LA-UR-08-0051
February 2008
EP2008-0006

Supplemental Investigation Report for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by the Environmental Programs Directorate

LA-UR-08-0051
EP2008-0006

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EXECUTIVE SUMMARY

This supplemental investigation report presents the results of additional remediation and investigation conducted in 2006 and 2007 at an area of elevated radioactivity within Consolidated Unit 21-018(a)-99 at Los Alamos National Laboratory. This consolidated unit consists of four inactive solid waste management units (SWMUs) and one inactive area of concern (AOC). The area of elevated radioactivity is within the vicinity of SWMU 21-018(a), to the east of three former absorption beds comprising Material Disposal Area (MDA) V within Technical Area (TA) 21.

The supplemental remediation and investigation finalized surface and subsurface chemical cleanup and characterization of Consolidated Unit 21-018(a)-99 and included removal of soil and tuff from an area of elevated radioactivity identified in a 2006 surface radiological survey. The data evaluated in this report supplement the data collected previously in 2005–2007 at Consolidated Unit 21-018(a)-99. Postexcavation confirmation data were used to define the nature and extent of contamination associated with the area of elevated radioactivity and to determine whether this area of the site poses a potential unacceptable risk to human health or the environment. The primary objective of remediation activities performed in 2006–2007 was to remove environmental media with concentrations of chemicals of potential concern (COPCs) exceeding residential soil screening levels (SSLs) for inorganic and organic chemicals or residential screening action levels (SALs) for radionuclides.

Based on the characterization data from current and previous investigations conducted at the site, the nature and extent are defined for radionuclide, inorganic, and organic COPCs in both surface and subsurface media for the four SWMUs and one AOC [SWMUs 21-018(a), 21-018(b), 21-013(b), 21-023(c), and AOC 21-013(g)]. The nature and extent of shallower pore gas were inconclusive in the initial subsurface investigation of pore gas at the site. Therefore, a monitoring well installation plan is being submitted with this supplemental investigation report to provide data needed to determine concentration trends for shallower pore gas nature and extent.

Maximum concentrations of all COPCs (carcinogenic, noncarcinogenic, and radionuclides) identified in the 2006–2007 supplemental investigation sampling of the area of elevated radioactivity at MDA V are less than the respective residential SSLs and SALs in all postexcavation samples. The total estimated excess cancer risk is approximately 3×10^{-7}, which is less than the target level of 1×10^{-5} set by the New Mexico Environment Department (NMED). The noncarcinogenic COPC hazard index (HI) is 0.1, which is less than the NMED target level of an HI of 1.0. The total dose is 0.44 millirem (mrem)/yr, which is less than the target dose of 15 mrem/yr set by the U.S. Department of Energy. Based on the human health risk assessment results presented in this supplemental investigation report, concentrations of COPCs in soil and tuff in the area of elevated radioactivity at Consolidated Unit 21-018(a)-99 do not pose a potential unacceptable risk/dose to human health under a residential scenario. The conclusions drawn in the previous investigation report that there are no potential unacceptable risks to human health under a residential scenario are still valid.

The ecological risk screening eliminated all chemicals of potential ecological concern (COPECs), indicating that no potential risk to terrestrial receptors exists from exposure to residual COPEC concentrations in the area of elevated radioactivity. Based on the ecological risk assessment results, the conclusions drawn in the previous investigation report that concentrations of COPECs in soil and tuff in the area of elevated radioactivity at Consolidated Unit 21-018(a)-99 do not pose a potential unacceptable risk to ecological receptors are still valid.

Based on the results of this and previous investigations, corrective action is complete at the area of elevated radioactivity and the five sites within Consolidated Unit 21-018(a)-99, specifically SWMUs 21-018(a), 21-018(b), 21-023(c), 21-013(b), and AOC 21-013(g). Additionally, the nature and

extent of contamination have been defined, with the exception of low levels of tritium in subsurface pore gas, as detailed in the 2007 MDA V investigation report, revision 1. Groundwater monitoring requirements for TA-21, including Consolidated Unit 21-018(a)-99, are addressed in the "Los Alamos and Pueblo Canyons Groundwater Monitoring Well Network Evaluation and Recommendations," which was submitted to NMED on December 21, 2007.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or 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 covers 40 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from 6200 to 7800 ft above mean sea level (amsl).

The Laboratory's Environmental Programs (EP) Directorate is participating in a national effort by DOE to clean up sites and facilities formerly involved in weapons research and development. The goal of EP is to ensure that past operations do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, EP is currently investigating sites potentially contaminated by past Laboratory operations. These sites are designated as solid waste management units (SWMUs) or areas of concern (AOCs). Individual SWMUs and AOCs may be grouped into consolidated units.

This supplemental investigation report addresses additional remediation and investigation activities conducted in 2006 and 2007 at Consolidated Unit 21-018(a)-99, also known as Material Disposal Area (MDA) V, in an area of elevated radioactivity on the eastern side of the site. All previous investigations at the site are detailed in the "Investigation Report for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21, Revision 1" (LANL 2007, 098942).

Corrective actions at the Laboratory are subject to the March 1, 2005, Compliance Order on Consent (Consent Order). The Consent Order was issued pursuant to the New Mexico Hazardous Waste Act, New Mexico Statutes Annotated (NMSA) 1978, §74-4-10, and the New Mexico Solid Waste Act, NMSA 1978, §74-9-36(D). Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to the New Mexico Environment Department (NMED) in accordance with DOE policy.

1.1 General Site Information

Consolidated Unit 21-018(a)-99 is located in the southeastern section of the Delta Prime (DP) Mesa (Figures 1.1-1 and 1.1-2). The elevation of DP Mesa ranges from 7160 to 7170 ft amsl, with a 5% slope southward at MDA V into BV Canyon, named for its location directly below MDAs B and V. The approximate elevation of the center of MDA V is 7165 ft amsl. The canyon slope ranges in elevation from 7050 ft amsl at the bottom of BV Canyon to 7160 ft amsl along the southern edge of Consolidated Unit 21-018(a)-99.

From 1945 to 1978, Technical Area (TA) 21 was used primarily for plutonium research, metal production, and related activities. Since 1978, various administrative and chemical research activities have been conducted at TA-21. The current land use is industrial, and it is expected to remain industrial for the reasonably foreseeable future.

Consolidated Unit 21-018(a)-99 consists of four inactive SWMUs and one inactive AOC consolidated in 1999 according to their related operational history as well as the proximity of each site to one another (Figure 1.1-3). The sites include the following:

- SWMU 21-018(a) (MDA V)—Three wastewater absorption beds that received effluent from 1945 to 1961, located on the mesa south of the laundry facility: The area of elevated radioactivity addressed in this report is located to the east of absorption bed 2.
- SWMU 21-018(b)—A former laundry facility for radioactively contaminated clothing that operated from 1945 to 1961: This site is located immediately south of DP Road and directly north of the absorption beds.
- SWMU 21-023(c)—A waste treatment laboratory septic system and outfall that received effluent from 1948 to 1965: The septic tank and inlet are located primarily on the mesa, and the outfall is on the south-facing hillslope of BV Canyon.
- SWMU 21-013(b)—A surface disposal area emplaced in 1965 during demolition of the laundry facility [SWMU 21-018(b)] and a waste research laboratory (AOC 21-009): This SWMU consists of building debris and is located south of the MDA V absorption beds on the slope leading into BV Canyon.
- AOC 21-013(g)—A surface disposal area emplaced post-1965 east of SWMU 21-013(b): This area consists of building debris of unknown origin and is located on the south-facing hillslope of BV Canyon.

1.2 Scope of Activities

The primary objective of this investigation was to complete remediation and characterization of Consolidated Unit 21-018(a)-99 at the area of elevated radioactivity to the east of absorption bed 2 within SWMU 21-018(a). Remediation activities were conducted to remove contaminated soil in an area where radionuclides exceeded residential screening action levels (SALs) (LANL 2005, 088493). Confirmation sampling was conducted after completion of excavation activities (Table 1.2-1). The investigation, remediation, and confirmation sampling activities were conducted in three phases between September 2006 and November 2007. The following describes each phase of the supplemental investigation:

- Phase 1—September 2006 investigation: Hand-auger sampling was conducted in an area of approximately 6 × 12 ft, to the east of absorption bed 2, where surface radiological walkover surveys indicated potential elevated radiological contamination.
- Phase 2—May 2007 excavation: Soil from the 6- × 12-ft area was removed to a depth of 4 ft using a backhoe and bucket. The removal exposed an approximate 2-in. layer of elevated radiological soil/waste material likely associated with historical absorption bed overflows or other laundry facility operations extending laterally beyond the 6- × 12-ft excavation area.
- Phase 3—August and November 2007 excavation and confirmation sampling: An area approximately 30 × 50 ft to a depth of 5 to 6 ft was excavated in August 2007 to remove the 2-in. layer of soil/waste material identified in May 2007. Following removal activities, confirmation samples were collected from the bottom of the excavation, the sidewalls of the excavation, and outside of the excavation perimeter. In November 2007, a small volume of tuff was removed (approximately 69 ft^2 × 1 ft deep) that was centered on the original May 2007 excavation because the August 2007 analytical results indicated residual contamination of plutonium-239 remained slightly above the residential SAL.

The presence of this area of elevated radioactivity was reported in the original investigation reports of MDA V (LANL 2006, 094361; LANL 2007, 098942). The supplemental remediation and investigation activities were conducted in accordance with the supplemental investigation work plan (LANL 2007, 097448) and approved by NMED (2007, 098287). This report refers to the previously reported remediation and sampling activities conducted at MDA V as “2005–2006,” even though additional remediation and sampling activities were conducted on the southwest slope [SWMU 21-013(b) and AOC 21-013(g)] in 2007. The supplemental sampling included in this report is referred to as “2006–2007.”

Appendix A provides the acronym list, glossary, metric conversion table, and data qualifier definitions for this report. Appendix B presents the analytical results for the 2006–2007 supplemental investigation. Specific details of the excavation and sampling activities are presented in Appendix C. The conversion of borehole 21-02523 for vapor monitoring at the site is addressed in Appendix D. Appendix E describes the analytical program, and Appendix F provides all of the analytical suites and results and analytical reports (on a compact disc [CD] included with this report). The waste disposal procedures and documentation are presented in Appendix G. Appendix H contains the results of the risk assessments performed for this supplemental investigation.

2.0 BACKGROUND

The following sections summarize the description and operational history of the site, the details of which are provided in the MDA V investigation report, revision 1 (LANL 2007, 098942, Section 2.0). The historical investigation report for Consolidated Unit 21-018(a)-99 (LANL 2004, 087358, Appendix B) provides details of previous investigations at Consolidated Unit 21-018(a)-99.

2.1 Site Description and Operational History

2.1.1 SWMU 21-018(a), MDA V

SWMU 21-018(a), more commonly referred to as MDA V, is a site approximately 1 acre, located immediately south of the former laundry facility [building 21-20; SWMU 21-018(b)] (Figure 1.1-3), consisting of three interconnected liquid waste absorption beds. MDA V received radioactive liquid waste that resulted from washing radioactively contaminated clothes in the laundry facility, and it was designed to enhance infiltration of liquids into the tuff bedrock. The absorption beds ran parallel to each other, with absorption bed 1 receiving effluent directly from the laundry. Effluent was transported from absorption bed 1 to absorption bed 2 and subsequently to absorption bed 3 by means of a series of collection and distribution pipes buried within the bed materials. This design was intended to allow absorption bed 1 to fill with effluent to a depth of approximately 2 ft from the bottom of the pit before the overflow pipes distributed water to the downgradient absorption beds.

The absorption beds were constructed in 1945 and operated until 1961. They remained on standby status until September 1963 when they were permanently removed from service (LANL 1991, 007529, p. 16-223). In January 1984, a chainlink fence was constructed around the absorption bed area. Minor surface stabilization work, including the installation of a soil cover, was completed in 1985 to repair erosion damage (Balo and Warren 1986, 007419, p. 69). It is not known whether a soil cover was ever installed over the site before the work was conducted in 1985 (LANL 1991, 007529, p. 16-223). No record exists of additional activities at the site after 1985.

2.1.2 SWMU 21-018(b), Former Laundry Facility

SWMU 21-018(b), the former laundry facility (building 21-20), was located at the eastern end and south of DP Road, immediately west of the security fence that encloses active TA-21 facilities to the east (Figure 1.1-3). Operational from 1945 to 1961, the laundry facility was used to wash personal protective clothing and other reusable cloth items used in both research and production operations involving radioactive materials at TA-21. It is estimated that the laundry facility generated approximately 2 million gal. of effluent annually (Abrahams 1962, 001306). This effluent was discharged to MDA V.

The laundry facility was a wood-frame structure with both concrete slab and wood-framing-on-pier floors. The wood portions of the building were decommissioned and demolished in 1965 and taken to MDA G where the debris was burned. The concrete foundation and associated piping were bulldozed over the edge of DP Mesa onto the south-facing slope of BV Canyon. This debris was later identified as SWMU 21-013(b). AOC 21-013(g) may have also received debris from demolition of the laundry facility.

2.1.3 SWMU 21-023(c), Waste Treatment Laboratory Septic Tank System

SWMU 21-023(c), a former septic system that consisted of a tank (structure 21-62), inlet and outlet lines, and an outfall, served as a waste treatment laboratory (building 21-33; AOC 21-009) (Figure 1.1-3). The septic tank was located immediately west of the MDA V absorption beds (drawing A5-C142, LANL 2004, 085559) and was constructed of reinforced concrete, 3.5 ft wide × 7 ft long × 5.8 ft deep. The inlet and outlet lines were 4-in. vitrified clay pipes; the outlet line surfaced 40 ft southwest from the tank, approximately 30 ft from the canyon edge above BV Canyon (drawings ENG-R-1191 and ENG-R-1193, LANL 2004, 085559). The outfall area extended south into BV Canyon.

The waste treatment laboratory septic system was put into service in 1948. Sewage was pumped from a sump in building 21-33 through the septic system. The tank was removed in 1965 and taken to MDA G. The 2005–2006 field activities confirmed that none of the septic system components remained in place.

2.1.4 SWMU 21-013(b) and AOC 21-013(g), Surface Disposal Area

SWMU 21-013(b) and AOC 21-013(g) are located immediately south of MDA V on the south-facing slope leading into BV Canyon (Figure 1.1-3). Both have historically been described as surface debris disposal sites. In 1990, sections of discarded pipe and building debris were observed during a site visit, and SWMU and AOC numbers were subsequently assigned. It is not known how long these sites received building debris; however, they did not receive wastes after 1994. SWMU 21-013(b) contained the external concrete piers, the concrete building foundations, and other building debris derived from the 1965 demolition of the laundry facility [building 21-20; SWMU 21-018(b)] and a waste treatment laboratory (building 21-33; AOC 21-009) (LANL 1991, 007680, pp. 17-29). Other debris included asphalt and concrete poured onto the slope before it solidified, broken asphalt, concrete, piping, and miscellaneous building materials. The origin of the additional debris is not documented. AOC 21-013(g) consisted of two discarded drainlines and miscellaneous building materials, also of unknown origin.

2.2 2005–2006 Investigation

The 2005–2006 investigation (LANL 2005, 088493) had two main objectives: (1) to define the lateral and vertical nature and extent of chemicals of potential concern (COPCs) at Consolidated Unit 21-018(a)-99 by collecting surface and subsurface data from around the site and (2) to reduce or prevent the migration of contamination by removing debris, infrastructure (e.g., piping), and environmental media (including absorption bed material) known to contain contaminants exceeding residential SALs for radionuclides (LANL 2005, 088493) or residential soil screening levels (SSLs) for inorganic and organic chemicals (NMED 2006, 092513). A summary is provided of the 2005–2006 remediation and characterization activities at Consolidated Unit 21-018(a)-99 in the following sections.

2.2.1 Subsurface Characterization Sampling

Characterization drilling was performed at Consolidated Unit 21-018(a)-99 from May 12 to June 9, 2005. The objectives of characterization drilling were to define the subsurface extent of contamination and to characterize fractures known to be present in the Tshirege Member of the Bandelier Tuff, units Qbt 3 and Qbt 2. Fifteen boreholes in and around MDA V [SWMU 21-018(a)] and the former laundry facility footprint [SWMU 21-018(b)] were drilled to total depths ranging from 40 to 380 ft below ground surface (bgs) for a total of 1160 linear ft.

All 2005–2006 characterization samples collected from the boreholes were analyzed for semivolatile organic compounds (SVOCs), pH, target analyte list (TAL) metals, nitrate, perchlorate, cyanide, radionuclides by gamma spectroscopy, americium-241, isotopic plutonium, isotopic uranium, strontium-90, and tritium. In addition, three samples from location 21-24524 (BH-01) included analyses of bromide, fluoride, chloride, and sulfate.

2.2.1.1 Geotechnical Analyses

Thirteen geotechnical samples were collected from location 21-24524 (BH-01) to characterize potential fractures underlying the absorption beds in MDA V. Geotechnical samples were analyzed for moisture content, bulk density, pH, porosity, and saturated hydraulic conductivity.

2.2.1.2 Geophysical Logging

Geophysical logging was also conducted for all 15 boreholes in July 2005. Within each borehole, the following measurements were taken: soil moisture content, gamma radiation, borehole diameter, and wall imagery to capture any subsurface features, such as character and orientation of potential fracture zones.

2.2.1.3 Pore-Gas Sampling

Pore-gas sampling was conducted twice in each of the 15 boreholes at two depth intervals in July–August 2005 and May–June 2006. The shallow interval was sampled at the extrapolated base of the waste disposal units (i.e., the approximate depth of the fill/tuff contact below the absorption beds). The depth interval was sampled at the bottom of the open borehole at the time of pore-gas sampling. All pore-gas samples were analyzed for volatile organic compounds (VOCs) and tritium.

2.2.2 Surface and Near-Surface Characterization Confirmation Sampling

2.2.2.1 SWMUs 21-018(a) and 21-018(b)

After absorption bed material was excavated and removed, seven confirmation samples from the floor of each absorption bed were collected from tuff at depths of approximately 12 ft below the original ground surface.

Following removal of the distribution line that carried wastewater from the laundry facility to MDA V, confirmation samples were collected from the trench at two depth intervals each (0–0.5 ft and 1.5–2.0 ft below the trench) from three locations. After removal of the steel sump line that ran from the west end of the laundry building, confirmation samples were collected from the trench at two depth intervals for each end of the pipeline (0–0.5 ft and 1.5–2.0 ft below the trench). Following removal of the clay pipeline, which was situated beneath and just to the west of the steel sump line, one location was sampled at approximately the middle of the run.

The confirmation samples collected at SWMUs 21-018(a) and 21-018(b) were analyzed for SVOCs, TAL metals, radionuclides by gamma spectroscopy, americium-241, isotopic plutonium, isotopic uranium, strontium-90, tritium, perchlorate, cyanide, pH, and nitrate.

2.2.2.2 SWMU 21-023(c)

Samples were collected from two depths (0–0.5 ft bgs and 1.5–2.0 ft bgs) at each of the following locations at SWMU 21-023(c):

- former septic system inlet line (4 locations)
- former septic system outlet line (3 locations)
- outfall (10 locations)
- Consolidated Unit 21-027(d)-99, drainage adjoining SWMU 21-023(c) outfall (6 locations)
- upgradient and downgradient of SWMU 21-023(c) in BV Canyon (7 locations)

All of the samples from the listed locations were analyzed for SVOCs, TAL metals, radionuclides by gamma spectroscopy, americium-241, isotopic plutonium, isotopic uranium, strontium-90, tritium, perchlorate, cyanide, pH, nitrate, and polychlorinated biphenyls (PCBs).

Excavation and removal of contaminated soil from the outfall channel were conducted in two field campaigns, starting from the southern edge of the mesa down into BV Canyon. Following removal of [outfall] soil in April 2006 from historical sampling locations where americium-241 and plutonium-239 exceeded the residential SALs and where no deeper sample was available to confirm vertical extent, eight confirmation samples were collected from a depth interval of 2 to 2.5 ft bgs.

Where activities of americium-241 and/or plutonium-239 exceeded residential SALs, additional soil and weathered tuff were removed in August 2006, and final confirmation samples were collected at depths varying between 2.5 and 4.5 ft bgs.

The April 2006 confirmation samples were analyzed for SVOCs, TAL metals, radionuclides by gamma spectroscopy, americium-241, isotopic plutonium, isotopic uranium, strontium-90, tritium, perchlorate, cyanide, pH, and nitrate. The five confirmation samples collected in August 2006 were analyzed for americium-241, plutonium-238, and plutonium-239 because extent had been established for all other COPCs.

2.2.2.3 SWMU 21-013(b) and AOC 21-013(g)

Debris removal was conducted at SWMU 21-013(b) and AOC 21-013(g) from July to October 2005. After debris was removed from the south-facing slope leading into BV Canyon, a total of 89 samples were collected from 45 locations along an approximate 25 m^2–grid spacing in and around SWMU 21-013(b) and AOC 21-013(g). Two depth intervals (0.0–0.5 ft bgs and 1.5–2.0 ft bgs) were sampled from all but one location. Confirmation samples were analyzed for SVOCs, TAL metals, radionuclides by gamma spectroscopy, americium-241, isotopic plutonium, isotopic uranium, strontium-90, tritium, perchlorate, cyanide, pH, and nitrate.

Additional sampling was conducted in May 2007 to determine the extent of benzo(a)anthracene at and downgradient of location 21-24650. Four locations were sampled at two depth intervals each and the samples were analyzed for SVOCs.

3.0 2006–2007 REMEDIATION AND SAMPLING ACTIVITIES

3.1 Remediation Activities

The primary objective of remediation activities performed in 2006–2007 was to complete the removal of soil and tuff at Consolidated Unit 21-018(a)-99 such that no residential SSLs or SALs were exceeded for inorganic chemicals, organic chemicals, or radionuclides. The removal activities at the area of elevated radioactivity were conducted to remove media contaminated with radionuclides, a result of overflow from the adjacent absorption beds. Material from an area of approximately 30 ft × 50 ft to a depth of 5 to 6 ft was removed from the site in August 2007, and an additional 69 ft^2 area was removed to a depth of approximately 1 ft in November 2007, representing a total volume of approximately 420 yd^3 of excavated material.

Investigation sampling at the area of elevated radioactivity falls into one of two categories: (1) preexcavation sampling, representing all samples taken at locations and depths where soil and tuff were excavated in August and November 2007, and (2) postexcavation sampling, representing all samples taken from soil and tuff that remain at the site after completion of the excavation. The preexcavation data are presented in this report but are not evaluated for potential risk, nature, and extent of potential contamination or used to make final decisions regarding cleanup because these data do not represent current or potential future site conditions. All qualified postexcavation data are presented in this report. Postexcavation data were evaluated for potential risk, nature, and extent of potential contamination and were used as the basis for determining whether cleanup goals have been met.

The preexcavation samples were collected to determine the volume of contamination of the area of elevated radioactivity, establish COPCs within the area, and evaluate the effectiveness of the excavation and remediation. Table 1.2-1 presents the preexcavation samples collected from the area of elevated radioactivity during the 2006–2007 supplemental investigation, as shown in Figure 3.1-1.

The postexcavation samples collected during the 2006–2007 investigation were collected to confirm the effectiveness of the excavation at the area of elevated radioactivity. Table 1.2-1 summarizes the postexcavation samples collected in the area of elevated radioactivity during the 2006–2007 supplemental investigation, as shown in Figure 3.1-2.

3.2 Sampling Activities

3.2.1 Preexcavation Sampling

Seven samples from three locations were collected from the area of elevated radioactivity between September 2006 and September 2007 that is representative of preexcavation conditions (Table 1.2-1). Additionally, three quality control (QC) samples were collected: one field duplicate, one field trip blank, and one field rinsate. The number and types of analyses performed varied as follows (number of samples in parentheses): anions (3), TAL metals (4), cyanide (4), nitrate (1), perchlorate (3), pH (3), SVOCs (3), VOCs (4), gamma spectroscopy (7), isotopic plutonium (7), isotopic uranium (7), americium-241 (7), strontium-90 (3), and asbestos (2).

One sample was collected from location 21-600105 at 2–2.0 ft bgs on August 22, 2007, and inspected for asbestos to determine if there was any potential health risk from asbestos to the field team. The results of this inspection are provided on the data CD included with this report; no asbestos was detected in the sample taken from this location. This sample is not summarized in the data tables or figures because it was not shipped through the Sample Management Office to an off-site lab.

3.2.2 Postexcavation Sampling

Fifteen samples from eight locations were collected from the area of elevated radioactivity in May and September 2007 that are representative of postexcavation (i.e., current) conditions (Table 1.2-1). The number and types of analyses performed on the samples varied as follows (number of samples in parentheses): anions (13), TAL metals (15), cyanide (15), perchlorate (15), pH (11), dioxins/furans (2), PCBs (2), SVOCs (13), VOCs (13), gamma spectroscopy (13), tritium (13), isotopic plutonium (13), isotopic uranium (13), americium-241 (11), strontium-90 (13), and asbestos (13). The dioxin/furan and PCB analyses were performed in May 2007 at location 21-600106 when the area of elevated radioactivity was first investigated. Because it was unknown at that time whether the area represented residual contamination related to the absorption beds and laundry facility operations or whether it was a newly identified SWMU related to other TA-21 operations, the samples collected from that location were analyzed for the COPCs identified for other TA-21 sites, which include dioxins/furans and PCBs.

4.0 REGULATORY CRITERIA

This section describes the criteria used for screening COPCs and evaluating potential risk to human and ecological receptors. Regulatory criteria identified in the Consent Order include cleanup standards, risk-based screening levels, and risk-based cleanup goals; these criteria are established by medium.

In accordance with the approved work plan for the supplemental remediation and sampling in the area of elevated radioactivity (LANL 2007, 097448), all relevant and qualified data collected during the 2006–2007 excavation and characterization activities were evaluated in risk-screening assessments (Appendix H). “Relevant data” refers to all samples collected after the submittal of the MDA V investigation report, revision 1 (LANL 2007, 098942), and “qualified data” refers to data validated according to current standards for data usability.

The human health screening assessment was performed according to NMED and U.S. Environmental Protection Agency (EPA) Region 6 guidance (NMED 2006, 092513; EPA 2007, 095866). The SSLs used in the human health screening assessment are presented in Appendix H (Tables H-4.1-1 and H-4.1-2) and were obtained from NMED (2006, 092513), EPA Region 6 (2007, 095866), and EPA Region 9 guidance (epa.gov/region09/waste/sfund/prg/files/04prgtable.pdf). The SALs were obtained from Laboratory guidance (2005, 088493) and were calculated using the radioactive residual materials model (Appendix H, Table H-4.1-3). Because this property may be transferred out of DOE control, residential SSLs and SALs are used for the cleanup levels for this site.

The human health screening levels listed are based on a target risk level of 10^{-5} for carcinogens or a hazard quotient of 1.0 for noncarcinogens (NMED 2006, 092513). For radionuclides, the target dose is 15 millirem (mrem)/yr based on DOE guidance (2000, 067489). The screening levels presented in Appendix H are based on these cleanup goals.

The ecological screening assessment was performed according to Laboratory guidance (2004, 087630). The ecological screening levels used in the screening assessment were obtained from the ECORISK Database, Version 2.2 (LANL 2005, 090032) (Appendix H, Table H-5.3-2).

Work Plan Variances

All 2006–2007 excavation, characterization, and sampling activities were conducted in accordance with the approved supplemental investigation work plan (LANL 2007, 097448), with the exception of the commitment in the work plan to abandon borehole 21-02523. After it was discovered that the borehole was uncased, ungrouted, and open to approximately 300 ft bgs, it was decided that the borehole would be converted to a vapor-monitoring well. The conversion of borehole 21-02523 for vapor monitoring at the site is addressed in Appendix D. The nature and extent of shallower pore gas were inconclusive in the initial subsurface investigation of pore gas at the site. Therefore, the monitoring well installation plan included in Appendix D will provide data needed to determine concentration trends for shallower pore gas nature and extent.

5.0 SITE CONTAMINATION

The following sections summarize the results of field-screening and fixed-analytical sampling performed during remediation activities at the area of elevated radioactivity. Appendix B provides details of the analytical results, Appendix E describes the analytical program, and Appendix F provides all of the analytical suites and results and analytical reports (on a CD included with this document).

5.1 Field-Screening Results

All pre- and postexcavation samples were field screened for alpha and beta radioactivity and VOCs. Details of the field-screening methods and instrumentation are provided in Appendix C. Table 5.1-1 presents the field-screening results (in units of disintegrations per minute [dpm] or parts per million [ppm]) for both pre- and postexcavation samples.

5.2 Soil and Rock Sampling Analytical Results

The analytical results for all pre- and postexcavation samples collected at the area of elevated radioactivity in 2006 and 2007 are summarized in Appendix B. The data reports for all of the samples evaluated are provided in Appendix F (on a CD included with this document). A summary of the analytical results for preexcavation and postexcavation samples is presented in Tables 5.2-1, 5.2-2, and 5.2-3 for inorganic, radionuclide, and organic COPCs, respectively. Figures 5.2-1, 5.2-2, and 5.2-3 show the analytical results for inorganic, radionuclide, and organic COPCs, respectively, for preexcavation samples. Postexcavation sample results are shown in Figures 5.2-4, 5.2-5, and 5.2-6 for inorganic, radionuclide, and organic COPCs, respectively. All August 2007 samples were also analyzed for asbestos because visual observation of the area of elevated radioactivity during the September 2006 activities revealed an approximate 2-in.-thick layer of debris material suspected of containing asbestos. Asbestos was not detected in any sample.

6.0 CONCLUSIONS

6.1 Summary of the Supplemental Investigation Activities

The primary objective of this supplemental investigation was to complete the remediation and characterization of Consolidated Unit 21-018(a)-99 at the area of elevated radioactivity to the east of absorption bed 2, in accordance with the approved supplemental work plan (LANL 2007, 097448; NMED 2007, 098287). The total volume of soil and tuff excavated from the area of elevated radioactivity was approximately 420 yd^3.

Although all primary potential sources of contamination have been removed from Consolidated Unit 21-018(a)-99, some residual contamination remains at concentrations below applicable residential SSLs and SALs, as discussed in the following sections.

6.2 Nature and Extent of Contamination

Appendix B provides a detailed discussion of the nature and extent of residual contamination in the area of elevated radioactivity. At Consolidated Unit 21-018(a)-99, all absorption bed material, infrastructure, debris, and media with COPC concentrations above residential SSLs and SALs have been removed. The results of the confirmation samples collected at the base and sidewalls of the excavation area indicate that little residual contamination remains. Samples collected during the 2006–2007 investigation show decreasing concentrations of COPCs, both laterally and with depth. Based on the analytical results of the 2006–2007 sampling, the objectives of the supplemental remediation and investigation have been met. Plutonium-239, the driver for the supplemental activities, was detected at approximately 2 orders of magnitude less than the overlying material removed during the excavation of the area of elevated radioactivity.

6.3 Comparisons of 2006–2007 Data with Screening Levels and Applicable Cleanup Levels

The 2006–2007 sample results were used to determine COPCs in soil and tuff and to complete risk-screening assessments for human and ecological receptors for the area of elevated radioactivity. The COPC identification for the area of elevated radioactivity is presented in Appendix B. Screening-level comparisons for determining potential risks to human health (residential receptors) and terrestrial ecological receptors are provided in Appendix H. The cleanup goals are a residential human health target risk level of 10^{-5} for carcinogens and a hazard index (HI) of 1.0 for noncarcinogens (NMED 2006, 092513). For radionuclides, the target dose is 15 mrem/yr, based on DOE guidance (2000, 067489). Appendix H provides a comparison of the maximum COPC concentrations with applicable residential SSLs and SALs for the postexcavation samples from the area of elevated radioactivity. In summary, detected concentrations of all COPCs are less than their respective residential SSLs and SALs. Therefore, the cleanup goals for the area of elevated radioactivity have been met.

6.4 Comparison of 2006–2007 Data with Previously Collected Data

The 2006–2007 postexcavation analytical results from the area of elevated radioactivity are compared with the 2005–2006 analytical results for Consolidated Unit 21-018(a)-99 in Table 6.4-1. The comparison was made to determine whether concentrations of COPCs identified in the area of elevated radioactivity are similar to previously collected data and whether conclusions still apply that were drawn in the MDA V investigation report, revision 1 (LANL 2007, 098942).

For the 0- to 10-ft horizon (the depth interval evaluated in the human health risk assessment), the data comparison was limited to the 2005–2006 analytical results of samples from 0 to 10 ft at SWMUs 21-018(a) and 21-018(b). This comparison was chosen because the area of elevated radioactivity is within the footprint of SWMUs 21-018(a) and 21-018(b). If the 2006–2007 analytical data results had been available from the area of elevated radioactivity when the initial MDA V investigation report was submitted, they would have been included with this subset of data from Consolidated Unit 21-018(a)-99. The detected concentrations of all COPCs between 0 and 10 ft bgs in the 2006–2007 data set are within the range of the 2005–2006 data previously evaluated for SWMUs 21-018(a) and 21-018(b), with the exception of chromium, americium-241, plutonium-239, and strontium-90. These COPCs were identified elsewhere at Consolidated Unit 21-018(a)-99, indicating that these are not new COPCs at the site. In addition, four organic chemicals (1,3-dichlorobenzene; 1,4-dichlorobenzene;

methylene chloride; and toluene) were detected at trace concentrations below applicable estimated quantitation limits (EQLs) in the 2006–2007 data set and were not previously detected in soil or tuff between 0 and 10 ft at SWMUs 21-018(a) and 21-018(b).

For the 0- to 5-ft horizon (the depth interval evaluated in the ecological risk assessment), the data comparison included all 2005–2006 analytical results of samples from 0 to 5 ft at Consolidated Unit 21-018(a)-99. This comparison is valid because the previous ecological assessment included all site data from 0 to 5 ft to be consistent with the 2006 ecological risk assessment. The detected concentrations of all COPCs between 0 and 5 ft bgs in the 2006–2007 data set are within the range of data previously evaluated for Consolidated Unit 21-018(a)-99. Four organic chemicals (1,3-dichlorobenzene; 1,4-dichlorobenzene; methylene chloride; and toluene) were detected at trace concentrations below applicable EQLs in the 2006–2007 data set and were not previously detected in soil or tuff between 0 and 5 ft at Consolidated Unit 21-018(a)-99.

For both data comparisons, the 2006–2007 results for dioxins/furans cannot be compared with previously collected data at Consolidated Unit 21-018(a)-99 because dioxins/furans were not analyzed for in the 2005–2006 samples; rather, the results for dioxins/furans are compared with data collected for the TA-21 DP Site Aggregate Area investigation report (LANL 2007, 099175). The concentrations of all dioxins/furans in the 2006–2007 data set are within the range of concentrations of dioxins/furans detected elsewhere at TA-21 (Table 6.4-1).

In summary, concentrations of COPCs identified at the area of elevated radioactivity are similar to previously collected data, and both previous and current sampling have COPC concentrations below residential SSLs and SALs. Therefore, conclusions drawn in the MDA V investigation report, revision 1 (LANL 2007, 098942), are still valid.

6.5 Summary of Risk Assessments

6.5.1 Human Health Risk-Screening Assessment

Maximum concentrations of all COPCs (carcinogenic, noncarcinogenic, and radionuclides) identified in the 2006–2007 supplemental investigation sampling of the area of elevated radioactivity at MDA V are less than the respective residential SSLs and SALs in all postexcavation samples. The total estimated excess cancer risk is approximately 3×10^{-7}, which is less than NMED's target level of 1×10^{-5} (NMED 2006, 092513). The noncarcinogenic HI is 0.1, which is less than the NMED target level of an HI of 1.0 (NMED 2006, 092513). The total dose is 0.44 mrem/yr (Table H-4.1-3), which is less than DOE's target dose of 15 mrem/yr (DOE 2000, 067489). This dose corresponds to a radiological risk of approximately 1.0×10^{-5}, based on a comparison with EPA radionuclide residential preliminary remediation goals (http://www.epa.gov/region09/waste/sfund/prg/).

Based on the human health risk assessment results presented in this supplemental investigation report, concentrations of COPCs in soil and tuff in the area of elevated radioactivity at Consolidated Unit 21-018(a)-99 do not pose a potential unacceptable risk/dose to human health under a residential scenario. The conclusions drawn in the previous investigation report (LANL 2007, 098942) that there are no potential unacceptable risks to human health under a residential scenario are still valid.

6.5.2 Ecological Risk-Screening Assessment

The ecological risk screening eliminated all chemicals of potential ecological concern (COPECs), indicating that no potential risk to terrestrial receptors exists from exposure to residual COPEC concentrations in the area of elevated radioactivity. Based on the ecological risk-assessment results, the conclusions drawn in the previous investigation report (LANL 2007, 098942) that concentrations of COPECs in soil and tuff at Consolidated Unit 21-018(a)-99 do not pose a potential unacceptable risk to ecological receptors are still valid.

7.0 RECOMMENDATIONS

Based on information and data presented in this supplemental investigation report, remediation and characterization activities are complete at Consolidated Unit 21-018(a)-99, in accordance with the approved supplemental work plan (LANL 2007, 097448; NMED 2007, 098287).

The area of elevated radioactivity at Consolidated Unit 21-018(a)-99 was remediated in 2006 and 2007 by removing environmental media with concentrations of COPCs exceeding residential SALs for radionuclides. No inorganic or organic chemicals were detected above residential SSLs in the 2006–2007 confirmation samples and all COPECs were eliminated. Thus, the residual contamination does not pose a potential unacceptable risk to human health (under a residential scenario) or the environment. Additionally, the nature and extent of contamination have been defined, with the exception of low levels of tritium in subsurface pore gas, as detailed in the MDA V investigation report, revision 1 (LANL 2007, 098942). Groundwater monitoring requirements for TA-21, including Consolidated Unit 21-018(a)-99, was addressed in the “Los Alamos and Pueblo Canyons Groundwater Monitoring Well Network Evaluation and Recommendations” (LANL 2007, 099936), which was submitted to NMED on December 21, 2007.

Based on the results of all remediation and sampling completed at the site from 2005 to 2007, corrective action is complete for Consolidated Unit 21-018(a)-99. Additional evaluation of tritium is pending.

8.0 REFERENCES AND MAP DATA SOURCES

8.1 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 number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate’s Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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LANL (Los Alamos National Laboratory), 2004. “List of Record Drawings Used in the HIR Report, MDA V, SWMU 21-018(a)-99,” Los Alamos, New Mexico. (LANL 2004, 085559)

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LANL (Los Alamos National Laboratory), December 2004. “Screening-Level Ecological Risk Assessment Methods, Revision 2,” Los Alamos National Laboratory document LA-UR-04-8246, Los Alamos, New Mexico. (LANL 2004, 087630)

LANL (Los Alamos National Laboratory), May 2005. “Derivation and Use of Radionuclide Screening Action Levels, Revision 1,” Los Alamos National Laboratory document LA-UR-05-1849, Los Alamos, New Mexico. (LANL 2005, 088493)

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LANL (Los Alamos National Laboratory), July 2007. “Investigation Report for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21, Revision 1,” Los Alamos National Laboratory document LA-UR-07-4390, Los Alamos, New Mexico. (LANL 2007, 098942)

LANL (Los Alamos National Laboratory), July 3, 2007. “Sampling Data for Area of Elevated Radioactivity Near Location ID 21-02523 and North of Absorption Bed 3, Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21,” Los Alamos National Laboratory letter (EP2007-0346) to J.P. Bearzi (NMED HWB) from S. Stiger (Environmental Programs Associate Director) and D. Gregory (DOE Federal Project Director), Los Alamos, New Mexico. (LANL 2007, 097448)

LANL (Los Alamos National Laboratory), November 2007. “Delta Prime Site Aggregate Area Investigation Report,” Los Alamos National Laboratory document LA-UR-07-5459, Los Alamos, New Mexico. (LANL 2007, 099175)

LANL (Los Alamos National Laboratory), December 2007. “Los Alamos and Pueblo Canyons Groundwater Monitoring Well Network Evaluation and Recommendations,” Los Alamos National Laboratory document LA-UR-07-8114, Los Alamos, New Mexico. (LANL 2007, 099936)

NMED (New Mexico Environment Department), June 2006. “Technical Background Document for Development of Soil Screening Levels, Revision 4.0, Volume 1, Tier 1: Soil Screening Guidance Technical Background Document,” New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2006, 092513)

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8.2 Map Data Sources

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Former TA-21 Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Potential Release Sites (SWMU/AOC); Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2005-0748; 1:2500 Scale Data; 22 November 2005.

Material Disposal Areas; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2004-0221; 1:2500 Scale Data; 23 April 2004.

