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Historical Investigation Report for Lower Mortandad/Cedro Canyons Aggregate Area

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EXECUTIVE SUMMARY

The Lower Mortandad/Cedro Canyons Aggregate Area includes a total of six solid waste management units (SWMUs) and areas of concern (AOCs) located in Technical Area 05 (TA-05) at Los Alamos National Laboratory. Of these six sites, one has been previously investigated and requires no further investigation, and one has been approved for no further action. The remaining four sites require further investigation. This historical investigation report provides site descriptions, summarizes previous investigations, and presents analytical results of these investigations. The background information and supporting data form the basis for the proposed sampling design necessary to complete the site investigations as presented in the Lower Mortandad/Cedro Canyons Aggregate Area investigation work plan.

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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 the Los Alamos National Security, LLC. The Laboratory is located in north-central New Mexico approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 40 mi^2 of the Pajarito Plateau (Figure 1.0-1), 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 approximately 6200 to 7800 ft. The location of Lower Mortandad/Cedro Canyons Aggregate Area with respect to the Laboratory technical areas (TAs) is shown in Figure 1.0-1.

The Laboratory's Environmental Programs (EP) Directorate, which includes the former Environmental Restoration (ER) Project, is participating in a national effort by DOE to reduce risk to human health and the environment at its facilities. The goal of EP Directorate 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. The sites under investigation are designated as either solid waste management units (SWMUs) or areas of concern (AOCs).

This historical investigation report (HIR) describes operational histories, previous investigations, and analytical data for SWMUs and AOCs in TA-05 within the Lower Mortandad/Cedro Canyons Aggregate Area. The sites addressed in this HIR are potentially contaminated with both hazardous and radioactive components. 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. Corrective actions at the Laboratory are subject to the March 1, 2005, Compliance Order on Consent (the Consent Order).

1.1 Historical Investigation Report Overview

The Lower Mortandad/Cedro Canyons Aggregate Area consists of six SWMUs and AOCs. Table 1.1-1 provides a summary of the six sites within the aggregate area and their regulatory status. One AOC has previously been approved for no further action (NFA), and one was investigated as part of the Middle Mortandad/Ten Site Canyons Aggregate Area (LANL 2008, 102187). These two sites do not require further investigation, and only brief descriptions and reference to the approval documents are provided in Table 1.1-1 of this HIR. Figure 1.1-1 shows the locations of the sites under investigation in the Lower Mortandad/Cedro Canyons Aggregate Area.

The purpose of this HIR is to provide supporting information for the activities necessary to complete the investigations as presented in the Lower Mortandad/Cedro Canyons Aggregate Area investigation work plan (LANL 2009, 107103). The SWMUs and AOCs are presented in this document on the basis of their regulatory status.

Section 2 of this HIR provides site descriptions and operational histories, summarizes previous investigations, and presents analytical data for the sites under investigation in the Lower Mortandad/Cedro Canyons Aggregate Area. For each site, the location, historical operations, and current status are described first, followed by descriptions of historical investigations with dates and activities conducted. The results of analytical data obtained from previous investigation are summarized. Section 3 provides references for cited documents and map data sources.

Appendix A includes a list of acronyms and abbreviations, a metric conversion table, and a table for data qualifier definitions. Appendix B presents data from past investigations (included on CD).

1.2 Data Overview

Data evaluated in this report include historical data collected from 1995 to 1998 as part of Resource Conservation and Recovery Act (RCRA) facility investigations (RFI) and other corrective actions. All data records in the Sample Management Database include a vintage code field denoting how and where samples were submitted for analyses. The data vintage is considered when the quality of historical data is evaluated. All historical data evaluated in this report are validated or revalidated by current quality control (QC) metrics.

Samples described in this report have undergone analyses at both on- and off-site laboratories. Because analytical practices and documentation of analyses vary in quality and completeness, analytical data are either screening-level or decision-level data. Screening-level data are appropriate for applications that require only determination of gross contamination areas and/or site characterization. Screening-level data are also used to specify areas where samples should be collected. Decision-level data are used to quantify the nature and extent of releases and to perform risk assessments. Decision-level data presented in the investigation work plan (LANL 2009, 107103) have been validated for such use and provide supporting information for the investigation activities proposed in the work plan. All historical data presented in this report are decision-level data.

Data presented in this report consist of inorganic chemicals and radionuclides above background and detected organic chemicals. Inorganic chemical and radionuclide data from previous investigations are compared with background values (BVs) and fallout values (FVs) (LANL 1998, 059730, p. 6-2). Fallout radionuclides in soil greater than a depth of 1 ft or in rock and organic chemicals are evaluated based on detection status.

2.0 SITES UNDER INVESTIGATION

TA-05 is located on the eastern side of the Laboratory (Figure 1.0-1) and is situated on a small finger mesa, Mesita del Buey, that extends eastward from the main mesa between Mortandad and Pajarito Canyons. The western portion of TA-05 is located within the Middle Mortandad/Ten Site Canyons Aggregate Area, and the eastern portion is located within Lower Mortandad/Cedro Canyons Aggregate Area. That portion of TA-05 within the Lower Mortandad/Cedro Canyons Aggregate Area is bounded by TA-53 and TA-72 to the north and east, Middle Mortandad/Ten Site Canyons Aggregate Area to the north and west, and Pueblo de San Ildefonso to the south. TA-05 is currently used as a security buffer zone and contains several physical support facilities, including an electrical substation and a water-supply well.

TA-05, also known as Beta Site, was established in 1944 as an adjunct test firing site to TA-04 (Alpha Site). Firing activities were conducted at two small firing sites located within the Middle Mortandad/Ten Site portion of TA-05 and one large firing site, known as Far Point Site, within the Lower Mortandad/Cedro portion of TA-05. Far Point Site was used briefly during 1944 and 1945 for half-scale mockup tests of the Trinity device (LANL 2008, 102187, p. 3). TA-05 was used as a firing site for implosion studies until 1947. After firing activities were halted, several Laboratory groups used the site for a variety of experiments, including the study of hydrogen fires, animal radiation experiments, and beryllium combustion experiments. In late 1959, two experimental reactors known as “Little Eva” and “Godiva” were brought to TA-05 and operated briefly (Ulery 1995, 046037). Little Eva was located inside a trailer, and Godiva was located in an underground chamber (SWMU 05-003). TA-05 was taken out of

service in 1959 and underwent decontamination and demolition in 1985 as part of the Los Alamos Site Characterization Program (LASCP). The 1985 LASCP addressed only radioactive contamination.

The four sites that will undergo additional investigation are described in the following sections, along with investigations that have been conducted previously at these sites and the results of those investigations. A summary of the historical samples collected and the laboratory analyses requested for historical samples is presented in Table 2.0-1. Inorganic chemicals detected above BVs or having detection limits above BVs are presented in Table 2.0-2. Organic chemicals detected are presented in Table 2.0-3, and radionuclides detected or detected above BVs/FVs are presented in Table 2.0-4. All laboratory analytical data are provided in Appendix B.

2.1 SWMU 05-003, Former Calibration Chamber

2.1.1 Description and History

SWMU 05-003 is a former underground calibration chamber (structure 05-21) located at the west end of TA-05 near the edge of Mortandad Canyon (Figure 2.1-1). The construction of the 7-ft × 7-ft chamber was completed in 1959, and the chamber was used to calibrate neutron detector systems for experiments at TA-49. The approximate dimensions and layout of the facility have been obtained through interviews with people who worked on the project, personal logs, and site inspections (Koch 1995, 091204; Pratt 1995, 091206) as well as historical drawings. The facility consisted of a 6-ft-diameter, 35-ft-deep shaft with an approximately 7-ft cubical room located at the base of the shaft, to the west. The shaft and room were connected by an 8-ft-tall, 9.5-ft-long tunnel. The connecting tunnel may have had a downward slope toward the room. A ladder was attached to the 6-ft-diameter shaft to access the underground chamber. A second 24-in.-diameter shaft extended from the center of the room to the surface. The shafts were separated by 15 ft (center to center). The smaller shaft was lined with a 16-in.-diameter casing and capped with concrete, with a 3-in.-diameter opening in the concrete cap. This shaft was used to direct neutrons from the underground chamber to detectors located above the shaft. The floor of the tunnel and chamber may have been covered with wood planking. An 8-ft × 12-ft × 8-ft-high wooden building (structure 05-20) was constructed at the surface over the large shaft.

The neutron source used in the calibration facility was a critical assembly called Godiva. This assembly used highly enriched uranium (HEU) and was operated in the underground chamber beneath the smaller shaft. Neutron detectors were placed on the ground surface above the opening in the small shaft. The Godiva assembly could be pulsed every 2 h and produced 2×10^{16} fissions per pulse. Small amounts of HEU would spall off the source with each pulse (Pratt 1995, 091206). Borated paraffin and lead bricks were used as shielding, and heavy water was used to moderate the energy and intensity of the neutrons.

