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Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014

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Prepared by
Environmental Stewardship–Remediation Services

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EXECUTIVE SUMMARY

This investigation work plan presents an approach for characterizing potential contamination at Material Disposal Area (MDA) A, Solid Waste Management Unit (SWMU) 21-014, which is located within Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory) in Los Alamos, New Mexico. The investigation activities proposed herein are required under the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) process, which is currently being conducted by the Laboratory's Environmental Stewardship–Remediation Services project (formerly the Environmental Restoration Project).

MDA A is a Hazard Category 2 nuclear facility comprised of a 1.25-acre fenced and radiologically controlled area situated on the east end of Delta Prime (DP) Mesa. It is bounded by DP Canyon to the north and Los Alamos Canyon to the south. Historically used to dispose of wastes generated during TA-21 operations, MDA A currently contains the features described below.

- Two storage tanks (referred to as *the General's Tanks*) that were buried within the MDA. They contain residual sludge from waste solutions contaminated with plutonium-239/240 and americium-241.
- Two vertical shafts that were drilled to clarify rinse water generated by cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. The General's Tanks were never filled with cement paste so the vertical shafts were not used. The vertical shafts were filled with soil in 1977.
- Two eastern pits that contain solid waste potentially contaminated with polonium, plutonium, uranium, thorium, and other unidentified chemicals associated with Laboratory operations.
- One central pit that contains TA-21 decontamination and decommissioning debris potentially contaminated with radionuclides.
- A former surface storage area that was used to store drums of sodium hydroxide solution and stable iodine contaminated with plutonium and possibly uranium.

Based on the MDA A historical data review, there is evidence that radionuclide and inorganic chemicals are potentially present within MDA A, in both the surface and subsurface, at concentrations above background and fallout values. Of primary concern are plutonium-238, plutonium-239/240, uranium-235, depleted uranium, americium-241, and metals. The presence of organic chemicals is unknown. The DP Canyon hillslope north of MDA A may have been influenced by historic operations at solid waste management units 21-011(k), 21-004(b)-99, and 21-024(h), as well as potential releases from MDA A. In addition, soils at MDA A may have been affected by a tritium plume(s) associated with historic operations at DP East and the Tritium System Test Assembly Facility.

The data requirements, as determined from the historical data review and outlined in this plan, include field surveys and surface and subsurface sampling to define the lateral and vertical extent of contamination at MDA A. The investigation activities presented in this plan have been designed to address these data requirements. The activities include

- a site-wide radiation mapping survey to document the current surface conditions of the site and to help focus surface sample collection activities. Due to the ubiquitous low levels of radionuclides present in the soils within and surrounding TA-21 and the chemicals historically associated with MDA A, both the MDA A disposal area and the DP Canyon slope immediately north of MDA A (the area of influence) will be surveyed for beta and gamma radiation coupled with a global positioning system unit.

- subsurface characterization sampling to obtain analytical data needed for characterizing potential releases from MDA A. Samples will be collected from 1 angled and 14 vertical boreholes that are proposed for locations around and beneath the MDA A tanks, pits, and shafts. The boreholes will be continuously cored down to a point below the base of the target waste unit, to a vertical depth 25 ft below the last field-screening detection. A minimum of six samples from each borehole will be submitted for analysis. Vapor samples will be collected for volatile organic compounds and tritium. The presence of perched water and bedrock fractures will also be evaluated in the one deep borehole (the borehole will penetrate the Cerro Toledo interval within the Bandelier Tuff).
- surface characterization sampling to obtain data needed for characterizing the nature and extent of potential contamination on the DP Canyon slope immediately north of MDA A and the MDA A cover. At least 24 locations will be sampled. To capture surface flow runoff generated from the MDA A site, characterization sampling will target areas of deposition along existing drainages. Sampling will also be performed at select historical RFI sample locations to determine if the historical data are representative of the existing site.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the US Department of Energy (DOE) and managed by the University of California. The Laboratory is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 30 mi northwest of Santa Fe. The Laboratory covers 40 mi^2 of the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation between 6200 ft and 7800 ft above sea level (asl).

The Laboratory's Environmental Stewardship–Remediation Services (ENV-RS) project, formerly the Environmental Restoration (ER) Project, is participating in a national effort by the DOE to clean up sites and facilities formerly involved in weapons research and development. The goal of the ENV-RS project is to ensure that past operations under the DOE do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, the ENV-RS project 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).

The SWMU addressed in this investigation work plan, SWMU 21-014, is potentially contaminated with both hazardous and radioactive components. Depending upon the type(s) of contaminant(s) present and the history of the site, either the New Mexico Environment Department (NMED) or the DOE has administrative authority (AA) over the work performed by the ENV-RS project at the site. Under the New Mexico Hazardous Waste Act, NMED has authority over cleanup of sites with hazardous waste or certain hazardous constituents, including the hazardous waste portion of mixed waste (i.e., waste containing both radioactive and hazardous constituents). The DOE has authority over cleanup of sites with radioactive contamination. Radionuclides are regulated under DOE Order 5400.5, "Radiation Protection of the Public and the Environment," and DOE Order 435.1, "Radioactive Waste Management."

NMED enforces the Hazardous and Solid Waste Amendments Module of the Laboratory's Hazardous Waste Facility Permit, hereafter referred to as Module VIII. Module VIII specifies the conditions and requirements for investigation and cleanup activities at the Laboratory. The US Environmental Protection Agency (EPA) issued Module VIII on May 23, 1990, and revised it on May 19, 1994 (EPA 1990, 01585; EPA 1994, 44146). NMED is currently revising the Hazardous Waste Facility Permit.

In accordance with Module VIII, the nature and extent of releases of hazardous waste or hazardous constituents are determined through the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) process.

1.1 General Site Information

Material Disposal Area (MDA) A is a Hazard Category 2 nuclear facility (DOE 2003, 87047) comprised of a 1.25-acre fenced and radiologically controlled area situated on the east end of Delta Prime (DP) Mesa. It is bounded by DP Canyon to the north and Los Alamos Canyon to the south. Figure 1.1-1 depicts the location of Technical Area 21 (TA-21) and MDA A with respect to other Laboratory technical areas and surrounding landholdings. MDA A is currently inactive and undergoing corrective action. The location of MDA A in relation to TA-21 and surrounding MDAs is shown on Figure 1.1-2. Historically used to dispose of wastes generated during TA-21 operations, MDA A currently contains the features described below:

- Two storage tanks (referred to as *the General's Tanks*) that were buried within the MDA. They contain residual sludge from waste solutions contaminated with plutonium-239/240 and americium-241.

- Two vertical shafts that were drilled to clarify rinse water generated by cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. The General's Tanks were never filled with cement paste so the vertical shafts were not used. The vertical shafts were filled with soil in 1977 (Shaw Environmental, Inc. 2004, 87448).
- Two eastern pits that contain solid waste potentially contaminated with polonium, plutonium, uranium, thorium, and other unidentified chemicals associated with Laboratory operations.
- One central pit that contains TA-21 decontamination and decommissioning debris potentially contaminated with radionuclides.
- A former surface storage area that was used to store drums of sodium hydroxide solution and stable iodine contaminated with plutonium and possibly uranium.

The relative locations of the General's Tanks, the vertical shafts, the pits, and the former drum storage area with respect to the MDA A fence line, additional site features, topography, and other SWMUs/AOCs are shown in Figure 1.1-3.

1.2 Investigation Objectives

The objectives of this investigation are (1) to determine the nature and extent of contamination at the site, and (2) to provide general site characterization data for the evaluation of remedial alternatives.

To help achieve these objectives, this investigation work plan will

- identify additional characterization data requirements based upon a review of MDA A historical data;
- establish the rationale for characterization data collection and analysis; and
- identify appropriate methods and protocols for collecting and analyzing samples to finalize the characterization of MDA A.

2.0 MDA A BACKGROUND

This section summarizes the historical and current characteristics of MDA A. The historical investigation report (HIR) presents a review of MDA A's structural and operational history (LANL 2005, 87452).

2.1 Site Description and Operational History

TA-21 is comprised of two operational areas, DP West and DP East, both of which produced liquid and solid radioactive wastes. Operations at DP West included plutonium processing, and operations at DP East included production of weapons initiators. MDA A was first used to bury solid waste that potentially contained polonium, plutonium, uranium, thorium, and other unidentified chemicals. This solid waste was placed in the pits at the eastern end of MDA A between 1945 and July of 1946. Liquid waste was stored in the General's Tanks at the western end of MDA A between 1945 and 1983, pending future improvement in the extraction process for recovery of plutonium. On December 3, 1975, two vertical shafts were excavated (McGinnis 1976, 00954). In 1969, the central pit was excavated to receive decontamination and decommissioning debris from TA-21 (Meyer 1971, 00557). The central pit was enlarged in 1972 and was used until late 1977 (Desilets 1972, 00484). MDA A was decommissioned in May 1978 and a crushed tuff cover was placed over the entire site in 1985 (Gerety et al. 1989, 06893, p. 3). Additional cover material was added in 1987 (Salazar 1987, 00491; Gerety et al. 1989, 06893, p. 4).

2.1.1 General's Tanks

In 1945, two 50,000-gal. cylindrical steel tanks (the General's Tanks) were buried at the west end of MDA A (Figures 1.1-3 and 2.1-1) to receive waste solutions containing plutonium-239/240 and americium-241. Liquid waste was to be stored until improved chemical recovery methods could be developed for extracting and recovering plutonium-239/240. A Los Alamos Scientific Laboratory (LASL) engineering drawing, ENG-C-2076, shows the two cylindrical tanks as 12 ft in diameter and 62 ft 10 in. long (LASL 1945, 24448). The tanks were placed on concrete piers that extend approximately 1 ft above the bottom of the excavation. The tanks were buried approximately 20 ft apart in excavations approximately 12 ft deep, 15 ft wide, and 86 ft 10 in. long. An 8-in.-thick concrete pad was poured over the top of the tanks. The pad is 58 ft wide and 68 ft 10 in. long. A 5-ft-high earthen berm was placed on top of the concrete pad to form a mound from 2.25 to 5.75 ft above grade (Figure 2.1-1).

Liquid waste was eventually removed from the tanks in 1975 and 1976 (McGinnis 1976, 00954). An unknown volume of sludge remains in the bottom of the tanks.

2.1.2 Vertical Shafts

In 1975, two 4-ft-diameter vertical shafts were excavated to a depth of approximately 65 ft, south of the General's Tanks (Figure 1.1-3) (Warren 1976, 00508; McGinnis 1976, 00954). The shafts were drilled to clarify rinse water generated by cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. There were plans to coat the shafts with asphalt (Warren 1976, 00508), but the plans were not implemented (Shaw Environmental, Inc., 2004, 87448). The General's Tanks were never filled with cement paste, so the vertical shafts were not used. In 1977, the vertical shafts were filled with soil (Shaw Environmental, Inc., 2004, 87448). The locations of the two vertical shafts are illustrated in ENG-R-4457 (LASL 1976, 24891).

2.1.3 Eastern Pits

In 1945, the eastern pits were excavated into Unit 3 of the Tshirege Member of the Bandelier Tuff to receive radioactive solid waste from DP East (Bolton 1952, 00555). The location of the eastern pits is shown on Figure 1.1-3. Early engineering drawings (ENG-1266 [LASL 1970, 24374]; ENG-C-2076 [LASL 1945, 24448]) indicate the pits to be approximately 18.0 ft wide by 125 ft long by 12.5 ft deep. In 1946, after the pits were full, crushed Bandelier Tuff was used to backfill and cover the pits.

2.1.4 Central Pit

In 1969, a large pit was excavated in the center of MDA A to receive and store debris from demolition work being conducted at TA-21 (Figure 1.1-3). In a memo dated November 9, 1972 (Desilets 1972, 00484), the pit was reported to be 40 ft long and wide and 22 ft deep. A request was made to enlarge the existing central pit (Desilets 1972, 00484) to provide approximately 6000 yd^3 of additional burial space for building materials from Building 21-012 at TA-21 (Desilets 1972, 00484). An engineering drawing from May 1976 shows the pit to be 172 ft long by 134 ft wide (LASL 1976, 24891).

In July 1972, exhaust ductwork from Building 21-005 was placed in the west end of the pit, covered with about 1 ft of dirt, and then the ductwork was crushed (Enders 1972–1975, 00514, p. 2). Between February and July of 1973, the pit received plutonium-contaminated building debris from the demolition of Building 21-012 (Christensen et al. 1975, 05481, pp. 6–7). Waste from Building 21-012 disposed of at MDA A included items such as doors, lumber, pipes, building materials, roofing materials, electrical boxes, wire, metals, concrete, brick, contaminated soil, and large metal items such as steel columns.

Building debris from other TA-21 buildings and structures was placed into the central pit until late 1974, when demolition work was completed. However, waste of an unspecified nature was placed in the unfilled parts of the pit (LANL 1991, 07529, p. 16-244) until 1977 when waste disposal operations at MDA A ended. Asphalt was also disposed of in this pit.

Radiologically contaminated waste placed into the central disposal pit contained plutonium-239/240, plutonium-238, uranium-235, depleted uranium, and other unspecified radionuclides associated with the waste. The pit was decommissioned in May 1978 when a soil cover (crushed tuff) was placed over the pit (Environmental Surveillance Group 1985, 06610, p. 66).

In 1985, final site-stabilization activities for the MDA A cover were conducted (Gerety et al. 1989, 06893, p. 4). These included removing surface contamination, adding cover material, recontouring, and reseeding. Additional soil was placed on the site again in 1987 (Salazar 1987, 00491).

2.1.5 Former Drum Storage Area

Emelity (1978, 00487) refers to the storage of several hundred 55-gal. drums containing iodide waste on the surface at the east end of MDA A in the late 1940s and early 1950s. The stored drums can be seen at the east end of MDA A on a 1949 aerial photograph and on a subsequent 1950 photograph (LANL 2005, 87452, Figure 2.2-3). These drums contained sodium hydroxide (NaOH) solution and stable iodine, which were used to scrub ventilation exhaust air that contained plutonium and possibly uranium (LANL 1991, 07529, p. 16-244). Corrosion of the drums resulted in liquid releases to the surface soil at MDA A (Emelity 1978, 00487).The drums were removed in 1960 and the storage area was paved.

2.2 Relationship to Other SWMUs and AOCs

MDA A is one of five MDAs at TA-21 that received wastes from TA-21 operations. The five are MDA A (SWMU 21-014), MDA B (SWMU 21-015), MDA T [SWMU 21-016(a)-99], MDA U [SWMU 21-017(a)-99], and MDA V [SWMU 21-018(a)-99] (Figure 1.1-2). In addition to MDA T, which is located west of MDA A, SWMUs and AOCs in the vicinity of MDA A include 21-004(b)-99, 21-011(b), 21-011(k), 21-012(a), 21-012(b), 21-024(h), 21-025(a), C-21-005, C-21-023, and C-21-026 (Figure 1.1-3). Of these, SWMUs 21-004(b)-99 and 21-011(b) are active sites and not currently under investigation or corrective action. SWMU 21-011(k) has been remediated. SWMUs/AOCs 21-012(a), 21-025(a), C-21-023, and C-21-026 have been approved for no further action (NFA). SWMUs 21-012(b) and 21-024(h) are included in the DP Site Aggregate Area work plan (LANL 2004, 87461). C-21-005 is included in the investigative work plan for MDA T (LANL 2004, 85641). Unless otherwise cited, brief descriptions of these SWMUs and AOCs are excerpted from the database and the "TA-21 Delta Prime Site Aggregate Area Work Plan" (LANL 2004, 87461) and are provided below. Locations of the SWMUs and AOCs with respect to MDA A are presented in Figure 1.1-3.

2.2.1 SWMU 21-004(b)-99

Consolidated SWMU 21-004(b)-99 is an active site consisting of two aboveground stainless-steel tanks located within an asphalt berm and a drainline from a sump pump to the outfall area in DP Canyon. The sump pump is connected to the TA-21 acid waste line, which carries wastewater produced at DP East to the TA-21 wastewater treatment plant (Building 21-257). Historically, waste may have been contaminated with tritium, polonium, actinium, plutonium, uranium, thorium, and mercury.

2.2.2 SWMU 21-011(b)

SWMU 21-011(b) is a currently active sump (Structure 21-223) located approximately 400 ft east of the TA-21 wastewater treatment plant (Building 21-257). The sump was installed in 1965 and transports wastewater from DP East to the wastewater treatment plant through a 3-in. cast-iron line. The waste is stored in two tanks (Structures 21-110 and 21-111) located immediately west of Building 21-257, treated in this wastewater treatment plant, and subsequently transported by truck to either TA-43 or TA-50, depending upon waste composition. The sump receives wastewater from Buildings 21-152, 21-155, and 21-209, through 6-in. cast-iron drainlines. The sump may have discharged to DP Canyon through a drainpipe before the installation of two 3000-gal. holding tanks [Structure 21-346, SWMUs 21-004(b) and 21-004(c)] that serve as emergency storage if the sump becomes inoperative or overflows. The holding tanks and outfall are designated as SWMU 21-004(b)-99.

2.2.3 SWMU 21-011(k)

SWMU 21-011(k) is the outfall discharge line that carried industrial wastewater from the two holding tanks (21-112 and 21-113) associated with the industrial wastewater treatment plant (Building 21-257) to a discharge point on the south slope of DP Canyon. The outfall is no longer active. The liquid waste remaining after treatment potentially contained a variety of radioactive and chemical constituents. Untreated waste from the former industrial wastewater treatment plant (former Building 21-35) was also discharged to the area of the outfall.

An interim action was completed in 1997 to remove a portion of the outfall area and to install stormwater control measures as a best management practice (LANL 1997, 55648). A voluntary corrective measure was conducted in 2003 to reduce concentrations of cesium-137 and americium-241. The voluntary corrective measure activities included excavating part of the outfall drainline and contaminated soil, tuff, and sediment; disposing of the drainline and contaminated material at Area G within TA-54; restoring the site; and installing stormwater run-on and runoff controls (LANL 2003, 82260, pp. 11-28).

2.2.4 SWMU 21-012(a)

SWMU 21-012(a) is identified as a dry well inside Building 21-357, the new TA-21 steam plant. The SWMU report (LANL 1990, 07512) also identified another dry well [SWMU 21-012(b)] associated with the former steam plant, Building 21-9. The former steam plant at TA-21 was torn down in 1985 and replaced with a new steam plant that went on-line in 1985. During two site visits (May 11, 1990, and August 8, 1990), investigating personnel found no indications of a dry well anywhere within the interior of the new steam plant. The discrepancy is attributed to the assumption that the new steam plant installation included a system similar to that of the former steam plant that contained dry well SWMU 21-012(b). SWMU 21-012(a) was approved for NFA by the AA and removed from the Laboratory's Hazardous Waste Facility Permit on December 23, 1998 (NMED 1998, 63042).

2.2.5 SWMU 21-012(b)

The former steam plant at TA-21 began operation in 1945, was torn down in 1985, and replaced with a new steam plant that went on-line in 1985 (LANL 2004, 87461). SWMU 21-012(b) is an inactive dry well that received boiler blow-down from the former steam plant (Building 21-9) from 1980 to 1985. The well, which is 4 ft long by 4 ft wide by 54 ft deep, was installed south of the 2500-gal. blow-down tank to replace a seepage pit. A 3-in. perforated pipe was suspended vertically into the dry well to a depth of 49 ft. The space surrounding the perforated pipe was filled with large gravel. Underground piping connected the well and the blow-down tank. When the former steam plant was removed and replaced by the new steam plant (Building 21-357), the area was regraded. There is no visible evidence of the former steam plant or of the concrete manhole cover for the dry well. At the time the Operable Unit (OU) 1106 RFI work plan was written (LANL 1991, 07529), it was unclear if underground piping from the 2500-gal. tank had been removed during the demolition of Building 21-9. The dry well may have remained, as is evidenced by an area of pavement that remains frost- and ice-free except after heavy snows or very cold temperatures. Although no data exist regarding potential contamination in the area of the former steam plant dry well, common constituents in boiler blow-down include sulfite, copper salts, and chromates. No contaminant releases from the dry well and related structures have been documented. The SWMU is currently proposed for a removal action under the DP Site Aggregate Area work plan (LANL 2004, 87461, p. 109).

