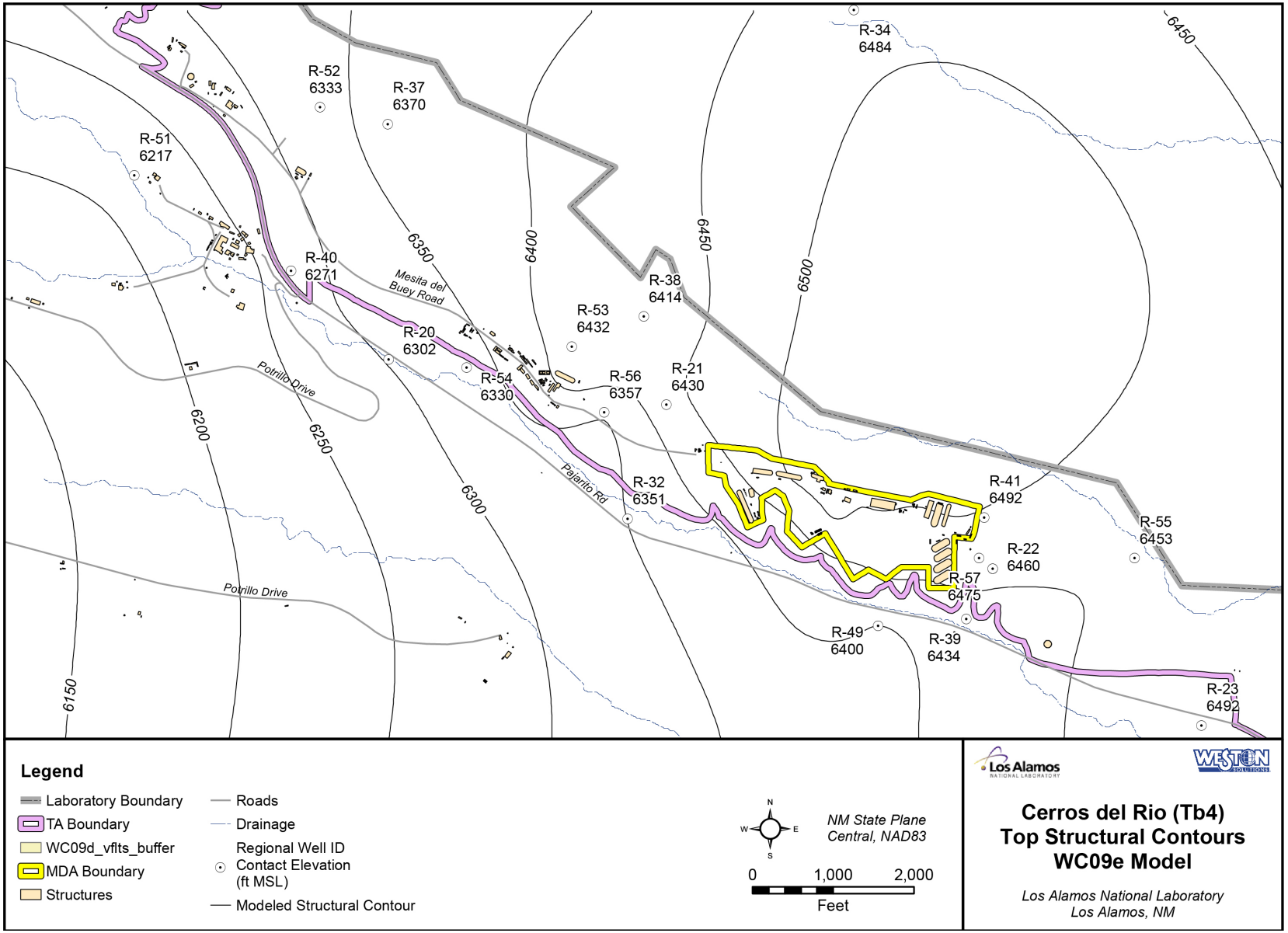
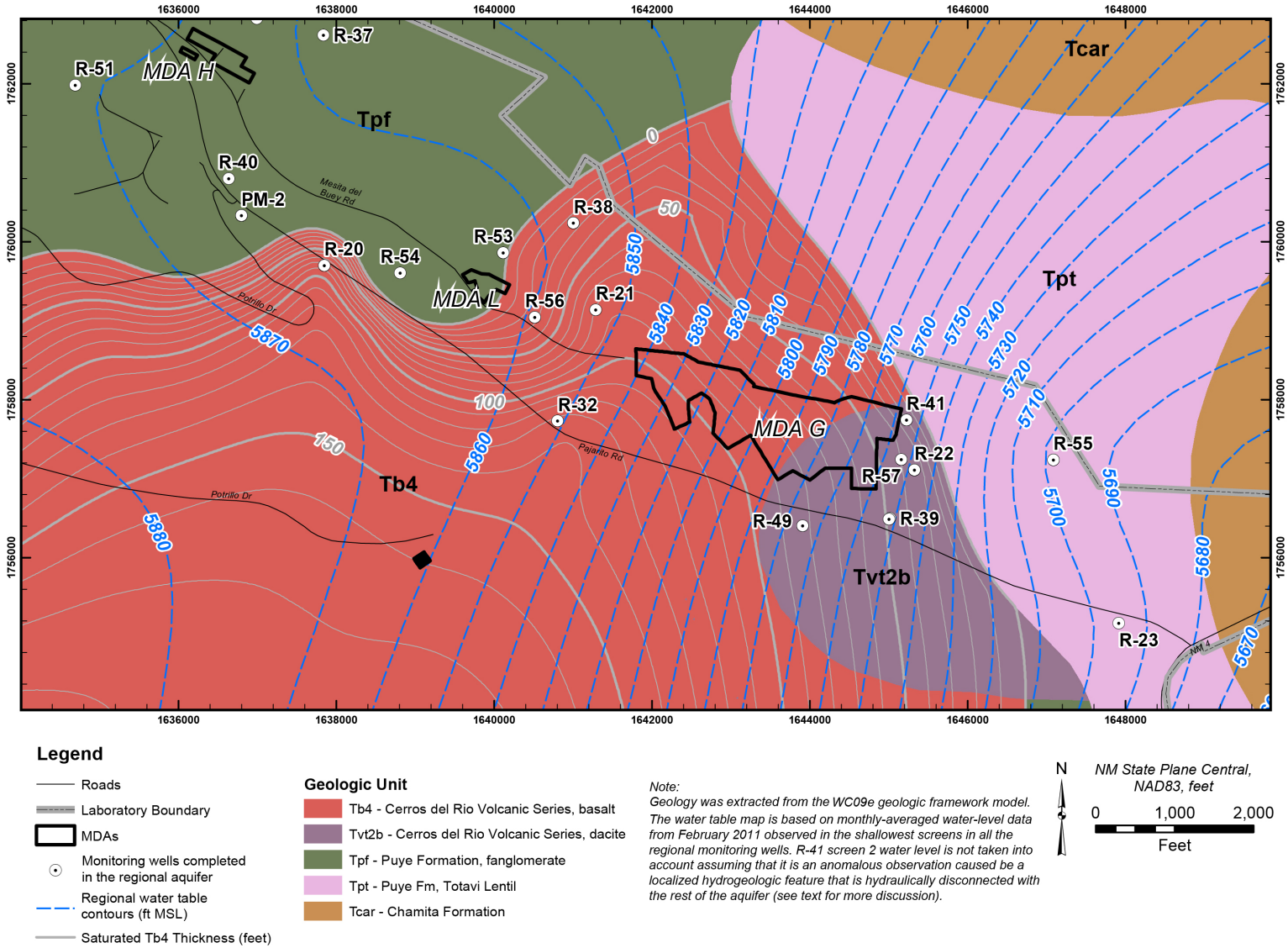


Figure E-2.1-11 Structure contour map for the top of Cerros del Rio volcanic rocks in the vicinity of TA-54



Note: Groundwater-level contour map is based on average data representative for September 2010.

Figure E-2.1-12 Hydrostratigraphy at the regional water table and estimated thickness of Cerros del Rio lavas beneath the regional water table (gray contours)

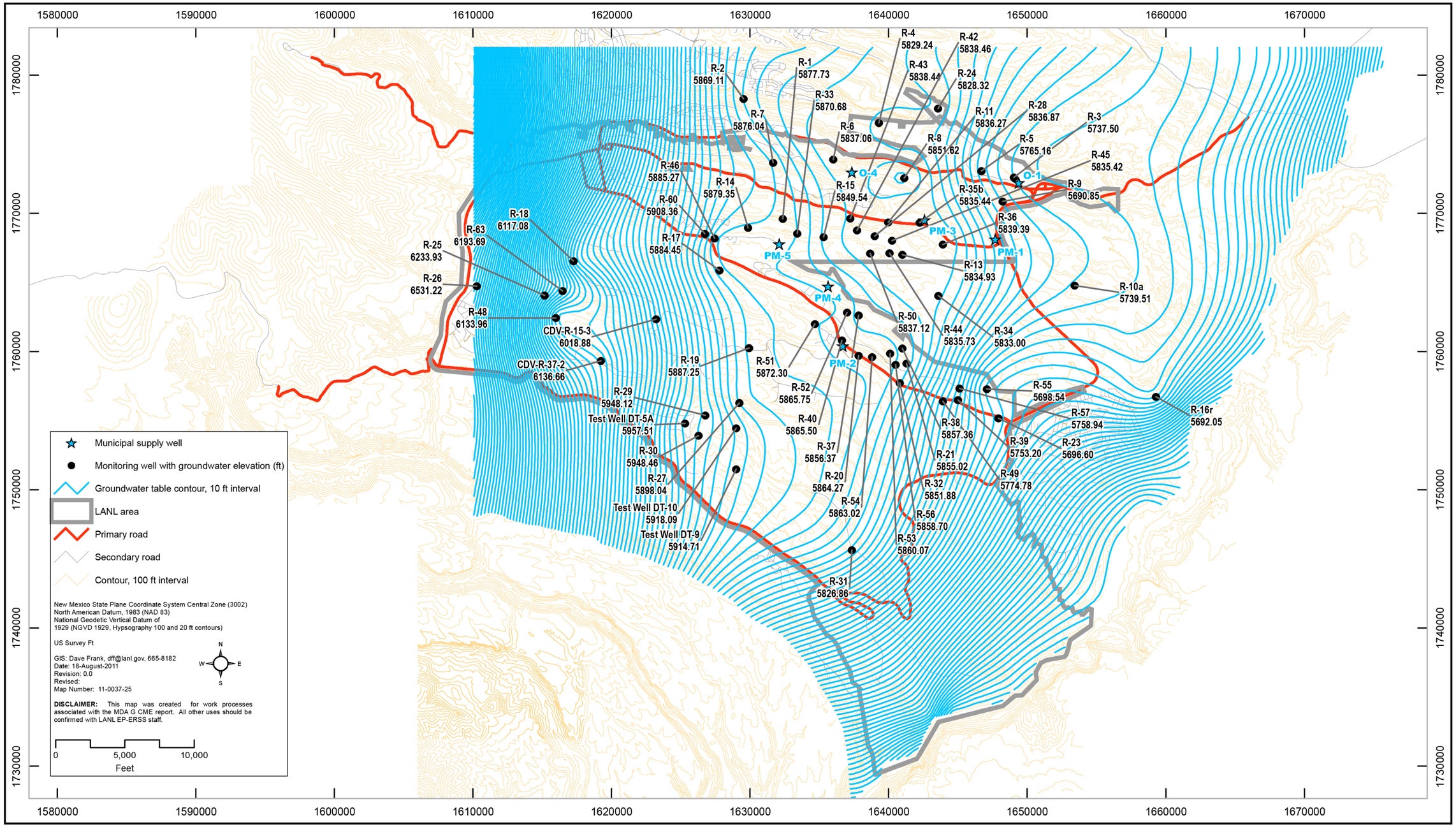
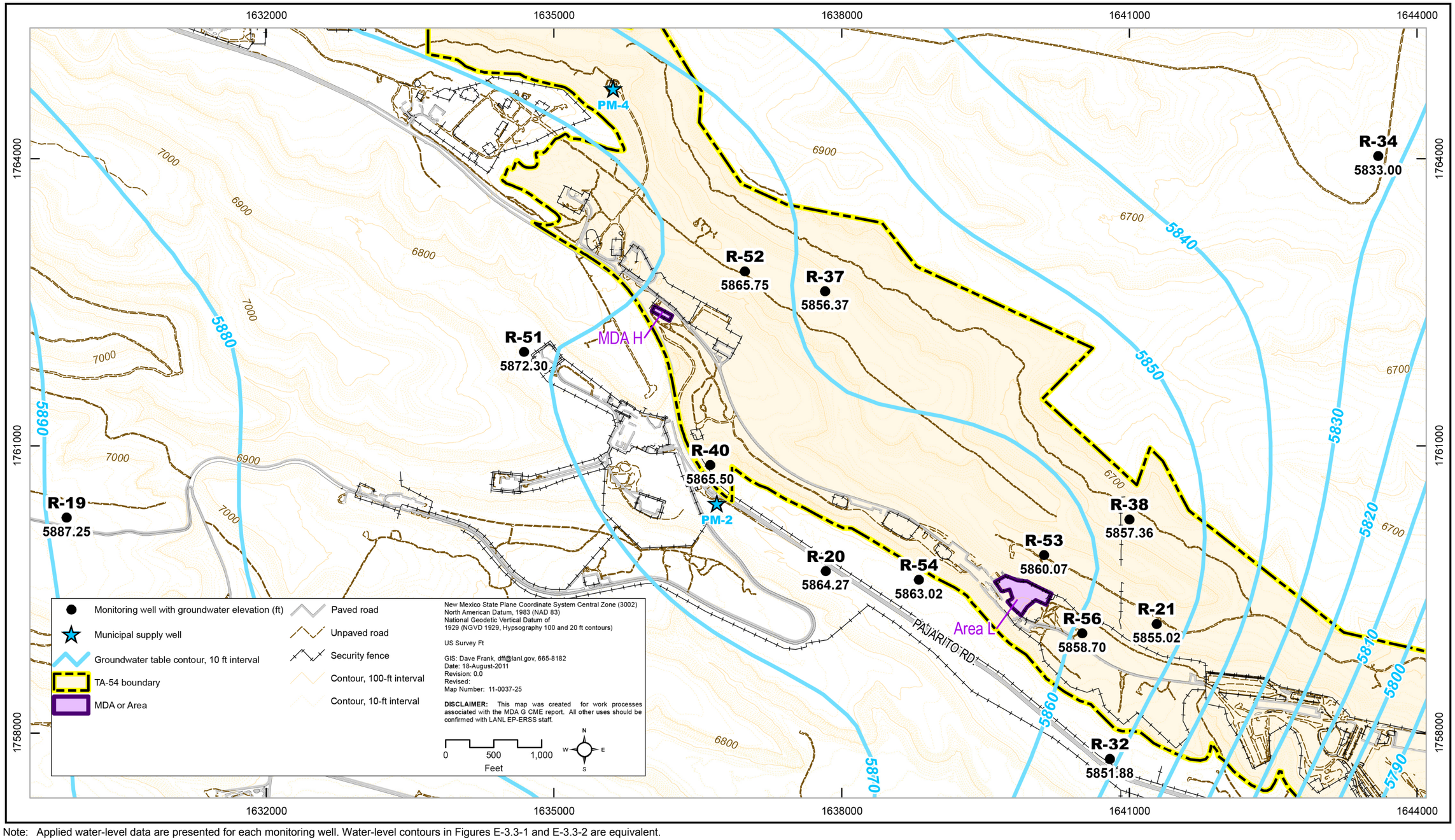
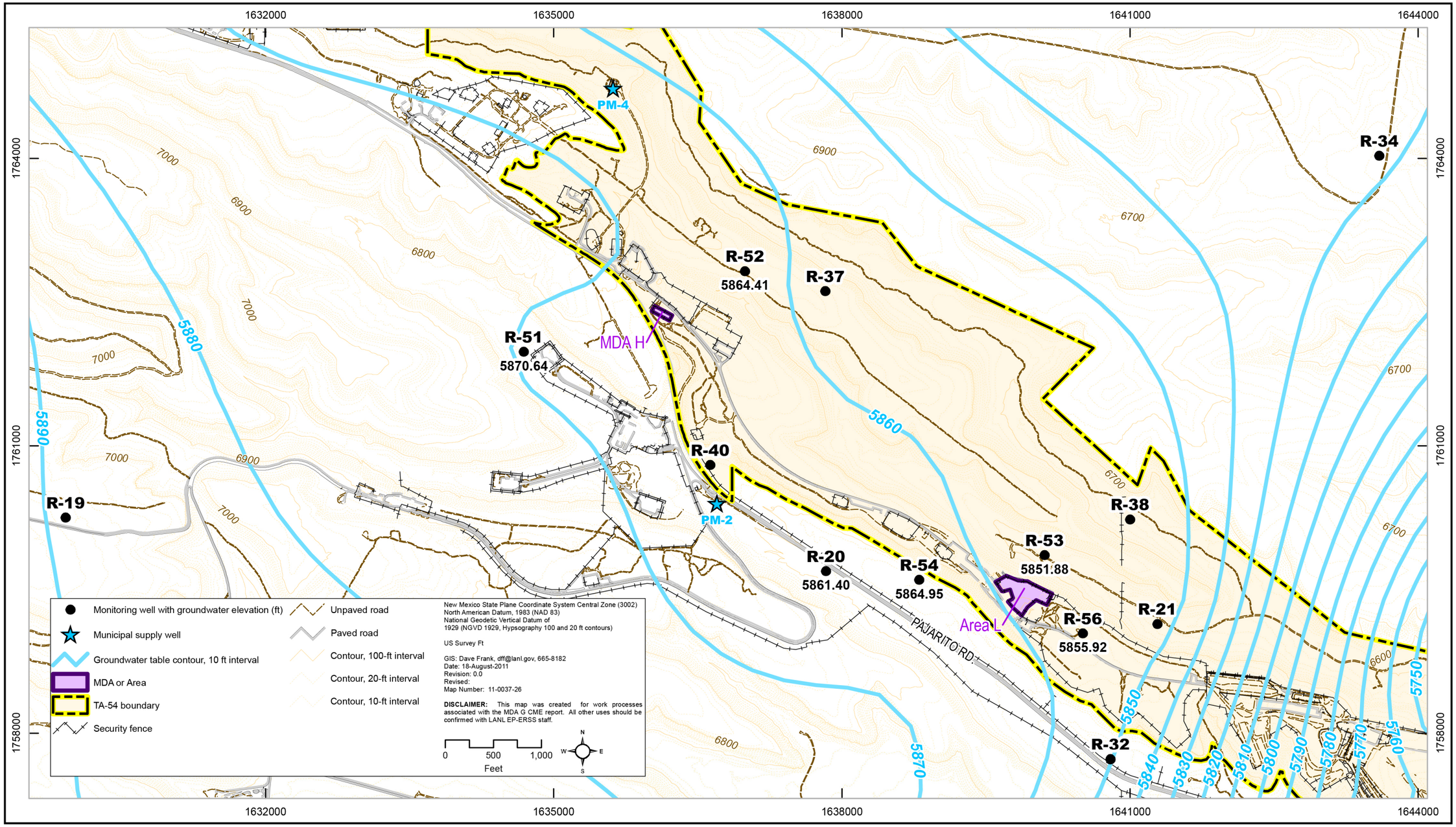


Figure E-3.3-1 Laboratory-scale regional water-table map based on February 2011 water levels



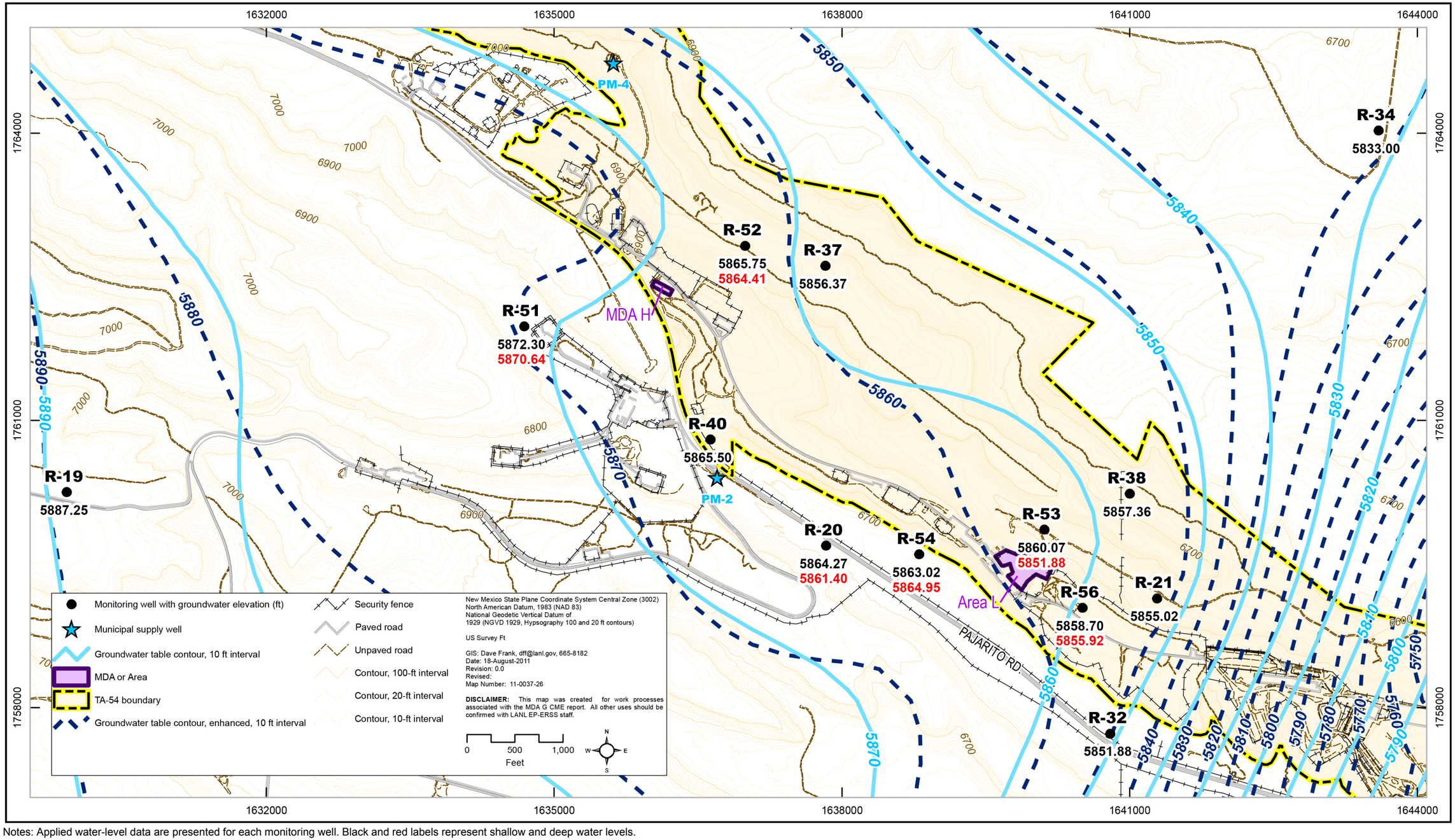
Note: Applied water-level data are presented for each monitoring well. Water-level contours in Figures E-3.3-1 and E-3.3-2 are equivalent.

Figure E-3.3-2 Water-level contour map representative of the regional water-table near MDA L; the map is based on February 2011 water levels measured in the shallowest screens in the monitoring wells



Note: Applied water-level data are presented for each monitoring well.

Figure E-3.3-3 Water-level contour map representative of the groundwater flow in the deeper section of the regional aquifer (about 100 ft below the regional water table) near MDA L; the map is based on February 2011 water levels measured in the deep screens of the regional monitoring wells (average distance between the shallow and deep screens in the wells is about 100 ft)



Notes: Applied water-level data are presented for each monitoring well. Black and red labels represent shallow and deep water levels.

Figure E-3.3-4 Comparison of the water-level contour maps presented in Figures E-3.3-2 and E-3.3-3; the light and dark blue contours represent the shallow and deep sections of the aquifer, respectively

Table E-3.1-1
Hydrogeologic Characteristics of the Regional Monitoring Wells in the Area Near MDA H

Well Screen	k (ft/d)	Unit	Submergence below the Water Table	Hydrodynamic Conditions	Comments
R-51 #1	16	Tpf	23	Potentially confined	Silt-rich materials 10 ft thick above screen 1; pumping test complicated because of gases in the aquifer
R-51 #2	4	Tpf	~135	Unconfined or partly confined	Pumping test complicated because of gases in the aquifer
R-52 #1	19	Tpf	19	Unconfined or partly confined	Pumping test complicated because of gases in the aquifer
R-52 #2	26	Tpf	~90	Unconfined or partly confined	Pumping test complicated because of gases in the aquifer
R-40 #2	4	Tpf mixed with Tpt	-4	Unconfined	Well screen straddles the regional water table; hydraulic connection between the regional aquifer and the overlying perched zone (screened at R-40 screen 1 and R-40i) is unknown.
R-37 #2	21	Tpf	14	Unconfined	Drawdown equilibration at late pumping times.

Note: Wells are ordered from west to east, approximately following the general groundwater flow directions of the regional aquifer.

Table E-3.1-2
Estimates of Effective Aquifer Hydraulic Properties
in the Area Near MDA H Based on Analysis of the Water-Level Transients
Observed at the Monitoring Wells Caused by Water-Supply Pumping by PM-2 and PM-4

	PM-2		PM-4		
Well Screen	Transmissivity (m^2/d)	Specific storage (-)	Transmissivity (m^2/d)	Specific storage (-)	Comment
R-51 #1	ND*	ND	2.3E+02	9.1E-02	Responses to PM-4 (~1 ft based on the existing data); Responses to PM-2 also expected
R-51 #2	ND	ND	2.6E+02	2.1E-02	Responses to PM-2 and PM-4 (~1.5 ft based on the existing data)
R-52 #1	ND	ND	1.5E+02	1.8E-01	Responses to PM-4 (~2 ft based on the existing data)
R-52 #2	ND	ND	1.7E+02	6.9E-02	Responses to PM-4 (~2.5 ft based on the existing data)
R-40 #2	ND	ND	4.4E+02	8.2E-03	Responses to PM-2 (~2 ft) and PM-4 (~0.75 ft based on the existing data)
R-37 #2	ND	ND	2.3E+02	9.1E-02	Responses to PM-2 and PM-4 (~2 ft based on the existing data)

Note: Wells are ordered from west to east, approximately following the general groundwater flow direction of the regional aquifer.
*ND = Not determined because PM-2 was not actively used for water supply during the period of observation.