The Godiva assembly was installed in the underground chamber on November 16, 1959 (Pratt 1995, 091206). TA-05 was officially abandoned on December 18, 1959 (Montoya 1976, 004547), and the Godiva assembly is presumed to have been removed at that time. During a radiation survey of TA-05 in 1973, structure 05-20 was noted to be locked and could not be entered (Martin 1973, 004544). A subsequent inspection in January 1974 noted there was a hole in the side of the building and the door was unlocked. Because of safety concerns, a cover was placed over the shaft (Bacastow 1974, 000756). A radiation survey of structure 05-20 was conducted in May 1976 to prepare for removal of the remaining structures from TA-05. This survey showed no detectable radioactivity (Blackwell 1976, 004546). The structures were removed sometime around 1976, and the shaft is presumed to have been backfilled at that time. Although the 1992 RFI work plan for Operable Unit 1129 indicates the lead shielding bricks had not been removed before backfilling (LANL 1992, 007666, p. 3-16), a subsequent review of records and

interviews with former site staff concluded that the lead bricks were removed before the shaft was backfilled (Pratt 1995, 091206).

The corrugated metal pipe (CMP) liner for the large shaft is still present at the site and extends approximately 2.5 ft above the ground surface. The inside of the CMP contains backfill and some vegetation is presently growing in the backfill. An 8.75-ft × 12.5-ft concrete pad extends around the CMP. Currently, there is no evidence of the smaller shaft.

2.1.2 Previous Investigations

In 1995, an engineering survey was conducted at the site of the former calibration chamber to locate the 24-in.-diameter shaft that was reported to be present at the site. This shaft was found 15 ft west of the 6-ft-diameter shaft. An 8.75- × 12.25-ft concrete pad was present around the 6-ft-diameter shaft and a smaller 1.5- × 5-ft concrete pad was located just north of the 24-in.-diameter shaft (Koch 1995, 091204). The larger pad was presumably the foundation for structure 05-20. The site was surveyed for potential high explosives (HE) materials in May 1995. Fragments of white material were found near the shaft but were determined to be paraffin rather than HE (Koch 1995, 048943.21).

No previous sampling has been performed at SWMU 05-003, and there are no analytical data for this site.

2.1.3 Analytical Results

There are no analytical results for SWMU 05-003.

2.2 SWMU 05-004, Former Septic Tank

2.2.1 Description and History

SWMU 05-004 is a former septic tank (structure 05-13), associated drainlines, and outfall that were located at the west end of TA-05 near the edge of Mortandad Canyon (Figure 2.1-1). From 1948 to 1949, the tank received industrial waste from a laboratory (building 05-1). The tank was constructed in May 1948 and abandoned in place in December 1959 (LANL 1992, 007666, p. 3-14). It was constructed of reinforced concrete and was 5 ft × 5 ft × 7 ft deep (LANL 1990, 007511). As-built drawings show the presence of an inlet line running from building 05-1 to the septic tank and an outlet line discharging south into an unnamed tributary of Mortandad Canyon. Historical information shows the tank was free of radiation and HE contamination but notes it contained unspecified toxic chemicals (LANL 1990, 007511). A 1952 memorandum states septic tank 05-13 was no longer needed to support use of building 05-1, and the structure was being returned to Engineering Division for disposition (Vogt 1952, 004379). A 1959 memorandum states the tank had been monitored for radioactivity and no radioactivity above background was found (Blackwell 1959, 000761). A site inspection conducted in January 1974 identified the septic tank as an open concrete pit, at least 3-ft deep, and having a 3-ft × 3-ft opening with a rotted wooden cover. The wooden cover was replaced with a metal grating cover (Bacastow 1974, 000756). Notes from a radiation survey conducted at TA-05 during May 1976 describe structure 05-13 as “an acid septic tank filled with liquid” (Blackwell 1976, 004546).

The types of materials used in building 05-1 are not known. Building 05-1 was inspected in 1959 and found to be free of contamination by toxic materials (Schulte 1959, 000894). A radiation survey of building 05-1 in 1973 detected no radioactive contamination (Martin 1973, 004544). During LASCP activities conducted in 1985, building 05-1 was determined to be free of radioactive and HE contamination and was removed. The 1985 LASCP investigation confirmed removal of the tank and piping, and no

evidence of radioactively contaminated soil was detected at that time (NUS Corporation 1990, 012571, p. 3-10). A 1988 survey detected gamma activity slightly above background. Notes taken during this survey described evidence of an outfall near the former location of structure 05-13. A site inspection conducted in December 1994 noted the location of an approximately 2-ft-wide × 1-ft-deep outfall trench cut into the tuff. The trench, which was filled with plant debris, flowed to the south onto a natural bedrock rill/gully to the canyon (Koch 1994, 048943.12). This trench presumably contained the discharge drainline that was removed.

The site currently contains no evidence of the tank or drainline. The outfall trench previously noted at the site was located at the edge of the mesa. No evidence of significant erosion or runoff from the site was found, and stormwater best management practices (BMPs), including straw wattles, are in place above and downslope of the site.

2.2.2 Previous Investigations

A radiation grid survey of the site was performed in October 1994. Radiation measurements were obtained from 84 grid locations spaced at approximately 10-ft intervals located at SWMUs 05-003 and 05-004. Beta/gamma radiation measurements were within background levels. Phase I sampling was performed in June 1995. Three surface samples (0 to 0.5 ft) were collected, two hand-auger holes were drilled to a depth of 3 ft, and one borehole was drilled to a depth of 15 ft. The hand-auger and surface samples were collected in the outfall trench between the septic tank location and the edge of the canyon. Three samples were collected from each hand-augered hole at depth intervals of 0 to 1 ft, 1 to 2 ft, and 2 to 3 ft. The borehole was drilled at the former location of the septic tank. Three samples were collected from the borehole at depth intervals of 3.5 to 4.5 ft, 8.8 to 9.8 ft, and 14 to 15 ft. All samples were submitted for laboratory analysis of isotopic plutonium and isotopic uranium. One sample from one hand-augered hole was also submitted for laboratory analysis of semivolatile organic compounds (SVOCs), and one sample from another hand-augered hole was submitted for laboratory analysis of volatile organic compounds (VOCs), gross-alpha, gross-beta, and gamma-emitting radionuclides. One sample from the 15-ft borehole was also submitted for laboratory analysis of metals, and one of the surface samples was submitted for analysis of HE.

A second sampling event was conducted at this site in 1998. A deeper borehole was advanced at the location of the former septic tank, and 11 samples were collected at 1-ft intervals from 14 ft to 25 ft. Additional samples were collected downslope of the outfall. Surface samples (0 to 0.5 ft) were collected at five locations, and subsurface samples (0.5 to 1.0 ft) were collected at three of these locations. All the samples were submitted for laboratory analysis of metals, SVOCs, and HE.

The samples collected in 1995 and 1998 and the analyses requested are presented in Table 2.0-1, and the sampling locations are shown in Figure 2.1-1.

2.2.3 Analytical Results

Analytical data from the 1995 and 1998 sampling events are presented in Tables 2.0-2, 2.0-3, and 2.0-4, which show inorganic chemicals detected above BVs or having detection limits above BVs, organic chemicals detected, and radionuclides detected or detected above BVs/FVs, respectively. Sampling locations and the results for organic chemicals detected and radionuclides detected or detected above BVs/FVs are shown in Figures 2.2-1 and 2.2-2, respectively.

No metals were detected above BV or had detection limits above BV during the 1995 RFI. Benzoic acid, the only organic chemical detected, was detected in one sample at 0.61 mg/kg. Plutonium-239/240, the only radionuclide detected, was detected at 0.098 pCi/g in one subsurface sample.

No metals were detected above BV during the 1998 sampling. Mercury had detection limits above the BVs for two soil samples and one sediment sample. Selenium had detection limits above the BV in two sediment samples. No organic chemicals were detected, and no samples were analyzed for radionuclides.

2.3 Consolidated Unit 05-005(b)-00

Consolidated Unit 05-005(b)-00 consists of SWMU 05-005(b), a former outfall, and SWMU 05-006(c), an area of potential soil contamination associated with a former building.

2.3.1 SWMU 05-005(b), Former Outfall

2.3.1.1 Description and History

SWMU 05-005(b) is an area of potentially contaminated soil associated with a former outfall located at the edge of Mortandad Canyon (Figure 2.3-1). The outfall, which is associated with building 05-5, was identified during a 1987 ER Project site reconnaissance (LANL 1992, 007666, p. 3-17). The outfall was located on the edge of the canyon, approximately 80 ft south of building 05-5. This building, which is associated with SWMU 05-006(c), was used as a shop, a calibration facility, and a photographic darkroom. The building was used as a darkroom from 1944 to1947 to process photographs of experiments conducted at the TA-05 firing sites. In 1952, building 05-5 was used to calibrate high-range radiation meters. The building was operational from about 1944 to 1959, and was destroyed by burning in May 1960 (Wingfield 1960, 029398). The outfall is believed to have also operated from 1944 to 1959.

The site currently contains no evidence of the outfall. A capped pipe is present at the ground surface at the former location of building 05-5. This pipe may have been the drainline from the building. A drainage channel that collects most of the runoff from the site is present at the edge of the mesa. No evidence of significant erosion or runoff from the site was found, and stormwater BMPs, including straw wattles, are in place above and downslope of the site.