2.2.6 SWMU 21-024(h)

SWMU 21-024(h) is a septic system that discharged sewage from an administrative building and shop (Building 21-151) through a septic tank (Structure 21-163) to the surface on the north rim of DP Mesa above DP Canyon (Engineering Drawing ENG-C-2213 [LASL 1945, 24459]). The system was constructed in 1945, later became inactive, and was left in place in 1966 (LANL 1991, 07529, p. 15-94). Above-background concentrations of americium-241, tritium, and plutonium-239/240 were associated with this SWMU. In 1996, a voluntary corrective action was conducted which included regrading, reseeding, and restoring the area to its original site conditions. The site is proposed for additional corrective action in the DP Site Aggregate Area work plan (LANL 2004, 87461, p. 109).

2.2.7 SWMU 21-025(a)

SWMU 21-025(a) is the location of a former Tritium System Test Assembly (TSTA) Facility (Building 21-155). The TSTA Facility tested tritium-control systems for the nuclear fusion program, prepared targets containing tritium for laser fusion research, and handled tritium for defense programs. Building 21-155 was completed in 1982 and operations began in 1984. The facility included an off-gas system used to vent gas containing small amounts of tritiated water after treatment. Releases from the off-gas system are identified as SWMU 21-019 (LANL 1991, 07680, p. 20-1). SWMU 21-025(a) and SWMU 21-019(a–m) were approved for NFA by the AA (EPA 2004, 87296).

2.2.8 AOC C-21-005

AOC C-21-005 is the location of a release of americium-241 and plutonium on the west side of a waste treatment plant [Building 21-257, SWMU 21-011(a)]. The spill resulted from a 1959 fire in a filter in a former laboratory building (Building 21-5). The resulting contamination was cleaned up at that time. This AOC is included in the investigation work plan for MDA T and will be investigated along with MDA T Boreholes 6 and 9, in conjunction with Building 21-257 (LANL 2004, 85641, p. 50).

2.2.9 AOC C-21-023

AOC C-21-023 is the former location of a laboratory (Building 21-54) and its associated soil. The laboratory was demolished and disposed of at TA-54, Area G. This site was discussed in the RFI work plan for OU 1106 as one of a group of AOCs at which no documented releases had occurred or where releases had occurred but cleanup had been conducted and documented (LANL 1991, 07680, p. 19-1). A permit modification request for NFA for this AOC was submitted in 1995 and approved by the AA (EPA 2004, 87296).

2.2.10 AOC C-21-026

AOC C-21-026 is the former location of an administrative building, with shops, removed in 1966 (LANL 1991, 07680, p. 19-1). Information from the TA-21 RFI work plan indicates that AOC C-21-026 is one of several AOCs where no documented releases have occurred, or where releases have occurred but cleanup has been conducted and documented (LANL 1991, 07680, p. 19-1). Approval for NFA was granted by the AA (EPA 2004, 87296).

2.3 MDA A Area of Influence

In June 2004, field reconnaissance was conducted on the DP Canyon hillslope immediately north of MDA A to define the area of surface drainage from MDA A into DP Canyon. During this reconnaissance, topography, slope, and drainage channels (both natural and human-made) were considered while defining the area. This hillslope drainage area is designated as the MDA A “area of influence” and is shown on Figure 2.3-1. The purposes of designating the MDA A area of influence are (1) to identify all relevant historical surface and near-surface sampling locations on a geographical basis, regardless of SWMU designation within the Laboratory data management system; (2) to spatially identify analytical data needs for the DP Canyon hillslope; and (3) to bound the extent for additional near-surface sampling.

The western, eastern, and southern boundaries of the area of influence are defined based on the ground surface slope of that portion of DP Mesa. The natural slope in this area is toward the north into DP Canyon, and even though the cover material of MDA A has created a localized radial flow off the cover, all surface runoff eventually flows north once it reaches the toe of the cover. The northern border of the MDA A area of influence is approximately 15 ft from the center of the channel in DP Canyon. The channel in DP Canyon has been investigated under the approved work plan and addendum for Los Alamos and Pueblo Canyons (LANL 1995, 50290; LANL 2002, 70235). The results of the DP Canyon investigation indicated that SWMU 21-011(k) was the major contributing source of contaminants to DP Canyon (LANL 2004, 87390, p. 9-1). The investigation concluded that human health risks are within acceptable risk ranges for current-day and reasonably foreseeable future land uses in the Los Alamos and Pueblo watershed, which includes DP Canyon. In addition, adverse ecological effects were not observed within terrestrial and aquatic systems in the watershed (LANL 2004, 87390, p. 9-3).

The MDA A area of influence overlaps with the eastern portions of SWMU 21-011(k), which is located on the hillslope northwest of MDA A (Figure 2.3-1). Surface contamination associated with SWMU 21-011(k) has been remediated (LANL 2003, 82260, p. 56); therefore, any hillslope areas within the SWMU 21-011(k) boundary are not included in the MDA A area of influence. Other SWMUs, such as 21-024(h) and 21-004(b)-99, are also contained within the MDA A area of influence, near the eastern boundary (Figure 2.3-1). Any contribution and migration of contaminants from these SWMUs to the MDA A area of influence will be considered in subsequent decision-making and will be based on historical and future data collected in support of those SWMU-specific investigations.

2.4 Conceptual Site Model

A conceptual site model (CSM) is based on the existing knowledge about a site and describes potential contaminants, environmental media to which individuals may be exposed, media through which chemicals may be transported to potential receptors, and any currently uncontaminated media that may become contaminated in the future due to contaminant migration (EPA 1989, 08021, p. 4-10). The current CSM for MDA A includes both surface and subsurface sources of potential contamination. The following subsections describe the current CSM for MDA A.

2.4.1 Source of Contamination

All contamination associated with MDA A would have originated from one of four identified waste areas: the General's Tanks, the central pit, the two eastern pits, or the former drum storage area. Potential contaminants include radionuclides, metals, and organic chemicals from the General's Tanks and eastern pits; radionuclides and metals from the central pit; and radionuclides (plutonium and uranium) contained in the NaOH solution and iodine stored in the former drum storage area. Because a complete waste inventory for MDA A does not exist, additional chemicals of potential concern (COPCs) may be identified. A list of process chemicals used at TA-21 during the operational period of MDA A (1945–1978) is provided in Table 2.4-1.

The CSM for COPCs at MDA A may be revised pending trenching of the pits at MDA B, which is scheduled to occur concurrently with the implementation of the investigation proposed in this work plan. After the MDA A eastern pits were filled and closed, the pits at MDA B were excavated to continue receiving process waste from TA-21 operations (LANL 1991, 07529, p. 16-25). Therefore, the waste at MDA A should be similar in nature to that at MDA B.

2.4.2 Transport Mechanisms

The following transport mechanisms may lead to the exposure of human and/or ecological receptors:

- Vaporization and gaseous diffusion and advection of contaminants in air
- Dissolution and/or particulate transport of surface contaminants during rainfall and snow melt runoff events, prior to placement of clean fill
- Airborne transport of contaminated surface soils, prior to placement of clean fill
- Continued dissolution and advective/dispersive transport of chemical and radiological contaminants contained in subsurface soil and bedrock
- Biotic perturbation and translocation of contaminants in subsurface waste

The four waste units at MDA A (General's Tanks, eastern pits, central pit, and former drum storage area) received solid and/or liquid waste that may have contributed to soil contamination beneath the facility. Since the pits at MDA A are unlined, there is the potential for infiltration of surface water through the cover material into the waste units. Additionally, the Bandelier Tuff at TA-21 is highly fractured, which may allow water to leach through the buried waste into the subsurface below the pits. Fractures may be pathways for volatile organic compounds (VOCs) and tritium vapors in the subsurface, if present, through soil/gas interactions.

Additional preferential contaminant migration pathways include a paleochannel identified during previous geophysical surveys conducted at MDA A. This paleochannel, if proximal to waste units, could provide a preferential pathway for soil vapors. The paleochannel would not be likely to provide a contaminant migration pathway for groundwater because it is stratigraphically located above the MDA A waste units, occurring less than 15 ft below ground surface (bgs). The depth to groundwater at MDA A is estimated to be 1200 ft bgs (see Section 3.2.3.3).

Transport of surface contamination off-site through surface runoff or atmospheric transport from MDA A is currently a minor pathway because the site has been covered with clean fill. However, before the cover was installed, surface runoff may have migrated into DP Canyon.

2.4.3 Potential Receptors

Currently, MDA A is a radiologically controlled site with access restrictions maintained by a chainlink fence that separates MDA A proper (former drum storage area, pits, shafts, and the General's Tanks) from the surrounding public lands of DP and Los Alamos Canyons. DP Canyon, immediately north of MDA A, is open to the general public and is currently used for recreational purposes only.

The following groups of human receptors could be reasonably expected to be present at MDA A or off-site areas affected by contaminants from MDA A:

- Industrial workers
- Recreational users

Potentially complete exposure pathways by which current or future human receptors could be exposed to chemical and/or radiological constituents from MDA A include

- Ingestion, dermal, and inhalation exposure to chemicals and/or radionuclides in surface soil transported off-site (current/future);
- Inhalation of volatile chemicals in ambient air (current/future);
- Ingestion, dermal, and inhalation exposure to chemicals and/or radionuclides in subsurface soil that has been excavated and deposited on the surface (future); and
- Direct external irradiation (current/future).

Because it is unlikely that MDA A wastes have affected groundwater, human receptors are not expected to be exposed to contaminants via groundwater ingestion, dermal contact, or volatile inhalation exposure pathways.

The contaminants associated with chemicals in surface or subsurface soil from MDA A may be available to biological receptors through the following exposure pathways:

- Rain splash or saltation-creep of contaminated off-site surface soil onto plants
- Ingestion, dermal, and inhalation exposure to chemicals and/or radionuclides in surface soil transported off-site or in subsurface soil excavated and deposited on the MDA A surface
- Food web transport (consumption of contaminated plants and animals)
- Direct exposure to off-site surface soil and/or on-site subsurface soil containing gamma-emitting radioactive contaminants
- Deposition of particulates in off-site surface soil or on-site subsurface soil that has been excavated and deposited on the surface and subsequently ingested by animals during grooming.

Exposure to groundwater at MDA A is an incomplete pathway for ecological receptors.

2.5 Waste Inventory

It is estimated that approximately 12 to 25 Ci (200 to 400 g) of plutonium-239/240 were placed in the General's Tanks (LANL 1991, 07529, p. 16-245). It is not known if this estimate also includes americium-241 (ingrowth from plutonium-241 decay) or if it is just for plutonium-239/240. It is known that plutonium-241 is formed along with plutonium-239/240 in the production reactor and inseparable from this isotope. Some estimates of the activity in the tanks (Voelz 1973, 00483) indicate that about one-third of the radioactivity is americium-241. It is also possible that the sludge contains inorganic chemicals used in plutonium processing (LANL 1991, 07529, p. 16-244). There is no evidence that the General's Tanks leaked (Balo and Warren 1982, 07205, p. 34).

No documentation has been found that details the types of chemicals and quantities of radionuclides and/or chemical contamination that were disposed of in the two eastern pits. Radionuclides present in the waste include plutonium, polonium, uranium, americium, curium, radium-lanthanum, and actinium (Meyer 1952, 28154). Polonium and plutonium-239/240 are the major contaminants in the waste. Only plutonium would be present at the site because of the short half-life of polonium (138.4 days). The waste types disposed of in the pits included laboratory equipment, building construction material, paper, rubber gloves, filters from air cleaning systems, and contaminated or toxic chemicals generated during chemistry and metallurgy research operations (Meyer 1952, 28154).

The quantities and concentrations of contaminants (radioactive and nonradioactive) that were placed into the large central pit are unknown. However, Rogers (1977, 05707, p. A-7) indicates that building debris put into the pit was contaminated with plutonium-239/240, plutonium-238, uranium-235, and depleted uranium, along with other unidentified radioactive isotopes. It is unknown if nonradiological hazardous wastes are present in this, or any other, disposal pit at MDA A. The Radioactive Waste Management Site Plan from July 1973 states that MDA A was reactivated with the addition of the central pit to be used for burying debris from the TA-21-012 demolition project (LASL 1973, 08902, p. 29). This debris was contaminated with transuranic elements at levels of less than 10 nCi/g (LASL 1973, 08902, p. 29). Another reference (Balo and Warren 1982, 07205, p. 85) stated that pressurized gas cylinders were buried in the pits, although the specific pit (central or eastern) was not specified.

An unknown amount of NaOH solution and iodine contaminated with plutonium and possibly uranium was released to the surface soils of MDA A from corroded drums in the former drum storage area (LANL 1991, 07529, p. 16-244).

2.6 Historical Releases

There is no documented information that releases occurred from the General's Tanks, the eastern pits, or the central pit. The vertical shafts never received waste. The drums stored in the former surface storage area near the eastern pits were reportedly corroded and leaking by the time they were finally removed (Emelity 1978, 00487). The drums contained an NaOH solution and iodine contaminated with plutonium and possibly uranium (LANL 1991, 07529, p. 16-244).

2.7 Summary of Historical Investigations

Historical investigations at MDA A, which are detailed in the HIR (LANL 2005, 87452), are categorized as pre-RFI (prior to 1992) or RFI.

Pre-RFIs were conducted in 1969 (Purtymun 1969, 00519); 1974 (Wheeler 1976, 00486); 1980 (LANL 1991, 07529, pp. 16-245 to 16-246); 1983 (LANL 1991, 07529, p. 16-247); 1984 (LANL 1991, 07529, pp. 16-246 to 16-247); 1985 (LANL 1991, 07529, p. 16-267); 1986 (LANL 1986, 00477); and 1990 (LANL 1991, 07529, p. 16-250; LANL 1997, 62292). These investigations generally focused on radiological sampling of the General's Tanks. RFIs were performed in 1992 (LANL 1994, 26073) and 1994 (LANL 1997, 62292).

Additionally, geophysical surveys were conducted at MDA A during 1989 (Gerety et al. 1989, 06893); 1996 (LANL 1996, 64694); 1999 (Johnson 1999, 87457; Martin 1999, 87458; Quesada, 1999, 87456;

Young 1999, 87459); and 2003 (AGS 2003, 81176). These geophysical surveys were performed to delineate and confirm subsurface features at MDA A, including pits and tanks, as well as identify natural features such as paleochannels. The HIR provides a complete review of the structural and operational history of MDA A (LANL 2005, 87452). A brief summary of these investigations is presented below.

2.7.1 Surface Soils, Alluvium, and Fill

Pre-RFI surface soil investigations were performed in 1980 (LANL 1991, 07529, pp. 16-245 to 16-246), 1984 (LANL 1991, 07529, pp. 16-246 to 16-247), and 1990 (LANL 1991, 07529, p. 16-250; LANL 1997, 62292). The sample locations for the 1980, 1984, and 1990 investigations are described in the HIR (LANL 2005, 87452) and shown on HIR Figures 3.2-2, 3.2-4, and 3.2-5 (LANL 2005, 87452). A total of 78 surface or shallow subsurface samples were collected during these three investigations. All samples were analyzed for radiological constituents only. Based on the information collected during these three investigations, it was determined that impacts on surface and shallow subsurface soils are widespread in the area surrounding MDA A. Concentrations of plutonium-238, plutonium-239/240, americium-241, uranium, and tritium were above established background values (BVs) in most sample locations in the area surrounding MDA A (LANL 2005, 87452).

RFI surface soil investigations were performed in 1992 (LANL 1994, 26073) and 1994 (LANL 1997, 62292) in the areas outside of the MDA A fence line, both immediately surrounding and downslope from the facility to the north (Figure 2.7-1). Surface and shallow subsurface soil samples were collected at depths up to 1.5 ft bgs. Samples were analyzed for radionuclides, metals, VOCs, and semivolatile organic compounds (SVOCs). As with previous investigations, americium-241, plutonium-238, plutonium-239/240, uranium, and tritium were detected in most samples above BVs. Several metals, including arsenic, cadmium, lead, and mercury, were detected above background levels in several of the samples collected downslope from the facility. SVOCs and VOCs, including bis(2-ethyhexyl)phthalate, acetone, and methylene chloride, were detected in a small number of these samples.

2.7.2 Subsurface Tuff

Pre-RFI subsurface investigations were conducted in 1969 (Purtymun 1969, 00519); 1974 (Wheeler 1976, 00486); and 1983 (LANL 1991, 07529, p. 16-247), all within the fenced perimeter. The 1969 investigation was an evaluation of fracture and joint patterns that was conducted during the excavation of the central disposal pit. The 1974 and 1983 investigations included the installation of 10 boreholes (4 in 1974 and 6 in 1983) with augers near the General's Tanks, with the purpose of determining if the tanks had leaked (Figure 2.7-1). The ten boreholes were sampled to depths of 30 ft (1983) and 35 ft (1974) into the tuff, approximately 20 ft below the base of the General's Tanks. The samples collected in 1974 were analyzed for gross alpha/beta; the 1983 samples were submitted for plutonium-238 and plutonium-239/240 analyses. Results from these two sampling events indicated that the tanks had not leaked (as of 1983), and the only detections noted were plutonium-239/240 in the shallower (0- to 3-ft) intervals.

2.7.3 Geophysical Surveys

Geophysical surveys were conducted at MDA A in 1989 (Gerety et al., 06893); 1996 (LANL 1996, 64694); 1999 (Johnson 1999, 87457; Martin 1999, 87458; Quesada 1999, 87456; Young 1999, 87459); and 2003 (AGS 2003, 81176). These surveys were conducted to determine the geometry of each of the disposal units and the General's Tanks. Additional features, including paleochannels and miscellaneous buried debris, were also identified. Each of these surveys used a combination of geophysical methods to locate subsurface structures and anomalies. These methods included a time domain electromagnetic system, seismic refraction, ground penetrating radar, resistivity, and induced polarization. Results of these surveys indicated that even though the General's Tanks locations were correct, the three waste pits are actually located 15 ft further east than what is shown on early engineering drawings. Four strongly magnetic anomalies were identified in the central pit (C1 through C4 in Figure 2.7-2) and are likely associated with buried steel exhaust ductwork or similar materials. Three small undocumented subsurface anomalies (D1, D2, and D3) were also detected inside the fenced area (Figure 2.7-2). Two paleochannel areas (Figure 2.7-1) were located north (Johnson 1999, 87457, p. 6; Martin 1999, 87458, p. 5; Quesada 1999, 87456, p. 4) and southeast of the facility (AGS 2003, 81176, Figure 11 and p. 10); these may be related to a paleochannel that was previously verified to the southwest at MDA T in Borehole 21-05051 (LANL 2004, 85641, p. B-28).

2.8 Historical Data Quality and Interpretation

2.8.1 Data Quality

To determine the environmental impacts associated with waste units at MDA A, several investigations have been conducted within the facility and on the hillslope north of MDA A. Within MDA A, all soil and tuff samples that have been collected to date are pre-RFI (prior to 1992), and all data associated with these samples are unqualified. In addition, these samples were analyzed for radionuclides only, and not for hazardous constituents. The surface soil data collected from the 1990 investigation are qualitative only because a sample location map is unavailable. Therefore, there is currently no data of defensible quality that adequately characterizes the surface and subsurface of MDA A within the MDA A perimeter fence.