Table E-3.1-3
Vertical Component of the Hydraulic Gradient at the Monitoring Wells Near TA-54

Well	Value
R-51	0.02
R-52	0.03
R-20	0.2
R-54	-0.03
R-53	0.09
R-56	0.05
R-32	0.02
R-49	0.4
R-57	0.2
R-22	0.2
R-55	0.03

Note: Wells are ordered from west to east, approximately following the general groundwater flow directions of the regional aquifer. The vertical distance between the screens does not account for the extent of the filter pack.

Table E-3.1-4
Barometric Efficiency and Earth-Tide Responses of the Monitoring Well Screens Near MDA H Based on Hourly Water-Level Data

Well	Screen	Barometric Efficiency (%)	Time Lag (hr)	Earth-Tide Response
R-51	R-51 #1	100	0	N
R-51	R-51 #2	90	3	N
R-52	R-52 #1	100	2	N
R-52	R-52 #2	100	3	N
R-40	R-40 #2	100	2	N
R-37	R-37 #2	100	1	N
R-20	R-20 #1	100	2	N
R-20	R-20 #2	80	24	Y
R-20	R-20 #3	—*	—	—

Note: Wells are ordered from west to east, approximately following the general groundwater flow directions of the regional.

*— = Response to PM-2 and PM-4 pumping inhibits evaluation.

Appendix F

Supporting Information for
Cost Estimates for Material Disposal Area H

F-1.0 INTRODUCTION

This appendix provides the basis for the cost estimates, summary cost information, assumptions, estimate details, and material and labor pricing data used in developing the cost estimates for corrective measures evaluation (CME) alternatives for Material Disposal Area (MDA) H at Technical Area 54 (TA-54) at Los Alamos National Laboratory (the Laboratory) (section 8 of the CME report). The estimates are intended to be consistent with U.S. Environmental Protection Agency (EPA) guidance on developing and documenting costs estimated during feasibility studies (EPA 2000, 071540). Cost estimates are expected to be within the accepted standard accuracy range of +50% to –30% established by EPA for remedial alternative estimates at the alternatives screening stage (EPA 2000, 071540, p. 2-4).

Three corrective measures alternatives were retained and have been brought forward for cost estimating purposes. These are in addition to the no-action alternative.

F-1.1 Compliance Order on Consent Requirements

The Compliance Order on Consent (Consent Order) requires the following: capital costs shall include, without limitation, construction and installation costs; equipment costs; land development costs; and indirect costs, including engineering costs, legal fees, permitting fees, startup and shakedown costs, and contingency allowances. Operations and maintenance (O&M) costs shall include, without limitation, operating labor and materials costs, maintenance labor and materials costs, replacement costs, utilities, monitoring and reporting costs, administrative costs, indirect costs, and contingency allowances. All costs shall be calculated based on their net present value (PV).

As presented in guidance documents, confusion often exists with the terms “direct” and “indirect” costs. Therefore, in this report the term “capital” costs includes planning, design, construction, management-related activities, and both labor and professional services for installing the remedial alternative. Recurring operations, maintenance, and monitoring costs, including regular annual costs and periodic costs, are separated out from capital costs. Periodic costs include 5-yr reviews, equipment replacement, and major repairs.

F-2.0 METHOD

The cost estimates have been developed based on a bottom-up approach using WINEST cost estimating software. The assumptions used in the calculations are discussed in section F-3.0. The construction pricing is based on the 2010 RS Means Database for equipment and materials and the current Davis Bacon Wage Rates for construction in Los Alamos. RS Means is a comprehensive database of industry averages for materials, labor, and equipment. Line items contain descriptions of appropriate materials, labor, and equipment to successfully perform particular tasks.

An example line item follows for installation of a fence:

> Fence, chain link industrial, aluminized steel, 6-gauge wire, 2-1/2-in. posts @ 10-ft on center, 8-ft high, includes excavation, in concrete, excludes barbed wire

For this line item, RS Means has taken an industry average of the cost of materials for a particular task, including aluminized 6-gauge steel wire; 2-1/2-in.-diameter, 8-ft-long posts; and concrete, not including barbed wire. This average includes the labor cost to string the aluminized wire, excavate post holes, set

the posts, and mix and place concrete and also includes any equipment costs for performing the excavation.

A labor factor was used to increase the project cost on labor because of the remote location of the site or for additional rigor for a site. The basic estimating units generally reflect a normal standard for construction costs. Many special work situations and job conditions may require additional material or labor work hours. The quantities used here are for estimating purposes only and vary slightly from quantities stated within the waste inventory, section 2.3. The actual design and operations costs will vary from these estimates when the corrective measure implementation (CMI) is completed.

F-2.1 Capital Costs

Capital costs include both direct and indirect costs. The capital costs consist of construction and installation costs; equipment costs; land development costs; distributables; and indirect costs, including engineering design costs, legal fees, permitting fees, professional management startup and shakedown costs, and contingency allowances. Detailed estimates of capital costs in calendar year 2010 dollars are provided below and in section 8 tables of the CME report.

The distributable costs include Field Non-Manual, which is calculated as 20% of direct capital labor hours: Craft Distributable–Labor, which is calculated as 25% of direct capital labor hours: and Craft Distributable –Materials, which in this estimate include a $7 per direct job hour cost to account for the nonlabor costs associated with temporary utilities/services, small tools, consumables, construction equipment not specifically identified in direct work line items, and training costs. For example,

> Site Fencing Labor Hours (220) + RCRA Cover Labor Hours (3098) * 20% = 664 hr of Field Non-Manual
>
> Site Fencing Labor Hours (220) + RCRA Cover Labor Hours (3098) = 3,318 hours * 25% = 829 hr of Craft Distributable–Labor
>
> Site Fencing Labor Hours (220) + RCRA Cover Labor Hours (3098) = 3,318 hours * 25% = 829 hr * $7/hr = $5,803 which is then burdened with applicable taxes including, NMGRT, G&A, Infrastructure, and AD Support Taxes for a Total Craft Distributable–Material Cost of $9,929.

The design costs were calculated as 16% of the total direct capital costs. For example,

> Site Fence Total ($77,398) + RCRA Cover Total ($846,585) + Distributable Total ($150,751) = $1,074,734 * 16% = $171,957 which is then burdened with applicable taxes including, NMGRT, G&A, Infrastructure, and AD Support Taxes for a Total Design Cost of $250,352.

The professional management costs were calculated as 26% of the total direct capital costs and design. For example,

> Site Fence Total ($77,398) + RCRA Cover Total ($846,585) + Distributable Total ($150,751) + Design Total ($250,352) = $1,325,086 * 26% = $344,522 which is then burdened with applicable taxes including, NMGRT, G&A, Infrastructure, and AD Support Taxes for a Total Professional Management Cost of $754,892.

The contingency costs were calculated as 50% of the total direct capital costs plus design and professional management costs. For example,

> Total Direct Capital Costs ($1,074,734) + Design Costs ($250,352) + Professional Management Costs ($754,892) = $2,079,978 * 50% = $1,039,989.

F-2.2 Operations and Maintenance Costs

O&M costs include both direct and indirect costs. The O&M costs include operating labor and materials costs, maintenance labor and materials costs, replacement costs, utilities, monitoring and reporting costs, administrative costs, O&M associated indirect costs, and contingency allowances. Estimates of O&M costs in 2010 dollars are provided below and in section 8 tables of the CME report.

The professional management costs were calculated as 26% of the total direct O&M costs prior to PV analysis. The costs are then discounted based on the PV analysis discussed below in section F-2.3.

The contingency costs were calculated as 50% of the total direct O&M costs plus professional management costs. For example,

> Total Direct O&M Costs ($444,924) + Professional Management O&M Costs ($174,098) = $619,022 * 50% = $309,510.

F-2.3 PV Analysis

To compare one alternative's costs with other alternative's costs over different time periods, the costs were discounted to a 2010 PV, as recommended in "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (EPA 2000, 071540). PV costs for a technology are the sum of all capital costs and continuing costs. Presentation of capital and O&M costs as PV is consistent with the CME requirements contained in Section VII.D.4.b.v of the Consent Order. The principle is also embraced for federal programs. The Office of Management and Budget (OMB) circular A-94 states, "The standard criterion for deciding whether a government program can be justified on economic principles is net present value" (Office of Management and Budget 1992, 094804, p. 3). The OMB circular Appendix C (revised December 2009) recommends the use of a real discount rate of 0.9% for activities lasting 3 yr and 2.7% for activities lasting between 20 and 30 yr. These assumptions have been used in the calculation of the net PV for the alternatives within this CME.

Net PV was calculated according to the following formula:

$$PV_{total} = \sum_{t=1}^{t=n} \frac{1}{(1+i)^t} \cdot C_t$$

where PV_{total} = present single sum of money,

t = specific year,

n = final project year,

i = the discounted interest rate, and

C_t = cost in year t in base-year dollars.

The discount factor, the $1/(1+i)^t$ term from the PV equation, has been calculated for the interest rates listed above. The PV analyses are presented in the cost estimate tables in Section 8 of the CME report.

F-2.4 General Assumptions

The estimates are based on an 8-h work day and 5-d work week. No overtime is included. On-site activities will be conducted under Hazardous Waste Operations and Emergency Response requirements. Safety levels are based on the Occupational Safety and Health Administration regulations in 29 Code of Federal Regulations Part 1910. Most activities are set to safety level D. All appropriate site-related plans (e.g., general safety plan, quality assurance plan, waste management plan, work plan, hoisting and rigging plan, and health and safety plan) will be prepared and submitted by the subcontractor. All plans will be reviewed and approved by the Laboratory as necessary so as not to adversely impact the project schedule.

Labor rates, waste disposal rates, and material pricing were based on 2010 RS Means rates.

The burdens included NMGRT applied to total costs at a defined recovery rate of 5.5%, G&A at 38%, Infrastructure at 21.5%, and AD support at 29%.

The project was assumed to be a DOE On-Site not DP project and escalation was not accounted for.

Attachment F-1 is the detailed cost assembly report for the estimates described below.

F-3.0 MDA H ALTERNATIVES

Three corrective measures alternatives, plus the no action alternative, are described below.

F-3.1 Alternative 1: No Action

This alternative involves leaving the site as is. No costs are involved with this alternative.

F-3.2 Alternative 2A: Multilayer Cover and Institutional Controls

This technology includes the following tasks:

- site preparation of the existing soil surface and installation of a multilayer cover (Resource Conservation and Recovery Act [RCRA] Subtitle C cover) over the shafts
- maintenance of the cover and institutional controls for 100 yr
- preparation of an annual long-term monitoring report for 100 yr

F-3.2.1 Assumptions

The following assumptions were used to develop the cost estimate for this technology:

- Area to be covered by the multilayer (RCRA) cover is 0.60 acres.
- Fencing around the site will total 700 ft.
- Construction of the multilayer (RCRA) cover will consist of
    - ❖ site preparation of the existing soil surface and cover preparation, which includes 3 ft of operational cover above the waste material;
    - ❖ a 2-ft layer of compacted natural or amended soil with a maximum saturated hydraulic conductivity of 1×10^{-7} cm/s;

  - ❖ a 40-mil flexible geomembrane liner, such as high-density polyethylene, to limit downward moisture movement;
  - ❖ a 1-ft drainage layer of sand having a minimum saturated hydraulic conductivity of 1×10^{-2} cm/s;
  - ❖ a 2-ft soil and vegetation layer graded at slopes between 3% and 5%; and
  - ❖ shoulder fill to meet grades of slopes from top of cover to existing ground surface.
- The site preparation costs for MDA H are relatively low because there will not be a need for a laydown yard and mobilization costs of an SVE system in comparison to other sites.
- No cover preparation was included in the MDA H cover because of the assumption that the site is relatively flat, and additional fill is not needed to prepare the site for the construction of the cover. However, all cover alternatives include site preparation, which accounts for scarifying the ground and mobilization activities.
- Time to complete construction will be 6 mo; irrigation will continue for 1 yr.
- Shoulder fill material parametric unit costs are higher than other cover materials because of the increase in hand labor needed to place these on steeper slopes.
- No armoring was included in the estimate for the MDA H cover because of the assumption that there is ample space available at MDA H to reduce the slopes; thus, there is no need for armoring.
- No time-domain reflectometers (TDRs) will be installed because of the construction of a drainage collection system in the RCRA cover.
- Site maintenance, including visual inspection, removal of debris and large woody plants, and erosion control for the entire site, will continue for 100 yr.
- Site maintenance includes periodic revegetation of bare areas and mowing of the entire site every 5 yr.
- Indirect O&M cost for professional management is based on 26% of direct O&M costs.
- Design costs are calculated using the percentage method, which calculates the design cost as a percentage of direct capital costs (16% of direct capital costs).
- Contingency is based on 50% total for both direct and indirect costs.

F-3.3 Alternative 2B: ET Cover and Institutional Controls

This technology includes the following tasks:

- site preparation of the existing soil surface and installation of an evapotranspiration (ET) cover over the shafts
- maintenance of the cover and institutional controls for 100 yr
- preparation of an annual long-term monitoring report for 100 yr

F-3.3.1 Assumptions

The following assumptions were used to develop the cost estimate for this technology:

- Area to be covered by the ET cover is 0.60 acres.
- Fencing around the site will total 700 ft.
- Construction of the ET cover will consist of
    - ❖ regrading the existing soil surface and cover preparation, which includes 3 ft of operational cover above the waste material;
    - ❖ a 1-ft layer of angular cobbles with a minimum diameter of 4 to 6 in. to act as a biointrusion barrier;
    - ❖ a 0.5-ft layer of sand and gravel mixture to prevent the mixing of soil layers;
    - ❖ a 3.5-ft layer of natural or amended soil meeting the water storage capacity of a typical sandy loam;
    - ❖ a 1.5-ft layer of natural or amended soil and vegetation, with minimal slopes, to ensure a desired stand of vegetation is maintained; and
    - ❖ shoulder fill to meet grades of slopes from top of cover to existing ground surface.
- The site preparation costs for MDA H are relatively low because there will not be a need for a laydown yard and mobilization costs of an SVE system in comparison to other sites.
- No cover preparation was included in the MDA H cover because of the assumption that the site is relatively flat, and additional fill is not needed to prepare the site for the construction of the cover. However, all cover alternatives include site preparation, which accounts for scarifying the ground and mobilization activities.
- Time to complete construction will be 6 mo; irrigation will continue for 1 yr.
- Shoulder fill material parametric unit costs are higher than other cover materials because of the increase in hand labor needed to place these on steeper slopes.
- No armoring was included in the estimate for the MDA H cover because of the assumption that there was ample space available at MDA H to reduce the slopes; thus, there is no need for armoring.
- TDRs will be installed for moisture monitoring.
- Site maintenance, including visual inspection, removal of debris and large woody plants, and erosion control for the entire site, will continue for 100 yr.
- Site maintenance includes periodic revegetation of bare areas and mowing of the entire site every 5 yr.
- Indirect O&M cost for professional management is based on 26% of direct O&M costs.
- Design costs are calculated using the percentage method (16% of direct capital costs).
- Contingency is based on 50% total for both direct and indirect costs.

F.3.6 Alternative 3: Excavation and Institutional Controls

This technology includes the following tasks:

- excavation of the waste in the shafts
- analysis and segregation of the waste

F-3.6.1 Assumptions

The following assumptions were used to develop the cost estimate for this technology:

- Excavation and disposal activities will be complete within 1 yr.
- Fencing around the site will total 3800 ft to incorporate the additional space needed to manage the excavation material.
- Excavation volume for the shafts will consist of 71,644 yd^3 of materials based on the profile shown in Figure F-3.6-1 and a depth of 62 ft.
- Secant pile walls will be built 760 ft long to act as blast shielding to protect the roadway from the excavation.
- A 32,400-ft^2 enclosure for excavation of the site, a 3200-ft^2 enclosure for processing the exumed wastes, and a 1600-ft^2 permacon for sorting and packaging of waste will be erected.
- Two sewer lines will be relocated, and temporary power will be introduced at the site.
- Any environmental media meeting the residential exposure standards will be replaced in the original excavation for the shafts (estimated to be 40,000 yd^3). This backfill is assumed to be moved a distance of 2000 ft for storage during excavation.
- Disposal of approximately 8500 yd^3 of waste from the shafts is estimated based on the assumption of 1500 yd^3 of waste from shafts and 7000 yd^3 of contaminated overburden.
- Indirect O&M cost for professional management is based on 26% of direct O&M costs. These costs will vary as O&M costs vary, such as when subsurface volatile organic compound vapor monitoring is complete at the end of the first 30 yr.
- Design costs are calculated using the percentage method (16% of direct capital costs).
- Contingency is based on 50% total of prior costs.

F-4.0 REFERENCES

The following list includes all documents cited in this appendix. 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.

EPA (U.S. Environmental Protection Agency), July 2000. “A Guide to Developing and Documenting Cost Estimates During the Feasibility Study,” EPA 540-R-00-002, prepared by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency Office of Emergency and Remedial Response, Washington, D.C. (EPA 2000, 071540)

Office of Management and Budget, October 29, 1992. “Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs,” Circular No. A-94, Washington, D.C. (Office of Management and Budget 1992, 094804)

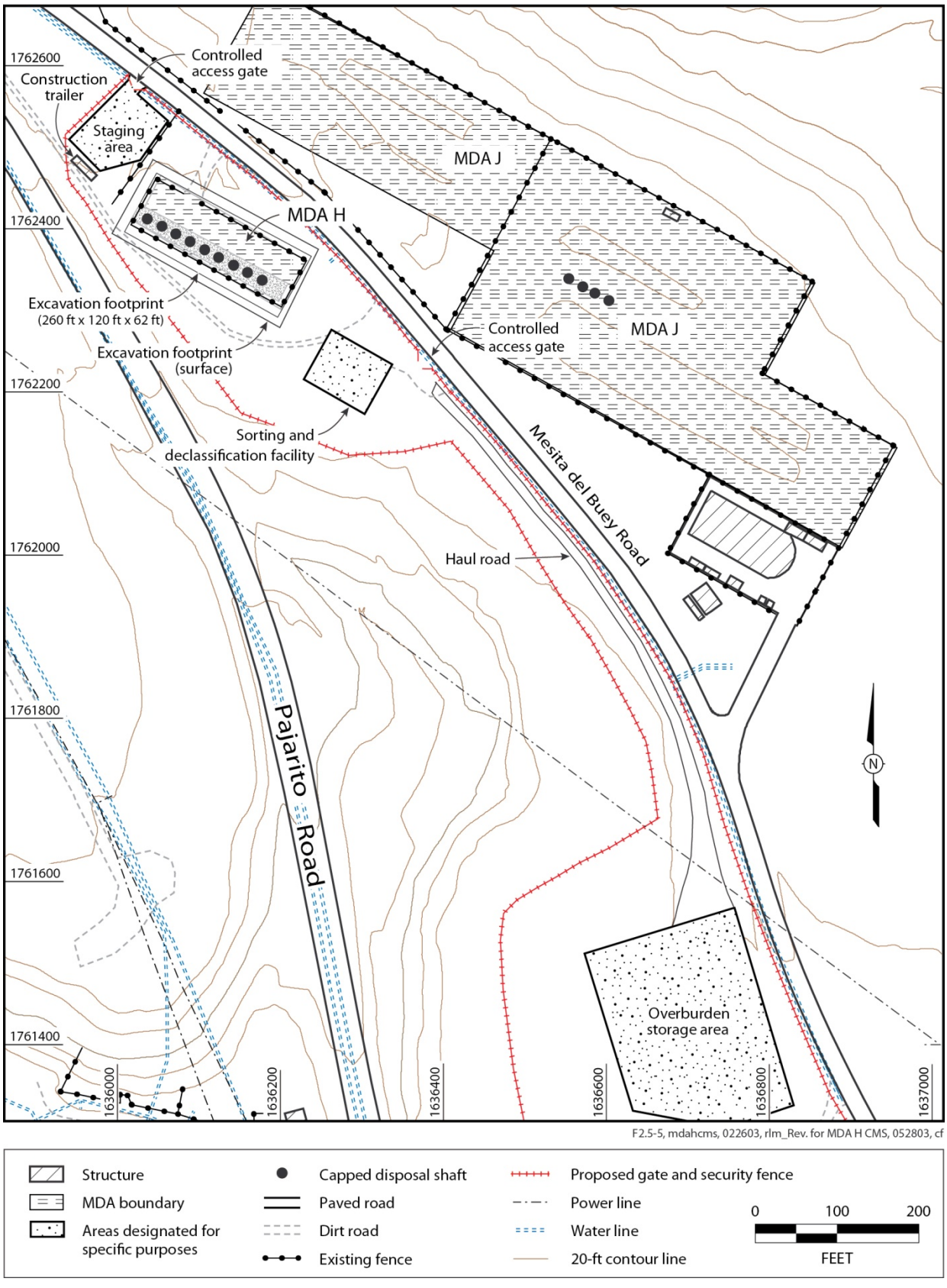


Figure F-3.6-1 Typical cross-section of shaft excavation

Attachment F-1

Detailed Cost Estimate Report

MDA-H Feasability Study Update

Project WBS	Activity Description	Quantity	Unit	Total Unit Price	Labor Hours	Labor Total - Gross	Material Total - Gross	Equip Total - Gross	Subs Total - Gross	Other Total - Gross	Gross Total Costs
1	**Project WBS: Material Disposal Area "H" Feasability Study**										
1.MDAH2A	**Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls**										
1.MDAH2A.1	**Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H – Direct Capital Costs**										
1.MDAH2A.1.01	**Project WBS: 2A RCRA Cover MDA H -DC- Fence**										
1.MDAH2A.1.01	**Project WBS: 2A RCRA Cover MDA H -DC- Fence**										
1.MDAH2A.1.01	Fence, chain link industrial, aluminized steel, 6 ga. wire, 2-1/2" posts @ 10' (	700.0	LF	56.72	170.0	13,579.73	52,702.47	1,652.94			67,935
1.MDAH2A.1.01	Fence, chain link industrial, galvanized steel, add for corner post, 6 ga. wire,	4.0	EA	162.19	4.4	349.02	718.67	42.44			1,110
1.MDAH2A.1.01	Fence, chain link industrial, double swing gates, 8' high, 20' opening, include	1.0	Opng	4,034.67	40.1	3,199.23	2,823.35	881.23			6,904
1.MDAH2A.1.01	Signs, stock, aluminum, reflectorized, .080" aluminum, 24" x 24", excludes p	7.0	EA	120.98	5.8	465.12	856.42	127.56			1,449
1.MDAH2A.1.01	**Total**				**220.3**	**17,593.09**	**57,100.91**	**2,704.17**			**77,398**
1.MDAH2A.1.01	**Total**				**220.3**	**17,593.09**	**57,100.91**	**2,704.17**			**77,398**
1.MDAH2A.1.02	**Project WBS: 2A RCRA Cover MDA H -DC- RCRA Cover**										
1.MDAH2A.1.02.01	**Project WBS: 2A RCRA Cover MDA H -DC- RCRA Cover - Site Prep**										
1.MDAH2A.1.02.01	Selective clearing, brush, with brush saw, includes cutting and site cleanup,	0.6	acre	3,022.82	35.0	2,988.02		115.42			3,103
1.MDAH2A.1.02.01	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 1	2.0	EA	529.39	9.7	767.90		1,043.78			1,812
1.MDAH2A.1.02.01	Track out device	2.0	EA	5,234.35	10.9	801.99	17,111.19				17,913
1.MDAH2A.1.02.01	Clean out track out device.	2.0	EA	1,185.53	21.8	1,603.97		2,453.18			4,057
1.MDAH2A.1.02.01	Rent toilet portable chemical	3.0	mnth	400.00				2,053.34			2,053
1.MDAH2A.1.02.01	Chemical toilet cleaning.	3.0	mnth	946.50	49.1	3,069.58		1,789.15			4,859
1.MDAH2A.1.02.01	Chemical toilet cleaning (labor)	3.0	mnth	573.07	49.1	2,941.75					2,942
1.MDAH2A.1.02.01	Excavation permit	1.0	ea	700.00					1,197.78		1,198
1.MDAH2A.1.02.01	Lister support	24.0	hour	100.10	43.7	4,110.79					4,111
1.MDAH2A.1.02.01	**Total**				**219.4**	**16,284.00**	**17,111.19**	**7,454.88**	**1,197.78**		**42,048**
1.MDAH2A.1.02.03	**Project WBS: 2A RCRA Cover MDA H -DC- RCRA Cover - 2' of 10-7 Clay Compacted**										
1.MDAH2A.1.02.03	Clay backfill material delivered, medium cost, up to 20 miles haul distance (4	1,939.0	L.C.Y.	50.00			165,893.01				165,893
1.MDAH2A.1.02.03	Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, with fro	1,939.0	CY	4.46	70.3	6,005.45		8,792.33			14,798
1.MDAH2A.1.02.03	Backfill, structural, common earth, 80 H.P. dozer, 300' haul	1,939.0	CY	4.62	128.1	10,946.65		4,379.98			15,327
1.MDAH2A.1.02.03	Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel roller	1,939.0	CY	0.94	17.8	1,406.04		1,725.34			3,131
1.MDAH2A.1.02.03	Water wagon 1,000 gal compaction	1,939.0	CY	0.44	23.3	1,454.91					1,455
1.MDAH2A.1.02.03	Clay handling and rework	1,939.0	CY	34.44	542.6	46,367.17		67,884.22			114,251
1.MDAH2A.1.02.03	**Total**				**782.1**	**66,180.22**	**165,893.01**	**82,781.87**			**314,855**
1.MDAH2A.1.02.04	**Project WBS: 2A RCRA Cover MDA H -DC- RCRA Cover - 40 mm HDPE Geomembrane**										
1.MDAH2A.1.02.04	40 mm HDPE Liner	3,054.0	SY	7.21	36.9	3,156.68	31,354.55	3,160.72			37,672
1.MDAH2A.1.02.04	Liner binding	1,309.0	SF	7.26	79.7	8,829.75	7,077.94	350.82			16,259
1.MDAH2A.1.02.04	**Total**				**116.7**	**11,986.43**	**38,432.49**	**3,511.54**			**53,930**
1.MDAH2A.1.02.05	**Project WBS: 2A RCRA Cover MDA H -DC- RCRA Cover - 1' of 10-2 Drainage Layer**										
1.MDAH2A.1.02.05	Aggregate, sand, washed, for concrete, loaded at the pit, includes material o	969.0	CY	24.50			40,622.83				40,623
1.MDAH2A.1.02.05	Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, with fro	969.0	CY	4.46	35.1	3,001.18		4,393.90			7,395
1.MDAH2A.1.02.05	Backfill, structural, common earth, 80 H.P. dozer, 300' haul	969.0	CY	4.62	64.0	5,470.50		2,188.86			7,659
1.MDAH2A.1.02.05	Water wagon 1,000 gal compaction	969.0	CY	0.44	11.6	727.08					727
1.MDAH2A.1.02.05	Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel roller	969.0	CY	0.94	8.9	702.66		862.23			1,565
1.MDAH2A.1.02.05	**Total**				**119.7**	**9,901.41**	**40,622.83**	**7,444.98**			**57,969**
1.MDAH2A.1.02.06	**Project WBS: 2A RCRA Cover MDA H -DC- RCRA Cover - 2' of Cover Soil/Surface Treatmen**										
1.MDAH2A.1.02.06	TUFF - Borrow, fill material only.	1,938.0	ton	20.50			67,981.06				67,981
1.MDAH2A.1.02.06	Tuff - Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, w	969.0	CY	4.46	35.1	3,001.18		4,393.90			7,395
1.MDAH2A.1.02.06	TUFF - Backfill, structural, common earth, 80 H.P. dozer, 300' haul	969.0	CY	4.62	64.0	5,470.50		2,188.86			7,659
1.MDAH2A.1.02.06	TUFF - Water wagon 1,000 gal compaction	969.0	CY	0.44	11.6	727.08					727
1.MDAH2A.1.02.06	Soil - Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, wi	969.0	CY	4.46	35.1	3,001.18		4,393.90			7,395
1.MDAH2A.1.02.06	Soil - Backfill, structural, common earth, 80 H.P. dozer, 300' haul	969.0	CY	4.62	64.0	5,470.50		2,188.86			7,659
1.MDAH2A.1.02.06	Soil - Water wagon 1,000 gal compaction	969.0	CY	0.44	11.6	727.08					727
1.MDAH2A.1.02.06	TUFF - Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel ro	969.0	CY	0.94	8.9	702.66		862.23			1,565
1.MDAH2A.1.02.06	Soil - Soils for earthwork, common borrow, spread with 200 H.P. dozer, inclu	969.0	CY	15.54	82.4	6,513.81	12,269.75	6,980.27			25,764
1.MDAH2A.1.02.06	Soil - Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel rolle	969.0	CY	0.94	8.9	702.66		862.23			1,565
1.MDAH2A.1.02.06	**Total**				**321.8**	**26,316.64**	**80,250.81**	**21,870.24**			**128,438**
1.MDAH2A.1.02.07	**Project WBS: 2A RCRA Cover MDA H -DC- RCRA Cover - Shoulder Fill**										
1.MDAH2A.1.02.07	Borrow, fill material only.	1,302.0	ton	20.50			45,671.48				45,671
1.MDAH2A.1.02.07	Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, with fro	651.0	CY	4.46	23.6	2,016.27		2,951.94			4,968
1.MDAH2A.1.02.07	Backfill, structural, common earth, 80 H.P. dozer, 300' haul	651.0	CY	4.62	43.0	3,675.23		1,470.53			5,146
1.MDAH2A.1.02.07	Water wagon 1,000 gal compaction	651.0	CY	0.44	7.8	488.47					488
1.MDAH2A.1.02.07	Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel roller	651.0	CY	0.94	6.0	472.06		579.27			1,051
1.MDAH2A.1.02.07	Manual Backfill, by hand, slope building	651.0	CY	90.61	1,181.2	100,933.07					100,933
1.MDAH2A.1.02.07	compact, by hand, 6" layers, air rammer/tamper	651.0	E.C.Y.	20.44	248.9	21,267.46		1,505.96			22,773
1.MDAH2A.1.02.07	**Total**				**1,510.5**	**128,852.56**	**45,671.48**	**6,507.70**			**181,032**
1.MDAH2A.1.02.09	**Project WBS: 2A RCRA Cover MDA H -DC- RCRA Cover - Re Vegetation**										
1.MDAH2A.1.02.09	Seeding, seeding utility mix with Bio-Sol, 0.09 lb. per M.S.F., hydro-seeding	26.2	Msf	34.33	14.3	1,051.60		487.54			1,539
1.MDAH2A.1.02.09	Hydroseeding materials.	1.0	lsum	26,317.00			45,031.53				45,032
1.MDAH2A.1.02.09	Broadcasting Mulch and Humate	26.2	Msf	34.33	14.3	1,051.60		487.54			1,539
1.MDAH2A.1.02.09	Mulch and Humate materials.	1.0	LS	11,807.00			20,203.19				20,203
1.MDAH2A.1.02.09	**Total**				**28.6**	**2,103.21**	**65,234.71**	**975.08**			**68,313**
1.MDAH2A.1.02	**Total**				**3,098.8**	**261,624.47**	**453,216.53**	**130,546.28**	**1,197.78**		**846,585**
1.MDAH2A.1.04	**Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H -DC- Distribs**										
1.MDAH2A.1.04	Field Non-Manual - JHRS	664.0	hour	66.10	664.0	75,101.71					75,102
1.MDAH2A.1.04	Craft Distributable - Labor	829.0	hour	46.33	829.0	65,719.48					65,719
1.MDAH2A.1.04	Craft Distributable - Materials	829.0	hour	7.00	829.0		9,929.63				9,930
1.MDAH2A.1.04	**Total**				**2,322.0**	**140,821.18**	**9,929.63**				**150,751**