2.3.1.2 Previous Investigations

A Phase I RFI was conducted at SWMU 05-005(b) in 1994 and 1995. Preliminary RFI activities included an interview with a former Beta Site supervisor and engineering surveys to identify sampling locations. The engineering surveys consisted of reviews of archival aerial photos and engineering drawings, site environmental surveys, and site visits and walkovers to locate the former building and site features. The location of the outfall was surveyed for potential HE contamination in May 1995, and no contamination was found (Koch 1995, 048943.21). A radiation grid survey was performed on July 7, 1995, covering an area of approximately 70 ft × 120 ft, and provided contiguous coverage of SWMUs 05-005(b) and 05-006(c). The radiation grid locations were spaced at 20-ft intervals. Beta/gamma radiation measurements were within background levels.

Phase I RFI sampling was performed in July 1995. Nine soil and tuff samples were collected from three locations at and below the outfall. At each location, samples were collected from depth intervals of 0 to 1 ft, 1 to 2 ft, and 2 to 3 ft. All samples were submitted for laboratory analysis of metals, isotopic uranium, and isotopic plutonium. One sample was also submitted for laboratory analysis of HE and another sample

for laboratory analysis of SVOCs. The samples collected in 1995 and the analyses requested are presented in Table 2.0-1, and the sampling locations are shown in Figure 2.3-1.

2.3.1.3 Analytical Results

Analytical data from the 1995 sampling event are presented in Tables 2.0-2, 2.0-3, and 2.0-4, which show inorganic chemicals detected above BVs or having detection limits above BVs, organic chemicals detected, and radionuclides detected or detected above BVs/FVs, respectively. The sampling locations and the results for inorganic chemicals detected above BVs, organic chemicals detected, and radionuclides detected or detected above BVs/FVs are shown in Figures 2.3-2, 2.3-3, and 2.3-4, respectively.

Metals detected above BVs in the 1995 sampling were chromium and nickel, each detected above its BV in four tuff samples with maximum concentrations 6 and 4 times the BVs, respectively. Antimony and selenium had detection limits above the tuff BV. Bis(2-ethylhexyl)phthalate, the only organic chemical detected, was detected in one sample at 0.29 mg/kg. Plutonium-238, the only radionuclide detected or detected above BV/FV, was detected at 0.0225 pCi/g in one sample.

2.3.2 SWMU 05-006(c), Area of Potential Soil Contamination

2.3.2.1 Description and History

SWMU 05-006(c) is an area of potentially contaminated soil associated with the location of a former shop and darkroom, building 05-5 (Figure 2.3-1). The shop was 16 ft × 16 ft and the darkroom was 9 ft × 6 ft (LANL 1990, 007511). The building was operational from about 1944 to 1959. The structure was originally used to support firing site activities, including processing photographs of experiments conducted at the firing sites. In 1952, J Division temporarily used the building to calibrate high-range meters (LANL 1992, 007666, p. 3-12). A 1959 memorandum indicates this structure was contaminated with HE (Penland 1959, 000806). This site is one of several areas of potential soil contamination at TA-05 identified during surveys conducted in 1958, 1959, and 1985. Potential soil contamination at these sites was reported to include HE and uranium. A 1959 list generated by the Laboratory's H-3 Group listed building 05-5 as an HE-contaminated structure. Building 05-5 was destroyed by burning on March 5, 1960 (Wingfield 1960, 029398).

Cleanup of the site of the former building was included in the 1985 LASCP. Surface debris, including wood, copper wire, scrap metal, and other building debris, was removed. No radioactive contamination was detected (NUS Corporation 1990, 012571). A mound of burned debris, including charred wood and melted glass, was noted to be present at the site during an inspection in September 1994 (Koch 1994, 048943.13).

Currently, a small amount of burned debris (charred wood, melted glass, and metal) is still present at the former location of building 05-5. Also present is a capped pipe at the ground surface. The site slopes to the south toward the edge of the mesa. No evidence of significant erosion or runoff from the site was found, and stormwater BMPs, including straw wattles, are in place above and downslope of the site.

2.3.2.2 Previous Investigations

A Phase I RFI was conducted at SWMU 05-006(c) in 1994 and 1995. Preliminary RFI activities included an interview with a former Beta Site supervisor and engineering surveys to identify sampling locations. The engineering surveys consisted of reviews of archival aerial photos and engineering drawings, site

environmental surveys, site visits and walkovers to locate the former buildings, and staking of sampling locations. The location of the outfall was surveyed for potential HE contamination in May 1995 and no contamination was found (Koch 1995, 048943.21). A radiation grid survey was performed on July 7, 1995, covering an area of approximately 70 ft × 120 ft, and provided contiguous coverage of SWMUs 05-005(b) and 05-006(c). The radiation grid locations were spaced at 20-ft intervals. Beta/gamma radiation measurements were within background levels.

Phase I RFI sampling was performed in July 1995. Thirteen soil and tuff samples were collected from seven locations. To characterize potential contamination from chemical disposal, nine soil and tuff samples were collected from three locations around three sides of the former building at areas where chemicals may have been poured on the ground. At each location, samples were collected from depth intervals of 0 to 1 ft, 1 to 2 ft, and 2 to 3 ft. All samples were submitted for laboratory analysis of metals, isotopic uranium, and isotopic plutonium. One sample was also submitted for analysis of gross-alpha and gross-beta radioactivity and gamma-emitting radionuclides. Four additional samples were collected to characterize potential contamination associated with the debris remaining from destruction of the building. A surface (0 to 0.5 ft) soil or sediment sample was collected at each of four locations at and downslope of the debris pile. All samples were submitted for laboratory analysis of metals. No samples were analyzed for organic chemicals. The samples collected in 1995 and the analyses requested are presented in Table 2.0-1, and the sampling locations are shown in Figure 2.3-1.

2.3.2.3 Analytical Results

Analytical data from the 1995 sampling event is presented in Table 2.0-2, which shows inorganic chemicals detected above BVs or having detection limits above BVs. Sampling locations and results for inorganic chemicals detected above BVs are shown in Figure 2.3-2.

Metals detected above BV in the 1995 sampling were antimony, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, nickel, selenium, silver, and zinc. Antimony, cadmium, and silver were each detected above their BVs for one soil sample with maximum concentrations 91, 13, and 21 times the BVs, respectively. Arsenic was detected slightly above the BV in one soil sample and slightly above the BV in one tuff sample. Barium was detected at less than 2 times the BV in one tuff sample, and calcium was detected at 2.5 times the BV in one tuff sample. Chromium was detected above the BV in six tuff samples with a maximum concentration 26 times the BV. Copper was detected above the BV in three soil samples with a maximum concentration 9 times the BV. Iron and selenium were each detected slightly above their BVs in one soil sample. Lead was detected above the BV in four soil samples and one tuff sample with a maximum concentration 1970 times the BV. Nickel was detected above the BV for two soil samples and five tuff samples with a maximum concentration 14 times the BV. Zinc was detected above the BV in three soil samples with a maximum concentration 6 times the BV. Mercury had detection limits above the soil BV in one sample. No samples were analyzed for organic chemicals. No radionuclides were detected or detected above BV or FV.

3.0 REFERENCES AND MAP DATA SOURCES

3.1 References

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility

(RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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3.2 Map Data Sources

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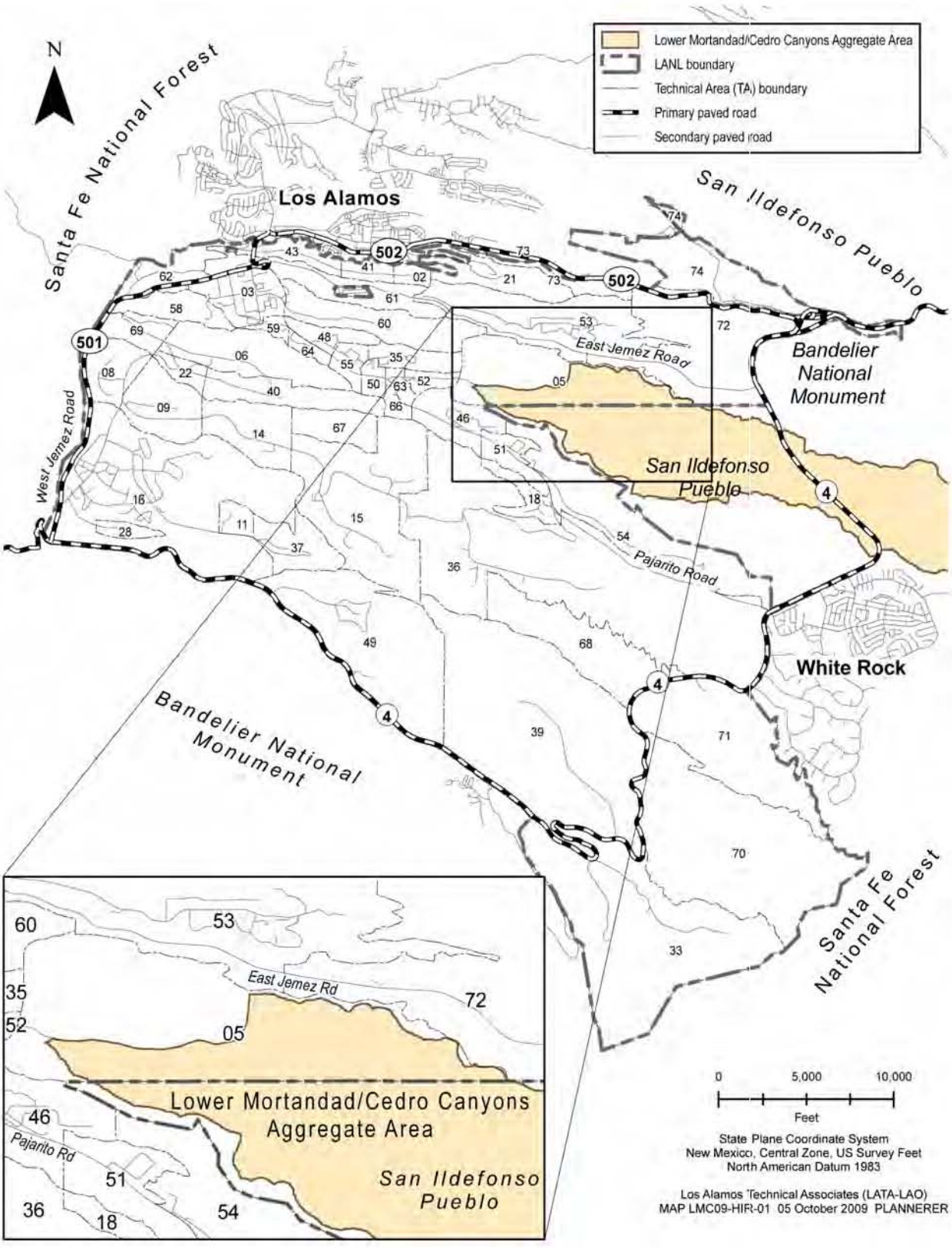