To date, the most reliable data collected are those that were collected during the 1992 and 1994 investigations. Surface and near-surface samples were collected during these RFIs. However, no subsurface tuff samples were collected. Chemical Science and Technology Forms were present for each request number, but there was no additional documentation for a majority of the request numbers. For inorganic chemical analyses, matrix spike and blind (quality control) QC sample results were available; however, laboratory blank, calibration and interference check, laboratory control, and serial dilution sample results were not included in the data package. For radiological analyses, laboratory duplicate and blind QC sample results were available; however, blank, tracer recovery, and laboratory control sample results were not included in the data package. Furthermore, no documentation of the minimum detectable activity is available. For organic chemicals, surrogate recovery and matrix spike sample results were available; however, blank, mass spectrum confirmation, initial and continuing calibration, internal standard, and laboratory control sample results were not included in the data package. Overall, the RFI data are determined to be of adequate quality to be usable; however, to fully ascertain the nature and extent of potential contamination from MDA A, additional surface and near-surface samples are needed in drainage channels downslope from MDA A.

2.8.2 Nature and Extent of Contamination

The nature and extent of contamination from MDA A was evaluated in two components: (1) the waste units comprising MDA A and the subsurface tuff below these waste units, and (2) the DP Canyon slope area north of MDA A.

2.8.2.1 MDA A Waste Units and Subsurface Tuff

Historical data collected within MDA A are limited to unqualified pre-RFI data (prior to 1992) and limited to radiological analyses. There are no inorganic or organic chemical analyses available for surface or subsurface samples within MDA A. Subsurface tuff has been sampled within shallow boreholes in the vicinity of the General's Tanks to a maximum depth of 35 ft bgs. All shallow borehole samples (to a depth of 3 ft bgs at the time of sampling) contained plutonium-238 and plutonium-239/240. One borehole detected these radionuclides at a depth interval of 27–30 ft bgs (LANL 2005, 87452, p. 8). There are no qualified data regarding the presence of hazardous constituents in MDA A or the potential migration of hazardous constituents from the waste units.

2.8.2.2 DP Canyon Slope Soil and Sediment

Data available from the 1992 and 1994 RFIs are limited to surface and near-surface samples collected outside of the MDA A perimeter fence. Additional samples collected within the area of influence from other SWMU investigations [e.g., SWMU 21-024(h)] were also reviewed. The historical data summarized below support the interpretation that no migration of hazardous constituents from MDA A resulted from surface runoff or air deposition. However, since the DP Canyon slope is subject to erosional and depositional processes, the collection of soil and sediment samples is proposed to determine if hazardous constituents are contained in hillslope drainages and if the historical data are still representative of current surface conditions. New sample locations in active drainages within the area of influence are proposed. The results of the historical RFIs (1992 and 1994) are summarized below.

Inorganic Chemicals

Surface soil and sediment samples were collected adjacent to, and downslope from, MDA A and analyzed for inorganic chemicals during the RFIs. The results of these investigations indicated that arsenic, cadmium, calcium, chromium, copper, lead, manganese, mercury, silver, sodium, uranium, vanadium, and zinc were detected above their respective soil and sediment BVs in (LANL 1998, 59730). Table 2.8-1 summarizes the sample locations where inorganic chemicals exceeded BVs. The table also compares the results to NMED or EPA Region 6 soil screening levels (SSLs) (NMED 2004, 85615, Table A-1; EPA 2003, 81724) in samples within the area of influence for MDA A. Appendix B of the HIR provides all tabulated analytical results (LANL 2005, 87452).

Uranium is detected above the BV of 1.82 mg/kg in sample locations throughout the area of influence (LANL 2005, 87452, Figure 4.1-1). Uranium and cadmium are typically two times higher than BVs, and silver and zinc are slightly higher than BVs directly below the SWMU 21-011(b) outfall. All detected concentrations of chromium, copper, manganese, mercury, and vanadium above BVs are associated with soil and sediment samples (21-02574 and 21-01869, respectively) collected in the drainage below the outfall for SWMU 21-024(h). These anayltes are likely to be associated with discharge from this SWMU or from SWMU 21-011(b) (located in upper part of the same drainage) and not with surface runoff from MDA A. Lead, zinc, and uranium were also detected above BVs in these same outfall drainage samples. Arsenic is the only inorganic chemical that was detected (in one sediment sample location [21-01689]), with a maximum detected concentration of 5.3 mg/kg above the residential SSL of 3.9 mg/kg and below the industrial SSL of 17.7 mg/kg (NMED 2004, 85615, Table A-1).

The spatial distribution of cadmium, lead, mercury, and arsenic in soil and sediment is shown on bubble plots (Figures 2.8-1 through 2.8-4). The bubble plots show the maximum concentrations at each location for a particular chemical. The size of the bubble is proportional to the concentrations in the data set. Additional information regarding the bubble plot presentation is provided in the HIR (LANL 2005, 87452) As described above, these figures illustrate that above-BV concentrations of inorganic chemicals are primarily confined to the drainage channel downslope from SWMUs 21-011(b) and 21-024(h) and do not appear related to MDA A. However, since not all drainage channels downslope from MDA A were investigated in the RFIs, additional surface and near-surface sampling in these areas is warranted.

Organic Chemicals

Surface soil and sediment samples were collected surrounding, and downslope from, MDA A and were analyzed for organic chemicals during the RFIs. Table 2.8-2 summarizes the information about those sample locations where organic chemicals were detected in surface soils and sediment and compares them to NMED SSLs (NMED 2004, 85615, Table A-1). Results of these investigations indicate detected concentrations of bis(2-ethylhexyl)phthalate in 2 of 83 samples, with a maximum concentration of 2.9 mg/kg; acetone in 24 of 26 samples, with a maximum concentration of 0.11 mg/kg, and methylene chloride in 7 of 26 samples, with a maximum concentration of 0.018 mg/kg. The sample locations with detected acetone and methylene chloride concentrations were downslope from SWMUs 21-011(b) and 21-024(h) (LANL 2005, 87452, Figure 4.1-9). The SSLs were not exceeded for any of the detected organic chemicals. Appendix B of the HIR provides all tabulated analytical results (LANL 2005, 87452).

Radionuclides

Surface soil and sediment samples were collected adjacent to, and downslope from, MDA A and were analyzed for radionuclides during the RFIs. The results of these investigations indicated that americium-241, plutonium-238, plutonium-239, thorium-228, tritium, and uranium-235 were detected above their respective BVs/fallout values (LANL 1998, 59730). Table 2.8-3 summarizes the information about those sample locations where radionuclides were detected above background or fallout values within the area of influence for MDA A and compares them to screening action levels (SALs) (LANL 2002, 73705). Appendix B of the HIR provides all tabulated analytical results (LANL 2005, 87452). Figure 4.1-5 of the HIR shows the locations where radionuclides were detected above the background or fallout value within the area of influence for MDA A (LANL 2005, 87452).

Americium-241 (by alpha spectroscopy) was detected above the fallout values of 0.013 pCi/g (soil) and 0.04 pCi/g (sediment) in 18 of 40 samples. Americium-241 (by gamma spectroscopy) was detected above the fallout value in 13 of 40 samples. The maximum americium-241 concentration was 1.424 pCi/g at location 21-01166. No americium-241 concentration exceeded the residential SAL of 39 pCi/g.

Plutonium-239 was detected above the fallout value of 0.054 pCi/g (soil) in 82 of 100 samples and above the fallout value of 0.068 pCi/g (sediment) in 3 of 3 samples. The maximum plutonium-239 concentration was 33 pCi/g at location 21-01414. No plutonium-239 concentration exceeded the residential SAL of 44 pCi/g.

The spatial distributions of americium-241 and plutonium-239 in soil and sediment adjacent to, and downslope from, MDA A are shown in Figures 2.8-5 and 2.8-6, respectively. These figures show that higher concentrations of americium-241 and plutonium-239 are located on the upper hillslope adjacent to DP Mesa but that, in general, americium-241 and plutonium-239 are detected in historical sampling locations throughout the hillslope, a distribution pattern most indicative of particulates dispersed by air. Since all drainage channels downslope from MDA A were not investigated in previous RFIs, additional samples are proposed for characterizing radionuclides in these areas.

Plutonium-238 was detected above its fallout value of 0.023 pCi/g (soil) or the fallout value of 0.006 pCi/g (sediment) in 43 of 103 samples. The maximum concentration of plutonium-238 was 0.914 pCi/g at location 21-01413. No plutonium-238 concentration exceeded the residential SAL of 49 pCi/g.

Thorium-228 was detected slightly above its soil BV of 2.28 pCi/g in 1 of 30 samples. Thorium-228 was detected at a concentration of 2.99 pCi/g at location 21-01409, downslope from SWMU 21-011(b). Thorium-228 is the only radionuclide to exceed the residential SAL of 2 pCi/g.

Tritium was detected above its soil fallout value of 0.76 pCi/mL in 49 of 52 samples on the hillslope north and northwest of MDA A (LANL 2005, 87452, Figure 4.1-5). The maximum concentration (1700 pCi/mL) was detected at sample location 21-01408. Two other sample locations in this small area (21-01409 and 21-01407) contain elevated tritium above the fallout value. Figure 2.8-7 shows the spatial distribution of tritium above fallout values in the MDA A area of influence. Assuming a soil moisture content of 10%, the conversion of the maximum tritium value from pCi/mL to pCi/g would result in a maximum concentration of 188 pCi/g, which is below the residential SAL of 890 pCi/g (LANL 1998, 59730).

Uranium-235 was detected above its soil BV in 1 of 6 soil samples (LANL 2005, 87452, Table 4.1-3). The maximum concentration detected was 0.4855 pCi/g at sample location 21-02574, in the drainage below the SWMU 21-024(h) outfall.

2.8.2.3 Summary

Based on a review of pre-RFI historical data collected within the MDA A perimeter fence, radionuclides are present in both the surface and subsurface at concentrations above background and fallout values. The radionuclides of primary concern are plutonium-238 and plutonium-239/240. Based upon information from historical documents, inorganic chemicals and organic chemicals have also been placed in the waste units. There are no historical inorganic or organic chemical analyses from soil and tuff beneath MDA A. The lateral and vertical extent of subsurface contamination associated with MDA A is currently unknown.

During previous RFIs, extensive surface and near-surface sampling has been conducted in the area of influence downslope from MDA A. These investigations show that arsenic, cadmium, calcium, chromium, copper, lead, manganese, mercury, silver, sodium, uranium, vanadium, and zinc were detected above their respective BVs in soil and sediment (LANL 1998, 59730). However, many of these elevated concentrations are associated with locations below the outfall for SWMUs 21-024(h) and 21-011(b). Arsenic is the only inorganic chemical that exceeded its residential SSL (at one sediment sampling location). Additional sampling for inorganic chemicals is warranted in drainage channels downslope from MDA A.

Americium-241, plutonium-239/240, plutonium-238, tritium, and uranium-235 were detected at concentrations greater than background and fallout levels in samples from most sampling locations. Thorium-228 was detected above background at only one sampling location and was the only radionuclide to exceed a residential SAL. While some of these radionuclides may be a result of waste practices historically implemented at TA-21, there are indications that operations conducted at other SWMUs downslope of MDA A have also impacted the MDA A area of influence. Additional sampling for radionuclides is needed in drainage channels downslope from MDA A.

Bis(2-ethylhexyl)phthalate, methylene chloride, and acetone were detected downslope from SWMUs 21-011(b) and 21-024(h). No organic chemicals exceeded a residential SSL. Although there is no indication from historical surface and near-surface sampling that organic chemicals are associated with MDA A, samples collected from the drainage channels downslope from MDA will be analyzed for SVOCs.

3.0 SITE CONDITIONS

This section describes the current surface features at, and the existing subsurface geologic characteristics beneath, TA-21 in general and MDA A in particular. The known surface and subsurface traits and their potential effects on the occurrence and concentration of contaminants include

- a canyon-mesa terrain that affects meteorological conditions and ecological habitats at the surface;
- a semiarid climate with low precipitation and a high evapotranspiration rate that limits the extent of subsurface moisture percolation, and this limits the amount of moisture available to leach radionuclides or other hazardous waste constituents; and
- a thick, relatively dry unsaturated (vadose) zone that greatly restricts or prevents downward migration of contaminants in the liquid phase through the vadose zone to the regional aquifer.

These and other elements of the environmental setting at MDA A are useful when evaluating site investigation data with respect to the fate and transport of contamination from historical site activities.

3.1 Surface Conditions

The elevation of DP Mesa in the vicinity of MDA A ranges from 7125 ft to 7135 ft asl, with a gentle slope to the north. The canyon slope ranges in elevation from 7035 ft asl in the bottom of DP Canyon to 7125 ft asl on the northern edge of DP Mesa, immediately north of MDA A.

The surface of MDA A is heavily vegetated with forbs, native grasses, and sagebrush. The surface slopes at a gradient of less than 5% downward across the site from south to north. Approximately 30 ft north of the site, the slope increases to approximately 30°. MDA A is located in the Bandelier Tuff, which breaks into a series of benches and steep slopes that grade into DP Canyon, approximately 175 ft north of MDA A's west end and 60 ft north of MDA A's east end.

3.1.1 Surface Water

Mesas of the Pajarito Plateau are generally dry, both on the surface and within the bedrock forming the mesa. Canyons range from wet to relatively dry; the wettest canyons contain continuous streams and perennial groundwater in the canyon-bottom alluvium. DP Mesa is bounded on the north by DP Canyon and on the south by Los Alamos Canyon and BV Canyon, which flows into Los Alamos Canyon near MDA V. DP and Los Alamos Canyons have intermittent flow sufficient to support alluvial groundwater systems (LANL 1998, 59599, Figures 2-7, 2-8, and pp. 4-48, 4-52).

There are no streams on DP Mesa; stormwater and snowmelt generally run off the mesa as sheet flow and in small drainages off the mesa sides. Stormwater runoff from MDA A mainly occurs as sheet flow north into DP Canyon. Some stormwater from MDA A may flow laterally in an easterly or westerly direction, but this overland flow is captured at the toe of the mounded cover in a drainage ditch and diverted north into DP Canyon through a culvert. Currently, shallow diversion channels are present on the south, west, and east sides of the facility and are used to move water around the base of the facility, toward the north, and to prevent run-on to MDA A. During July 2001, a surface water site assessment was conducted for MDA A in accordance with ENV-RS standard operating procedure (SOP) 02.01. The results of the assessment documented an erosion potential score of 15.8, indicating a low erosion potential at MDA A (LANL 2001, 87375, p. 5).

3.1.2 Soils

At TA-21, including MDA A, the natural or undisturbed surface soil cover is limited because of Laboratory operations such as building and road construction and demolition. Where undisturbed, soils on the mesa surface are thin and poorly developed. They tend to be sandy in texture near the surface and more clay-like beneath the surface. Soil profiles tend to be more poorly developed on the cliff-forming south-facing slopes than on the north-facing slopes which tend to have a higher organic content. A discussion of soils in the Los Alamos area can be found in Section 2.2.1.3 of the ER Project's installation work plan (LANL 1998, 62060, p. 2–21) and in Nyhan et al. (1978, 05702, pp. 24–25).

3.2 Subsurface Conditions

3.2.1 Stratigraphy

The generalized stratigraphy of DP Mesa in the area of MDA A is shown in Figure 3.2-1. DP Mesa consists of Bandelier Tuff (Qbt) overlain by a thin layer of alluvium and soil. The Bandelier Tuff unit is subdivided into two members, the Otowi and the Tshirege (in ascending order). MDA A is situated within the Tshirege Member, which is a compound cooling unit divided into four distinct cooling units: 4, 3, 2, and 1v/1g (Broxton et al. 1995, 50121, pp. 33–63). The bedrock directly underlying TA-21 is cooling unit 3 (Qbt 3) of the Upper Tshirege, a cliff-forming nonwelded to partially welded tuff. Below MDA A, the Otowi and Tshirege Members are separated at about 340 ft bgs by the Cerro Toledo (Qct) interval, a 10- to 40-ft-thick sequence of volcaniclastic sediments deposited in braided stream systems. The Bandelier Tuff and deposits of the Cerro Toledo interval are derived primarily from explosive volcanic eruptions in the Valles Caldera approximately 1.2 million years ago (Goff 1995, 49682, p. 7). The basal Guaje Pumice Bed of the Otowi Member separates the Bandelier Tuff from the underlying clastic fanglomerate sediments of the Puye Formation (Tp). This feature may be locally absent in portions of TA-21 (LANL 2004, 87291, p.13).

Previous geophysical studies conducted at MDA A have determined that there are at least two paleochannel areas in the subsurface near or below MDA A (AGS 2003, 81176, p. 10; Johnson 1999, 87457, p. 6; Martin 1999, 87458, p. 5; Quesada 1999, 87456, p. 4). The two paleochannel areas, north and east of MDA A (see Figure 2.7-1), may actually be an eastern bifurcation of the primary paleochannel that is located at MDA T. Previous drilling activities (Borehole 21-05051) have verified the presence of the paleochannel located at MDA T (LANL 2004, 85641, p. B-28); however, the areas identified to the north and east of MDA A have not been verified.

3.2.2 Cliff Retreat and Fractures

According to the article "Geomorphic Studies at DP Mesa and Vicinity," (Reneau 1995, 50143, pp. 65–92), tributary stream systems and their canyons (possibly including BV Canyon and the upper reaches of DP Canyon) developed prior to incision of Los Alamos Canyon and minimal cliff retreat has occurred in these canyons since then. The article indicates that exposure of most of the MDAs at TA-21 on DP Mesa (including the area adjacent to MDA A) through cliff retreat is improbable over periods exceeding 10,000 years. Fracture characteristics of unit 2 of the Tshirege Member, which was the focus of the study, are very similar to previous fracture studies of unit 3, allowing for extrapolation of results to the rocks directly below TA-21.

An additional fracture study was conducted in June 1969 during excavation activities at the MDA A central disposal pit (Purtymun 1969, 00519). Although findings of this study are similar to those discussed in a 1995 study (Wohletz 1995, 58845, pp. 19–31), with fracture sets oriented in a northerly direction, there were other fracture orientations noted from N40°E to N60°E and from N70°E to N80°E. It was also noted that these fractures/joints contained a dark brown to gray clay plating.

3.2.3 Hydrogeology

3.2.3.1 Infiltration

Surface and near-surface conditions (topography, precipitation, surface runoff) control water infiltration to the subsurface and the transport of contaminants into the shallow subsurface. In this respect, the climate behavior of mesas and canyons forming the plateau differ from one another (LANL 1998, 59599). Mesas are generally quite dry, both on the surface and within the rock forming the mesa. Canyons range from wet to relatively dry; the wettest canyons contain continuous streams and perennial groundwater in the canyon-bottom alluvium. Dry canyons have only occasional stream flow and may lack alluvial groundwater.

Relatively small volumes of water move beneath mesa tops under natural conditions because of low rainfall, run-off into canyons, high evaporation, and efficient water use by vegetation. Liquid water generally infiltrates the mesa, and water vapor generally moves upward, undergoing evaporation and transpiration (or “evapotranspiration”) along the top and sides of the mesa. Air circulates through the mesa-top units because of the relatively dry pore spaces and the topographic relief. Air circulation may be driven by temperature variations, barometric pumping, or surface winds. This process promotes atmospheric evaporation, which may extend deep within the mesa and further inhibit the downward liquid-water flow.