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Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

Steam Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

Sewer Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

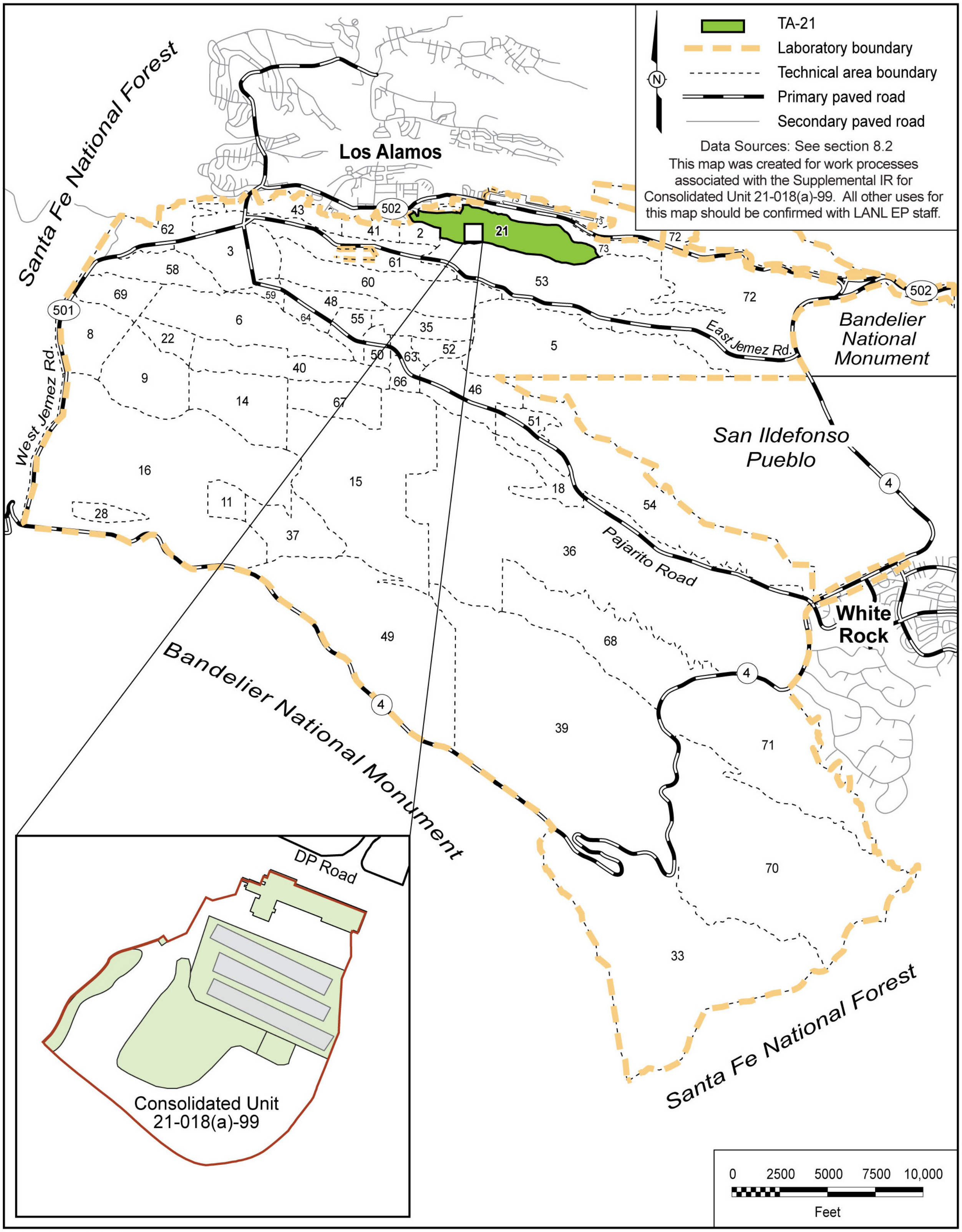
Industrial Waste Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Electric Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 08 August 2002; Development Edition of 05 January 2005.

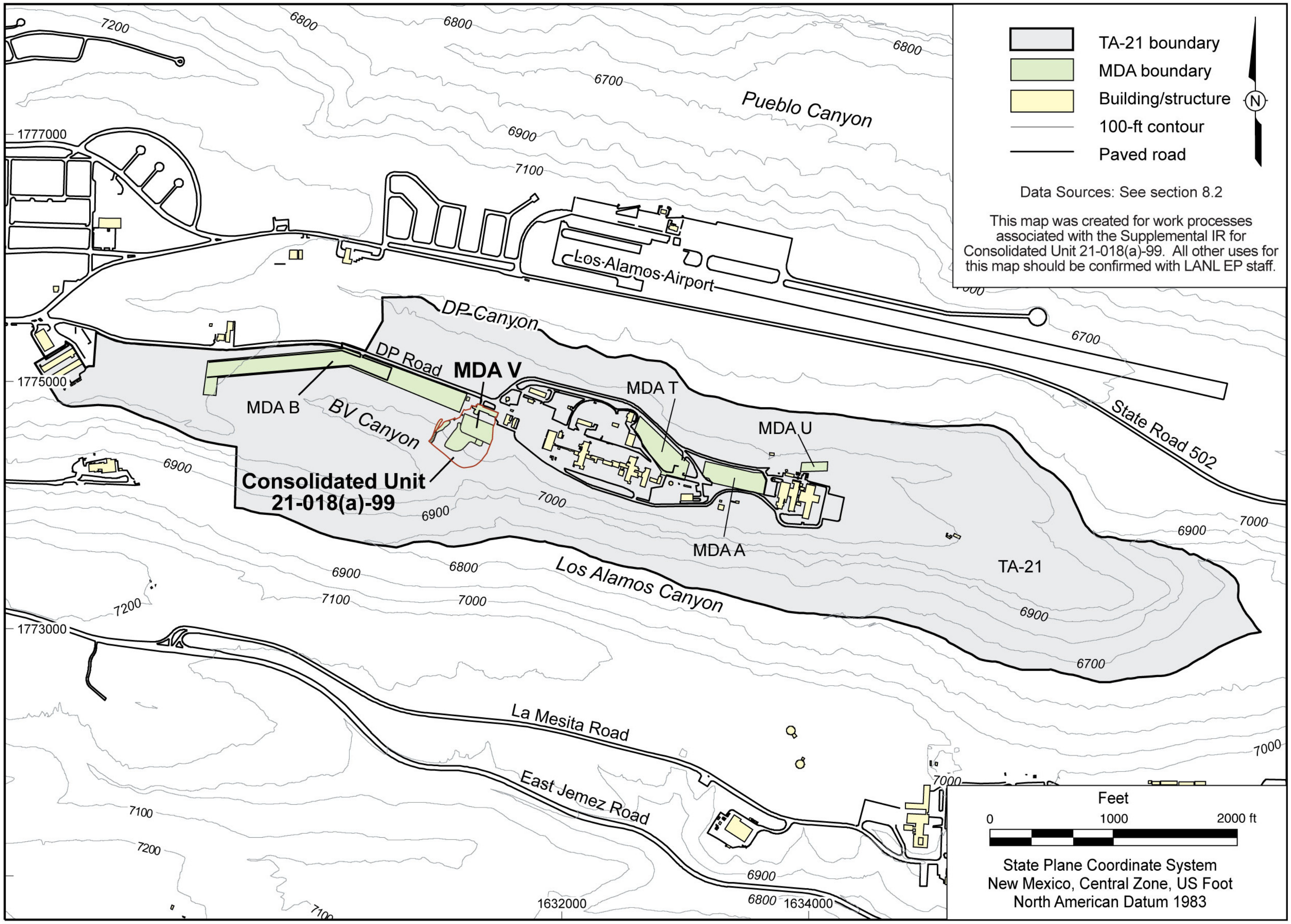
ER Location IDs point (borehole and sample locations); Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1:2500 Scale Data; 10 November 2005.

Former Drainline; Los Alamos National Laboratory, ENV Environmental Remediation and Stewardship Program; 1:2500 Scale Data, 02 October 2006.



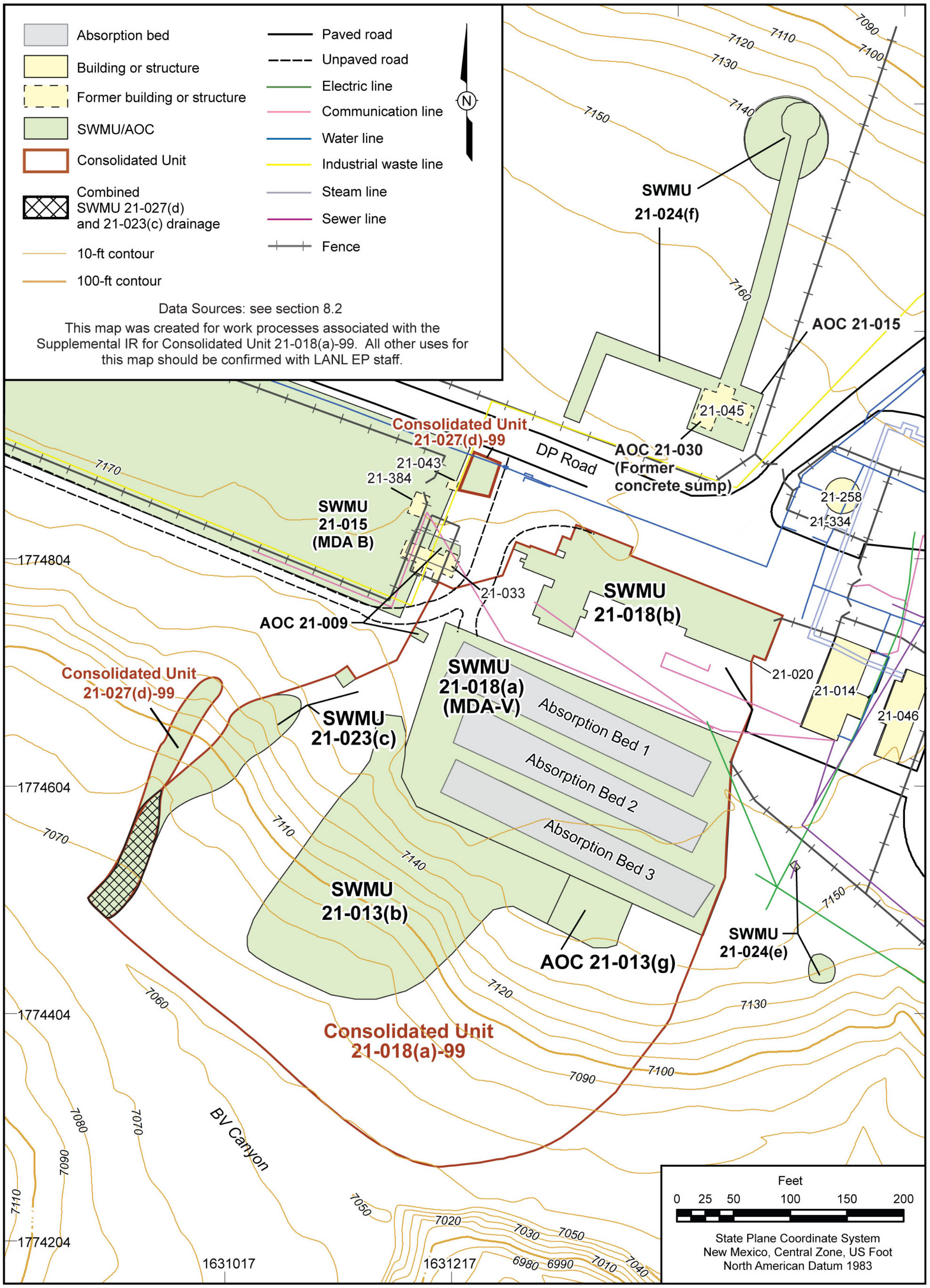
129175.01000000 A4

Figure 1.1-1 TA-21 and Consolidated Unit 21-018(a)-99 with respect to Laboratory technical areas and surrounding land holdings



129175.01000000 A11

Figure 1.1-2 Consolidated Unit 21-018(a)-99 within TA-21 and surrounding MDAs



Data Sources: see section 8.2

This map was created for work processes associated with the Supplemental IR for Consolidated Unit 21-018(a)-99. All other uses for this map should be confirmed with LANL EP staff.

129175.01000000 A12

Figure 1.1-3 Consolidated Unit 21-018(a)-99 and adjacent SWMUs and AOCs

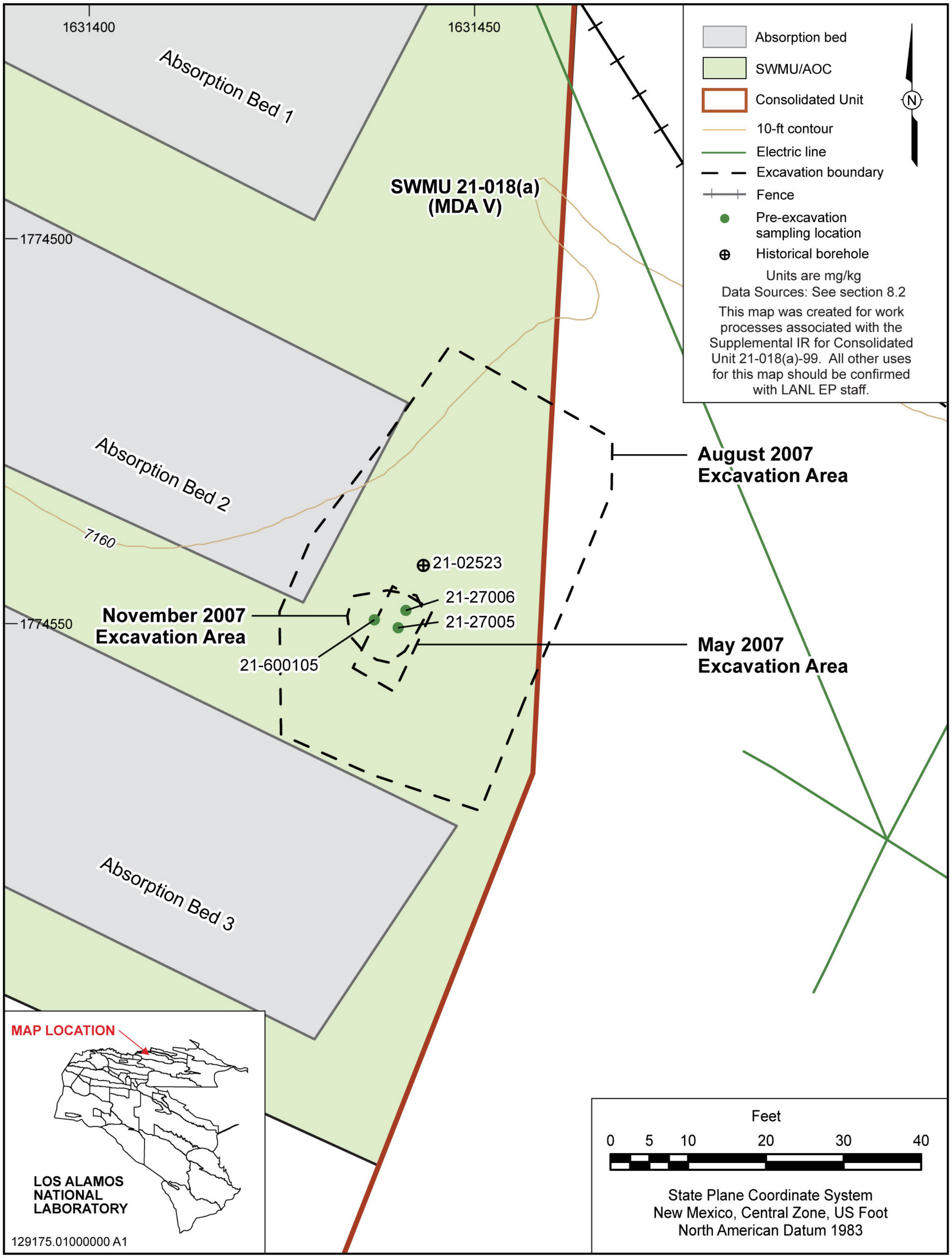


Figure 3.1-1 **Preexcavation sample locations at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99**

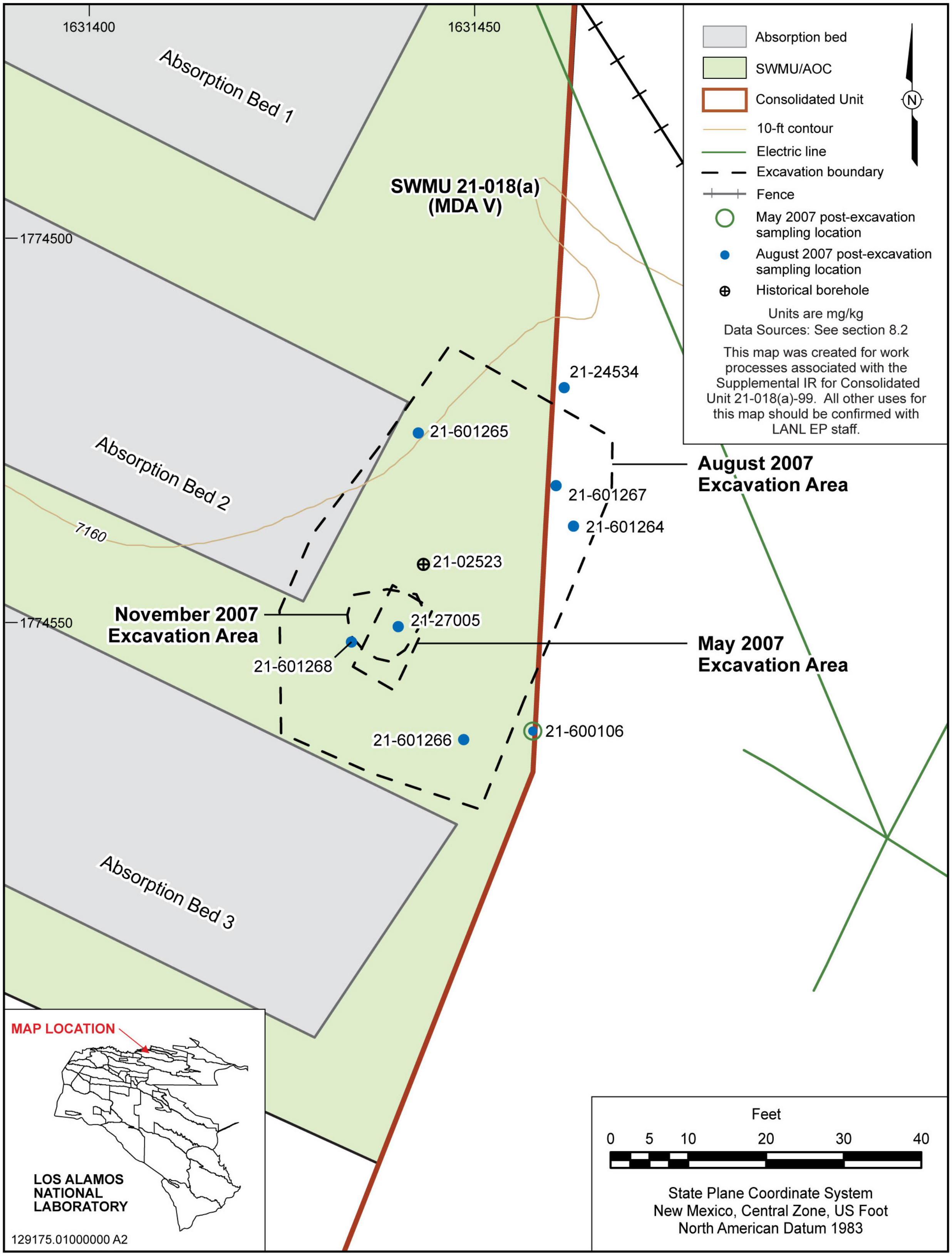


Figure 3.1-2 Postexcavation sample locations at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99

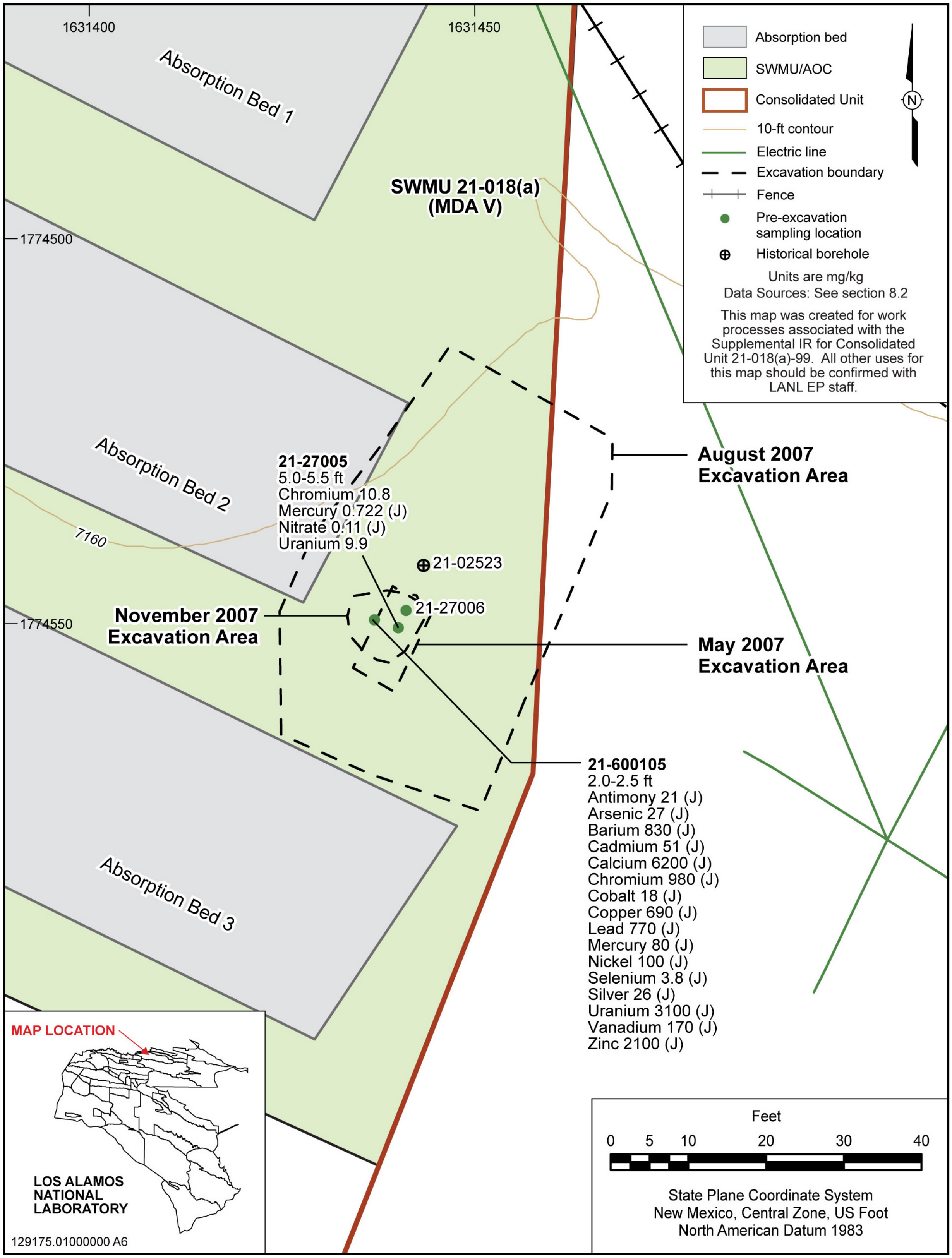


Figure 5.2-1 **Preexcavation samples: inorganic chemicals detected above background values (BVs) at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99**

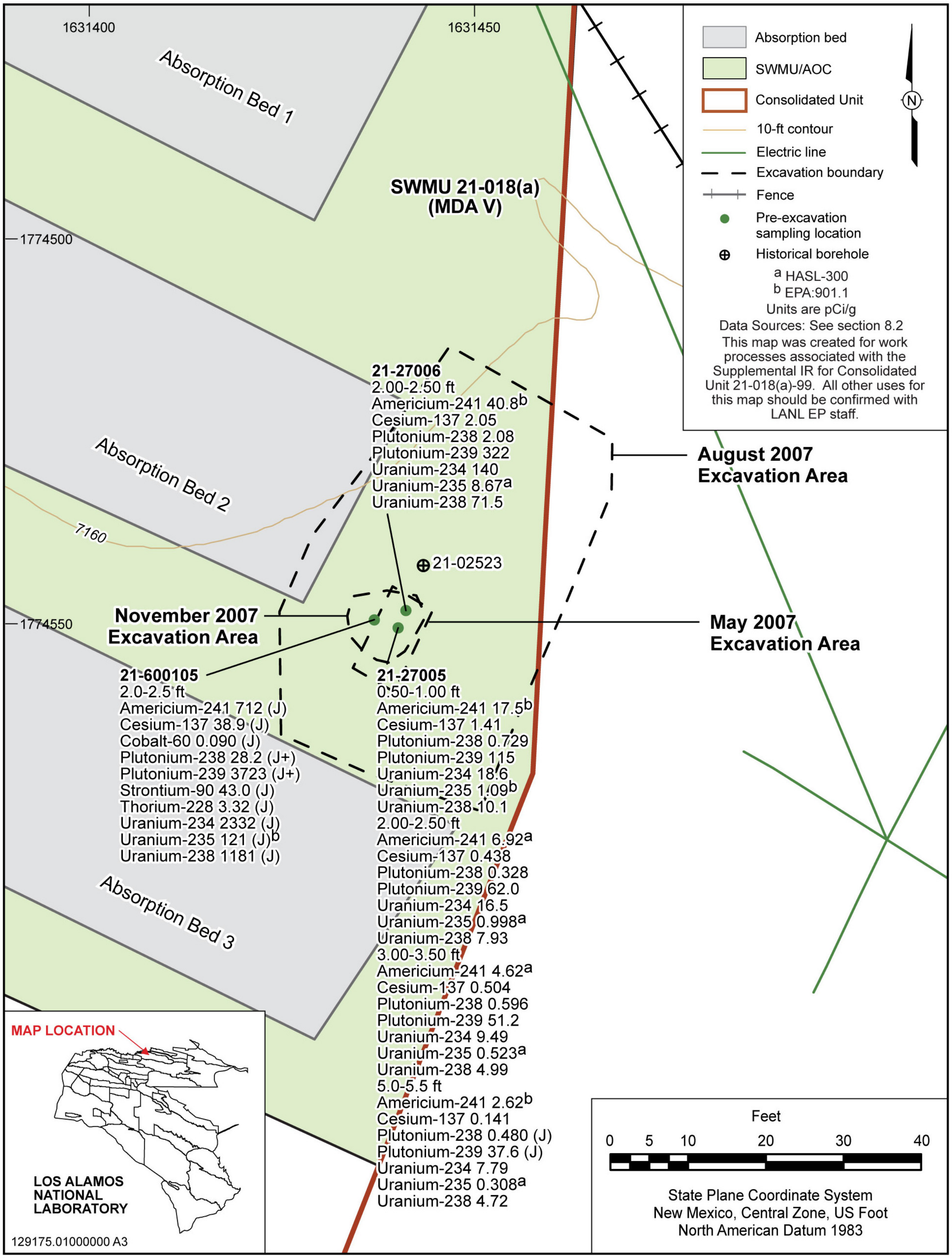


Figure 5.2-2 **Preexcavation samples: radionuclides detected or detected above BVs/fallout values (FVs) at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99**

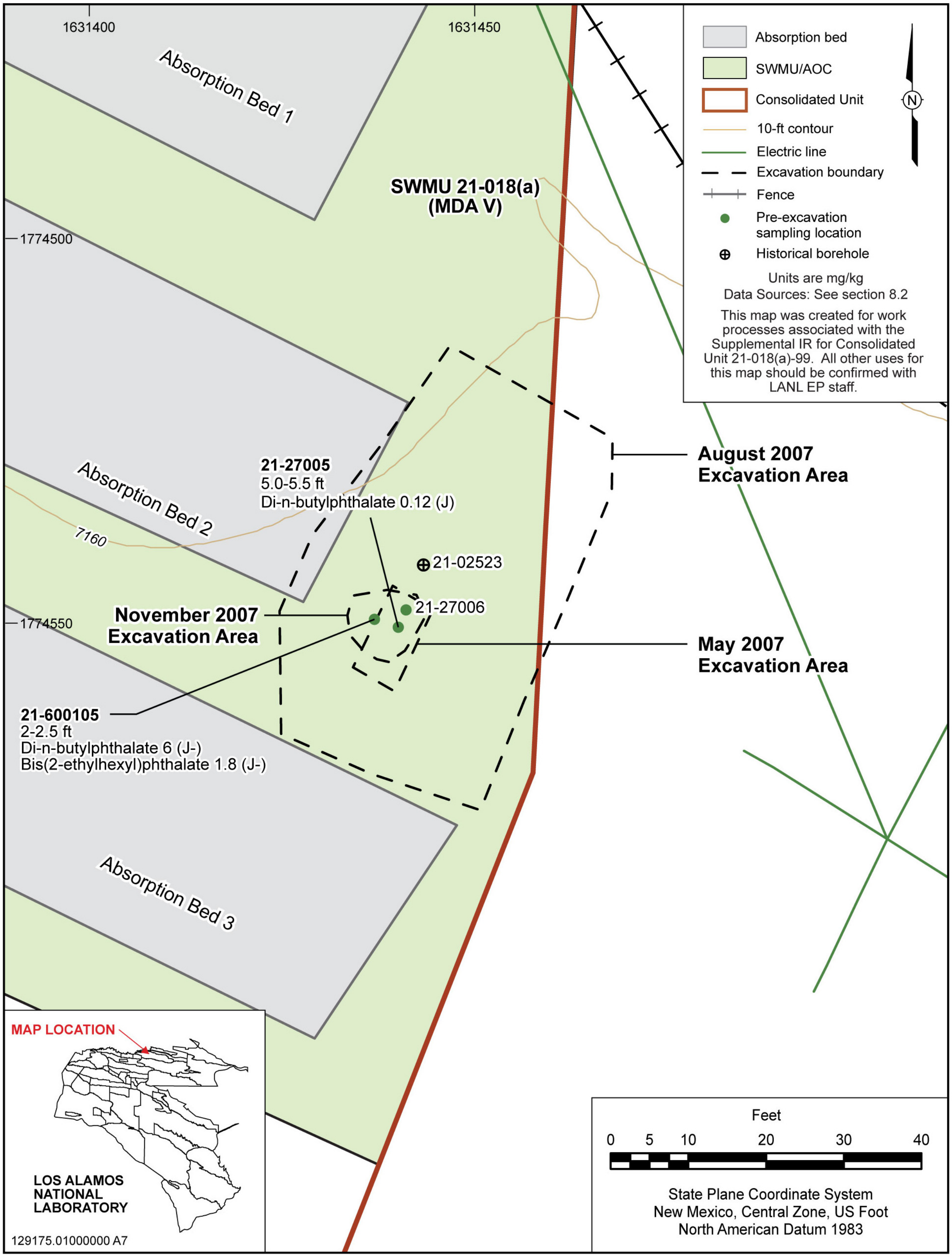


Figure 5.2-3 **Preexcavation samples: organic chemicals detected at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99**

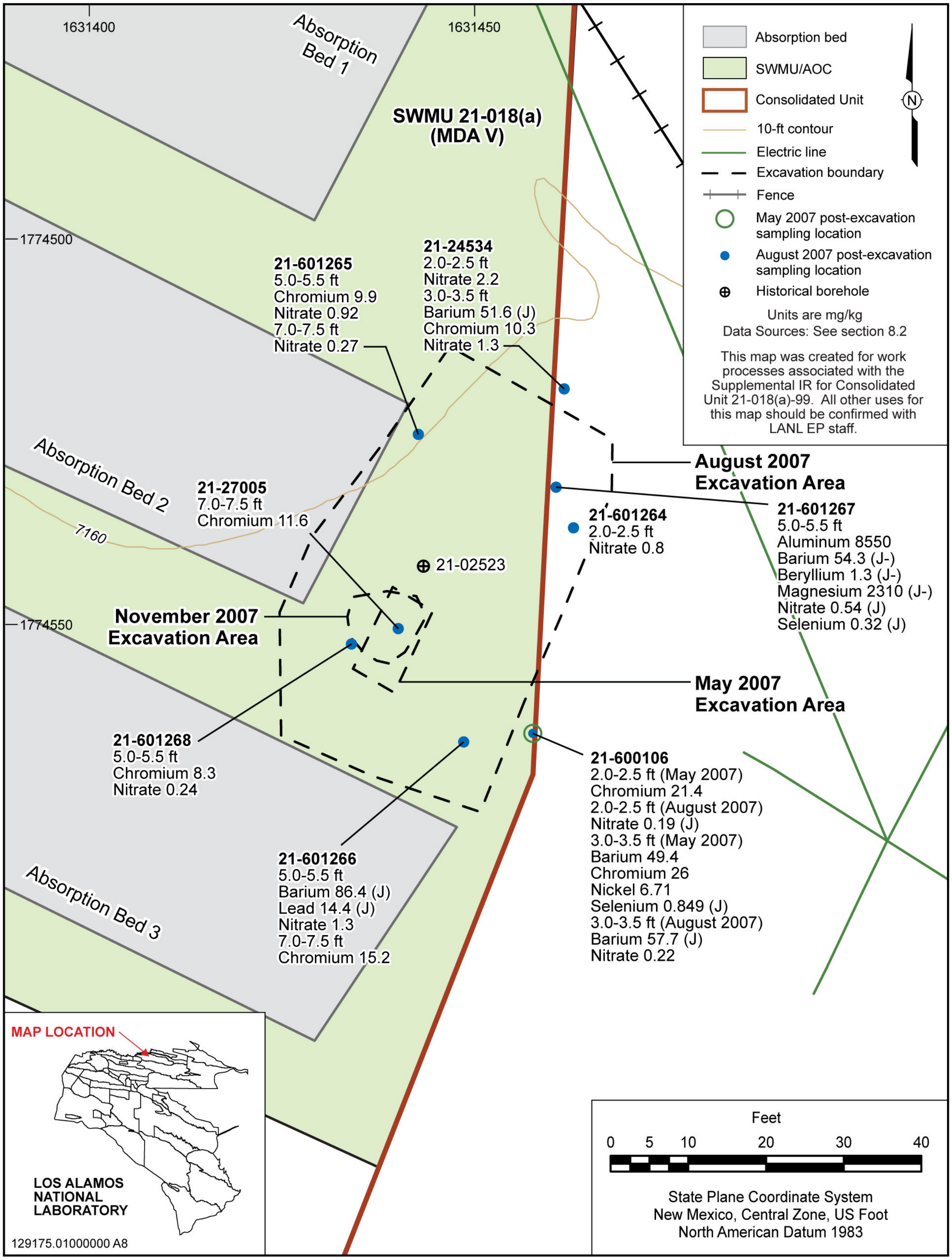


Figure 5.2-4 **Postexcavation samples: inorganic chemicals detected above BVs at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99**

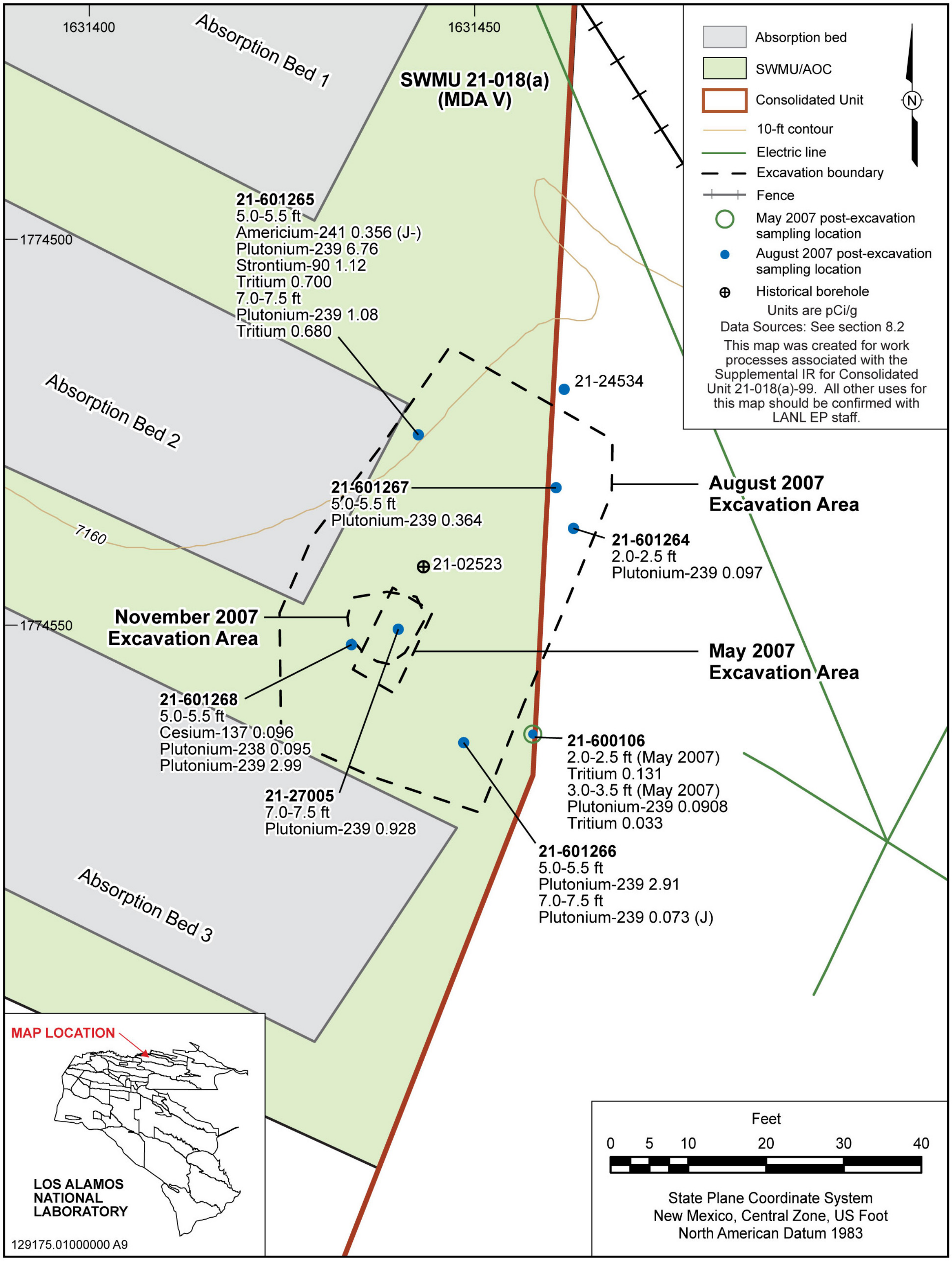


Figure 5.2-5 **Postexcavation samples: radionuclides detected or detected above BVs/FVs at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99**

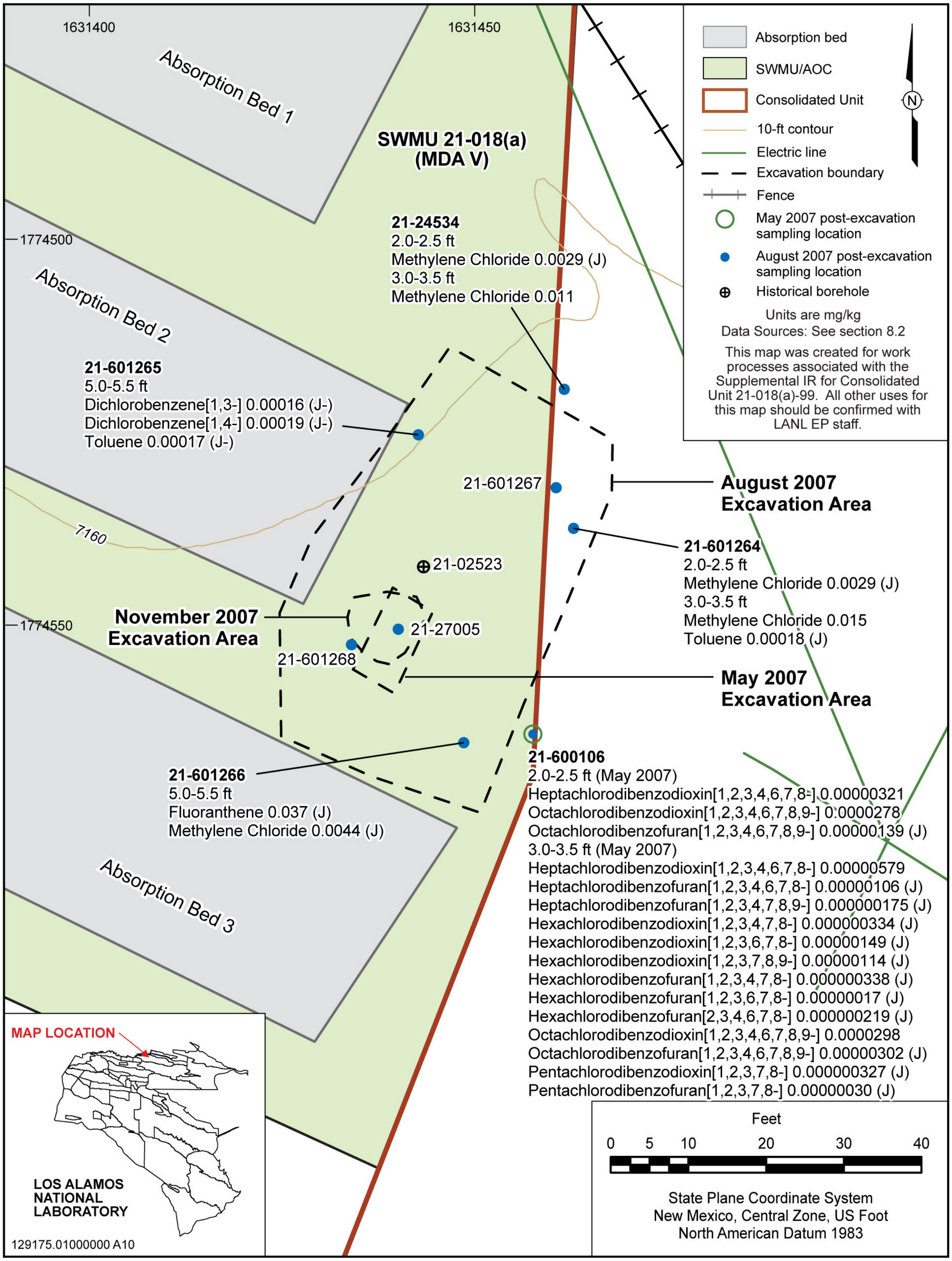


Figure 5.2-6 Postexcavation samples: organic chemicals detected at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99

Table 1.2-1
Summary of Samples Collected for Analyses at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Sample Collection Date	Media	Depth (ft bgs)	Field QC Type	Anions	Metals	Asbestos	Cyanide	Nitrates	Perchlorate	pH	Dioxins/ Furans
Preexcavation Samples													
21-27005	MD21-06-73535	9/19/06	Fill	0.5–1.0	n/a[a]	NA[b]	NA	NA	NA	NA	NA	NA	NA
21-27005	MD21-06-73536	9/19/06	Soil	2.0–2.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA
21-27005	MD21-06-73537	9/19/06	QBT3	3.0–3.0	n/a	NA	NA	NA	NA	NA	NA	NA	NA
21-27005	RE21-07-6040	9/10/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-27005	RE21-07-6053	9/10/07	QBT3	5.0–5.5	FD[c]	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-27005	RE21-07-6057	9/10/07	ALLH	—[d]	FTB[e]	NA	NA	NA	NA	NA	NA	NA	NA
21-27005	RE21-07-6059	9/10/07	n/a	—	FR[f]	NA	SW-846 6020/7470A	NA	SW-846 9012A	EPA 353.1	SW-846 6850	NA	NA
21-27006	MD21-06-73538	9/20/06	Soil	2.0–2.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA
21-600105	RE21-07-601	5/17/07	ALLH	2.0–2.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA
21-600105	RE21-07-6042	8/22/07	ALLH	2.0–2.5	n/a	EPA 300.0/314.0	SW-846 6010B/6020/7471A	NA	SW-846 9012A	NA	NA	SW-846 9045C	NA
Postexcavation Samples													
21-24534	RE21-07-6043	9/10/07	QBT3	2.0–2.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-24534	RE21-07-6044	9/10/07	QBT3	3.0–3.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-27005	RE21-07-6041	9/10/07	QBT3	7.0–7.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-600106	RE21-07-603	5/29/07	Soil	2.0–2.5	n/a	NA	SW-846 6010B/6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	NA	SW-846 8290
21-600106	RE21-07-6055	9/10/07	Soil	2.0–2.5	n/a	EPA 300.0	SW-846 6020/7471A	NA	SW-846 9012A	NA	SW-846 6850	NA	NA
21-600106	RE21-07-604	5/29/07	QBT3	3.0–3.5	n/a	NA	SW-846 6010B/6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	NA	SW-846 8290
21-600106	RE21-07-6056	9/10/07	QBT3	3.0–3.5	n/a	EPA 300.0	SW-846 6020/7471A	NA	SW-846 9012A	NA	SW-846 6850	NA	NA
21-601264	RE21-07-6045	9/10/07	QBT3	2.0–2.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601264	RE21-07-6046	9/10/07	QBT3	3.0–3.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601265	RE21-07-6047	9/10/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601265	RE21-07-6048	9/10/07	QBT3	7.0–7.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601266	RE21-07-6049	9/10/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601266	RE21-07-6050	9/10/07	QBT3	7.0–7.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601267	RE21-07-6051	9/7/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601268	RE21-07-6052	9/10/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA

Table 1.2-1 (continued)

Location ID	Sample ID	Sample Collection Date	Media	Depth (ft bgs)	Field QC Type	PCBs	SVOCs	VOCs	Gamma Spectroscopy[g]	Tritium	Isotopic Plutonium	Isotopic Uranium	Americium-241	Strontium-90
Preexcavation Samples														
21-27005	MD21-06-73535	9/19/06	Fill	0.5–1.0	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	HASL-300	NA
21-27005	MD21-06-73536	9/19/06	Soil	2.0–2.5	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	HASL-300	NA
21-27005	MD21-06-73537	9/19/06	QBT3	3.0–3.0	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	HASL-300	NA
21-27005	RE21-07-6040	9/10/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-27005	RE21-07-6053	9/10/07	QBT3	5.0–5.5	FD	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-27005	RE21-07-6057	9/10/07	ALLH	—	FTB	NA	NA	SW-846 8260B	NA	NA	NA	NA	NA	NA
21-27005	RE21-07-6059	9/10/07	n/a	—	FR	NA	NA	NA	NA	NA	NA	NA	NA	NA
21-27006	MD21-06-73538	9/20/06	Soil	2.0–2.5	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	HASL-300	NA
21-600105	RE21-07-601	5/17/07	ALLH	2.0–2.5	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	NA	EPA 905.0
21-600105	RE21-07-6042	8/22/07	ALLH	2.0–2.5	n/a	NA	SW-846 8270C	SW-846 8260B	NA	NA	NA	NA	NA	NA
Postexcavation Samples														
21-24534	RE21-07-6043	9/10/07	QBT3	2.0–2.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-24534	RE21-07-6044	9/10/07	QBT3	3.0–3.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-27005	RE21-07-6041	9/10/07	QBT3	7.0–7.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-600106	RE21-07-603	5/29/07	Soil	2.0–2.5	n/a	SW-846 8082	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	NA	EPA 905.0
21-600106	RE21-07-6055	9/10/07	Soil	2.0–2.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA	NA
21-600106	RE21-07-604	5/29/07	QBT3	3.0–3.5	n/a	SW-846 8082	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	NA	EPA 905.0
21-600106	RE21-07-6056	9/10/07	QBT3	3.0–3.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA	NA
21-601264	RE21-07-6045	9/10/07	QBT3	2.0–2.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601264	RE21-07-6046	9/10/07	QBT3	3.0–3.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601265	RE21-07-6047	9/10/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601265	RE21-07-6048	9/10/07	QBT3	7.0–7.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601266	RE21-07-6049	9/10/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601266	RE21-07-6050	9/10/07	QBT3	7.0–7.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601267	RE21-07-6051	9/7/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601268	RE21-07-6052	9/10/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0

[a] n/a = Not applicable.