Figure 1.0-1 Location of Lower Mortandad/Cedro Canyons Aggregate Area

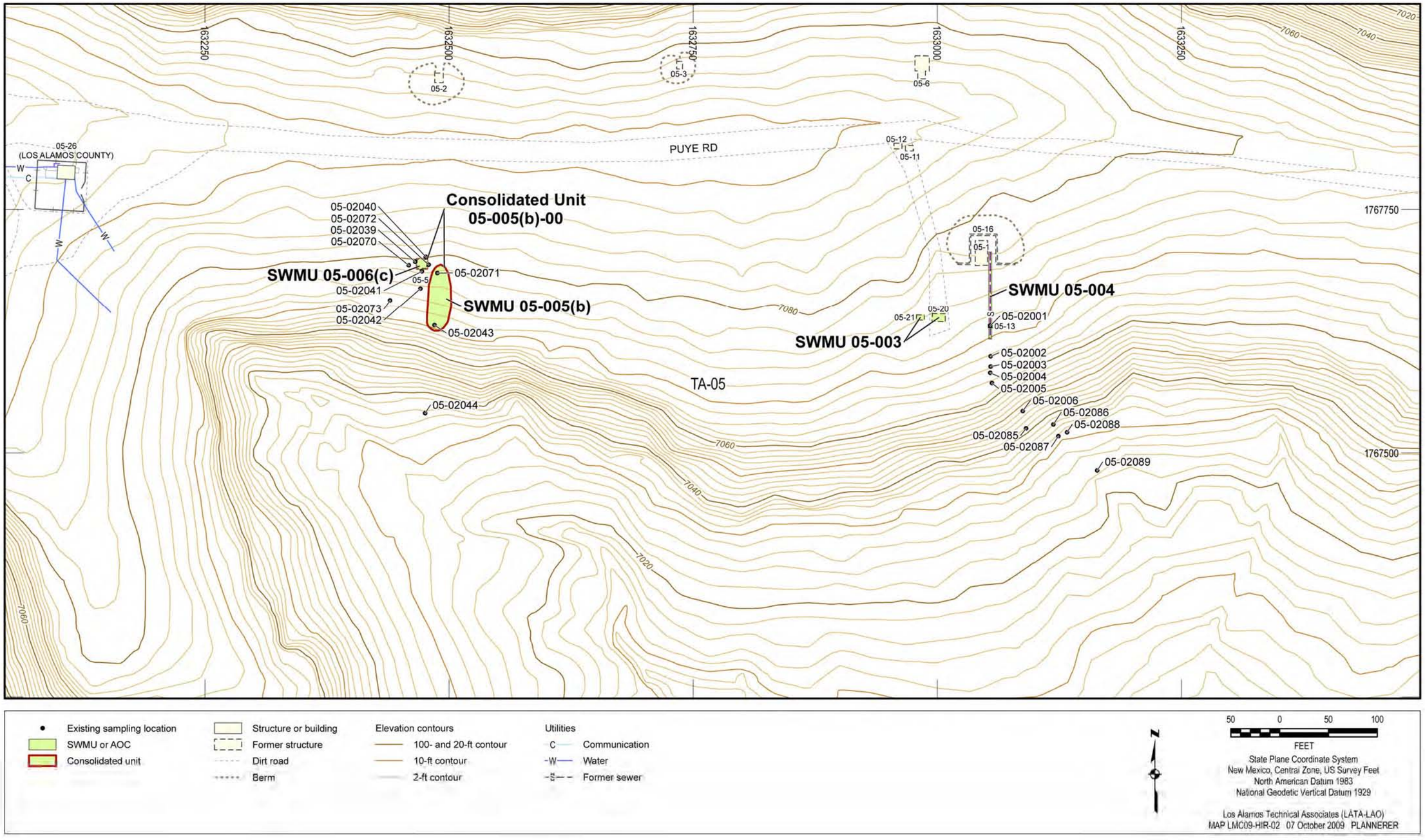

Figure 1.1-1 Locations of sites in Lower Mortandad/Cedro Canyons Aggregate Area

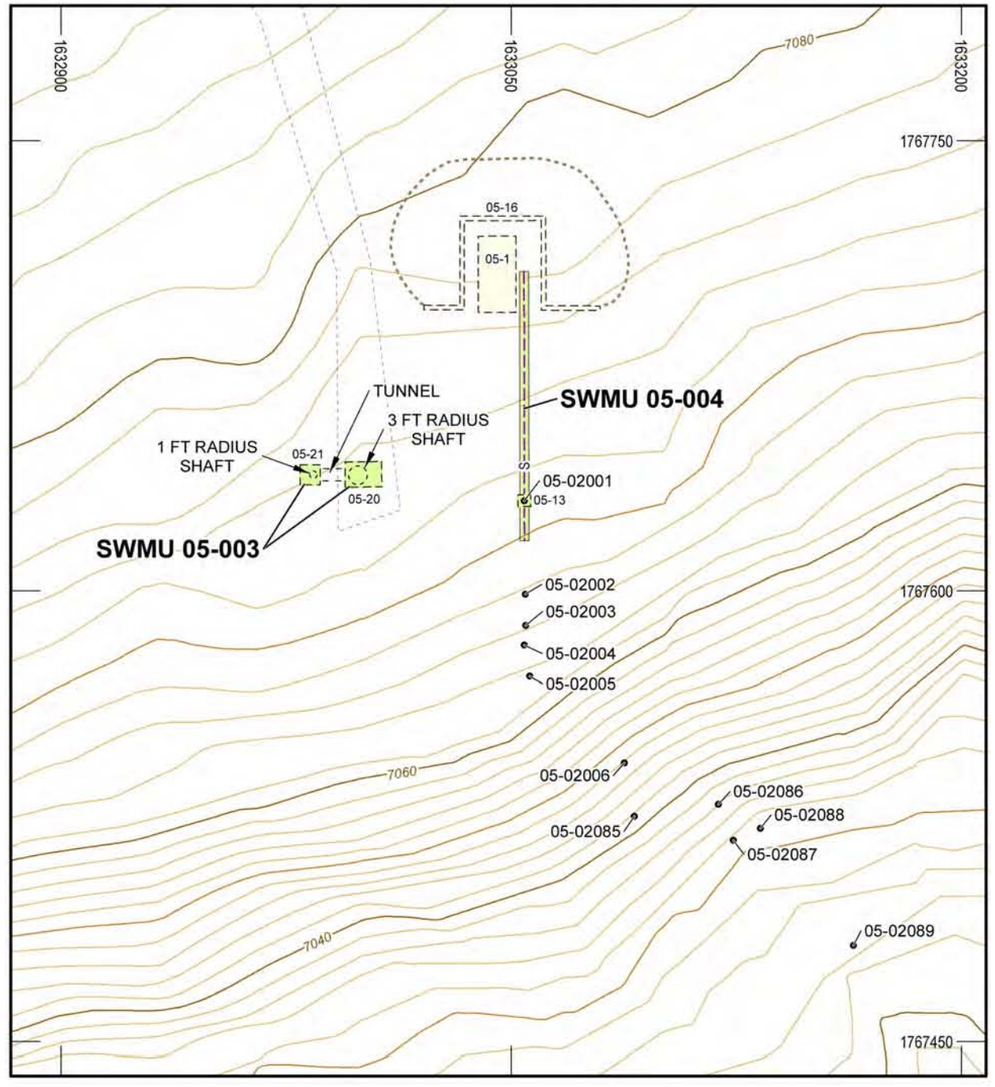

Figure 2.1-1 Site features and historical sampling locations for SWMUs 05-003 and 05-004