The proposed hydrogeologic conceptual model for the Pajarito Plateau (Figure 3.2-2) (LANL 1998, 59599, p. 5), including MDA A, predicts infiltration of water into the subsurface and subsequent transport of water, vapor, and solutes through the upper regions of the vadose zone. This process is heavily influenced by surface conditions such as topography, surface water flow, and precipitation. The natural source of moisture in the vadose zone is precipitation, most of which is removed as runoff, and evaporation and transpiration (LANL 1997, 63131, pp. 2–27). The subsurface movement of the remaining moisture (often referred to as recharge) is predominantly vertical in direction and is influenced by properties and conditions of the vadose zone.

Differences in degree of surface disturbance and the geologic properties of the tuff lead to differences in recharge rates. Mesa-top recharge can be locally significant when vegetation is removed, soil and near surface bedrock are disturbed, or water is artificially added to the local hydrologic system by activities such as effluent disposal.

Two geologic properties of the Bandelier Tuff that significantly influence recharge rates are the degree of welding and devitrification, both effects of prolonged presence of residual gases and high temperatures following deposition. Because different tuff units were deposited at different temperatures, and because individual units were laid out in variable thicknesses over different landscapes, cooling was not uniform. Consequently, welding varies spatially, both between and within separate depositional layers. Welded tuffs tend to be more fractured than nonwelded tuffs. Fractures within the tuff do not enhance the movement of dissolved contaminants unless saturated conditions exist. Under unsaturated conditions, most of the open fractures beneath the site are expected to be completely dry, and the water will exist in the tuff matrix only. Only in situations when substantial infiltration occurs from the ground surface will the fractures become wet and conduct water. However, modeling studies predict when fractures disappear at contacts between stratigraphic subunits, when fracture fills are encountered, or when fracture coatings are interrupted, fracture moisture is absorbed into the tuff matrix (Soll and Birdsell 1998, 70011, pp. 193–202).

3.2.3.2 Perched Groundwater

Observations of perched intermediate groundwater in Laboratory wells are rare on the Pajarito Plateau. Perched waters are thought to form mainly at horizons where medium properties change dramatically, such as at paleosol horizons with clay or caliche found in basalt and volcanic sediment sequences. The Cerro Toledo interval, Guaje Pumice Bed, and Puye Formation are local examples.

Figure 3.2-3 shows a hydrogeologic cross-section through TA-21. The Cerro Toledo interval was drilled through to a depth of 293 ft bgs at borehole LADP-4 which was located immediately north of TA-21 in DP Canyon (Figure 3.2-4), but groundwater was not observed and the Guaje Pumice Bed was encountered between 545 ft and 573 ft bgs and contained no perched water (Broxton et al. 1995, 50119, pp. 98–99). Saturated conditions were not encountered in the borehole at location 21-02523 near MDA V (LANL 2004, 87291, p. 14). This borehole was drilled into the Otowi Member of the Bandelier Tuff to a depth of 660 ft bgs (approximately 6500 ft asl). Perched intermediate groundwater has been observed at some locations on the plateau, including at borehole LADP-3 (in the Guaje Pumice Bed at 6430 ft asl) and at well Otowi-4 on the eastern base of DP Mesa east of TA-21 (in the Puye at 6380 ft asl) (Broxton et al. 1995, 50119, pp. 93–109; LANL 1998, 59599, Figure 2-8 and p. 4-52). Figure 3.2-4 shows groundwater elevations at the Laboratory. Perched groundwater was encountered at R-6, located northwest of Otowi-4 in DP Canyon, at approximately 603 ft bgs (Vaniman 2004, 87463).

3.2.3.3 Regional Aquifer

The regional aquifer in the Los Alamos area slopes eastward towards the Rio Grande within the Santa Fe Group into the Puye Formation beneath the central and western portion of the Pajarito Plateau. Depth of the regional aquifer decreases from about 1200 ft bgs along the western margin of the plateau to about 600 ft bgs along the eastern margin. The regional aquifer was encountered in deep wells proximal to MDA A at 5870 ft asl (R-7), 5850 ft asl (Otowi-4), and 5835 ft asl (R-8) (Figures 3.2-3 and 3.2-4), resulting in an approximate depth to groundwater at MDA A of 1265 ft bgs (Broxton et al. 1995, 50119, pp. 93–109; LANL 2002, 72878, pp. 26–33; LANL 2003, 79594, pp. 18–26). Preliminary data from the drilling of R-6 indicate that the depth to regional aquifer is approximately 1180 ft at an elevation of 5815 ft. The groundwater in the regional aquifer is separated from alluvial and perched groundwater by 350 to 620 ft of tuff and volcanic sediments (Purtyman 1995, 45344, p. 29).

4.0 SCOPE OF ACTIVITIES

This section describes the specific activities that will be performed during the field investigation of MDA A. The primary goal of this investigation is to determine how buried waste materials which were disposed of at the MDA A facility may have migrated into soil and subsurface bedrock in the area and the extent of the migration. The main activities associated with this investigation are (1) surveying to locate waste unit perimeters for drilling setbacks associated with DOE requirements (see Section 4.1) and sampling locations; (2) radiological surveying of surface radiation; (3) drilling boreholes and sampling soil/tuff; (4) collecting pore-gas vapor samples; (5) collecting surface and near-surface samples in the MDA A area of influence; and (6) installing vapor monitoring wells (if required). If groundwater is encountered at any time during the field investigation, groundwater monitoring wells may be installed and samples collected. Concurrently with the MDA A sampling and drilling activities, activities such as collection of field-screening data, collection of survey data, and management of investigation-derived waste (Appendix B) will also be conducted.

4.1 MDA A Nuclear Hazard Category and Considerations for Investigation Activities

MDA A has been categorized by the DOE as a Hazard Category 2 nuclear facility (DOE 2003, 87047). Facility categories are determined by 10 Code of Federal Regulations (CFR) 830, Subpart B, and requirements set forth in DOE-STD-1027-92, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports, and Documented Safety Analyses (DSA). A Hazard Category 2 nuclear facility is a facility for which a hazard analysis shows the potential for significant on-site consequences.

DOE nuclear safety requires that a safety basis be prepared and maintained for the range of planned operations at MDA A. The safety basis prepared for the General’s Tanks and pits will include reliance upon hazard controls to provide adequate protection of workers, the public, and the environment. Hazard controls at MDA A include the geophysical verification surveys of waste units and the establishment of benchmark controls. The safety basis must be kept current and must consider any changes to the facility, the facility operations, or the facility hazards as they are analyzed. The DSA for MDA A will be prepared by the Laboratory for the DOE and is not part of this document. The MDA A DSA will contain controls to protect the public, workers, and the environment from the hazards associated with MDA A’s postulated inventory, which may include both hazardous chemicals and radionuclides. Work conducted as part of this investigation will be performed in accordance with the controls established by the DSA as well as any resultant technical safety requirements. The controls will be incorporated into the site-specific health and safety plan required by 29CFR1926, integrated work documents, and other site-specific procedures.

Characterization of waste in the disposal units will not be conducted as part of the field investigation described in this work plan. The characterization of the residual radioactive waste contained in the General’s Tanks will be conducted during a radioactive waste stabilization investigation. Building demolition waste placed in the central pit has been documented with photographs as shown in the MDA A HIR (LANL 2005, 87452). Characterization of the waste in the eastern pits is pending receipt of data obtained from the trenching operations proposed for MDA B (LANL 2004, 87290, p. 14). At this time, the waste contained in the MDA B pits is thought to be comparable in nature to the waste placed in the MDA A eastern pits. When the eastern pits at MDA A were quickly filled from TA-21 operations, the pits at MDA B were excavated to hold the waste from the continuing operations (LANL 1991, 07529, p. 16-25). Current information about the vertical shafts indicates that no waste was placed in the shafts and that the shafts were filled with soil.

All drilling and sampling activities will be tailored to achieve the specific investigation objectives identified and outlined in Section 1.2. As part of this investigation, drilling will be employed for the following reasons:

- to establish the lateral and vertical extent of potential contamination at MDA A with shallow angled and shallow and deep vertical boreholes;
- to collect subsurface geotechnical, lithologic, stratigraphic, and analytical data; and
- to characterize potential releases from individual waste units.

4.2 MDA A Investigation Activities

The field investigation of MDA A will consist of the activities summarized below. Details regarding the specific proposed methods for implementing each of these activities are described in Section 5.

Field survey—The exact location of each waste pit, the General's Tanks, the vertical shafts, and the borehole/soil sampling locations will be determined with a geodetic survey. Utility surveys will be performed as part of the excavation permitting process. Each location will be thoroughly examined to identify potential hazards for subsurface drilling.

Radiological surface survey—Radiological walkover surface surveys will be performed prior to initiation of any field activities. Beta/gamma surveys will be conducted on 10-ft interval transects.

Installation of 15 boreholes—One angled and 14 vertical boreholes will be installed at MDA A. The angled borehole will be installed in conjunction with a paired vertical borehole to determine the lateral and vertical extent of potential chemical migration from the General's Tanks. All other waste units will be investigated by using vertical boreholes to determine the lateral and vertical extent of potential chemical migration from MDA A. Boreholes will be advanced at the angle and to the depths and lengths specified in Section 4.3.

Collection of core samples for analysis—Continuous core samples will be collected from each borehole. Core will be visually inspected and field screened for alpha and beta/gamma radioactivity. Lithologic descriptions and fracture-characterization data will be recorded for each borehole. Tuff samples will be collected at specified intervals. Four samples will be collected for laboratory analysis from each borehole based on the following criteria: (1) the highest field-screening detect; (2) the maximum depth of a field-screening detect; (3) the base depth to pits, vertical shafts, tanks, or other structure of potential concern; and (4) the total depth (TD) of the borehole. For each borehole less than 100 ft in TD, two additional samples will be collected from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals. For boreholes exceeding 100 ft in TD, four additional samples will be collected from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals. However, if subsurface conditions are extremely variable, additional samples may be collected. All samples will be analyzed by an off-site laboratory in conformance with ENV-RS quality procedures (QPs) 7.1 and 7.2.

Soil and sediment sampling and analysis—Ten soil and sediment locations will be sampled from the DP Canyon hillslope north of MDA A. Samples will be collected in drainages and other areas of deposition to determine if there is downslope migration of contaminants from MDA A. In addition, six historical RFI sampling locations will be resampled to verify if the data are still representative of hillslope surface conditions. Eight soil/fill samples will be collected from the existing MDA A cover. Samples will be collected from two depth intervals at each sampling location (0–0.5 ft and 1.5–2.0 ft).

Geophysical logging and fracture characterization—Geophysical logging and fracture characterization will be conducted on all boreholes.

Vapor and groundwater sampling—After drilling is completed, subsurface vapor samples will be collected from all boreholes at a depth that corresponds to the base of the nearest waste unit (e.g., tank, pit, or vertical shaft) and at TD. If perched groundwater is encountered during implementation of the field investigation described in this work plan, perched groundwater samples will be collected.

4.3 Field Surveys to Locate Waste Units and Topographic Benchmarks

The location and survey of the waste units have been defined by reviewing historic photos and documents. Engineering drawings and all past geophysical surveys were used to verify the locations and configurations of known subsurface structures and to identify any additional unknown structures/objects that may not have been documented. In general, the waste unit locations as defined from most of the previous geophysical surveys have been consistent with the design drawings. The interpreted boundaries identified by the geophysical surveys will be used to identify the waste unit locations to guide the selection of borehole locations. Because of uncertainty associated with the waste unit boundaries, appropriate setbacks for drilling will be applied.

A field reconnaissance was conducted during June 2004 to determine the area of influence from the MDA A facility. During this reconnaissance, topography and drainage channels (both natural and human-made) were considered. Using a global positioning system (GPS), a survey was conducted in July 2004. During this survey, three of four brass survey monuments were located at three of the MDA A fence corners. The coordinates from these benchmarks were used to tie historical geophysical data to the current base map.

4.4 Number, Locations, and Depth of Boreholes

To define the nature and extent of contamination at MDA A, 15 boreholes will be installed. The boreholes will provide information about MDA A's subsurface stratigraphy, potential migration pathways (e.g., paleochannels and fractures), and geotechnical data. The borehole locations proposed in this investigation work plan are based on an evaluation of access limitations, safety, historic data, and other relevant information. The proposed drilling activities will accomplish the following objectives:

- define the nature and extent of possible contamination in subsurface tuff, including
    - ♦ lateral and vertical extent of contamination in tuff beneath the General's Tanks, the central pit, the two eastern pits, the drum storage area, and the two vertical shafts, and
    - ♦ concentrations and spatial extent of VOCs and tritium in the vapor phase in subsurface tuff;
- identify perched groundwater beneath MDA A; and
- obtain information about hydrogeologic properties and fracture characteristics of the vadose zone in support of contaminant transport modeling.

Proposed borehole locations are shown in Figure 4.4-1. Proposed borehole locations were determined using the following considerations: (1) data requirements; (2) access constraints, including setback requirements (no-drill zones) for the waste units within the MDA; (3) drilling equipment limitations; (4) geophysical anomalies identified during geophysical surveys; and (5) other factors such as subsurface utilities. All boreholes will be drilled using a hollow-stem auger drilling rig. If drilling difficulties are encountered (e.g., refusal) for particular boreholes, the boreholes will be completed using an air-rotary drilling rig. The rationale for the installation of each borehole is presented below.

<u>Borehole 1</u>: A 45° angled borehole will be advanced below the lateral extent of the General's Tanks. The borehole will be advanced from the north side of the tank area, outside of the perimeter fence and immediately north of the General's Tanks (Figure 4.4-1). The borehole will be installed in a north-south direction with a maximum vertical target depth of 82 ft when terminated at the south end of the General's Tanks. This borehole entry location and orientation will verify potential tank releases and provide a sufficient safety factor margin to adequately address the radiological concerns associated with tank integrity. A paired vertical borehole (Borehole 14 described below) will be installed to assess the vertical extent of potential hazardous or radiological releases from the tanks.

Borehole 2: This borehole will provide information about subsurface conditions adjacent to the vertical shafts. The borehole will be advanced northwest of the shaft area (shafts filled with clean soil) to parallel fracture trends at the site. The vertical shafts extend to a depth of approximately 65 ft bgs. The borehole will be advanced to a target depth of 85 ft bgs.

Boreholes 3, 4, and 5: These boreholes will provide information about the lateral and vertical extent of releases from the central disposal pit. These boreholes are placed to align with the predominant northwest fracture orientation and will be installed to a target depth of 45 ft bgs.

Boreholes 6, 7, and 8: These boreholes will provide information about the lateral and vertical extent of releases from the eastern pits. These boreholes are placed to align with the predominant northwest fracture orientation and will be installed to a target depth of 35 ft bgs.

Borehole 9: This borehole will be installed in the former drum storage area to determine if releases from leaking drums have impacted the underlying soil/tuff. The borehole will be installed to a target depth of 35 ft bgs to determine the vertical extent of potential releases from the former drum storage area. The borehole also will provide information about the lateral extent of potential chemical and radiological releases associated with the eastern disposal pits.

Boreholes 10 and 11: These boreholes will be installed south (Borehole 10) and northeast (Borehole 11) of the former drum storage area to determine the lateral extent of chemical and radiological potential releases from the former drum storage area and the eastern pits. The borehole locations align with the predominant northeast fracture orientation and will be drilled to a target depth of 35 ft bgs.

Borehole 12: This deep borehole will be installed 10 ft beyond the Cerro Toledo/Otowi contact adjacent to the central disposal pit and between the two eastern pits. The target depth for this borehole is 335 ft bgs. This borehole will provide information about the subsurface conditions and possible perched groundwater zones beneath the MDA A waste units.

Borehole 13: This borehole will be located southeast of the MDA A perimeter fence in a possible paleochannel area, as identified by a 2003 geophysical survey (AGS 2003, 81176, p. 10), to verify if the paleochannel is present and to define the lateral extent of potential releases from MDA A to the southwest. This borehole will be drilled to a target depth of 45 ft bgs.

Borehole 14: This borehole will be drilled adjacent to, and east of, Borehole 1 (an angled borehole) to determine the vertical extent of chemical and radiological potential releases from the General's Tanks. The borehole will be drilled to a target depth of 280 ft bgs.

Borehole 15: This borehole will be located north of the MDA A perimeter fence in a possible paleochannel identified by a geophysical survey in 1999 (Johnson 1999, 87457, p. 6; Martin 1999, 87458, p. 5; Quesada 1999, 87456, p. 4). Information from the borehole will help the assessment of the lateral extent of migration from the General's Tanks and verify if the paleochannel exists as a preferential migration pathway. This borehole will be drilled to a target depth of 45 ft bgs.

4.5 Soil and Rock Sampling from Boreholes

All boreholes will be continuously cored and samples will be field screened on 5-ft intervals as discussed in Section 4.8. Four samples will be collected from each borehole for laboratory analysis, using the following criteria: (1) the highest field-screening detect; (2) the maximum depth of a field screen detect; (3) the base depth to pits, vertical shafts, tanks, or other structure of potential concern; and (4) the TD of the borehole. Additional samples will be collected from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals, if encountered. To define vertical extent, the continuation of the boreholes beyond the target depths will be based on the presence of elevated field screening and/or field observations (such as unusual staining). All boreholes will be advanced 25 ft beyond the last field-screening detection.

Field documentation of samples collected from fracture zones will include a detailed physical description of the fracture fill material and rock matrix sampled. The volumes of fracture-fill and rock-matrix material included in the sample will be estimated from field measurements. An additional sample will be collected from the rock matrix adjacent to the fracture-sample material to allow for comparison. The fractures and matrix samples are paired and will be assigned unique identifiers.

4.6 Surface and Near-Surface Sampling

Surface and near-surface samples will be collected within the MDA A area of influence. Proposed sample locations are shown in Figure 4.6-1. These sampling activities will be performed with the following objectives:

- To confirm if the 1992/1994 RFI sample results are representative of current hillslope conditions. Six of the 66 historical sample locations will be resampled in the surface (0–0.50 ft) and near-surface soil (1.5–2.0 ft). Previous RFI sample results are depicted in Figures 4.1-1, 4.1-5, and 4.1-9 of the HIR (LANL 2005, 87452).
- To identify surface/drainage impacts downslope from MDA A in DP Canyon. Ten locations will be selected within obvious drainages and depositional areas north of MDA A. Surface (0–0.50 ft) and near-surface (1.5–2.0 ft) samples will be collected.
- To characterize the cap material used to cover MDA A in 1987. Eight locations on the MDA A cover will be sampled. Surface (0–0.50 ft) and near-surface (1.5–2.0 ft) soil samples will be collected.

The surface and near-surface sampling is summarized in Table 4.6-1. All samples will be field screened as discussed in Section 4.8. Samples will be collected and submitted to an approved off-site laboratory as discussed in Section 4.8.

4.7 Subsurface Vapor Monitoring

Subsurface pore-gas samples for VOCs and tritium will be collected from all boreholes, following the current version of ENV-RS-SOP-06.31. For each borehole, two samples will be collected (1) beneath the base of the nearest disposal unit, and (2) at TD.

Vapor monitoring will be conducted as described in Section 5.5. If VOCs are detected in the vapor samples following drilling, a vapor-monitoring plan will be submitted to the AA as described in Section 5.5.

4.8 Perched Water Sampling

Borehole 12 will extend through the Cerro Toledo to determine if perched groundwater is present below MDA A. If saturation is encountered as the borehole advances, drilling will be stopped to determine whether sufficient water volume is available to analyze the water quality. If sufficient volume exists, a groundwater sample will be collected and analyzed for metals, anions, perchlorate, alkalinity, total organic carbon, total inorganic carbon, and total dissolved solids. A monitoring well design will be submitted to the AA in accordance with Section 5.6 of this work plan

4.9 Field Screening

Section IV.C.2.c.iv, Items 2 and 4, of the NMED September 1, 2004, draft Compliance Order on Consent specifies that core samples be screened using the methods described in Section IX.B. Section IX.B.2.d of the Consent Order specifies that all core samples be screened by (1) visual examination, (2) headspace vapor screening for VOCs, and (3) metals screening using x-ray fluorescence (XRF). Additional screening for release-specific characteristics, such as high explosives (HE), shall be conducted where appropriate. Section IV.C.1.c.iv, Item 6, of the proposed Consent Order indicates that screening results from the samples collected in the field be used to identify samples for laboratory analysis.