MDA-H Feasability Study Update

Project WBS	Activity Description	Quantity	Unit	Total Unit Price	Labor Hours	Labor Total - Gross	Material Total - Gross	Equip Total - Gross	Subs Total - Gross	Other Total - Gross	Gross Total Costs
1.MDAH2A.1	Total				5,641.1	420,038.74	520,247.06	133,250.45	1,197.78		1,074,734
1.MDAH2A.2	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H - Indirect Capital Costs										
1.MDAH2A.2.01	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H -IC- Design										
1.MDAH2A.2.01	RCRA MDA L Pad Design	1.0	lsum	171,957.00					250,352.20		250,352
1.MDAH2A.2.01	Total								250,352.20		250,352
1.MDAH2A.2.02	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H -IC- Professional Management										
1.MDAH2A.2.02	Professional Management	1.0	lsum	344,522.00	3,459.1	754,892.32					754,892
1.MDAH2A.2.02	Total				3,459.1	754,892.32					754,892
1.MDAH2A.2.03	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H -IC- Contingency										
1.MDAH2A.2.03	Contingency - Cost 30%	1.0	lsum	623,993.00	1.0					623,993.00	623,993
1.MDAH2A.2.03	Contingency - Schedule 10%	1.0	lsum	207,997.00	1.0					207,997.00	207,997
1.MDAH2A.2.03	Contingency - TPRA 10%	1.0	lsum	207,997.00	1.0					207,997.00	207,997
1.MDAH2A.2.03	Total				3.0					1,039,987.00	1,039,987
1.MDAH2A.2	Total				3,462.1	754,892.32			250,352.20	1,039,987.00	2,045,232
1.MDAH2A.3	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H - Direct O&M Costs										
1.MDAH2A.3.01	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H -DOM- Cover Maintenance & Inspections										
1.MDAH2A.3.01	Cover Inspections and Maintenance (100 years)	1.0	lsum	148,476.00	3,204.8	216,166.21					216,166
1.MDAH2A.3.01	Annual Long Term Monitoring Report	1.0	lsum	157,125.00	3,391.5	228,758.29					228,758
1.MDAH2A.3.01	Total				6,596.2	444,924.50					444,924
1.MDAH2A.3	Total				6,596.2	444,924.50					444,924
1.MDAH2A.4	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H - Indirect O&M Costs										
1.MDAH2A.4.02	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H -IOM- Professional Management										
1.MDAH2A.4.02	Professional Management (years 0-100)	1.0	lsum	79,456.00	797.8	174,098.39					174,098
1.MDAH2A.4.02	Total				797.8	174,098.39					174,098
1.MDAH2A.4.03	Project WBS: 2A Multilayer (RCRA) Cover, Institutional Controls MDA H -IOM- Contingency										
1.MDAH2A.4.03	Contingency - Cost 30%	1.0	lsum	185,706.00	1.0					185,706.00	185,706
1.MDAH2A.4.03	Contingency - Schedule 10%	1.0	lsum	61,902.00	1.0					61,902.00	61,902
1.MDAH2A.4.03	Contingency - TPRA 10%	1.0	lsum	61,902.00	1.0					61,902.00	61,902
1.MDAH2A.4.03	Total				3.0					309,510.00	309,510
1.MDAH2A.4	Total				800.8	174,098.39				309,510.00	483,608
1.MDAH2A	Total				16,500.2	1,793,953.94	520,247.06	133,250.45	251,549.98	1,349,497.00	4,048,498
1.MDAH2B	Project WBS: 2B ET Cover, Institutional Controls										
1.MDAH2B.1	Project WBS: 2B ET Cover, Institutional Controls MDA H - Direct Capital Costs										
1.MDAH2B.1.01	Project WBS: 2B ET Cover MDA H -DC- Fence										
1.MDAH2B.1.01	Fence, chain link industrial, aluminized steel, 6 ga. wire, 2-1/2" posts @ 10' (	700.0	LF	56.72	170.0	13,579.73	52,702.47	1,652.94			67,935
1.MDAH2B.1.01	Fence, chain link industrial, galvanized steel, add for corner post, 6 ga. wire,	4.0	EA	162.19	4.4	349.02	718.67	42.44			1,110
1.MDAH2B.1.01	Fence, chain link industrial, double swing gates, 8' high, 20' opening, include	1.0	Opng	4,034.67	40.1	3,199.23	2,823.35	881.23			6,904
1.MDAH2B.1.01	Signs, stock, aluminum, reflectorized, .080" aluminum, 24" x 24", excludes p	7.0	EA	120.98	5.8	465.12	856.42	127.56			1,449
1.MDAH2B.1.01	Total				220.3	17,593.09	57,100.91	2,704.17			77,398
1.MDAH2B.1.02	Project WBS: 2B ET Cover MDA H -DC- ET Cover										
1.MDAH2B.1.02.01	Project WBS: 2B ET Cover MDA H -DC- ET Cover - Site Prep										
1.MDAH2B.1.02.01	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 1	2.0	EA	529.39	9.7	767.90		1,043.78			1,812
1.MDAH2B.1.02.01	Track out device	2.0	EA	5,234.35	10.9	801.99	17,111.19				17,913
1.MDAH2B.1.02.01	Clean out track out device.	2.0	EA	1,185.53	21.8	1,603.97		2,453.18			4,057
1.MDAH2B.1.02.01	Rent toilet portable chemical	3.0	mnth	400.00				2,053.34			2,053
1.MDAH2B.1.02.01	Chemical toilet cleaning.	3.0	mnth	946.50	49.1	3,069.58		1,789.15			4,859
1.MDAH2B.1.02.01	Chemical toilet cleaning (labor)	3.0	mnth	573.07	49.1	2,941.75					2,942
1.MDAH2B.1.02.01	Excavation permit	1.0	ea	700.00					1,197.78		1,198
1.MDAH2B.1.02.01	Lister support	24.0	hour	100.10	43.7	4,110.79					4,111
1.MDAH2B.1.02.01	Selective clearing, brush, with brush saw, includes cutting and site cleanup,	0.6	acre	3,022.82	35.0	2,988.02		115.42			3,103
1.MDAH2B.1.02.01	Total				219.4	16,284.00	17,111.19	7,454.88	1,197.78		42,048
1.MDAH2B.1.02.03	Project WBS: 2B ET Cover MDA H -DC- ET Cover - Installation of 1' Biobarrier										
1.MDAH2B.1.02.03	Cobble - Cobble Material and Delivery	1,308.0	TN	20.50			45,881.95				45,882
1.MDAH2B.1.02.03	Cobble - Backfill, bulk, 6" to 12" lifts, dozer backfilling	969.0	CY	3.30	26.7	2,107.97		3,365.81			5,474
1.MDAH2B.1.02.03	Total				26.7	2,107.97	45,881.95	3,365.81			51,356
1.MDAH2B.1.02.04	Project WBS: 2B ET Cover MDA H -DC- ET Cover - Installation of .5' Filter Laye										
1.MDAH2B.1.02.04	Base course drainage layers, aggregate base course for roadways and large	2,908.0	SY	8.87	42.2	3,608.23	36,821.92	3,683.27			44,113
1.MDAH2B.1.02.04	Total				42.2	3,608.23	36,821.92	3,683.27			44,113
1.MDAH2B.1.02.05	Project WBS: 2B ET Cover MDA H -DC- ET Cover - Installation of 3.5' Fine Grained Cover Soil (ET Layer										
1.MDAH2B.1.02.05	TUFF - TUFF Material and Delivery	6,706.0	TN	20.50			235,232.70				235,233
1.MDAH2B.1.02.05	TUFF - Backfill, bulk, 6" to 12" lifts, dozer backfilling	3,393.0	CY	3.30	93.4	7,381.15		11,785.54			19,167
1.MDAH2B.1.02.05	TUFF - Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel ro	3,393.0	CY	0.94	31.1	2,460.38		3,019.13			5,480
1.MDAH2B.1.02.05	TUFF & SOIL - Rent water truck, off highway, 6000 gallon capacity - Rent pe	7.0	days	1,309.30	76.4	6,040.38		9,642.16			15,683
1.MDAH2B.1.02.05	Total				201.0	15,881.91	235,232.70	24,446.82			275,561
1.MDAH2B.1.02.06	Project WBS: 2B ET Cover MDA H -DC- ET Cover - Installation of 1.5' Cover Soil/ Surface Treatment										
1.MDAH2B.1.02.06	TUFF - Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel ro	727.0	CY	0.94	6.7	527.17		646.89			1,174
1.MDAH2B.1.02.06	Soil - Soils for earthwork, common borrow, spread with 200 H.P. dozer, inclu	727.0	CY	15.54	61.8	4,887.04	9,205.48	5,237.01			19,330
1.MDAH2B.1.02.06	Soil - Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel rolle	727.0	CY	0.94	6.7	527.17		646.89			1,174
1.MDAH2B.1.02.06	TUFF - Borrow, fill material only.	1,453.0	ton	20.50			50,968.25				50,968
1.MDAH2B.1.02.06	Tuff - Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, w	727.0	CY	4.46	26.4	2,251.66		3,296.56			5,548
1.MDAH2B.1.02.06	TUFF - Backfill, structural, common earth, 80 H.P. dozer, 300' haul	727.0	CY	4.62	48.0	4,104.29		1,642.21			5,746
1.MDAH2B.1.02.06	TUFF - Water wagon 1,000 gal compaction	727.0	CY	0.44	8.7	545.50					545
1.MDAH2B.1.02.06	Soil - Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, wi	727.0	CY	4.46	26.4	2,251.66		3,296.56			5,548
1.MDAH2B.1.02.06	Soil - Backfill, structural, common earth, 80 H.P. dozer, 300' haul	727.0	CY	4.62	48.0	4,104.29		1,642.21			5,746
1.MDAH2B.1.02.06	Soil - Water wagon 1,000 gal compaction	727.0	CY	0.44	8.7	545.50					545
1.MDAH2B.1.02.06	Total				241.4	19,744.27	60,173.73	16,408.32			96,326

MDA-H Feasability Study Update

Project WBS	Activity Description	Quantity	Unit	Total Unit Price	Labor Hours	Labor Total - Gross	Material Total - Gross	Equip Total - Gross	Subs Total - Gross	Other Total - Gross	Gross Total Costs
1.MDAH2B.1.02.07	Project WBS: 2B ET Cover MDA H -DC- ET Cover - Shoulder Fill										
1.MDAH2B.1.02.07	Borrow, fill material only.	1,302.0	ton	20.50			45,671.48				45,671
1.MDAH2B.1.02.07	Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, with fro	651.0	CY	4.46	23.6	2,016.27		2,951.94			4,968
1.MDAH2B.1.02.07	Backfill, structural, common earth, 80 H.P. dozer, 300' haul	651.0	CY	4.62	43.0	3,675.23		1,470.53			5,146
1.MDAH2B.1.02.07	Water wagon 1,000 gal compaction	651.0	CY	0.44	7.8	488.47					488
1.MDAH2B.1.02.07	Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel roller	651.0	CY	0.94	6.0	472.06		579.27			1,051
1.MDAH2B.1.02.07	Manual Backfill, by hand, slope building	651.0	CY	90.61	1,181.2	100,933.07					100,933
1.MDAH2B.1.02.07	compact, by hand, 6" layers, air rammer/tamper	651.0	E.C.Y.	20.44	248.9	21,267.46		1,505.96			22,773
1.MDAH2B.1.02.07	Total				1,510.5	128,852.56	45,671.48	6,507.70			181,032
1.MDAH2B.1.02.09	Project WBS: 2B ET Cover MDA H -DC- ET Cover - Revegetation										
1.MDAH2B.1.02.09	Seeding, seeding utility mix with Bio-Sol, 0.09 lb. per M.S.F., hydro-seeding	26.2	Msf	34.33	14.3	1,051.60		487.54			1,539
1.MDAH2B.1.02.09	Hydroseeding materials.	1.0	lsum	26,317.00			45,031.53				45,032
1.MDAH2B.1.02.09	Broadcasting Mulch and Humate	26.2	Msf	34.33	14.3	1,051.60		487.54			1,539
1.MDAH2B.1.02.09	Mulch and Humate materials.	1.0	LS	11,807.00			20,203.19				20,203
1.MDAH2B.1.02.09	Total				28.6	2,103.21	65,234.71	975.08			68,313
1.MDAH2B.1.02.10	Project WBS: 2B ET Cover MDA H -DC- TDR Moisture Monitor										
1.MDAH2B.1.02.10	TDR Monitoring of ET Cover	1.0	EA	41,921.77	72.8	7,566.18	64,166.97				71,733
1.MDAH2B.1.02.10	Total				72.8	7,566.18	64,166.97				71,733
1.MDAH2B.1.02	Total				2,342.7	196,148.32	570,294.66	62,841.88	1,197.78		830,483
1.MDAH2B.1.04	Project WBS: 2B ET Cover, Institutional Controls MDA H -DC- Distribs										
1.MDAH2B.1.04	Field Non-Manual - JHRS	512.0	hour	66.10	512.0	57,909.75					57,910
1.MDAH2B.1.04	Craft Distributable - Labor	640.0	hour	46.33	640.0	50,736.39					50,736
1.MDAH2B.1.04	Craft Distributable - Materials	640.0	hour	7.00	640.0		7,665.81				7,666
1.MDAH2B.1.04	Total				1,792.0	108,646.14	7,665.81				116,312
1.MDAH2B.1	Total				4,355.0	322,387.55	635,061.38	65,546.05	1,197.78		1,024,193
1.MDAH2B.2.01	Project WBS: 2B ET Cover, Institutional Controls MDA H -IC- Design										
1.MDAH2B.2.01	ET MDA L Mat Design	1.0	lsum	163,870.00					238,578.33		238,578
1.MDAH2B.2.01	Total								238,578.33		238,578
1.MDAH2B.2.02	Project WBS: 2B ET Cover, Institutional Controls MDA H -IC- Professional Management										
1.MDAH2B.2.02	Professional Management	1.0	lsum	328,320.00	3,296.4	719,391.64					719,392
1.MDAH2B.2.02	Total				3,296.4	719,391.64					719,392
1.MDAH2B.2.03	Project WBS: 2B ET Cover, Institutional Controls MDA H -IC- Contingency										
1.MDAH2B.2.03	Contingency - Cost 30%	1.0	lsum	594,648.00	1.0					594,648.00	594,648
1.MDAH2B.2.03	Contingency - Schedule 10%	1.0	lsum	198,216.00	1.0					198,216.00	198,216
1.MDAH2B.2.03	Contingency - TPRA 10%	1.0	lsum	198,216.00	1.0					198,216.00	198,216
1.MDAH2B.2.03	Total				3.0					991,080.00	991,080
1.MDAH2B.3.01	Project WBS: 2B ET Cover, Institutional Controls MDA H -DOM- Cover Maintenance & Inspections										
1.MDAH2B.3.01	Cover Inspections and Maintenance (100 years)	1.0	lsum	148,476.00	1,490.7	216,166.21					216,166
1.MDAH2B.3.01	Annual Long Term Monitoring Report	1.0	lsum	157,125.00	1,577.6	228,758.29					228,758
1.MDAH2B.3.01	Total				3,068.3	444,924.50					444,924
1.MDAH2B.4.02	Project WBS: 2B ET Cover, Institutional Controls MDA H -IOM- Professional Management										
1.MDAH2B.4.02	Professional Management (years 0-100)	1.0	lsum	79,456.00	797.8	174,098.39					174,098
1.MDAH2B.4.02	Total				797.8	174,098.39					174,098
1.MDAH2B.4.03	Project WBS: 2B ET Cover, Institutional Controls MDA H -IOM- Contingency										
1.MDAH2B.4.03	Contingency - Cost 30%	1.0	lsum	185,706.00	1.0					185,706.00	185,706
1.MDAH2B.4.03	Contingency - Schedule 10%	1.0	lsum	61,902.00	1.0					61,902.00	61,902
1.MDAH2B.4.03	Contingency - TPRA 10%	1.0	lsum	61,902.00	1.0					61,902.00	61,902
1.MDAH2B.4.03	Total				3.0					309,510.00	309,510
1.MDAH2B	Total				11,523.4	1,660,802.07	635,061.38	65,546.05	239,776.12	1,300,590.00	3,901,776
1.MDAH3X	Project WBS: 3 Excavation and Institutional Contols MDA H										
1.MDAH3X.1	Project WBS: 3 Excavation and Institutional Contols MDA H - Direct Capital Costs										
1.MDAH3X.1.01	Project WBS: 3 Excavation -DC- Fence										
1.MDAH3X.1.01	Fence, chain link industrial, aluminized steel, 6 ga. wire, 2-1/2" posts @ 10' (	3,800.0	LF	56.72	923.1	73,718.54	286,099.14	8,973.11			368,791
1.MDAH3X.1.01	Fence, chain link industrial, galvanized steel, add for corner post, 6 ga. wire,	15.0	EA	162.19	16.4	1,308.81	2,695.01	159.13			4,163
1.MDAH3X.1.01	Fence, chain link industrial, double swing gates, 8' high, 20' opening, include	4.0	Opng	4,034.67	160.2	12,796.91	11,293.39	3,524.91			27,615
1.MDAH3X.1.01	Signs, stock, aluminum, reflectorized, .080" aluminum, 24" x 24", excludes p	38.0	EA	120.98	31.6	2,524.93	4,649.11	692.49			7,867
1.MDAH3X.1.01	Total				1,131.3	90,349.18	304,736.65	13,349.64			408,435
1.MDAH3X.1.02	Project WBS: 3 Excavation -DC- Site Prep										
1.MDAH3X.1.02	Lister support	48.0	hour	100.10	87.4	8,221.59					8,222
1.MDAH3X.1.02	Selective clearing, brush, with brush saw, includes cutting and site cleanup,	2.0	acre	3,022.82	116.6	9,960.07		384.73			10,345
1.MDAH3X.1.02	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 1	4.0	EA	529.39	19.4	1,535.80		2,087.57			3,623
1.MDAH3X.1.02	Track out device	4.0	EA	5,234.35	21.8	1,603.97	34,222.39				35,826
1.MDAH3X.1.02	Clean out track out device.	12.0	EA	1,185.53	131.0	9,623.83		14,719.09			24,343
1.MDAH3X.1.02	Rent toilet portable chemical	24.0	mnth	400.00				16,426.74			16,427
1.MDAH3X.1.02	Chemical toilet cleaning.	24.0	mnth	946.50	393.1	24,556.60		14,313.20			38,870
1.MDAH3X.1.02	Chemical toilet cleaning (labor)	24.0	mnth	573.07	393.1	23,534.02					23,534
1.MDAH3X.1.02	Excavation permit	2.0	ea	700.00					2,395.57		2,396
1.MDAH3X.1.02	Laydown - Base course drainage layers, aggregate base course for roadway	778.0	SY	8.87	11.3	965.34	9,851.26	985.41			11,802
1.MDAH3X.1.02	Laydown - Backfill, bulk, 6" to 12" lifts, dozer backfilling	98.0	CY	3.30	2.7	213.19		340.40			554
1.MDAH3X.1.02	laydown - Compaction, 2 passes, 6" lifts, riding, sheepsfoot or wobbly wheel	98.0	CY	0.94	0.9	71.06		87.20			158
1.MDAH3X.1.02	Crane need	24.0	mnth	8,932.65	1,092.0	110,168.05		256,667.89			366,836
1.MDAH3X.1.02	Crane Lift Plan	5.0	ea	1,539.54	91.0	13,171.67					13,172
1.MDAH3X.1.02	Total				2,360.4	203,625.18	44,073.64	306,012.24	2,395.57		556,107
1.MDAH3X.1.03	Project WBS: 3 Excavation -DC- Utility Relocate										
1.MDAH3X.1.03	Backfill, structural, common earth, 200 H.P. dozer, 50' haul	2,844.0	L.C.Y.	0.82	15.7	1,340.88		2,649.26			3,990
1.MDAH3X.1.03	Compaction, 4 passes, 24" wide, 12" lifts, walk behind, vibrating roller	2,844.0	E.C.Y.	1.78	81.2	6,937.60		1,735.74			8,673