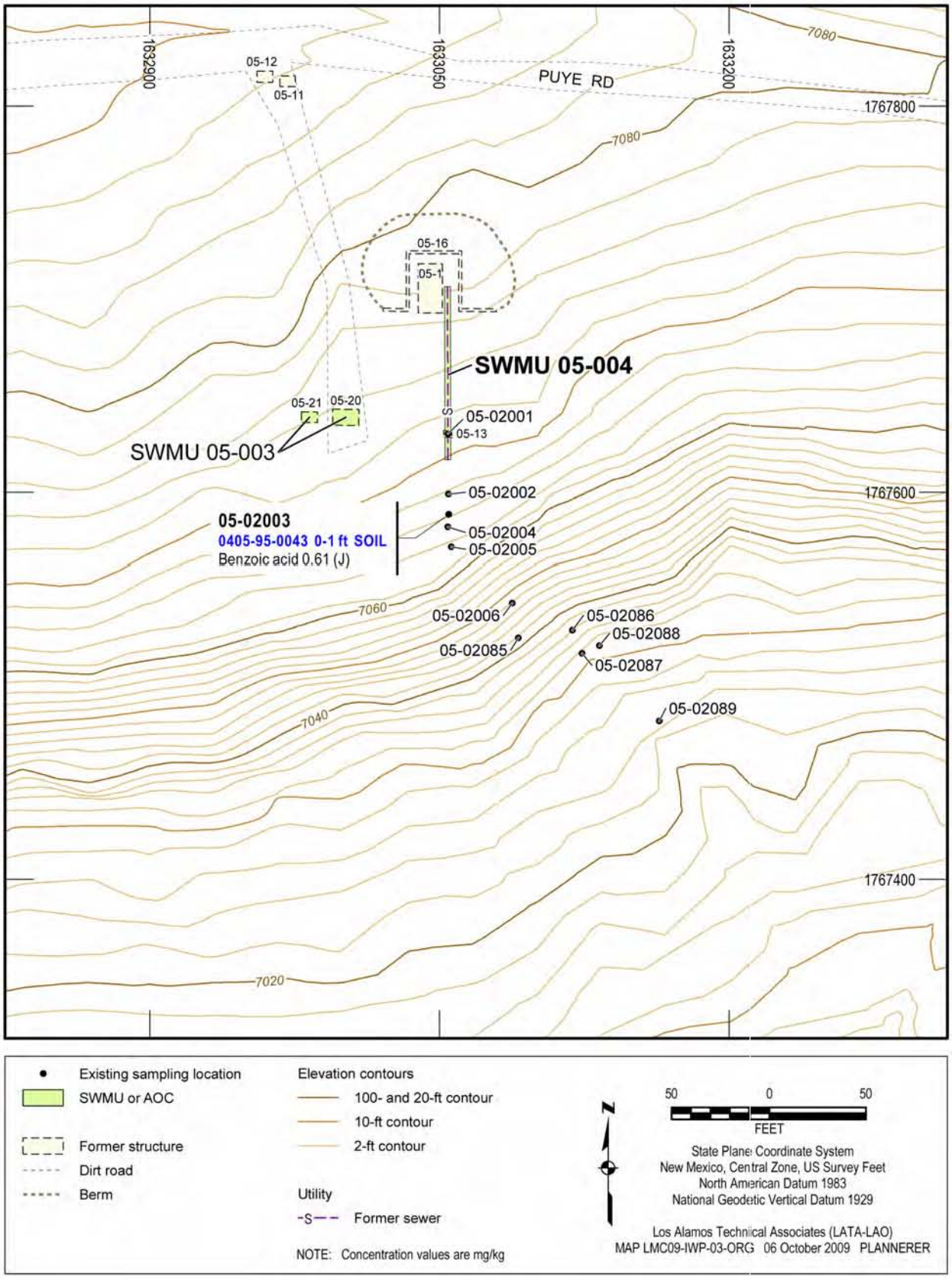

Figure 2.2-1 Organic chemical detected at SWMU 05-004

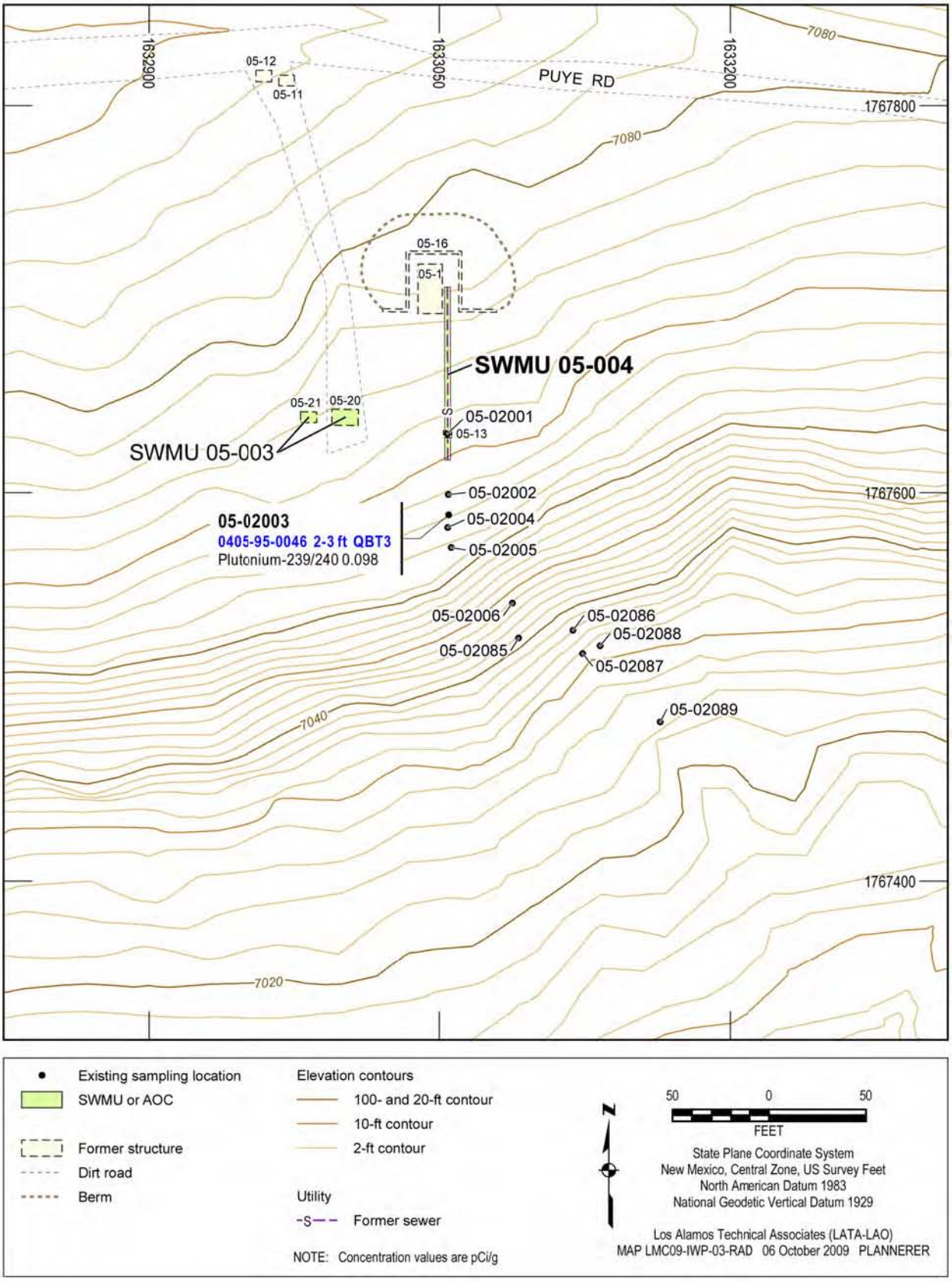

Figure 2.2-2 Radionuclide detected or detected above BV/FV at SWMU 05-004

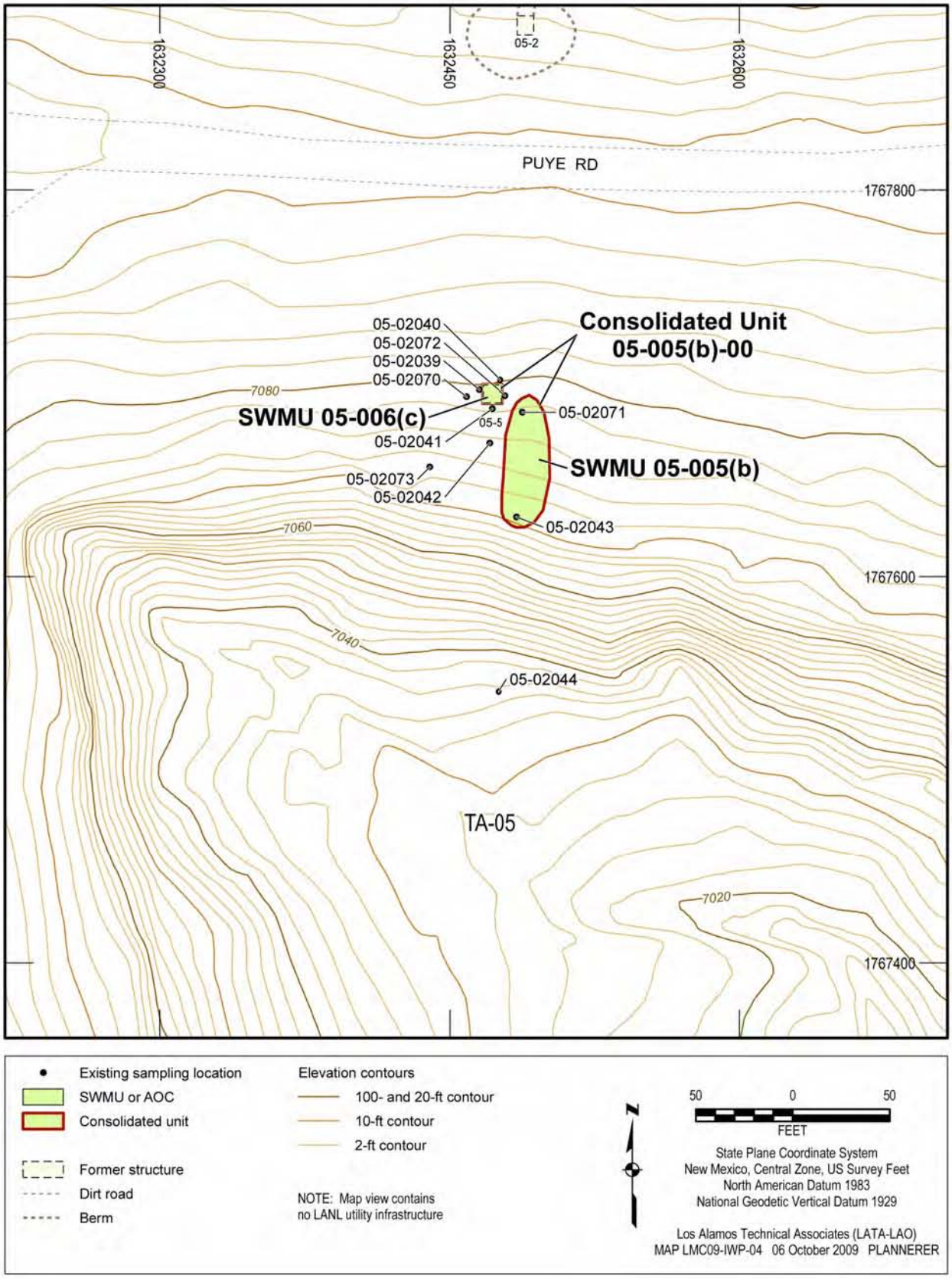