The Laboratory’s field-screening approach will be to (1) visually examine all samples for evidence of contamination; (2) screen for organic vapors at 10-ft intervals; and (3) continuously screen for radiological contamination. This approach differs from that specified in the Consent Order by not using the Order-specified field-screening methods for metals as a basis for identifying samples to be submitted for laboratory analysis.

To provide a detailed justification for the Laboratory’s chosen approach, the limitations of field-screening methods for various classes of analytes specific to MDA A are discussed below.

4.9.1 VOCs

VOCs will be screened at a minimum 10-ft interval in all boreholes. Screening will be accomplished through headspace analysis and using a photo-ionization detector (PID) capable of measuring quantities as low as 1 ppm. VOC screening will be used to guide drilling beyond the target depth. Boreholes will be advanced 25 ft beyond the last field-screening detection.

4.9.2 Metals

Because the concentrations of metals detected in the historical samples are low (near or below background), XRF methods are not useful as a guide to planned sample-collection activities, and they will not be used to screen surface and subsurface soil/rock samples.

4.9.3 Radioactivity

Radiation screening of all samples will be used for health and safety purposes and for identifying samples for laboratory analysis. All samples will be continuously field screened for gross alpha and for beta/gamma radiation. There is no real-time field-screening method for tritium.

4.10 Field Analytical Screening

No field analytical screening is proposed for the MDA A investigation. There are no documented processes that involve HE at MDA A.

4.11 Analytical Suites

4.11.1 Tuff, Soil, and Sediment Samples

All soil/tuff samples collected from the boreholes will be analyzed for VOCs, SVOCs, pH, nitrates, perchlorate, total uranium, target analyte list (TAL) metals, and cyanide. In addition, total iodide analyses and radionuclide analyses will be performed. The radionuclide analyses include gamma spectroscopy and isotopic analyses of americium, plutonium, uranium, strontium, and tritium. Explosive compounds, dioxin/furans, and polychlorinated biphenyl (PCB) analyses will not be performed as there is no operational history to indicate that these materials were disposed of at MDA A (Table 2.4-1). However, if analytical results from the MDA B investigation identifies these chemicals, the MDA A analytical program will be modified. Dioxin/furan analyses will only be performed if the MDA T investigation documents the presence of dioxins/furans. If present at MDA T, then MDA A core samples collected from depths that represent the former operational surface of MDA A will be analyzed for dioxins/furans. A summary of the borehole soil/tuff analytical requirements for MDA A is provided in Table 4.11-1.

All soil and sediment samples collected from the hillslope will be analyzed for SVOCs, pH, perchlorate, total uranium, cyanide, and TAL metals. In addition, total iodide analyses and radionuclide analyses will be performed. The radionuclide analyses include gamma spectroscopy and isotopic analyses of americium, plutonium, uranium, strontium, and tritium. Explosive compounds and PCB analyses will not be performed as there is no operational history to indicate these types of chemicals were disposed of at MDA A (Table 2.4-1). VOC analyses will not be requested for surface and near-surface soil samples for the following reasons: (1) historical surface soil data from the MDA A area of influence indicate that VOCs are not COPCs in the hillslope surface, (2) low vapor pressure organic compounds are unlikely to have been retained in the upper 6 in. of hillslope soil over the last 20 yr since the MDA A cover was emplaced, and (3) the surface soil on the MDA A cover was imported crushed tuff and not representative of site conditions. A summary of the surface/near-surface analytical requirements for MDA A are provided in Table 4.11-1.

4.11.2 Vapor Samples

Pore-gas samples will be collected from all the boreholes for field measurements of percent oxygen, organic vapors, percent carbon dioxide, and static subsurface pressure. Vapor samples will also be collected for laboratory analysis of percent moisture, VOCs, and tritium. Details of the sample collection and analyses are provided in Section 5.5.

4.11.3 Groundwater Samples

Groundwater samples from wells in DP, Pueblo, and Los Alamos Canyons are collected as part of the interim site-wide monitoring program. In addition, any perched groundwater encountered during the implementation of the field investigation described in this work plan will be analyzed for perchlorate, total uranium, TAL metals, cyanide, VOCs, SVOCs, and explosive compounds. In addition, the groundwater samples will be analyzed for total iodide, pH, americium-241, isotopic plutonium, isotopic uranium, strontium-90, tritium, and gamma spectroscopy.

4.12 Geotechnical Testing

Tuff samples will be collected above the Qbt2/Qct contact and analyzed for permeability. Borehole 12 is proposed to intercept this contact. Permeability analyses from MDA T proposed Borehole 2 and Borehole 3, located 300 and 500 ft east of MDA A, respectively, and from MDA U proposed borehole BH-4, located 430 ft east of MDA A, will provide additional permeability data (LANL 2004, 85641; LANL 2004, 87454.3). Additional geotechnical data collected from cores at MDA T, such as saturated and unsaturated hydraulic conductivity, porosity, partition coefficient, bulk density, permeability, and moisture content, will also support future transport modeling.

4.13 Justification of Alternate Scope of Work

The proposed work scope contains differences from that presented in the proposed Consent Order. The proposed alternatives are detailed in Table 4.13-1, along with a justification for each alternative. The significant deviations from the proposed Consent Order are described below.

- No direct characterization of the waste pit inventory. The MDA B investigation will trench the waste pits and characterize waste inventory. Since the MDA B pits were filled with a continuation of the TA-21 waste stream originally placed in MDA A pits, the MDA B investigation should provide adequate information about the waste pit inventory at MDA A. The MDA B inventory will be used to identify additional COPCs at MDA A.
- A reduction from three to one deep borehole penetrating the Cerro Toledo interval at MDA A. Additional boreholes are not necessary because of MDA A's proximity to MDA T proposed deep Boreholes 2 and 3, which are less than 300 and 500 ft west of MDA A, respectively (LANL 2004, 85641). In addition, the MDA U deep borehole, BH-4, is located 430 ft east of MDA A (LANL 2004, 87454.3). With an approximate 350 ft depth to the Cerro Toledo at MDA A, the boreholes at MDA T and MDA U are sufficiently proximate to MDA A to define nature and extent of contamination encountered at depth by drilling a single borehole within the MDA A boundary. As a result, only one additional sample will be collected for permeability analyses from the tuff overlying the Qbt2/Qct contact.
- Proposed COPC-specific analyte list for tuff, soil, and sediment samples. Specifically, there is no operational information to indicate that explosive compounds, PCBs, or dioxin/furans were disposed of in the MDA A pits. If these explosive compounds or PCBs are detected in the MDA B investigation, and/or if dioxin/furans are detected in the MDA T investigation, the MDA A analyte list will be modified. Additional analyses for total iodide and radionuclides have been proposed because of the nature of suspected waste at the site.
- All boreholes will be continuously cored to TD. Continuous coring is preferable for fracture analysis and identification of perched zones, and it provides better stratigraphic data than sample collection at discrete intervals. Discrete samples will be collected from specific depths and submitted for analytical testing.
- Installation and monitoring of any regional groundwater wells associated with MDA A will be performed in conjunction with the Laboratory hydrogeologic work plan (LANL 1998, 59599). However, perched groundwater monitoring wells will be installed if saturated conditions are encountered.

5.0 INVESTIGATION METHODS

The current versions of the ENV-RS SOPs, QPs, and the ENV-RS Quality Management Plan, which are available at http://erproject.lanl.gov/documents/ procedures.html, are applicable to the investigation methods proposed in this investigation work plan and are detailed in Table 5.0-1. Additional procedures may be added as necessary to describe and document quality-affecting activities.

5.1 Drilling Methods for Boreholes

All boreholes will be drilled using the hollow-stem auger method because it allows for collecting undisturbed samples of core and subsurface vapors within the Tshirege Member of the Bandelier Tuff.

Each borehole will be logged with caliper, camera, neutron and natural gamma tools according to the current revision of ENV-RS-SOP-4.04.

The boreholes will be drilled using a hollow-stem drilling rig with 10-in.-diameter auger flights with a split-core barrel sampler to TD. A hollow-stem auger consists of a hollow steel shaft with a continuous spiraled steel flight welded onto the exterior site of the stem. The stem is connected to an auger bit, and it transports cuttings to the surface when it is rotated. The hollow stem of the auger allows drill rods, split-spoon core barrels, Shelby tubes, and other samplers to be inserted through the center of the auger so the samples may be retrieved during drilling operations. The hollow stem also acts to case the borehole temporarily so that the casing (riser) may be inserted through the center of the augers once the desired depth is reached, thus minimizing the risk of possible borehole collapse. A bottom plug or pilot bit can be fastened onto the bottom of the augers to keep out most of the soils and/or water that tend to clog the bottom of the augers during drilling. Drilling without a center plug is acceptable provided that the soil plug formed in the bottom of the auger is removed before sampling or installing well casings. The soil plug can be removed by washing out the plug using a side-discharge rotary bit or by augering out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger.

If drilling difficulties or refusal is encountered in any borehole, the drilling will be converted to air-rotary drilling. The air-rotary method uses a drill pipe or drill stem coupled to a drill bit that rotates and cuts through soil and rock. The cuttings produced from the rotation of the drilling bit are transported to the surface by compressed air, which is forced down the borehole through the drill pipe and returns to the surface through the annular space (between the drill pipe and the borehole wall). The circulation of the compressed air not only removes the cuttings from the borehole but also helps to cool the drill bit. The air-rotary drilling method is best suited for hard rock formations. In soft unconsolidated formations, casing is driven to keep the formation from caving. When using the air-rotary method, the air compressor will have an in-line organic filter system to filter the air coming from the compressor. The organic filter system will be inspected regularly to ensure that it is functioning properly. In addition, a cyclone-velocity dissipator or similar air-containment/dust-suppression system will be used to funnel the cuttings to one location instead of allowing the cuttings to discharge uncontrolled from the borehole. An air-rotary method that employs the dual-tube (reverse circulation) drilling system is acceptable because the cuttings are contained within the drill stem and are discharged through a cyclone-velocity dissipator to the ground surface.

A minimum of six samples per borehole (eight if a borehole is greater than 100 ft in TD) will be collected as specified in Section 4.5. Samples may be collected at additional depths depending upon screening results. All samples will be field screened for VOCs and radioactivity. In addition, the samples will be visually inspected and geologically logged. All drilling activities will be performed in accordance with appropriate Laboratory procedures to ensure health and safety issues are reviewed and addressed during field operations.

The one angled borehole (Borehole 1) beneath the General's Tanks will be installed in such a way as to collect a representative sample below the tank bottoms, while maintaining the necessary margin of safety to ensure that the tanks are not contacted. The integrity of the General's Tanks will be ensured with (1) a combination of field surveys prior to drilling, (2) initiation of the borehole a minimum of 20 ft from the ends of each tank and located between the two tanks, and (3) drilling at a 45° angle to preclude contact with the bottom of either tank. A paired vertical borehole (Borehole 14) will be drilled to determine the vertical extent of potential chemical or radiological releases from the General's Tanks.

The exact location of each borehole will be determined using GPS field surveys of the pits and General's Tanks boundaries, utility locations identified as part of the excavation permitting process, and other access-restrictive surface conditions. In addition, the location of each borehole will be determined after extensive and careful review of the potential risks and access limitations. Pits, vertical shafts, and

General's Tanks boundaries will be mapped using a differential GPS survey, following the current revision of ENV-RS-SOP-03.11, to further refine borehole locations. A line location survey will also be conducted to further define potentially dangerous utility lines in the work area. Each location will be thoroughly examined to identify potential hazards for subsurface drilling. All boreholes will be field-verified, surveyed in advance relative to disposal features, and recorded in field notebooks.

All boreholes will be advanced at least 20 ft below the base of the nearest disposal unit and a vertical depth of 25 ft below the last field-screening detection.

5.2 Collection of Tuff Samples

All boreholes will be cored continuously to TD. The cores will be geologically logged to TD following the current versions of ENV-RS-SOP-4.01 and ENV-RS-SOP-12.01. Following the current revision of ENV-RS-SOP-6.26, subsurface tuff samples will be collected from core retained in a split-spoon core barrel and placed into sealed sleeves or core-protect bags to preserve core moisture. The analytical suites for the samples from each borehole are listed in Table 4.11-1.

The primary screening methods to be used include (1) visual examination, (2) radiological screening, and (3) vapor screening for VOCs. All boreholes will be advanced 25 ft beyond the last field-screening detection.

Radiological screening shall target gross alpha, beta, and gamma radiation. Field screening for alpha, beta, and gamma radiation will be conducted within 6 in. from the core material. All instrument background checks, background ranges, and calibration procedures will be documented daily in the field logbooks.

Vapor screening of subsurface core for VOCs will be conducted using a PID equipped with an 11.7 electron volt lamp. The maximum value and the ambient air temperature will be recorded on the field borehole or test pit log for each sample. The PID will be calibrated each day to the manufacturer's standard for instrument operation (all daily calibration results will be documented in the field logbooks). Field screening for VOCs will be accomplished using headspace analysis on 10-ft intervals in each borehole.

The boreholes will be advanced 25 ft beyond any positive detection by field screening. If a positive field-screening result is detected within 25 ft of the target depth, the borehole will be advanced in 10-ft intervals until no positive field-screening result is detected over a 25-ft interval.

Based on this field screening, samples with the highest field-screening results and with the deepest detected field-screening results will be submitted for laboratory analysis. Samples collected at key locations (e.g., below the base of each waste unit, fracture zones, TD, etc.) will also be submitted for laboratory analysis, regardless of screening results. All samples submitted to the laboratory will be analyzed for the constituents listed in Table 4.11-1.

Quality assurance (QA)/QC samples will include (1) field duplicate samples to evaluate the reproducibility of the sampling technique and (2) rinsate blanks to evaluate decontamination procedures. These samples will be collected following the current revision of ENV-RS-SOP-01.05 and will comply with a field duplicate collection frequency of 10% of total samples collected.

Following the current version of ENV-RS-SOP-12.01, field documentation of samples collected from fractures will include a detailed physical description of the fracture-fill material and rock matrix sampled. The volumes of fracture-fill and rock-matrix material included in the sample will be estimated from field measurements. An additional sample will be collected from the rock matrix adjacent to the fracture sample material, thus allowing for comparison.

Field documentation will also include detailed borehole logs for each borehole drilled. The borehole logs will document the matrix material in detail and will include the results of all field screening; fractures and matrix samples will be assigned unique identifiers. Field documentation will be completed in accordance with the current revision of ENV-RS-QP-5.7.

5.3 Collection of Soil and Sediment Samples

While surface samples will be collected during drilling activities (collected from the 0- to 0.5-ft interval of the core barrel), the most common method for collecting surface and near-surface soil samples will be the spade-and-scoop method, as described in the current revision of ENV-RS-SOP-06.09. All soil and sediment samples will be collected from two sample depths, 0–0.5 ft and 1.5–2.0 ft. Stainless-steel shovels, spades, scoops, and bowls will be used for ease of decontamination. Disposable tools made of polystyrene or Teflon will also be used, if necessary. In some cases, hand-augering tools will be used to collect shallow subsurface samples if geologic material conditions permit. The tools to be used and their applicability is described in the current version of ENV-RS-SOP-06.10. If the surface location is at bedrock, an axe or hammer and chisel will be used to collect samples.

Soil and sediment samples will be field screened for health and safety purposes prior to collection, then placed in zippered bags and/or sample jars as grabs derived from hand augers, scoops, or chiseling devices, in accordance with the sampling guidance document and appropriate ENV-RS-SOPs (the SOP-01.01 through SOP-01.08 series).

5.4 Collection of Geotechnical Data

All boreholes will be cored continuously to TD and will be geologically logged in accordance with American Society for Testing and Materials (ASTM) D2487 and ASTM D2488, including lithology, apparent moisture, structural features, and core recovery compared to interval drilled, per the current versions of ENV-RS-SOP-12.01 and ENV-RS-SOP-04.01. Rock quality designation (RQD) will also be documented in the field. The RQD is expressed as a percentage of solid core obtained and is defined as the collective length of core in excess of 2 by 4 in. The RQD is dependent upon the strength and number of discontinuities in the rock mass. Low RQDs reflect incompetent, heavily fractured, or sandy formations. High RQDs indicate competent formations. If the RQD is consistently decreasing in a borehole, then brass sleeves will be used to enhance core recovery. At Borehole 12, brass sleeves will be used in the relatively unconsolidated Cerro Toledo interval to improve recovery and maintain structural integrity for geophysical characterization, and permeability analyses will be performed on tuff samples collected above the Qbt2/Qct contact using analytical methods specified by contract requirements of the Laboratory's Sample Management Office (SMO) (LANL 2000, 71233). QC will conform to the applicable ASTM methods.

5.5 Collection of Pore-Gas Samples for VOC Analyses

Subsurface vapor samples will be collected from all boreholes in accordance with the current version of ENV-RS-SOP-6.31, after allowing for equilibration of pore gases at the completion of drilling activities. In each borehole, one sample will be collected at the depth of the nearest adjacent disposal unit; the second sample will be collected at TD. Pore-gas samples will be collected using a straddle packer to isolate discrete depths within the borehole. Each interval will be purged prior to sampling until measurements of carbon dioxide and oxygen are stable and representative of subsurface conditions. In brief, a purge pump is used to withdraw borehole and formation vapors through the borehole or constructed sampling port. Concentrations of purge indicator gases (carbon dioxide and oxygen) are monitored continuously during this pre-sampling cycle. Once indicator gas concentrations are stable, proper purge is achieved and formation vapor sampling can proceed. Subsurface pore-gas samples will be collected in SUMMA canisters and submitted for VOC analysis using EPA Method TO-14.

QA/QC samples for VOCs in pore gas will consist of an equipment blank and field duplicate. After sampling and purge decontamination, the equipment blank will be collected by pulling zero gas (99.9% ultrahigh purity nitrogen) through the packer sampling apparatus. This sample will be used to evaluate decontamination procedures. The field duplicate sample will be used to evaluate the reproducibility of the sampling technique. QA/QC samples will be collected according to the current version of ENV-RS-SOP-1.05.

5.6 Collection of Pore-Gas Samples for Tritium Analyses

Pore-gas samples for tritium analyses will be collected in conjunction with the samples for VOC analyses from two depths in all proposed boreholes. These samples will be collected by pulling pore gas through columns filled with absorbent silica gel, following the current version of ENV-RS-SOP-6.31. After allowing time for equilibration, the newly completed boreholes will be sampled at the depth equal to the base depth of the adjacent disposal unit and at TD. Samples from the newly completed boreholes will be collected using an inflatable straddle packer. All samples will be analyzed at an off-site fixed laboratory by EPA Method 906.0. QA/QC samples and field duplicates will be collected per applicable SOPs.

5.7 Collection of Perched Water Samples

During drilling operations, zones of elevated moisture content, localized saturation, and groundwater may be encountered. These zones may not be assignable to either an alluvial or regional groundwater system and may represent a localized phenomenon. If saturation is encountered as a borehole advances, drilling will be stopped to determine if sufficient water volume is available for analyzing the water quality. Generally, the total water volume required is approximately 0.5–1 L. If this minimum volume of groundwater cannot be collected, the borehole will be advanced to the targeted depth or until saturation is encountered again and the process is repeated, or until the required TD is achieved. A porous cup lysimeter or absorbent membrane will be installed at the depth of saturation to monitor the zone if the borehole is completed for pore-gas monitoring. Insufficient water sample volumes from discrete depths will not be composited to make up the required volume for screening analysis.