[b] NA = Not analyzed.

[c] FD = Field duplicate.

[d] — = Field trip blank or rinsate; sample interval not applicable.

[e] FTB = Field trip blank.

[f] FR = Field rinsate.

[g] Thorium-228 was not analyzed for in the postexcavation samples.

Table 5.1-1
Field-Screening Results from the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Sample Collection Date	Media	Depth (ft bgs)	Field QC Type	Alpha (dpm)	Beta (dpm)	PID (ppm)
Preexcavation Samples								
21-27005	MD21-06-73535	9/19/06	Fill	0.5–1.0	n/a[a]	320	2320	4.0
21-27005	MD21-06-73536	9/19/06	Soil	2.0–2.5	n/a	105	1998	0.9
21-27005	MD21-06-73537	9/19/06	QBT3	3.0–3.0	n/a	124	2120	0.8
21-27005	RE21-07-6040	9/10/07	QBT3	5.0–5.5	n/a	60	1000	0.0
21-27005	RE21-07-6057	9/10/07	ALLH	—[b]	FTB[c]	NA[d]	NA	NA
21-27005	RE21-07-6059	9/10/07	n/a	—	FR[e]	NA	NA	NA
21-27006	MD21-06-73538	9/20/06	Soil	2.0–2.5	n/a	301	2900	1.6
21-600105	RE21-07-601	5/15/07	ALLH	2.0–2.5	n/a	1000	30000	5.3
21-600105	RE21-07-6042	8/22/07	ALLH	2.0–2.5	n/a	0.87	14.3	0.0
Postexcavation Samples								
21-24534	RE21-07-6043	9/10/07	QBT3	2.0–2.5	n/a	50	1100	0.1
21-24534	RE21-07-6044	9/10/07	QBT3	3.0–3.5	n/a	50	1000	0.0
21-27005	RE21-07-6041	9/10/07	QBT3	7.0–7.5	n/a	20	970	0.1
21-600106	RE21-07-603	5/29/07	Soil	2.0–2.5	n/a	0.0	395	7.9
21-600106	RE21-07-6055	9/10/07	Soil	2.0–2.5	n/a	80	1000	73.2
21-600106	RE21-07-604	5/29/07	QBT3	3.0–3.5	n/a	12	557	2.7
21-600106	RE21-07-6056	9/10/07	QBT3	3.0–3.5	n/a	10	800	3.5
21-601264	RE21-07-6045	9/10/07	QBT3	2.0–2.5	n/a	30	1000	0.3
21-601264	RE21-07-6046	9/10/07	QBT3	3.0–3.5	n/a	30	1000	0.5
21-601265	RE21-07-6047	9/10/07	QBT3	5.0–5.5	n/a	10	92	0.1
21-601265	RE21-07-6048	9/10/07	QBT3	7.0–7.5	n/a	2	1200	0.0
21-601266	RE21-07-6049	9/10/07	QBT3	5.0–5.5	n/a	40	1100	0.0
21-601266	RE21-07-6050	9/10/07	QBT3	7.0–7.5	n/a	50	930	0.1
21-601267	RE21-07-6051	9/7/07	QBT3	5.0–5.5	n/a	0.05	2.4	0.6
21-601268	RE21-07-6052	9/10/07	QBT3	5.0–5.5	n/a	5	1100	0.0

[a] n/a = Not applicable.

[b] — = Field trip blank or rinsate; sample interval not applicable.

[c] FTB = Field trip blank.

[d] NA = Not analyzed.

[e] FR = Field rinsate.

Table 5.2-1
Results of Inorganic Chemicals above BVs at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Media	Depth (ft bgs)	Asbestos	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper
Soil BV				**na**[a]	**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**	**19.3**	**8.64**	**14.7**
QBT3 BV				**na**	**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**	**7.14**	**3.14**	**4.66**
SSL Residential				**na**	**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**	**2100**[b]	**1520**	**3130**
Preexcavation Samples														
21-27005	MD21-06-73535	Fill	0.5–1.0	—[c]	—	—	—	—	—	—	—	—	—	—
21-27005	MD21-06-73536	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-27005	MD21-06-73537	QBT3	3.0–3.0	—	—	—	—	—	—	—	—	—	—	—
21-27005	RE21-07-6040	QBT3	5.0–5.5	—	—	—	—	—	—	—	3270 (U)	10.8	—	5 (U)
21-27006	MD21-06-73538	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-601	ALLH	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-6042	ALLH	2.0–2.5	—	—	21 (J)	27 (J)	830 (J)	—	51 (J)	6200 (J)	980 (J)	18 (J)	690 (J)
Postexcavation Samples														
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-24534	RE21-07-6044	QBT3	3.0–3.5	—	—	—	—	51.6 (J)	—	—	—	10.3	—	—
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	0.58 (UJ)	—	—	—	—	—	11.6	—	—
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	—	0.553 (U)	—	21.4	—	—
21-600106	RE21-07-6055	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-600106	RE21-07-604	QBT3	3.0–3.5	—	—	—	—	49.4	—	—	—	26	—	—
21-600106	RE21-07-6056	QBT3	3.0–3.5	—	—	—	—	57.7 (J)	—	—	—	—	—	—
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	—	—	—	—	—	—	—
21-601265	RE21-07-6047	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	9.9	—	17.2 (U)
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—	—
21-601266	RE21-07-6049	QBT3	5.0–5.5	—	—	—	—	86.4 (J)	—	—	4870 (U)	—	—	5.5 (U)
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	0.55 (UJ)	—	—	—	—	—	15.2	—	—
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	8550	—	—	54.3 (J-)	1.3 (J-)	—	—	—	—	—
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	8.3	—	—

Table 5.2-1 (continued)

Location ID	Sample ID	Media	Depth (ft bgs)	Lead	Magnesium	Mercury	Nickel	Nitrate	Selenium	Silver	Uranium	Vanadium	Zinc
Soil BV				**22.3**	**4610**	**0.1**	**15.4**	**na**	**1.52**	**1**	**1.82**	**39.6**	**48.8**
QBT3 BV				**11.2**	**1690**	**0.1**	**6.58**	**na**	**0.3**	**1**	**2.40**	**17.0**	**63.5**
SSL Residential				**400**	**na**	**23**[d]	**1560**	**100000**	**391**	**391**	**16**[e]	**78.2**	**23500**
Preexcavation Samples													
21-27005	MD21-06-73535	Fill	0.5–1.0	—	—	—	—	—	—	—	—	—	—
21-27005	MD21-06-73536	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—
21-27005	MD21-06-73537	QBT3	3.0–3.0	—	—	—	—	—	—	—	—	—	—
21-27005	RE21-07-6040	QBT3	5.0–5.5	—	—	0.722 (J)	—	0.11 (J)	0.56 (U)	—	9.9	—	—
21-27006	MD21-06-73538	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-601	ALLH	2.0–2.5	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-6042	ALLH	2.0–2.5	770 (J)	—	80 (J)	100 (J)	—	3.8 (J)	26 (J)	3100 (J)	170 (J)	2100 (J)
Postexcavation Samples													
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	2.2	0.53 (U)	—	—	—	—
21-24534	RE21-07-6044	QBT3	3.0–3.5	14.3 (U)	—	—	7 (U)	1.3	0.53 (U)	—	—	—	—
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—
21-600106	RE21-07-6055	Soil	2.0–2.5	—	—	—	—	0.19 (J)	—	—	—	—	—
21-600106	RE21-07-604	QBT3	3.0–3.5	—	—	—	6.71	—	0.849 (J)	—	—	—	—
21-600106	RE21-07-6056	QBT3	3.0–3.5	—	—	—	—	0.22	0.53 (U)	—	—	—	—
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	0.8	0.55 (U)	—	—	—	—
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	—	0.54 (U)	—	—	—	—
21-601265	RE21-07-6047	QBT3	5.0–5.5	—	—	—	11.3 (U)	0.92	0.53 (U)	—	—	—	—
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	0.27	—	—	—	—	—
21-601266	RE21-07-6049	QBT3	5.0–5.5	14.4 (J)	—	—	—	1.3	0.55 (U)	—	4.2 (U)	—	—
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	—	8.1 (U)	—	—	—	—	—	—
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	2310 (J-)	—	—	0.54 (J)	0.32 (J)	—	—	—	—
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	—	—	—	0.24	—	—	—	—	—

Sources: BVs from LANL (1998 059730). SSLs from NMED (2006 092513).

Notes: Units are mg/kg. Data qualifiers are defined in Appendix A.

[a] na = Not available.

[b] SSL from Region 6 EPA (2007, 095866) and is corrected to 10^{-5} cancer risk.

[c] — = If analyzed, sample result is less than BV. If no BV is available, analyte was not detected.

[d] SSL from Region 6 EPA (2007, 095866).

[e] SSL from Region 9 EPA 2004 (http://www.epa.gov/region09/waste/sfund/prg/).

Table 5.2-2
Results of Radionuclides Detected or Detected above BVs/FVs at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Media	Depth (ft bgs)	Americium-241	Cesium-137	Cobalt-60	Plutonium-238	Plutonium-239	Strontium-90	Thorium-228	Tritium	Uranium-234	Uranium-235	Uranium-238
Soil BV/FV[a]				**0.013**	**1.65**	**na[b]**	**0.023**	**0.054**	**1.31**	**2.28**	**na**	**2.59**	**0.2**	**2.29**
QBT3 BV/FV				**na**	**na**	**na**	**na**	**na**	**na**	**2.52**	**na**	**1.98**	**0.09**	**1.93**
SAL Residential				**30**	**5.6**	**1.3**	**37**	**33**	**5.7**	**2.3**	**750**	**170**	**17**	**86**
Preexcavation Samples														
21-27005	MD21-06-73535	Fill	0.5–1.0	17.5[c]	1.41	—[d]	0.729	115	—	—	—	18.6	1.09[c]	10.1
21-27005	MD21-06-73536	Soil	2.0–2.5	6.92[c]	0.438	—	0.328	62.0	—	—	—	16.5	0.998[c]	7.93
21-27005	MD21-06-73537	QBT3	3.0–3.0	4.62[c]	0.504	—	0.596	51.2	—	—	—	9.49	0.523[c]	4.99
21-27005	RE21-07-6040	QBT3	5.0–5.5	2.62[c]	0.141	—	0.480 (J)	37.6 (J)	—	—	—	7.79	0.308[c]	4.72
21-27006	MD21-06-73538	Soil	2.0–2.5	40.8[c]	2.05	—	2.08	322	—	—	—	140	8.67[c]	71.5
21-600105	RE21-07-601	ALLH	2.0–2.5	712 (J)	38.9 (J)	0.090 (J)	28.2 (J+)	3723 (J+)	43.0 (J)	3.32 (J)	—	2332 (J)	121 (J)[c]	1181 (J)
Postexcavation Samples														
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	—	—	NA[e]	—	—	—	—
21-24534	RE21-07-6044	QBT3	3.0–3.5	—	—	—	—	—	—	NA	—	—	—	—
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	—	—	0.928	—	NA	—	—	—	—
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	—	NA	0.131	—	—	—
21-600106	RE21-07-604	QBT3	3.0–3.5	—	—	—	—	0.0908	—	NA	0.033	—	—	—
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	0.097	—	NA	—	—	—	—
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	—	—	NA	—	—	—	—
21-601265	RE21-07-6047	QBT3	5.0–5.5	0.356 (J-)	—	—	—	6.76	1.12	NA	0.700	—	—	—
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	1.08	—	NA	0.680	—	—	—
21-601266	RE21-07-6049	QBT3	5.0–5.5	—	—	—	—	2.91	—	NA	—	—	—	—
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	—	—	0.073 (J)	—	NA	—	—	—	—
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	—	—	—	0.364	—	NA	—	—	—	—
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	0.096	—	0.095	2.99	—	NA	—	—	—	—

Sources: BVs/FVs from LANL (1998 059730). SALs from LANL (2005 088493).

Notes: Units are pCi/g. Data qualifiers are defined in Appendix A.

[a] Applies only to samples from 0 to 0.5 ft bgs.

[b] na = Not available.

[c] Detected above BV by either EPA Method 901.1 or HASL-300. Most conservative (higher or detected) value shown.

[d] — = If analyzed, sample result is below the detection limit or is less than BV. If no BV is available, analyte was not detected.

[e] NA = Not analyzed; see the Summary of Samples Collected table.

Table 5.2-3
Results of Organic Chemicals Detected at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Media	Depth (ft bgs)	Di-n-butylphthalate	Dichlorobenzene[1,3-]	Dichlorobenzene[1,4-]	Bis(2-ethylhexyl)phthalate	Fluoranthene	Heptachlorodibenzodioxin [1,2,3,4,6,7,8-]	Heptachlorodibenzofuran [1,2,3,4,6,7,8-]	Heptachlorodibenzofuran [1,2,3,4,6,7,9-]	Hexachlorodibenzodioxin [1,2,3,4,7,8-]	Hexachlorodibenzodioxin [1,2,3,6,7,8-]
SSL Residential				**6110**	**32.6**	**39.5**	**347**	**2290**	**na**[a]	**na**	**na**	**na**	
Preexcavation Samples													
21-27005	RE21-07-6040	QBT3	5.0–5.5	0.12 (J)	—[b]	—	—	—	—	—	—	—	
21-600105	RE21-07-6042	ALLH	2.0–2.5	6 (J-)	—	—	1.8 (J-)	—	—	—	—	—	
Postexcavation Samples													
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	—	—	—	—	—	
21-24534	RE21-07-6044	QBT3	3.0–3.5	—	—	—	—	—	—	—	—	—	
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	0.00000321	—	—	—	
21-600106	RE21-07-604	QBT3	3.0–3.5	—	—	—	—	—	0.00000579	0.00000106 (J)	0.000000175 (J)	0.000000334 (J)	0.00000149
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	—	—	—	—	—	
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	—	—	—	—	—	
21-601265	RE21-07-6047	QBT3	5.0–5.5	—	0.00016 (J-)	0.00019 (J-)	—	—	—	—	—	—	
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	
21-601266	RE21-07-6049	QBT3	5.0–5.5	—	—	—	—	0.037 (J)	—	—	—	—	
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	

Table 5.2-3 (continued)

Location ID	Sample ID	Media	Depth (ft bgs)	Hexachlorodibenzodioxin [1,2,3,7,8,9-]	Hexachlorodibenzofuran [1,2,3,4,7,8-]	Hexachlorodibenzofuran [1,2,3,6,7,8-]	Hexachlorodibenzofuran [2,3,4,6,7,8-]	Methylene chloride	Octachlorodibenzodioxin [1,2,3,4,6,7,8,9-]	Octachlorodibenzofuran [1,2,3,4,6,7,8,9-]	Pentachlorodibenzodioxin [1,2,3,7,8-]	Pentachlorodibenzofuran [1,2,3,7,8-]	Toluene
SSL Residential				**na**	**na**	**na**	**na**	**182**	**na**	**na**	**na**	**na**	**252**
Preexcavation Samples													
21-27005	RE21-07-6040	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-6042	ALLH	2.0–2.5	—	—	—	—	—	—	—	—	—	—
Postexcavation Samples													
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	0.0029 (J)	—	—	—	—	—
21-24534	RE21-07-6044	QBT3	3.0–3.5	—	—	—	—	0.011	—	—	—	—	—
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	0.0000278	0.00000139 (J)	—	—	—
21-600106	RE21-07-604	QBT3	3.0–3.5	0.00000114 (J)	0.000000338 (J)	0.00000017 (J)	0.000000219 (J)	—	0.0000298	0.00000302 (J)	0.000000327 (J)	0.0000003 (J)	—
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	0.0029 (J)	—	—	—	—	—
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	0.015	—	—	—	—	0.00018 (J)
21-601265	RE21-07-6047	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	0.00017 (J-)
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—
21-601266	RE21-07-6049	QBT3	5.0–5.5	—	—	—	—	0.0044 (J)	—	—	—	—	—
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	—
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	—

Source: SSLs from NMED (2006 092513).

Notes: Units are mg/kg. Data qualifiers are defined in Appendix A.

[a] na = Not available.

[b] — = If analyzed, sample result is below the detection limit.

Table 6.4-1
Comparison of 2006–2007 COPC Analytical Results for Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99, with 2005–2006 Data

COPC	Postexcavation 2006–2007 Range of Concentrations (mg/kg)	Postexcavation 2006–2007 Maximum Detected Concentration 0–10 ft bgs (mg/kg)	2005–2006 Range of Concentrations 0–10 ft bgs[a] (mg/kg)	Postexcavation 2006–2007 Maximum Detected Concentration 0–5 ft bgs (mg/kg)	2005–2006 Range of Concentrations 0–5 ft bgs[b] (mg/kg)
Inorganic Chemicals					
Aluminum	[279]–8670	8670	329–28400	8670	4.8–28400
Antimony	ND[c]	0.15	0.111–[5.30]	ND	ND
Barium	[3.1]–286	286	3.42–364	286	3.04–364
Beryllium	0.19–1.3	1.3	0.249–1.4	0.961	[0.2]–1.55
Cadmium	ND	0.05	[0.05]–0.456	ND	[0.05]–2.5
Chromium	1.6–26	26	0.35–20.6	26	[0.571]–48.1
Cobalt	[0.29]–2.5	2.5	0.221–9.78	2.3	0.2–9.78
Copper	ND	6.94	0.685–13.7	6.94	[0.81]–22.6
Cyanide	0.12–[0.58]	0.12	[0.24]–0.317	0.12	[0.232]–5.28
Lead	ND	10	0.551–23.8	9.07	[1.06]–97.4
Mercury	0.0121–0.0503	0.0503	0.003–1.06	0.0503	0.003–1.06
Nickel	ND	6.71	0.692–19.2	6.71	[0.63]–19.2
Nitrate	0.19–2.2	2.2	0.231–10.6	2.2	0.231–15.5
Selenium	0.19–0.897	0.897	ND	0.897	ND
Silver	0.029–[0.23]	0.15	ND	0.087	[0.07]–24.5
Uranium	ND	0.57	[0]–132	ND	7.52–132
Radionuclides[d]					
Americium-241	[-0.0965]–0.356	0.356	[0.002]–0.046	ND	[0.001]–44.4
Cesium-137	[-0.00764]–0.096	0.096	[0.002]–0.143	ND	[0.001]–2.65
Plutonium-238	[-0.009]–0.095	0.095	[-0.0232]–0.997	ND	[0.001]–0.997
Plutonium-239	[0.0142]–6.76	6.76	[0.001]–0.735	0.097	[0.001]–28.9
Strontium-90	[-0.09]–1.12	1.12	ND	ND	[0.001]–0.53
Tritium	[-0.078]–0.7	0.7	ND	0.131	[0.003]–1.31
Organic Chemicals					
Dichlorobenzene[1,3-]	0.00016–[0.38]	0.00016	ND	ND	ND
Dichlorobenzene[1,4-]	0.00019–[0.38]	0.00019	ND	ND	ND
Fluoranthene	ND	0.037	0.013–[0.36]	ND	[0.016]–0.925
Methylene chloride	0.0029–0.015	0.015	ND	0.015	ND
Toluene	0.00017–[0.0057]	0.00018	ND	0.00018	ND

Table 6.4-1 (continued)

COPC	Postexcavation 2006–2007 Range of Concentrations (mg/kg)	Postexcavation 2006–2007 Maximum Detected Concentration 0–10 ft bgs (mg/kg)	2005–2006 Range of Concentrations 0–10 ft bgs[a] (mg/kg)	Postexcavation 2006–2007 Maximum Detected Concentration 0–5 ft bgs (mg/kg)	2005–2006 Range of Concentrations 0–5 ft bgs[b] (mg/kg)
Dioxins/Furans[e]					
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	3.21E-08–5.79E-08	5.79E-08	1.58E-05[f]	5.79E-08	1.58E-05[f]
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	1.06E-08	1.06E-08	8.16E-07[g]	1.06E-08	8.16E-07[g]
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	1.75E-09	1.75E-09	1.13E-07[g]	1.75E-09	1.13E-07[g]
Hexachlorodibenzodioxin[1,2,3,4,7,8-]	3.34E-08	3.34E-08	4.01E-07[g]	3.34E-08	4.01E-07[g]
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	1.49E-07	1.49E-07	7.18E-07[g]	1.49E-07	7.18E-07[g]
Hexachlorodibenzodioxin[1,2,3,7,8,9-]	1.14E-07	1.14E-07	5.19E-07[g]	1.14E-07	5.19E-07[g]
Hexachlorodibenzofuran[1,2,3,4,7,8-]	3.38E-08	3.38E-08	2.27E-06[g]	3.38E-08	2.27E-06[g]
Hexachlorodibenzofuran[1,2,3,6,7,8-]	1.70E-08	1.70E-08	6.77E-07[g]	1.70E-08	6.77E-07[g]
Hexachlorodibenzofuran[2,3,4,6,7,8-]	2.19E-08	2.19E-08	4.95E-07[g]	2.19E-08	4.95E-07[g]
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	8.34E-09–8.94E-09	8.94E-09	2.99E-06[f]	8.94E-09	2.99E-06[f]
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	4.17E-10–9.06E-10	9.06E-10	1.06E-07[g]	9.06E-10	1.06E-07[g]
Pentachlorodibenzodioxin[1,2,3,7,8-]	3.27E-07	3.27E-07	9.83E-06[g]	3.27E-07	9.83E-06[g]
Pentachlorodibenzofuran[1,2,3,7,8-]	9.00E-09	9.00E-09	3.93E-07[g]	9.00E-09	3.93E-07[g]

Source: 2005–2006 ranges from LANL (2007 099175).

Note: Brackets indicate that analyte was not detected.

[a] SWMUs 21-018(a) and 21-018(b) data (0–10 ft bgs) from LANL (2007 098943).

[b] Combined data (0–5 ft bgs) for entire site from LANL (2007 098943).

[c] ND = Not detected.

[d] Units are pCi/g.

[e] Dioxin/furan data are adjusted for 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalency quotient in Appendix H (Table H.2.0-3).

[f] TA-21 maximum detected concentration [from Consolidated Unit 21-026(a)-99].

[g] TA-21 maximum detected concentration [from SWMU 21-024(c)].

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
AOC	area of concern
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	area use factor
bgs	below ground surface
BV	background value
CD	compact disc
COC	chain-of-custody
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
cpm	counts per minute
CSM	conceptual site model
CVAA	cold vapor atomic absorption
DI	deionized
DOE	Department of Energy (U.S.)
DL	detection limit
DP	Delta Prime
dpm	disintegration per minute
Eh	oxidation/reduction
EP	Environmental Programs
EPA	Environmental Protection Agency (U.S.)
EPC	exposure point concentration
EQL	estimated quantitation limit
ESL	ecological screening level
FV	fallout value
ha	hectare
HI	hazard index
HQ	hazard quotient
HR	home range
IA	information architecture
ID	identification
IDW	investigation-derived waste
K_d	soil-water partition coefficient

K_{oc}	organic carbon-water partition coefficient
K_{ow}	octanol-water partition coefficient
LAL	lower acceptance level
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
LLW	low-level waste
LOAEL	lowest observed adverse effect level
MCL	maximum contaminant level
MDA	material disposal area
mrem	millirem
MS	matrix spike
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NOAEL	no observed adverse effect level
PAUF	population area use factor
PCB	polychlorinated biphenyl
PID	photoionization detector
ppm	part per million
QA	quality assurance
QC	quality control
QP	quality procedure
RAIS	Risk Assessment Information System
RCT	radiological control technician
RfD	reference dose
RPF	Records Processing Facility
SAL	screening action level
SCL	sample collection log
SF	slope factor
SMO	Sample Management Office
SOP	standard operating procedure
SOW	statement of work
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
T&E	threatened and endangered

TA	technical area
TAL	target analyte list
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TD	total depth
TEF	toxicity equivalency factor
TEQ	toxicity equivalency quotient
TPU	total propagated uncertainty
VOC	volatile organic compound
WCSF	waste characterization strategy form
WPF	waste profile form

A-2.0 GLOSSARY

abandonment—The plugging of a well or borehole in a manner that precludes the migration of surface runoff or groundwater along the length of the well or borehole.

absorption—The uptake of water, other fluids, or dissolved chemicals by a cell or organism (e.g., tree roots absorb dissolved nutrients in soil).

action level—(1) A numerical value that has been established by statistical analysis or has been set according to regulatory limits and is used as a criterion for action. Contamination found in a particular medium below an appropriate action level is not generally subject to remediation or further study. (2) A health- and environment-based concentration derived using chemical-specific toxicity information and standardized exposure assumptions. An action level can be developed on a facility-specific basis or can be taken from standardized lists.

administrative authority—For Los Alamos National Laboratory, one or more regulatory agencies, such as the New Mexico Environment Department, the U.S. Environmental Protection Agency, or the U.S. Department of Energy, as appropriate.

alluvial—Pertaining to geologic deposits or features formed by running water.

alpha radiation—A form of particle radiation that is highly ionizing and has low penetration. Alpha radiation consists of two protons and two neutrons bound together into a particle that is identical to a helium nucleus and can be written as He^{2+}.

analysis—A critical evaluation, usually made by breaking a subject (either material or intellectual) down into its constituent parts, then describing the parts and their relationship to the whole. Analyses may include physical analysis, chemical analysis, toxicological analysis, and knowledge-of-process determinations.

analyte—The element, nuclide, or ion a chemical analysis seeks to identify and/or quantify; the chemical constituent of interest.

analytical method—A procedure or technique for systematically performing an activity.

area of concern (AOC)—(1) A release that may warrant investigation or remediation and is not a solid waste management unit (SWMU). (2) An area at Los Alamos National Laboratory that may have had a release of a hazardous waste or a hazardous constituent but is not a SWMU.

artificial fill—A material that has been imported and typically consists of disturbed *soils* mixed with crushed Bandelier Tuff or other rock types.

ash-flow tuff—A tuff deposited by a hot, dense volcanic current. Ash-flow tuff can be either welded tuff or nonwelded tuff.

assessment—(1) The act of reviewing, inspecting, testing, checking, conducting surveillance, auditing, or otherwise determining and documenting whether items, processes, or services meet specified requirements. (2) An evaluation process used to measure the performance or effectiveness of a system and its elements. In this glossary, assessment is an all-inclusive term used to denote any one of the following: audit, performance evaluation, management system review, peer review, inspection, or surveillance.

assessment endpoint—In an ecological risk assessment, the expression of an environmental value to be protected (e.g., fish biomass or reproduction of avian populations).

background concentration—Naturally occurring concentrations of an inorganic chemical or radionuclide in soil, sediment, or tuff.

background data—Data that represent naturally occurring concentrations of inorganic and radionuclide constituents in a geologic medium. Los Alamos National Laboratory's (the Laboratory's) background data are derived from samples collected at locations that are either within, or adjacent to, the Laboratory. These locations (1) are representative of geological media found within Laboratory boundaries, and (2) have not been affected by Laboratory operations.

background level—(1) The concentration of a substance in an environmental medium (air, water, or soil) that occurs naturally or is not the result of human activities. (2) In exposure assessment, the concentration of a substance in a defined control area over a fixed period of time before, during, or after a data-gathering operation.

background radiation—The amount of radioactivity naturally present in the environment, including cosmic rays from space and natural radiation from soils and rock.

background sample—A sample collected from an area or site that is similar to the one being studied but known, or thought, to be free from constituents of concern.

background value (BV)—A statistically derived concentration (i.e., the upper tolerance limit [UTL]) of a chemical used to represent the background data set. If a UTL cannot be derived, either the detection limit or maximum reported value in the background data set is used.

barrier—Any material or structure that prevents, or substantially delays, the movement of solid-, liquid-, or gaseous-phase chemicals in environmental media.

baseline risk assessment—A site-specific analysis of the potential adverse effects of hazardous constituents that have been released from a site in the absence of any controls or mitigating actions. A baseline risk assessment consists of the following four steps: data collection and analysis, exposure assessment, toxicity assessment, and risk characterization.

bentonite—An absorbent aluminum silicate clay formed from volcanic ash and used in various adhesives, cements, and ceramic fillers. Because bentonite can absorb large quantities of water and expand to several times its normal volume, it is a common drilling mud additive.

best management practices—Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.

beta radiation—High-energy electrons emitted by certain types of radioactive nuclei, such as potassium-40. The beta particles emitted are a form of ionizing radiation also known as beta rays.

bias—The systematic deviation from a true value that remains constant over replicated measurements within the statistical precision of the measurement process.

blank—A sample that is expected to have a negligible or unmeasurable amount of an analyte. Results of blank sample analyses indicate whether field samples might have been contaminated during the sample collection, transport, storage, preparation, or analysis processes.

borehole—(1) A hole drilled or bored into the ground, usually for exploratory or economic purposes. (2) A hole into which casing, screen, and other materials may be installed to construct a well.

borehole logging—The process of making remote measurements of physical, chemical, or other parameters at multiple depths in a borehole.

calibration—A process used to identify the relationship between the true analyte concentration or other variable and the response of a measurement instrument, chemical analysis method, or other measurement system.

calibration blank—A calibration standard prepared to contain negligible or unmeasurable amounts of analytes. A calibration blank is used to establish the zero concentration point for analytical measurement calibrations.

calibration standard—A sample prepared to contain known amounts of analytes of interest and other constituents required for an analysis.

caliche (properly called pedogenic calcite, also known as calcrete)—A layer of hard subsoil encrusted with calcium carbonate that occurs in arid or semiarid regions or precipitates out of groundwater (groundwater caliche). Typically found in near-surface soil.

canyon—A stream-cut chasm or gorge, the sides of which are composed of cliffs or a series of cliffs rising from the chasm's bed. Canyons are characteristic of arid or semiarid regions where downcutting by streams greatly exceeds weathering.

chain of custody (COC)—An unbroken, documented trail of accountability that is designed to ensure the uncompromised physical integrity of samples, data, and records.

chemical—Any naturally occurring or human-made substance characterized by a definite molecular composition.

chemical analysis—A process used to measure one or more attributes of a sample in a clearly defined, controlled, and systematic manner. Chemical analysis often requires treating a sample chemically or physically before measurement.

chemical of potential concern (COPC)—A detected chemical compound or element that has the potential to adversely affect human receptors as a result of its concentration, distribution, and toxicity.

chemical of potential ecological concern (COPEC)—A detected chemical compound or element that has the potential to adversely affect ecological receptors as a result of its concentration, distribution, and toxicity.

cleanup—A series of actions taken to deal with the release, or threat of a release, of a hazardous substance that could affect humans and/or the environment. The term cleanup is sometimes used interchangeably with the terms remedial action, removal action, or corrective action.

cleanup levels—Media-specific contaminant concentration levels that must be met by a selected corrective action. Cleanup levels are established by using criteria such as the protection of human health and the environment; compliance with regulatory requirements; reduction of toxicity, mobility, or volume through treatment; long- and short-term effectiveness; implementability; and cost.

Code of Federal Regulations (CFR)—A document that codifies all rules of the executive departments and agencies of the federal government. The code is divided into 50 volumes, known as titles. Title 40 of the CFR (referenced as 40 CFR) covers environmental regulations.

Compliance Order on Consent (Consent Order)—For the Environmental Remediation and Surveillance Program, an enforcement document signed by the New Mexico Environment Department, the U.S. Department of Energy, and the Regents of the University of California on March 1, 2005, which prescribes the requirements for corrective action at Los Alamos National Laboratory. The purposes of the Consent Order are (1) to define the nature and extent of releases of contaminants at, or from, the facility; (2) to identify and evaluate, where needed, alternatives for corrective measures to clean up contaminants in the environment and prevent or mitigate the migration of contaminants at, or from, the facility; and (3) to implement such corrective measures. The Consent Order supersedes the corrective action requirements previously specified in Module VIII of the Laboratory's Hazardous Waste Facility Permit.

Consent Order—See Compliance Order on Consent.

consolidated unit—A group of solid waste management units (SWMUs), or SWMUs and areas of concern, which generally are geographically proximate and have been combined for the purposes of investigation, reporting, or remediation.

contaminant—(1) Chemicals and radionuclides present in environmental media or on debris above background levels. (2) According to the March 1, 2005, Compliance Order on Consent (Consent Order), any hazardous waste listed or identified as characteristic in 40 Code of Federal Regulations (CFR) 261 (incorporated by 20.4.1.200 New Mexico Administrative Code [NMAC]); any hazardous constituent listed in 40 CFR 261 Appendix VIII (incorporated by 20.4.1.200 NMAC) or 40 CFR 264 Appendix IX (incorporated by 20.4.1.500 NMAC); any groundwater contaminant listed in the Water Quality Control Commission (WQCC) Regulations at 20.6.3.3103 NMAC; any toxic pollutant listed in the WQCC Regulations at 20.6.2.7 NMAC; explosive compounds; nitrate; and perchlorate. (Note: Under the Consent Order, the term "contaminant" does not include radionuclides or the radioactive portion of mixed waste.)

contract analytical laboratory—An analytical laboratory under contract to the University of California to analyze samples from work performed at Los Alamos National Laboratory.

corrective action—(1) In the Resource Conservation and Recovery Act, an action taken to rectify conditions potentially adverse to human health or the environment. (2) In the quality assurance field, the process of rectifying and preventing nonconformances.

daily calibration—The combination of a calibration blank and calibration standard used to determine if the instrument response to an analyte concentration is within acceptable bounds relative to the initial calibration. A daily calibration establishes the instrument response factors on which quantitations are based, thus verifying the satisfactory performance of an instrument on a day-to-day basis.

data package—The hard copy deliverable for each sample delivery group produced by a contract analytical laboratory in accordance with the statement of work for analytical services.

data-quality assessment—The statistical and/or scientific evaluation of a data set that establishes whether the data set is adequate for its intended use.

data-quality objectives—Qualitative and quantitative statements of the overall level of uncertainty that a decision maker will accept regarding results or decisions based on environmental data. The objectives provide the statistical framework for planning and managing environmental data operations that will meet user needs.

data validation—A systematic process that applies a defined set of performance-based criteria to a body of data and that may result in the qualification of the data. The data-validation process is performed independently of the analytical laboratory that generates the data set and occurs before conclusions are drawn from the data. The process may include a standardized data review (routine data validation) and/or a problem-specific data review (focused data validation).

decommissioning—The permanent removal of facilities and their components from service after the discontinued use of structures or buildings that are deemed no longer useful. Decommissioning must take place in accordance with regulatory requirements and applicable environmental policies.

decontamination—The removal of unwanted material from the surface of, or from within, another material.

detect (detection)—An analytical result, as reported by an analytical laboratory, that denotes a chemical or radionuclide to be present in a sample at a given concentration.

detection limit (DL)—The minimum concentration that can be determined by a single measurement of an instrument. A detection limit implies a specified statistical confidence that the analytical concentration is greater than zero.

discharge—The accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying, or dumping of hazardous waste into, or on, any land or water.

disposal—The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into, or on, any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters.

dose (dosage)—(1) The actual quantity of a chemical that is administered to an organism or to which it is exposed. (2) The amount of a substance that reaches a specific tissue (e.g., the liver). (3) The amount of a substance that is available for interaction with metabolic processes after it has crossed an organism's outer boundary.

dose equivalent—The product of the absorbed dose from ionizing radiation and factors that account for biological differences as a result of the radiation type and its distribution in the body.

drill bit—The cutting tool attached to the bottom of a drill stem.

drill rod (drill pipe)—Special pipe used to transmit rotation and energy from the drill rig to the bit. This conduit conveys circulation fluids such as air, water, or other mixtures to cool the bit and evacuate the borehole cuttings.

duplicate analysis—An analysis performed on one member of a pair of identically prepared subsamples taken from the same sample.

ecological screening levels—Soil, sediment, or water concentrations that are used to screen for potential ecological effects. The concentrations are based on a chemical's no-observed-adverse-effect level for a receptor, below which no risk is indicated.

Environmental Restoration (ER) Project—A Los Alamos National Laboratory project established in 1989 as part of a U.S. Department of Energy nationwide program, and precursor of today's Environmental Remediation and Surveillance (ERS) Program. This program is designed (1) to investigate hazardous and/or radioactive materials that may be present in the environment as a result of past Laboratory operations, (2) to determine if the materials currently pose an unacceptable risk to human health or the environment, and (3) to remediate (clean up, stabilize, or restore) those sites where unacceptable risk is still present.

environmental samples—Air, soil, water, or other media samples that have been collected from streams, wells, and soils, or other locations, and that are not expected to exhibit properties classified as hazardous by the U.S. Department of Transportation.

equipment blank (rinsate blank)—A sample used to rinse sample-collection equipment and expected to have negligible or unmeasurable amounts of analytes. The equipment blank is collected after the equipment decontamination is completed but before the collection of another field sample.

ER data—Data derived from samples that have been collected and paid for through Environmental Remediation and Surveillance Program funding.

ER database (ERDB)—A database housing analytical and other programmatic information for the Environmental Remediation and Surveillance Program. The ERDB currently contains about 3 million analyses in 300 tables.

ER identification (ER ID) number—A unique identifier assigned by the Environmental Remediation and Surveillance Program‘s Records Processing Facility to each document when it is submitted as a final record.

exposure pathway—Any path from the sources of contaminants to humans and other species or settings through air, soil, water, or food.

facility—All contiguous land (and structures, other appurtenances, and improvements on the land) used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units. For the purpose of implementing a corrective action, a facility is all the contiguous property that is under the control of the owner or operator seeking a permit under Subtitle C of the Resource Conservation and Recovery Act.

fault—A fracture, or zone of fractures, in rock along which vertical or horizontal movement has taken place and adjacent rock layers or bodies have been displaced.