MDA-H Feasability Study Update

Project WBS	Activity Description	Quantity	Unit	Total Unit Price	Labor Hours	Labor Total - Gross	Material Total - Gross	Equip Total - Gross	Subs Total - Gross	Other Total - Gross	Gross Total Costs
1.MDAH3X.1.03	Fill by borrow and utility bedding, borrow, for embankments, 1 mile haul, spr	356.0	L.C.Y.	18.28	8.3	713.43	9,137.38	1,283.67			11,134
1.MDAH3X.1.03	Excavating, chain trencher, utility trench, common earth, 12 H.P., 24" wide,	2,844.0	B.C.Y.	0.72	8.5	725.40		2,787.26			3,513
1.MDAH3X.1.03	Backfill, 12" layers, compaction in layers, air tamp, add	77.9	E.C.Y.	7.80	10.9	934.68		104.56			1,039
1.MDAH3X.1.03	Backfill, trench, up to 300' haul, dozer backfilling, excludes compaction	77.9	L.C.Y.	2.00	1.0	89.42		176.87			266
1.MDAH3X.1.03	Fill, granular fill	77.9	L.C.Y.	20.00			2,665.72				2,666
1.MDAH3X.1.03	Excavating, trench or continuous footing, common earth, 3/4 C.Y. excavator,	85.3	B.C.Y.	6.57	6.1	519.47		440.42			960
1.MDAH3X.1.03	Excavating, trench or continuous footing, common earth, trim sides and bott	128.0	SF	0.83	2.0	174.91		7.35			182
1.MDAH3X.1.03	Utility Area Drains, catch basins or manholes frames and covers, cast iron, h	2.0	EA	422.94	6.1	546.55	752.89	147.95			1,447
1.MDAH3X.1.03	Storm Drainage Manholes, Frames, and Covers, concrete, precast, 4' I.D., 8	2.0	EA	1,873.82	30.0	2,669.05	3,388.02	355.60			6,413
1.MDAH3X.1.03	Storm Drainage Manholes, Frames, and Covers, heavyweight cast iron step	10.0	EA	27.12	2.0	178.32	285.76				464
1.MDAH3X.1.03	C.I.P. concrete forms, footing, spread, plywood, 4 use, includes erecting, bra	40.0	sfca	4.60	3.1	275.08	39.70				315
1.MDAH3X.1.03	Reinforcing Steel, in place, footings, #4 to #7, A615, grade 60, incl labor for	0.0	ton	1,649.82	0.6	51.68	55.59				107
1.MDAH3X.1.03	Structural concrete, ready mix, normal weight, 3000 psi, includes local aggre	1.9	CY	99.00			313.39				313
1.MDAH3X.1.03	Structural concrete, placing, spread footing, direct chute, under 1 C.Y., inclu	1.9	CY	46.17	1.6	142.63		3.53			146
1.MDAH3X.1.03	Public Sanitary Utility Sewerage Piping, piping polyvinyl chloride pipe, B & S	400.0	LF	8.12	27.4	3,036.84	2,518.77				5,556
1.MDAH3X.1.03	Total				204.7	18,335.93	19,157.21	9,692.20			47,185
1.MDAH3X.1.04	**Project WBS: 3 Excavation -DC- Electrical Supply**										
1.MDAH3X.1.04	Backfill, heavy soil, by hand, no compaction	18.7	L.C.Y.	66.15	24.8	2,118.10					2,118
1.MDAH3X.1.04	Backfill, 12" layers, compaction in layers, vibrating plate, add to above	18.7	E.C.Y.	8.55	3.0	258.41		15.39			274
1.MDAH3X.1.04	Structural excavation for minor structures, bank measure, heavy soil or clay,	22.2	B.C.Y.	181.24	80.6	6,884.67					6,885
1.MDAH3X.1.04	Structural concrete, in place, spread footing (3000 psi), under 1 C.Y., include	3.5	CY	522.07	25.3	2,165.10	942.46	6.57			3,114
1.MDAH3X.1.04	Power poles, anchor base, galvanized steel, 30' high, excl concrete bases	6.0	EA	2,325.04	95.5	10,934.59	12,320.06	615.88			23,871
1.MDAH3X.1.04	Power poles, galvanized steel, bracket arms, 1 arm, excl concrete bases	6.0	EA	298.27	11.0	1,255.29	1,806.94				3,062
1.MDAH3X.1.04	Medium-cable single cable, copper, XLP shielding, ungrounded neutral, 15 k	30.0	Clf	1,248.87	290.9	33,308.56	30,800.15				64,109
1.MDAH3X.1.04	Wire, copper, stranded, 600 volt, 3/0, type THW, in raceway	10.0	Clf	729.80	58.3	6,670.00	5,817.81				12,488
1.MDAH3X.1.04	Rigid galvanized steel conduit, 3-1/2" diameter, to 15' H, incl 2 terminations,	1,000.0	LF	65.81	662.1	75,814.27	36,789.06				112,603
1.MDAH3X.1.04	Transformer, oil-filled, single phase 13.8 kV primary, 120/240 V secondary,	3.0	EA	1,750.11	34.9	3,997.11	4,748.36	238.46			8,984
1.MDAH3X.1.04	Circuit breaker, 3 pole, 600 volt, 100 amp, enclosed (NEMA 1)	6.0	EA	1,108.70	38.0	4,350.00	7,032.70				11,383
1.MDAH3X.1.04	Safety switches, general duty, 3 pole, fusible, 240 volt, 100 amp, NEMA 1	6.0	EA	858.28	46.0	5,269.71	3,542.02				8,812
1.MDAH3X.1.04	Circuit breakers, plug-in, 3 pole, 50 Amp	60.0	EA	219.03	116.1	13,298.57	9,188.71				22,487
1.MDAH3X.1.04	Wire, copper, stranded, 600 volt, #6, type THW, in raceway	1,800.0	Clf	205.11	4,038.0	462,342.73	169,400.81				631,744
1.MDAH3X.1.04	Backfill, trench, 6" to 12" lifts, dozer backfilling, compaction with vibrating roll	1.3	E.C.Y.	3.93	0.0	3.64		5.23			9
1.MDAH3X.1.04	Excavating, bulk bank measure, 1/2 C.Y. = 30 C.Y./hour, hydraulic excavato	4.4	B.C.Y.	25.78	1.4	127.26		68.16			195
1.MDAH3X.1.04	Excavating, trench or continuous footing, common earth, trim sides and bott	72.0	SF	1.55	2.1	186.41		4.13			191
1.MDAH3X.1.04	C.I.P. concrete forms, footing, continuous wall, dowel supports, 1 use, more	24.0	LF	6.80	2.8	249.05	30.39				279
1.MDAH3X.1.04	C.I.P. concrete forms, footing, spread, plywood, 4 use, includes erecting, bra	56.0	sfca	7.89	7.9	700.89	55.58				756
1.MDAH3X.1.04	Reinforcing Steel, in place, footings, #4 to #7, A615, grade 60, incl labor for	0.1	ton	2,301.57	2.2	198.02	117.04				315
1.MDAH3X.1.04	Structural concrete, ready mix, normal weight, 3000 psi, includes local aggre	3.1	CY	99.00			528.53				529
1.MDAH3X.1.04	Structural concrete, placing, spread footing, direct chute, over 5 C.Y., include	3.1	CY	38.34	2.3	201.95		2.73			205
1.MDAH3X.1.04	Concrete finishing, floors, basic finishing for unspecified flatwork, bull float or	72.0	SF	0.56	0.8	69.31					69
1.MDAH3X.1.04	Medium-cable single cable, copper, XLP shielding, ungrounded neutral, 15 k	30.0	Clf	1,248.87	290.9	33,308.56	30,800.15				64,109
1.MDAH3X.1.04	Wire, copper, stranded, 600 volt, 3/0	10.0	Clf	729.80	58.3	6,670.00	5,817.81				12,488
1.MDAH3X.1.04	Rigid galvanized steel conduit, 3-1/2" diameter, to 15' H, incl 2 terminations,	1,000.0	LF	65.81	662.1	75,814.27	36,789.06				112,603
1.MDAH3X.1.04	Transformer, oil-filled, single phase 13.8 kV primary, 120/240 V secondary,	1.0	EA	1,750.11	11.6	1,332.37	1,582.79	79.49			2,995
1.MDAH3X.1.04	Circuit breaker, 3 pole, 600 volt, 100 amp, enclosed (NEMA 1)	2.0	EA	1,108.70	12.7	1,450.00	2,344.23				3,794
1.MDAH3X.1.04	Safety switches, general duty, 3 pole, fusible, 240 volt, 100 amp, NEMA 1	2.0	EA	858.28	15.3	1,756.57	1,180.67				2,937
1.MDAH3X.1.04	Circuit breakers, plug-in, 3 pole, 50 Amp	20.0	EA	219.03	38.7	4,432.86	3,062.90				7,496
1.MDAH3X.1.04	Wire, copper, stranded, 600 volt, #6, type THW, in raceway	1,800.0	Clf	205.11	4,038.0	462,342.73	169,400.81				631,744
1.MDAH3X.1.04	Total				10,671.8	1,217,511.00	534,099.03	1,036.04			1,752,646
1.MDAH3X.1.05	**Project WBS: 3 Excavation -DC- Secant Pile Walls & Blast Wall**										
1.MDAH3X.1.05	Secant Pile Template used in drilling	2.0	EA	9,270.70	291.2	24,882.07			6,844.48		31,727
1.MDAH3X.1.05	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggr	5,836.0	CY	154.50			1,542,851.22				1,542,851
1.MDAH3X.1.05	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includ	5,836.0	CY	22.33	2,545.4	217,498.65		5,495.79			222,994
1.MDAH3X.1.05	Reinforcing Steel, in place, columns, alternate method, #3 to #7, A615, grad	80.0	tn	942.68	4.3	367.21	128,676.17				129,043
1.MDAH3X.1.05	Microtunneling, microtunneling slurry method, 24" to 48" outside diameter, e	21,888.0	LF	790.00					29,587,853.08		29,587,853
1.MDAH3X.1.05	Microtunneling, rent microtunneling machine, average month's lease	2.0	mnth	88,000.00					301,156.99		301,157
1.MDAH3X.1.05	Microtunneling, microtunneling operating technician	40.0	days	585.00					40,040.19		40,040
1.MDAH3X.1.05	Microtunneling, mobilization and demobilization, minimum	1.0	Job	38,000.00					65,022.53		65,023
1.MDAH3X.1.05	Structural steel member, 100-ton project, 1 to 2 story building, W24x94, A99	3,480.0	LF	125.57	469.2	47,336.40	690,744.63	9,647.94			747,729
1.MDAH3X.1.05	Blast wall	334.0	CY	1,191.91	4,863.0	432,583.76	248,608.52				681,192
1.MDAH3X.1.05	Total				8,173.2	722,668.09	2,610,880.54	15,143.73	30,000,917.27		33,349,610
1.MDAH3X.1.06	**Project WBS: 3 Excavation -DC- Excavation Enclosure**										
1.MDAH3X.1.06	Enclosure - Enclosure	32,400.0	sqft	15.33					849,899.25		849,899
1.MDAH3X.1.06	Enclosure - Enclosure Erection	32,400.0	sqft	21.38					1,185,312.85		1,185,313
1.MDAH3X.1.06	Enclosure - Ventilation Equipment	32,400.0	sqft	28.43					1,576,166.72		1,576,167
1.MDAH3X.1.06	Enclosure - Mechanical Equipment Install	32,400.0	sqft	7.49					415,247.58		415,248
1.MDAH3X.1.06	Enclosure - Fire Suppression System	32,400.0	sqft	5.83					323,216.74		323,217
1.MDAH3X.1.06	Enclosure - Dust Suppression System	32,400.0	sqft	4.70					260,569.24		260,569
1.MDAH3X.1.06	Enclosure - Electrical installation	32,400.0	sqft	15.11					837,702.39		837,702
1.MDAH3X.1.06	Enclosure - Video System installation	32,400.0	sqft	10.42					577,687.55		577,688
1.MDAH3X.1.06	Enclosure - Miscellaneous Field Services	32,400.0	sqft	6.72					372,558.58		372,559
1.MDAH3X.1.06	Total								6,398,360.91		6,398,361
1.MDAH3X.1.07	**Project WBS: 3 Excavation -DC- Enclosure with Processing Facility**										

MDA-H Feasability Study Update

Project WBS	Activity Description	Quantity	Unit	Total Unit Price	Labor Hours	Labor Total - Gross	Material Total - Gross	Equip Total - Gross	Subs Total - Gross	Other Total - Gross	Gross Total Costs
1.MDAH3X.1.07	Enclosure - Enclosure	6,300.0	sqft	15.33					165,258.19		165,258
1.MDAH3X.1.07	Enclosure - Enclosure Erection	6,300.0	sqft	21.38					230,477.50		230,477
1.MDAH3X.1.07	Enclosure - Ventilation Equipment	6,300.0	sqft	28.43					306,476.86		306,477
1.MDAH3X.1.07	Enclosure - Mechanical Equipment Install	6,300.0	sqft	7.49					80,742.58		80,743
1.MDAH3X.1.07	Enclosure - Fire Suppression System	6,300.0	sqft	5.83					62,847.70		62,848
1.MDAH3X.1.07	Enclosure - Dust Suppression System	6,300.0	sqft	4.70					50,666.24		50,666
1.MDAH3X.1.07	Enclosure - Electrical installation	6,300.0	sqft	15.11					162,886.58		162,887
1.MDAH3X.1.07	Enclosure - Video System installation	6,300.0	sqft	10.42					112,328.14		112,328
1.MDAH3X.1.07	Enclosure - Miscellaneous Field Services	6,300.0	sqft	6.72					72,441.95		72,442
1.MDAH3X.1.07	Fine grading, finish grading, small area, to be paved with grader	693.0	SY	3.63	27.7	2,459.60		1,848.72			4,308
1.MDAH3X.1.07	Fill, gravel fill, compacted, under floor slabs, 4" deep	6,300.0	SF	0.65	29.6	2,629.93	4,312.02	112.85			7,055
1.MDAH3X.1.07	C.I.P. concrete forms, slab on grade, edge, wood, to 6" high, 4 use, includes	189.0	LF	3.04	10.1	896.65	87.32				984
1.MDAH3X.1.07	Expansion joint, premolded, bituminous fiber, 1/2" x 6"	1,386.0	LF	1.52	29.6	2,634.76	972.36				3,607
1.MDAH3X.1.07	Welded wire fabric, sheets, 6 x 6 - W2.1 x W2.1 (8 x 8) 30 lb. per C.S.F., A1	75.6	Csf	45.75	39.0	3,473.59	2,444.92				5,919
1.MDAH3X.1.07	Structural concrete, ready mix, normal weight, 3500 psi, includes local aggre	119.7	CY	99.50			20,379.69				20,380
1.MDAH3X.1.07	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includ	119.7	CY	15.48	34.8	3,096.07		75.15			3,171
1.MDAH3X.1.07	Concrete finishing, floors, for specified Random Access Floors in ACI Classe	6,300.0	SF	0.75	87.9	7,822.99		275.34			8,098
1.MDAH3X.1.07	Concrete surface treatment, curing, sprayed membrane compound	63.0	Csf	14.38	10.6	946.25	603.68				1,550
1.MDAH3X.1.07	Vapor Retarders, building paper, polyethylene vapor barrier, standard, .006"	63.0	sq	16.48	13.6	1,210.63	565.95				1,777
1.MDAH3X.1.07	Permacon - Enclosure	1,600.0	sqft	15.33					41,970.33		41,970
1.MDAH3X.1.07	Permacon - Enclosure Erection	1,600.0	sqft	21.38					58,533.97		58,534
1.MDAH3X.1.07	Permacon - Ventilation Equipment	1,600.0	sqft	28.43					77,835.39		77,835
1.MDAH3X.1.07	Permacon - Mechanical Equipment Install	1,600.0	sqft	7.49					20,506.05		20,506
1.MDAH3X.1.07	Permacon - Fire Suppression System	1,600.0	sqft	5.83					15,961.32		15,961
1.MDAH3X.1.07	Permacon - Dust Suppression System	1,600.0	sqft	4.70					12,867.62		12,868
1.MDAH3X.1.07	Permacon - Electrical installation	1,600.0	sqft	15.11					41,368.02		41,368
1.MDAH3X.1.07	**Total**				**283.0**	**25,170.47**	**29,365.94**	**2,312.05**	**1,513,168.44**		**1,570,017**
1.MDAH3X.1.08	**Project WBS: 3 Excavation -DC- Excavation of pit**										
1.MDAH3X.1.08.01	**Project WBS: 3 Excavation -DC- Excavation of pit -DC - Excavation**										
1.MDAH3X.1.08.01	Excavating, 3/8 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewaterir	71,644.0	CY	25.78	30,024.4	2,565,484.68		594,922.36			3,160,407
1.MDAH3X.1.08.01	BROKK 400	2.0	ea	312,440.00			1,069,244.21				1,069,244
1.MDAH3X.1.08.01	BROKK Operation	71,644.0	CY	2.23	3,477.1	273,034.98					273,035
1.MDAH3X.1.08.01	BROKK Scheduled Maintenance	4.0	ea	4,200.00					28,746.80		28,747
1.MDAH3X.1.08.01	BROKK replacement tips.	2.0	SET	1,069.64	7.3	571.65	2,053.34			1,035.57	3,661
1.MDAH3X.1.08.01	Water wagon 1,000 gal soil processing	71,644.0	CY	0.44	860.6	53,757.40					53,757
1.MDAH3X.1.08.01	Equipment only. Water wagon 1,000 gal soil processing	71,644.0	CY	0.26				32,364.14			32,364
1.MDAH3X.1.08.01	Mobilization or demobilization, dozer, loader, backhoe or excavator, 70 H.P.	2.0	EA	327.74	7.5	642.79		478.81			1,122
1.MDAH3X.1.08.01	Skidsteer bucket, sand and gravel, excludes compaction	71,644.0	L.C.Y.	1.44	1,460.5	124,797.77		51,150.33			175,948
1.MDAH3X.1.08.01	BROKK 400 - Attachments	2.0	ea	176,200.00			602,998.43				602,998
1.MDAH3X.1.08.01	**Total**				**35,837.4**	**3,018,289.27**	**1,674,295.98**	**678,915.64**	**28,746.80**	**1,035.57**	**5,401,283**
1.MDAH3X.1.08.02	**Project WBS: 3 Excavation -DC- Excavation of pit -DC- Confirmatory Sampling**										
1.MDAH3X.1.08.02	Confirmatory Sampling	1,248.0	EA	3,658.77	2,271.4	279,211.04		774.11	7,533,236.26		7,813,221
1.MDAH3X.1.08.02	**Total**				**2,271.4**	**279,211.04**		**774.11**	**7,533,236.26**		**7,813,221**
1.MDAH3X.1.08.03	**Project WBS: 3 Excavation -DC- Excavation of pit -DC- Backfill**										
1.MDAH3X.1.08.03	Borrow, fill material only.	4,017.0	ton	16.50			113,413.84				113,414
1.MDAH3X.1.08.03	Fill, from stockpile, 300 H.P. dozer, 2-1/2 C.Y., 300' haul, spread fill, with fro	71,644.0	CY	4.46	2,596.9	221,895.12		324,867.29			546,762
1.MDAH3X.1.08.03	Backfill, structural, common earth, 80 H.P. dozer, 300' haul	71,644.0	CY	4.62	4,733.6	404,467.06		161,835.51			566,303
1.MDAH3X.1.08.03	Water wagon 1,000 gal tuff processing	71,644.0	CY	0.44	860.6	53,757.40					53,757
1.MDAH3X.1.08.03	Equipment only. Water wagon 1,000 gal tuff processing	71,644.0	CY	0.26				32,364.14			32,364
1.MDAH3X.1.08.03	**Total**				**8,191.0**	**680,119.58**	**113,413.84**	**519,066.94**			**1,312,600**
1.MDAH3X.1.08.04	**Project WBS: 3 Excavation -DC- Excavation of pit -DC- Disposal of Waste**										
1.MDAH3X.1.08.04	Waste container delivery.	128.0	ea	1,453.61	3,178.1	210,657.45		107,716.96			318,374
1.MDAH3X.1.08.04	Waste container unload on site and handling during project.	2,555.0	ea	4,607.32	209,261.3	16,535,845.22		3,606,941.94			20,142,787
1.MDAH3X.1.08.04	Waste containers.	2,555.0	ea	2,018.34			8,824,000.29				8,824,000
1.MDAH3X.1.08.04	Fill waste containers.	2,555.0	ea	549.81	27,291.1	2,156,543.76		247,175.93			2,403,720
1.MDAH3X.1.08.04	Waste, ship off site. Packaging, Handling, Shipping and Disposal fees.	8,514.0	cy	1,114.00					16,229,274.98		16,229,275
1.MDAH3X.1.08.04	Trucking cost per 43,000 pound load	26.0	Trip	4,471.00						198,910.77	198,911
1.MDAH3X.1.08.04	Confirmatory Sampling	26.0	EA	3,658.77	47.3	5,816.90		16.13	156,942.42		162,775
1.MDAH3X.1.08.04	**Total**				**239,777.8**	**18,908,863.33**	**8,824,000.29**	**3,961,850.96**	**16,386,217.41**	**198,910.77**	**48,279,843**
1.MDAH3X.1.08.05	**Project WBS: 3 Excavation -DC- Excavation of pit -DC- Equipment Decontamination**										
1.MDAH3X.1.08.05	Confirmatory Sampling	86.0	EA	3,658.77	156.5	19,240.50		53.34	519,117.24		538,411
1.MDAH3X.1.08.05	Decontamination of equipment.	100.0	hour	149.94	100.0	8,544.67	17,111.19				25,656
1.MDAH3X.1.08.05	Swipes	100.0	hour	649.94	100.0	8,544.67	102,667.16				111,212
1.MDAH3X.1.08.05	RCT involvment in swipes and decontamination process	40.0	hour	124.97	20.0	1,708.93	6,844.48				8,553
1.MDAH3X.1.08.05	**Total**				**376.5**	**38,038.77**	**126,622.83**	**53.34**	**519,117.24**		**683,832**
1.MDAH3X.1.08	**Total**				**286,454.1**	**22,924,521.99**	**10,738,332.94**	**5,160,660.98**	**24,467,317.71**	**199,946.34**	**63,490,780**
1.MDAH3X.1.09	**Project WBS: 3 Excavation -DC- Demo Enclosure with Processing Facility**										
1.MDAH3X.1.09	Demo - PROCESSING FACILITY - Excavation Enclosures, take down, proc	6,300.0	sf	350.40					3,777,330.01		3,777,330
1.MDAH3X.1.09	Demo - PERMACON - Excavation Enclosures, take down, processing, packa	1,600.0	sf	350.40					959,321.91		959,322
1.MDAH3X.1.09	Demo - EXCAVATION COVER - Excavation Enclosures, take down, proces	1,600.0	sf	350.40					959,321.91		959,322
1.MDAH3X.1.09	**Total**								**5,695,973.83**		**5,695,974**
1.MDAH3X.1.10	**Project WBS: 3 Excavation -DC- Demo Electrical Supply**										
1.MDAH3X.1.10	Demo - Medium-cable single cable, copper, XLP shielding, ungrounded neut	30.0	Clf	713.04	319.7	36,602.82					36,603
1.MDAH3X.1.10	Demo - Wire, copper, stranded, 600 volt, 3/0, type THW, in raceway	10.0	Clf	428.36	64.0	7,329.67					7,330

MDA-H Feasability Study Update

Project WBS	Activity Description	Quantity	Unit	Total Unit Price	Labor Hours	Labor Total - Gross	Material Total - Gross	Equip Total - Gross	Subs Total - Gross	Other Total - Gross	Gross Total Costs
1.MDAH3X.1.10	Demo - Rigid galvanized steel conduit, 3-1/2" diameter, to 15' H, incl 2 termi	1,000.0	LF	48.69	727.6	83,312.38					83,312
1.MDAH3X.1.10	Demo - Transformer, oil-filled, single phase 13.8 kV primary, 120/240 V secc	3.0	EA	902.12	38.4	4,392.43		238.46			4,631
1.MDAH3X.1.10	Demo - Circuit breaker, 3 pole, 600 volt, 100 amp, enclosed (NEMA 1)	6.0	EA	465.60	41.7	4,780.22					4,780
1.MDAH3X.1.10	Demo - Safety switches, general duty, 3 pole, fusible, 240 volt, 100 amp, NE	6.0	EA	564.05	50.6	5,790.89					5,791
1.MDAH3X.1.10	Demo - Circuit breakers, plug-in, 3 pole, 50 Amp	60.0	EA	142.34	127.6	14,613.81					14,614
1.MDAH3X.1.10	Demo - Wire, copper, stranded, 600 volt, #6, type THW, in raceway	1,800.0	Clf	164.96	4,437.4	508,068.94					508,069
1.MDAH3X.1.10	Total				5,807.0	664,891.15		238.46			665,130
1.MDAH3X.1.11	Project WBS: 3 Excavation -DC- Revegetation										
1.MDAH3X.1.11	Seeding, seeding utility mix with Bio-Sol, 0.09 lb. per M.S.F., hydro-seeding	26.2	Msf	34.33	14.3	1,051.60		487.54			1,539
1.MDAH3X.1.11	Hydroseeding materials.	1.0	lsum	26,317.00			45,031.53				45,032
1.MDAH3X.1.11	Broadcasting Mulch and Humate	26.2	Msf	34.33	14.3	1,051.60		487.54			1,539
1.MDAH3X.1.11	Mulch and Humate materials.	1.0	LS	11,807.00			20,203.19				20,203
1.MDAH3X.1.11	Total				28.6	2,103.21	65,234.71	975.08			68,313
1.MDAH3X.1.12	Project WBS: 3 Excavation, and Institutional Contols MDA H -DC- Distribs										
1.MDAH3X.1.12	Field Non-Manual - JHRS	63,022.0	hour	66.10	63,022.0	7,128,102.29					7,128,102
1.MDAH3X.1.12	Craft Distributable - Labor	78,778.0	hour	46.33	78,778.0	6,245,173.52					6,245,174
1.MDAH3X.1.12	Craft Distributable - Materials	78,778.0	hour	7.00			943,589.88				943,590
1.MDAH3X.1.12	Total				141,800.0	13,373,275.80	943,589.88				14,316,866
1.MDAH3X.1	Total				456,914.1	39,242,452.01	15,289,470.54	5,509,420.44	68,078,133.72	199,946.34	128,319,423
1.MDAH3X.2	Project WBS: 3 Excavation, and Institutional Contols MDA H - Indirect Capital Costs										
1.MDAH3X.2.01	Project WBS: 3 Excavation and Institutional Contols MDA H -IC- Design										
1.MDAH3X.2.01	Full Excavation Design	1.0	lsum	12,806,332.00					18,644,738.76		18,644,739
1.MDAH3X.2.01	Total								18,644,738.76		18,644,739
1.MDAH3X.2.02	Project WBS: 3 Excavation, and Institutional Contols MDA H -IC- Professional Management										
1.MDAH3X.2.02	Professional Management	1.0	lsum	38,210,682.00	383,641.4	83,724,552.55					83,724,553
1.MDAH3X.2.02	Total				383,641.4	83,724,552.55					83,724,553
1.MDAH3X.2.03	Project WBS: 3 Excavation, and Institutional Contols MDA H -IC- Contingency										
1.MDAH3X.2.03	Contingency - Cost 30%	1.0	lsum	69,206,614.00	1.0					69,206,614.00	69,206,614
1.MDAH3X.2.03	Contingency - Schedule 10%	1.0	lsum	23,068,871.00	1.0					23,068,871.00	23,068,871
1.MDAH3X.2.03	Contingency - TPRA 10%	1.0	lsum	23,068,871.00	1.0					23,068,871.00	23,068,871
1.MDAH3X.2.03	Total				3.0					115,344,356.00	115,344,356
1.MDAH3X.2	Total				383,644.4	83,724,552.55			18,644,738.76	115,344,356.00	217,713,647
1.MDAH3X.3	Project WBS: 3 Excavation, and Institutional Contols MDA H - Direct O&M Costs										
1.MDAH3X.3.01	Project WBS: 3 Excavation, and Institutional Contols MDA H -DOM- Cover Maintenance & Inspections										
1.MDAH3X.3.01	Annual Long Term Monitoring Report	1.0	lsum	157,125.00	1,577.6	228,758.29					228,758
1.MDAH3X.3.01	Total				1,577.6	228,758.29					228,758
1.MDAH3X.3	Total				1,577.6	228,758.29					228,758
1.MDAH3X.4	Project WBS: 3 Excavation, and Institutional Contols MDA H - Indirect O&M Cost										
1.MDAH3X.4.02	Project WBS: 3 Excavation, and Institutional Contols MDA H -IOM- Professional Managemen										
1.MDAH3X.4.02	Professional Management (years 0-100)	1.0	lsum	40,852.00	410.2	89,512.02					89,512
1.MDAH3X.4.02	Total				410.2	89,512.02					89,512
1.MDAH3X.4.03	Project WBS: 3 Excavation, and Institutional Contols MDA H -IOM- Contingency										
1.MDAH3X.4.03	Contingency - Cost 30%	1.0	lsum	95,481.00	1.0					95,481.00	95,481
1.MDAH3X.4.03	Contingency - Schedule 10%	1.0	lsum	31,827.00	1.0					31,827.00	31,827
1.MDAH3X.4.03	Contingency - TPRA 10%	1.0	lsum	31,827.00	1.0					31,827.00	31,827
1.MDAH3X.4.03	Total				3.0					159,135.00	159,135
1.MDAH3X.4	Total				413.2	89,512.02				159,135.00	248,647
1.MDAH3X	Total				842,549.2	123,285,274.86	15,289,470.54	5,509,420.44	86,722,872.48	115,703,437.34	346,510,476
1	Total				870,572.8	126,740,030.88	16,444,778.99	5,708,216.94	87,214,198.58	118,353,524.34	354,460,750
	Grand Total				870,572.8	126,740,030.88	16,444,778.99	5,708,216.94	87,214,198.58	118,353,524.34	354,460,750