If a sufficient volume exists, a groundwater sample will be collected and analyzed for metals, anions, perchlorate, alkalinity, total organic carbon, total inorganic carbon, and total dissolved solids, on a rapid turnaround basis at a LANL-certified geochemistry laboratory. Typically, results of groundwater screening samples are available within 48 hr. During this time, the borehole may be advanced to the targeted depth, and the perched zone (and any subsequent perched zones encountered during drilling) will be isolated to prevent downhole migration.

Geophysical logging of the borehole will determine the thickness of the zone of saturation and the characteristics of the perching horizon. A monitoring well will be designed and submitted to NMED for approval. Following approval of the design, the well will be installed and a groundwater monitoring plan will be included in the MDA A investigation report.

5.8 Borehole Abandonment

All boreholes, except those identified for completion as vapor-monitoring wells or perched groundwater-monitoring wells, will be abandoned by filling the borehole with a bentonite/concrete mixture. A tremie pipe will be used to fill the boreholes upward from the bottom of the borehole to the surface. All cuttings will be managed as investigative-derived waste as specified in Appendix B of this document. All borehole abandonment information will be provided in the MDA A investigation report.

Backfilling (abandonment) of boreholes will be conducted according to the current version of ENV-RS-SOP-05.03. The procedure takes into account any subsurface characteristics (perched zones, etc.) requiring isolation if the decision to abandon versus installing a well has been made. The use of backfill materials such as bentonite and concrete will be documented in a field logbook with regard to volume (calculated and actual), intervals of placement, and additives used to enhance backfilling.

5.9 Equipment Decontamination

Following drilling and sampling activities, project personnel will decontaminate all equipment involved in drilling and sampling activities. Residual material adhering to equipment will be removed using dry decontamination methods such as the use of wire brushes and scrapers (ENV-RS-SOP-01.08). If equipment cannot be free-released using dry decontamination methods, wet decontamination methods will be used. Pressure washing of equipment will be performed on a temporary decontamination pad with a high-density polyethylene liner. Cleaning solutions and wash water will be collected and contained for proper disposal. Decontamination solutions will be sampled and analyzed to determine the final disposition of the wastewater and the effectiveness of the decontamination procedures. All parts of the drilling equipment, including the undercarriage, wheels, tracks, chassis, and cab, will be thoroughly cleaned. Air filters on equipment operating in the exclusion zone will be considered contaminated and will be removed and replaced before equipment leaves the site. Equipment ready for demobilization will be surveyed by a Health and Safety Radiation Control Division technician before it is released from the site.

6.0 ONGOING MONITORING AND SAMPLING PROGRAM

Currently, there is no ongoing groundwater monitoring at MDA A. Existing wells will be sampled as part of the interim site-wide monitoring program; however, there are no plans to develop and maintain an active MDA A-specific groundwater monitoring program at this time. If groundwater is encountered and monitoring wells are installed, a formal groundwater monitoring program will be developed and submitted to NMED for approval. Although vapor-monitoring wells may be installed as part of the activities proposed in this investigation work plan, the implementation of a formal vapor-monitoring program is not anticipated. The results of the investigation will determine if a vapor-monitoring program is warranted; if so, a vapor-monitoring plan will be developed and submitted to NMED for approval.

7.0 SCHEDULE

The planned date for submittal of the MDA A investigation work plan to NMED is January 31, 2005. A 105-day approval period of the plan by NMED would allow field activity preparation and performance to commence. The start of fieldwork (any intrusive sampling within the MDA A proper) is dependent upon the finalization of the authorization basis documentation process required for this Hazard Category 2 nuclear facility environmental site (Section 4.1). Preparation activities and implementation of the fieldwork are anticipated to require approximately 90 days through demobilization from the site. Sample submittals to the SMO should be completed by that time. Receipt of investigation results is anticipated 30 days after demobilization. The MDA A investigation report is scheduled to be submitted by August 31, 2006.

8.0 REFERENCES

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Copies of the reference sets are maintained at the NMED Hazardous Waste Bureau; the DOE Los Alamos Site Office; US EPA, Region 6; and the ENV-RS project. The sets were developed to ensure that the AA has all material needed to review this document, and they are updated periodically as needed. Documents previously submitted to the AA are not included.

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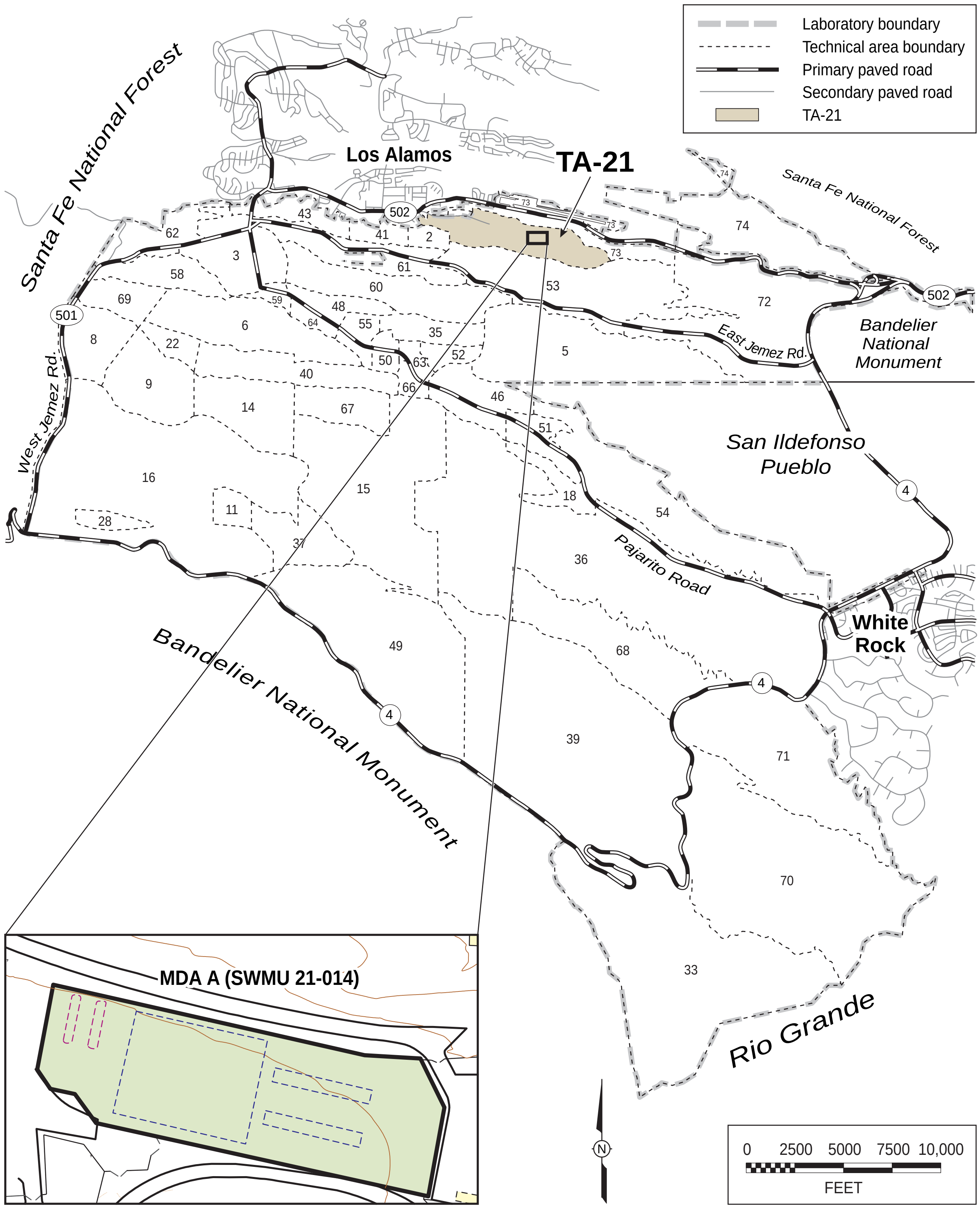


FIMAD, G104997 8/9/96
Rev. for F1, MDA A IWP, 071504, ptm

Figure 1.1-1. Location of TA-21 and MDA A with respect to other Laboratory technical areas and surrounding landholdings

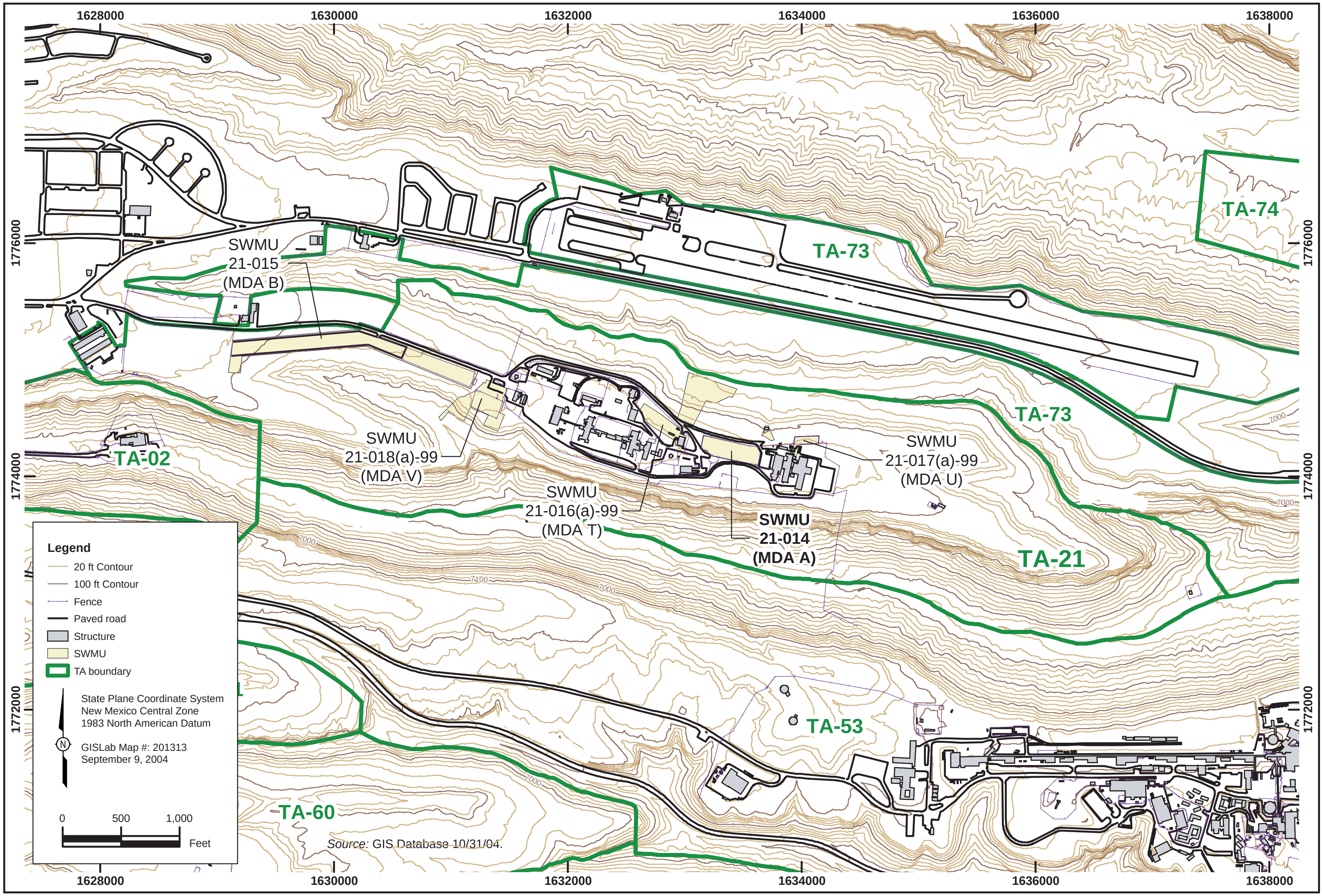


Figure 1.1-2 (TA-21).ai

Figure 1.1-2. Location of MDA A with respect to TA-21 and surrounding MDAs

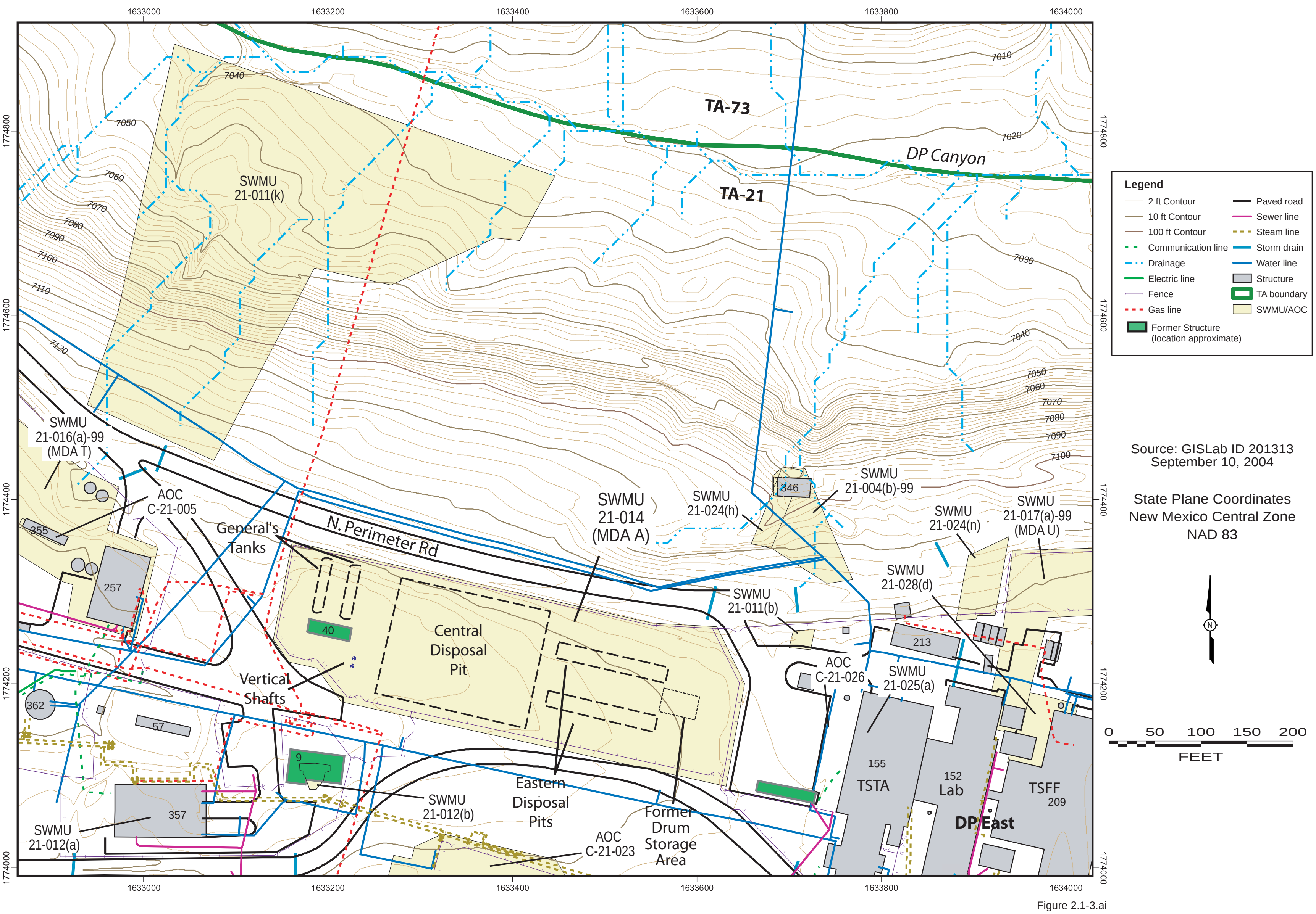
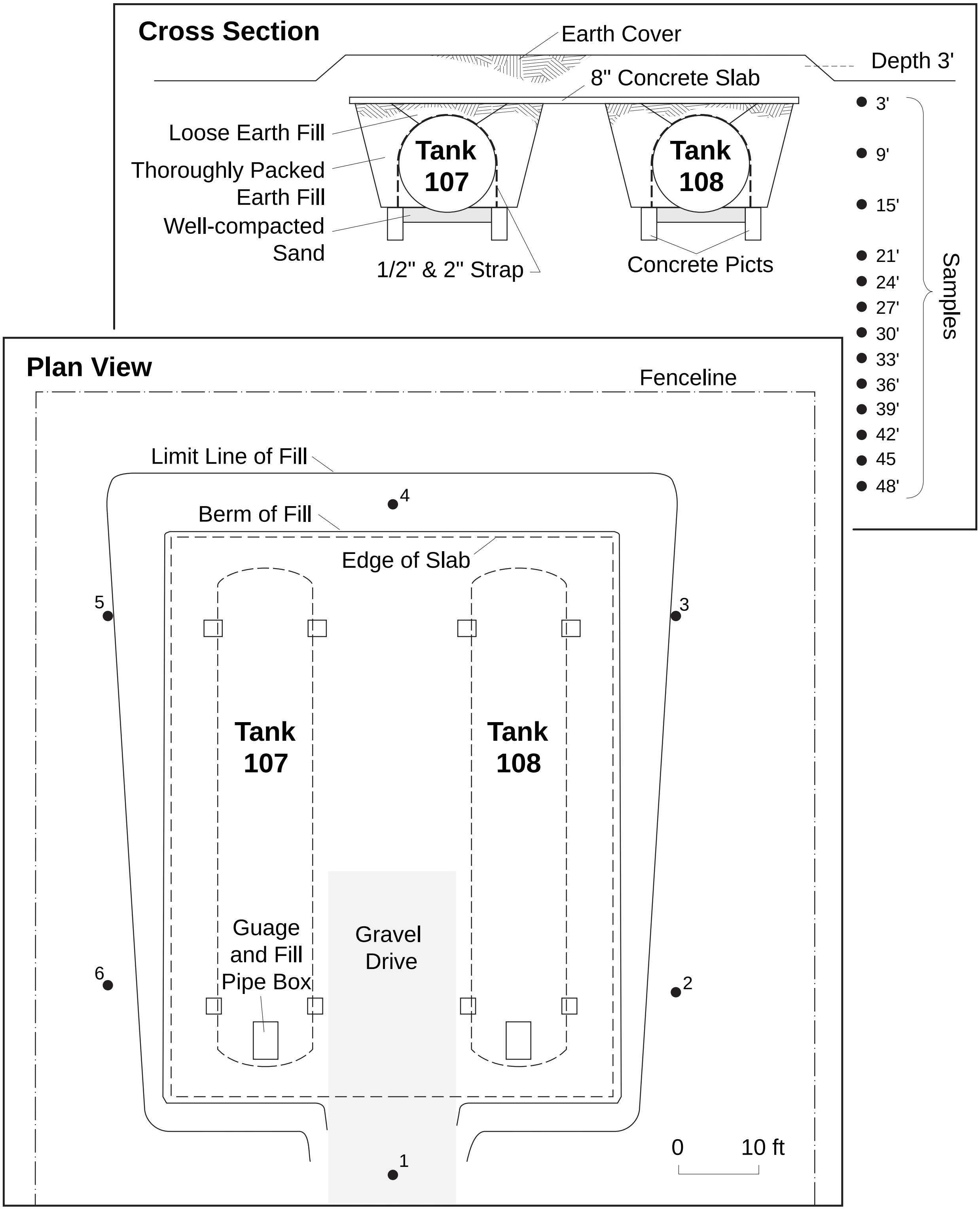