Federal Register (FR)—The official daily publication for Rules, Proposed Rules, and Notices from federal agencies and organizations, as well as Executive Orders and other presidential documents.

field blank (field reagent blank)—A blank sample prepared in the field or carried to the sampling site, exposed to sampling conditions (e.g., by removing bottle caps), and returned to a laboratory to be analyzed in the same manner in which environmental samples are being analyzed. Field blanks are used to identify the presence of any contamination that may have been added during the sampling and analysis process.

field duplicate (replicate) samples—Two separate, independent samples taken from the same source, which are collected as collocated samples (i.e., equally representative of a sample matrix at a given location and time).

field matrix spike—A known amount of a field sample to which a known amount of a target analyte has been added and used to compute the proportion of the added analyte that is recovered upon analysis.

field notebook—A record of activities performed in the field or a compilation of field data.

field reagent blank—See field blank.

field sample—See sample.

focused data validation—A technically based analyte-, sample-, and data-use-specific process that extends the qualification of data beyond the method or contractual compliance and provides a higher level of confidence that an analyte is present or absent. If an analyte is present, the quality of the quantitation may be obtained through focused validation.

gamma radiation—A form of electromagnetic, high-energy ionizing radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays (though at higher energy) and require heavy shielding, such as concrete or steel, to be blocked.

grab sample—A specimen collected by a single application of a field sampling procedure to a target population (e.g., the surface soil from a single hole collected after the spade-and-scoop sampling procedure, or a single air filter left in the field for three months).

gravimetric moisture content—See water content.

ground cover—Natural or human-made materials (e.g., grasses, pine needles, asphalt, or concrete) which overlay soils.

groundwater—Interstitial water that occurs in saturated earth material and is capable of entering a well in sufficient amounts to be used as a water supply.

grout—Cement or bentonite mixtures used for sealing boreholes and wells and for zone isolation. Only Portland Type I or II cement is approved for use at investigative sites.

half-life—(1) The time required for a pollutant to lose one-half of its original concentration (for example, the biochemical half-life of DDT [dichlorodiphenyltrichloroethane] in the environment is 15 yr). (2) The time required for one half of the atoms in a radioactive element to undergo self-transmutation or decay (the half-life of radium is 1620 yr). (3) The time required for the elimination of one half of a total dose from the body.

hazard index (HI)—The sum of hazard quotients for multiple contaminants to which a receptor may have been exposed.

Hazardous and Solid Waste Amendments (HSWA)—Public Law No. 98-616, 98 Stat. 3221, enacted in 1984, which amended the Resource Conservation and Recovery Act of 1976 (42 United States Code § 6901 et seq).

hazardous constituent (hazardous waste constituent)—According to the March 1, 2005, Compliance Order of Consent (Consent Order), any constituent identified in Appendix VIII of Part 261, Title 40 Code of Federal Regulations (CFR) (incorporated by 20.4.1.200 New Mexico Administrative Code [NMAC]) or any constituent identified in 40 CFR 264, Appendix IX (incorporated by 20.4.1.500 NMAC).

hazardous waste—(1) Solid waste that is listed as a hazardous waste, or exhibits any of the characteristics of hazardous waste (i.e., ignitability, corrosivity, reactivity, or toxicity, as provided in 40 CFR, Subpart C). (2) According to the March 1, 2005, Compliance Order of Consent (Consent Order), any solid waste or combination of solid wastes that, because of its quantity, concentration, or physical, chemical, or infectious characteristics, meets the description set forth in New Mexico Statutes Annotated 1978, § 74-4-3(K) and is listed as a hazardous waste or exhibits a hazardous waste characteristic under 40 CFR 261 (incorporated by 20.4.1.200 New Mexico Administrative Code).

Hazardous Waste Bureau—The New Mexico Environment Department bureau charged with providing regulatory oversight and technical guidance to New Mexico hazardous waste generators and to treatment, storage, and disposal facilities, as required by the New Mexico Hazardous Waste Act.

Hazardous Waste Facility Permit—The authorization issued to Los Alamos National Laboratory (the Laboratory) by the New Mexico Environment Department that allows the Laboratory to operate as a hazardous waste treatment, storage, and disposal facility.

hazard quotient (HQ)—The ratio of the estimated site-specific exposure concentration of a single chemical from a site to the estimated daily exposure level at which no adverse health effects are likely to occur.

holding time—The maximum elapsed time a sample can be stored without unacceptable changes in analyte concentrations. Holding times apply under prescribed conditions, and deviations from these conditions may affect the holding times. Extraction holding time refers to the time lapsed between sample collection and sample preparation. Analytical holding time refers to the time lapsed between sample preparation and analysis.

HSWA module—See Module VIII.

hydrogen-ion activity (pH)—The effective concentration (activity) of dissociated hydrogen ions (H+); a measure of the acidity or alkalinity of a solution that is numerically equal to 7 for neutral solutions, increases with alkalinity, and decreases as acidity increases.

initial calibration—The process used to establish the relationship between instrument response and analyte concentration at several analyte concentration values in order to demonstrate that an instrument is capable of acceptable analytical performance.

institutional controls—Controls that prohibit or limit access to contaminated media. Institutional controls may include use restrictions, permitting requirements, standard operating procedures, laboratory implementation requirements, laboratory implementation guidance, and laboratory performance requirements.

instrument detection limit (IDL)—A measure of instrument sensitivity without any consideration for contributions to the signal from reagents. The IDL is calculated as follows: Three times the average of the standard deviations obtained on three nonconsecutive days from the analysis of a standard solution, with seven consecutive measurements of that solution per day. The standard solution must be prepared at a concentration of three to five times the instrument manufacturer’s estimated IDL.

internal standards—Compounds added to a sample after the sample has been prepared for qualitative and quantitative instrument analysis. The compounds serve as a standard of retention time and response that is invariant from run to run.

investigation-derived waste (IDW)—Solid waste or hazardous waste that was generated as a result of corrective action investigation or remediation field activities. Investigation-derived waste may include drilling muds, cuttings, and purge water from the installation of test pits or wells; purge water, soil, and other materials from the collection of samples; residues from the testing of treatment technologies and pump-and-treat systems; contaminated personal protective equipment; and solutions (aqueous or otherwise) used to decontaminate nondisposable protective clothing and equipment.

laboratory control sample (LCS)—A known matrix that has been spiked with compound(s) representative of target analytes. LCSs are used to document laboratory performance, and the acceptance criteria for LCSs are method-specific.

LANL (Los Alamos National Laboratory) data validation qualifiers—The Los Alamos National Laboratory data qualifiers which are defined by, and used, in the Environmental Remediation and Surveillance (ERS) Program validation process. The qualifiers describe the general usability (or quality) of data. For a complete list of data qualifiers applicable to any particular analytical suite, consult the appropriate ERS standard operating procedure.

LANL (Los Alamos National Laboratory) data validation reason codes—The Los Alamos National Laboratory designations applied to sample data by data validators who are independent of the contract laboratory that performed a given sample analysis. Reason codes provide an analysis-specific explanation for applying a qualifier, with some description of the qualifier's potential impact on data use. For a complete list of data qualifiers applicable to any particular analytical suite, consult the appropriate Environmental Remediation and Surveillance Program standard operating procedure.

logbook—A notebook used to record tabulated data (e.g., the history of calibrations, sample tracking, numerical data, or other technical data).

lower acceptance limit (LAL)—The lowest limit that is acceptable according to quality control (QC) criteria for a specific QC sample and for a specific method. Any results lower than the LAL are qualified following the routine validation procedure.

material disposal area (MDA)—A subset of the solid waste management units at Los Alamos National Laboratory (the Laboratory) that include disposal units such as trenches, pits, and shafts. Historically, various disposal areas (but not all) were designated by the Laboratory as MDAs.

matrix—Relatively fine material in which coarser fragments or crystals are embedded; also called "ground mass" in the case of igneous rocks.

matrix spike (MS)—An aliquot of a sample to which a known concentration of target analyte has been added. Matrix spike samples are used to measure the ability to recover prescribed analytes from a native sample matrix. The spiking typically occurs before sample preparation and analysis.

matrix spike duplicate—An intralaboratory duplicate sample to which a known amount of target analyte has been added. Spiking typically occurs before sample preparation and analysis.

measuring and test equipment—Devices or systems used to calibrate, measure, gauge, test, or inspect entities to control or acquire data and verify conformance to specified requirements.

medium (environmental)—Any material capable of absorbing or transporting constituents. Examples of media include tuffs, soils and sediments derived from these tuffs, surface water, soil water, groundwater, air, structural surfaces, and debris.

medium (geological)—The solid part of the hydrogeological system; may be unsaturated or saturated.

method blank—An analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing, and which is prepared and analyzed in the same manner as the corresponding environmental samples. The method blank is used to assess the potential for sample contamination during preparation and analysis.

method detection limit (MDL)—The minimum concentration of a substance that can be measured and reported with a known statistical confidence that the analyte concentration is greater than zero. After subjecting samples to the usual preparation, the MDL is determined by analyzing those samples of a given matrix type that contain the analyte. The MDL is used to establish detection status.

migration—The movement of inorganic and organic chemical species through unsaturated or saturated materials.

migration pathway—A route (e.g., a stream or subsurface flow path) for the potential movement of contaminants to environmental receptors (plants, humans, or other animals).

minimum detectable activity—For the analysis of radionuclides, the lowest detectable radioactivity for a given analytical technique. The following equation is used to calculate the MDA unless otherwise noted or approved by Los Alamos National Laboratory. (Note: "MDA" here should not to be confused with material disposal area):

$$\mathrm{MDA} = \frac{4.65(\mathrm{BKG})^{0.5} + 2.71}{2.22 \times \mathrm{EFF} \times \mathrm{V} \times \mathrm{T_s} \times \mathrm{Y}} \quad ,$$

where BKG = the total background counts,
EFF = the fraction detector efficiency,
V = the volume or unit weight,
T_s = the sample count duration, and
Y = the fractional chemical recovery obtained from the tracer recovery.

Depending on the type of analysis, other terms may also be required in the denominator (e.g., gamma abundance).

mixed waste—Waste containing both hazardous and source, special nuclear, or byproduct materials subject to the Atomic Energy Act of 1954.

model—A schematic description of a physical, biological, or social system, theory, or phenomenon that accounts for its known or inferred properties and may be used for the further study of its characteristics.

Module VIII—Module VIII of the Los Alamos National Laboratory (the Laboratory) Hazardous Waste Facility Permit. This permit allows the Laboratory to operate as a hazardous-waste treatment, storage, and disposal facility. From 1990 to 2005, Module VIII included requirements from the Hazardous and Solid Waste Amendments. These requirements have been superceded by the March 1, 2005, Compliance Order on Consent (Consent Order).

nondetect—A result that is less than the method detection limit.

notices of approval, of approval with modification, or of disapproval—Notices issued by the New Mexico Environment Department (NMED). Upon receipt of a work plan, schedule, report, or other deliverable document, NMED reviews the document and approves the document as submitted, modifies the document and approves it as modified, or disapproves the document. A notice of approval means that the document is approved as submitted. A notice of approval with modifications means that the document is approved but with modifications specified by NMED. A notice of disapproval means that the document is disapproved and it states the deficiencies and other reasons for disapproval.

operable units (OUs)—At Los Alamos National Laboratory, 24 areas originally established for administering the Environmental Remediation and Surveillance Program. Set up as groups of potential release sites, the OUs were aggregated according to geographic proximity for the purposes of planning and conducting Resource Conservation and Recovery Act (RCRA) facility assessments and RCRA facility investigations. As the project matured, it became apparent that there were too many areas to allow efficient communication and to ensure consistency in approach. In 1994, the 24 OUs were reduced to 6 administrative field units.

outfall—A place where effluent is discharged into receiving waters.

percent recovery (%R)—The amount of material detected in a sample (less any amount already in the sample) divided by the amount added to the sample, expressed as a percentage.

perched water—A zone of unpressurized water held above the water table by impermeable rock or sediment.

polychlorinated biphenyls (PCBs)—Any chemical substance limited to the biphenyl molecule that has been chlorinated to varying degrees, or any combination that contains such substances. PCBs are colorless, odorless compounds that are chemically, electrically, and thermally stable and have proven to be toxic to both humans and other animals.

porosity—The degree to which soil, gravel, sediment, or rock is permeated with pores or cavities through which water or air can move.

precision—The degree of mutual agreement among a series of individual measurements, values, or results.

quality assurance/quality control (QA/QC)—A system of procedures, checks, audits, and corrective actions set up to ensure that all U.S. Environmental Protection Agency research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

quality-control sample—A specimen that, upon analysis, is intended to provide information that is useful for adjusting, controlling, or verifying the continuing acceptability of sampling and/or analysis activities in progress.

radiation—A stream of particles or electromagnetic waves emitted by atoms and molecules of a radioactive substance as a result of nuclear decay. The particles or waves emitted can consist of neutrons, positrons, alpha particles, beta particles, or gamma radiation.

radioactive material—For purposes of complying with U.S. Department of Transportation regulations, any material having a specific activity (activity per unit mass of the material) greater than 2 nanocuries per gram (nCi/g) and in which the radioactivity is evenly distributed.

radioactive waste—Waste that, by either monitoring and analysis, or acceptable knowledge, or both, has been determined to contain added (or concentrated and naturally occurring) radioactive material or activation products, or that does not meet radiological release criteria.

radioactivity (radioactive decay; radioactive disintegration)—The spontaneous change in an atom by the emission of charged particles and/or gamma rays.

radionuclide—Radioactive particle (human-made or natural) with a distinct atomic weight number.

RCRA facility investigation (RFI)—A Resource Conservation and Recovery Act (RCRA) investigation that determines if a release has occurred and characterizes the nature and extent of contamination at a hazardous waste facility. The RFI is generally equivalent to the remedial investigation portion of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

reference set—A hard-copy compilation of reference items cited in Environmental Remediation and Surveillance Program documents.

regional aquifer—Geologic material(s) or unit(s) of regional extent whose saturated portion yields significant quantities of water to wells, contains the regional zone of saturation, and is characterized by the regional water table or potentiometric surface.

request number—An identifying number assigned by the Environmental Remediation and Surveillance Program to a group of samples submitted for analysis.

residential scenario—The land use condition under which individuals may be exposed to contaminants as a result of living on or near contaminated sites.

Resource Conservation and Recovery Act (RCRA)—The Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976 (Public Law [PL] 94-580, as amended by PL 95-609 and PL 96-482, United States Code 6901 et seq.).

rinsate blank—See equipment blank.

risk—A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.

risk assessment—See baseline risk assessment.

routine data validation—The process of reviewing analytical data relative to quantitative routine acceptance criteria. The objective of routine data validation is two-fold—

- to estimate the technical quality of the data relative to minimum national standards adopted by the Environmental Remediation and Surveillance Program, and
- to indicate to data users the technical data quality at a gross level by assigning laboratory qualifiers to environmental data whose quality indicators do not meet acceptance criteria.

runoff—The portion of the precipitation on a drainage area that is discharged from the area.

run-on—Surface water that flows onto an area as a result of runoff occurring higher up on a slope.

sample—A portion of a material (e.g., rock, soil, water, or air), which, alone or in combination with other portions, is expected to be representative of the material or area from which it is taken. Samples are typically either sent to a laboratory for analysis or inspection or are analyzed in the field. When referring to samples of environmental media, the term field sample may be used.

sample matrix—In chemical analysis, that portion of a sample that is exclusive of the analytes of interest. Together, the matrix and the analytes of interest form the sample.

screening action level (SAL)—A radionuclide's medium-specific concentration level; it is calculated by using conservative criteria below which it is generally assumed that no potential exists for a dose that is unacceptable to human health. The derivation of a SAL is based on conservative exposure and on land-use assumptions. However, if an applicable regulatory standard exists that is less than the value derived, it is used in place of the SAL.

screening risk assessment—A risk assessment that is performed with few data and many assumptions in order to identify exposures that should be evaluated more carefully for potential risk.

site characterization—Defining the pathways and methods of migration of hazardous waste or constituents, including the media affected; the extent, direction and speed of the contaminants; complicating factors influencing movement; or concentration profiles.

soil—(1) A material that overlies bedrock and has been subject to soil-forming processes. (2) A sample media group that includes naturally occurring and artificial fill materials.

soil moisture—The water contained in the pore space of the unsaturated zone.

soil screening level (SSL)—The concentration of a chemical (inorganic or organic) below which no potential for unacceptable risk to human health exists. The derivation of an SSL is based on conservative exposure and land-use assumptions, and on target levels of either a hazard quotient of 1.0 for a noncarcinogenic chemical or a cancer risk of 10^{-5} for a carcinogenic chemical.

solid waste management unit (SWMU)—(1) Any discernible site at which solid wastes have been placed at any time, whether or not the site use was intended to be the management of solid or hazardous waste. SWMUs include any site at a facility at which solid wastes have been routinely and systematically released. This definition includes regulated sites (i.e., landfills, surface impoundments, waste piles, and land treatment sites), but does not include passive leakage or one-time spills from production areas and sites in which wastes have not been managed (e.g., product storage areas). (2) According to the March 1, 2005, Compliance Order on Consent (Consent Order), any discernible site at which solid waste has been placed at any time, and from which the New Mexico Environment Department determines there may be a risk of a release of hazardous waste or hazardous waste constituents (hazardous constituents), whether or not the site use was intended to be the management of solid or hazardous waste. Such sites include any area in Los Alamos National Laboratory at which solid wastes have been routinely and systematically released; they do not include one-time spills.

split sample—A sample that has been divided into two or more portions that are expected to be of the same composition; used to characterize within-sample heterogeneity, sample handling, and measurement variability.

split-spoon sampler—A hollow, tubular sampling device below a drill stem that is driven by a weight to retrieve soil samples. The core barrel can be opened to remove samples. This is a sampling method commonly used with auger drilling. The split-spoon sampler can be driven into the ground or can be advanced inside hollow-stem augers.

standard operating procedure (SOP)—A document that details the officially approved method(s) for an operation, analysis, or action, with thoroughly prescribed techniques and steps.

surface sample—A sample taken at a collection depth that is (or was) representative of the medium’s surface during the period of investigative interest. A typical depth interval for a surface sample is 0 to 6 in. for mesa-top locations, but may be up to several feet in sediment-deposition areas within canyons.

target analyte—A chemical or parameter, the concentration, mass, or magnitude of which is designed to be quantified by a particular test method.

technical area (TA)—At Los Alamos National Laboratory, an administrative unit of operational organization (e.g., TA-21).

topography—The physical or natural features of an object or entity and their structural relationships.

trip blank—A sample of analyte-free medium taken from a sampling site and returned to an analytical laboratory unopened, along with samples taken in the field; used to monitor cross contamination of samples during handling and storage both in the field and in the analytical laboratory.

tuff—Consolidated volcanic ash, composed largely of fragments produced by volcanic eruptions.

U.S. Department of Energy (DOE)—The federal agency that sponsors energy research and regulates nuclear materials for weapons production.

U.S. Environmental Protection Agency (EPA)—The federal agency responsible for enforcing environmental laws. Although state regulatory agencies may be authorized to administer some of this responsibility, EPA retains oversight authority to ensure the protection of human health and the environment.

vadose zone—The zone between the land surface and the water table within which the moisture content is less than saturation (except in the capillary fringe) and pressure is less than atmospheric. Soil pore space also typically contains air or other gases. The capillary fringe is included in the vadose zone.

water content—The amount of water in an unsaturated medium, expressed as the ratio of the weight of water in a sample to the weight of the oven-dried sample (often expressed as a percentage).

welded tuff—A volcanic deposit hardened by the action of heat, pressures from overlying material, and hot gases.

work plan—A document that specifies the activities to be performed when implementing an investigation or remedy. At a minimum, the work plan should identify the scope of the work to be performed, specify the procedures to be used to perform the work, and present a schedule for performing the work. The work plan may also present the technical basis for performing the work.

A-3.0 METRIC TO ENGLISH CONVERSIONS

Multiply SI (Metric) Unit	by	To Obtain U.S. 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-4.0 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

Data Review

B-1.0 INTRODUCTION

This appendix summarizes the investigation and confirmation data collected during the remediation of the area of elevated radioactivity at Consolidated Unit 21-018(a)-99 (also referred to as Material Disposal Area [MDA] V). All data were shipped through the Sample Management Office (SMO) to off-site contract laboratories and are identified by the vintage code "SMO." The tables presented in this appendix include fully validated and verified data collected in 2006–2007 from the area of elevated radioactivity.

Following completion of the MDA V final site grading, a radiological walkover survey was performed at the site in September 2006. As a result of this survey, a shallow area of elevated radioactivity (less than 5 ft deep and an area of approximately 6 × 12 ft in) was identified. In May 2007, this target area was excavated, and a layer of material was encountered that was operationally related to the laundry facility and extended beyond the 6 × 12 ft area, based on field observations. Potholes were excavated with a backhoe to visually determine the lateral extent of this layer. Radiological field screening was performed on the sidewalls of each pothole to determine the extent of the area. Based on radiological field-screening and analytical laboratory results, the full extent of the area of elevated radioactivity was estimated at approximately 50 ft long × 30 ft wide (Figure B-1.1-1).

Americium-241, cesium-137, plutonium-238, plutonium-239, uranium-234, uranium-235, and uranium-238 were detected above background values (BVs) in all four samples collected in May 2007. Plutonium-239 was detected at concentrations ranging from 51.2 to 322 pCi/g. Americium-241 was detected at concentrations ranging from 6.9 to 29.5 pCi/g. The highest field radiological screening values were detected (direct reading of 220–1000 disintegrations per minute [dpm] alpha-emitting radionuclides and 10,000–30,000 dpm beta/gamma-emitting radionuclides) in a thin 1–2-in. layer of material. This material appeared to be fibrous, with a matrix of silty to coarse, sand-sized particles and fine wood chips less than ¼ in. long. The material varied from dark brown to black and grayish-green. A sample was collected from the highest radiological field-screening location within the layer and was analyzed for radiological constituents. Radiological field screening above and below the layer indicated radionuclides may have migrated vertically to a depth of 4–5 ft below ground surface (bgs). Additional removal activities were conducted in August and November 2007, the results of which are provided in this supplemental investigation report.

B-1.1 Overview of Analytical Data

Table B-1.1-1 summarizes the samples collected and the requested analyses for each sample. Figures B-1.1-1 and B-1.1-2 show the locations of samples collected in the area of elevated radioactivity before and after excavation, respectively. The remainder of this appendix focuses on the postexcavation analytical data because the nonexcavated samples are representative of current site conditions. Only data associated with these samples are used for determining chemicals of potential concern (COPCs), determining the nature and extent of contamination, and making recommendations regarding site cleanup status. The data provided in this appendix are from samples collected in 2006 and 2007 and include analytical data results from both soil and tuff (unit Qbt 3) samples.

One sample was collected from location 21-600105 on August 22, 2007, and inspected for asbestos to determine if there was any potential health risk from asbestos to the field team. The results of this inspection are provided on a compact disc included with this report; no asbestos was detected in the sample taken from this location. This sample is not summarized in the data tables or figures because it was not validated per SMO procedures (see section B-1.0).

B-1.2 Identification of COPCs

The purpose of the data review is to identify COPCs for the area of elevated radioactivity at Consolidated Unit 21-018(a)-99. Inorganic chemical and radionuclide data were compared with media-specific background data (LANL 1998, 059730). For background comparisons, the first step compares the site data with a BV. A BV may be a calculated value for the background data set (the upper tolerance limit [95, 95] or the 95% upper confidence bound on the 95th quantile), a detection limit (DL), a fallout value (FV), or it may be calculated based on secular equilibrium or a total analysis. A FV for fallout radionuclides applies only to surface samples, generally from depths of 0 to 0.5 ft bgs. All postexcavation samples were collected from a depth in soil of at least 2 ft bgs; therefore, FVs do not apply to this data set. If a BV is not available, the inorganic chemicals and radionuclides were evaluated according to detection status. Background comparisons do not apply to organic chemicals, which were evaluated according to their detection status.

The criteria used to identify COPCs are as follows:

- If at least one detected concentration or a DL for an analyte is above both the BV and the range of concentrations in the background data set, the analyte is retained as a COPC.
- If an analyte is detected in at least one sample and has no BV associated with it, the analyte is retained as a COPC.
- If all detected concentrations and DLs for an analyte are below the BV, the analyte is not retained as a COPC.

COPCs are determined for soil and tuff separately.

B-2.0 RESULTS OF INORGANIC CHEMICALS IN SAMPLES COLLECTED FROM AREA OF ELEVATED RADIOACTIVITY

Table B-2.0-1 presents the analytical results for inorganic chemicals detected above BVs or detected, if no BV is available, in the area of elevated radioactivity. The locations and concentrations of inorganic chemicals detected above BVs are shown in Figure B.2.0-1.

B-2.1 Inorganic Chemicals in Soil

Two soil samples were collected and analyzed for inorganic chemicals, including asbestos, cyanide, perchlorate, and nitrate. The status of each of the inorganic chemicals is described below:

- Aluminum, antimony, arsenic, barium, beryllium, calcium, cobalt, copper, cyanide, lead, magnesium, mercury, nickel, selenium, silver, uranium, vanadium, and zinc were not detected above their respective BVs. These inorganic chemicals are not retained as COPCs in soil.
- Asbestos has no BV and was not detected in any sample. Asbestos is not retained as a COPC in soil.
- Cadmium was reported with one DL above its BV but below the maximum concentration in the background data set. Cadmium is not retained as a COPC in soil.
- Chromium was detected above the BV in one soil sample but below the maximum concentration in the background data set. Chromium is not retained as a COPC in soil.

- Nitrate was detected in at least one soil sample but has no BV. Nitrate is retained as a COPC in soil.

B-2.2 Inorganic Chemicals in Qbt 3

Thirteen samples collected from Qbt 3 were analyzed for inorganic chemicals, including asbestos, cyanide, perchlorate, and nitrate. The status of each of the inorganic chemicals is described below:

- Arsenic, cadmium, cobalt, cyanide, mercury, silver, vanadium, and zinc were not detected above their respective BVs. These inorganic chemicals are not retained as COPCs in tuff.
- Asbestos has no BV and was not detected in any sample. Asbestos is not retained as a COPC in tuff.
- Beryllium, lead, and magnesium were detected above their BVs in one sample each. These detections were less than the maximum concentrations in the background data sets. Beryllium, lead, and magnesium are not retained as COPCs in tuff.
- Calcium was reported with one DL above its BV, at approximately 2 times the maximum concentration within the background data set. Additionally, calcium is an essential nutrient. Therefore, calcium is not retained as a COPC in tuff.
- Uranium was reported with a DL above the BV but below the maximum concentration in the background data set and is not retained as a COPC in tuff.
- Aluminum, barium, chromium, and nickel were detected above their respective BVs in at least one sample. These inorganic chemicals are retained as COPCs in tuff.
- Antimony, copper, and selenium were reported with DLs above the BVs and are retained as COPCs in tuff.
- Nitrate was detected in at least one sample but has no BV and is retained as a COPC in tuff.

B-3.0 RESULTS OF RADIONUCLIDES IN SAMPLES COLLECTED FROM AREA OF ELEVATED RADIOACTIVITY

Table B-3.0-1 presents the analytical results for radionuclides detected above BVs at the area of elevated radioactivity. If no BV is available for a specific radionuclide, the table shows all detections for that radionuclide. The locations and concentrations of radionuclides detected above BVs/FVs are shown in Figure B.3.0-1.

B-3.1 Radionuclides in Soil

Two soil samples were analyzed for americium-241, radionuclides by gamma spectroscopy, isotopic plutonium, strontium-90, tritium, and isotopic uranium. The status of each of the radionuclides is described below:

- Americium-241, cesium-137, cobalt-60, plutonium-238, plutonium-239, strontium-90, uranium-234, uranium-235, and uranium-238 were not detected above their respective BVs/FVs. These radionuclides are not retained as COPCs in soil.
- Tritium was detected in one soil sample but has no FV. This radionuclide is retained as a COPC in soil.

B-3.2 Radionuclides in Qbt 3

Thirteen samples were collected from Qbt 3 and analyzed for americium-241, radionuclides by gamma spectroscopy, isotopic plutonium, strontium-90, tritium, and isotopic uranium (not all samples included all analyses listed). The status of each of the radionuclides is described below:

- Uranium-234, uranium-235, and uranium-238 were not detected above their respective BVs in any tuff sample. These radionuclides are not retained as COPCs in tuff.
- Americium-241, cesium-137, plutonium-238, plutonium-239, strontium-90, and tritium were detected in at least one tuff sample. These radionuclides have no tuff FVs and are retained as COPCs in tuff.

B-4.0 RESULTS OF ORGANIC CHEMICALS IN SAMPLES COLLECTED FROM AREA OF ELEVATED RADIOACTIVITY

Table B-4.0-1 presents the analytical results for inorganic chemicals detected at the area of elevated radioactivity. The locations and concentrations of detected organic chemicals are shown in Figure B-4.0-1.

B-4.1 Organic Chemicals in Soil

One soil sample was analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and dioxins/furans. Three dioxin/furan congeners (1,2,3,4,6,7,8-heptachlorodibenzodioxin; 1,2,3,4,6,7,8,9-octachlorodibenzodioxin; and 1,2,3,4,6,7,8,9-octachlorodibenzofuran) were detected and retained as COPCs in soil. No other organic chemicals were detected in soil samples from the area of elevated radioactivity.

B-4.2 Organic Chemicals in Qbt 3

Twelve samples were collected from Qbt 3 and analyzed for VOCs and SVOCs, one of which was also analyzed for polychlorinated biphenyls and dioxins/furans. A total of 5 organic chemicals and 13 dioxin/furan congeners were detected and retained as COPCs in tuff. The following organic chemicals were detected in tuff:

- 1,3-dichlorobenzene
- 1,4-dichlorobenzene
- fluoranthene
- methylene chloride
- toluene

The following dioxin/furan congeners were detected in tuff:

- 1,2,3,4,6,7,8-heptachlorodibenzodioxin
- 1,2,3,4,6,7,8-heptachlorodibenzofuran
- 1,2,3,4,6,7,9-heptachlorodibenzofuran
- 1,2,3,4,7,8-hexachlorodibenzodioxin

- 1,2,3,6,7,8-hexachlorodibenzodioxin
- 1,2,3,7,8,9-hexachlorodibenzodioxin
- 1,2,3,4,7,8-hexachlorodibenzofuran
- 1,2,3,6,7,8-hexachlorodibenzofuran
- 2,3,4,6,7,8-hexachlorodibenzofuran
- 1,2,3,4,6,7,8,9-octachlorodibenzodioxin
- 1,2,3,4,6,7,8,9-octachlorodibenzofuran
- 1,2,3,7,8-pentachlorodibenzodioxin
- 1,2,3,7,8-pentachlorodibenzofuran

B-5.0 SUMMARY OF COPCs AT AREA OF ELEVATED RADIOACTIVITY

Table B-5.0-1 provides a summary of the COPCs in the area of elevated radioactivity at Consolidated Unit 21-018(a)-99. A total of 8 inorganic chemicals, 6 radionuclides, and 18 organic chemicals are retained as COPCs.

Soil excavation and confirmation sampling were conduced in accordance with the supplemental work plan (LANL 2007, 097448) and approved by New Mexico Environment Department (NMED) (2007, 098287). Remediation activities were conducted to remove contaminated soil and tuff in an area where radionuclides exceeded screening action levels (SALs) (LANL 2005, 088493). Confirmation sampling was conducted after excavation was completed. The investigation, remediation, and confirmation sampling activities were conducted in three phases from 2006 to 2007.

At the area of elevated radioactivity within Consolidated Unit 21-018(a)-99, all media with COPC concentrations above soil screening levels (SSLs)/SALs have been removed. The results of confirmation samples collected at the base and sidewalls of the excavation area indicate little residual contamination remains in this area. Samples collected during the 2006–2007 investigation show decreasing concentrations of COPCs, both laterally and with depth. Plutonium-239, the driver for the supplemental activities, was detected at approximately 2 orders of magnitude less than the overlying material removed during the excavation of the area of elevated radioactivity. Based on the analytical results of the 2006–2007 activities, the objectives of the supplemental remediation and investigation have been met.

All qualified data from samples that were not excavated are included in the evaluation of the nature and extent of contamination in the area of elevated radioactivity. Figures B-2.0-1, B-3.0-1, and B-4.0-1 show the distribution of inorganic, radionuclide, and organic COPCs, respectively. Tables B-2.0-1, B-3.0-1, and B-4.0-1 summarize inorganic chemical, radionuclide, and organic chemical results, respectively.

B-5.1 Inorganic Chemicals

Inorganic COPCs in soil and tuff at the area of elevated radioactivity include aluminum, antimony, barium, chromium, copper, nickel, nitrate, and selenium (Table B-5.0-1). A discussion of the nature and extent of these COPCs follows:

- Aluminum was detected at a concentration of 8550 mg/kg, slightly above the maximum background concentration of 8370 mg/kg in one tuff sample (location 21-601267). Aluminum is below the soil and tuff BVs at all other locations and depths in the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for aluminum.

- Antimony was not detected above the BV but had DLs slightly above the tuff BV of 0.5 mg/kg in two samples: 0.58 mg/kg at location 21-27005 and 0.55 mg/kg at location 21-601266. Detected concentrations and other DLs of antimony are below the soil and tuff BVs at all other locations and depths in the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for antimony.
- Barium was detected above the BV in five tuff samples at concentrations below 2 times the maximum concentration in the tuff background data set (51.6 mg/kg). Barium concentrations decrease with depth at location 21-601266 and are similar to the maximum tuff background concentration at the other locations where it was detected above the BV. Barium is below the soil and tuff BVs at all other locations and depths in the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for barium.
- Chromium was detected above BVs in six tuff samples and one soil sample. The soil sample was detected at 21.4 mg/kg, which is below the maximum concentration in the soil background data set (36.5 mg/kg). Four tuff samples were detected below the maximum background concentration of 13 mg/kg, one tuff sample was detected slightly above the maximum background concentration, and one tuff sample was detected at a concentration below 2 times the maximum background concentration. Therefore, both lateral and vertical extent are defined for chromium.
- Copper was not detected above the BV but had DLs above the BV in two tuff samples (locations 21-601265 and 21-601266). Detected concentrations and DLs of copper are below the soil and tuff BVs at all other locations and depths in the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for copper.
- Nickel was detected above the BV in one tuff sample and had DLs above the BV in three tuff samples. The detected concentration (6.71 mg/kg at location 21-600106) is less than the maximum concentration in the background data set (7 mg/kg). Nickel is below the soil and tuff BVs at all other locations and depths in the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for nickel.
- Nitrate, for which there are no BVs or background data sets for soil or tuff, was detected in nine tuff samples. Tuff concentrations ranged from 0.22 to 2.2 mg/kg. Concentrations either decreased or remained essentially the same with depth. Additionally, nitrate concentrations detected in tuff at the area of elevated radioactivity are likely naturally occurring. Therefore, both lateral and vertical extent are defined for nitrate.
- Selenium was detected above the tuff BV in two samples (locations 21-600106 and 21-601267) and had DLs above the BV in seven tuff samples. Selenium was not detected in samples collected from the depth interval of 7 to 7.5 ft bgs, the deepest samples collected at the site. Therefore, both lateral and vertical extent are defined for selenium.

B-5.2 Radionuclides

Radionuclide COPCs in the area of elevated radioactivity include americium-241, cesium-137, plutonium-238, plutonium-239, strontium-90, and tritium (Table B-5.0-1). A discussion of the nature and extent of these COPCs follows:

- Americium-241 was detected in one tuff sample (0.356 pCi/g at location 21-601265). Americium-241 concentrations decreased with depth at this location and were not detected at any other location or depth in the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for americium-241.

- Cesium-137 was detected in one tuff sample (0.096 pCi/g at location 21-601268). Cesium-137 was not detected at any other location or depth in the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for cesium-137.
- Plutonium-238 was detected in one tuff sample (0.095 mg/kg at location 21-601268). Plutonium-238 was not detected at any other location or depth in the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for plutonium-238.
- Plutonium-239 was detected in nine tuff samples. Plutonium-239 concentrations ranged from 0.073 to 6.76 pCi/g and decreased with depth. In addition, detected concentrations were 1 to 4 orders of magnitude below the preexcavation sample concentrations, indicating that the source of plutonium-239 has been removed. Lateral and vertical extent of plutonium-239 are defined.
- Strontium-90 was detected in one tuff sample (1.12 pCi/g at location 21-601265). Strontium-90 was not detected in the deeper sample from this location nor was it detected at any other location or depth within the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for strontium-90.
- Tritium was detected in one soil sample (0.131 pCi/g at location 21-600106). Tritium was also detected in a tuff sample from location 21-600106 at 3–3.5 ft bgs and in two tuff samples from location 21-601265. Tritium concentrations decreased with depth or remained essentially unchanged at both locations where it was detected. Additionally, tritium was not detected at any other location or depth within the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for tritium.

B-5.3 Organic Chemicals

Five organic COPCs were identified in samples from the area of elevated radioactivity:

- 1,3-dichlorobenzene
- 1,4-dichlorobenzene
- fluoranthene
- methylene chloride
- toluene

Thirteen dioxin/furan congeners were detected in samples from the area of elevated radioactivity:

- 1,2,3,4,6,7,8-heptachlorodibenzodioxin
- 1,2,3,4,6,7,8-heptachlorodibenzofuran
- 1,2,3,4,6,7,9-heptachlorodibenzofuran
- 1,2,3,4,7,8-hexachlorodibenzodioxin
- 1,2,3,6,7,8-hexachlorodibenzodioxin
- 1,2,3,7,8,9-hexachlorodibenzodioxin
- 1,2,3,4,7,8-hexachlorodibenzofuran
- 1,2,3,6,7,8-hexachlorodibenzofuran

- 2,3,4,6,7,8-hexachlorodibenzofuran
- 1,2,3,4,6,7,8,9-octachlorodibenzodioxin
- 1,2,3,4,6,7,8,9-octachlorodibenzofuran
- 1,2,3,7,8-pentachlorodibenzodioxin
- 1,2,3,7,8-pentachlorodibenzofuran

Table B-5.0-1 summarizes the COPCs by media for the area of elevated radioactivity within Consolidated Unit 21-018(a)-99. A discussion of the nature and extent of these COPCs follows:

- 1,3-Dichlorobenzene and 1,4-dichlorobenzene were detected at concentrations below the estimated quantitation limit (EQL) of 0.38 mg/kg in the shallower sample from location 21-601265 but not in the deeper sample from this location. Additionally, these COPCs were not detected at any other location or depth within the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for 1,3-dichlorobenzene and 1,4-dichlorobenzene.
- Fluoranthene was detected below the EQL of 0.38 mg/kg in the shallower sample from location 21-601266 but not in the deeper sample from this location. Additionally, fluoranthene was not detected at any other location or depth within the area of elevated radioactivity. Therefore, both lateral and vertical extent are defined for fluoranthene.
- Methylene chloride was detected in five tuff samples. Three detections were at concentrations below the EQL of 0.0057 mg/kg. Methylene chloride was not detected in any of the deepest samples from the site (7–7.5 ft bgs). Therefore, both lateral and vertical extent are defined for methylene chloride.
- Toluene was detected in two tuff samples at concentrations below the EQL of 0.0057 mg/kg. Therefore, both lateral and vertical extent are defined for toluene.
- Thirteen dioxin/furan congeners were detected in one tuff sample, and three dioxin/furan congeners were detected in one soil sample. The ranges of concentrations are similar to those reported at other TA-21 sites (Table 6.4-1), for which additional sampling was not required by NMED (Chamberlain 2006, 093677; LANL 2007, 099175; Roberts 2007, 098470).

B-5.4 Summary of Nature and Extent at the Area of Elevated Radioactivity

At the area of elevated radioactivity within Consolidated Unit 21-018(a)-99, all contaminated media above residential SSLs and SALs have been removed. The results of postexcavation confirmation samples collected from beneath the base and along the sidewalls of the excavation indicate that little residual contamination remains, and the confirmation samples show decreasing COPC concentrations vertically and laterally. Of particular importance is that detections of radionuclide COPCs are orders of magnitude less in the postexcavation confirmation samples as compared with the preexcavation samples.

Based on the distribution and concentrations of COPCs in the area of elevated radioactivity, the objectives of the supplemental remediation and investigation have been met, with the exception of defining the extent of low levels of tritium in subsurface pore gas. This was an outstanding issue identified in the original investigation report for MDA V (LANL 2007, 098942) and remains an open item to be addressed on a mesawide basis; groundwater monitoring requirements for TA-21, including Consolidated Unit 21-018(a)-99, are addressed in the “Los Alamos and Pueblo Canyons Groundwater Monitoring Well Network Evaluation and Recommendations” (LANL 2007, 099936), which was submitted to NMED on December 21, 2007.

B-6.0 REFERENCES AND MAP DATA SOURCES

B-6.1 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 number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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LANL (Los Alamos National Laboratory), September 22, 1998. "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments, and Bandelier Tuff at Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-98-4847, Los Alamos, New Mexico. (LANL 1998, 059730)

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LANL (Los Alamos National Laboratory), July 2007. "Investigation Report for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21, Revision 1," Los Alamos National Laboratory document LA-UR-07-4390, Los Alamos, New Mexico. (LANL 2007, 098942)

LANL (Los Alamos National Laboratory), July 3, 2007. "Sampling Data for Area of Elevated Radioactivity Near Location ID 21-02523 and North of Absorption Bed 3, Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21," Los Alamos National Laboratory letter (EP2007-0346) to J.P. Bearzi (NMED HWB) from S. Stiger (Environmental Programs Associate Director) and D. Gregory (DOE Federal Project Director), Los Alamos, New Mexico. (LANL 2007, 097448)

LANL (Los Alamos National Laboratory), November 2007. "Delta Prime Site Aggregate Area Investigation Report," Los Alamos National Laboratory document LA-UR-07-5459, Los Alamos, New Mexico. (LANL 2007, 099175)

LANL (Los Alamos National Laboratory), December 2007. "Los Alamos and Pueblo Canyons Groundwater Monitoring Well Network Evaluation and Recommendations," Los Alamos National Laboratory document LA-UR-07-8114, Los Alamos, New Mexico. (LANL 2007, 099936)

NMED (New Mexico Environment Department), August 9, 2007. "Approval with Modification for the Supplemental Work Plan for Consolidated Unit 21-018(a)-99, at Technical Area 21," New Mexico Environment Department letter to D. Gregory (DOE LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED HWB), Santa Fe, New Mexico. (NMED 2007, 098287)

Roberts, K., September 20, 2007. RE: DP Site Aggregate Area Extended Suite Analysis. E-mail message to M.S. Thacker (LANL) from K. Roberts (NMED), Santa Fe, New Mexico. (Roberts 2007, 098470)

B-6.2 Map Data Sources

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Former TA-21 Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Potential Release Sites (SWMU/AOC); Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2005-0748; 1:2500 Scale Data; 22 November 2005.