Acronyms and Abbreviations for Attachment F-1

AD	Associate Directorate
ADPM	Associate Directorate Project Management
BPS	Business and Project Services
CAMU	corrective action management unit
CF	cubic foot
CFO	chief financial officer
CLAS	class
CME	corrective measures evaluation
CMI	corrective measure implementation
CY	cubic yard
DC	direct capital (cost)
DOE	Department of Energy (U.S.)
DOM	direct operations and maintenance
DP	Defense Program
EA	each
EP	Environmental Programs Directorate
EPA	Environmental Protection Agency (U.S.)
Eq Rm	equipment room
ET	evapotranspiration
EST	estimate
FLUTe	Flexible Liner
G&A	general and administrative
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	high-density polyethelyene
H.P.	horsepower
IC	indirect capital (cost)
IOM	indirect operations and maintenance
LCY	loose cubic yard
LSUM	lump sum
JHRS	job hours
LDR	land disposal restriction
LF	linear foot

LLW	low-level waste
LOCN	location
MDA	material disposal area
MNTH	month
MPH	mile per hour
MSF	thousands of square feet
N/A	not applicable
NMGRT	New Mexico gross receipts tax
O&M	operation and maintenance
O&P	overhead and profit
OC	on center
OMB	Office of Management and Budget
OPC	other project costs
opng	opening
OSHA	Occupational Safety and Health Administration
PI	pit and impoundments
PPE	personal protective equipment
PV	present value
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
RCT	radiation control technician
S	shafts
S/C	subcontractor
SME	subject matter expert
spec	specification
STDP	standard productivity
SVE	soil-vapor extraction
SY	square yard
TA	technical area
TDR	time-domain reflectometry
TN	ton
TPC	total project cost
TPRA	technical programmatic risk assessment
TRM	turf-reinforcing mat

VOC	volatile organic compound
VZ	vadose zone
WBS	work breakdown structure
YR	year

Appendix G

Conceptual Multilayer
Resource Conservation and Recovery Act Cover Design

G-1.0 INTRODUCTION

This appendix describes modeling used to develop specifications for a conceptual multilayer, or Resource Conservation and Recovery Act (RCRA), cover at Material Disposal Area (MDA) H within Technical Area 54 (TA-54). The specifications for the MDA H RCRA cover are based on standard prescribed specifications for a RCRA cover. A standard RCRA cover for MDA G, also located at TA-54, was used in the modeling scenarios provided in Attachment G-1. Both MDA G and MDA H are located on Mesita del Buey, have similar geological conditions, and are impacted by the same weather. The effectiveness of a RCRA cover depends on the amount of precipitation, the climate's demand for water or potential evapotranspiration, unsaturated soil hydraulic properties, and long-term reliability of engineering materials (i.e., geomembranes). These major factors would be identical for both MDAs H and G and thus allow modeling work on MDA G covers to provide guidance at MDA H. The MDA H cover would be smaller and would likely have less steep and shorter slopes than MDA G. These differences allow the conceptual cover design cross-section produced for MDA G to fall into the design envelope for MDA H.

This report provides a summary of the basis for the conceptual multilayer cover design for MDA H as part of the corrective measures evaluation (CME) for remediation of the site. Conceptually this cover is designed to meet the minimum U.S. Environmental Protection Agency (EPA) performance guidelines including the following from bottom to top (EPA 1991, 097899):

1. *A Low-Hydraulic-Conductivity Geomembrane/Soil Layer.* A 60-cm (24-in.) layer of compacted natural or amended soil with a hydraulic conductively of 1×10^{-7} cm/s in intimate contact with a minimum 0.5-mm (20-mil) geomembrane liner.

2. *A Drainage Layer.* A minimum 30-cm (12-in.) soil layer having a minimum hydraulic conductivity of 1×10^{-2} cm/s or a layer of geosynthetic material having the same characteristics.

3. *A Top Vegetation/Soil Layer.* A top layer with vegetation (or armored top surface) and a minimum of 60 cm (24 in.) of soil graded at a slope between 3% and 5%.

The multilayer cover will cover the waste disposal units at MDA H, approximately 0.6 acres, and will be graded to provide the required slopes for surface drainage. In addition there will be a drain collection system designed to move water out of the drainage layer and away from the waste material.

The Hydrologic Evaluation of Landfill Performance (HELP) infiltration model (Schroeder et al. 1994, 205357) was used to evaluate the effectiveness of the multilayer cover. The HELP model is an EPA hydrologic model used for computing water balances of cover systems and other solid waste management facilities. The primary purpose of the model is to assist in comparing design alternatives. The HELP model uses weather, soil, and design data to compute a water balance for the cover system. This water balance accounts for the effects of surface storage, snowmelt, runoff, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, leachate recirculation, unsaturated vertical drainage, and leakage through soil, geomembrane, or composite liners.

G-2.0 CONCEPTUAL DESIGN

The RCRA cover conceptual design is shown in Figure G–2.0-1. The conceptual RCRA cover consists of 2 ft of surface treatment, a 1-ft soil drainage layer, a high-density polyethylene (HDPE) geomembrane (40 mil), and 2 ft of compacted clay. A brief description of each layer in the cover profile is included in Table G-2.0-1, with expanded descriptions presented in sections G-2.1 to G-2.5.

G-2.1 Vegetation

Seed and/or live plants used to revegetate disturbed areas at the Laboratory will be native to the Los Alamos vicinity. Table G-2.1-1 lists the seed mix to be used for the cover system at MDA H.

Seeding of native vegetation on the cover systems will be performed in the spring, after the last frost of the season and before the arrival of the summer rains that typically occur in July and August. Seeding will not be done from August 1 to September 30 to avoid germination too close to the first frost, which can kill the new seedlings.

Revegetation will be done by first preparing the soil by tilling and applying fertilizer. Care will be taken to ensure the rock-soil surface treatment maintains the desired ratio during this activity. Care will also be taken to ensure the rock-soil surface treatment layer is not mixed deeper into the cover profile. Slow-release organic fertilizers will be applied as necessary to eliminate any deficiencies of the topsoil. Biosol or a similar fertilizer will be applied at rates of up to 1500 lb/acre. Analyses of cover soils used will dictate the actual fertilizer rate required. Granular humate can be applied at 400 lb/acre to 500 lb/acre if it is in a hydroseeding slurry and up to 1800 lb/acre if it is incorporated into the top 4 in. of the soil. Application rates of composted manure vary depending on the source (chicken, horse, etc.) and the type of materials (wood chips, paper, soil, etc.) used to compost. If composted manure is to be applied, the nutrient content will be tested and interpreted before it is used.

Drill seeding will be the method used to apply the seed mix. Drilling introduces seed directly into the prepared seedbed by machine. Seeding will be performed by drilling at a minimum rate of 25 pure live seed (PLS) lb/acre. In areas that limit equipment access, broadcast seeding may be used at a rate of 40 PLS lb/acre.

G-2.2 Cover Soil Layer (Surface Treatment–Rock/Soil Admixture)

To address potential erosion of the cover system, a surface treatment composed of a mixture of gravel and cover soil will be used. The purpose of the cover soil layer is to (1) support vegetation (minimizing erosion and maximizing evapotranspiration), (2) separate the waste from the surface, (3) store water that infiltrates the cover system, and (4) protect underlying materials from freezing during winter and from desiccation during dry periods. The soil in this top layer will be capable of sustaining nonwoody plants, will have an adequate water-holding capacity, and will be deep enough to allow for expected long-term erosional losses. A medium-textured soil will be used, such as a loam. The final slopes of the cover will be uniform and at an optimum slope of 3%–5%, and the edges will be constructed to not allow the formation of erosion rills and gullies.

The addition of a gravel-soil admixture to the surface will minimize annual soil loss because of wind and runoff. The gravel-soil admixture will include a mixture of 33% gravel by weight. The gravel size to be used will be between 1.5 in. (3.8 cm) and 3 in. (7.6 cm) in diameter. The total gravel-soil admixture thickness is to be no less than 24 in. (0.67 m). Slopes and slope lengths were estimated, and these estimates will be replaced with measured values during the final design phase.

G-2.3 Soil Drainage Layer

The soil drainage layer will minimize the time that infiltrated water is in contact with the bottom clay layer and hence lessen the potential for water to reach the waste. This soil drainage layer will also minimize the head built up on the geomembrane, thus minimizing the chance of ripping at localized stress points or seepage at welded seams. Water that infiltrates the top layer will be intercepted by this highly permeable soil drainage layer and rapidly move to an exit drain. The drainage pipes will be designed in a manner to

avoid potential damage to the geomembrane. The granular material will be 12 in. thick and have a hydraulic conductivity of at least 1×10^{-2} cm/s. To maximize the hydraulic conductivity of this layer, the material will be relatively free of fines, defined as materials that will pass through the openings of a No. 200 sieve (.075 mm). In addition, a minimum amount of compaction will be specified in the final design so excessive compaction does not grind up soil particles, which could lower the hydraulic conductivity.

G-2.4 Geomembrane

An HDPE 40-mil-thick geomembrane is specified for the purposes of this conceptual design. This type of geomembrane is readily used in these applications and is a good choice to meet the minimum requirements. RCRA allows the use of a 20-mil-thick geomembrane, while the industry standard is typically 60 mil. To provide a level of conservatism against industry standards, a 40-mil geomembrane was used. One of the key reasons for choosing the HDPE over another type of material is its ability to withstand ultraviolet, which would potentially be a problem at MDA H.

The geomembrane will be placed on the smooth, even, compacted clay layer and have a minimum slope of 3%. The quality control of this step in the construction process will be critical to ensure the membrane is welded correctly and is in intimate contact with the compacted clay layer and no puncture holes are inflicted on the membrane during installation. Any of these quality-control issues can drastically impact the overall performance of this type of cover. A quality assurance/quality control plan will be strictly adhered to during the construction activity.

G-2.5 Compacted Clay Layer

The compacted clay layer, which is a low-hydraulic-conductivity soil component placed over the waste, will be at least 2 ft thick and free of detrimental rock, clods, and other soil debris; will have an upper surface with a 3% maximum slope; and will be below the maximum frost line. The surface will be smooth so no small-scale stress points are created for the geomembrane.

The primary requirement for the compacted clay liner is that it be capable of being compacted to produce a suitably low hydraulic conductivity. A hydraulic conductivity of 1×10^{-7} cm/s was used for modeling purposes. Some of the critical design parameters follow:

- Fines—The soil should contain at least 20% fines (fines are defined as the percentage, on a dry weight basis, of material passing a No. 200 sieve).
- Plasticity Index—The soil should have a plasticity index of at least 10% and generally between 10% and 35%.
- Percentage of Gravel—The percentage of gravel (defined as material retained on a No. 4 sieve) must not be excessive. A maximum amount of 10% gravel will be a requirement.
- Stones and Rocks—No stones or rocks larger than 1 to 2 in. in diameter will be allowed within this material.
- Water Content—The clay layer will be compacted wet of optimum to maximize the mixing of the any remnant clods typical of clay-rich soils and reduce the hydraulic conductivity.

G-3.0 HELP MODELING

The HELP model was developed at the U.S. Army Engineering Experiment Station under a cooperative agreement with the EPA to support RCRA and Superfund programs. Use of the HELP model is

recommended by the EPA for RCRA cover designs; however, the user should be cautioned that the model does not work well with other cover types that do not contain geomembrane liners, in part because the HELP model does not take into account important physical processes that control unsaturated water movement, such as matric potential in soil barrier layers (Dwyer 2003, 097902).

The model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of landfills. The model accepts weather, soil, and design data and uses solution techniques that account for the effects of surface storage, snowmelt, runoff, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, leachate recirculation, unsaturated vertical drainage, and leakage through soil, geomembrane, or composite liners. The free available water is used to compute the runoff by the Natural Resources Conservation Service (NRCS) rainfall-runoff relationship.

G-3.1 HELP Input Parameters

A set of input parameters was developed for simulations using HELP for the given cover profiles. These parameters were developed based on field and laboratory measurements, values from the literature, and expert opinion. The detailed parameters are listed in Attachment G-1, HELP Model Run Output and are discussed as they relate to the different conditions described below.

G-3.2 Model Geometry

The model geometry was based on the depth of the cover profile shown in Figure G-2.0-1. The modeled cover profile includes (1) a 2-ft surface-treatment layer, (2) a 1-ft drainage layer, (3) a 40-mil HDPE geomembrane, (4) 2 ft of compacted clay. Assumptions in the modeling include (1) 3 ft of existing operational cover over the waste, (2) approximately 60 ft of waste material, and (3) approximately 900 ft of vadose zone. The geometry for the modeled cover is found in the profile structure of Attachment G-1.

G-3.3 Boundary Conditions

Los Alamos, New Mexico, is located in a dry environment where the climate's demand for water, referred to as potential evapotranspiration, far exceeds the actual supply of water or precipitation. The HELP model divides precipitation into overland flow and infiltration based on a modified version of the NRCS runoff curve number method. Water that infiltrates remains in storage or is subjected to evapotranspiration, lateral drainage, and percolation. Water is removed by evapotranspiration only from the evaporative depth of the cover, which is defined as the maximum depth from which water may be removed by evapotranspiration. If the layer is a vertical percolation layer, water from soil-water storage is routed based on a unit hydraulic gradient in the vertically downward direction using Darcy's law and unsaturated hydraulic conductivity. Water from the vertical percolation layer is removed by percolation or evapotranspiration if the water content is above the wilting point. An assumption in the HELP model is that the barrier soil liner is saturated with ponded water, which in an arid climate such as Los Alamos is not expected.

G-3.4 Upper Boundary Condition—Climate/Data

The surface boundary condition during evaporation was modeled as a flux that required daily weather data. Precipitation data for the wettest decade on record for Los Alamos National Laboratory (1985 to 1994) was used in the model assumptions (http://environweb.lanl.gov/weathermachine/). Because the RCRA requirements to minimize flux were the regulatory drivers for determining the storage capacity requirements of the cover profile, the wettest decade on record was deemed to provide a conservative measure for evaluation.

G-3.5 Vegetation Data

An average leaf area index of 0.65 was used (McDowell et al. 2008, 205356). This value represents an average of values reported for the site of 0.3 and 1.0. The assumed onset and termination of the growing season for the site were Julian days 98 and 299, respectively.

G-3.6 Soil Properties

Soil hydraulic properties were obtained from laboratory testing of soil samples collected from the TA-61 borrow site (Shaw Environmental Inc. 2006, 091368). The saturated hydraulic conductivity of the soils was obtained using flexible wall permeameters in accordance with the American Society for Testing and Materials (ASTM) Standard D 5084, Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter. Unsaturated soil properties were obtained from data using pressure plates and water columns (depending on the section values) to develop values of water content as a function of pressure head (ASTM D 6836, Standard Test Methods for Determination of the Soil Water Characteristic Curve for Desorption Using a Hanging Column, Pressure Extractor, Chilled Mirror Hygrometer, and/or Centrifuge). These data were then used as input into the RETention Curve Computer Code (RETC) (van Genuchten et al. 1991, 205358) to compute curve-fitting parameters used to estimate moisture characteristic curves for the soil layers (van Genuchten 1980, 063542). The Maulem conductivity function was used to describe the unsaturated hydraulic conductivity of the soils. The van Genuchten "m" parameter for this function is assumed to be "1 − 1/n"; "n" being one of the established van Genuchten parameters. The initial soil conditions are expressed in terms of suction-head values that correspond to the average moisture content between each soil layer's field capacity and permanent wilting point determined from each respective soil layer's moisture characteristic curve. The soil properties used as input parameters are summarized in Attachment G-1.

G-3.7 Modeled Percolation

Percolation results from the redistribution of water through a soil profile in response to gradients formed by differences in the energy state of the water. Annual percolation, as an annual total rate, is provided in Attachment G-1. Percolation through layer 4, which is the compacted clay layer, is estimated to be 0.075 cm (0.75 mm) in year 1. The total percolation through this layer is estimated to be 2.70 cm over a 30-yr time frame, or an average of 0.09 cm/yr (0.9 mm/yr).

G-4.0 REFERENCES

The following list includes all documents cited in this appendix. 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 New Mexico Environment Department 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.

Dwyer, S.F., May 2003. "Water Balance Measurements and Computer Simulations of Landfill Covers," Ph.D. dissertation, University of New Mexico, Albuquerque, New Mexico. (Dwyer 2003, 097902)

Dwyer, S.F., R.E. Rager, and J. Hopkins, April 2007. "Cover System Design Guidance and Requirements Document," Los Alamos National Laboratory document LA-UR-06-4715, Los Alamos, New Mexico. (Dwyer et al. 2007, 096232)

EPA (U.S. Environmental Protection Agency), May 1991. "Design and Construction of RCRA/CERCLA Final Covers," Seminar Publication, EPA/625/4-91/025, Office of Research and Development, Washington, D.C. (EPA 1991, 097899)

McDowell, N.G., S. White, and W.T. Pockman, 2008. "Transpiration and Stomatal Conductance across a Steep Climate Gradient in the Southern Rocky Mountains," *Ecohydrology,* Vol. 1, No. 3, pp. 193–204. (McDowell et al. 2008, 205356)

Schroeder, P.R., T.S. Dozier, P.A. Zappi, B.M. McEnroe, J.W. Sjostrom, and R.L. Peyton, September 1994. "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3," EPA/600/R-94/168b, Office of Research and Development, Washington, D.C. (Schroeder et al. 1994, 205357)

Shaw Environmental Inc., February 2006. "Geotechnical and Hydraulic Characterization at the Technical Area 61 Borrow Area," report prepared for Los Alamos National Laboratory, Albuquerque, New Mexico. (Shaw Environmental, Inc. 2006, 091368)

van Genuchten, M.T., 1980. "A Closed-Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils," *Soil Science Society of America Journal,* Vol. 44, pp. 892-898. (van Genuchten 1980, 063542)

van Genuchten, M.T., F.J. Leij, and S.R. Yates, December 1991. "The RETC Code for Quantifying the Hydraulic Functions of Unsaturated Soils," EPA/600/2-91/065, Office of Research and Development, Washington, D.C. (van Genuchten et al. 1991, 205358)

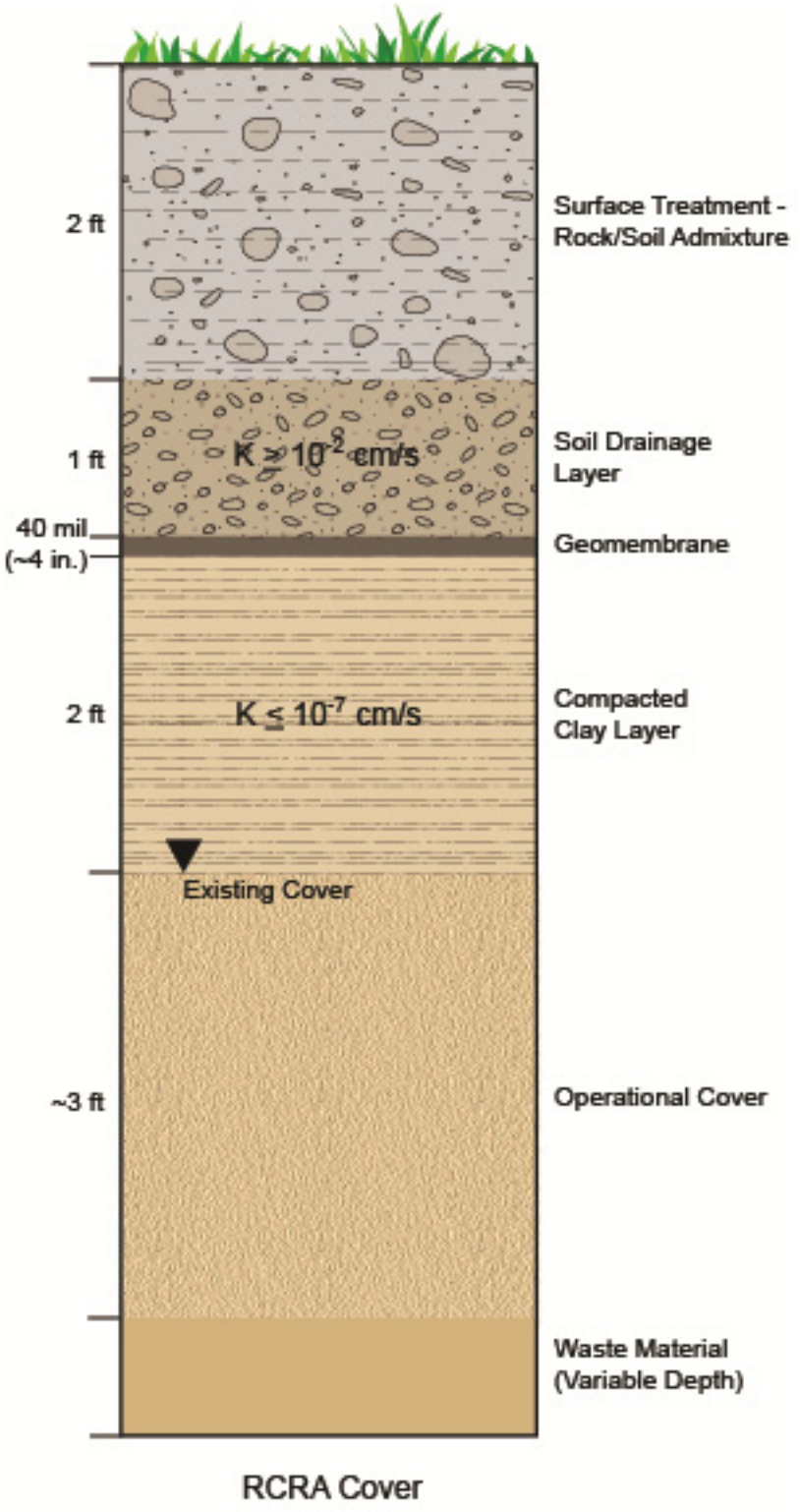


Figure G-2.0-1 RCRA cover conceptual design

Table G-2.0-1
RCRA Conceptual Cover Profile Layer Details and Justification

Cover-System Layer	Design Details	Design Justification
Vegetation	The site is to be seeded with native vegetation composed of both cool and warm weather species (grasses). Refer to Table G-2.1-1 for a recommended seed mix.	The vegetation will help stabilize the cover surface, minimize erosion, and remove limited infiltrated water via transpiration.
Surface Treatment	Mixture of cover soil and gravel. The gravel is to be mixed into the cover soil at a rate of 33% by weight. The gravel will be1.5 in. (3.8 cm) to 3 in. (7.6 cm) in diameter. The cover soil will be capable of maintaining native vegetation with adequate storage capacity and nutrient availability.	The gravel/soil admixture is designed to minimize erosion due to both wind and surface runoff.
Soil Drainage Layer	The granular material will be 12 in. thick and have a hydraulic conductivity of at least 1×10^{-2} cm/s. To maximize the hydraulic conductivity of this layer the material will be relatively free of fines, defined as materials that will pass through the openings of a No. 200 sieve (0.075 mm).	The soil drainage layer is designed to minimize the time the infiltrated water is in contact with the bottom, low-hydraulic-conductivity layer.
Geomembrane	For the purposes of this conceptual design, HDPE, 40-mm thick, will be used.	In conjunction with the compacted clay layer, the geomembrane will act to provide a low-hydraulic-conductivity geomembrane/soil layer.
Compacted Clay Layer	The low-hydraulic-conductivity soil component placed over the waste will be at least 2 ft thick and free of detrimental rock, clods, and other soil debris; have an upper surface with a 3% maximum slope; have a hydraulic conductivity of no greater than 1×10^{-7} cm/s; and be below the maximum frost line.	In conjunction with the geomembrane, the compacted clay layer will act to provide a low-hydraulic-conductivity geomembrane/soil layer. This low hydraulic conductivity has been prescribed by the EPA to be no greater than 1×10^{-7} cm/s.
Operational Cover/Subgrade	The upper foot of existing operational cover soil shall be scarified and recompacted to a minimum of 95% of the maximum dry density and dry of the optimum moisture content as determined by ASTM D698.	The operational cover/subgrade will provide a firm foundation for the construction of the cover profile and will provide the final grades and slopes for installation of a uniform cover profile.

Table G-2.1-1
Seed Mix

Common Name	Scientific Name	Percent of Mix	PLS (lb/acre)
Sideoats grama	*Bouteloua curtipendula*	15%	3.75
Blue grama	*Bouteloua gracilis*	15%	3.75
Indian ricegrass	*Oryzopsis hymenoides*	10%	2.5
Western wheatgrass	*Agropyron smithii*	15%	3.75
Sand dropseed	*Sporobolus cryptandrus*	10%	2.5
Sheep fescue	*Festuca ovina*	20%	5
Firewheel	*Gaillardia pulchella*	3%	0.75
Western yarrow	*Achillea millefoium*	2%	0.5
Prairie coneflower	*Ratibida columnifera*	4%	1
Blue flax	*Linum perenne lewisii*	6%	1.5
		Total	**25**

Source: (Dwyer et al. 2007, 096232).