Figure 2.3-1 Site features and historical sampling locations for SWMUs 05-005(b) and 05-006(c)

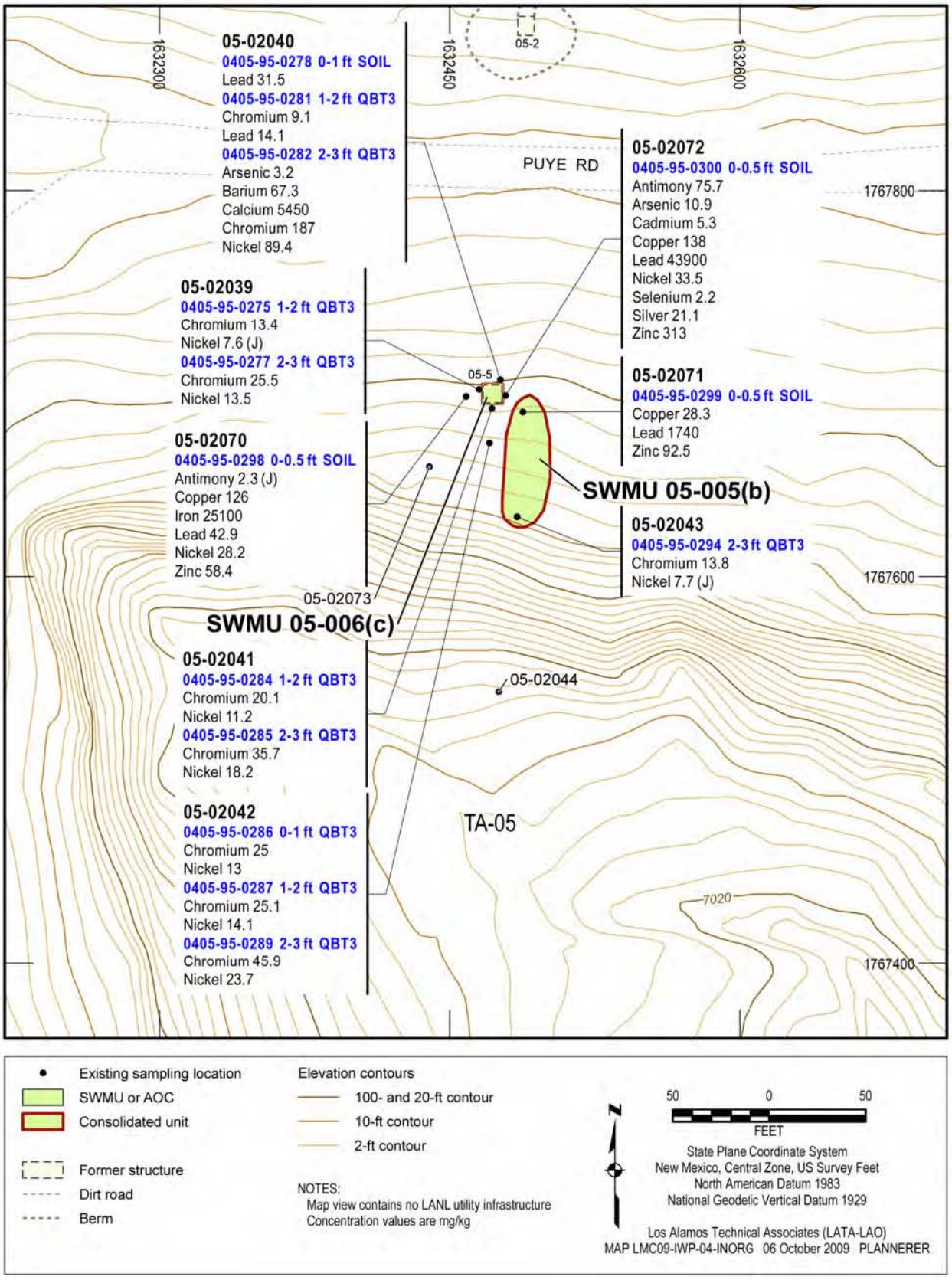

Figure 2.3-2 Inorganic chemicals detected above BV at SWMUs 05-005(b) and 05-006(c)