Material Disposal Areas; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2004-0221; 1:2500 Scale Data; 23 April 2004.

Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

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Industrial Waste Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

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Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 08 August 2002; Development Edition of 05 January 2005.

ER Location IDs point (borehole and sample locations); Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1:2500 Scale Data; 10 November 2005.

Former Drainline; Los Alamos National Laboratory, ENV Environmental Remediation and Stewardship Program; 1:2500 Scale Data, 02 October 2006.

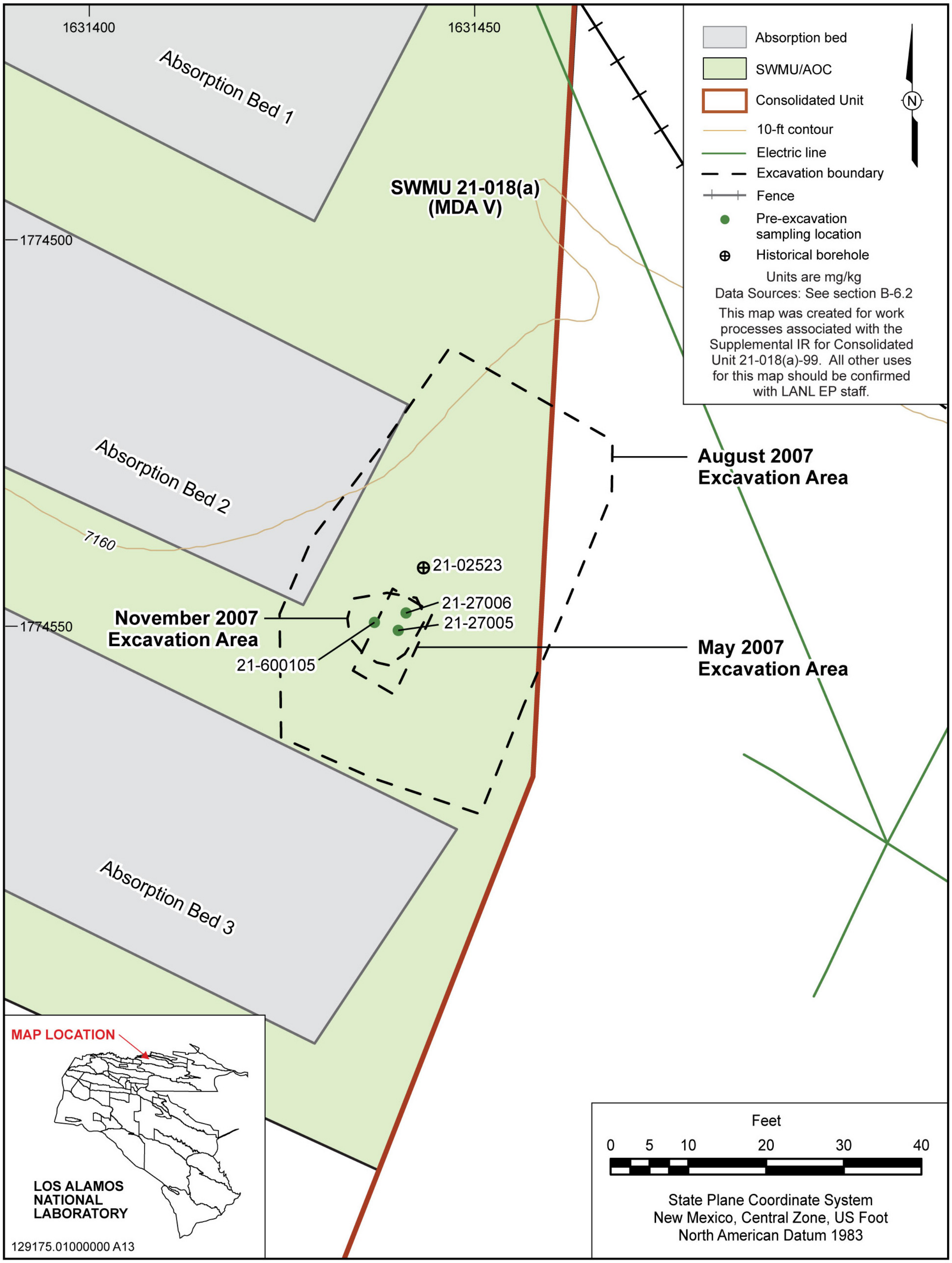


Figure B-1.1-1 **Preexcavation sample locations at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99**

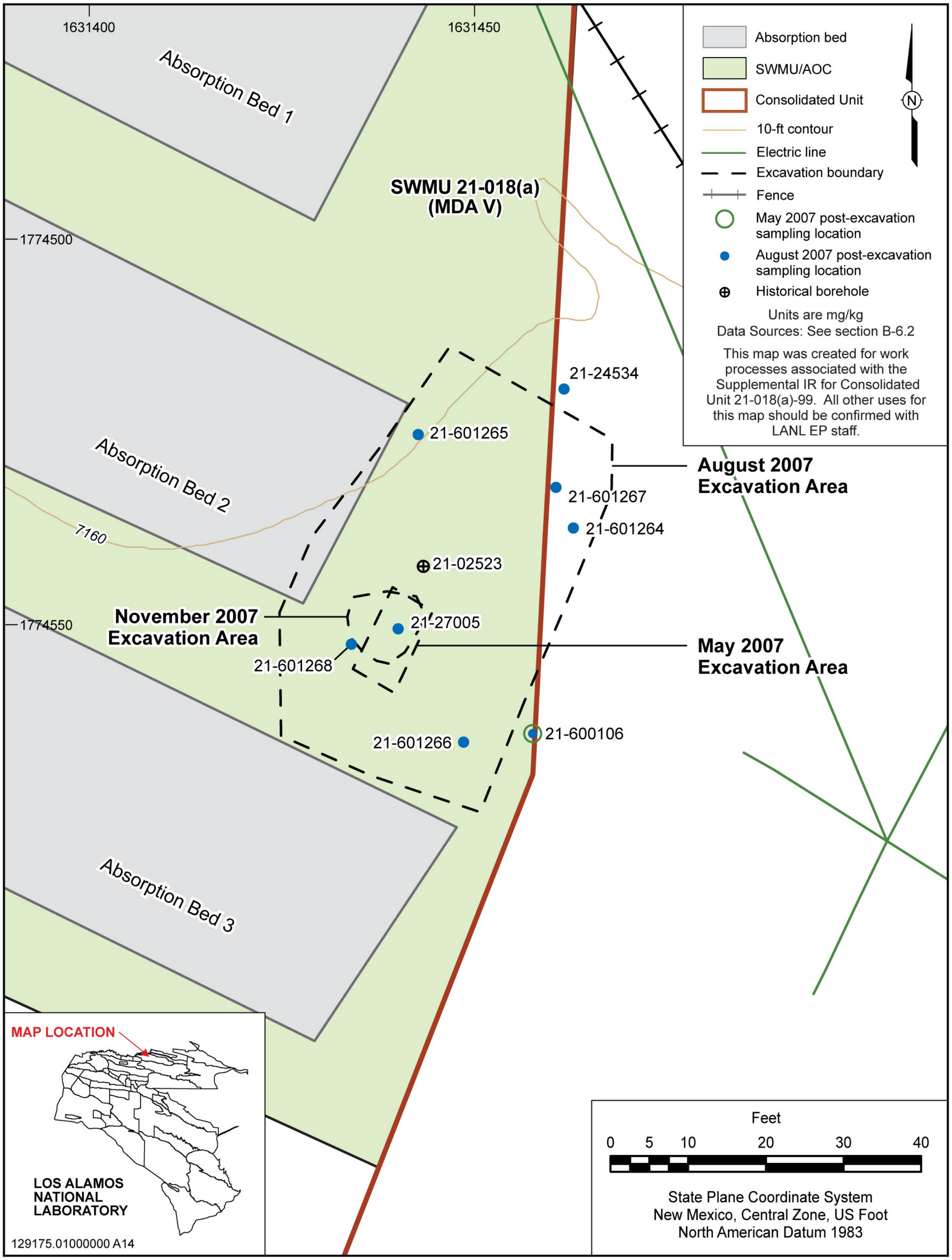


Figure B-1.1-2 Postexcavation sample locations at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99

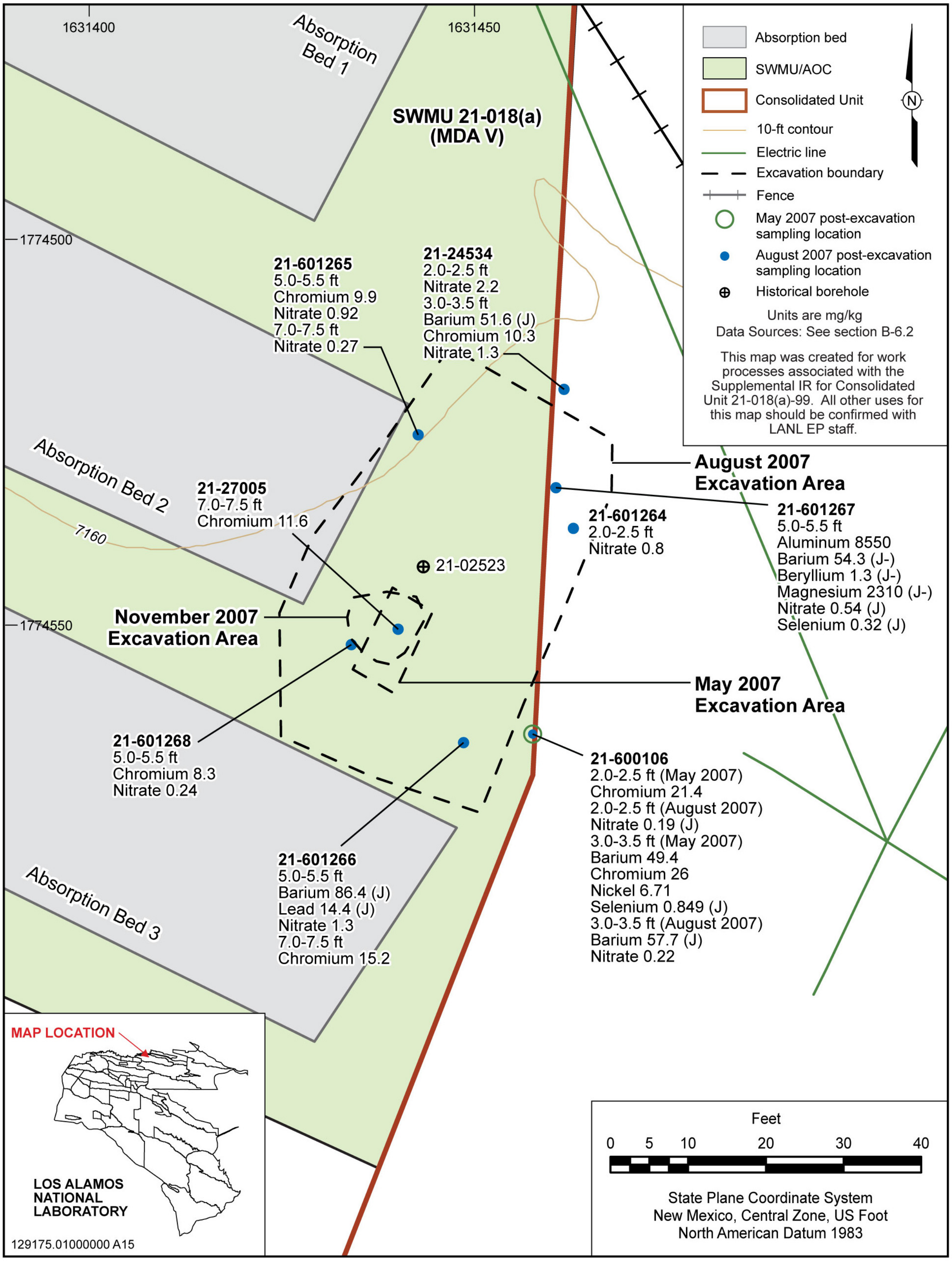


Figure B-2.0-1 Postexcavation samples: inorganic chemicals detected above BVs at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99

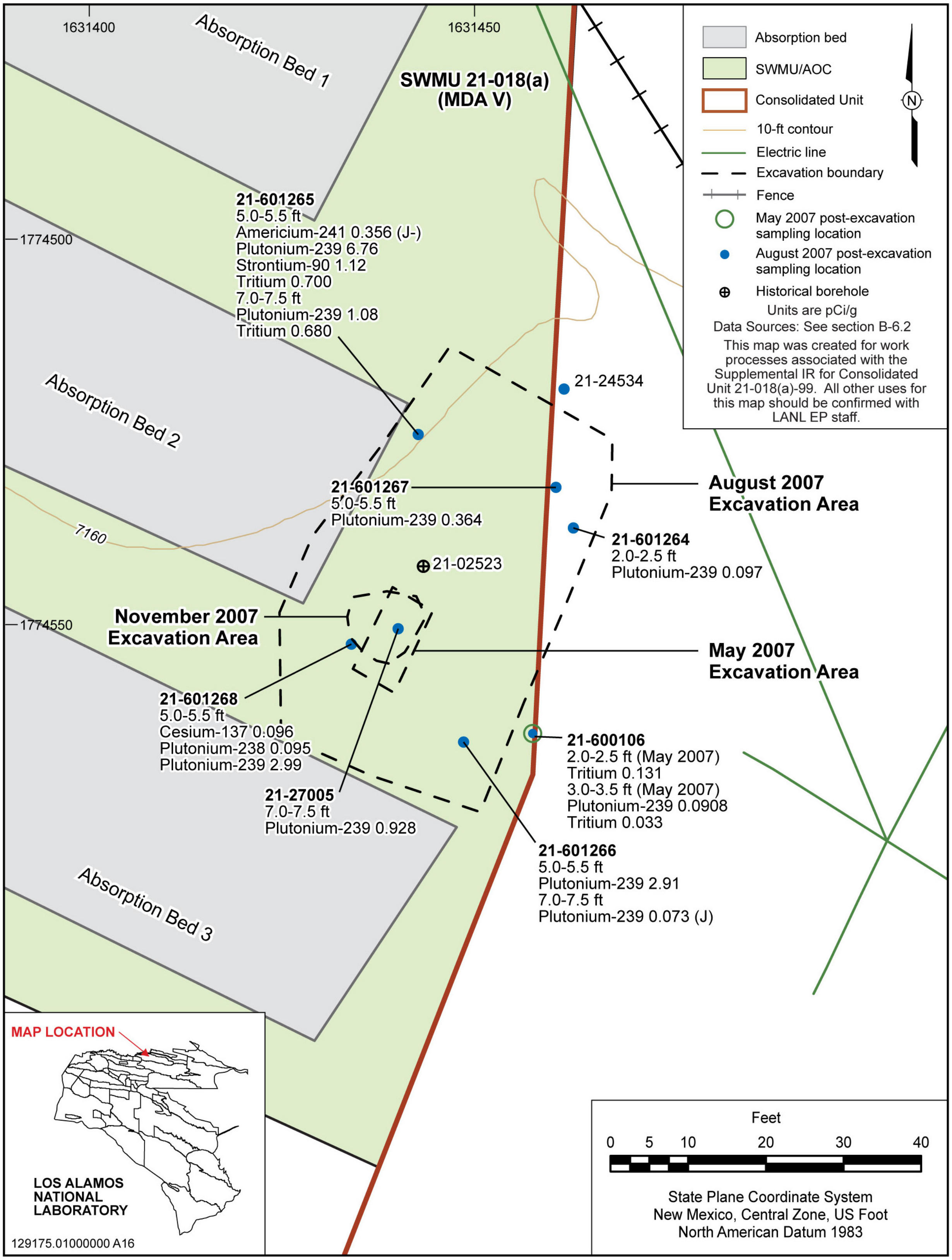


Figure B-3.0-1 **Postexcavation samples: radionuclides detected or detected above BVs/FVs at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99**

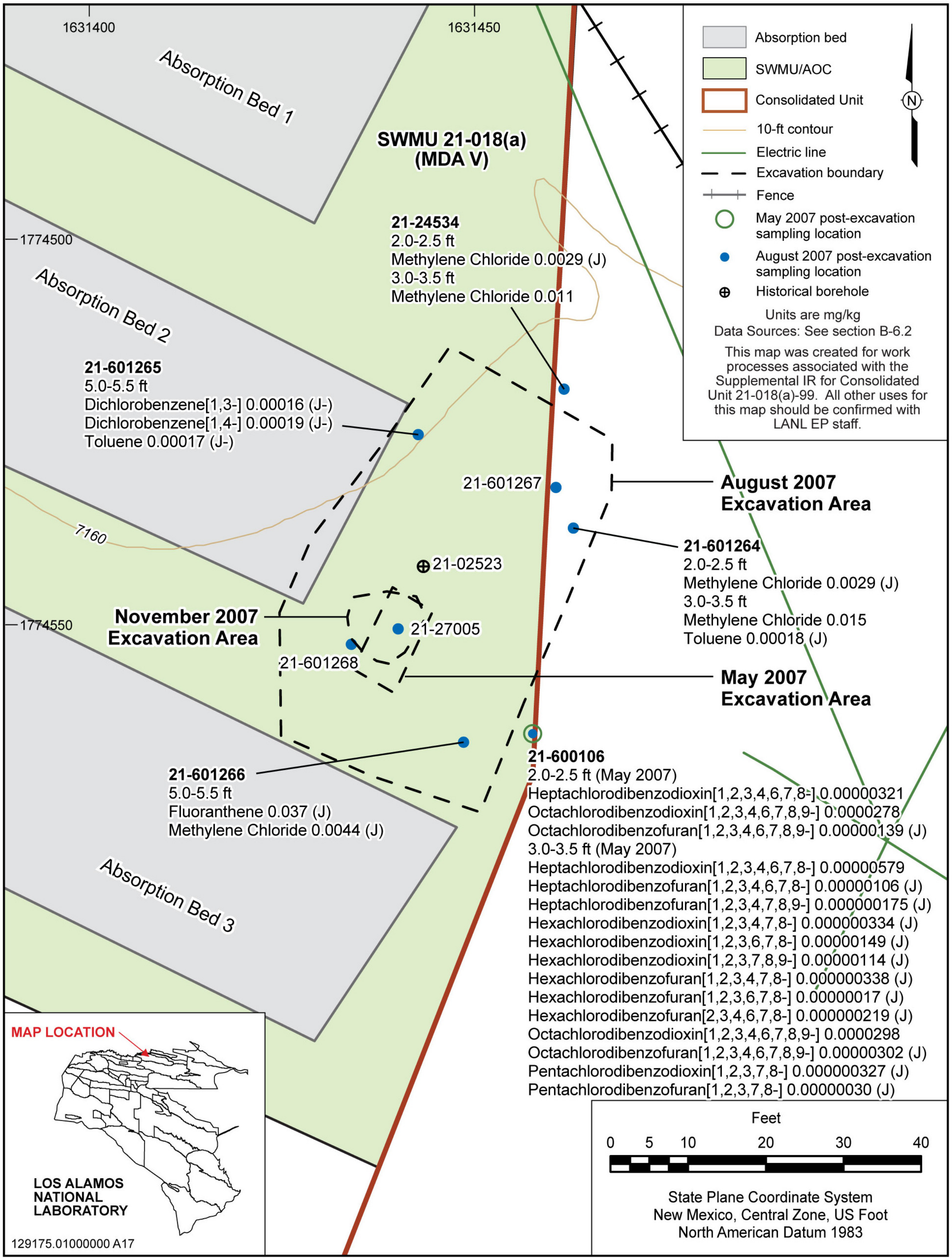


Figure B-4.0-1 Postexcavation samples: organic chemicals detected at the area of elevated radioactivity, Consolidated Unit 21-018(a)-99

Table B-1.1-1
Summary of Samples Collected for Analyses at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Sample Collection Date	Media	Depth (ft bgs)	Field QC Type	Anions	Metals	Asbestos	Cyanide	Nitrates	Perchlorate	pH	Dioxins/ Furans
Preexcavation Samples													
21-27005	MD21-06-73535	9/19/06	Fill	0.5–1.0	n/a[a]	NA[b]	NA	NA	NA	NA	NA	NA	NA
21-27005	MD21-06-73536	9/19/06	Soil	2.0–2.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA
21-27005	MD21-06-73537	9/19/06	QBT3	3.0–3.0	n/a	NA	NA	NA	NA	NA	NA	NA	NA
21-27005	RE21-07-6040	9/10/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-27005	RE21-07-6053	9/10/07	QBT3	5.0–5.5	FD[c]	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-27005	RE21-07-6057	9/10/07	ALLH	—[d]	FTB[e]	NA	NA	NA	NA	NA	NA	NA	NA
21-27005	RE21-07-6059	9/10/07	n/a	—	FR[f]	NA	SW-846 6020/7470A	NA	SW-846 9012A	EPA 353.1	SW-846 6850	NA	NA
21-27006	MD21-06-73538	9/20/06	Soil	2.0–2.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA
21-600105	RE21-07-601	5/17/07	ALLH	2.0–2.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA
21-600105	RE21-07-6042	8/22/07	ALLH	2.0–2.5	n/a	EPA 300.0/314.0	SW-846 6010B/6020/7471A	NA	SW-846 9012A	NA	NA	SW-846 9045C	NA
Postexcavation Samples													
21-24534	RE21-07-6043	9/10/07	QBT3	2.0–2.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-24534	RE21-07-6044	9/10/07	QBT3	3.0–3.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-27005	RE21-07-6041	9/10/07	QBT3	7.0–7.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-600106	RE21-07-603	5/29/07	Soil	2.0–2.5	n/a	NA	SW-846 6010B/6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	NA	SW-846 8290
21-600106	RE21-07-6055	9/10/07	Soil	2.0–2.5	n/a	EPA 300.0	SW-846 6020/7471A	NA	SW-846 9012A	NA	SW-846 6850	NA	NA
21-600106	RE21-07-604	5/29/07	QBT3	3.0–3.5	n/a	NA	SW-846 6010B/6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	NA	SW-846 8290
21-600106	RE21-07-6056	9/10/07	QBT3	3.0–3.5	n/a	EPA 300.0	SW-846 6020/7471A	NA	SW-846 9012A	NA	SW-846 6850	NA	NA
21-601264	RE21-07-6045	9/10/07	QBT3	2.0–2.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601264	RE21-07-6046	9/10/07	QBT3	3.0–3.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601265	RE21-07-6047	9/10/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601265	RE21-07-6048	9/10/07	QBT3	7.0–7.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601266	RE21-07-6049	9/10/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601266	RE21-07-6050	9/10/07	QBT3	7.0–7.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601267	RE21-07-6051	9/7/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA
21-601268	RE21-07-6052	9/10/07	QBT3	5.0–5.5	n/a	EPA 300.0	SW-846 6020/7471A	EPA 600M4	SW-846 9012A	NA	SW-846 6850	SW-846 9045C	NA

Table B-1.1-1 (continued)

Location ID	Sample ID	Sample Collection Date	Media	Depth (ft bgs)	Field QC Type	PCBs	SVOCs	VOCs	Gamma Spectroscopy[g]	Tritium	Isotopic Plutonium	Isotopic Uranium	Americium-241	Strontium-90
Preexcavation Samples														
21-27005	MD21-06-73535	9/19/06	Fill	0.5–1.0	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	HASL-300	NA
21-27005	MD21-06-73536	9/19/06	Soil	2.0–2.5	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	HASL-300	NA
21-27005	MD21-06-73537	9/19/06	QBT3	3.0–3.0	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	HASL-300	NA
21-27005	RE21-07-6040	9/10/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-27005	RE21-07-6053	9/10/07	QBT3	5.0–5.5	FD	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-27005	RE21-07-6057	9/10/07	ALLH	—	FTB	NA	NA	SW-846 8260B	NA	NA	NA	NA	NA	NA
21-27005	RE21-07-6059	9/10/07	n/a	—	FR	NA	NA	NA	NA	NA	NA	NA	NA	NA
21-27006	MD21-06-73538	9/20/06	Soil	2.0–2.5	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	HASL-300	NA
21-600105	RE21-07-601	5/17/07	ALLH	2.0–2.5	n/a	NA	NA	NA	EPA 901.1	NA	HASL-300	HASL-300	NA	EPA 905.0
21-600105	RE21-07-6042	8/22/07	ALLH	2.0–2.5	n/a	NA	SW-846 8270C	SW-846 8260B	NA	NA	NA	NA	NA	NA
Postexcavation Samples														
21-24534	RE21-07-6043	9/10/07	QBT3	2.0–2.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-24534	RE21-07-6044	9/10/07	QBT3	3.0–3.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-27005	RE21-07-6041	9/10/07	QBT3	7.0–7.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-600106	RE21-07-603	5/29/07	Soil	2.0–2.5	n/a	SW-846 8082	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	NA	EPA 905.0
21-600106	RE21-07-6055	9/10/07	Soil	2.0–2.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA	NA
21-600106	RE21-07-604	5/29/07	QBT3	3.0–3.5	n/a	SW-846 8082	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	NA	EPA 905.0
21-600106	RE21-07-6056	9/10/07	QBT3	3.0–3.5	n/a	NA	NA	NA	NA	NA	NA	NA	NA	NA
21-601264	RE21-07-6045	9/10/07	QBT3	2.0–2.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601264	RE21-07-6046	9/10/07	QBT3	3.0–3.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601265	RE21-07-6047	9/10/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601265	RE21-07-6048	9/10/07	QBT3	7.0–7.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601266	RE21-07-6049	9/10/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601266	RE21-07-6050	9/10/07	QBT3	7.0–7.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601267	RE21-07-6051	9/7/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0
21-601268	RE21-07-6052	9/10/07	QBT3	5.0–5.5	n/a	NA	SW-846 8270C	SW-846 8260B	EPA 901.1	EPA 906.0	HASL-300	HASL-300	HASL-300	EPA 905.0

[a] n/a = Not applicable.

[b] NA = Not analyzed.

[c] FD = Field duplicate.

[d] — = Field trip blank or rinsate; sample interval not applicable.

[e] FTB = Field trip blank.

[f] FR = Field rinsate.

[g] Thorium-228 was not analyzed for in the postexcavation samples.

Table B-2.0-1
Results of Inorganic Chemicals above BVs at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Media	Depth (ft bgs)	Asbestos	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper
Soil BV				**na[a]**	**29200**	**0.83**	**8.17**	**295**	**1.83**	**0.4**	**6120**	**19.3**	**8.64**	**14.7**
QBT3 BV				**na**	**7340**	**0.5**	**2.79**	**46**	**1.21**	**1.63**	**2200**	**7.14**	**3.14**	**4.66**
SSL Residential				**na**	**77800**	**31.3**	**3.9**	**15600**	**156**	**39**	**na**	**2100[b]**	**1520**	**3130**
Preexcavation Samples														
21-27005	MD21-06-73535	Fill	0.5–1.0	—[c]	—	—	—	—	—	—	—	—	—	—
21-27005	MD21-06-73536	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-27005	MD21-06-73537	QBT3	3.0–3.0	—	—	—	—	—	—	—	—	—	—	—
21-27005	RE21-07-6040	QBT3	5.0–5.5	—	—	—	—	—	—	—	3270 (U)	10.8	—	5 (U)
21-27006	MD21-06-73538	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-601	ALLH	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-6042	ALLH	2.0–2.5	—	—	21 (J)	27 (J)	830 (J)	—	51 (J)	6200 (J)	980 (J)	18 (J)	690 (J)
Postexcavation Samples														
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-24534	RE21-07-6044	QBT3	3.0–3.5	—	—	—	—	51.6 (J)	—	—	—	10.3	—	—
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	0.58 (UJ)	—	—	—	—	—	11.6	—	—
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	—	0.553 (U)	—	21.4	—	—
21-600106	RE21-07-6055	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-600106	RE21-07-604	QBT3	3.0–3.5	—	—	—	—	49.4	—	—	—	26	—	—
21-600106	RE21-07-6056	QBT3	3.0–3.5	—	—	—	—	57.7 (J)	—	—	—	—	—	—
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	—	—	—	—	—	—	—
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	—	—	—	—	—	—	—
21-601265	RE21-07-6047	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	9.9	—	17.2 (U)
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—	—
21-601266	RE21-07-6049	QBT3	5.0–5.5	—	—	—	—	86.4 (J)	—	—	4870 (U)	—	—	5.5 (U)
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	0.55 (UJ)	—	—	—	—	—	15.2	—	—
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	8550	—	—	54.3 (J-)	1.3 (J-)	—	—	—	—	—
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	8.3	—	—

Table B-2.0-1 (continued)

Location ID	Sample ID	Media	Depth (ft bgs)	Lead	Magnesium	Mercury	Nickel	Nitrate	Selenium	Silver	Uranium	Vanadium	Zinc
Soil BV				**22.3**	**4610**	**0.1**	**15.4**	**na**	**1.52**	**1**	**1.82**	**39.6**	**48.8**
QBT3 BV				**11.2**	**1690**	**0.1**	**6.58**	**na**	**0.3**	**1**	**2.40**	**17.0**	**63.5**
SSL Residential				**400**	**na**	**23**[d]	**1560**	**100000**	**391**	**391**	**16**[e]	**78.2**	**23500**
Preexcavation Samples													
21-27005	MD21-06-73535	Fill	0.5–1.0	—	—	—	—	—	—	—	—	—	—
21-27005	MD21-06-73536	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—
21-27005	MD21-06-73537	QBT3	3.0–3.0	—	—	—	—	—	—	—	—	—	—
21-27005	RE21-07-6040	QBT3	5.0–5.5	—	—	0.722 (J)	—	0.11 (J)	0.56 (U)	—	9.9	—	—
21-27006	MD21-06-73538	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-601	ALLH	2.0–2.5	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-6042	ALLH	2.0–2.5	770 (J)	—	80 (J)	100 (J)	—	3.8 (J)	26 (J)	3100 (J)	170 (J)	2100 (J)
Postexcavation Samples													
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	2.2	0.53 (U)	—	—	—	—
21-24534	RE21-07-6044	QBT3	3.0–3.5	14.3 (U)	—	—	7 (U)	1.3	0.53 (U)	—	—	—	—
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	—	—	—	—	—
21-600106	RE21-07-6055	Soil	2.0–2.5	—	—	—	—	0.19 (J)	—	—	—	—	—
21-600106	RE21-07-604	QBT3	3.0–3.5	—	—	—	6.71	—	0.849 (J)	—	—	—	—
21-600106	RE21-07-6056	QBT3	3.0–3.5	—	—	—	—	0.22	0.53 (U)	—	—	—	—
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	0.8	0.55 (U)	—	—	—	—
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	—	0.54 (U)	—	—	—	—
21-601265	RE21-07-6047	QBT3	5.0–5.5	—	—	—	11.3 (U)	0.92	0.53 (U)	—	—	—	—
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	0.27	—	—	—	—	—
21-601266	RE21-07-6049	QBT3	5.0–5.5	14.4 (J)	—	—	—	1.3	0.55 (U)	—	4.2 (U)	—	—
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	—	8.1 (U)	—	—	—	—	—	—
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	2310 (J-)	—	—	0.54 (J)	0.32 (J)	—	—	—	—
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	—	—	—	0.24	—	—	—	—	—

Sources: BVs from LANL (1998 059730). SSLs from NMED (2006 092513).

Notes: Units are mg/kg. Data qualifiers are defined in Appendix A.

[a] na = Not available.

[b] SSL from Region 6 EPA (2007, 095866) and is corrected to 10^{-5} cancer risk.

[c] — = If analyzed, sample result is less than BV. If no BV is available, analyte was not detected.

[d] SSL from Region 6 EPA (2007, 095866).

[e] SSL from Region 9 EPA 2004 (http://www.epa.gov/region09/waste/sfund/prg/).

Table B-3.0-1
Results of Radionuclides Detected or Detected above BVs/FVs at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Media	Depth (ft bgs)	Americium-241	Cesium-137	Cobalt-60	Plutonium-238	Plutonium-239	Strontium-90	Thorium-228	Tritium	Uranium-234	Uranium-235	Uranium-238
Soil BV/FV[a]				**0.013**	**1.65**	**na[b]**	**0.023**	**0.054**	**1.31**	**2.28**	**na**	**2.59**	**0.2**	**2.29**
QBT3 BV/FV				**na**	**na**	**na**	**na**	**na**	**na**	**2.52**	**na**	**1.98**	**0.09**	**1.93**
SAL Residential				**30**	**5.6**	**1.3**	**37**	**33**	**5.7**	**2.3**	**750**	**170**	**17**	**86**
Preexcavation Samples														
21-27005	MD21-06-73535	Fill	0.5–1.0	17.5[c]	1.41	—[d]	0.729	115	—	—	—	18.6	1.09[c]	10.1
21-27005	MD21-06-73536	Soil	2.0–2.5	6.92[c]	0.438	—	0.328	62.0	—	—	—	16.5	0.998[c]	7.93
21-27005	MD21-06-73537	QBT3	3.0–3.0	4.62[c]	0.504	—	0.596	51.2	—	—	—	9.49	0.523[c]	4.99
21-27005	RE21-07-6040	QBT3	5.0–5.5	2.62[c]	0.141	—	0.480 (J)	37.6 (J)	—	—	—	7.79	0.308[c]	4.72
21-27006	MD21-06-73538	Soil	2.0–2.5	40.8[c]	2.05	—	2.08	322	—	—	—	140	8.67[c]	71.5
21-600105	RE21-07-601	ALLH	2.0–2.5	712 (J)	38.9 (J)	0.090 (J)	28.2 (J+)	3723 (J+)	43.0 (J)	3.32 (J)	—	2332 (J)	121 (J)[c]	1181 (J)
Postexcavation Samples														
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	—	—	NA[e]	—	—	—	—
21-24534	RE21-07-6044	QBT3	3.0–3.5	—	—	—	—	—	—	NA	—	—	—	—
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	—	—	0.928	—	NA	—	—	—	—
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	—	NA	0.131	—	—	—
21-600106	RE21-07-604	QBT3	3.0–3.5	—	—	—	—	0.0908	—	NA	0.033	—	—	—
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	0.097	—	NA	—	—	—	—
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	—	—	NA	—	—	—	—
21-601265	RE21-07-6047	QBT3	5.0–5.5	0.356 (J-)	—	—	—	6.76	1.12	NA	0.700	—	—	—
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	1.08	—	NA	0.680	—	—	—
21-601266	RE21-07-6049	QBT3	5.0–5.5	—	—	—	—	2.91	—	NA	—	—	—	—
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	—	—	0.073 (J)	—	NA	—	—	—	—
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	—	—	—	0.364	—	NA	—	—	—	—
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	0.096	—	0.095	2.99	—	NA	—	—	—	—

Sources: BVs/FVs from LANL (1998 059730). SALs from LANL (2005 088493).

Notes: Units are pCi/g. Data qualifiers are defined in Appendix A.

[a] Applies only to samples from 0 to 0.5 ft bgs.

[b] na = Not available.

[c] Detected above BV by either EPA Method 901.1 or HASL-300. Most conservative (higher or detected) value shown.

[d] — = If analyzed, sample result is below the detection limit or is less than BV. If no BV is available, analyte was not detected.

[e] NA = Not analyzed; see the Summary of Samples Collected table.

Table B-4.0-1
Results of Organic Chemicals Detected at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Location ID	Sample ID	Media	Depth (ft bgs)	Di-n-butylphthalate	Dichlorobenzene[1,3-]	Dichlorobenzene[1,4-]	Bis(2-ethylhexyl)phthalate	Fluoranthene	Heptachlorodibenzodioxin [1,2,3,4,6,7,8-]	Heptachlorodibenzofuran [1,2,3,4,6,7,8-]	Heptachlorodibenzofuran [1,2,3,4,6,7,9-]	Hexachlorodibenzodioxin [1,2,3,4,7,8-]	Hexachlorodibenzodioxin [1,2,3,6,7,8-]
SSL Residential				**6110**	**32.6**	**39.5**	**347**	**2290**	**na**[a]	**na**	**na**	**na**	
Preexcavation Samples													
21-27005	RE21-07-6040	QBT3	5.0–5.5	0.12 (J)	—[b]	—	—	—	—	—	—	—	
21-600105	RE21-07-6042	ALLH	2.0–2.5	6 (J-)	—	—	1.8 (J-)	—	—	—	—	—	
Postexcavation Samples													
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	—	—	—	—	—	
21-24534	RE21-07-6044	QBT3	3.0–3.5	—	—	—	—	—	—	—	—	—	
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	0.00000321	—	—	—	
21-600106	RE21-07-604	QBT3	3.0–3.5	—	—	—	—	—	0.00000579	0.00000106 (J)	0.000000175 (J)	0.000000334 (J)	0.00000149
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	—	—	—	—	—	
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	—	—	—	—	—	
21-601265	RE21-07-6047	QBT3	5.0–5.5	—	0.00016 (J-)	0.00019 (J-)	—	—	—	—	—	—	
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	
21-601266	RE21-07-6049	QBT3	5.0–5.5	—	—	—	—	0.037 (J)	—	—	—	—	
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	

Table B-4.0-1 (continued)

Location ID	Sample ID	Media	Depth (ft bgs)	Hexachlorodibenzodioxin [1,2,3,7,8,9-]	Hexachlorodibenzofuran [1,2,3,4,7,8-]	Hexachlorodibenzofuran [1,2,3,6,7,8-]	Hexachlorodibenzofuran [2,3,4,6,7,8-]	Methylene chloride	Octachlorodibenzodioxin [1,2,3,4,6,7,8,9-]	Octachlorodibenzofuran [1,2,3,4,6,7,8,9-]	Pentachlorodibenzodioxin [1,2,3,7,8-]	Pentachlorodibenzofuran [1,2,3,7,8-]	Toluene
SSL Residential				**na**	**na**	**na**	**na**	**182**	**na**	**na**	**na**	**na**	**252**
Preexcavation Samples													
21-27005	RE21-07-6040	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	—
21-600105	RE21-07-6042	ALLH	2.0–2.5	—	—	—	—	—	—	—	—	—	—
Postexcavation Samples													
21-24534	RE21-07-6043	QBT3	2.0–2.5	—	—	—	—	0.0029 (J)	—	—	—	—	—
21-24534	RE21-07-6044	QBT3	3.0–3.5	—	—	—	—	0.011	—	—	—	—	—
21-27005	RE21-07-6041	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—
21-600106	RE21-07-603	Soil	2.0–2.5	—	—	—	—	—	0.0000278	0.00000139 (J)	—	—	—
21-600106	RE21-07-604	QBT3	3.0–3.5	0.00000114 (J)	0.000000338 (J)	0.00000017 (J)	0.000000219 (J)	—	0.0000298	0.00000302 (J)	0.000000327 (J)	0.0000003 (J)	—
21-601264	RE21-07-6045	QBT3	2.0–2.5	—	—	—	—	0.0029 (J)	—	—	—	—	—
21-601264	RE21-07-6046	QBT3	3.0–3.5	—	—	—	—	0.015	—	—	—	—	0.00018 (J)
21-601265	RE21-07-6047	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	0.00017 (J-)
21-601265	RE21-07-6048	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—
21-601266	RE21-07-6049	QBT3	5.0–5.5	—	—	—	—	0.0044 (J)	—	—	—	—	—
21-601266	RE21-07-6050	QBT3	7.0–7.5	—	—	—	—	—	—	—	—	—	—
21-601267	RE21-07-6051	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	—
21-601268	RE21-07-6052	QBT3	5.0–5.5	—	—	—	—	—	—	—	—	—	—

Source: SSLs from NMED (2006 092513).

Notes: Units are mg/kg. Data qualifiers are defined in Appendix A.

[a] na = Not available.

[b] — = If analyzed, sample result is below the detection limit.

Table B-5.0-1
Summary of COPCs by Media at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Inorganic COPCs	Radionuclide COPCs	Organic COPCs
Soil		
Nitrate	Tritium	Heptachlorodibenzodioxin[1,2,3,4,6,7,8-] Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]
Tuff		
Aluminum Antimony Barium Chromium Copper Nickel Nitrate Selenium	Americium-241 Cesium-137 Plutonium-238 Plutonium-239 Strontium-90 Tritium	Dichlorobenzene[1,3-] Dichlorobenzene[1,4-] Fluoranthene Heptachlorodibenzodioxin[1,2,3,4,6,7,8-] Heptachlorodibenzofuran[1,2,3,4,6,7,8-] Heptachlorodibenzofuran[1,2,3,4,7,8,9-] Hexachlorodibenzodioxin[1,2,3,4,7,8-] Hexachlorodibenzodioxin[1,2,3,6,7,8-] Hexachlorodibenzodioxin[1,2,3,7,8,9-] Hexachlorodibenzofuran[1,2,3,4,7,8-] Hexachlorodibenzofuran[1,2,3,6,7,8-] Hexachlorodibenzofuran[2,3,4,6,7,8-] Methylene chloride Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] Octachlorodibenzofuran[1,2,3,4,6,7,8,9-] Pentachlorodibenzodioxin[1,2,3,7,8-] Pentachlorodibenzofuran[1,2,3,7,8-] Toluene

Appendix C

Field Methods

C-1.0 INTRODUCTION

This appendix summarizes field methods used at the area of elevated radioactivity within Consolidated Unit 21-018(a)-99 at Los Alamos National Laboratory (LANL or the Laboratory) for remediation and investigation activities conducted in 2006–2007. All activities were conducted in accordance with the most current versions of applicable Environmental Programs Directorate standard operating procedures (SOPs) and quality procedures (QPs), available at http://erproject.lanl.gov/documents/VL/operations.html#procedures (Table C-1.0-1).

Remediation and sampling activities at the area of elevated radioactivity were conducted between September 2006 and December 2007, in accordance with the supplemental investigation work plan (LANL 2007, 097448), approved by the New Mexico Environment Department (NMED) (2007, 098287). The activities were conducted in three phases.

- Phase 1—September 2006 investigation: Hand-auger sampling was conducted in an area of approximately 6 ft × 12 ft, to the east of absorption bed 2, where surface radiological walkover surveys indicated potential elevated radiological contamination.
- Phase 2—May 2007 excavation: Soil from the 6- × 12-ft area was removed to a depth of 4 ft using a backhoe and bucket. The removal exposed an approximate 2-in. layer of elevated radiological soil/waste material likely associated with historical absorption bed overflows or other laundry facility operations extending laterally beyond the 6- × 12-ft excavation area.
- Phase 3—August and November 2007 excavation and confirmation sampling: An area approximately 30 × 50 ft to a depth of 5–6 ft was excavated in August 2007 to remove the 2-in. layer of soil/waste material identified in May 2007. Following removal activities, confirmation samples were collected from the bottom of the excavation, the sidewalls of the excavation, and outside of the excavation perimeter. In November 2007, a small volume of tuff was removed (approximately 69 ft^2 × 1 ft deep) that was centered on the original May 2007 excavation because the August 2007 analytical results indicated residual contamination of plutonium-239 remained slightly above the residential screening action level (SAL).