Attachment G-1

HELP Model Run Output

Description

Model : HELP

An US EPA model for predicting landfill hydrologic processes and testing of effectiveness of landfill designs

Client : LANL MDA-G RCRA CAP

Location : TA-54

8/20/2011

1. Profile. RCRA Cover

Model Settings

[HELP] Case Settings

Parameter	Value	Units
Runoff Method	Model calculated	(-)
Initial Moisture Settings	Model calculated	(-)

[HELP] Surface Water Settings

Parameter	Value	Units
Runoff Area	100	(%%)
Vegetation Class	Good stand of grass	(-)

Profile Structure

Layer	Top (ft)	Bottom (ft)	Thickness (ft)
Loamy Sand	0.0000	-2.0000	2.0000
Coarse Sand	-1.9995	-2.9995	1.0000
High Density Polyethylene	-2.9995	-3.0028	0.0033
Barrier Soil	-3.0028	-5.0028	2.0000
Silty Loam	-5.0028	-8.0028	3.0000
Municipal Waste (312 kg/cub.m)	-8.0023	-68.0023	60.0000
Sand	-68.0023	-968.0023	900.0000

1.1. Layer. Loamy Sand

Top Slope Length: 100.0000
Bottom Slope Length: 100.0000
Top Slope: 3.0000
Bottom Slope : 3.0000

[HELP] Vertical Perc. Layer Parameters

Parameter	Value	Units
total porosity	0.437	(vol/vol)
field capacity	0.105	(vol/vol)
wilting point	0.047	(vol/vol)
sat.hydr.conductivity	4.4E-4	(cm/sec)
subsurface inflow	0	(mm/year)

1.2. Layer. Coarse Sand

Top Slope Length: 100.0000
Bottom Slope Length: 100.0000
Top Slope: 3.0000
Bottom Slope : 3.0000

[HELP] Lateral Drainage Layer Parameters

Parameter	Value	Units
total porosity	0.417	(vol/vol)
field capacity	0.045	(vol/vol)
wilting point	0.018	(vol/vol)
sat.hydr.conductivity	0.01	(cm/sec)
subsurface inflow	0	(mm/year)

1.3. Layer. High Density Polyethylene

Top Slope Length: 100.0000
Bottom Slope Length: 100.0000
Top Slope: 3.0000
Bottom Slope : 3.0000

[HELP] Geomembrane Liner Parameters

Parameter	Value	Units
sat.hydr.conductivity	2E-13	(cm/sec)
pinhole density	2	(#/ha)
installation defects	2	(#/ha)
placement quality	4	(-)
geotextile transmissivity	0	(cm2/sec)

1.4. Layer. Barrier Soil

Top Slope Length: 100.0000
Bottom Slope Length: 100.0000
Top Slope: 3.0000
Bottom Slope : 3.0000

[HELP] Barrier Soil Liner Parameters

Parameter	Value	Units
total porosity	0.427	(vol/vol)
field capacity	0.418	(vol/vol)
wilting point	0.367	(vol/vol)
sat.hydr.conductivity	1E-7	(cm/sec)
subsurface inflow	0	(mm/year)

1.5. Layer. Silty Loam

Top Slope Length: 100.0000
Bottom Slope Length: 100.0000
Top Slope: 3.0000
Bottom Slope : 3.0000

[HELP] Vertical Perc. Layer Parameters

Parameter	Value	Units
total porosity	0.501	(vol/vol)
field capacity	0.284	(vol/vol)
wilting point	0.135	(vol/vol)
sat.hydr.conductivity	4.9E-3	(cm/sec)
subsurface inflow	0	(mm/year)

1.6. Layer. Municipal Waste (312 kg/cub.m)

Top Slope Length: 100.0000
Bottom Slope Length: 0.0000
Top Slope: 3.0000
Bottom Slope : 0.0000

[HELP] Vertical Perc. Layer Parameters

Parameter	Value	Units
total porosity	0.6710	(vol/vol)
field capacity	0.2920	(vol/vol)
wilting point	0.0770	(vol/vol)
sat.hydr.conductivity	86.40000000000001	(cm/day)
subsurface inflow	0.0000	(cm/day)

1.7. Layer. Sand

Top Slope Length: 0.0000
Bottom Slope Length: 0.0000
Top Slope: 0.0000
Bottom Slope : 0.0000

[HELP] Lateral Drainage Layer Parameters

Parameter	Value	Units
total porosity	0.437	(vol/vol)
field capacity	0.062	(vol/vol)
wilting point	0.024	(vol/vol)
sat.hydr.conductivity	0.0058	(cm/sec)
subsurface inflow	0	(mm/year)

Annual Totals rate (cm)

	Year-1 (cm)	Year-10 (cm)	Year-20 (cm)	Year-30 (cm)
Precipitation (cm)	5.4127E+01	5.4178E+01	5.1130E+01	4.8870E+01
Runoff (cm)	7.6646E+00	1.8393E+01	1.9691E+01	1.3394E+01
Evapotranspiration (cm)	3.5990E+01	3.6686E+01	3.9274E+01	4.1411E+01
Change in water storage (cm)	1.0471E+01	-9.3167E-01	-7.9243E+00	-6.0261E+00
Water budget balance (cm)	-8.1291E-07	-8.1368E-07	-7.6790E-07	-7.3395E-07
Soil water (cm)	2.3260E+03	2.3241E+03	2.3245E+03	2.3254E+03
Snow water (cm)	0.0000E+00	1.0333E+00	0.0000E+00	0.0000E+00
Lateral drainage collected from Layer 2 (cm)	1.0033E-03	1.2668E-03	1.2007E-03	1.2193E-03
Percolation or leakance through Layer 4 (cm)	7.5335E-02	9.2321E-02	8.8096E-02	8.9290E-02
Average head on top of Layer 3 (cm)	6.1441E+01	7.5760E+01	7.2017E+01	7.3143E+01
Percolation or leakance through Layer 7 (cm)	1.0272E-03	3.0003E-02	8.7986E-02	8.8983E-02

(continued)

	Total (cm)
Precipitation (cm)	1.6584E+03
Runoff (cm)	4.4619E+02
Evapotranspiration (cm)	1.2006E+03
Change in water storage (cm)	9.8332E+00
Water budget balance (cm)	-2.4907E-05
Soil water (cm)	6.9757E+04
Snow water (cm)	5.0184E+01
Lateral drainage collected from Layer 2 (cm)	3.7037E-02
Percolation or leakance through Layer 4 (cm)	2.7076E+00
Average head on top of Layer 3 (cm)	2.2188E+03
Percolation or leakance through Layer 7 (cm)	1.7103E+00

Annual Totals volume (m3)

	Year-1 (m3)	Year-10 (m3)	Year-20 (m3)	Year-30 (m3)
Precipitation (m3)	1.1171E+05	1.1182E+05	1.0553E+05	1.0086E+05
Runoff (m3)	1.5819E+04	3.7961E+04	4.0640E+04	2.7644E+04
Evapotranspiration (m3)	7.4280E+04	7.5716E+04	8.1058E+04	8.5469E+04
Change in water storage (m3)	2.1610E+04	-1.9229E+03	-1.6355E+04	-1.2437E+04
Water budget balance (m3)	-1.6778E-03	-1.6793E-03	-1.5849E-03	-1.5148E-03
Soil water (m3)	4.8006E+06	4.7967E+06	4.7976E+06	4.7993E+06
Snow water (m3)	0.0000E+00	2.1326E+03	0.0000E+00	0.0000E+00
Lateral drainage collected from Layer 2 (m3)	2.0708E+00	2.6146E+00	2.4782E+00	2.5164E+00
Percolation or leakance through Layer 4 (m3)	1.5548E+02	1.9054E+02	1.8182E+02	1.8428E+02
Percolation or leakance through Layer 7 (m3)	2.1201E+00	6.1922E+01	1.8159E+02	1.8365E+02

(continued)

	Total (m3)
Precipitation (m3)	3.4228E+06
Runoff (m3)	9.2089E+05
Evapotranspiration (m3)	2.4780E+06
Change in water storage (m3)	2.0295E+04
Water budget balance (m3)	-5.1405E-02
Soil water (m3)	1.4397E+08
Snow water (m3)	1.0358E+05
Lateral drainage collected from Layer 2 (m3)	7.6440E+01
Percolation or leakance through Layer 4 (m3)	5.5882E+03
Percolation or leakance through Layer 7 (m3)	3.5298E+03

Accumulated rate (cm)

	Year-1 (cm)	Year-10 (cm)	Year-20 (cm)	Year-30 (cm)
Precipitation (cm)	5.4127E+01	5.9774E+02	1.1192E+03	1.6584E+03
Runoff (cm)	7.6646E+00	1.8243E+02	3.0175E+02	4.4619E+02
Evapotranspiration (cm)	3.5990E+01	4.0559E+02	8.0761E+02	1.2006E+03
Lateral drainage collected from Layer 2 (cm)	1.0033E-03	1.2264E-02	2.4502E-02	3.7037E-02
Percolation or leakance through Layer 4 (cm)	7.5335E-02	8.9715E-01	1.7931E+00	2.7076E+00
Percolation or leakance through Layer 7 (cm)	1.0272E-03	1.0724E-01	8.1466E-01	1.7103E+00

Accumulated volume (m3)

	Year-1 (m3)	Year-10 (m3)	Year-20 (m3)	Year-30 (m3)
Precipitation (m3)	1.1171E+05	1.2337E+06	2.3100E+06	3.4228E+06
Runoff (m3)	1.5819E+04	3.7651E+05	6.2278E+05	9.2089E+05
Evapotranspiration (m3)	7.4280E+04	8.3709E+05	1.6668E+06	2.4780E+06
Lateral drainage collected from Layer 2 (m3)	2.0708E+00	2.5312E+01	5.0569E+01	7.6440E+01
Percolation or leakance through Layer 4 (m3)	1.5548E+02	1.8516E+03	3.7007E+03	5.5882E+03
Percolation or leakance through Layer 7 (m3)	2.1201E+00	2.2132E+02	1.6814E+03	3.5298E+03

Peak daily values

	Rate (cm)	Volume (m3)	Day	Year
Precipitation	1.2395E+01	2.5582E+04	113	23
Runoff	1.2109E+01	2.4991E+04	113	23
Lateral drainage collected from Layer 2	4.2760E-06	8.8251E-03	319	1
Percolation or leakance through Layer 4	3.0367E-04	6.2674E-01	319	1
Percolation or leakance through Layer 7	4.0114E-04	8.2791E-01	74	30
Snow water	1.2041E+01	2.4852E+04	19	18

Appendix H

Conceptual Evapotranspiration Cover Design

H-1.0 INTRODUCTION

This appendix describes modeling used to develop specifications for an evapotranspiration (ET) cover at Material Disposal Area (MDA) H within Technical Area 54 (TA-54) at Los Alamos National Laboratory (LANL or the Laboratory). The specifications are based on modeling produced for MDA G that is applicable to MDA H as well. Both MDAs G and H are located on Mesita del Buey and are impacted by the same kind of weather patterns. The effectiveness of an ET cover depends on precipitation, potential ET, and unsaturated soil hydraulic properties. These three major factors are identical for both MDAs L and G and thus allow previous analysis of MDA G covers to provide guidance at MDA H. The MDA H cover is smaller and would have less steep and shorter slopes than MDA G. These differences allow the conceptual cover design cross-section produced for MDA G to fall into the design envelope for MDA H.

Borrow soil with amendments will be used to construct the ET covers at MDA H. TA-61 is a likely source of the borrow soil. Attachment H-1 provides supporting documentation for the modeling and specifications. The UNSAT-H infiltration modeling used to calculate cover thickness was based on precipitation data of the wettest decade on record, which is a common data set used for Resource Conservation and Recovery Act (RCRA) hazardous waste landfill cover design (Benson 2007, 097054, p. 3). The conceptual design includes a 3.5-ft (1-m) cover depth with 1.5 ft (0.45 m) of soil-gravel admixture to reduce flux through the cover to less than 0.04 in./yr (1 mm/yr), the RCRA Subtitle C–equivalent infiltration rate. Burrowing animals and plant roots on Mesita del Buey will be deterred by the biobarrier that consists of a thin filter layer and a cobble layer. This biobarrier is described below. These cover layers will be placed on the existing subgrade of interim (operational) cover. The existing subgrade will be prepared to promote adhesion to the final cover. All necessary precautions will be taken during the final design so as not to impact in-place waste.

This appendix describes the purpose for each layer of the ET cover, the design methodology used, and the calculations and modeling results that validate the design (Attachment H-1). Most of the input parameters are identical for the MDA H and MDA G sites, with only differences in the cover slopes and slope lengths, which are conservative for MDA H.

H-2.0 BACKGROUND

TA-54 is located on Mesita del Buey and spans the boundary of the Cañada del Buey and Pajarito Canyon watersheds. TA-54 ranges in elevation from 6700 ft to 6800 ft with a depth to groundwater ranging between 900 ft and 980 ft. The major industrial activity at TA-54 has been waste storage and disposal. MDA H is a 0.3-acre site that served as the Laboratory's designated disposal site for classified, solid-form waste from 1960 to 1986. The stormwater runoff from MDA H is directed into a single drainage toward Pajarito Canyon.

This appendix summarizes the basis for the conceptual ET cover design for MDA H as part of the corrective measures evaluation (CME) for remediation of the site. Many of the calculations and specifications for the MDA H site are similar to those developed by Dwyer in the report titled "Conceptual Cover Design Report for the Corrective Evaluation Measure for Closure of MDA G" (Dwyer 2007, 098276). At MDA H, an ET cover with an erosion-resistant surface treatment and a biobarrier can be constructed to provide adequate protection and risk reduction. ET covers consist of a vegetated soil layer constructed to represent an optimum mix of soil texture, soil thickness, and vegetation cover (Figure H-2.0-1).

The ET cover concept relies on the soil to act as a sponge (Dwyer 2003, 097902, p. 162). Infiltrated water is held in this "sponge" until it can be removed via ET. Generally, ET is defined as water removed because of both evaporation from the surface and transpiration by vegetation. Previous research has shown that a simple soil cover with vegetation can be very effective at minimizing percolation and erosion, particularly in dry environments.

The MDA H site is an ideal site for an ET cover. In Los Alamos, the climate's demand for water or potential evapotranspiration (PET) far exceeds the actual supply of water (precipitation) as shown in Figure H-2.0-2. The ET cover also provides for a deep-rooting medium that will provide an opportunity for native vegetation to survive lengthy drought periods.

H-3.0 CONCEPTUAL DESIGN

The ET cover system proposed for MDA H is shown in Figure H-3.0-1. A brief description of each layer in the cover profile is presented in Table H-3.0-1, with more complete descriptions presented in sections H-3.1 through H-3.5.

H-3.1 Vegetation

Seed and/or live plants used to revegetate disturbed areas at the Laboratory will be native to the Los Alamos vicinity. Table H-3.1-1 lists the seed mix to be used for the cover system at MDA H.

Seed Application

Seeding of native vegetation on the cover systems will be performed in the spring, after the last frost of the season and before the arrival of the summer rains that typically occur in July and August. Seeding will not be done from August 1 to September 30 to avoid germination too close to the first frost, which can kill the new seedlings.

Revegetation will be done by first preparing the soil by tilling and applying fertilizer. Care will be taken to ensure the rock-soil surface treatment maintains the desired ratio during this activity. Care will also be taken to ensure the rock-soil surface treatment layer is not mixed deeper into the cover profile. Slow-release organic fertilizers will be applied as necessary to eliminate any deficiencies of the topsoil. Table H-3.1-1 lists the recommended levels of available plant nutrients. Bio-Sol or a similar fertilizer will be applied at rates up to 1500 lb/acre. Analyses of cover soils used will dictate the actual fertilizer rate required. Granular humate can be applied at 400 lb/acre to 500 lb/acre if it is in a hydroseeding slurry and up to 1800 lb/acre if it is incorporated into the top 4 in. of the soil. Application rates of composted manure vary depending on the source (chicken, horse, etc.) and the type of materials (wood chips, paper, soil, etc.) used to compost. If composted manure is to be applied, the nutrient content will be tested and interpreted before it is used.

Drill seeding will be the method used to apply the seed mix. Drilling introduces seed directly into the prepared seedbed by machine. Seeding will be performed by drilling at a minimum rate of 25 pure live seed (PLS) lb/acre. In areas that limit equipment access, broadcast seeding may be used at a rate of 40 PLS lb/acre.

H-3.2 Surface Treatment

To address potential erosion of the cover system, a surface treatment composed of a mixture of gravel and cover soil will be used. This admixture was designed following the procedure described in Dwyer et al. (1999, 099309, p. 34; 2007, 096232, pp. 5-19-5-25).

The gravel-to-soil ratio and gravel size were determined based on the most critical drainage section (north-south). With the addition of the gravel-soil admixture to the surface, annual soil loss because of both wind and runoff was estimated to be minimal. The gravel-soil admixture will include a mixture of 33% gravel by weight. The cover soil will exhibit the storage capacity and soil nutrients described in section H-3.3. Salts in this soil will also be limited in the cover soil as described in section H-3.3. The critical gravel size was determined to be 1.5 in. (3.8 cm) (gravel size between 1.5 in. [3.8 cm] and 3 in. [7.6 cm] in diameter to be used), and the total gravel-soil admixture thickness is to be no less than 18 in. (0.5 m). The design methodology and procedure with input and output specifics are included in Attachment H-1. Many of the input parameters required to calculate the specifics of this gravel admixture, surface treatment such as bulk density and percentage of silt/clay in the soil were estimated based on soil-amendment requirements. Slopes and slope lengths were estimated, and these estimates will be replaced with measured values during the final design phase.

Soil Placement

The gravel-soil admixture used as a surface treatment will be placed in one uncompacted lift, if practical. Two lifts are also acceptable provided the bottom lift is not overcompacted because of placement of the top lift. This surface treatment layer will be placed as dry as possible but no wetter than the optimum moisture content as determined by American Society for Testing and Materials (ASTM) D698. Any excessive compaction this layer receives during placement will be scarified. The loose placement is to provide the best means for vegetation establishment. Overcompaction is one of the primary causes of unsuccessful revegetation efforts.

H-3.3 Cover Soil

The cover soil layer beneath the gravel-soil admixture will be a minimum of 3.5 ft (1 m) of amended soil meeting the water storage capacity properties of a typical sandy loam soil, based on the ROSETTA Software, Version 1.2, developed in 2000 by Marcel G. Schaap of the U.S. Salinity Laboratory, Riverside, California. The cover soil, including the soil in the surface treatment (gravel admixture), must have adequate storage capacity to retain infiltrated water until that water can be removed via ET. This soil must provide a quality rooting medium to maintain native vegetation; therefore, the soil must have acceptable levels of available plant nutrients, and its salt content must be below acceptable levels.

The depth of the cover soil was determined based on water storage requirements to meet RCRA-equivalency of less than 1 mm/yr. Modeling using UNSAT-H (Fayer 2000, 072734) was performed to determine the minimum thickness required to provide adequate storage capacity for an upper boundary condition consisting of the wettest decade in recorded history in Los Alamos (1985 to 1994).

Average hydraulic properties (Shaw Environmental Inc. 2006, 091368, Appendix D) from the TA-61 soil borrow site were used as input parameters. The modeling output determined that a depth greater than 6.6 ft (2 m) would be required to minimize flux largely because of the lack of water-storage capacity in the TA-61 soils (Figure H-3.3-1). The TA-61 soils consist of crushed tuff and were classified as a sandy loam but are on the coarser side of sandy loam soils. The ROSETTA software, Version 1.2, was used to perform another modeling exercise using typical sandy loam hydraulic properties to ascertain if this soil

type would decrease the soil depth requirement. This output (Figure H-3.3-2) determined that approximately 5 ft (1.5 m) of typical sandy loam soil would minimize flux to a point of diminishing returns (Dwyer et al. 2007, 096232, pp. 3-10-3-11).

The depth of the surface treatment was determined to be a minimum of 1.5 ft (0.5 m). Therefore, the additional cover soil depth required to minimize flux is 3.5 ft (1 m). This depth provides for a minimum cover soil depth of 5 ft (1.5 m). A third modeling exercise was performed to capture the entire conceptual design that includes all layers above the existing subgrade. This modeling output determined that flux through the cover will be negligible with the conditions modeled. It is important to note that the inclusion of a filter medium above the biobarrier and the inclusion of a biobarrier create a capillary barrier. Details of the modeling performed, including specific input and output parameters, are included in Attachment H-1.

The amendments will ensure the cover soil is capable of maintaining a desired stand of native vegetation. The plant nutrients should allow for the final amended soil to meet the requirements listed in Table H-3.3-1.

Additionally, the salt content in the soils must be below levels that would hinder the establishment and growth of native vegetation. The final amended soils will comply with the requirements outlined in Table H-3.3-2.

Soil Placement

An important aspect involved with the construction of a soil cover system is that the soils are placed in a uniform manner to help limit preferential flow through the cover. Dwyer (2003, 097902, p. 32) describes the impact of preferential flow in landfill covers. Preferential flow cannot be avoided, but necessary precautions will be taken to ensure it is minimized. An important feature of the design specifications will involve determining an acceptable density range for installation of the cover soils. To increase the initial storage capacity of the cover system and mitigate the potential for desiccation cracking, the soils will be placed as dry as possible but not more than the optimum moisture content as determined by ASTM D698. The acceptable density and moisture content placement range is described as the acceptable compaction zone (ACZ).

The ACZ (Figure H-3.3-2) is unknown as of the date of this CME report because the desired soil will require amendment to meet the performance objectives of the cover system. Therefore, the process involved in determining this ACZ is briefly described here. Further details may be found in Dwyer et al. (2007, 096232, pp. 3-7-3-8).

The determination of the ACZ for placement of cover soil follows.

1. Cover soil shall be placed at the goal density. The goal density is best determined from the borrow soil's in situ density. That is, over an extended period of time, a given soil will move toward its "natural" density state. Therefore, it is the goal of the soil installation to place the soil at a density that is as close to that "goal" density as possible from the onset. In this case, because the soil will be amended, the goal density shall be assumed to be between 85% to 90% of the maximum dry density (MDD), as determined by ASTM D698.
2. A standard proctor curve must be determined for the amended soil used per ASTM D698, "Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort," to obtain the respective MDD and optimum moisture content.
3. The allowable dry unit weight or soil density during construction shall be the goal density, plus or minus 5 lb/ft^3 (80.1 g/L).

4. The cover soils shall be placed as dry as possible not to exceed the optimum moisture content per ASTM D698 derived for each borrow soil used. Installing soil dry will provide for a maximum initial water-storage capacity in the cover and minimize the potential for desiccation cracking, particularly when clays are used (Dwyer 2003, 097902). This moisture content is applicable for all soils in the cover system, including the upper 1 ft (31 cm) of the interim (operational) cover or subgrade.

H-3.4 Filter Medium

A filter medium composed of sand and/or gravel will be placed above the biobarrier, between the biobarrier and the overlying cover soil layer. This layer is designed to prevent the mixing of soil layers and meet specified filter criteria. The depth of this layer is to be determined in the field and will be the minimum depth required to completely cover the biobarrier layer and provide a smooth and continuous surface layer for placement of the cover soil. For estimating purposes, this layer is assumed to be 6 in. (15 cm) thick.

Two primary mechanisms of concern for transport of contaminants from the MDA H site are biointrusion and erosion. Both burrowing animals and roots are of concern because they can bring contaminants to the surface. A biobarrier of cobbles is included in the conceptual design to minimize the potential for burrowing animals and roots from accessing the buried source materials. To prevent the mixing of finer cover soil into the cobble layer, a filter layer is included.

The filter medium will be composed of coarse material (sand and/or gravel) that meets specific filter criteria to prevent the mixing of materials. These criteria are as follows:

$$D_{15}/\ d_{85} \leq 5 \qquad \textbf{Equation H-3.4-1}$$

where D_{15} = particle size of the coarse soil for which 15% of the particles are finer, and

d_{85} = particle size of the fine soil for which 85% of the particles are finer.

The filter design criteria, summarized in a U.S. Department of Energy technical report (DOE 1989, 099296, Table 4.2-3), and the following requirements will also be used. The filter material must pass the 3-in. sieve for minimizing particle segregation and bridging during placement. Smaller maximum particle sizes may be specified if practical. Also, filters must not have more than 5% passing the No. 200 mesh sieve to prevent excessive movement of fines in the filter. Filter material needs to be reasonably well-graded throughout the in-place layer thickness.

A capillary barrier will be formed with the inclusion of the filter medium beneath the fine cover soils. A second capillary barrier may also be formed between the filter medium and the cobble biobarrier. Consequently, all requirements for a capillary barrier must be followed, as outlined in Dwyer et al. (2007, 096232). Of particular concern are long slope lengths and consequently the diversion capacity of the capillary barrier. The interface between the materials forming the capillary barrier(s) must be a smooth and continuous interface. Discontinuities in this interface may result in significant preferential flow and must be prevented.

H-3.5 Biobarrier

As stated in section H-3.4, a biobarrier is included in the cover profile to minimize the intrusion of flora and fauna into the buried source materials. A minimum 1-ft- (0.3-m-) thick layer of cobble with a minimum diameter of 6 in. (15 cm) will be included in the cover profile. This layer will minimize the potential

burrowing of the animal of most concern at the site (gophers) as well as the intrusion of woody roots from plants such as shrubs, piñon, and juniper.

Biointrusion in a landfill cover system refers to the flora and fauna (including insects) interactions or intrusion into the cover system. Biointrusion is important in that it can represent a mechanism leading to vertical transport of contaminants to the ground surface via plant root uptake or soil excavation by burrowing animals and insects. Biointrusion can also lead to increased infiltration and preferential flow of surface water through the cover system and contribute to a change in the soil layer's hydraulic properties. However, the increased soil moisture resulting from burrowing effects on infiltration can actually stimulate increased plant growth, leading to an increase in plant transpiration (Gonzales et al. 1995, 073708; Hakonson 2002, 099469) and a net decrease in flux.

Vertical transport by biota may be small over a short time scale; however, over many decades these processes may become dominant in mobilizing buried waste or contaminated soil (Dwyer et al. 2007, 096232, p. 4-7). Burrowing by animals and insects has the potential to access buried waste several meters below ground surface, which may lead to chemical and radiation exposures to organisms and physical transport of waste upward in the soil profile to ground surface, to biota, and across the landfill surface to off-site areas. These processes are enhanced by erosion (wind/water), transport of animals moving on/off the landfill, deposition of soil particles on biological surfaces from rain splash and wind resuspension, and wind transport of senescent vegetation to off-site areas.

H-3.6 Subgrade/Interim (Operational) Cover Preparation

MDA H consists of nine disposal shafts. All of the shafts were filled to within 6 ft of the surface. Eight of the nine shafts were then covered with a 3-ft thick concrete plug and then 3 ft of crushed tuff. The remaining shaft was covered with a 6-ft thick concrete plug. For the purpose of modeling the upper 3 ft was considered to perform as interim, or operational, soil cover. The site will require minor clearing, grubbing, and some regrading before placement of the final cover system.

H-4.0 REFERENCES

The following list includes all documents cited in this appendix. 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 New Mexico Environment Department 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.