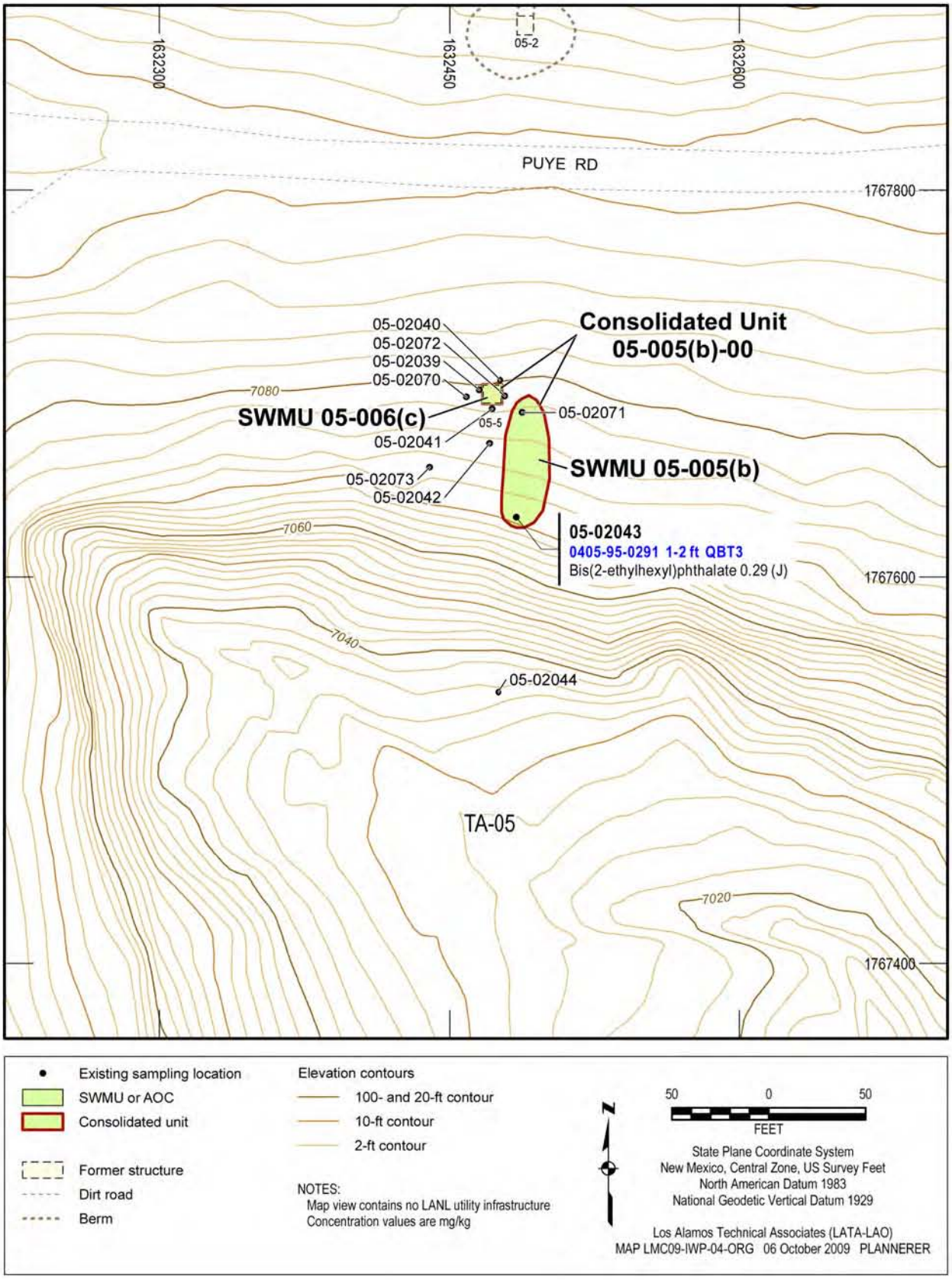

Figure 2.3-3 Organic chemical detected at SWMUs 05-005(b) and 05-006(c)

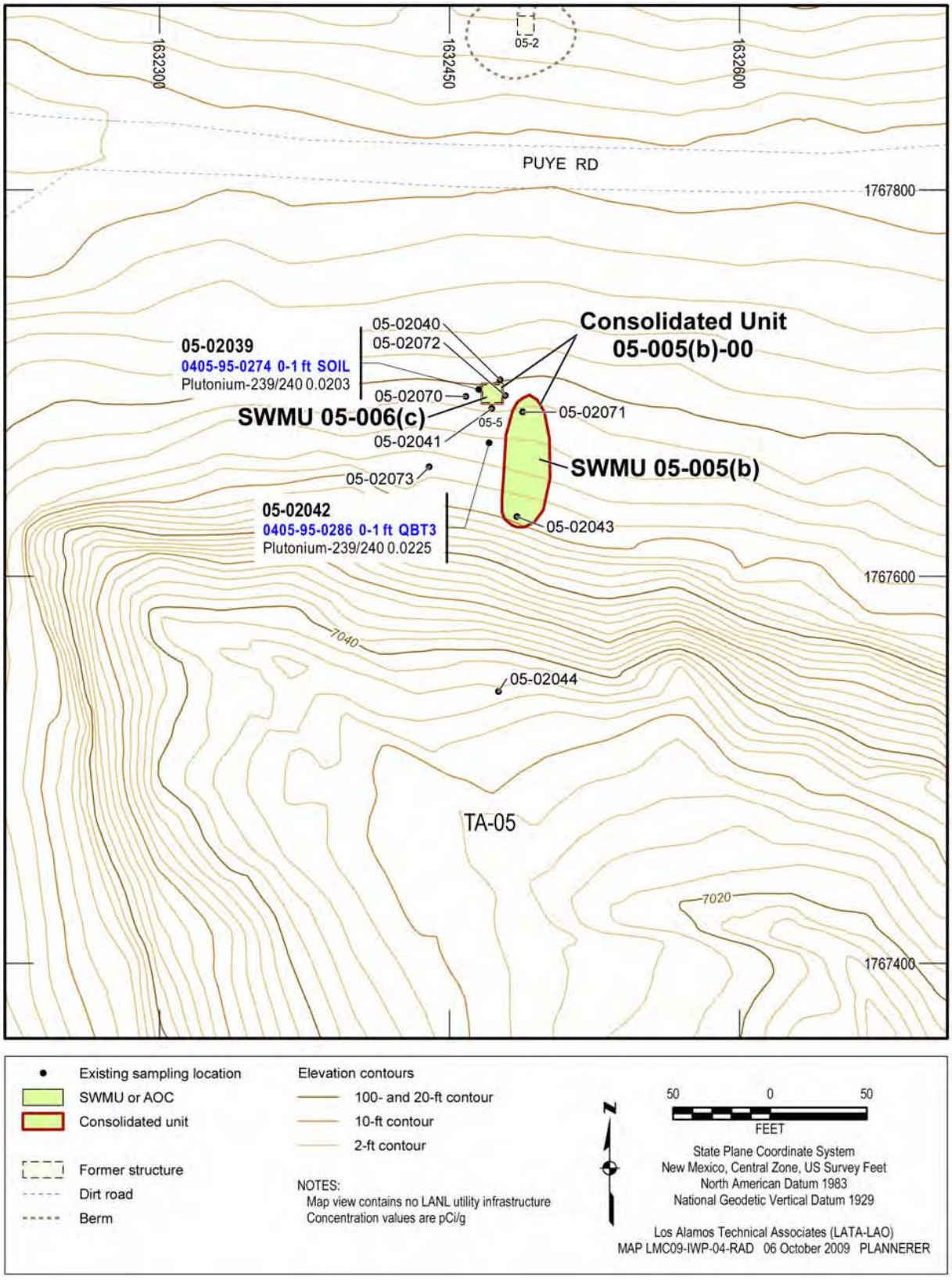

Figure 2.3-4 Radionuclides detected or detected above BV/FV at SWMUs 05-005(b) and 05-006(c)

Table 1.1-1
Status of SWMUs and AOCs in Lower Mortandad/Cedro Canyons Aggregate Area

Consolidated Unit	Site	Brief Description	Site Status	Reference
	AOC 05-001(c)	Firing site	Investigation completed as part of Middle Mortandad/ Ten Site Aggregate Area	LANL 2008, 102187 NMED 2008, 101115
	SWMU 05-003	Former calibration chamber	Under investigation	Work plan section 2.1
	SWMU 05-004	Former septic tank	Under investigation	Work plan section 2.2
05-005(b)-00	SWMU 05-005(b)	Former outfall associated with former building 05-05	Under investigation	Work plan section 2.3
	SWMU 05-006(c)	Area of potential soil contamination from former building 05-05	Under investigation	Work plan section 2.3
	AOC 05-006(a)	Former building location	NFA approved, 01/21/05	EPA 2005, 088464

Table 2.0-1
Summary of Historical Samples Collected and Analyses Requested

Sample ID	Location ID	Depth (ft)	Media	Metals	VOCs	SVOCs	HE	Isotopic Plutonium	Isotopic Uranium	Gamma Spectroscopy	Gross Alpha	Gross Beta
SWMU 05-004												
0405-95-0037	05-02001	3.5–4.5	Fill	540[a]	—[b]	—	—	541	541	—	—	—
0405-95-0039	05-02001	8.8–9.8	Qbt 3	—	—	—	—	541	541	—	—	—
0405-95-0041	05-02001	14–15	Qbt 3	—	—	—	—	541	541	—	—	—
RE05-98-0001	05-02001	14–15	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0002	05-02001	15–16	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0003	05-02001	16–17	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0004	05-02001	17–18	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0005	05-02001	18–19	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0006	05-02001	19–20	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0008	05-02001	20–21	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0009	05-02001	21–22	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0010	05-02001	22–23	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0012	05-02001	23–24	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
RE05-98-0013	05-02001	24–25	Qbt 3	4368R	—	4366R	4367R	—	—	—	—	—
0405-95-0042	05-02002	0–0.5	Soil	—	—	—	—	541	541	—	—	—
0405-95-0043	05-02003	0–1.0	Soil	—	—	539	—	541	541	—	—	—
0405-95-0045	05-02003	1.0–2.0	Qbt 3	—	—	—	—	541	541	—	—	—
0405-95-0046	05-02003	2.0–3.0	Qbt 3	—	—	—	—	541	541	—	—	—
0405-95-0047	05-02004	0–1.0	Soil	—	—	—	—	541	541	—	—	—
0405-95-0048	05-02004	1.0–2.0	Qbt 3	—	539	—	—	541	541	541	541	541
0405-95-0051	05-02004	2.0–3.0	Qbt 3	—	—	—	—	541	541	—	—	—
0405-95-0053	05-02005	0–0.5	Soil	—	—	—	—	541	541	—	—	—