Table C-1.0-2 summarizes the field methods used in the excavation and investigation activities. The following sections describe specific field methods used for the remediation and characterization activities at the area of elevated radioactivity. Sample information is presented in Table 1.2-1 and Figures 3.1-1 and 3.1-2. Photographs of the field activities are provided in Attachment C-1.

C-2.0 PHASE 1: SEPTEMBER 2006 INVESTIGATION

Investigation sampling was performed on September 19 and 20, 2006, to determine the potential extent of an area of elevated radioactivity to the east of absorption bed 2 that was identified during a radiological surface survey conducted at the site. Four samples were collected from locations 21-27005 and 21-27006 and analyzed for radionuclides. The laboratory analytical results indicated that radionuclide chemicals of potential concern were present above residential SALs at these two locations, resulting in the subsequent excavation at this area.

C-3.0 PHASE 2: MAY 2007 EXCAVATION AND INVESTIGATION

The first excavation was conducted in May 2007 and included removal of a relatively small area of 6 × 12 ft to a 4-ft depth. During the excavation, an approximate 2-in.-thick layer of debris was discovered on the west wall beyond the extent of the excavation with elevated radiological levels. Limited exploratory trenching and radiological field screening were performed to determine the extent of the debris layer beyond the excavation boundary, providing the basis for the supplemental investigation work plan (LANL 2007, 097448). One sample was collected from the debris layer at a location with the highest radiological field-screening results (location 21-600105) and analyzed for radionuclides. Two additional samples were collected from a location to the east of the area of elevated radioactivity (21-600106) and analyzed for inorganic chemicals (target analyte list metals, cyanide, nitrate, perchlorate, asbestos), organic chemicals (volatile organic compounds [VOCs], semivolatile organic compounds, dioxins/furans, polychlorinated biphenyl compounds), and radionuclides.

C-4.0 PHASE 3: AUGUST–NOVEMBER 2007 EXCAVATION AND INVESTIGATION

In August 2007, the extent of the 2-in. layer of debris material identified in May 2007 was excavated using a backhoe and front-end loader (excavation area of approximately 30 × 50 ft to a depth of 5 ft). The excavated material was placed directly into plastic-lined, rolloff bins and managed as low-level waste. Following excavation activities, a total of 14 confirmation samples from eight locations were collected from the bottom of the excavation, the sidewalls of the excavation, and outside of the excavation perimeter. In November 2007, a small volume of tuff (approximately 69 ft^2 × 1 ft deep), centered on location 21-27005, was removed because the August 2007 analytical results indicated that residual contamination of plutonium-239 remained slightly above the residential SAL.

A total volume of 420 yd^3 of material (21 rolloff bins × 20 yd^3 per bin = 420 yd^3) was generated as waste from the area of elevated radioactivity.

C-5.0 FIELD SCREENING

Organic Vapors

Field screening for organic vapors was conducted by the field crew using a MiniRAE 2000 portable VOC photoionization detector (PID) monitor model PGM-7600. The PID was equipped with an 11.7-electronvolt (eV) lamp with sensitivity to 1 part per million (ppm). Background levels for the PID were obtained in the general area where the sampling took place. The PID was operated in the ambient air for approximately 5 min and that value was used as the background level. Field-screening results for VOCs are provided in Table 5.1-1.

Radioactivity

Field screening for the presence of alpha- and beta/gamma-emitting radionuclides was completed by a Laboratory radiological control technician (RCT) as work was performed and on all samples collected from the area of elevated radioactivity. Radiological screening was conducted using an Eberline E-600 radiation meter with an SHP-380AB alpha/beta scintillation detector. The Eberline E-600 with attachment SHP-380AB consists of a dual phosphor plate covered by two mylar windows housed in a light-excluding metal body. The phosphor plate is a plastic scintillator for detecting beta emissions and is thinly coated with zinc sulfide for detecting alpha emissions. The operational range varies from trace emissions to1 million disintegrations per minute (dpm). Field-screening results for radioactivity are provided in Table 5.1-1.

Local background levels in air were calculated daily using the following procedure. Minimum detectable activity describes the instrument’s lower detection limit. A background reading using the SHP-380AB attachment was taken in the field to determine the minimum detectable activity, which is calculated as follows:

$$\text{minimum detectable activity} = \frac{2.71 + 4.65/(R_b \times 0.2)}{0.2}$$

where R_b is the background rate in counts per minute (cpm). Minimum detectable activity was converted from cpm to dose per minute as follows:

$$\text{dose per minute} = \frac{\text{corrected cpm}}{\text{efficiency}}$$

where efficiency was assumed to be 20% for the SHP-380AB attachment, based on the manufacturer's specifications. All field-screening results for radioactivity were recorded in dose per minute.

Swipe samples were collected from sample containers and analyzed by a Laboratory RCT before they were removed from the site. Samples were transported to the Sample Management Office (SMO) in sealed coolers before they were shipped to the analytical laboratory. The SMO reviewed and approved the sample collection logs (SCLs) and chain-of-custody (COC) forms and accepted custody of the samples, after which the samples were shipped to the laboratory for analysis.

C-6.0 FIELD INSTRUMENT CALIBRATION

Instrument calibration was completed twice daily: once in the morning and again in the afternoon. Several environmental factors affected the instrument's integrity, including air temperature, atmospheric pressure, wind speed, and humidity. The PID was calibrated by the site safety officer and the Eberline E-600 was calibrated by the RCT. All calibrations were performed according to the manufacturers' specifications and requirements.

PID Calibration

The PID was calibrated both to ambient air and a standard reference gas (100 ppm isobutylene). The ambient-air calibration determined the zero point of the instrument sensor calibration curve in ambient air. Calibration with the standard reference gas determined a second point of the sensor calibration curve. Each calibration was within 3% of 100 ppm isobutylene, qualifying the instrument for use.

The following calibration information was recorded daily in the health and safety site logbook:

- instrument identification (ID) number
- initial and final span settings
- date and time
- concentration and type of calibration gas used (isobutylene at 100 ppm)
- name of the site safety officer performing the calibration

All daily calibration procedures for the MiniRAE 2000 PID met the manufacturer's specifications for standard reference gas calibration and the requirements of QP-5.2, Control of Measuring and Test Equipment.

Eberline E-600 Instrument Calibration

The Eberline E-600 was calibrated daily by the RCT before local background levels for radioactivity were measured and recorded by the RCT on the radiological survey form, RP-1. The instrument was calibrated using plutonium-239 and chloride-36 sources for alpha and beta/gamma emissions, respectively. The following five checks were performed as part of the calibration procedures: date of calibration, signs of physical damage, battery function, response to a source of radioactivity, and background level. All calibrations performed for the Eberline E-600 met the manufacturer's specifications, the requirements of QP-5.2, and the applicable radiation detection instrument manual.

C-7.0 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Quality assurance/quality control (QA/QC) samples for soil and rock were collected in accordance with SOP-01.05, Field Quality Control Samples. Field duplicate samples were collected at a frequency of at least 1 duplicate sample for every 10 samples collected. Field rinsate samples were collected from sampling equipment at a frequency of at least 1 rinsate sample for every 10 samples. Field trip blanks were also collected at a frequency of 1 for every 10 samples. Data for QA/QC samples for soil and rock are included in Appendix F (on compact disc).

C-8.0 SAMPLE DOCUMENTATION AND HANDLING

Surface and shallow subsurface samples were collected from soil and tuff using a spade and scoop or hand auger. All sampling was performed in accordance with SOP-06.09 and SOP-06.10, respectively.

Field personnel completed an SCL and associated COC form for each sample set. Sample containers were sealed with signed COC seals and placed into coolers to maintain a temperature of approximately 4°C. The samples were packaged with preservatives, as necessary, depending on the analytical method to be used, then packed, handled, and shipped in accordance with SOP-01.03, Handling, Packaging, and Transporting Field Samples, and SOP-01.02, Sample Containers and Preservation.

Swipe samples were collected and analyzed by the RCT before the characterization sample containers were removed from the site. Samples were transported to the SMO where personnel reviewed and approved the SCLs and COC forms and accepted custody of the samples. The samples were packaged and shipped to the laboratory for analysis.

C-9.0 DECONTAMINATION OF SAMPLING EQUIPMENT

The split-spoon, hand auger, and all other sampling equipment that came or may have come into contact with sample materials were decontaminated after the sample was retrieved and logged. Decontamination included wiping the equipment with Alconox, deinonized (DI) water, and paper towels. Dry decontamination of the equipment was performed with wire brushes between samples to avoid cross-contamination. Decontamination activities were performed in accordance with SOP-01.08, Field Decontamination of Drilling and Sampling Equipment, and SOP-01.05, Field Quality Control Samples.

C-10.0 HEALTH AND SAFETY

Field activities were conducted in accordance with the approved site-specific health and safety plan for Technical Area 21 (LANL 2005, 094088). All field personnel were required to sign a statement acknowledging they had read, understood, and agreed to abide by the requirements of the plan before being allowed on-site.

Tailgate safety meetings were conducted daily before the start of field activities for all field personnel. At the conclusion of the meetings, all attendees were required to sign the safety meeting form before beginning the day's work activities.

C-11.0 BACKFILLING AND SITE RESTORATION

Backfilling will be performed in early 2008 (Appendix D). Site restoration will be performed after all work at the area of elevated radioactivity is completed.

C-12.0 WASTE MANAGEMENT

All investigation-derived waste (IDW) generated during field activities (including personal protective equipment, sampling supplies, and plastic) was managed in accordance with the requirements of all applicable U.S. Environmental Protection Agency (EPA) and NMED regulations, U.S. Department of Energy (DOE) orders, and Laboratory implementation requirements. The SOPs applicable to the characterization and management of IDW at Consolidated Unit 21-018(a)-99 include SOP-01.06, Management of Environmental Restoration Project Waste, and SOP-01.10, Waste Characterization.

A waste characterization strategy form (WCSF) was prepared and approved for the area of elevated radioactivity before the initiation of field activities. The form provided information on IDW characterization, management, containerization, and estimated volumes. The form was followed for handling of waste generated on-site.

Additional details of waste management are provided in Appendix G.

C-13.0 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 number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

LANL (Los Alamos National Laboratory), May 5, 2005. "Site-Specific Health & Safety Plan (SSHASP), Interim Measure and Investigation of SWMU 21-018(a)-99, MDA-V at TA-21," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2005, 094088)

LANL (Los Alamos National Laboratory), July 3, 2007. "Sampling Data for Area of Elevated Radioactivity Near Location ID 21-02523 and North of Absorption Bed 3, Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21," Los Alamos National Laboratory letter (EP2007-0346) to J.P. Bearzi (NMED HWB) from S. Stiger (Environmental Programs Associate Director) and D. Gregory (DOE Federal Project Director), Los Alamos, New Mexico. (LANL 2007, 097448)

NMED (New Mexico Environment Department), August 9, 2007. "Approval with Modification for the Supplemental Work Plan for Consolidated Unit 21-018(a)-99, at Technical Area 21," New Mexico Environment Department letter to D. Gregory (DOE LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED HWB), Santa Fe, New Mexico. (NMED 2007, 098287)

Table C-1.0-1
QPs and SOPs Used for the 2006–2007 Characterization and Remediation Activities at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

QP-2.1, Personnel Qualification and Selection Process
QP-2.2, Personnel Training Management
QP-3.4, Corrective Action Process
QP-3.5, Peer Review Process
QP-4.3, Records Management
QP-4.4, Record Transmittal to the Record Processing Facility
QP-4.5, Document Control
QP-4.9, Document Development and Approval Process: Peer Review Required
QP-5.2, Control of Measuring and Test Equipment
QP-5.3, Readiness Planning and Review
QP-5.7, Notebook Documentation for Environmental Restoration Technical Activities
QP-7.1, Procurement
QP-8.1, Inspection and Acceptance Testing
QP-10.3, Stop Work and Restart
SOP-01.01, General Instructions for Field Investigations
SOP-01.02, Sample Containers and Preservation
SOP-01.03, Handling, Packaging, and Transporting Field Samples
SOP-01.04. Sample Control and Field Documentation
SOP-01.05, Field Quality Control Samples
SOP-01.06, Management of Environmental Restoration Project Waste
SOP-01.08, Field Decontamination of Drilling and Sampling Equipment
SOP-01.10, Waste Characterization
SOP-01.12, Field Site Closeout Checklist
SOP-01.13, Initiating and Managing Data Set Requests
SOP-03.11, Coordinating and Evaluating Geodetic Surveys
SOP-04.04, Contract Geophysical Logging
SOP-05.03, Monitoring Well and RFI Borehole Abandonment
SOP-06.09, Spade and Scoop Method for Collection of Soil Samples
SOP-06.10, Hand Auger and Thin-Wall Tube Sampler
SOP-10.14, Performing and Documenting Gross Gamma Radiation Scoping Surveys

Note: These procedures are available at: http://erproject.lanl.gov/documents/VL/operations.html#procedures.

Table C-1.0-2
Summary of Investigation Methods

Method	Summary
Spade-and-Scoop and Hand-Auger Collection of Samples	These methods were used for collection of surface (spade and scoop for samples from 0–6 in. of soil or from friable layers of excavation sidewalls) and subsurface (hand auger for samples at depths greater than 6 in. and in tuff). For the spade-and-scoop method, a hole was dug to the desired depth and a discrete grab sample was collected and homogenized in a decontaminated stainless-steel bowl before it was transferred to the appropriate sample containers. For the hand-auger method, a thin-walled tube sampler was used to extract soil or tuff from subsurface depths greater than 6 in.; each sample was homogenized in a decontaminated stainless-steel bowl before it was transferred into the appropriate sample containers.
VOC Screening	All samples were field screened for VOCs by placing a portion of the sample in a glass amber container that was secured with foil and a lid with an opening. The sample was allowed to equilibrate for 5 min. The sample was then screened by inserting a PID probe equipped with an 11.7-eV lamp through the opening and the foil into the container. The results were recorded in units of ppm on the SCLs.
Radiological Screening	Field screening was conducted by a Laboratory RCT on all samples collected from the area of elevated radioactivity for alpha- and beta/gamma-emitting radionuclides using an Eberline E-600 radiation meter with an SHP-380AB alpha/beta scintillation detector. The results were recorded in units of dpm on the SCLs.
Handling, Packaging, and Shipping of Samples	Samples were sealed and labeled before being packed in ice, and sample and transport containers were examined to ensure they were free of external contamination. Samples were packaged to minimize the possibility of breakage during transport. After environmental samples were collected, packaged, and preserved, they were transported to the SMO. A split of each sample was sent to an SMO-approved radiation-screening laboratory under COC. Once radiation-screening results were received, the SMO sent the corresponding analytical samples to fixed laboratories for full analysis.
Containers and Preservation of Samples	Specific requirements/processes for sample containers, preservation techniques, and holding times were based on EPA guidance for environmental sampling, preservation, and QA. Specific requirements for each sample were printed in the SCLs provided by the SMO (size and type of container, preservatives, etc.). All samples were preserved by placing them in insulated containers with ice to maintain a temperature of 4°C.
Sample Control and Field Documentation	Collecting, screening, and transporting samples were documented on standard forms generated by the SMO, including SCLs, COC forms, and sample container labels. Collection logs were completed at the time the samples were collected and were signed by the sampler and a reviewer who verified that the logs were complete and accurate. Corresponding labels were initialed and applied to each sample container, and custody seals were placed around container lids or openings. The COC forms were completed and assigned to verify that the samples were not left unattended.
Coordinating and Evaluating Geodetic Surveys	Geodetic surveys were conducted with a Trimble 5700 D global positioning system. The survey data conformed to Laboratory information architecture (IA) project standards IA-CB02, “GIS Horizontal Spatial Reference System,” and IA-D802, “Geospatial Positioning Accuracy Standard for A/E/C/ and Facility Management.” All coordinates are expressed as State Plane Coordinate System, North American Datum 83, New Mexico Central Zone, U.S. survey ft. All elevation data are reported relative to the National Geodetic Vertical Datum of 1983.

Table C-1.0-2 (continued)

Method	Summary
Management, Characterization, and Storage of IDW	The IDW was managed, characterized, and stored in accordance with an approved WCSF that documented site history, field activities, and the characterization approach for each waste stream managed. Waste characterization complied with on- or off-site waste acceptance criteria, as appropriate. All stored IDW was marked with appropriate signs and labels. The means to store, control, and transport each potential waste type and the classification of the waste were determined before field operations began. A waste storage area was established before waste was generated. Each waste container was individually labeled with waste classification, item ID, and radioactivity (if applicable) immediately following containerization. All waste was segregated by classification and compatibility to prevent cross-contamination.
Field QC Samples	Field QC samples were collected as directed in the Compliance Order on Consent as follows for the postexcavation samples (15 total): *Field Duplicate*—At a frequency of 10%: One field duplicate was collected and submitted for the same analyses. *Equipment Rinsate Blank*—At a frequency of 10%: One rinsate blank was collected by rinsing sampling equipment with DI water collected in a sample container and submitted for laboratory analysis. *Trip Blanks*—Required for sample collection that includes VOC analysis: One trip blank was collected, which consisted of certified clean sand that was kept with the other sample containers during the sampling process.
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination was the preferred method for minimizing liquid IDW. Dry decontamination included using a wire brush or other tool to remove soil or material adhering to the sampling equipment, followed by applying a commercial cleaning agent (Alconox and DI water) and paper wipes.

Attachment C-1

Photo Log

Photo 1 Area of elevated radioactivity before excavation, May 2007 (view to the east)

Photo 2 Close-up view of the 2-in.-thick layer of blackened debris found during excavation, May 2007

Photo 3 View of the 2-in.-thick layer of blackened debris found during excavation, May 2007

Photo 4 Mobilization of rolloff bins for excavated media, May 2007

Photo 5 Preparation of area of elevated radioactivity for excavation, May 2007

Photo 6 Excavation of area of elevated radioactivity, August–September 2007

Photo 7 Excavation of elevated area of radioactivity, August-September 2007

Photo 8 Transfer of removed soil to front-end loader, August-September 2007

Photo 9 **Front-end loader transport of removed soil to rolloff bins, August–September 2007**

Photo 10 **Front-end loader delivering removed soil to rolloff bins, August–September 2007**

Photo 11 Excavation within northwest corner of area of elevated radioactivity, August–September 2007

Photo 12 RCTs surveying soil in backhoe bucket during excavation, August–September 2007

Photo 13 RCT surveying the boundary of excavated area, August–September 2007

Photo 14 Exposed borehole 21-02523 in center of excavation area

Photo 15 Area of excavation (view to the south), September 2007

Photo 16 On-site sampling, August–September 2007

Photo 17 **Sampling using hand auger, August–September 2007**

Photo 18 **Dry decontamination of hand auger, August–September 2007**

Appendix D

Subsurface Vapor-Monitoring Plan for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21

D-1.0 INTRODUCTION

This appendix describes the proposed subsurface vapor-monitoring activities and the location, depths, and frequencies at which they will be conducted within the vadose zone beneath Consolidated Unit 21-018(a)-99, Material Disposal Area (MDA) V. One open borehole at location 21-02523 will be retrofit for monitoring tritium in water vapor beneath MDA V. This additional sampling will assist in characterizing the nature and extent of tritium in subsurface water vapor at MDA V. The nature and extent of shallower pore gas were inconclusive in the initial subsurface investigation of pore gas at the site. Therefore, the additional sampling will also provide data needed to determine concentration trends for shallower pore gas nature and extent.

This appendix also updates previously published information regarding borehole 21-02523. The previous investigation report (LANL 2007, 098942) provided drilling logs for the borehole that indicated a total depth (TD) of 660 ft below ground surface (bgs). However, additional archived drilling information has since been located that reports a TD of 708 ft bgs. Attachment D-1 provides a complete drilling record for this borehole that is composed of the detailed drilling log for depths up to 660 ft bgs and daily drilling summaries for depths from 660 to the TD of 708 ft bgs.

D-2.0 2005–2006 DATA SUMMARY

Fifteen boreholes drilled in 2005 were sampled at two depth intervals for vapor-phase volatile organic compounds (VOCs) and tritium (LANL 2007, 098942, Figure 1.2-1). The shallow interval was sampled at the approximate base of the absorption beds, and the deep interval was to be sampled at the TD of the borehole. In 2005, samples were not collected at the drilled TD of the boreholes because all boreholes contained several feet of sloughed material that resulted from auger flight removal and heavy equipment traffic. In 2006, each borehole was reamed to the original depth, and the augers were left in place to allow TD samples to be collected. In 2006, samples were collected from each borehole at the two depth intervals described above and were analyzed for VOCs and tritium (LANL 2007, 098942, Appendix B). In June 2006, all 15 boreholes were plugged and abandoned (LANL 2007, 098942, p. 22). No historical vapor-monitoring data have been obtained from location 21-02523.

D-2.1 VOCs in Pore-Gas Samples

The following 21 VOCs were detected in pore-gas samples collected in 2005: acetone; 2-butanone; 1-butanol; carbon disulfide; carbon tetrachloride; chloroform; 1,1-dichloroethane; 1,4-dioxane; ethanol; ethylbenzene; 4-ethyltoluene; methanol; 2-propanol; styrene; tetrachloroethene; toluene; 1,1,1-trichloroethane; trichloroethene; 1,2,4-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene (LANL 2007, 098942, Appendix B, Table B-2.4-2). The maximum VOC concentration detected in 2005 was 1-butanol (720 $\mu g/m^3$) at 4–5 ft bgs from location 21-24525. This borehole is located within the footprint of the former laundry facility.

Thirty-six VOCs were detected in pore-gas samples collected in 2006 (LANL 2007, 098942, Table B-2.4-1). These include acetone; benzene; bromodichloroethane; 1-butanol; 2-butanone; carbon disulfide; carbon tetrachloride; chloroform; chloromethane; dichlorodifluoromethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,2-dichloropropane; ethanol; ethylbenzene; 4-ethyltoluene; hexane; 2-methyl-4-pentanone; methylene chloride; n-heptane; propylene; styrene; tetrachloroethene; tetrahydrofuran; toluene; 1,2,2-trichloro-1,1,2-trifluoroethane; 1,1,1-trichloroethane; trichloroethane; trichlorofluoromethane; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; vinyl acetate; vinyl chloride; xylene (total); 1,2-xylene; and 1,3-xylene+1,4-xylene (LANL 2007, 098942, Table B-2.4-2). The maximum

VOC concentration in 2006 was acetone (680 µg/m^3) at TD (379–380 ft bgs) from location 21-24524. Generally, vapor-phase VOCs were detected at similar concentrations in 2005 and 2006.

Styrene was detected in all 30 pore-gas samples collected in 2005, ranging from 6.8 to 170 µg/m^3. The maximum concentration was detected at location 21-24527 in the sample from 4.5 to 5.5 ft bgs, decreasing to 71 µg/m^3 at depth. Styrene in 2005 pore-gas samples decreased with depth in 10 of 15 boreholes (styrene increased slightly or did not change in the other five boreholes). In 2006, styrene was detected in only nine pore-gas samples, all with concentrations less than 11 µg/m^3.

Toluene was detected in 29 samples, ranging from 7 to 50 µg/m^3 in 2005, with the maximum concentration at location 21-24524. Generally, toluene concentrations in 2005 pore-gas samples decreased or remained constant with depth at most locations. Toluene was also detected in 27 boreholes in 2006, ranging from 2.1 to 46 µg/m^3, with concentrations decreasing or remaining stable both laterally and with depth.

The VOC data were screened to determine whether vapor-phase VOCs in the subsurface were a potential source of groundwater contamination through migration of pore gas to groundwater (LANL 2007, 098942, Appendix H). The results of this screening indicate that vapor-phase VOCs in the subsurface at MDA V are not a potential source of groundwater contamination. Additionally, VOC vapor intrusion via an indoor pathway was evaluated, and the calculated risk for Consolidated Unit 21-018(a)-99 potential future residential vapor intrusion is less than the New Mexico Environment Department (NMED) target level of 1×10^{-5} (NMED 2006, 092513) for both the shallow and deep pore-gas model site conditions. The results of the ecological risk-screening assessment indicate no potential risk to ecological receptors at Consolidated Unit 21-018(a)-99 from vapor-phase VOCs. Thus, additional VOC vapor-monitoring data for Consolidated Unit 21-018(a)-99 (MDA V) do not need to be collected.

D-2.2 Tritium in Water-Vapor Samples

The concentration of tritium in subsurface water vapor was determined by collecting samples of subsurface pore gas containing tritiated water vapor. Pore-gas samples were collected and analyzed for tritium in both 2005 and in 2006 (LANL 2007, 098942, Table B-2.4-3). In 2005, the maximum detected tritium activity (24,570 pCi/L at 14–15 ft bgs) occurred at location 21-24524 between absorption beds 1 and 2. In 2006, location 21-24524 also had the maximum detected tritium activity (132,100 pCi/L) at TD. Most locations showed decreased or similar concentrations with depth. Six locations showed an increase in tritium activity with depth. Tritium activity decreased with distance away from location 21-24524 in both 2005 and 2006 samples. However, sufficient data are not available to conclusively define the vertical and lateral extent of tritium in subsurface water vapor in the fractured tuff at a depth (greater than 380 ft) below the former absorption beds. Figures 7.6-3 and 7.6-4 in the investigation report present tritium activity in pore gas in 2005 and 2006, respectively (LANL 2007, 098942).

D-3.0 PROPOSED VAPOR-MONITORING PLAN

D-3.1 Monitoring Distribution and Frequency

Borehole 21-02523 will remain open and is proposed for a vapor-monitoring well (Figure D-3.1-1). The borehole was backfilled to a depth of approximately 300 ft bgs in 1995 (Attachment D-1). The well will be equipped with multiple sampling ports for vapor monitoring. Sampling ports will be installed at approximately the midpoint of each of the four volcanic units, remaining open to the borehole: Qbt 3, Qbt 2, Qbt 1v, and Qbt 1g. The sample tubing will consist of ¼-in. stainless steel connected with Swagelok fittings. The 5-ft-thick sampling intervals will be filled with 10/20 silica sand. Bentonite chips will be tremied into the borehole and hydrated to isolate the sampling intervals. Figure D-3.1-2 provides a generalized schematic of the vapor-monitoring well design. Samples will be analyzed for tritium and will be collected quarterly for a minimum of 1 yr following construction of the vapor-monitoring well.

D-3.2 Monitoring Methods

The method for monitoring tritium in water vapor at MDA V includes purging the sampling port and field screening purge gas, followed by collecting samples in silica gel columns from prescribed intervals for off-site laboratory analysis. The silica gel column captures and contains water for tritium analysis. Water vapor is adsorbed onto the silica when subsurface air is pulled though the column. After a sample of subsurface water vapor has been collected, the column is removed from the system and sealed. The sealed columns are then shipped to an analytical laboratory for analysis. Silica gel column samples will be analyzed for tritium by the U.S. Environmental Protection Agency (EPA) Method 906.0. Field screening of subsurface vapor at MDA V will include measuring the percent carbon dioxide, percent oxygen, and organic vapors.

Vapor monitoring at MDA V will be conducted in accordance with the current version of Standard Operating Procedure 06.31, Sampling Sub-Atmospheric Air. According to this procedure, field screening will be performed before analytical samples are collected. Each port will be purged and monitored with a Landtec GEM2000 instrument or equivalent, until the percent carbon dioxide and oxygen levels have stabilized at values representative of subsurface vapor conditions. Before each sampling cycle, vapor-sample tubing must be purged of stagnant air in the line by drawing air from the sampling interval through the line. Purging the line ensures that the sample collected is representative of the subsurface air at depth; every sampling activity must include a purge cycle. Once purging and field screening are completed, water-vapor samples will be collected using silica gel columns. During each sampling event, a field duplicate silica gel column quality assurance sample will be collected and analyzed for tritium.

D-3.3 Reporting

The results from the quarterly monitoring will be included in a status report. This report may include recommendations for future monitoring based on data results and trends.

D-4.0 REFERENCES AND MAP DATA SOURCES

D-4.1 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 number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

LANL (Los Alamos National Laboratory), July 2007. "Investigation Report for Consolidated Unit 21-018(a)-99, Material Disposal Area V, at Technical Area 21, Revision 1," Los Alamos National Laboratory document LA-UR-07-4390, Los Alamos, New Mexico. (LANL 2007, 098942)

NMED (New Mexico Environment Department), June 2006. "Technical Background Document for Development of Soil Screening Levels, Revision 4.0, Volume 1, Tier 1: Soil Screening Guidance Technical Background Document," New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2006, 092513)

D-4.2 Map Data Sources

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Former TA-21 Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Potential Release Sites (SWMU/AOC); Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2005-0748; 1:2500 Scale Data; 22 November 2005.

Material Disposal Areas; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2004-0221; 1:2500 Scale Data; 23 April 2004.

Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

Hypsography, 10, 20, and 100 Foot Contour Interval; Los Alamos National Laboratory, RRES Remediation Services Project; 1991.

Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

Steam Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

Sewer Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

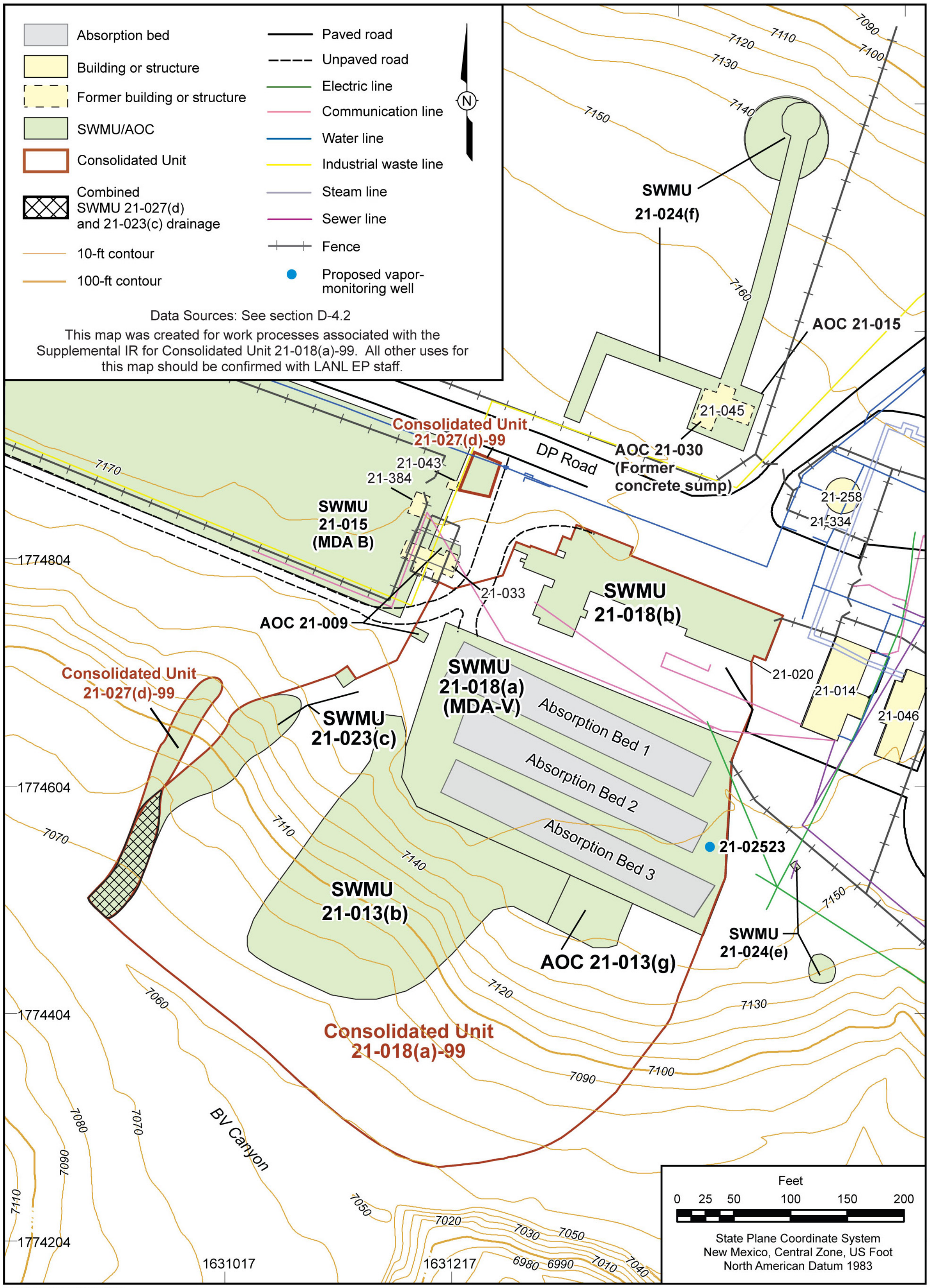
Industrial Waste Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Electric Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 08 August 2002; Development Edition of 05 January 2005.

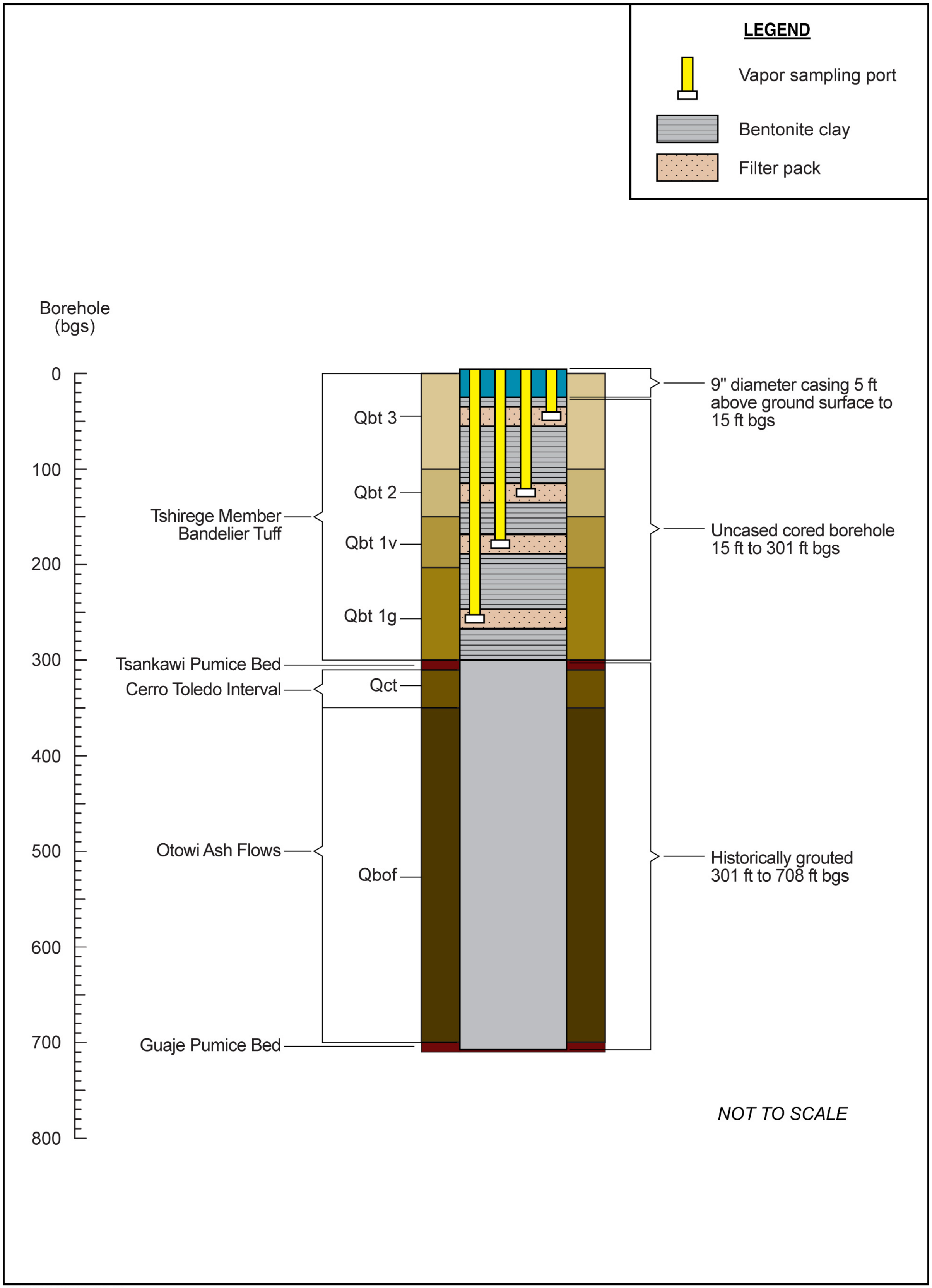
ER Location IDs point (borehole and sample locations); Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1:2500 Scale Data; 10 November 2005.

Former Drainline; Los Alamos National Laboratory, ENV Environmental Remediation and Stewardship Program; 1:2500 Scale Data, 02 October 2006.



129175.01000000 A20

Figure D-3.1-1 Proposed vapor-monitoring well location



129175.01000000 A19

Figure D-3.1-2 Proposed vapor-monitoring well construction details, location 21-02523

Attachment D-1

Borehole 21-02523 Drilling Log
(on CD included with this document)

Appendix E

Analytical Program

E-1.0 INTRODUCTION

Quality assurance (QA)/quality control (QC) and data validation procedures were implemented in accordance with the requirements of the Los Alamos National Laboratory (LANL or the Laboratory) "Quality Assurance Project Plan Requirements for Sampling and Analysis" (LANL 1996, 054609) and the Laboratory's analytical services statements of work (SOWs) for contract laboratories (LANL 1995, 049738; LANL 2000, 071233). The results of the QA/QC activities were used to estimate accuracy, bias, and precision of the analytical measurements. QC samples included method blanks, blank spikes, matrix spikes (MSs), and laboratory control samples (LCSs) to assess accuracy. The type and frequency of QC analyses are described in the analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233). Other QC factors, such as sample preservation and holding times, were also assessed. Evaluating these QC indicators allows estimates to be made of the accuracy, bias, and precision of the analytical results. A focused data validation was performed for all the data packages (also referred to as request numbers). It followed the same procedure discussed above and included a more detailed review of the raw data generated by the analytical laboratory.

Some analytical results were rejected for various reasons and are not usable for the purposes of this appendix. The remaining data, including qualified data, lend themselves for evaluation and interpretation. Data qualifier definitions are listed in Appendix A and in Table E-1.0-1. Summaries of the analytical methods for inorganic chemicals, radionuclides, and organic chemicals are provided in the following sections.

E-2.0 INORGANIC CHEMICAL ANALYSIS METHODS

The primary methods used for the analysis of inorganic chemicals are U.S. Environmental Protection Agency (EPA) SW-846 Method 6010B and EPA SW-846 Method 6020, but a variety of methods were used for individual analytes (e.g., mercury was analyzed by cold vapor atomic absorption [CVAA]). The analytical methods used for inorganic chemicals are listed in Table E-2.0-1.

E-2.1 Inorganic Chemical QA/QC Samples

LCSs, method blanks, MS samples, laboratory duplicate samples, interference check samples, and serial dilution samples were analyzed to assess accuracy and precision of inorganic chemical analyses. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233) and described briefly as follows.

The LCS serves as a monitor of the overall performance of each step during the analysis, including sample digestion. The analytical results for the samples were qualified according to National Functional Guidelines (EPA 1994, 048639) if the individual LCS recoveries were not within method-specific acceptable criteria. LCS recoveries should fall into the control limits of 75%–125% (LANL 1995, 049738; LANL 2000, 071233).

Method blanks serve as a measurement of bias and potential cross-contamination. All target analytes should be below the contract-required detection limit (LANL 1995, 049738; LANL 2000, 071233).

MS samples assess the accuracy of inorganic chemical analyses. An MS sample is designed to provide information about the effect of each sample matrix on the sample preparation procedures and analytical technique. The spike sample recoveries should be within the acceptance range of 75%–125% (LANL 1995, 049738; LANL 2000, 071233).

Laboratory duplicate samples assess the precision of inorganic chemical analyses. All relative percent differences between the sample and laboratory duplicate should be ±35% (LANL 1995, 049738; LANL 2000, 071233).

Interference check samples verify interelement and background correction factors at the beginning and end of each analysis run.

Serial dilution samples are used to determine the concentration of an analyte when serial dilution is employed. The purpose of such dilution is to bring the concentration of an analyte in the sample within the range of the analysis or to increase the precision of the detected result.

The validation of inorganic chemical data using QA/QC samples and other methods can result in the assignment of various qualifiers to individual sample results or the rejection of the data. The inorganic chemical data were qualified using the appropriate standard operating procedures (SOPs), and the qualifiers do not affect the usability of the sampling results. The results of qualified data were used as reported. Table E-2.1-1 summarizes the qualified inorganic chemical data.

E-2.2 Rejected Data

The postexcavation rejected inorganic chemical data are summarized in Table E-2.2-1. The rejected data were not used to characterize nature and extent and do not affect the nature and extent discussions in Appendix B or the risk assessments in Appendix H.

Both postexcavation rejected results were associated with sample RE21-07-6051, location 21-601267. The rejected data were for chromium and cyanide, detected at low concentrations (4.7 and 0.56 mg/kg, respectively). One other cyanide sample was collected at this location and was qualified as not detected.

E-3.0 SUMMARY OF RADIONUCLIDE ANALYSIS

The primary method used for the analysis of radionuclides is gamma-ray spectroscopy, EPA SW-846 Method 901.1, but a variety of methods were used for individual analytes (e.g., isotopic uranium was analyzed by alpha spectroscopy). Samples were analyzed for one or more of the following: gamma-emitting radionuclides, americium-241, isotopic plutonium, strontium-90, tritium, and isotopic uranium. The analytical methods used for radionuclides are listed in Table E-3.0-1.

E-3.1 Radionuclide QA/QC Samples

Radionuclides with reported values less than the minimum detectable activity were qualified as not detected (U). Each radionuclide result was also compared with the corresponding one sigma total propagated uncertainty (TPU). If the result was not greater than 3 times the TPU, the radionuclide was qualified as not detected (U).