Benson, C.H., January 23-25, 2007. "Preliminary Design Methods," presented at the U.S. Environmental Protection Agency's Alternative Covers for Landfills, Waste Repositories, and Mine Wastes: Design, Modeling, Construction, and Monitoring, Riverside, California. (Benson 2007, 097054)

DOE (U.S. Department of Energy), December 1989. "Technical Approach Document," report no. DOE/UMTRA-050425-002, DE91-005807, Washington, D.C. (DOE 1989, 099296)

Dwyer, S.F., May 2003. "Water Balance Measurements and Computer Simulations of Landfill Covers," Ph.D. dissertation, University of New Mexico, Albuquerque, New Mexico. (Dwyer 2003, 097902)

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Fayer, M.J., June 2000. "UNSAT-H Version 3.0: Unsaturated Soil Water and Heat Flow Model, Theory, User Manual, and Examples," document PNNL-13249, Pacific Northwest National Laboratory, Richland, Washington. (Fayer 2000, 072734)

Gonzales, G.J., M.T. Saladen, and T.E. Hakonson, 1995. "Effects of Pocket Gopher Burrowing on Cesium-133 Distribution on Engineered Test Plots," *Journal of Environmental Quality,* Vol. 24, pp. 1056-1062. (Gonzales et al. 1995, 073708)

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NRC (U.S. Nuclear Regulatory Commission), September 2002. "Design of Erosion Protection for Long-Term Stabilization," Final Report, report no. NUREG-1853, Washington, D.C. (NRC 2002, 097900)

Shaw Environmental Inc., February 2006. "Geotechnical and Hydraulic Characterization at the Technical Area 61 Borrow Area," report prepared for Los Alamos National Laboratory, Albuquerque, New Mexico. (Shaw Environmental, Inc. 2006, 091368)

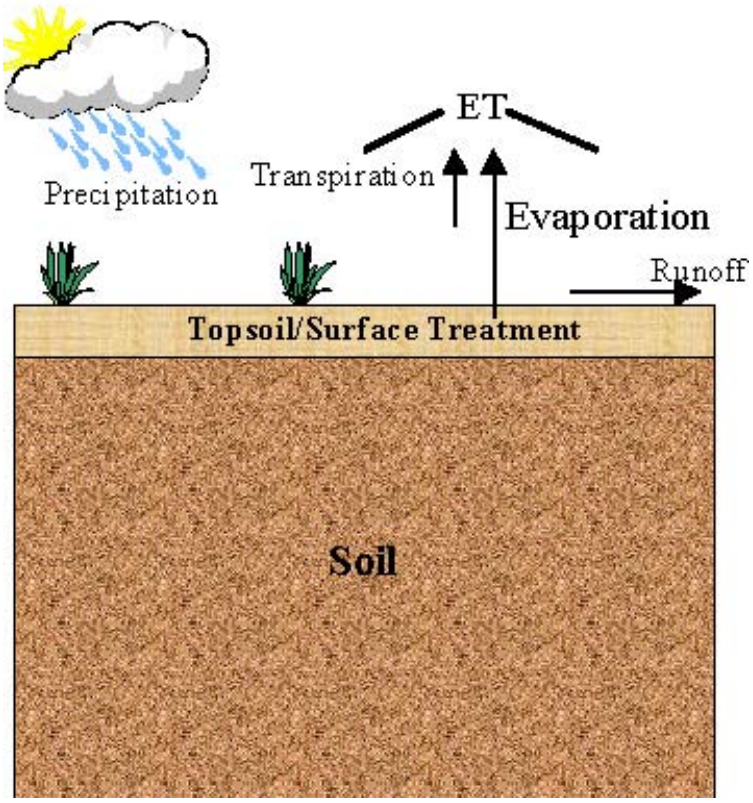


Figure H-2.0-1 Typical ET cover profile

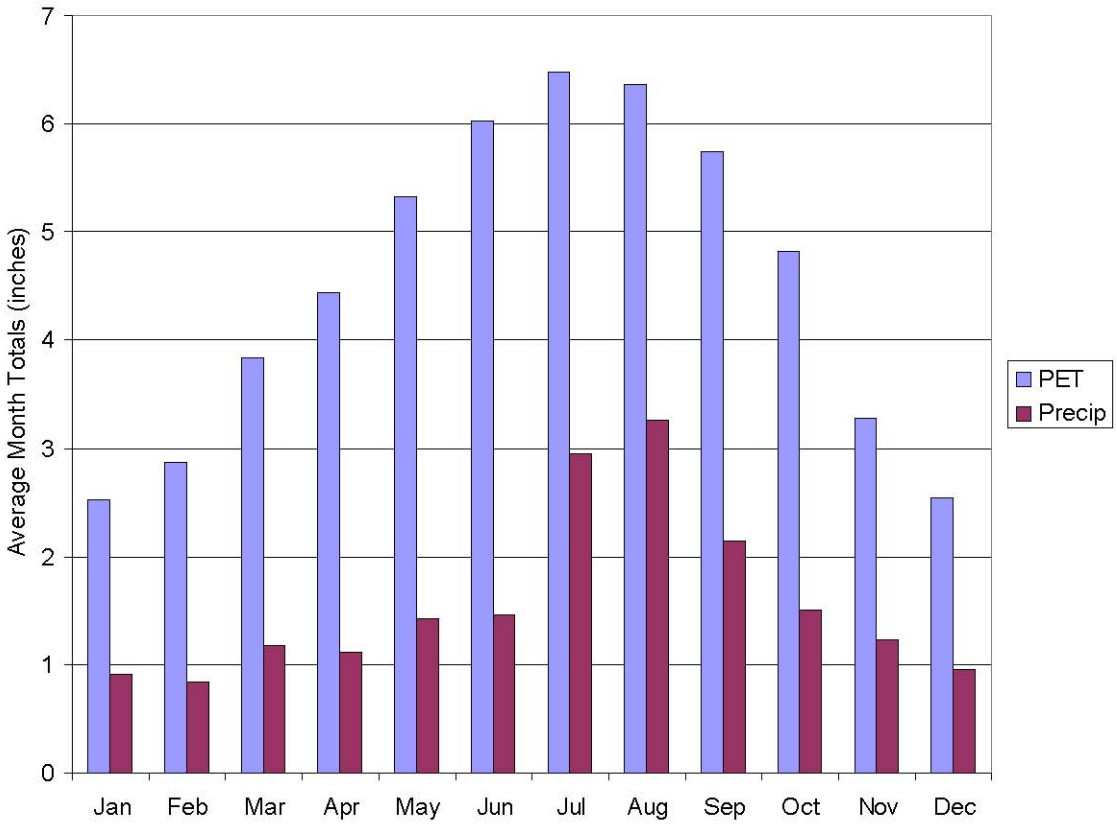


Figure H-2.0-2 Climate's demand for water (PET) versus supply of water (precipitation) for Los Alamos, New Mexico

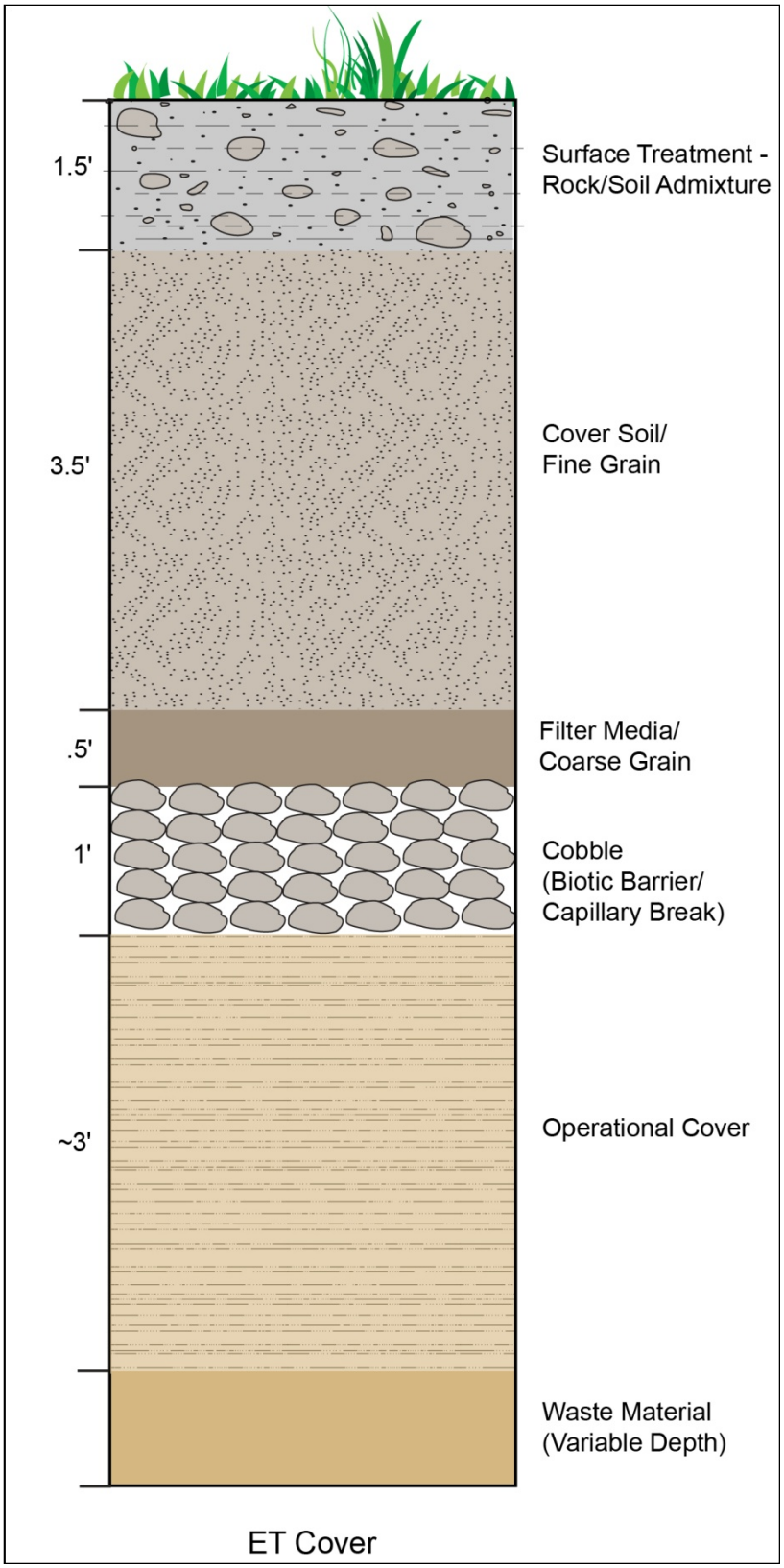


Figure H-3.0-1 MDA H CME conceptual ET cover profile

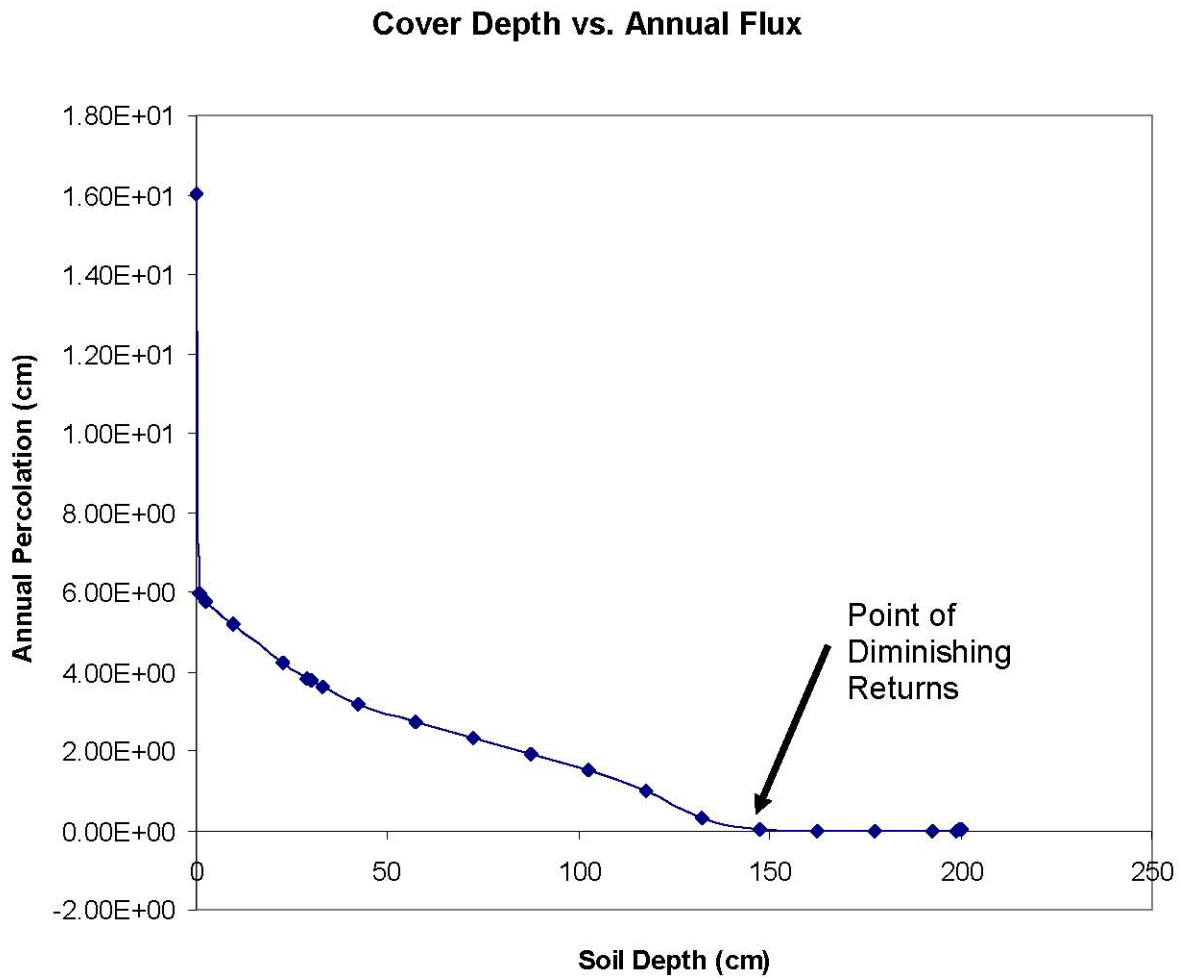


Figure H-3.3-1 Typical sandy loam soil: point of diminishing returns (1.5 m)

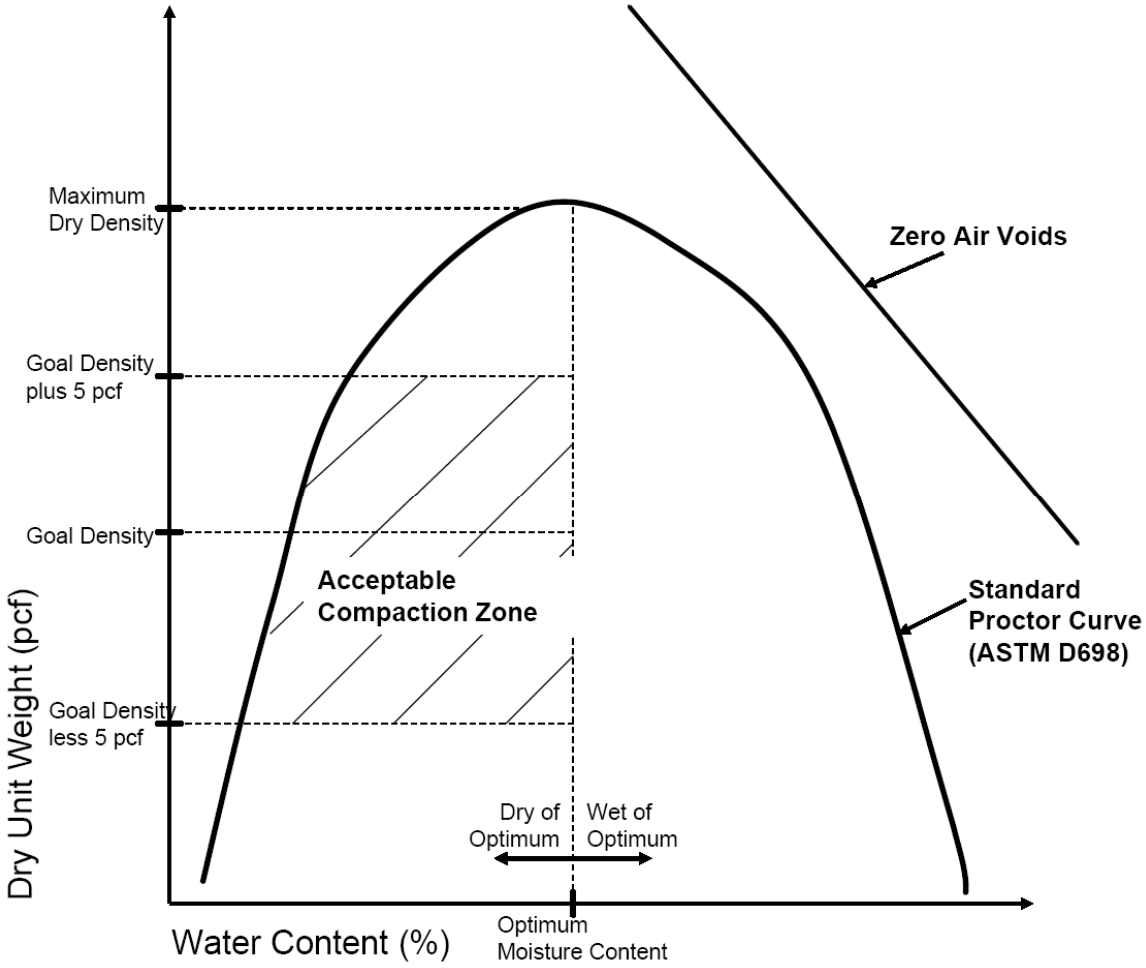


Figure H-3.3-2 Acceptable compaction zone for soil placement

Table H-3.0-1
ET Conceptual Cover Profile Layer Specifics and Justification

Cover System Layer	Design Specifics	Design Justification
Vegetation	The site is to be seeded with native vegetation composed of both cool and warm weather species (grasses). Table H-3.1-1 lists the recommended seed mix.	The vegetation will help stabilize the cover surface, minimize erosion, and remove infiltrated water via transpiration.
Surface Treatment	Mixture of cover soil and gravel. The gravel is to be mixed into the cover soil at a rate of 33% by weight. The gravel will be 1.5 in. (3.8 cm) to 3 in. (7.6 cm) in diameter. The cover soil will be capable of maintaining native vegetation with adequate storage capacity and nutrient availability. This layer will be a minimum of 18 in. (0.5 m) thick.	The gravel-soil admixture is designed to minimize erosion because of both wind and surface runoff.
Cover Soil	The cover soil depth will be a minimum of 3.5 ft (1 m). The layer will consist of soil from TA-61 with a determined mix of soil amendments. The cover soil will be capable of maintaining native vegetation with adequate storage capacity and nutrient availability.	Hydraulic characteristics of a typical sandy loam were used to determine the required soil depth because it is recommended that the TA-61 borrow soils be amended to possess the storage capacity of this soil type. The soil depth was determined using modeling where a depth of soil was determined to minimize flux. The modeling used the wettest decade on record as the upper boundary condition. However, because the site requires a 30-yr performance period, it was estimated that the added storage capacity offered by the inclusion of a biobarrier that creates a capillary barrier was more than adequate to store any infiltration events that would occur over this return period.
Filter Layer	This layer is composed of sand and gravel that meet determined filter criteria to prevent the overlying finer cover soils from migrating into the underlying biobarrier.	A thin layer placed directly on the biobarrier to serve as a filter medium to prevent the overlying finer soils from migrating into the underlying biobarrier.
Biobarrier	A layer of minimum 6-in.- (15-cm-) diameter cobble composed of rock or concrete. The layer is to be a minimum of 1 ft (0.3 m) thick.	The layer prevents biointrusion (burrowing animals and plant roots) from entering the underlying source material.
Subgrade	The area around the disposal shafts will be scarified and recompacted to a minimum of 95% of the maximum dry density and dry of the optimum moisture content as determined per ASTM D698.	The subgrade provides a firm foundation for the construction of the cover profile and the final grades and slopes for installation of a uniform cover profile.

Table H-3.1-1
Seed Mix

Common Name	Scientific Name	% of Mix	PLS (lb/acre)
Sideoats grama	*Bouteloua curtipendula*	15%	3.75
Blue grama	*Bouteloua gracilis*	15%	3.75
Indian ricegrass	*Oryzopsis hymenoides*	10%	2.5
Western wheatgrass	*Agropyron smithii*	15%	3.75
Sand dropseed	*Sporobolus cryptandrus*	10%	2.5
Sheep fescue	*Festuca ovina*	20%	5
Firewheel	*Gaillardia pulchella*	3%	0.75
Western yarrow	*Achillea millefoium*	2%	0.5
Prairie coneflower	*Ratibida columnifera*	4%	1
Blue flax	*Linum perenne lewisii*	6%	1.5
Total			**25**

Source: Dwyer et al. 2007, 096232.

Table H-3.2-1
Scoring Criteria for Determining Rock Quality

	Weighting Factor			Score										
	Limestone	Sandstone	Igneous	10	9	8	7	6	5	4	3	2	1	0
Specific Gravity (SSD[a])	12	6	9	2.75	2.70	2.65	2.60	2.55	2.50	2.45	2.40	2.35	2.40	2.25
Absorption (%)	13	5	2	0.1	0.3	0.5	0.67	0.83	1.0	1.5	2.0	2.5	3.0	3.5
Sodium Sulfate (%)	4	3	11	1	3	5	6.7	8.3	10	12.5	15	20	25	30
Abrasion (%)	1	8	1	1	3	5	6.7	8.3	10	12.5	15	20	25	30
Schmidt Hammer	11	13	1	70	65	60	54	47	40	32	24	16	8	0
Tensile Strength (psi[b])	5	4	10	1400	1200	1000	833	666	500	400	300	200	100	<100

Source: Modified from U.S. Nuclear Regulatory Commission guidance (NRC 2002, 097900).

[a] SSD = Saturated surface dry.

[b] psi = Pounds per square inch.

Table H-3.3-1
Recommended Available Plant Nutrients for Cover Soil

Test	Limits
Cation exchange capacity	Greater than 15
Percent organic matter	Greater than 2% (g/g)
N	Greater than 6 ppm
P	4 to 7 ppm
K	61 to 120 ppm

Table H-3.3-2
Recommended Limitations of Salt in Cover Soil

Test	Limits
Electrical conductivity	Less than 8 µS/cm
Sodium absorption ratio	Less than 6
Exchangeable sodium percentage	Less than 15% (g/g)
$CaCO_3$	Less than 15% (g/g) to 3-ft (91-cm) depth of cover; no limit below 3 ft (91 cm)

Attachment H-1

Attachments A–C of the "Conceptual Design Report for the Corrective Evaluations Measure for the Closure of MDA G"

Attachment A
GRAVEL ADMIXTURE DESIGN

DESIGN RAINFALL EVENT

The rainfall intensity value used to calculate the runoff volume was determined using data supplied by the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) Hydrometerological Design Studies Center and is available on the internet on NOAA's Precipitation Frequency Data Server (http://hdsc.nws.noaa.gov/hdsc/pfds/sa/nm_pfds.html). The data from NOAA Atlas 14 for Los Alamos, NM was used whereby the 30 minute precipitation frequency estimate for a 1000 return period is 2.46 inches (6.25 cm). The 30 minute time of concentration is conservative for any contributory area less than 50 acres (20 hectares) (Lindeburg 1989).

RUNOFF PREDICTION

The "rational method" was used to estimate runoff volumes. This method is commonly used in civil engineering applications and is a method approved by DOE (1989) for design of cover systems for sites regulated by the Uranium Mill Tailings Radiation Control Act of 1978 (i.e., UMTRA sites). Refer to "LANL Engineering Standards Manual," Section G20 (http://engstandards.lanl.gov/engrman/3civ/pdfs/Ch3_G20-R1.pdf). The rational method is based on the assumption that rainfall occurs uniformly over the watershed at a constant intensity for a duration equal to the time of concentration.

Using the rational method, the peak rate of runoff, (Q), in cubic feet per second (cfs) (runoff is actually in acre-inches/hour but is rounded to cfs is given by the following expression:

$$Q = C\ I\ A \qquad \textbf{Equation A.1}$$

where:

C = Runoff coefficient (dimensionless)

I = Rainfall intensity (in/hr)

A = Surface area that contributes to runoff (acres)

The value for "I" in this case was 2.46 inches/hour (6.25 cm/hr). For storms with return periods longer than 100 years, DOE recommends the use of C = 1.0 (DOE 1989). The surface area was calculated based on the assumed configuration shown in figure A.1 where L is the critical slope length. Slopes and slope lengths were estimated from proposed contoured plans of the MDA G conceptual cover. Because most of the drainage areas from the cover were irregularly shaped, the slopes and slope lengths were estimated to match the area configuration described here.

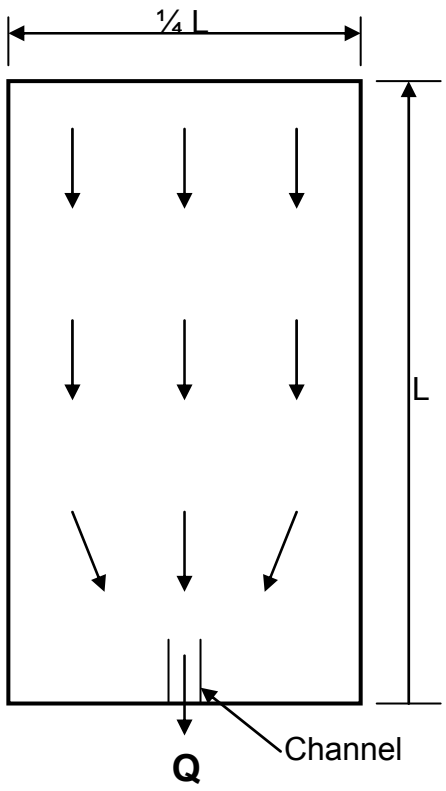


Figure A.1
Contributory area for gully formation

Channel Geometry

The channel geometry shown in Figure A.2 is that assumed for the gully formation.

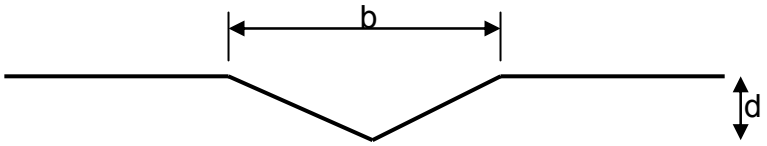


Figure A.2
Channel geometry

The geometry of the channel that forms is based on regression equations developed from analysis of a large number of channels (Simon, Li & Assoc. 1982). The channel width is given by:

$$b = 37 (Q_m^{0.38} / M^{0.39})$$ **Equation A.2**

where:

b = width of flow (ft);

Q_m = mean annual flow (cfs);

M = percentage of silts and clays in soils.