Figure 1.1-3. Detailed site map of MDA A, surrounding SWMUs/AOCs, and subsurface utility corridors



Source: "TA-21 Operable Unit RFI Work Plan for Environmental Restoration, Vol. II," (LANL 1991, 07529, Figure 16-8-5, p. 16-258)
Figure 3.2-3 (16.8-5) 1983.ai

Figure 2.1-1. Configuration of the General's Tanks located at the west end of MDA A

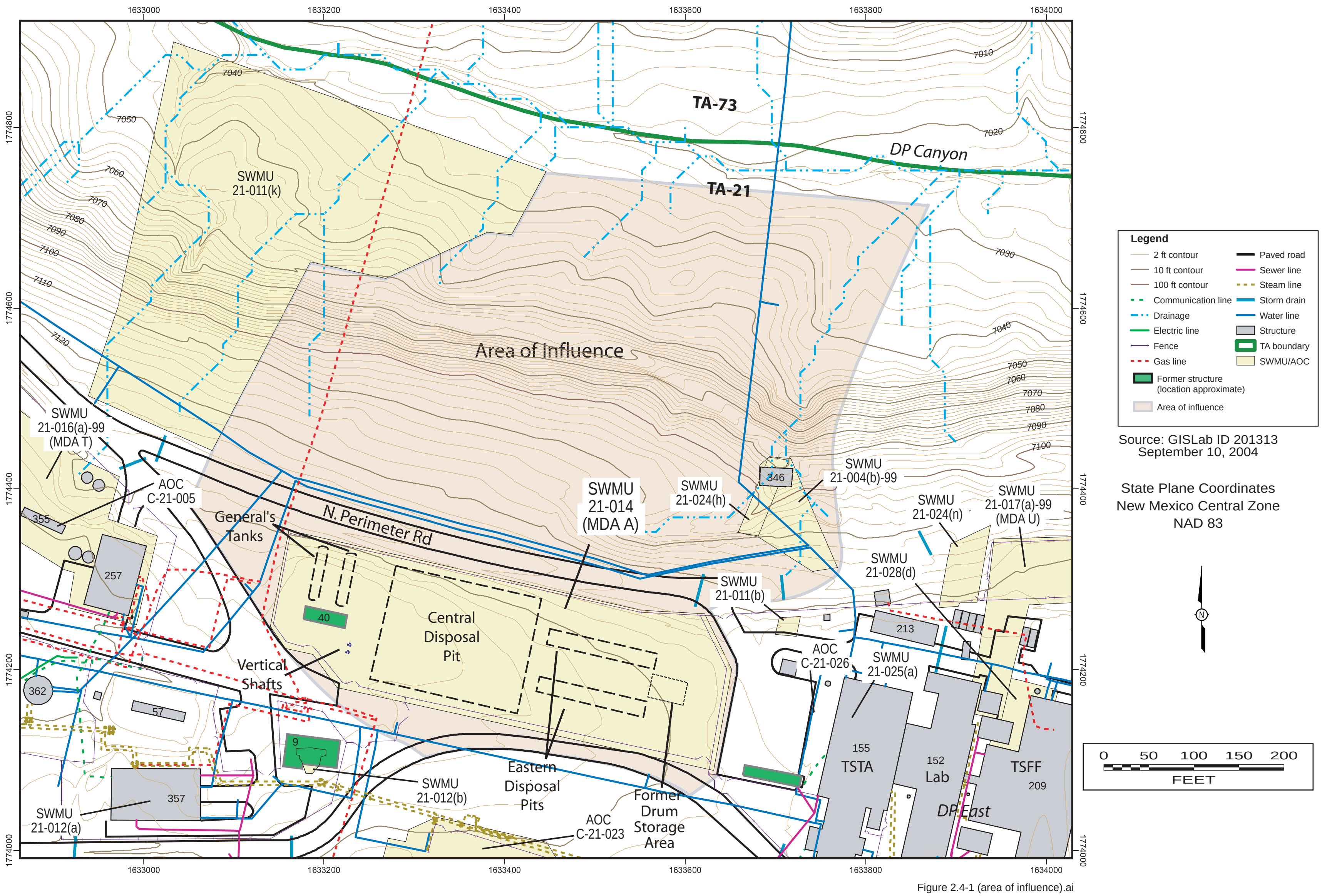


Figure 2.3-1. MDA A area of influence

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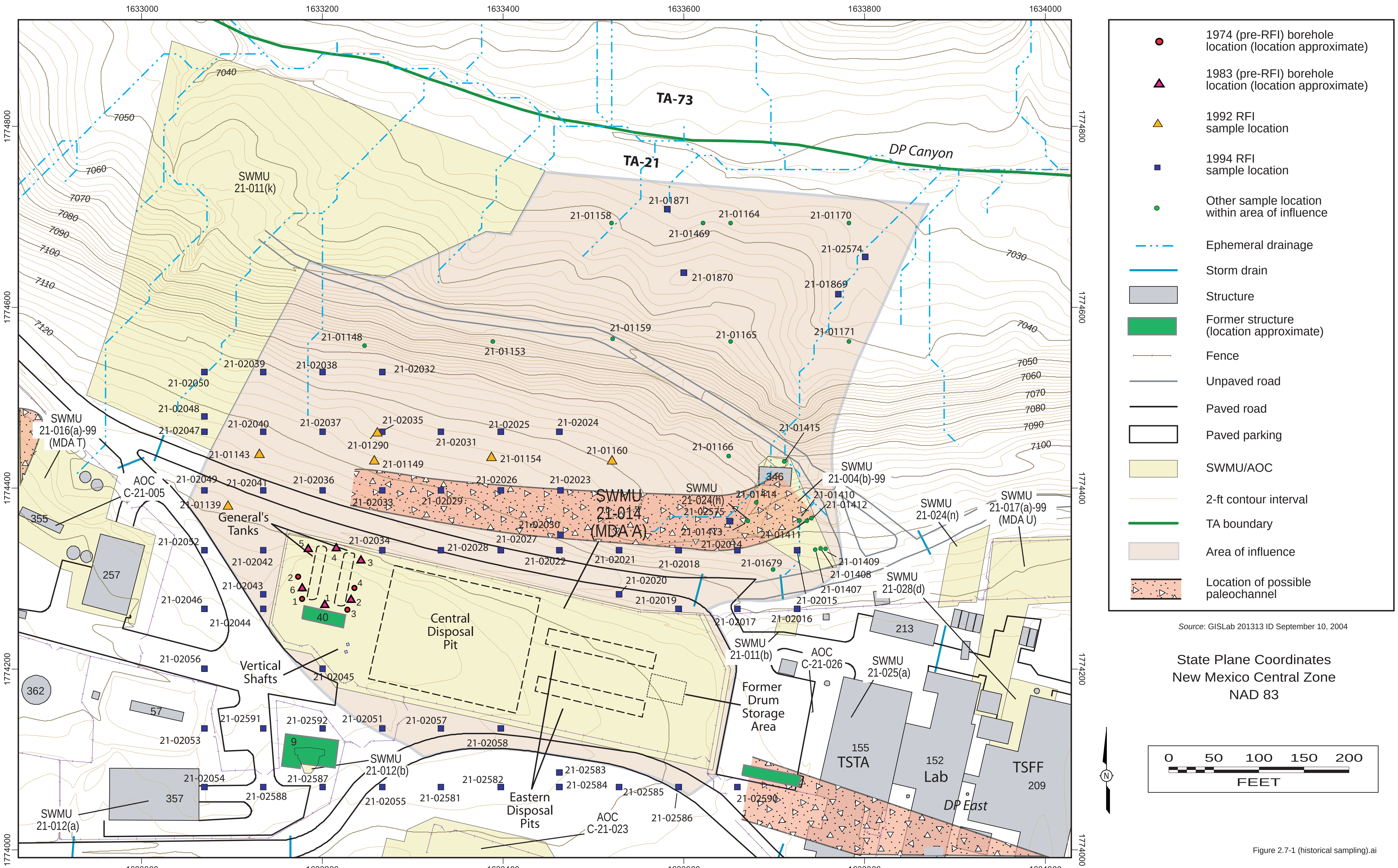


Figure 2.7-1. RFI surface and pre-RFI subsurface historical sample locations at MDA A

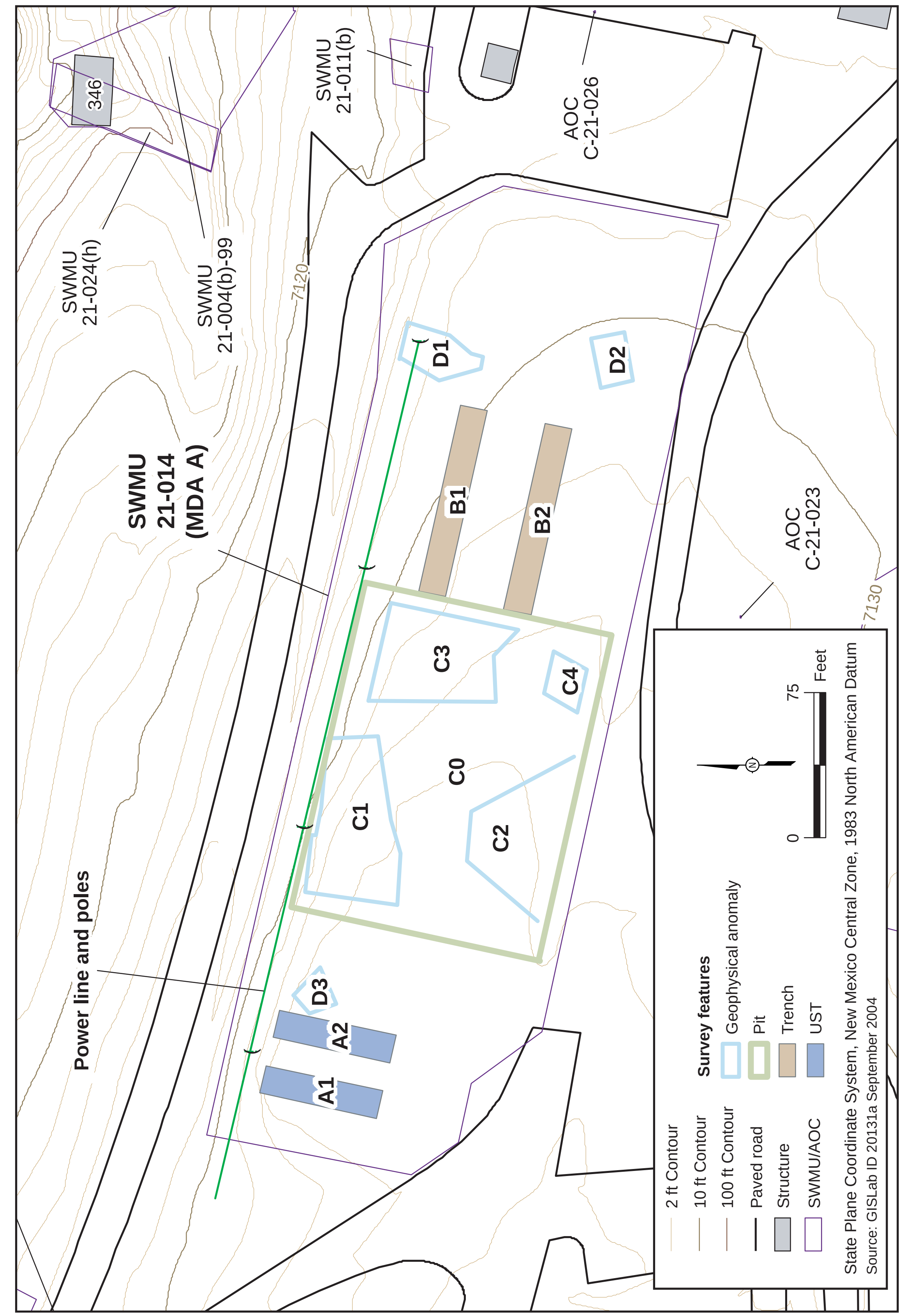
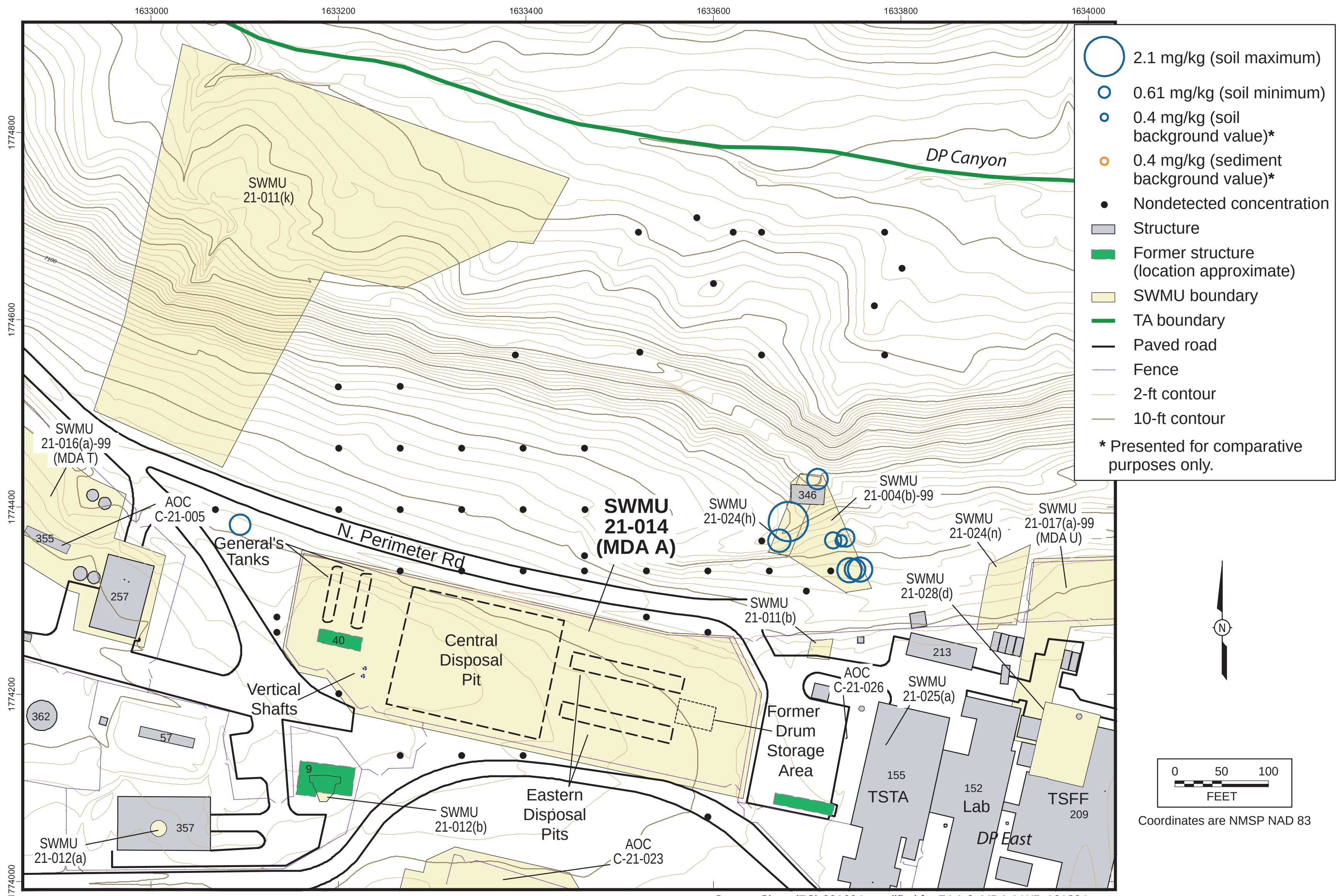
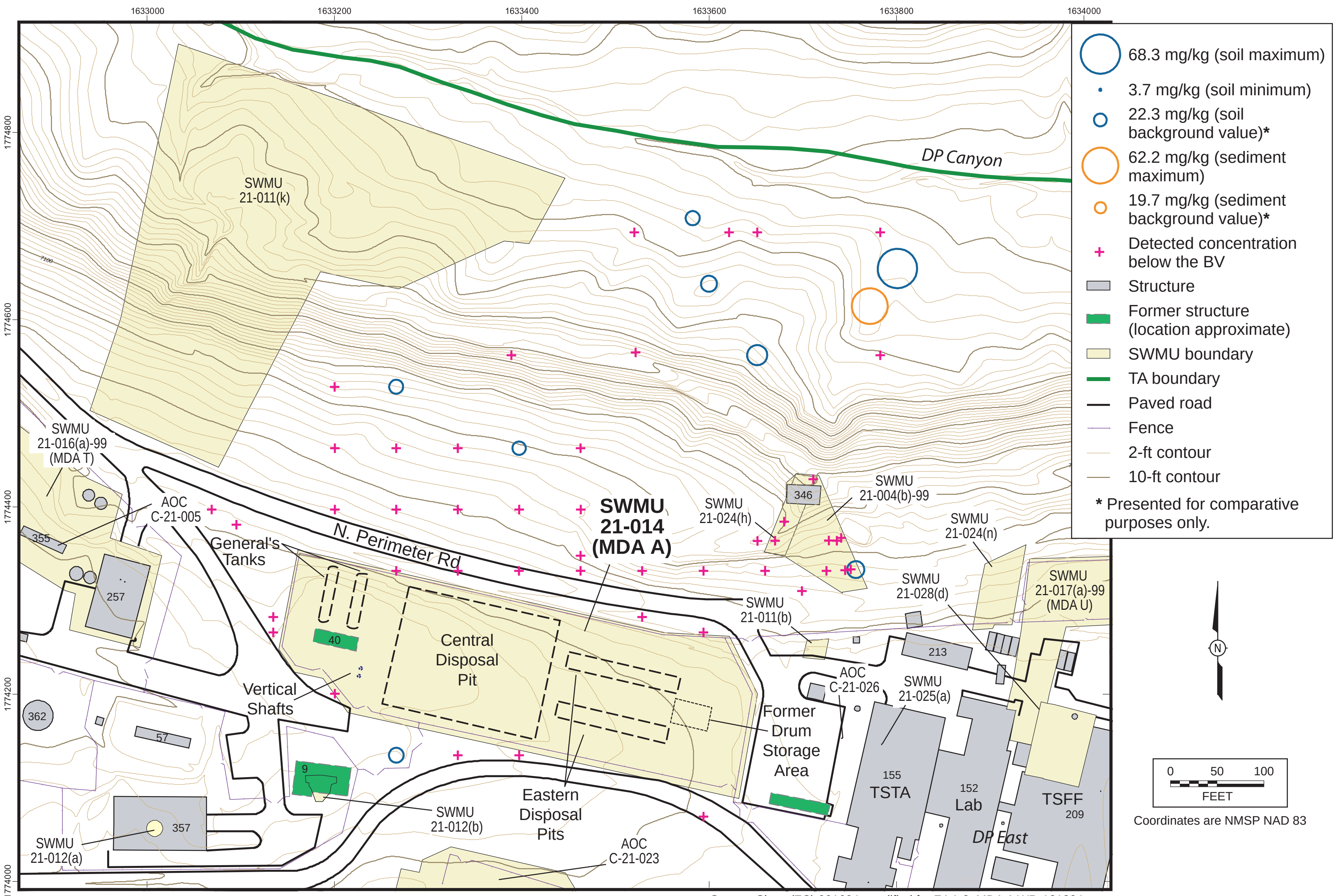


Figure 2.7-2. **Geophysical survey results, including General's Tanks (A1 and A2), eastern pits (B1 and B2), central pit (C0), and other targets identified at MDA A, as presented in Gerety et al. (1989, 06893) geophysics report (locations based on data from multiple geophysical techniques)**