The precision and bias of radiochemical analyses performed at external laboratories were assessed using MS samples, LCSs, method blanks, laboratory duplicates, and tracers. The analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233) specify that spike sample recoveries should be within ±25% of the certified value. LCSs were analyzed to assess the accuracy of radionuclide analyses. The LCSs serve as a monitor of the overall performance of each step during the analysis, including the radiochemical separation preparation. The analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233) specify that the LCS recoveries should be within ±25% of the certified value. Method blanks are also used to assess bias. The analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233) specify that the method blank concentration should not exceed the required minimum detectable activity.

The validation of radionuclide data using QA/QC samples and other methods can result in the assignment of various qualifiers to individual sample results or the rejection of the data. The radionuclide data were qualified using the appropriate SOPs, and the qualifiers do not affect the usability of the sampling results. The results of qualified data were used as reported. Table E-3.1-1 summarizes the qualified radionuclide data.

E-3.2 Rejected Data

The postexcavation-rejected radionuclide data are summarized in Table E-3.2-1. The rejected data were not used to characterize nature and extent and do not affect the discussions of nature and extent in Appendix H.

One postexcavation result was rejected for cesium-134, associated with sample RE21-07-604, location 21-600106. All other results (12) for cesium-134 were reported as not detected.

E-4.0 ORGANIC CHEMICAL ANALYSIS METHODS

Samples were analyzed for one or more of the following organic chemical analytical suites: volatile organic chemicals (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and dioxins/furans. The analytical methods used for organic chemicals are listed in Table E-4.0-1.

E-4.1 Organic Chemical QA/QC Samples

Calibration verifications, instrument-performance checks, LCSs, method blanks, MS samples, surrogates, and internal standards were analyzed to assess the accuracy and precision of the organic chemical analyses. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233) and described briefly as follows.

Calibration verification, consisting of initial and continuing verification, is the establishment of a quantitative relationship between the response of the analytical procedure and the concentration of the target analyte. The initial calibration verifies the accuracy of the calibration curve and the individual calibration standards used to perform the calibration. The continuing calibration ensures that the initial calibration is still holding and correct as the instrument is used to process samples. The continuing calibration also serves to determine whether analyte identification criteria, such as retention times and spectral matching, are being met.

Instrument performance checks consist of both background and check source counts for the proportional and liquid scintillation counters and check source counts and full width at half maximum determinations for the gamma spectrometers.

The LCS is a sample of a known matrix that has been spiked with compounds that are representative of the target analytes, and it serves as a monitor of the overall performance of a “controlled” sample. On a daily basis, the LCS is the primary demonstration of the ability to analyze samples with good qualitative and quantitative accuracy. The analytical results for the samples were qualified according to National Functional Guidelines (EPA 1999, 066649) if the individual LCS recoveries were not within method-specific acceptable criteria. LCS recoveries should fall into the control limits of 75%–125% (LANL 1995, 049738; LANL 2000, 071233).

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing and which is extracted and analyzed in the same manner as the corresponding environmental samples. Method blanks are used to assess the potential for sample contamination during extraction and analysis. All target analytes should be below the contract-required detection limit in the method blank (LANL 1995, 049738; LANL 2000, 071233).

MS samples are used to measure the ability to recover prescribed analytes from a native sample matrix. MS samples are aliquots of the submitted samples spiked with a known concentration of the target analyte(s). Spiking typically occurs before sample preparation and analysis. The spike sample recoveries should be within the acceptance range of 75%–125% (LANL 1995, 049738; LANL 2000, 071233).

A surrogate compound (surrogate) is an organic chemical compound used in the analyses of organic target analytes that is similar in composition and behavior to the target analytes but not normally found in environmental samples. Surrogates are added to every blank, sample, and spike to evaluate the efficiency with which analytes are recovered during the extraction and analysis. The recovery percentage of the surrogates must be within specified ranges, or the results may be rejected or assigned a qualifier (LANL 1995, 049738; LANL 2000, 071233).

Internal standards are chemical compounds added to every blank, sample, and standard extract at a known concentration. They are used to compensate for analyte concentration changes that might occur during storage of the extract and quantitation variations that can occur during analysis. Internal standards are used as the basis for quantitation of target analytes. The percent recovery for internal standards should be within the range of 50%–200% (LANL 1995, 049738; LANL 2000, 071233).

The validation of organic chemical data using QA/QC samples and other methods can result in the assignment of various qualifiers to individual sample results or the rejection of the data. The organic chemical data were qualified using the appropriate SOPs, and the qualifiers do not affect the usability of the sampling results. The results of qualified data were used as reported. Table E-4.1-1 summarizes the qualified organic chemical data.

E-4.2 Rejected Data

No postexcavation data for organic chemicals were rejected.

E-5.0 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 number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

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EPA (U.S. Environmental Protection Agency), February 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," EPA-540/R-94/013, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1994, 048639)

EPA (U.S. Environmental Protection Agency), October 1999. "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," EPA540/R-99/008, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1999, 066649)

LANL (Los Alamos National Laboratory), July 1995. “Statement of Work (Formerly Called "Requirements Document") - Analytical Support, (RFP number 9-XS1-Q4257), (Revision 2 - July, 1995),” Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1995, 049738)

LANL (Los Alamos National Laboratory), March 1996. “Quality Assurance Project Plan Requirements for Sampling and Analysis,” Los Alamos National Laboratory document LA-UR-96-441, Los Alamos, New Mexico. (LANL 1996, 054609)

LANL (Los Alamos National Laboratory), December 2000. “University of California, Los Alamos National Laboratory (LANL), I8980SOW0-8S, Statement of Work for Analytical Laboratories,” Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2000, 071233)

Table E-1.0-1
Definition of Data Qualifiers

Qualifier	Definition
J	The reported value should be regarded as estimated detect.
J+	The reported value should be regarded as estimated detect and biased high.
J-	The reported value should be regarded as estimated detect and biased low.
U	The analyte was analyzed for but not detected. Reported value is the sample-specific estimated quantitation limit or detection limit.
UJ	The analyte was analyzed for but regarded as estimated not detected. Reported value is an estimate of the sample-specific quantitation or detection limit.
R	The sample results were rejected because of serious deficiencies in the ability to analyze the sample and meet QC criteria; presence or absence cannot be verified.

Table E-2.0-1
Inorganic Chemical Analytical Methods

Analytical Method	Analytical Description	Target Compound List
EPA SW-846:6010B	Inductively coupled plasma-atomic emission spectrometry	Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc
EPA SW-846:6020	Field portable x-ray fluorescence	Antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, potassium, rubidium, selenium, silver, strontium, thallium, thorium, tin, titanium, vanadium, zinc, and zirconium
EPA SW-846:6850	High-performance liquid chromatography/electrospray ionization/mass spectroscopy	Perchlorate
EPA SW-846:7470A	Mercury in liquid waste—manual CVAA	Mercury
EPA SW-846:7471A	Mercury in solid or semisolid waste—manual CVAA	Mercury
EPA SW-846:9012A	Automated colorimetric, with offline distillation	Cyanide
EPA SW-846:9045C	Electrometric	pH
EPA 300.0	Ion chromatography (IC)	Inorganic anions
EPA 314.0	IC	Perchlorate
EPA 353.1	Nitrogen, nitrate-nitrite—colorimetric, automated hydrazine reduction	Nitrate
EPA 600M4	Particle count	Asbestos

Table E-2.1-1
Qualified Inorganic Chemical Data

Number of Samples	Qualifier	Reason Code	Qualifier Description
Preexcavation Data Qualifiers			
23	J	I3b	Results of the affected analytes are considered estimated (J) because the mass spectrum was analyzed on a non-LANL sample.
2	J	J_LAB	The analytical laboratory qualified the detected result as estimated (J) because the result was less than the practical quantitation limit but greater than the method detection limit.
3	J	I1	Results for the affected analytes are considered estimated (J) because the results were between the estimated quantitation limit and the method detection limit.
2	J	I10c	Results for the affected analytes are considered estimated (J) because both the sample and duplicate sample results were greater than or equal to five times the reporting limit and the duplicate relative percent difference was greater than 35% for soil samples
1	UJ	I3b	Results of the affected analytes are considered estimated not detected (UJ) because the mass spectrum was analyzed on a non-LANL sample.
Postexcavation Data Qualifiers			
23	J	I1	Results for the affected analytes are considered estimated (J) because the results were between the estimated quantitation limit and the method detection limit.
14	J	I10c	Results for the affected analytes are considered estimated (J) because both the sample and duplicate sample results were greater than or equal to five times the reporting limit and the duplicate relative percent difference was greater than 20% for water samples and greater than 35% for soil samples.
1	J	I10d	Results for the affected analytes are considered estimated (J) because either the sample or duplicate sample results or both were greater than or equal to five times the reporting limit, and the difference between the samples is greater than the reporting limit for water samples or greater than two times the reporting limit for soil samples.
1	J	I18b	Results of the affected analytes are considered estimated (J) because the serial dilution sample RPD was greater than 10% and the sample result was greater than 50 times the method detection limit (>100 times the MDL for inductively coupled plasma mass spectrometry).
9	J	J_LAB	The analytical laboratory qualified the detected result as estimated (J) because the result was less than the practical quantitation limit but greater than the MDL.
9	J-	I3e	Results for the affected analytes are considered estimated and biased low (J-) because the analyte was recovered below the lower acceptance level but greater than 30% in the associated spike sample.
2	J+	I3c	Results for the affected analytes are considered estimated and biased high (J+) because the analyte was recovered above 150% in the associated spike sample.
2	J+	I3d	Results for the affected analytes are considered estimated and biased high (J+) because the analyte was recovered above the upper acceptance level but less than 150% of the associated spike sample.
184	U	I4a	Results for the affected analytes are regarded as undetected (U) because the results are less than five times the amount in the preparation blank.

Table E-2.1-1 (continued)

Postexcavation Data Qualifiers (continued)			
3	UJ	I10c	Results for the affected analytes are considered estimated not detected (UJ) because both the sample and duplicate sample results were greater than or equal to five times the reporting limit and the duplicate relative percent difference was greater than 20% for water samples and greater than 35% for soil samples.
3	UJ	I3e	Results for the affected analytes are considered estimated not detected (UJ) because the analyte was recovered below the lower acceptance level but greater than 30% in the associated spike sample.
1	UJ	I9	Results for the affected analytes are considered estimated not detected (UJ) because the samples were analyzed after the appropriate hold time had passed.

Table E-2.2-1
Rejected Postexcavation Inorganic Chemical Data

Number of Samples	Qualifier	Reason Code	Qualifier Description	Analyte
1	R	I16e	Results for the affected analytes are considered rejected (R) because the associated multipoint calibration correlation coefficient is less than 0.995.	Chromium
1	R	I3	Results of the affected analytes are considered rejected (R) because the mass spectrum was not analyzed with the samples for unspecified reasons.	Cyanide

Table E-3.0-1
Radionuclide Analytical Methods

Analytical Method	Analytical Description	Target Compound List
EPA Method: 901.1	Gamma-ray spectroscopy	Americium-241, bismuth-211, bismuth-212, bismuth-214, cadmium-109, cerium-139, cesium-134, cesium-137, cobalt-60, europium-152, lead-212, lead-214, mercury-203, potassium-40, radium-223, radium-224, radium-226, radium-228, ruthenium-106, sodium-22, strontium-85, thallium-208, thorium-227, thorium-231, thorium-234, tin-113, uranium-235, and yttrium-88
EPA Method: 905.0	Precipitation, alpha/beta counting	Strontium-90
EPA Method: 906.0	Distillation and liquid scintillation	Tritium
HASL-300: Am-241	Alpha spectroscopy	Americium-241
HASL-300: ISOPU	Alpha spectroscopy	Isotopic plutonium
HASL-300: ISOU	Alpha spectroscopy	Isotopic uranium

Table E-3.1-1
Qualified Radionuclide Data

Number of Samples	Qualifier	Reason Code	Qualifier Description
Preexcavation Data Qualifiers			
17	J	R7	Results for the affected analytes are qualified as estimated (J) because duplicate documentation is missing.
4	J	R7b	Results for the affected analytes are estimated because the associated duplicate sample has a duplicate error ratio greater than or equal to 2 but less than or equal to 4.
2	J+	R1d	The results for the affected analytes are qualified as estimated and biased high (J+) because the associated tracer recovery was greater than 105%.
9	UJ	R7	Results for the affected analytes are qualified as estimated not detected (UJ) because duplicate documentation is missing. Validation can proceed without this information with qualification.
Postexcavation Data Qualifiers			
3	J	R7b	Results for the affected analytes are qualified as estimated (J) because the associated duplicate sample has a duplicate error ratio greater than or equal to two but less than or equal to four.
1	J-	R1b	The results for the affected analytes are qualified as estimated and biased low (J-) because the associated tracer recovery was less than 30% but greater than 10%.
2	UJ	R1c	The reporting limits for the affected analytes are qualified as estimated not detected (UJ) because the associated tracer recovery was less than 30% but greater than 10%.

Table E-3.2-1
Rejected Postexcavation Radionuclide Data

Number of Samples	Qualifier	Reason Code	Qualifier Description	Analyte
1	R	R5b	Results for the affected analytes are rejected (R) because spectral interference prevents positive identification of the analytes.	Cesium-134

Table E-4.0-1
Organic Chemical Analytical Methods

Analytical Method	Analytical Description	Target Compound List
SW-846:8260B	VOCs by gas chromatography/mass spectroscopy capillary column technique	See analytical SOW (LANL 2000, 071233)
SW-846:8270C	SVOCs by gas chromatography/mass spectroscopy capillary column technique	See analytical services SOW (LANL 2000, 071233)
SW-846:8082	PCBs by gas chromatography capillary column technique	See analytical services SOW (LANL 2000, 071233)
SW-846:8290	Dioxins/furans by high resolution gas chromatography/mass spectroscopy	See analytical services SOW (LANL 2000, 071233)

Table E-4.1-1
Qualified Organic Chemical Data

Number of Samples	Qualifier	Reason Code	Qualifier Description
Preexcavation Data Qualifiers			
2	J	J_LAB	The analytical laboratory qualified the detected result as estimated (J) because the result was less than the practical quantitation limit but greater than the MDL.
2	J-	SV9	The results/reporting limits for affected analytes are considered estimated and biased low (J-) because the extraction holding time was exceeded by less than two times the published method for holding time.
2	U	V4	Results for the affected analytes are considered not detected (U) because the associated sample concentration was less than five times/ten times the amount in the method blank.
135	UJ	SV9, V9	Results/reporting limits for affected analytes are considered estimated not detected (UJ) because the extraction/analytical holding time was exceeded by less than two times the published method holding time requirement.
11	UJ	SV7a, V7a	Results/reporting limits for affected analytes are considered estimated not detected (UJ) because the associated percent relative standard deviation/percent difference exceeded criteria in the initial or continuing calibration standards.
Postexcavation Data Qualifiers			
16	J	J_LAB	The analytical laboratory qualified the detected result as estimated (J) because the result was less than the practical quantitation limit but greater than the method detection limit.
1	J	V4a	Results for the affected analytes are considered estimated (J) because the associated sample concentration was greater than five times/ten times the amount in the method blank.
3	J-	V3a	Results for the affected analytes are considered estimated with a potential negative bias (J-) because the sample surrogate recovery was less than the lower acceptance limit but greater than 10%.
14	U	V4	Results for the affected analytes are considered not detected (U) because the associated sample concentration was less than five times/ten times the amount in the method blank.
56	UJ	V3c	Reporting limits for the affected analytes are considered estimated not detected (UJ) because the sample surrogate recovery was less than the lower acceptance limit but greater than or equal to 10%.
68	UJ	SV7a, V7a	Results/reporting limits for affected analytes are considered estimated not detected (UJ) because the associated percent relative standard deviation/percent difference exceeded criteria in the initial or continuing calibration standards.

Appendix F

Analytical Suites and Results and Analytical Reports
(on CD included with this document)

Appendix G

Waste Management

G-1.0 INTRODUCTION

This appendix contains the waste management plans, waste storage activities, and disposal records for waste streams generated during the 2007 excavations and/or field activities at Material Disposal Area (MDA) V, which is one of the sites within the Delta Prime (DP) Site aggregate area. Consistent with Los Alamos National Laboratory (LANL or the Laboratory) procedures, a waste characterization strategy form (WCSF) was prepared for the anticipated waste streams from the field investigation to identify and plan for the types of waste, the respective waste characterization approaches, and applicable on-site storage and final disposal methods. Ten anticipated and potential waste streams were documented in the WCSF (Attachment G-1). During the 2006–2007 supplemental investigation at MDA V, the only waste generated was from waste stream #7 (excavated rock and soil).

Wastes were initially placed in one satellite and three less-than-90-d accumulation areas established for the project wastes and managed conservatively as hazardous and radioactive, pending completion of characterization. The investigation-derived waste (IDW) characterization is based on analytical data for the media sampled. At the present time, all waste stored in the less-than-90-d accumulation areas has been sampled as described in the amendment to the WCSF (Attachment G-1). Some analytical data have not yet been received; therefore, characterization is ongoing for wastes held less than 90 d.

The analytical data for the media sampled are used to develop waste profile forms (WPFs). Final WPFs have been prepared to address the wastes generated by this investigation project. WPFs identify the waste streams in a standardized format to support planning and final disposition of the wastes. All waste from MDA V was included under one WPF (#40300) (Attachment G-2). WPFs for other waste streams listed in the WCSF will be developed if those waste streams are produced during future investigations. All the waste from MDA V was determined to be low-level waste (LLW) and sent to Area G at Technical Area (TA) 54 for disposal. Manifests are provided in electronic format on a compact disc in Attachment G-2 for all the waste generated.

All IDW generated was managed in accordance with applicable Environmental Programs Directorate standard operating procedures and quality procedures. The most current versions of these procedures are available online at http://erproject.lanl.gov/documents/VL/operations.html#procedures.

G-2.0 IDW SUMMARY

All the IDW consisted of overburden soil (waste stream #7), except trace amounts (less than 1%) of the material, which consisted of personal protective equipment (waste stream #6). This waste was stored in twenty-one 20-yd rolloff bins staged on-site until it was sent for disposal. The total waste volume was 420 yd^3. Table G-2.0-1 identifies waste generated during the investigation activities at MDA V, including container identification (ID), waste volume, waste description, and current disposition status. The table is organized by container ID number. All the waste was sent to Area G at TA-54 for disposal.

G-3.0 WCSF

A WCSF for the DP Site Aggregate Area investigation was prepared and approved by the Laboratory in June 2006 before initiation of field activities and generation of IDW. WCSF ER2006-0476, dated June 21, 2006, provides a description of 10 waste streams either anticipated or identified as having the potential to be generated during sampling and excavation activities at the site. The WSCF was amended on January 17, 2007 (Final Amendment 1), to include a direct waste sampling strategy for waste containers (rolloff bins, 55-gal. drums, and wrangler bags) and in situ waste material (including contents of septic tanks and drainlines). This amendment also modified waste streams #3, #4, and #7 to include steel and/or small amounts of rusted steel. Steel was added to the waste streams after a steel septic tank was discovered at Solid Waste Management Unit 21-024(c) instead of the anticipated concrete septic tank. A copy of the approved and signed WCSF and the amendment is provided in Attachment G-1.

G-4.0 INTERIM WASTE STAGING AND STORAGE

In addition to the waste stream description and characterization approach, the WCSF addresses storage and disposal plans for each waste stream. Wastes from the field activities have been managed conservatively as hazardous and radioactive waste in the satellite accumulation area or the less-than-90-d accumulation areas, pending characterization results based on investigation and bin sample analyses.

The less-than-90-d accumulation area used for the 2006–2007 supplemental investigation was located at MDA V (decommissioned on July 9, 2007). After the material was determined to be nonhazardous, the waste was stored on-site outside the accumulation area until it was sent for disposal.

Table G-4.0-1 provides a summary of waste storage and disposal plans for IDW based on characterization results, as applicable for waste streams actually generated during the investigation of these sites.

Table G-2.0-1
Summary of DP Site Aggregate Area IDW Generated at MDA V

Waste Description	Container Type	Container ID	Waste Type	Waste Quantity (yd^3)	Final Destination	Clean Backfill Quantity (yd^3)
Overburden Soil	20-yd Rolloff	5342	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5585	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5586	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5599	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5601	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5619	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5623	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5624	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5625	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5626	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5638	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5639	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5640	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5641	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5643	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5644	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5646	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5758	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5759	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5763	LLW	20.00	TA-54, Area G	0
Overburden Soil	20-yd Rolloff	5764	LLW	20.00	TA-54, Area G	0

Table G-4.0-1
DP Site Aggregate Area Waste Storage and Disposal Plans by Waste Stream

Waste Stream # from WCSF	Waste Stream	Waste Storage	Waste Disposal based on Characterization
6	Personal protective equipment and sampling wastes	55-gal. drum	LLW will be disposed of at TA-54 east. Nonhazardous waste will be disposed of off-site at a Laboratory-approved industrial disposal facility. Hazardous waste will be sent off-site for treatment/disposal in a permitted facility.
7	Excavated soil, rock, sand, and small pieces of rusty metal	Twenty-one 20-yd rolloff bins	

Attachment G-1

Waste Characterization Strategy Form and Final Amendment 1
(on CD included with this document)

Attachment G-2

Waste Profile Form and On-Site Waste Manifests
(on CD included with this document)

Appendix H

Risk Assessments

EXECUTIVE SUMMARY

This appendix presents the results of the human health and ecological risk-screening assessments performed in support of the supplemental remediation and investigation activities conducted in 2006-2007 at the area of elevated radioactivity within Consolidated Unit 21-018(a)-99. The analytical results for the 2006–2007 postexcavation data evaluated in this appendix indicate that the primary objective has been met for the supplemental remediation and investigation at the area of elevated radioactivity within Consolidated Unit 21-018(a)-99: no soil or tuff samples collected after completion of excavation activities have chemical of potential concern (COPC) concentrations that exceed applicable residential soil screening levels for inorganic and organic chemicals or screening action levels for radionuclides.

The total estimated excess cancer risk is approximately 3×10^{-7}, which is less than the New Mexico Environment Department (NMED) target level of 1×10^{-5}. The noncarcinogenic COPC hazard index (HI) is 0.1, which is less than the NMED target level of an HI of 1.0. The total dose is 0.44 millirem per year (mrem)/yr, which is less than the U.S. Department of Energy target dose of 15 mrem/yr. This dose corresponds to a radiological risk of approximately 1×10^{-5}, based on a comparison with U.S. Environmental Protection Agency radionuclide preliminary remediation goals for a residential receptor.

The ecological risk screening eliminated all chemicals of potential ecological concern (COPECs), indicating that no potential risk to terrestrial receptors exists from exposure to residual COPEC concentrations in the area of elevated radioactivity.

In summary, these results support the conclusion that no further investigation or corrective action is warranted at the site.

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Figures

Tables

H-1.0 INTRODUCTION

This appendix presents the results of the human health and ecological risk-screening assessments performed in support of the 2006–2007 supplemental remediation and investigation activities conducted at the area of elevated radioactivity within Consolidated Unit 21-018(a)-99, located on Delta Prime (DP) Mesa in Technical Area (TA) 21 at Los Alamos National Laboratory (LANL or the Laboratory). Field activities were conducted at the area of elevated radioactivity according to the supplemental investigation work plan (LANL 2007, 097448) and the New Mexico Environment Department's (NMED's) approval with modifications (2007, 098287). The primary objective of the supplemental investigation was to remove all soil and tuff with chemical of potential concern (COPC) concentrations greater than residential screening levels within the area of elevated radioactivity.

Consolidated Unit 21-018(a)-99 consists of four inactive solid waste management units (SWMUs) and one area of concern (AOC) consolidated in 1999 according to their related operational history and their proximity to one another (Figure 1.1-3). The following SWMUs and AOC comprise Consolidated Unit 21-018(a)-99:

- SWMUs 21-018(a) and 21-018(b), the three absorption beds and laundry facility south of DP Road, respectively
- SWMU 21-013(b) and AOC 21-013(g), debris disposal areas south of the absorption beds on the south-facing hillslope of BV Canyon (the canyon located directly below Material Disposal Areas [MDAs] B and V)
- SWMU 21-023(c), a septic system and outfall immediately west of the surface disposal areas and also on the south-facing hillslope of BV Canyon

The current land use for Consolidated Unit 21-018(a)-99 is industrial and is expected to remain industrial for the reasonably foreseeable future. However, the decision scenario for cleanup and the associated risk is a residential scenario.

The risk-screening assessments evaluate COPCs in all soil and tuff confirmation samples in the area of elevated radioactivity that is within SWMU 21-018(a) to the east of absorption bed 2, and the samples were collected after excavation activities were completed.

The main features of the risk-screening assessments for the area of elevated radioactivity are as follows:

- summary of historical operations at the site, site features, historical releases, and contamination sources (sections H-1.1 through H-1.3)
- description of the conceptual site model (CSM) for both human and ecological receptors (section H-3.0)
- comparison of maximum inorganic chemical, organic chemical, and radionuclide COPC concentrations with human health soil screening levels (SSLs) for inorganic and organic chemicals and screening action levels (SALs) for radionuclides (section H-4.0)
- comparison of maximum inorganic chemical, organic chemical, and radionuclide COPC concentrations with ecological screening levels (ESLs) (section H-5.0)
- uncertainty analyses relevant to the risk-screening results (sections H-4.2 and H-5.4)
- conclusions of the risk-screening assessments (section H-6.0)

Potential adverse effects to both human and ecological receptors are evaluated based on exposure to COPCs in all postexcavation (i.e., confirmation) samples collected in the area of elevated radioactivity. The human health risk-screening assessment is based on NMED and U.S. Environmental Protection Agency (EPA) Region 6 guidance (NMED 2006, 092513; EPA 2007, 095866) and compares maximum COPC concentrations in the 2006–2007 postexcavation samples with residential SSLs for inorganic and organic chemicals and residential SALs for radionuclides. The ecological risk-screening assessment is performed in accordance with the methodology presented in “Screening Level Ecological Risk Assessment Methods, Revision 2” (LANL 2004, 087630) and compares maximum COPC concentrations in the 2006–2007 postexcavation samples with ESLs.

H-1.1 Site Background

From 1945 to 1978, TA-21 was used primarily for plutonium research, metal production, and related activities. Since 1978, various administrative and chemical research activities have been conducted at TA-21. In general, the historical operations at Consolidated Unit 21-018(a)-99 included activities related to wastewater treatment and disposal and surface debris disposal. Historical operations at the individual SWMUs and AOC in the consolidated unit are summarized in section H-1.2.

H-1.2 Site Description and Operational History

Consolidated Unit 21-018(a)-99 is located on the south side of DP Road, just west of the main gate to the Laboratory’s TA-21 operational facilities, and is currently inactive (Figures 1.1-1, 1.1-2, and 1.1-3). The site consists of four inactive SWMUs and one AOC consolidated in 1999 according to their related operational history as well as their proximity to one another and include the following:

- SWMU 21-018(a) (MDA V)—Three wastewater absorption beds that received effluent from 1945 to 1961, located on the mesa south of the laundry facility: The beds were approximately 30 × 250 ft and 12 ft deep and were connected by gravity-fed overflow pipes. The beds and piping were excavated during the 2005–2006 removal activities.
- SWMU 21-018(b)—A former laundry facility for radioactively contaminated clothing that operated from 1945 to 1961, located immediately south of DP Road and directly north of the absorption beds: Operational from 1945 to 1961, the laundry facility was used to wash personal protective clothing and other reusable cloth items used in both research and production operations involving radioactive materials at TA-21. Wastewater was transported first to a concrete well then to the MDA V absorption beds. The wood portions of the building were decommissioned, decontaminated, and demolished in 1965 and taken to MDA G, where the debris was burned. The concrete foundation and associated piping were bulldozed over the edge of DP Mesa and still remain on the south-facing slope of BV Canyon. This debris was later designated SWMU 21-013(b) and AOC 21-013(g).
- SWMU 21-023(c)—A waste treatment laboratory septic system (tank and drainlines) and outfall that received effluent from 1948 to 1965: The septic tank and inlet are located primarily on the mesa, and the outfall is located on the south-facing hillslope of BV Canyon. The tank was removed in 1965 and taken to MDA G. Trenching activities performed during the 2005–2006 investigation indicated that no additional infrastructure (septic tank, lines, etc.) remained at the site.
- SWMU 21-013(b) and AOC 21-013(g)—A surface disposal area from the 1965 demolition of the laundry facility, consisting of building debris downslope of the absorption beds on the south-facing hillslope of BV Canyon: No clear demarcation exists between the SWMU and AOC. Other debris

on the slope includes asphalt and concrete poured onto the slope before it solidified, broken asphalt, concrete, piping, and miscellaneous building materials. The origin of the additional debris is not documented. AOC 21-013(g) consists of two discarded drainlines and miscellaneous building materials, also of unknown origin. It is not known how long these sites received building debris; however, they did not receive wastes after 1994.

SWMUs 21-018(a) and (b) are located on the mesa top. SWMU 21-013(b) and AOC 21-013(g) are located on the slope leading into BV Canyon. The SWMU 21-023(c) septic system is located primarily on the mesa top; the outfall is located on the slope leading into BV Canyon, west of SWMU 21-013(b) and AOC 21-013(g). The area of elevated radioactivity addressed in this supplemental investigation report is within SWMU 21-018(a), to the east of absorption bed 2. Additional details of the historical operations at Consolidated Unit 21-018(a)-99 are provided in the MDA V investigation report (LANL 2007, 098943).

H-1.3 Historical Releases and Contamination Sources

Historical releases and sources of surface and subsurface contamination at the site are related to the historical operations summarized in section H-1.2. In general, these include the following factors:

- The laundry facility discharged wastewater from washing machines at a rate ranging from 22,710 to 30,280 L (6000 to 8000 gal.) per day, equal to approximately 7.57 million L (2 million gal.)/yr, or 151.4 million L (40 million gal.) of effluent over the operating life of the facility (LANL 1991, 007529, p. 16-222).
- Observations as early as 1946 indicated the absorption beds were not functioning properly, causing large amounts of effluent to pool on the ground surface. Also, effluent was reported to have overflowed absorption bed 3 at one time (Abrahams 1962, 001306, p. 22).
- No releases from the debris material on the south slope were identified.
- No historical information was found regarding the amount of effluent (if any) discharged from the blow-down sump to the drainpipe and subsequently to the surface of DP Mesa from the sanitary septic system.

Additional details of the historical releases and sources of surface and subsurface contamination at Consolidated Unit 21-018(a)-99 are provided in the MDA V investigation report (LANL 2007, 098942).

H-2.0 INVESTIGATION SAMPLING AND COPC DETERMINATION

Investigation and confirmation sampling at the area of elevated radioactivity at Consolidated Unit 21-018(a)-99 were conducted in 2006–2007. A total of 15 soil and rock (tuff) confirmation samples were collected from the area of elevated radioactivity during 2006–2007 after the excavation activities were completed.

For both human and ecological receptors, the area of elevated radioactivity is evaluated as a single exposure area. The human health screening assessment uses analytical data for all 15 samples. The ecological screening assessment uses analytical data only for those samples collected from depths (0-5 ft below ground surface [bgs]) that might result in exposure to ecological receptors (seven samples).

Appendix B summarizes the COPC selection process and provides a complete data summary. Table H-2.0-1 summarizes the COPCs identified in the 2006–2007 postexcavation samples.

Table H-2.0-2 summarizes the COPCs identified in the 2006–2007 postexcavation samples collected from 0 to 5 ft bgs, which were evaluated in the ecological risk assessment.

Congeners of dioxins and furans were detected in two subsurface samples. Table H-2.0-3 presents the maximum detected concentration for each congener. The maximum concentrations are converted to an equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) by multiplying each concentration by a toxicity equivalency factor (TEF), thus deriving a congener-specific toxic equivalent TCDD concentration (www.who.int/ipcs/assessment/tef_updae/en/index.html). The sum of the TCDD-converted values (called the toxicity equivalency quotient [TEQ]) is compared with the TCDD SSL from EPA Region 6 (EPA 2007, 095866) and ecological TCDD ESL (see sections H-4.1 and H-5.3).

H-3.0 CSM

H-3.1 Receptors and Exposure Pathways

Current and future land uses within Consolidated Unit 21-018(a)-99 are industrial. However, the main objective of all remediation activities performed since 2005 has been to remove infrastructure and environmental media with concentrations of COPCs exceeding residential SSLs for inorganic and organic COPCs and residential SALs for radionuclide COPCs. Therefore, the residential scenario was evaluated as the primary decision scenario for the human health risk assessment.

The potential pathways for human exposure to surface soil and tuff are dermal contact, inhalation of vapors or fugitive dust, incidental soil ingestion, and external irradiation. Pathways from subsurface contamination to potential human receptors are complete only if contaminated soil or tuff is excavated and brought to the surface. The potential pathways are similar to those of a surface soil release (i.e., dermal contact, inhalation of vapors or fugitive dust, incidental soil ingestion, and external irradiation). Surface water is not evaluated in the human health screening assessment because no surface water exists at the site.

For ecological receptors, pathways from subsurface contamination to potential surface-dwelling animals are complete only if contaminated soil or tuff is excavated and brought to the surface. The potential pathways are similar to those of a surface soil release (i.e., dermal contact, inhalation of vapors or fugitive dust, incidental ingestion of soil, root uptake by plants, food web transport, and external irradiation). Pathways from subsurface releases may be complete for plants. Surface water is not evaluated in the ecological screening assessment because no surface water exists at the site.

Weathering of tuff is the only viable natural process that may result in the exposure of receptors to COPCs in tuff; because of the slow rate of weathering expected for tuff, exposure to COPCs in tuff is negligible, although it is included in the assessments.

The potential exposure pathways for the human health and ecological receptors are presented in the CSM diagram (Figure H-3.1-1).

H-3.2 Transport Pathways

The primary mechanisms of contaminant release at the site are related to the historical operations summarized in section H-1.3. Saturation is the primary factor in determining the potential for COPCs to migrate to groundwater. Based on previous investigation results, saturated conditions are not present within Consolidated Unit 21-018(a)-99. Downward migration in the vadose zone is also limited by the lack of both hydrostatic pressure and a source for the continued release of contamination. Without sufficient moisture and a source, little or no potential migration of materials can occur through the vadose zone to groundwater. Surface and subsurface soil and tuff are the media at the area of elevated radioactivity evaluated in this supplemental investigation report.

H-3.3 Environmental Fate and Transport

The evaluation of environmental fate addresses the chemical processes affecting the persistence of a chemical in the environment, and the evaluation of transport addresses the physical processes affecting mobility along a migration pathway. Transport through soil and tuff depends on soil pH, the precipitation or snowmelt, soil moisture, and soil hydraulic properties. Joints and fractures in the tuff may provide additional pathways for moisture and chemicals to enter the subsurface.

Consolidated Unit 21-018(a)-99 lies on a dry mesa top, approximately 1300 ft above the regional aquifer. Saturated conditions currently do not exist in the soil and tuff beneath Consolidated Unit 2-018(a)-99. Current measurements of the gravimetric water content in the upper 75 ft of the soil column indicate that soil on the mesa is relatively dry, and no evidence of a saturated subsurface zone has been found. Downward migration in the vadose zone is also limited by the lack of both hydrostatic pressure and a source for the continued release of contamination.

The nature and extent of contamination at the area of elevated radioactivity have been defined (Appendix B). The results from the deepest samples collected showed either no detected concentrations of COPCs or low trace-level concentrations of only a few inorganic, organic, and radionuclide COPCs in tuff. Also, no source(s) continue(s) to release contamination into the subsurface beneath the site. Because the vertical extent of contamination has been defined for the area of elevated radioactivity at Consolidated Unit 21-018(a)-99, it is apparent that no migration to groundwater has occurred. The limited extent of contamination is related to the absence of the key factors that contribute to migration, as discussed above.

Inorganic Chemicals

The physical and chemical factors that determine the distribution of inorganic COPCs within the soil and tuff at the site are the soil-water partition coefficient (K_d) of the inorganic chemicals, the pH of the soil, soil characteristics (such as sand or clay content), and redox potential. The interaction of these factors is complex, but the K_d values can provide a general assessment of the potential for migration through the subsurface: chemicals with higher K_d values are less likely to be mobile than those with lower ones. Table H-3.3-1 presents the K_d values for the inorganic COPCs at the area of elevated radioactivity (NMED 2006, 092513); these values match the K_d values recommended by EPA for the default pH of 6.8 for evaluation of Superfund sites (EPA 1996, 059902) and represent conservative values applicable to a wide range of sites. Chemicals with K_d values greater than 40 are not likely to migrate through soil toward the water table (Kincaid et al. 1998, 093270). Based on this K_d criterion, aluminum, antimony, barium, chromium, and nickel have a very low potential for migration to groundwater at Consolidated Unit 21-018(a)-99. K_d values were not available for nitrate and uranium. The nitrate concentrations detected are probably naturally occurring levels, and nitrate extent was defined (Appendix B).

The K_d values for copper and selenium given in Table H-3.3-1 indicate that these inorganic chemicals are relatively immobile in soil. Other factors, besides the K_d values, such as speciation in soil and oxidation/reduction (Eh) potential, also play a role in the likelihood that inorganic chemicals will migrate. Information about the fate and transport properties of inorganic chemicals was obtained from individual chemical profiles published by the Agency for Toxic Substances and Disease Registry (ATSDR) (1997, 056531). The information for these inorganic chemicals is also available from the ATSDR website at http://www.atsdr.cdc.gov/toxprofiles.

Most copper deposited in soil is strongly adsorbed and remains in the upper few centimeters of soil. In general, copper adsorbs to organic matter, carbonate minerals, clay minerals, or hydrous iron and manganese oxides. The soil at the area of elevated radioactivity is close to neutral pH (range from 7.3 to 8.9) and does not exhibit a high rate of leaching for copper. Selenium is not often found in the environment in its elemental form but is usually combined with sulfide minerals or with silver, copper, lead, and nickel minerals. In soil, pH and Eh are determining factors in the transport and partitioning of selenium. In soil with a pH greater than 7.5, selenates, which have high solubility and a low tendency to adsorb onto soil particles, are the major selenium species and are very mobile. The soil pH at the area of elevated radioactivity is generally higher than 7.5, which indicates that selenium may migrate in this soil. Nitrate is detected at naturally occurring concentrations and the extent of nitrate is defined (Appendix B).

Radionuclides

For radionuclides, an examination of K_d values also provides an assessment of whether a radionuclide is likely to be mobile in the subsurface at the area of elevated radioactivity. The K_d values for radionuclide COPCs presented in Table H-3.3-2 are from the Superfund chemical data matrix (EPA 1996, 064708). Radionuclides with K_d values greater than 40 are very unlikely to migrate to groundwater (Kincaid et al. 1998, 093270). Based on K_d values, americium-241, cesium-137, plutonium-238, and plutonium-239 have a very low potential to migrate toward groundwater at the area of elevated radioactivity.

The K_d value of 35 indicates that strontium-90 is relatively immobile in the subsurface. Vertical extent is defined for strontium-90.

Tritium’s initial behavior in the environment is determined by the source. If it is released as a gas or vapor to the atmosphere, substantial dispersion can be expected, and the rapidity of deposition is dependent on climatic factors. If tritium is released in liquid form, it is diluted in surface water and is subject to physical dispersion, percolation, and evaporation (Whicker and Schultz 1982, 058209, p. 147). Tritium concentrations in the subsurface at the area of elevated radioactivity are low (<1 pCi/g), indicating that the area of elevated radioactivity is not a significant source of tritium, although this radionuclide is relatively mobile. Because tritium migrates in association with moisture, the low moisture content of the subsurface limits the potential for tritium to migrate to groundwater.

Organic Chemicals

Table H-3.3-3 presents the physical and chemical properties (organic carbon-water partition coefficient [K_{oc}], logarithm to the base octanol-water partition coefficient [log K_{ow}], and solubility) of the organic COPCs at the area of elevated radioactivity. The physical and chemical properties of organic chemicals are important when evaluating fate and transport. The K_{oc} and solubility values were obtained from either Table B-1 of NMED guidance (2006, 092513), EPA Region 6 (2007, 095866), or the Risk Assessment Information System (RAIS) database (http://rais.ornl.gov/). Log K_{ow} values were obtained from the RAIS database. Other information is presented to illustrate some aspects of the fate and transport tendencies of the COPCs (Ney 1995, 058210).

Water solubility is an important chemical characteristic that indicates the mobility of organic chemicals. The higher the water solubility of a chemical, the more likely it is to be mobile and the less likely it is to accumulate, bioaccumulate, volatilize, or persist in the environment. A highly soluble chemical (water solubility greater than 1000 mg/L) is prone to biodegradation and metabolism that may detoxify the parent chemical. Methylene chloride has a solubility greater than 1000 mg/L. Dichlorobenzene[1,3-], dichlorobenzene[1,4-], and toluene are also soluble in water but to a lesser extent than methylene chloride.

The remaining organic COPCs at the area of elevated radioactivity have solubilities of less than 10 mg/L (i.e., these COPCs are relatively insoluble). The lower the water solubility of a chemical (especially less than 10 mg/L), the more likely it will be immobilized by adsorption. Chemicals with lower water solubilities tend to be more likely to accumulate or bioaccumulate and persist in the environment, are slightly prone to biodegradation, and may be metabolized in plants and animals.

Chemicals with a Henry's law constant greater than 10^{-5} atmosphere m^{-3}/mol and a molecular weight less than 200 g/mol are likely to volatilize; therefore, their concentrations at the site are reduced over time. Vapors of these chemicals are more likely to travel toward the atmosphere and not migrate toward groundwater. The following organic COPCs from the area of elevated radioactivity are likely to volatilize: 1,3-dichlorobenzene; 1,4-dichlorobenzene; methylene chloride; and toluene.

The soil K_{oc} measures the tendency of a chemical to adsorb to organic carbon in soil. K_{oc} values greater than 500 cm^3/g indicate a strong tendency to adsorb to soil (NMED 2006, 092513). Table H-3.3-3 provides the K_{oc} values for organic COPCs at the area of elevated radioactivity. Only three COPCs have K_{oc} values less than 500 cm^3/g: 1,3-dichlorobenzene; methylene chloride; and toluene.