The mean annual flow (Q_m) is assumed to be between 10% and 20% of the peak rate of runoff (Q) (Dwyer et al. 1999). In this case 20% was conservatively used.

For the given discharge point of geometry, the hydraulic depth (d_h), defined as the flow cross-sectional area divided by the width of water surface, is half of the gully depth (d).

For flows at the critical slope:

$$b = 0.5\, F^{0.6}\, F_r^{-0.4} Q^{0.4} \qquad \textbf{Equation A.3}$$

where:

F = width to depth ratio = b/dh;

F_r = Froude Number ≈ 1.0.

These equations were solved simultaneously to yield the channel width and depth for the given peak flow rate and percentage of silt and clay. Refer to Table A.1 for the summary of calculations performed.

Incipient Particle Size

The incipient particle size is the particle that is on the brink of movement at the assumed conditions. Any increase in the erosional forces acting on the particle, due to an increase in velocity or slope, for example, will cause its movement. This incipient particle size (D_c) was calculated using the Shield's Equation:

$$D_c = \tau / F_s(\gamma_s - \gamma) \qquad \textbf{Equation A.4}$$

where:

τ = total average shear stress (pcf);

F_s = Shield's dimensionless shear stress = 0.047;

γ_s = specific weight of soil (pcf);

γ = water density = 62.4 pcf.

The total average shear stress is given by:

$$\tau = \gamma\, d_h\, S \qquad \textbf{Equation A.5}$$

where:

S = slope (ft/ft).

d_h = hydraulic depth (ft)

Depth of Scour and Armoring Required

The incipient particle size defines the maximum size of particle that will be eroded for a given set of conditions. The material larger than the incipient particle size will not be displaced or eroded, and can form an armoring that will protect the channel from further erosion from similar or lesser storm events.

The depth of scour (Ys) (Figure A.3) to establish an armor layer is given by (Pemberton and Lara 1984):

$$Y_s = Y_a [(1/P_{c)}-1] \qquad \textbf{Equation A.6}$$

where:

Y_s = scour depth;

Y_a = armor layer thickness;

P_c = decimal fraction of material coarser than the incipient particle size.

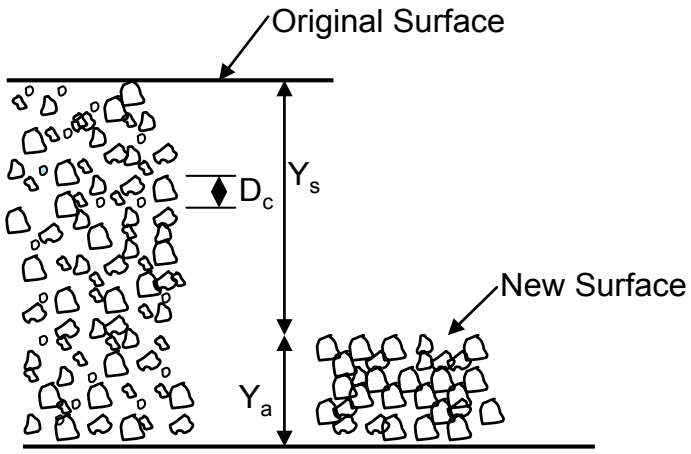


Figure A.3
"Desert Pavement" development

Table A.1 summarizes the gravel admixture calculations performed including critical input and output parameters. The slopes and slope lengths were estimated based on approximate drainage paths and contributory areas as they relate to that assumed in this set of calculations. The first column describes the section that is related to the project drawings produced by PRO2SERVE (not part of this report).

TABLE A.1
GRAVEL ADMIXTURE CALCULATIONS SUMMARY

Section	C Value	I (in/hr)	S (%)	Slope Length (ft)	Q (cfs)	Q_m (cfs)	% silt/clay[1]	Bulk Density[1] (pcf)	Critical Gravel Size [2] (in)	Ratio	Total depth req'd (inches)
DA1	1.0	2.46	2.7	350	1.73	0.17	20	115	0.75	33%	9
DA2	1.0	2.46	3	500	3.53	0.35	20	115	1.25	33%	15
DA3	1.0	2.46	4	375	1.99	0.20	20	115	1.25	33%	15
DA4	1.0	2.46	2.8	800	9.04	0.90	20	115	1.50	33%	18
DA5	1.0	2.46	3.5	500	3.53	0.35	20	115	1.25	33%	15
DA6	1.0	2.46	2	750	7.94	0.79	20	115	1.00	33%	12
DA7	1.0	2.46	2	750	7.94	0.79	20	115	1.00	33%	12

[1] assumed values based on amendments and gravel mixture
[2] value rounded up to nearest quarter inch

Attachment B
BIOINTRUSION STUDIES

Plutonium is the best example of a radionuclide whose transport to animals in arid ecosystems is dominated by physical processes. Data from many field sites and source conditions show that gut availability of plutonium and other contaminants bound to soil in a variety of animals including rodents, deer and cattle is very low (gut to blood transfer $<10^{-5}$) leading to very low concentrations of contaminant in internal tissues and organs (Smith, 1977; Moore et al., 1977; Hakonson and Nyhan, 1980; Arthur et al., 1987). Highest concentrations of most soil contaminants in dry, dusty environments are usually found in tissues exposed to the external environment. Those tissues include the pelt, gastro-intestinal tract, and lungs. At Los Alamos, about 96% of the plutonium body burden in rodents from the canyon liquid waste disposal areas was in the pelt and gastro-intestinal tract (Hakonson and Nyhan, 1980).

Because soil passes through the gastro-intestinal tract of free-ranging animals on a daily basis, there is a potential to redistribute soil radionuclides across the landscape. Studies at Nevada Test Site with cattle (Moore et al., 1977), at Rocky Flats Plant with mule deer and small mammals (Little, 1980; Arthur, 1979), and at Idaho National Engineering Laboratory with small mammals and coyotes (Arthur and Markham, 1983; Arthur et al., 1980) demonstrate that horizontal (and vertical in the case of burrowing animals) redistribution of soil plutonium does occur as animals move within and outside contaminated areas. However, the magnitude of this transport was shown to be very small over the short-term (Arthur, 1979; Arthur and Markham, 1983; Arthur et al., 1980).

There are circumstances where animal transport of soil contaminants can assume more importance. For example, fission product sludge containing 90Sr and 137Cs in a salt form was released to unlined cribs at Hanford and the cribs were backfilled with clean soil. A large animal, probably a coyote or badger then burrowed down to the sludge and created direct access for other animals seeking the salts including jackrabbits (O'Farrell and Gilbert, 1975). Jackrabbits ingested the radioactive salts, became contaminated and then excreted 90Sr on the ground surface. Levels of 90Sr in excreta were found over a 15 km^2 surface area (O'Farrell and Gilbert, 1975). This incident with 90Sr and jackrabbits was a special case that involved liquid waste sludge disposal trenches that were not adequately covered.

Potentially more soluble strontium and cesium transport to animals in arid ecosystems involves a combination of physical and physiological processes. The more tightly bound these radionuclides are to soil (related to clay content of soil and local climate); the more their transport will be governed by soil particle transport. Data on Sr90 and Cs137 in small mammals from the Nevada Test Site (Romney et al., 1983) and at a burial ground at Idaho National Engineering Laboratory (Arthur et al., 1987) show relatively high concentrations of these radionuclides in lung, pelt and gastro-intestinal tract similar to plutonium. This suggests that physical transport of these more "soluble" radionuclides is also important as with plutonium. The bioavailability of radionuclides such as cesium and strontium will depend on chemical form, local environmental conditions, and the structure and function of the relevant food webs.

Tritium would be one of the few exceptions to the general observation that physical transport mechanisms dominate in the transport of soil surface contaminants to biota. Uptake by roots or sorption through the leaf surface would dominate in tritium transport to vegetation. Levels of tritium in animals would reflect levels in the source (i.e.,

concentration ratios are 1 or less) since tritium is not concentrated as it moves through abiotic and biotic pathways. Furthermore, tritium in vegetation is available to nectivorous organisms such as honeybees as well as herbivores. While tritium is readily transported through ecosystems, it is rapidly turned over in biological systems at rates corresponding to water turnover in these systems. In humans, body water turnover is about 3 days (RHH, 1970).

Although vegetation is very important in controlling erosion and percolation in landfill covers (Nyhan et al., 1984), deeply penetrating plant roots have the potential to access buried waste and bring plant available constituents including landfill contaminants to the surface of the site (Klepper et al., 1979; Foxx et al., 1984; Tierney and Foxx, 1987). Contaminants such as tritium can be incorporated within plant tissue and enter the food web of herbivorous or nectivorous organisms. For example, at Los Alamos National Laboratory tritium transport away from a controlled low-level waste site occurred via the soil moisture/plant nectar/honey bee/ honey pathway (Hakonson and Bostick, 1976). As another example, deep-rooted Russian Thistle (Salsola kali) growing over the waste burial cribs at Hanford penetrated into the waste, mobilized 90Sr, and then transferred it to the ground surface. The contaminated surface foliage was transferred away from the cribs when the matured Thistle (tumbleweeds) blew away from the site (Klepper et al., 1979). Two mechanisms for soil contaminant transport to terrestrial plants are absorption by roots and deposition of contaminated soil particles on foliage surfaces. Field studies suggest that deposition of soil particles on foliage surfaces is a major transport mechanism for soil associated contaminants under many arid site and contaminant source conditions (Romney and Wallace, 1976; Romney et al., 1987; White et al., 1981; Arthur and Alldredge, 1982).

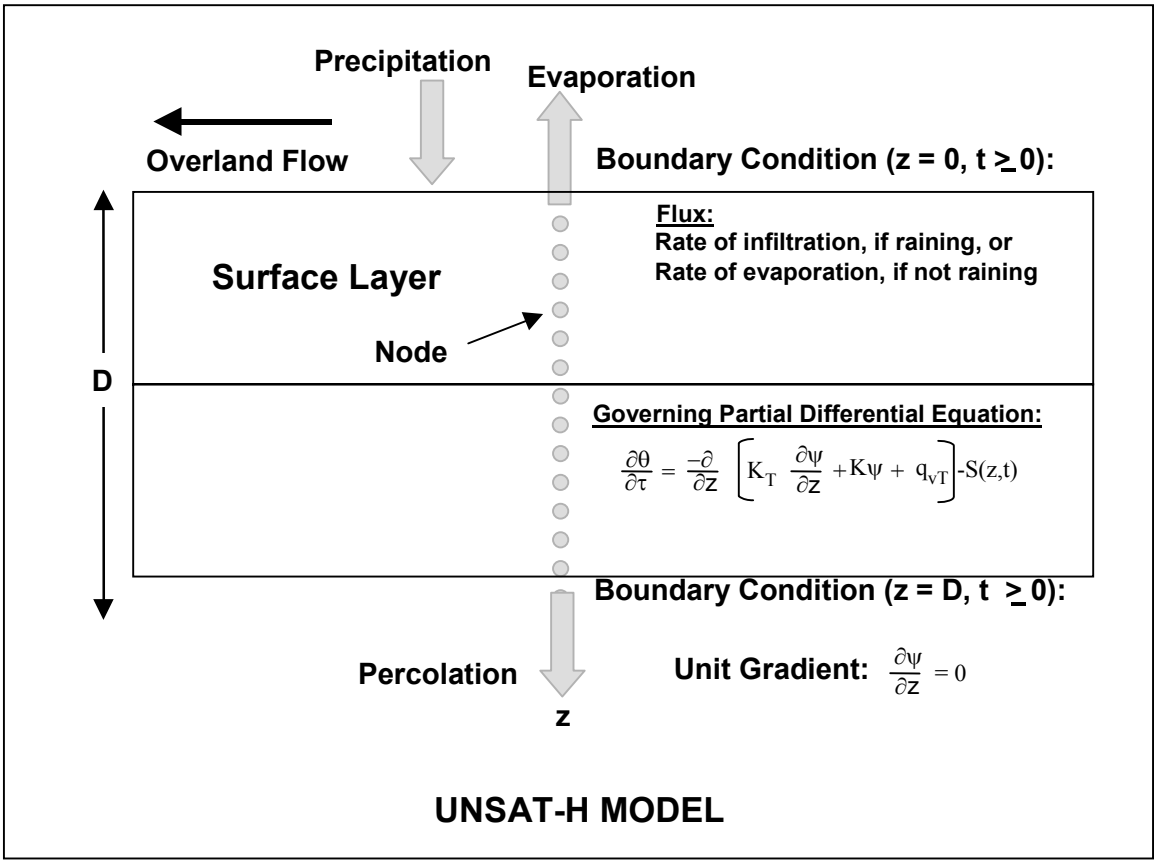
Attachment C
MODELING

Overview of UNSAT-H

UNSAT-H has been used to design many recent alternative earthen cover designs (Dwyer 2003). Unlike most unsaturated flow programs, UNSAT-H was specifically developed for the evaluation of earthen covers. UNSAT-H is a one-dimensional, finite-difference computer program developed at the Pacific Northwest National Laboratory by Fayer and Jones (1990). UNSAT-H can be used to simulate the water balance of earthen covers as well as soil heat flow (Fayer 2000). UNSAT-H simulates water flow through soils by solving Richards' equation and simulates heat flow by solving Fourier's heat conduction equation.

A schematic illustration showing how UNSAT-H computes the water balance is shown in Figure C.1. UNSAT-H separates precipitation falling on an earthen cover into infiltration and overland flow. The quantity of water that infiltrates depends on the infiltration capacity of the soil profile immediately prior to rainfall (e.g., total available porosity). Thus, the fraction of precipitation shed as overland flow depends on the saturated and unsaturated hydraulic conductivities of the soils characteristic of the final cover. If the rate of precipitation exceeds the soil’s infiltration capacity, the extra water is shed as surface runoff. UNSAT-H does not consider absorption and interception of water by the plant canopy, or the effect of slope and slope-length when computing surface runoff.

Figure C.1
SCHEMATIC REPRESENTATION OF WATER BALANCE COMPUTATION BY UNSAT-H (modified from Khire 1995)



Water that has infiltrated a soil profile during an UNSAT-H simulation moves upward or downward as a consequence of gravity and matric potential. Evaporation from the cover surface is computed using Fick's law. Water removal by transpiration of plants is treated as a sink term in Richards' equation. Potential evapotranspiration (PET) is computed from the daily wind speed, relative humidity, net solar radiation, and daily minimum and maximum air temperatures using a modified form of Penman's equation given by Doorenbos and Pruitt (1977). Soil water storage is computed by integrating the water content profile. Flux from the lower boundary is via percolation. UNSAT-H, being a one-dimensional program, does not compute lateral drainage.

UNSAT-H Input Parameters

A set of input parameters were developed for simulations using UNSAT-H for the given cover profiles. These parameters were developed based on field and laboratory measurements, values from the literature, and expert opinion.

Model Geometry

The model geometry was based on the depth of the cover profile modeled.

Boundary Conditions

The MDA G site in Los Alamos, NM is located in a dry environment where the climate's demand for water referred to as PET far exceeds the actual supply of water or precipitation (Figure 2.2). These are ideal conditions for deployment of an earthen soil cover such as an ET Cover.

The flow of water across the surface and lower boundary of the cover profile is determined by boundary condition specifications. The UNSAT-H program partitions PET into potential evaporation (E_p) and potential transpiration (T_p). Potential evaporation is estimated or derived from daily weather parameters (Fayer 2000). Potential transpiration is calculated using a function (Equation C.1) that is based on the value of the assigned leaf area index (LAI) and an equation developed by Ritchie and Burnett (1971) as follows:

$$T_p = PET\,[a + b(LAI)^c] \quad \text{where } d \leq LAI \leq e \qquad \textbf{Equation C.1}$$

Where:

a,b,c,d, and e are fitting parameters;
a = 0.0, b = 0.52, and c = 0.5, d = 0.1, and e = 2.7 (Fayer 2000)

The UNSAT-H program partitioned PET into E_p and T_p. PET was derived from daily weather parameters obtained from this weather data. T_p was calculated using a function developed by Equation 1 above.

The lower boundary condition was a unit gradient. With the unit gradient, the calculated drainage flux depended upon the hydraulic conductivity of the lower boundary node. The unit gradient corresponded to gravity-induced drainage and was most appropriate when drainage was not impeded.

Upper Boundary Condition - Climate Data

The surface boundary condition during evaporation was modeled as a flux that required daily weather data. The wettest decade on record was used (1985 to 1994) from Los Alamos National Laboratory (weather.lanl.gov). The annual precipitation totals for this decade are summarized in Tables C.2 to C.4. Because the RCRA requirements to minimize flux was the regulatory driver for determining the storage capacity requirements of the cover profile, it was determined that the wettest decade on record would provide a conservative measure to evaluate the RCRA-equivalency of the cover profile.

VEGETATION DATA

Vegetation will generally increase ET from the cover because a plant's matric potential or suction is orders of magnitude higher than that of the soil (Figure C.2). The input parameters representing vegetation include the LAI, rooting depth and density, root growth rate, the suction head values that corresponds to the soil's field capacity, wilting point, and water content above which plants do not transpire because of anaerobic conditions. The onset and termination of the growing season for the site are defined in terms of Julian days. The root length density (RLD) is assumed to follow an exponential function such as that defined in Equation C.2:

$$RLD = a \exp(-bz) + c \qquad \textbf{Equation C.2}$$

where:

a,b, and c are fitting parameters

z = depth below surface

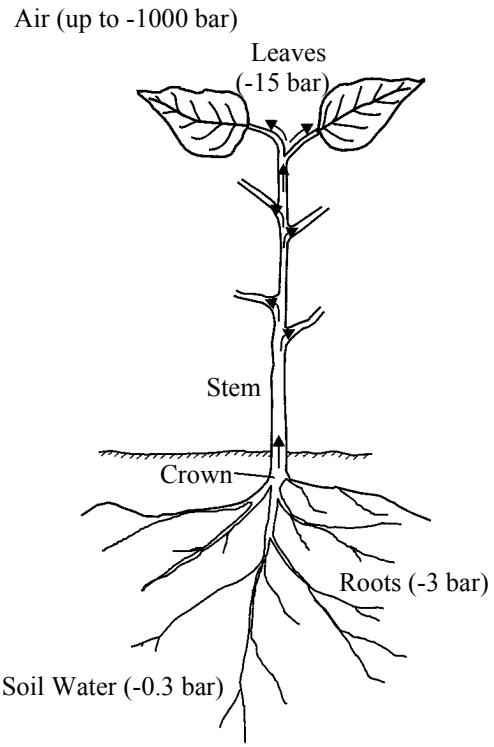
The parameters used for the RLD functions in Equation C.2 were: a = 0.315, b=0.0073, and c = 0.076 (Fayer 2000). The time required for maximum rooting depth establishment was set at full depth beginning on day 1. The rooting depth was set at 6.6-feet (200 cm) (Foxx et al 1984). An average LAI of 0.65 was used (McDowell et al 2005). This value represents an average of values reported for the site of 0.3 and 1.0. The onset and termination of the growing season for the site were Julian days 74 and 288, respectively (EIS, Appendix E). The LAI was transitioned from 0 to 0.65 starting with Julian day 74 to 90. Day 91 through 270, the full LAI equal to 0.65 was utilized. The LAI was then transitioned down from 0.65 to 0 from Julian day 271 to 288. This was conservative since it is realistic that plants can transpire longer than indicated at this site. An average percent bare area of 84.4% was used. This value represents an average of reported values for the area of 91.5% and 77.3 % (Tierney and Foxx 1982). The relative humidity for the site was set at 51% based on the average conditions for Los Alamos (Los Alamos Climatology internet site).

SOIL PROPERTIES RELATED TO VEGETATION

Suction head values corresponding to the wilting point, field capacity, and a head value corresponding to the water content above which plants do not transpire because of anaerobic conditions were defined. Matric potential or suction heads are generally written as positive numbers, but in reality are negative values. Consequently, the higher the value, the greater the soil suction. The maximum water content a soil can hold after all downward drainage resulting from gravitational forces is referred to as its field capacity. Field capacity is often arbitrarily reported as the water content at about 330 cm of matric potential head (Jury et al, 1991). Below field capacity, the hydraulic conductivity is assumed to be so low that gravity drainage becomes negligible and the soil moisture is held in place by suction or matric potential.

Not all of the water stored in the soil can be removed via transpiration. Vegetation is generally assumed to reduce the soil moisture content to the permanent wilting point. The wilting point was conservatively assumed to be 20,000 cm (typical for native grasses) used although the shrubs present at the site could remove water from the soil to a suction of 100,000 cm (Figure C.2). Evaporation from the soil surface can further reduce the soil moisture below the wilting point toward the residual saturation, which is the water content at an infinite matric potential.

Figure C.2
TYPICAL SOIL-PLANT-ATMOSPHERE WATER POTENTIAL VARIATION
(Hillel 1998)



Soil Properties

Soil hydraulic properties were obtained from laboratory testing of soil samples collected from the TA61 borrow site (Shaw 2006). The saturated hydraulic conductivity of the soils were obtained using flexible wall permeameters in accordance with ASTM D 5084. Unsaturated soil properties were obtained from data using pressure plates and water columns (depending on the suction values) to develop values of water content as a function of pressure head (ASTM D 6836). These data were then used as input into the RETC code (van Genuchten et al 1991) to compute curve fitting parameters used to estimate the moisture characteristic curve (van Genuchten 1980). The Mualem conductivity function was used to describe the unsaturated hydraulic conductivity of the soils. The van Genuchten 'm' parameter for this function is assumed to be'1-1/n'; 'n' being one of the established van Genuchten parameters. The initial soil conditions are expressed in terms of suction head values that correspond to the average moisture

content between each soil layer's field capacity and permanent wilting point determined from each respective soil layer's moisture characteristic curve. The soil properties used as input parameters are summarized in Table C.1.

Table C.1
COVER SOIL PROPERTIES

Cover Profile	Soil Layer Type	Soil Layer Depth	van Genuchten Parameters				Sat. Hydr. Cond. (cm/hr)
			Θ_s	Θ_r	α	n	
TA61 BORROW SOILS USED (BH1 @ 15 TO 25-FT DEPTH)							
Cover Soil Only	Cover Soil	6.6 ft (200 cm)	0.2454	0	0.0027	1.6175	17.64
TYPICAL SANDY LOAM (ROSETTA 2000)							
Cover Soil Only	Cover Soil	6.6 ft (200 cm)	0.387	0.039	0.0267	1.4488	1.5951
CONCEPTUAL COVER DESIGN WITH TYPICAL SANDY LOAM							
Conceptual Cover Profile	Gravel/ Soil Admixture	1.5 ft (46 cm)	0.383	0.039	0.0267	1.4488	1.5951
	Cover Soil	3.5 ft (108 cm)	0.383	0.039	0.0267	1.4488	1.5951
	Filter Layer	6 in (15 cm)	0.34	0.026	0.0597	2.81	65.52
	Bio-barrier	1 ft (31 cm)	0.374	0.017	2.5075	2.47	15912.0

Modeled Percolation

Percolation results from the redistribution of water through a soil profile in response to gradients formed by differences in the energy state of the water. Flux is defined as the volume flow rate per unit area (Jury et al 1991) through a given soil profile. Other mechanisms that might induce water redistribution, such as geothermal gradients and barometric pressure fluctuations, have been shown to be minor contributors to water flow in most instances (Jones 1978, Gee and Simmons 1979). Tables C.2 TO C.4 present predicted annual flux values for the modeled cover profiles under the typical or average annual precipitation volumes.

Table C.2 summarizes a monolithic soil profile modeled with hydraulic soil properties from the TA61 borrow site. The soil sample that possessed a saturated hydraulic conductivity closest to the overall average of all soil samples tested form the site was used. The overall average was calculated to be 6.6E-03 cm/sec. This soil sample was BH1 taken from a depth of 15 to 25-ft. The saturated hydraulic conductivity for sample BH1 was 4.9E-03 cm/sec. As seen in figure 3.2, the Point of Diminishing Returns (Dwyer et al 2006) was greater than 6.6 ft (200 cm). Consequently, it was determined that the soil would require amendment to improve its water storage capacity and thus decrease the soil depth required. The soil amendment will also provide for adequate plant available nutrients.

The TA61 soils were characterized as sandy loams. However, they were relatively coarse sandy loams. Table C.3 summarizes a monolithic soil profile that used a typical sandy loam with somewhat better storage capacity than the TA61 soils. This value was obtained from ROSETTA (2000). These soils are commonly found throughout New Mexico. These soils significantly improved the cover performance by producing a Point of Diminishing Returns at about 5 ft (1.5 m).

Table C.4 summarizes the output from the actual conceptual cover profile that includes all layers. The addition of the bio-barrier created a capillary barrier. The final predicted flux through the cover profile utilizing a sandy loam soil overlying a coarse material was zero.

Table C.2.
WETTEST DECADE CLIMATE DATA WITH TA61 SOILS

Cover Depth (cm)	Annual Flux (cm/year)										
	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**Average**
50	5.53	4.11	3.14	4.68	3.17	3.92	6.01	0.98	2.05	4.43	3.80
100	2.84	1.70	1.42	2.37	1.31	1.51	3.06	0.47	1.22	2.04	1.79
150	1.12	0.56	0.71	0.95	0.40	0.06	1.19	0.30	0.49	0.72	0.65
200	.05	0.03	0.03	0.03	0.29	0.26	0.03	0.04	0.02	0.02	0.08
Precipitation (cm)	49.76	47.48	40.34	42.55	35.74	43.31	47.78	32.11	32.54	43.05	41.47

Table C.3.
WETTEST DECADE CLIMATE DATA WITH TYPICAL SOILS FOR SANDY LOAM (ROSETTA 2000)

Cover Depth (cm)	Annual Flux (cm/year)										
	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**Average**
50	4.31	3.37	2.94	4.28	1.69	3.03	5.39	1.19	2.07	3.64	3.20
100	7.16E-2	1.13	1.59	1.94	8.43E-1	8.17E-1	2.31	1.37	6.15E-1	7.31E-1	1.14
150	0	0	5.41E-4	9.12E-2	5.33E-1	1.69E-1	1.96E-1	7.70E-1	2.29E-1	9.21E-2	2.08E-1
200	0	0	0	0	0	6.93E-6	6.72E-6	7.25E-6	9.14E-6	1.71E-5	4.71E-6
Precipitation (cm)	49.76	47.48	40.34	42.55	35.74	43.31	47.78	32.11	32.54	43.05	41.47

Table C.4.
WETTEST DECADE CLIMATE DATA WITH CONCEPTUAL COVER PROFILE THAT UTILIZED TYPICAL SOILS FOR SANDY LOAM (ROSETTA 2000)

Cover Depth (cm)	Annual Flux (cm/year)[1]										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Average
Base of Cover	0	0	0	0	0	0	0	0	0	0	0
Precipitation (cm)	49.76	47.48	40.34	42.55	35.74	43.31	47.78	32.11	32.54	43.05	41.47

[1] values less than 1E-10 cm/year were approximated to be zero