Table 2.0-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Metals	VOCs	SVOCs	HE	Isotopic Plutonium	Isotopic Uranium	Gamma Spectroscopy	Gross Alpha	Gross Beta
0405-95-0054	05-02006	0–0.5	Soil	—	—	—	487	541	541	—	—	—
RE05-98-0007	05-02085	0–0.5	Soil	4348R	—	4347R	4349R	—	—	—	—	—
RE05-98-0011	05-02086	0–0.5	Soil	4348R	—	4347R	4349R	—	—	—	—	—
RE05-98-0015	05-02087	0–0.5	Soil	4348R	—	4347R	4349R	—	—	—	—	—
RE05-98-0016	05-02087	0.5–1.0	Soil	4348R	—	4347R	4349R	—	—	—	—	—
RE05-98-0019	05-02088	0–0.5	Soil	4348R	—	4347R	4349R	—	—	—	—	—
RE05-98-0020	05-02088	0.5–1.0	Soil	4348R	—	4347R	4349R	—	—	—	—	—
RE05-98-0023	05-02089	0–0.5	Sed	4348R	—	4347R	4349R	—	—	—	—	—
RE05-98-0024	05-02089	0.5–1.0	Sed	4348R	—	4347R	4349R	—	—	—	—	—
SWMU 05-005(b)												
0405-95-0286	05-02042	0–1.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0287	05-02042	1.0–2.0	Qbt 3	647	—	—	646	648	648	—	—	—
0405-95-0289	05-02042	2.0–3.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0290	05-02043	0–1.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0291	05-02043	1.0–2.0	Qbt 3	647	—	646	—	648	648	—	—	—
0405-95-0294	05-02043	2.0–3.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0295	05-02044	0–1.0	Soil	647	—	—	—	648	648	—	—	—
0405-95-0296	05-02044	1.0–2.0	Soil	647	—	—	—	648	648	—	—	—
0405-95-0297	05-02044	2.0–3.0	Soil	647	—	—	—	648	648	—	—	—
SWMU 05-006(c)												
0405-95-0274	05-2039	0–1.0	Soil	647	—	—	—	648	648	—	—	—
0405-95-0275	05-2039	1.0–2.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0277	05-2039	2.0–3.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0278	05-2040	0–1.0	Soil	647	—	—	—	648	648	648	648	648

Table 2.0-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Metals	VOCs	SVOCs	HE	Isotopic Plutonium	Isotopic Uranium	Gamma Spectroscopy	Gross Alpha	Gross Beta
0405-95-0281	05-2040	1.0–2.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0282	05-2040	2.0–3.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0283	05-2041	0–1.0	Soil	647	—	—	—	648	648	—	—	—
0405-95-0284	05-2041	1.0–2.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0285	05-2041	2.0–3.0	Qbt 3	647	—	—	—	648	648	—	—	—
0405-95-0298	05-2070	0–0.5	Soil	647	—	—	—	—	—	—	—	—
0405-95-0299	05-2071	0–0.5	Soil	647	—	—	—	—	—	—	—	—
0405-95-0300	05-2072	0–0.5	Soil	647	—	—	—	—	—	—	—	—
0405-95-0301	05-2073	0–0.5	Soil	647	—	—	—	—	—	—	—	—

[a] Request numbers.

[b] — = Analysis not requested.

Table 2.0-2
Inorganic Chemicals Detected above BV during Historical Investigations

Sample ID	Location ID	Depth (ft)	Media	Antimony	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Mercury	Nickel	Selenium	Silver	Zinc
Soil BV[a]				**0.83**	**8.17**	**295**	**0.4**	**6120**	**19.3**	**14.7**	**21500**	**22.3**	**0.1**	**15.4**	**1.52**	**1**	**48.8**
Sediment BV[a]				**0.83**	**3.98**	**127**	**0.4**	**6120**	**10.5**	**11.2**	**21500**	**19.7**	**0.1**	**9.38**	**0.3**	**1**	**60.2**
Qbt 2, 3, 4 BV[a]				**0.5**	**2.79**	**46**	**1.63**	**2200**	**7.14**	**4.66**	**14500**	**11.2**	**0.1**	**6.58**	**0.3**	**1**	**63.5**
SWMU 05-004																	
RE05-98-0019	05-02088	0.0–0.5	Soil	—[b]	—	—	—	—	—	—	—	—	0.11 (U)	—	—	—	—
RE05-98-0020	05-02088	0.5–1.0	Soil	—	—	—	—	—	—	—	—	—	0.11 (U)	—	—	—	—
RE05-98-0023	05-02089	0.0–0.5	Sed	—	—	—	—	—	—	—	—	—	—	—	0.51 (UJ)	—	—
RE05-98-0024	05-02089	0.5–1.0	Sed	—	—	—	—	—	—	—	—	—	0.11 (U)	—	1.1 (UJ)	—	—
SWMU 05-005(b)																	
0405-95-0286	05-02042	0.0–1.0	Qbt 3	—	—	—	—	—	25	—	—	—	—	13	0.45 (U)	—	—
0405-95-0287	05-02042	1.0–2.0	Qbt 3	0.52 (U)	—	—	—	—	25.1	—	—	—	—	14.1	0.44 (U)	—	—
0405-95-0289	05-02042	2.0–3.0	Qbt 3	—	—	—	—	—	45.9	—	—	—	—	23.7	0.44 (U)	—	—
0405-95-0290	05-02043	0.0–1.0	Qbt 3	—	—	—	—	—	—	—	—	—	—	—	0.44 (U)	—	—
0405-95-0291	05-02043	1.0–2.0	Qbt 3	0.56 (U)	—	—	—	—	—	—	—	—	—	—	0.43 (U)	—	—
0405-95-0294	05-02043	2.0–3.0	Qbt 3	0.56 (U)	—	—	—	—	13.8	—	—	—	—	7.7 (J)	0.43 (U)	—	—
SWMU 05-006(c)																	
0405-95-0275	05-02039	1.0–2.0	Qbt 3	—	—	—	—	—	13.4	—	—	—	—	7.6 (J)	0.45 (U)	—	—
0405-95-0277	05-02039	2.0–3.0	Qbt 3	0.55 (U)	—	—	—	—	25.5	—	—	—	—	13.5	0.44 (U)	—	—
0405-95-0278	05-02040	0.0–1.0	Soil	0.85 (U)	—	—	—	—	—	—	—	31.5	—	—	—	—	—
0405-95-0281	05-02040	1.0–2.0	Qbt 3	0.59 (U)	—	—	—	—	9.1	—	—	14.1	—	—	0.44 (U)	—	—
0405-95-0282	05-02040	2.0–3.0	Qbt 3	1.2 (U)	3.2	67.3	—	5450	187	—	—	—	—	89.4	0.44 (U)	—	—
0405-95-0284	05-02041	1.0–2.0	Qbt 3	0.74 (U)	—	—	—	—	20.1	—	—	—	—	11.2	0.43 (U)	—	—
0405-95-0285	05-02041	2.0–3.0	Qbt 3	—	—	—	—	—	35.7	—	—	—	—	18.2	0.43 (U)	—	—
0405-95-0298	05-02070	0.0–0.5	Soil	2.3 (J)	—	—	—	—	—	126	25100	42.9	—	28.2	—	—	58.4
0405-95-0299	05-02071	0.0–0.5	Soil	1.2 (U)	—	—	—	—	—	28.3	—	1740	0.11 (U)	—	—	—	92.5
0405-95-0300	05-02072	0.0–0.5	Soil	75.7	10.9	—	5.3	—	—	138	—	43900	—	33.5	2.2	21.1	313

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

[a] BVs from LANL (1998, 059730).

[b] — = Result was not detected or was below the BV.

Table 2.0-3
Organic Chemicals Detected during Historical Investigations

Sample ID	Location ID	Depth (ft)	Media	Benzoic Acid	Bis(2-ethylhexyl)phthalate
SWMU 05-004					
0405-95-0043	05-02003	0.0–1.0	Soil	0.61 (J)	—*
SWMU 05-005(b)					
0405-95-0291	05-02043	1.0–2.0	Qbt 3	—	0.29 (J)

Notes: Units are mg/kg. Data qualifiers are defined in Appendix A.
*— = Result was not detected.

Table 2.0-4
Radionuclides Detected or Detected above BV/FV during Historical Investigations

Sample ID	Location ID	Depth (ft)	Media	Plutonium-238	Plutonium-239/240
Qbt 3 BV/FV[a]				**na**[b]	**na**
SWMU 05-004					
0405-95-0046	05-02003	2.0–3.0	Qbt 3	—[c]	0.098
SWMU 05-005(b)					
0405-95-0286	05-02042	0.0–1.0	Qbt 3	0.0225	—

Note: Units are pCi/g.
[a] BVs/FVs from LANL (1998, 059730).
[b] na = Not available.
[c] — = Result was not detected or was below the BV/FV.

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

AOC	area of concern
BMP	best management practice
BV	background value
CMP	corrugated metal pipe
DOE	Department of Energy (U.S.)
EP	Environmental Programs Directorate
ER	Environmental Restoration Project
FV	fallout value
HE	high explosives
HEU	highly enriched uranium
HIR	historical investigation report
LANL	Los Alamos National Laboratory
LASCP	Los Alamos Site Characterization Program
NMED	New Mexico Environment Department
NFA	no further action
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RPF	Records Processing Facility
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area
VOC	volatile organic compound

A-2.0 METRIC CONVERSION TABLE

Multiply Sl (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-3.0 DATA QUALIFIER DEFINITIONS

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

Appendix B

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