Table H-3.3-3 shows the log K_{ow} for organic COPCs at the area of elevated radioactivity. With the exception of methylene chloride and toluene, all the chemicals have a log K_{ow} greater than 3, indicating that most of the organic COPCs are likely to sorb to soil and are relatively immobile. Extent has been defined for both of these COPCs.

Summary

Saturation is the primary factor in determining the potential for COPCs to migrate to groundwater. Based on investigation results, saturated conditions are not present within the area of elevated radioactivity at Consolidated Unit 21-018(a)-99. Downward migration in the vadose zone is also limited by the lack of both hydrostatic pressure and a source for the continued release of contamination. Without sufficient moisture and a source, little or no potential migration of materials can occur through the vadose zone to groundwater.

The nature and extent of contamination at the area of elevated radioactivity at Consolidated Unit 21-018(a)-99 are defined, and no source(s) continue(s) to release contamination into the subsurface beneath the site. The lack of saturated conditions and hydrostatic pressure severely limits the movement of contamination toward groundwater at the site. The relative solubilities and/or their partitioning properties also limit the mobility of the COPCs at the site. As a result, the potential for COPC migration to groundwater is very low, based on current site conditions, physical and chemical properties of COPCs (section H-3.3), the distance to the regional aquifer below the site (approximately 1300 ft), and the absence of a source for continued releases into the subsurface.

H-4.0 HUMAN HEALTH RISK-SCREENING ASSESSMENT

A human health risk-screening assessment was conducted to determine whether COPC concentrations in soil and tuff at the area of elevated radioactivity might pose a potential unacceptable risk to human receptors. The assessment assumes residential land use to support corrective action or no further action decisions at the area of elevated radioactivity.

H-4.1 Screening Evaluation

The human health risk-screening assessment compares maximum detected concentrations at the area of elevated radioactivity with residential SSLs for inorganic and organic chemicals and residential SALs for radionuclides. The SSL/SAL comparisons are presented separately for noncarcinogenic chemicals, carcinogenic chemicals, and radionuclides. SSLs for noncarcinogens are based on a hazard quotient (HQ) of 1.0; SSLs for carcinogens are based on a target cancer risk of 10^{-5} (NMED 2006, 092513). Cumulative cancer risk and a hazard index (HI) are also provided for the area evaluated. The ratio of each COPC exposure, calculated as the maximum detected concentration divided by the respective SSL, is the HQ; the sum of all HQs is the HI. The residential chemical SSLs are from NMED guidance (2006, 092513), but if NMED does not have an SSL for a chemical, EPA Region 6 guidance (2007, 095866) or EPA Region 9 values (http://www.epa.gov/region09/waste/sfund/prg/) are used, adjusted to 10^{-5} risk for carcinogens. The SALs for radionuclides are based on a dose of 15 millirem (mrem)/yr and are derived according to Laboratory guidance (2005, 088493).

The maximum detected concentrations for carcinogenic COPCs in the area of elevated radioactivity do not exceed the respective residential SSLs (Table H-4.1-1). The total estimated excess cancer risk is approximately 3×10^{-7}, which is less than NMED's target level of 1×10^{-5} (2006, 092513). The maximum concentrations for the noncarcinogenic COPCs in the area of elevated radioactivity also do not exceed the respective residential SSLs (Table H-4.1-2). The HI for the area of elevated radioactivity is 0.1, which is less than the NMED target level of an HI of 1.0 (2006, 092513). The total dose is 0.44 millirem per year (mrem/yr) (Table H-4.1-3), which is less than the U.S. Department of Energy's (DOE's) target dose of 15 mrem/yr (2000, 067489).

H-4.2 Uncertainty Analysis

The analyses presented in human health risk-screening assessments are subject to varying degrees and types of uncertainty. Aspects of data evaluation and COPC identification, exposure assessment, toxicity assessment, and the additive approach all contribute to uncertainties in the risk assessment process.

H-4.2.1 Data Evaluation and COPC Identification Process

A primary uncertainty associated with the COPC identification process is the possibility that a chemical may be inappropriately identified as a COPC. It is unlikely that inorganic chemicals were inappropriately excluded as COPCs because the only inorganic chemicals excluded were those with concentrations less than the background value or within the range of background concentrations (LANL 1998, 059730). Organic chemicals were appropriately identified as COPCs because all detected organic chemicals were retained for analysis.

Uncertainties associated with the inorganic chemical, organic chemical, and radionuclide data include sampling errors, laboratory analysis errors, and data analysis errors. For the area of elevated radioactivity, these uncertainties have no effect on the results, although detected concentrations of organic COPCs were J-qualified, indicating the values were less than estimated quantitation limits and could only be estimated.

H-4.2.2 Exposure Assessment

The following uncertainties result in a conservative (overestimation) of potential risk to human receptors from COPCs in soil and tuff at the area of elevated radioactivity:

- **Identification of Receptors—**The current and proposed future land use is industrial. However, the primary objective of remediation activities performed in the area of elevated radioactivity was to remove environmental media with concentrations of COPCs exceeding residential SALs for radionuclides or SSLs for inorganic and organic chemicals. Therefore, residential receptors were evaluated as the primary receptors within this risk assessment.
- **Exposure Pathways—**A number of assumptions are made relative to exposure pathways, including input parameters, whether or not a given pathway is complete, the contaminated media to which an individual may be exposed, and intake rates for different routes of exposure. In the absence of site-specific data, the exposure assumptions used were consistent with default values (NMED 2006, 092513). When several upper-bound values (as are found in NMED 2006, 092513) are combined to estimate exposure for any one pathway, the resulting risk can exceed the 99th percentile of “expected risk” and therefore can exceed the range of risk that may be reasonably expected. Also, the assumption that residual concentrations of chemicals in the tuff are available and cause exposure in the same manner as if they were in soil overestimates the potential risk to receptors.
- **Exposure Point Concentrations—**Some uncertainty is introduced in the concentration aggregation of data for estimating the exposure point concentrations (EPCs). Risk from a single location or area with relatively high COPC concentrations may overestimate exposure. The use of the maximum detected concentration is intended to provide an upper-bound (e.g., conservative) COPC concentration at the site, which may lead to an overestimation of exposure to a COPC across the site.
- **Similarity to Background Concentrations—**EPCs for inorganic COPCs may be similar to background concentrations and may therefore overestimate the potential exposure and risk to a receptor.

H-4.2.3 Toxicity Assessment

The primary uncertainty associated with the SSLs is related to the derivation of toxicity values used in their calculation. Toxicity values (slope factors [SFs] and reference doses [RfDs]) were used to derive the SSLs used in this risk-screening assessment (NMED 2006, 092513). Uncertainties were identified in three areas with respect to the toxicity values, as discussed in this section: extrapolation from animals to humans, extrapolation from one route of exposure to another route of exposure, and individual variability in the human population.

- **Extrapolation from Animals to Humans**—The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist in chemical absorption, metabolism, excretion, and toxic responses between animals and humans. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address these uncertainties in the dose-response relationship. However, conservatism is usually incorporated into each of these steps, resulting in the overestimation of potential risk.
- **Extrapolation from One Route of Exposure to Another Route of Exposure—**The SFs and RfDs often contain extrapolations from one exposure route to another that result in additional

conservatism in the risk calculations. For example, an extrapolation from the oral route to the inhalation and/or the dermal route was used in this assessment (NMED 2006, 092513), and differences between the two exposure pathways contribute to the uncertainty in the estimation of potential risk at this site.

- **Individual Variability in the Human Population—**For noncarcinogenic effects, the degree of variability in human physical characteristics is important both in determining the risks that can be expected at low exposures and in defining the no observed adverse effect level (NOAEL). The NOAEL uncertainty factor approach incorporates a 10-fold factor to reflect individual variability within the human population that can contribute to uncertainty in the risk assessment. This factor of 10 is generally considered to result in a conservative estimate of risk to noncarcinogenic COPCs.

H-4.2.4 Additive Approach

For noncarcinogens, the effects of exposure to multiple chemicals are generally not known, and possible interactions could be synergistic or antagonistic, resulting in either an overestimation or underestimation of the potential risk. Additionally, RfDs used in the risk calculations typically are not based on the same endpoints with respect to severity, effects, or target organs. Therefore, the potential for noncarcinogenic effects may be overestimated for individual COPCs that act by different mechanisms and on different target organs but are addressed additively.

H-4.3 Results of Human Health Screening Analysis

The maximum concentrations for carcinogenic COPCs in the area of elevated radioactivity do not exceed the respective residential SSLs (Table H-4.1-1). The total estimated excess cancer risk is approximately 3×10^{-7}, which is less than NMED's target level of 1×10^{-5} (2006, 092513). The maximum detected concentrations for the noncarcinogenic COPCs in the area of elevated radioactivity also do not exceed the respective residential SSLs (Table H-4.1-2). The HI is 0.1, which is less than the NMED target level of an HI of 1.0 (2006, 092513). The total dose is 0.44 mrem/yr (Table H-4.1-3), which is less than DOE's target dose of 15 mrem/yr (2000, 067489). This dose corresponds to a radiological risk of approximately 1×10^{-5}, based on a comparison with EPA radionuclide preliminary remediation goals for a residential receptor (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

H-5.0 ECOLOGICAL SCREENING ASSESSMENT

An ecological screening assessment was conducted to determine whether COPCs at the area of elevated radioactivity pose a potential unacceptable risk to ecological receptors. The approach used to evaluate ecological risk is described in "Screening Level Ecological Risk Assessment Methods, Revision 2" (LANL 2004, 087630).

H-5.1 Scoping Evaluation

The scoping evaluation establishes the breadth and focus of the ecological screening assessment. The ecological checklist (Attachment H-2 of LANL 2007, 098942) organizes existing ecological information about the site for the scoping evaluation and forms the basis for the determination of key aspects of the CSM: habitat type and quality, potential receptor exposure, and contaminant transport pathways.

The area of elevated radioactivity is highly disturbed and consists primarily of bare soil and rock from the removal actions that have taken place. The dominant overstory vegetation type surrounding the area is ponderosa pine, with minor vegetation components of fir (white and Douglas) and piñon pine. The understory surrounding the site contains mostly native and nonnative grasses and ruderal species indicative of disturbance, with a few shrubs and forbs. The general habitat quality in undisturbed areas surrounding the site is sufficient to support grazing and foraging by terrestrial receptors. However, the habitat within the boundary of the area of elevated radioactivity is of relatively poor quality because of significant disturbance from the removal activities conducted at the site. No threatened and endangered (T&E) species habitat is present at the site.

Surface water runoff terminates to the south-southwest of the site in BV Canyon. The area of elevated radioactivity is located upgradient of the steep slope to the canyon. No potential for exposure to aquatic receptors exists because no persistent aquatic habitat or perennial source of water occurs in the canyon. Additionally, the depth of the regional aquifer (approximately 1300 ft bgs) and the semiarid climate provide for minimal hydrologic head and preclude migration of COPCs to groundwater. Thus, exposure to groundwater is not evaluated in the screening-level ecological assessment for the area of elevated radioactivity.

The potential exposure of terrestrial receptors to COPCs in surface soil and unconsolidated tuff is by root uptake, dust inhalation, soil ingestion, external irradiation, dermal exposure, and food web transport (Figure H-3.1-1). Exposure pathways to receptors from COPCs in consolidated tuff are incomplete because COPCs in tuff are generally immobilized and become available to receptors only as a function of the slow rates of weathering of the tuff. Plant exposure to COPCs in tuff is largely limited to fractures near the surface, which does not produce sufficient biomass to support an herbivore population. Consequently, COPCs in tuff are not available to the extent necessary to cause adverse population-level effects.

Potentially complete pathways for exposure of terrestrial receptors to COPCs exist at the site. The potential risk is evaluated quantitatively in this risk-screening assessment for the following ecological receptors, representing several feeding guilds and trophic levels:

- plants
- soil-dwelling invertebrates (represented by the earthworm)
- deer mouse (mammalian omnivore)
- Montane shrew (mammalian insectivore)
- desert cottontail (mammalian herbivore)
- fox (mammalian carnivore)
- American robin (avian insectivore, omnivore, and herbivore)
- American kestrel (avian insectivore and carnivore); surrogate for avian T&E species

Of the terrestrial receptors evaluated, only the Montane shrew is not expected to be present at the area of elevated radioactivity because it requires free water for survival—surface water does not exist at the site. However, because the shrew represents the insectivorous feeding guild for mammals, which is not specifically represented by any of the other terrestrial receptors, the shrew is evaluated in this risk-screening assessment.

H-5.2 Assessment Endpoints

An assessment endpoint is an “explicit expression of the actual environmental value that is to be protected, operationally defined by an ecological entity and its attributes” (EPA 1998, 062809). Assessments should include ecologically relevant endpoints that help to sustain the natural structure, function, and biodiversity of an ecosystem or its components. In this screening assessment, the assessment endpoints are the populations and communities of the terrestrial receptors listed in this section, and the assessment is consistent with EPA guidance (1997, 059370).

The screening process is designed to be protective of biotic populations and ecological communities rather than individual organisms, except for “special status species,” which include listed or candidate T&E species or treaty-protected species (EPA 1999, 070086). The American kestrel is evaluated as a surrogate for the Mexican spotted owl, a special status avian receptor (listed T&E species) known to live on and near Laboratory property.

In accordance with EPA guidance on assessment endpoints, the Laboratory developed generic assessment endpoints to ensure that valued and ecologically relevant receptors at all levels within a given ecological community are considered in the screening process (LANL 1999, 064137). These endpoints are evaluated by measuring potential impacts to reproduction, growth, and survival that may adversely affect populations. The specific receptors chosen for the screening evaluation represent feeding guilds and thus exposure scenarios for each ecological functional group within the terrestrial communities expected at the site. Receptor species are chosen because of their presence at the site, potential sensitivity to the COPCs, and potential for exposure to those COPCs. In summary, the screening evaluation is designed to protect the selected receptors and other species within the same feeding guilds who occupy similar ecological niches as the selected receptors.

H-5.3 Screening Evaluation

The ecological screening evaluation identifies chemicals of potential ecological concern (COPECs) in soil and tuff from 0 to 5 ft bgs and is based on the comparison of maximum detected concentrations at the site with minimum ESLs. The comparison is summarized in the calculation of HQs for each COPC and screening receptor. The HQ is defined as the ratio of the EPC in the exposure medium being investigated to the concentration that has been determined to be acceptable to a given ecological receptor. The higher the contaminant levels relative to the ESLs, the higher the potential risk to receptors; conversely, the higher the ESLs relative to the contaminant levels, the lower the potential risk to receptors. The analysis begins with a comparison of the minimum ESL with the maximum detected concentration for a given COPC (Table H-5.3-1). COPCs with HQs greater than 0.3 are used to identify COPECs requiring further evaluation (LANL 2004, 087630). COPECs are carried forward in the analysis, and receptor-specific ESLs are compared with the maximum detected concentrations, resulting in an HQ for each COPEC/receptor combination. Individual HQs for a receptor are summed to derive an HI; an HI greater than 1.0 is an indication of potential adverse impacts to a given receptor from exposure to multiple COPECs at a site. Additionally, chemicals without ESLs are retained as COPECs and are evaluated further in the uncertainty section. The HQ/HI analysis is a conservative indication of potential adverse effects and is designed to minimize the potential of overlooking possible COPECs at the site.

ESLs were obtained from the ECORISK Database, Version 2.2 (LANL 2005, 090032), as presented in Table H-5.3-2, for COPECs requiring further analysis based on the final ESL screen. ESLs are based on similar species and are derived from experimentally determined NOAELs, lowest observed adverse effect levels (LOAELs), or doses determined lethal to 50% of the test population. Information relevant to the calculation of ESLs, including concentration equations, dose equations, bioconcentration factors, transfer factors, and toxicity reference values, are presented in the ECORISK Database, Version 2.2 (LANL 2005, 090032).

Of the COPCs identified for evaluation of ecological risk at the area of elevated radioactivity, four COPCs (methylene chloride, toluene, plutonium-239, and tritium) were eliminated from further evaluation because the minimum ESL analysis indicated that HQs for all receptors were less than 0.3 (Table H-5.3-1). A total of five COPCs (four inorganic chemicals and dioxin/furan congeners evaluated as TCDD TEQ) were identified as COPECs. Nitrate could not be evaluated for any receptor because ESLs are not available (Table H-5.3-1) and was retained as a COPEC. As presented in Table H-5.3-3, the HIs for the terrestrial receptors range from 0.02 (American kestrel, top carnivore) to 86 (plant).

H-5.4 Uncertainty Analysis

This section provides an evaluation of the ecological screening assessment results in the context of assumptions used in the screening process to determine whether the results are ecologically meaningful, indicating potential risk to ecological receptors and requiring additional analysis.

A variety of factors contribute to the uncertainty associated with the ecological screening evaluation. Uncertainty is inherent in all aspects of the risk-screening process, including the estimation of exposure to receptors, the characterization of potential ecological effects related to this exposure, and the final evaluation of potential risk to the receptors. The screening analysis is designed so the uncertainties do not lead to an underestimation of the actual risk to the ecological receptors at the site but rather overestimate the potential risk posed by COPECs. When multiple conservative biases are used, the result is a multiplicative effect on the overestimation of risk. The uncertainties identified for the ecological screening assessment for the area of elevated radioactivity are summarized in this section.

H-5.4.1 Chemical Form

Toxicological data are typically based on the most toxic and bioavailable chemical species of a COPC, conditions not likely to occur in the environment. The inorganic, radiological, and organic COPCs identified for the area of elevated radioactivity are generally not 100% bioavailable (as assumed in the screening evaluation) to receptors in the environment because of numerous factors, including adsorption to matrix surfaces (e.g., soil) and rapid oxidation or reduction changes that render chemical species unavailable to biota. This uncertainty leads to an overestimation of potential risk to ecological receptors.

H-5.4.2 Exposure Assumptions

The following assumptions regarding the exposure for terrestrial receptors lead to an overestimation of potential risk to ecological receptors:

- The vicinity around the area of elevated radioactivity is an active industrial area and has been substantially disturbed by the removal activities at the site. Thus, little of the area is available as habitat for ecological receptors.
- EPCs used in the HQ calculations are the maximum detected concentrations in the soil and/or tuff to a depth of 5 ft, assumed to represent the sitewide concentrations of COPCs at the area of elevated radioactivity.
- Receptors are assumed to ingest 100% of their food and spend 100% of their time at the area of elevated radioactivity.
- COPCs in tuff were included in the analysis, although they are not available to receptors.

In addition, the assessment assumes that the COPECs are distributed uniformly across the site. COPECs detected once or only in a few locations are unlikely to impact a receptor population.

H-5.4.3 Toxicity Values

The HQs were calculated using ESLs that are based on NOAELs as threshold-effect levels; actual risk for a given COPEC/receptor combination occurs at a higher level, somewhere between the NOAEL-based threshold and the threshold based on the LOAEL. Using NOAELs leads to an overestimation of potential risk to ecological receptors. The ESLs are based on laboratory studies requiring extrapolation to wildlife receptors. Laboratory studies are typically based on artificial and maintained populations with genetically similar individuals and are limited to single chemical exposures in isolated and controlled conditions using a single exposure pathway. Wild species are concomitantly exposed to a variety of chemical and environmental stressors, potentially rendering them more susceptible to chemical stress. On the other hand, wild populations are probably more genetically diverse than laboratory populations, making wild populations, as a whole, less sensitive to chemical exposure than laboratory populations. The uncertainties associated with the ESLs may under- or overestimate potential risk.

H-5.4.4 Background Concentrations

The ecological screening is based on the exposure of ecological receptors to contamination to a depth of 5 ft. Table H-5.4-1 presents the EPCs for inorganic COPECs and the range of soil and tuff background concentrations (LANL 1998, 059730). All inorganic COPECs had maximum detected concentrations either within the range of background concentrations or less than or equal to twice the maximum background concentration. Based on the comparison of the maximum detected concentrations and the range of background concentrations, barium, chromium, nickel, and selenium were eliminated as COPECs because exposure is similar to background across the site and is not likely to pose a potential ecological risk.

H-5.4.5 Area Use Factors

In addition to the direct comparison of the EPC with the ESLs, area use factors (AUFs) are used to account for the amount of time that a receptor is likely to spend within the contaminated areas based on the size of the receptor's home range (HR). The AUFs for individual organisms were developed by dividing the size of the site by the HR for that receptor. The area of elevated radioactivity is approximately 0.014 hectare (ha). The HR for the Mexican spotted owl is 366 ha; therefore, the AUF for the Mexican spotted owl is 0.000038 (Table H-5.4-2). Based on the application of the AUF for the Mexican spotted owl to the HI for the carnivorous kestrel (0.02), which is a surrogate for the owl, no potential exists for ecological risk to the Mexican spotted owl (HI = 0.000008).

H-5.4.6 Population Area Use Factors

According to the HI analysis (Table H-5.3-3), all terrestrial receptors, except the red fox, desert cottontail, and American kestrel (top carnivore), had HI values greater than 1.0; the HIs for the robin are approximately 1.0. EPA guidance is to manage the ecological risk to populations rather than to individuals, with the exception of T&E species (1999, 070086). To estimate the spatial extent of the areas inhabited by the wildlife populations, one approach is to assess potential effects on populations at the area of elevated radioactivity.

The population area for each receptor is based on the individual receptor HR and its dispersal distance (Bowman et al. 2002, 073475). Bowman et al. (2002, 073475) estimate that the median dispersal distance for mammals is 7 times the linear dimension of the HR (i.e., the square root of the HR area). If only the dispersal distances for the mammals with HRs within the range of the screening receptors are used, the median dispersal distance becomes 3.6 times the square root of the HR ($R^2 = 0.91$; Bowman et al. 2002, 073475). If it is assumed that the receptors can disperse the same distance in any direction, the population area is circular and the dispersal distance is the radius of the circle. Therefore, the population area for each receptor is approximately 40 HR.

The area of elevated radioactivity is estimated as 0.014 ha. The population area use factor (PAUF) is calculated by dividing the site area of 0.014 ha by the population area of the receptor (Table H-5.4-2). The resulting value is multiplied by the receptor HI to determine whether a potential impact may occur on the population. The HI values for the plant and earthworm are not adjusted by PAUFs because these receptors do not have HRs from which PAUFs can be calculated.

The adjusted HIs for all ecological receptors are equal to or less than 1.0 (Table H-5.4-3), as adjusted for population area use and inorganic COPECs, with maximum detected concentrations similar to background concentrations.

H-5.4-7 COPECs without ESLs

Nitrate has no ESL for any terrestrial receptor. Nitrate was detected in five of eight samples collected between 0 and 5 ft bgs. The maximum detected nitrate concentration of 2.2 mg/kg is considerably lower than the NMED residential SSL of 100,000 mg/kg, indicating that potential toxicity to nitrate is very low. In addition, nitrate is naturally occurring and the concentrations detected are likely not from a release. Nitrate is eliminated as a COPEC.

H-5.5 Results of Ecological Screening Analysis

Based on the ecological screening assessment for the area of elevated radioactivity at Consolidated Unit 21-018(a)-99, several COPECs were identified. All COPECs were eliminated by analyzing several factors that resulted in HIs that do not indicate a potential risk to receptors.

H-6.0 CONCLUSIONS

The analytical results for the 2006–2007 postexcavation data evaluated in this appendix indicate that the primary objective of the supplemental remediation and investigation at the area of elevated radioactivity within Consolidated Unit 21-018(a)-99 has been met: no soil or tuff samples collected after completion of excavation activities have COPC concentrations that exceed applicable residential SSLs and SALs.

The total estimated excess cancer risk is approximately 3×10^{-7}, which is less than NMED's target level of 1×10^{-5} (2006, 092513). The noncarcinogenic COPC HI is 0.1, which is less than the NMED target level of an HI of 1.0 (2006, 092513). The total dose is 0.44 mrem/yr (Table H-4.1-3), which is less than DOE's target dose of 15 mrem/yr (2000, 067489). This dose corresponds to a radiological risk of approximately 1×10^{-5}, based on a comparison with EPA radionuclide preliminary remediation goals for a residential receptor (http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls).

The ecological risk screening eliminated all COPECs, indicating that no potential risk to terrestrial receptors exists from exposure to residual COPEC concentrations in the area of elevated radioactivity.

In summary, these results support the conclusion that no further investigation or corrective action is warranted at the site.

H-7.0 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 number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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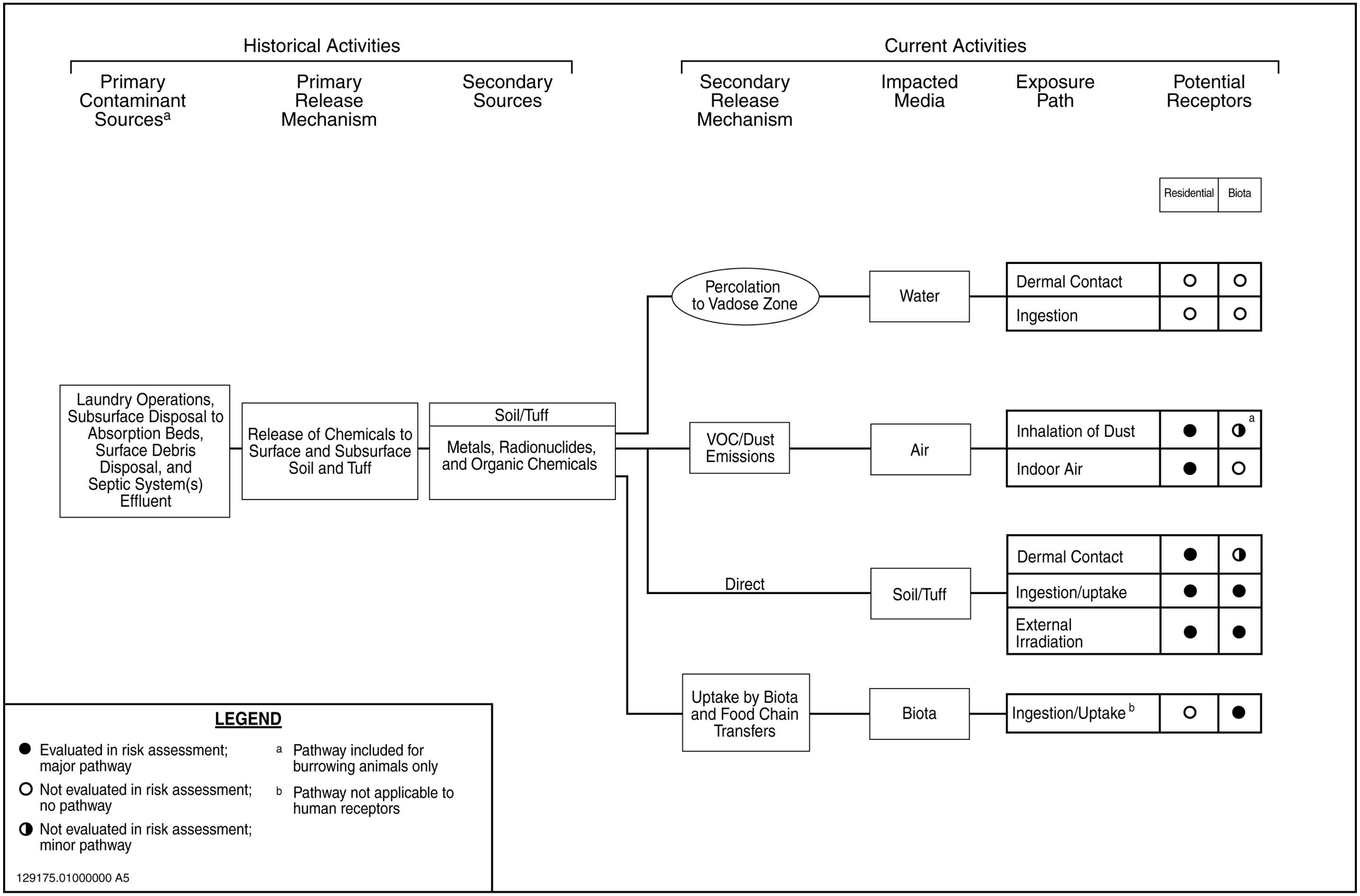

Figure H-3.1-1 CSM flow diagram for Consolidated Unit 21-018(a)-99

Table H-2.0-1
Summary of COPCs Evaluated in Human Health Risk Assessment for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Inorganic COPCs 0–10 ft bgs	Radionuclide COPCs 0–10 ft bgs	Organic COPCs 0–10 ft bgs
Aluminum	Americium-241	Dichlorobenzene[1,3-]
Antimony	Cesium-137	Dichlorobenzene[1,4-]
Barium	Plutonium-238	Fluoranthene
Chromium	Plutonium-239	Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]
Copper	Strontium-90	Heptachlorodibenzofuran[1,2,3,4,6,7,8-]
Nickel	Tritium	Heptachlorodibenzofuran[1,2,3,4,7,8,9-]
Nitrate		Hexachlorodibenzodioxin[1,2,3,4,7,8-]
Selenium		Hexachlorodibenzodioxin[1,2,3,6,7,8-]
		Hexachlorodibenzodioxin[1,2,3,7,8,9-]
		Hexachlorodibenzofuran[1,2,3,4,7,8-]
		Hexachlorodibenzofuran[1,2,3,6,7,8-]
		Hexachlorodibenzofuran[2,3,4,6,7,8-]
		Methylene chloride
		Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]
		Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]
		Pentachlorodibenzodioxin[1,2,3,7,8-]
		Pentachlorodibenzofuran[1,2,3,7,8-]
		Toluene

Table H-2.0-2
Summary of COPCs Evaluated in Ecological Risk Assessment for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Inorganic COPCs 0–5 ft bgs	Radionuclide COPCs 0–5 ft bgs	Organic COPCs 0–5 ft bgs
Barium	Plutonium-239	Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]
Chromium	Tritium	Heptachlorodibenzofuran[1,2,3,4,6,7,8-]
Nickel		Heptachlorodibenzofuran[1,2,3,4,7,8,9-]
Nitrate		Hexachlorodibenzodioxin[1,2,3,4,7,8-]
Selenium		Hexachlorodibenzodioxin[1,2,3,6,7,8-]
		Hexachlorodibenzodioxin[1,2,3,7,8,9-]
		Hexachlorodibenzofuran[1,2,3,4,7,8-]
		Hexachlorodibenzofuran[1,2,3,6,7,8-]
		Hexachlorodibenzofuran[2,3,4,6,7,8-]
		Methylene chloride
		Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]
		Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]
		Pentachlorodibenzodioxin[1,2,3,7,8-]
		Pentachlorodibenzofuran[1,2,3,7,8-]
		Toluene

Table H-2.0-3
Dioxin/Furan TCDD TEQ Conversions for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPC	TEF	2006–2007 Maximum Concentration (mg/kg)	TEF-Adjusted 2006–2007 Maximum Concentration* (mg/kg)
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	0.01	5.79E-06	5.79E-08
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	0.01	1.06E-06	1.06E-08
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]	0.01	1.75E-07	1.75E-09
Hexachlorodibenzodioxin[1,2,3,4,7,8-]	0.1	3.34E-07	3.34E-08
Hexachlorodibenzodioxin[1,2,3,6,7,8-]	0.1	1.49E-06	1.49E-07
Hexachlorodibenzodioxin[1,2,3,7,8,9-]	0.1	1.14E-06	1.14E-07
Hexachlorodibenzofuran[1,2,3,4,7,8-]	0.1	3.38E-07	3.38E-08
Hexachlorodibenzofuran[1,2,3,6,7,8-]	0.1	1.70E-07	1.70E-08
Hexachlorodibenzofuran[2,3,4,6,7,8-]	0.1	2.19E-07	2.19E-08
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]	0.0003	2.98E-05	8.94E-09
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]	0.0003	3.02E-06	9.06E-10
Pentachlorodibenzodioxin[1,2,3,7,8-]	1	3.27E-07	3.27E-07
Pentachlorodibenzofuran[1,2,3,7,8-]	0.03	3.00E-07	9.00E-09
Total TCDD TEQ (based on maximum detected concentrations)			**7.85E-07**

Source: TEFs from http://www.who.int/ipcs/assessment/tef_update/en/index.html.

Note: TEFs apply to both humans and mammals.

* Adjusted concentrations calculated as (data value) x TEF.

Table H-3.3-1
K_d Values for Inorganic COPCs at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPC	K_d (cm^3/g)
Aluminum	1500
Antimony	45
Barium	41
Chromium[a]	1800000
Copper	35
Nickel	65
Nitrate	na[b]
Selenium	5

Source: K_d values from NMED (2006 092513).

[a] K_d value for chromium(III), the predominant species of chromium, used.

[b] na = Not available.

Table H-3.3-2
K_d Values for Radionuclide COPCs at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPC	K_d (cm^3/g)
Americium-241	680
Cesium-137	1000
Plutonium-238	4500
Plutonium-239	4500
Strontium-90	35
Tritium	na*

Source: K_d values from EPA (1996, 064708).

* na = Not available.

Table H-3.3-3
Chemical Properties of Organic COPCs at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPCs	K_{oc} (cm^3/g)	Water Solubility (mg/L)	Log K_{ow} (unitless)
Dichlorobenzene[1,3-]	3.80E+01	1.56E+02	3.53E+00
Dichlorobenzene[1,4-]	6.16E+02	7.38E+01	3.44E+00
Fluoranthene	1.07E+05	2.06E-01	5.16E+00
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Heptachlorodibenzofuran[1,2,3,4,7,8,9-]*	1.46E+05	2.00E-04	6.80E+00
Hexachlorodibenzodioxin[1,2,3,4,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Hexachlorodibenzodioxin[1,2,3,6,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Hexachlorodibenzodioxin[1,2,3,7,8,9-]*	1.46E+05	2.00E-04	6.80E+00
Hexachlorodibenzofuran[1,2,3,4,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Hexachlorodibenzofuran[1,2,3,6,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Hexachlorodibenzofuran[2,3,4,6,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Methylene chloride	1.20E+01	1.30E+04	1.25E+00
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]*	1.46E+05	2.00E-04	6.80E+00
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]*	1.46E+05	2.00E-04	6.80E+00
Pentachlorodibenzodioxin[1,2,3,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Pentachlorodibenzofuran[1,2,3,7,8-]*	1.46E+05	2.00E-04	6.80E+00
Toluene	1.82E+02	5.26E+02	2.73E+00

Sources: K_{oc} and water solubility values from NMED (2006, 092513) unless otherwise noted. Log K_{ow} from RAIS database (http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=nrad).

* Values for TCDD from RAIS database.

Table H-4.1-1
Carcinogenic Screening Evaluation for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPC	Maximum Detected Concentration 0–10 ft bgs (mg/kg)	Residential SSL (mg/kg)	Residential Cancer Risk
Inorganic Chemicals			
Chromium	26	2100[a]	1.24E-07
Organic Compounds			
Dichlorobenzene[1,4-]	0.00019	39.5[b]	4.81E-11
Methylene chloride	0.015	182[b]	8.24E-10
Dioxins/Furans			
TCDD	7.85E-07	3.90E-05[c]	2.01E-07
		Total Excess Cancer Risk	**3E-07**

[a] SSL from EPA Region 6 (2007, 095866) and is corrected to 10^{-5} cancer risk.

[b] SSLs from NMED (2006, 092513).

[c] SSL from EPA Region 6 (2007, 095866) and is corrected to 10^{-5} cancer risk. Dioxin/furan data are adjusted for total TCDD toxicity equivalency in Table H.2.0-3.

Table H-4.1-2
Noncarcinogenic Screening Evaluation for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPC	Maximum Detected Concentration 0–10 ft bgs (mg/kg)	Residential SSL (mg/kg)	Residential HQ
Inorganic Chemicals			
Aluminum	8670	77800	0.11
Antimony	0.15	31.3	0.0048
Barium	286	15600	0.018
Copper	6.64	3130	0.0021
Nickel	6.71	1560	0.0043
Nitrate	2.2	100000	0.00002
Selenium	0.897	391	0.0023
Organic Compounds			
Dichlorobenzene[1,3-]	0.00016	32.6	0.000005
Fluoranthene	0.079	2290	0.00003
Toluene	0.00018	252	0.000001
		HI	**0.1**

Source: SSLs from NMED (2006, 092513) unless otherwise noted.

Table H-4.1-3
Radionuclide Screening Evaluation for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPC	Maximum Detected Concentration 0–10 ft bgs (pCi/g)	Residential SAL (pCi/g)	Residential Dose (mrem/yr)
Americium-241	0.356	30	0.012
Cesium-137	0.096	5.6	0.017
Plutonium-238	0.095	37	0.0026
Plutonium-239	6.76	33	0.20
Strontium-90	1.12	5.7	0.20
Tritium	0.7	750	0.0009
		Total Dose	**0.44**

Source: SALs from LANL (2005, 088493).

Table H-5.3-1
Final ESL Comparisons for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPC	Maximum Detected Concentration 0–5 ft bgs (mg/kg)	Final ESL (mg/kg)	HQ	Final ESL Receptor
Inorganic Chemicals				
Barium	286	110	**2.6**	Plant
Chromium	26	0.34[a]	**76.5**	Earthworm (invertebrate)
Nickel	6.71	20	**0.34**	Plant
Nitrate	2.2	na[b]	n/a[c]	n/a
Selenium	0.897	0.1	**8.97**	Plant
Organic Compounds				
Methylene chloride	0.015	2.6	0.006	Deer mouse (omnivore)
Toluene	0.00018	23	7.83E-06	Montane shrew (insectivore)
Dioxins/Furans				
TCDD	7.85E-07	2.90E-07	**2.71**	Montane shrew (insectivore)
Radionuclides (pCi/g)				
Plutonium-239	0.097	47	0.002	Earthworm (invertebrate)
Tritium	0.131	36000	3.64E-06	Plant

Source: ESLs from ECORISK Database Version 2.2 (LANL 2005, 090032).

Note: Bold denotes HQ exceeds 0.3.

[a] ESL for hexavalent chromium.

[b] na = Not available.

[c] n/a = Not applicable.

Table H-5.3-2
ESLs for COPECs at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPEC	ESL (mg/kg)										
	American kestrel (intermediate carnivore)	**American kestrel (top carnivore)**	**American robin (herbivore)**	**American robin (insectivore)**	**American robin (omnivore)**	**Deer mouse (omnivore)**	**Desert cottontail (herbivore)**	**Earthworm (invertebrate)**	**Plant**	**Montane shrew (insectivore)**	**Red fox (top carnivore)**
Inorganic Chemicals											
Barium	11000	37000	820	1000	930	1800	3300	330	110	1300	41000
Chromium[a]	2200	5400	280	190	220	530	1900	0.34	0.35	170	4400
Nickel	530	9500	530	70	120	530	12000	100	20	250	31000
Selenium	8.5	140	1.5	1.1	1.3	1.1	3	7.7	0.1	0.92	110
Dioxins/Furans											
TCDD	na[b]	na	na	na	na	5.80E-07	4.80E-05	5.00E+00	na	2.90E-07	1.20E-06

Source: ESLs from ECORISK Database Version 2.2 (LANL 2005, 090032).

[a] ESL for hexavalent chromium.

[b] na = Not available.

Table H-5.3-3
HI Analysis for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPEC	Maximum Detected Concentration 0–5 ft bgs (mg/kg)	HQ										
		American kestrel (intermediate carnivore)	**American kestrel (top carnivore)**	**American robin (herbivore)**	**American robin (insectivore)**	**American robin (omnivore)**	**Deer mouse (omnivore)**	**Desert cottontail (herbivore)**	**Earthworm (invertebrate)**	**Plant**	**Montane shrew (insectivore)**	**Red fox (top carnivore)**
Inorganic Chemicals												
Barium	286	0.026	0.008	0.349	0.286	0.308	0.159	0.087	0.867	**2.6**	0.22	0.007
Chromium[a]	26	0.012	0.005	0.093	0.137	0.118	0.049	0.014	**76.5**	**74.3**	0.153	0.006
Nickel	6.71	0.013	0.001	0.013	0.096	0.056	0.013	0.001	0.067	0.336	0.027	0.0002
Selenium	0.897	0.106	0.006	0.598	0.815	0.69	0.815	0.299	0.116	**8.97**	0.975	0.008
Dioxins/Furans												
TCDD	7.85E-07	na[b]	na	na	na	na	**1.35**	0.016	1.57E-07	na	**2.71**	0.654
	HI	0.1	0.02	**1.1**	**1.3**	**1.2**	**2.4**	0.4	**78**	**86**	**4**	0.7

Note: Bold denotes HQ or HI exceeds 1.0.

[a] ESL for hexavalent chromium.

[b] na = Not available.

Table H-5.4-1
Comparison of Inorganic COPECs to Background Concentrations at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPEC	Maximum Detected Concentration 0–5 ft bgs (mg/kg)	Range of Soil Background Concentrations (mg/kg)	Range of Tuff Background Concentrations (mg/kg)
Barium	286 (soil)	21–410	n/a*
Chromium	26 (tuff)	n/a	0.25–13
Nickel	6.71 (tuff)	n/a	1–7
Selenium	0.897 (soil)	0.1–1.7	n/a

Source: Background values from LANL (1998, 059730).

* n/a = Not applicable.

Table H-5.4-2
PAUFs for Ecological Receptors at the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

Receptor	HR (ha)	Population Area (ha)	PAUF*
American robin	0.42	16.8	0.00083
Deer mouse	0.077	3.1	0.0047
Montane shrew	0.39	15.6	0.00089

Source: HR areas from EPA (1993, 059384).

* PAUF is calculated as the area of excavation (0.014 ha) divided by the population area.

Table H-5.4-3
COPEC- and PAUF-Adjusted HI Analysis for the Area of Elevated Radioactivity, Consolidated Unit 21-018(a)-99

COPEC	**Maximum Detected Concentration 0–5 ft bgs (mg/kg)**	**American robin (herbivore)**	**American robin (insectivore)**	**American robin (omnivore)**	**Deer mouse (omnivore)**	**Earthworm (invertebrate)**	**Plant**	**Montane shrew (insectivore)**
Chromium	26	0.093	0.137	0.118	**0.049**	**76.5**	**74.3**	**0.153**
TCDD	7.85E-07	na[a]	na	na	**1.35**	1.57E-07	na	**2.71**
	HI	0.093	0.137	0.118	**1.40**	**76.5**	**74.3**	**2.86**
	PAUF-Adjusted HI	7.72E-05	1.14E-04	9.79E-05	0.0066	n/a[b]	n/a	0.025

Note: Bold denotes HQ or HI exceeds 1.0.

[a] na = Not available.

[b] n/a = Not applicable.