Source: Shaw (ZC) 091604; modified for F4.1-2, MDA A WP, 121304, ptm

Figure 2.8-1. Cadmium bubble plot of soil and sediment samples near MDA A



Source: Shaw (ZC) 091604; modified for F4.1-3, MDA A WP, 121304, ptm

Figure 2.8-2. Lead bubble plot of soil and sediment samples near MDA A

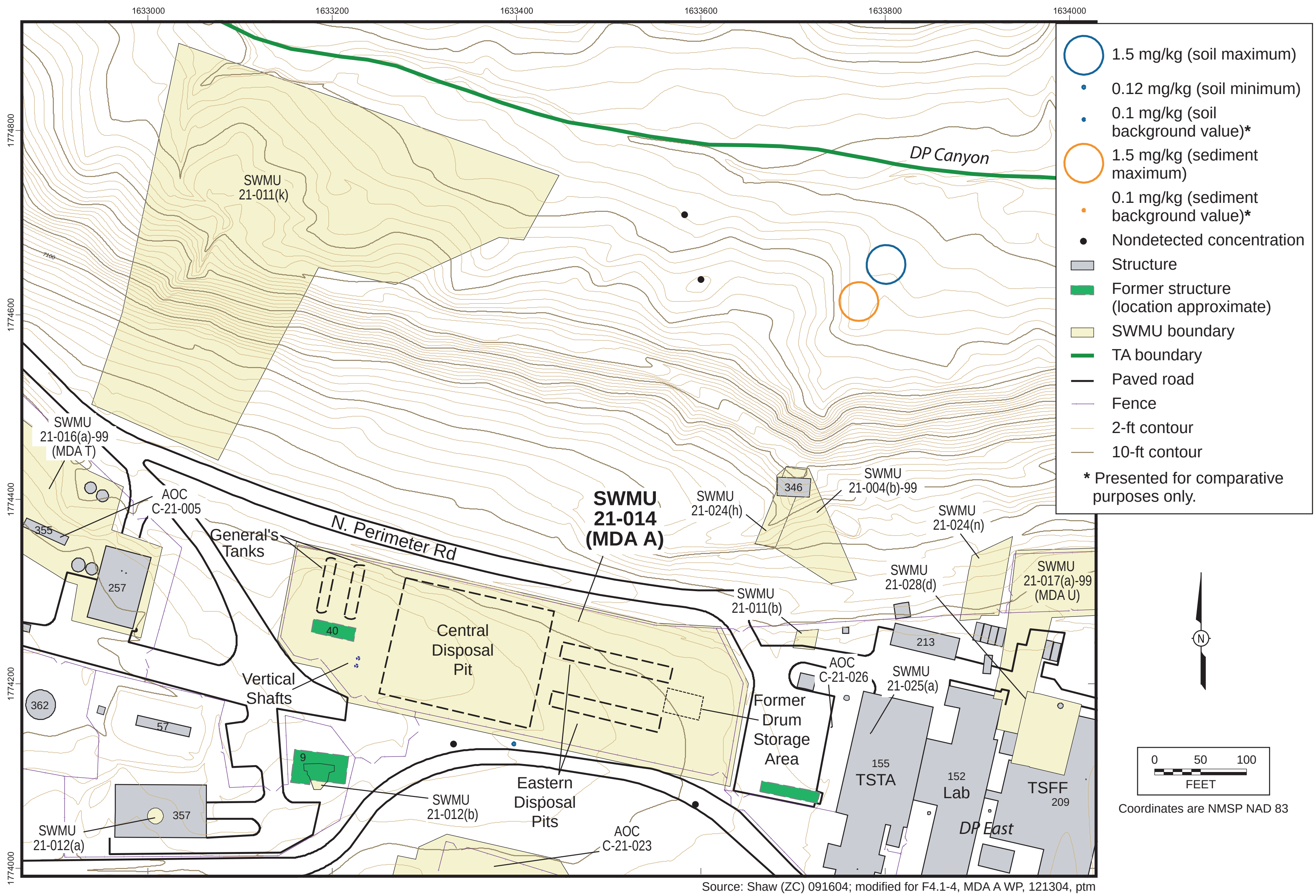
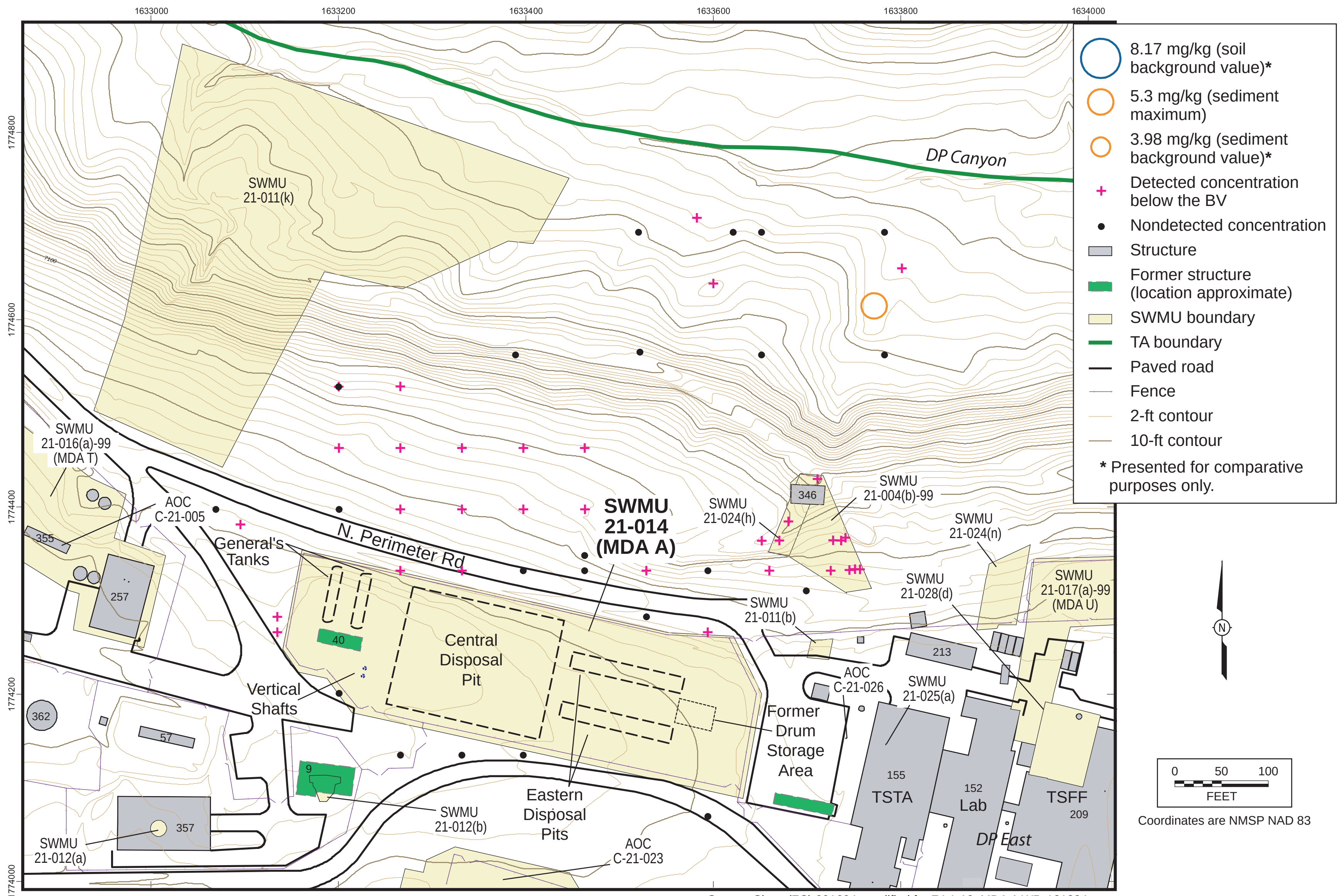
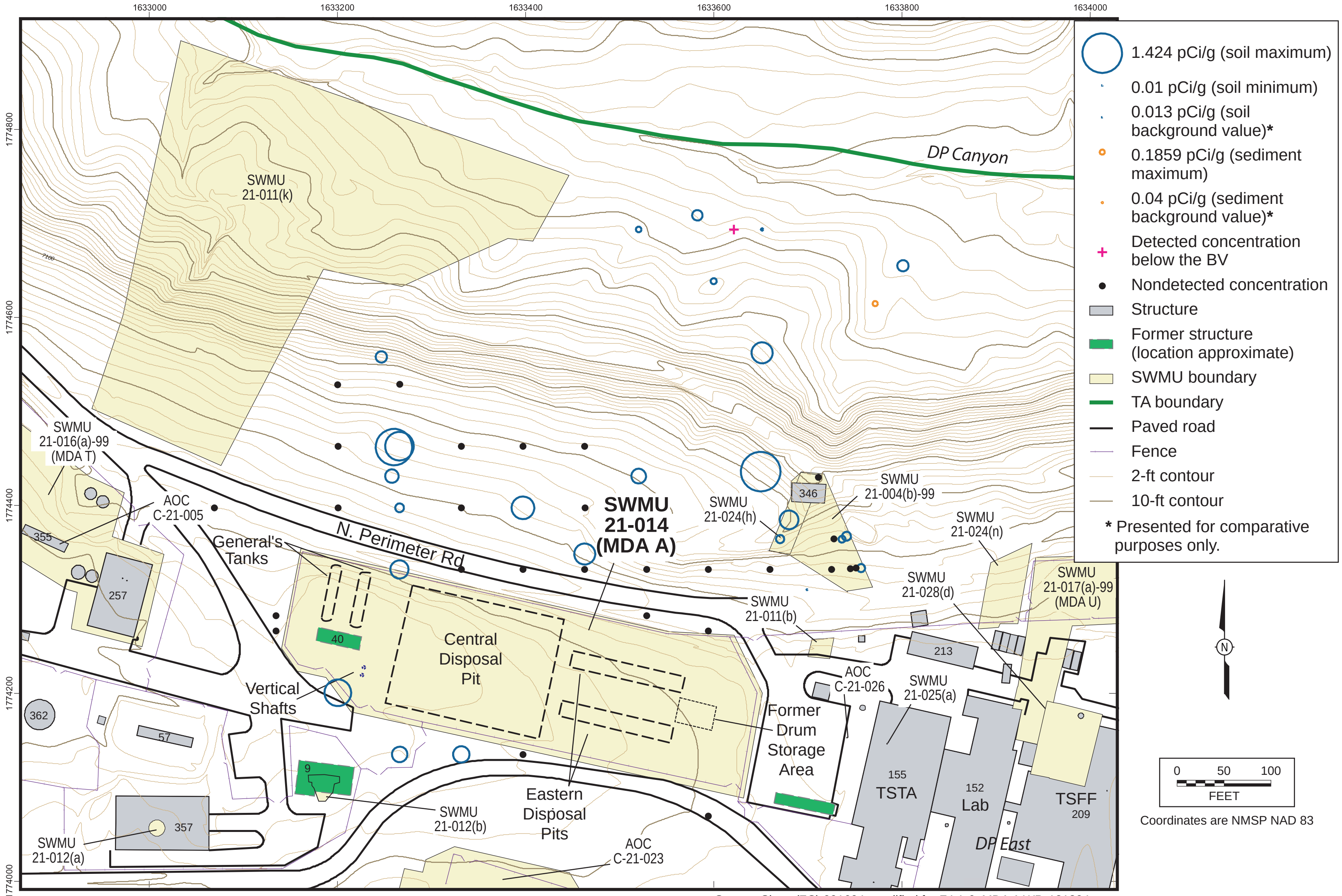


Figure 2.8-3. Mercury bubble plot of soil and sediment samples near MDA A



Source: Shaw (ZC) 091604; modified for F4.1-10, MDA A WP, 121304, ptm

Figure 2.8-4. Arsenic bubble plot of soil and sediment samples near MDA A



Source: Shaw (ZC) 091604; modified for F4.1-6, MDA A WP, 121304, ptm

Figure 2.8-5. Americium-241 bubble plot of soil and sediment samples near MDA A

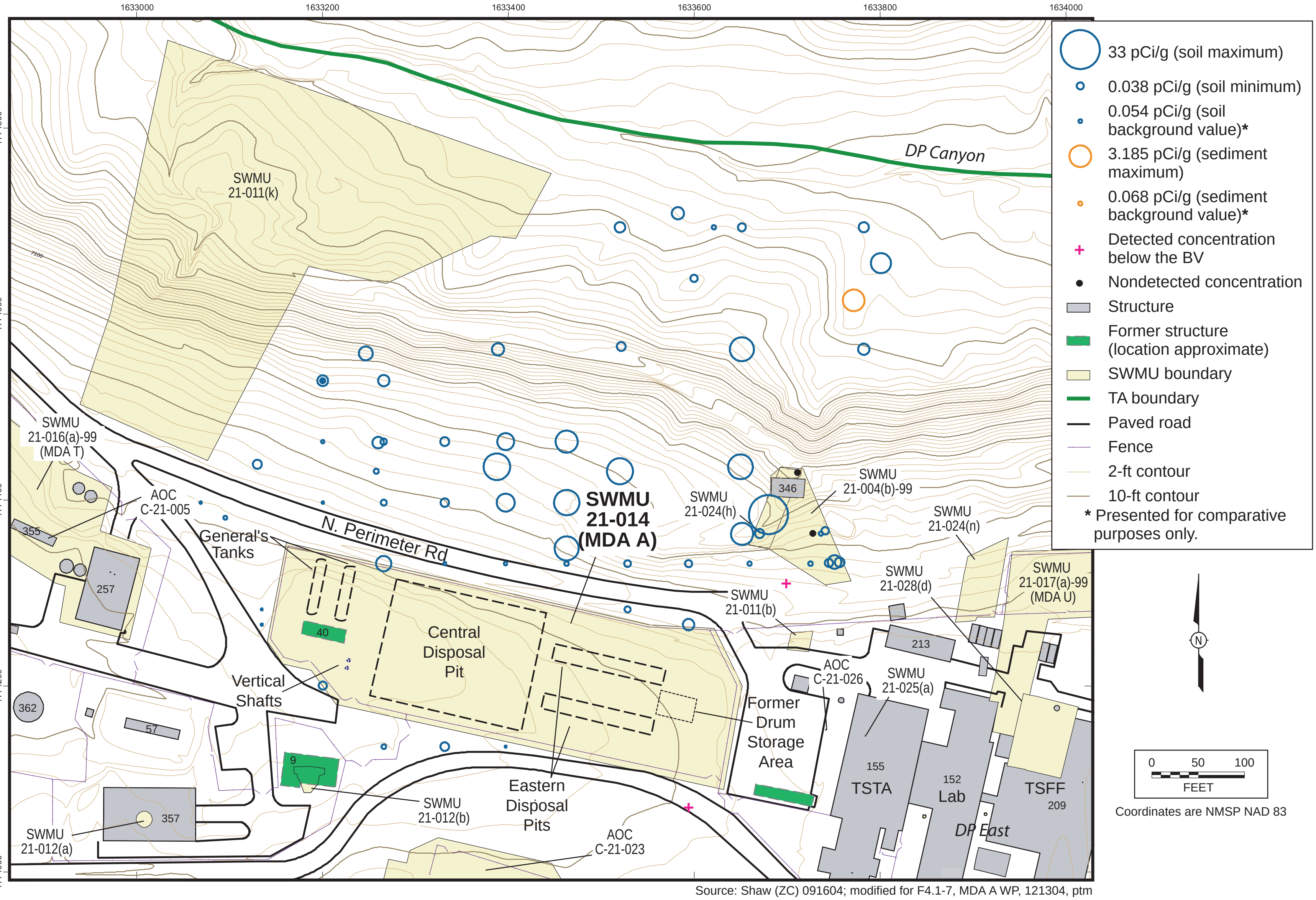


Figure 2.8-6. Plutonium-239 bubble plot of soil and sediment samples near MDA A

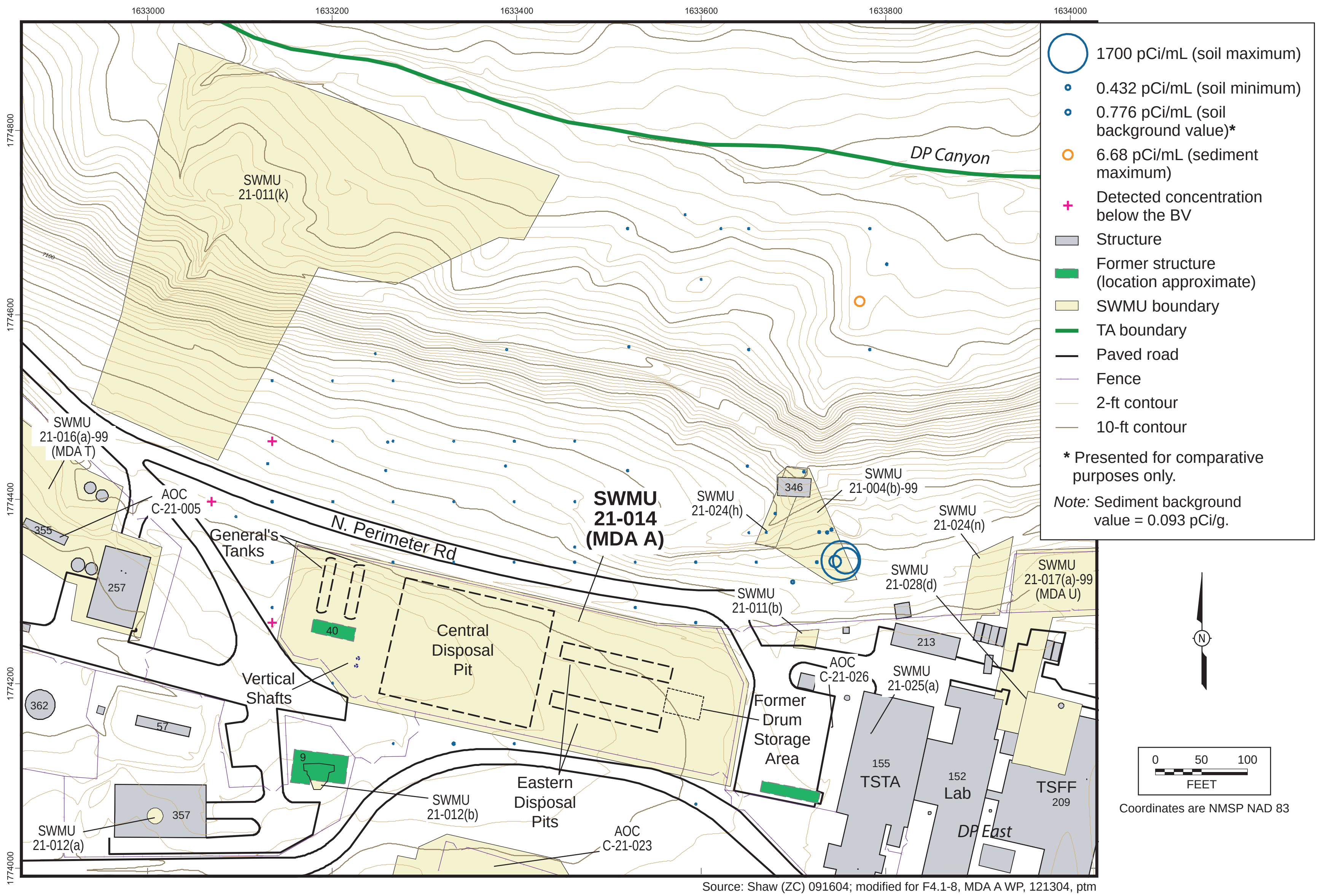
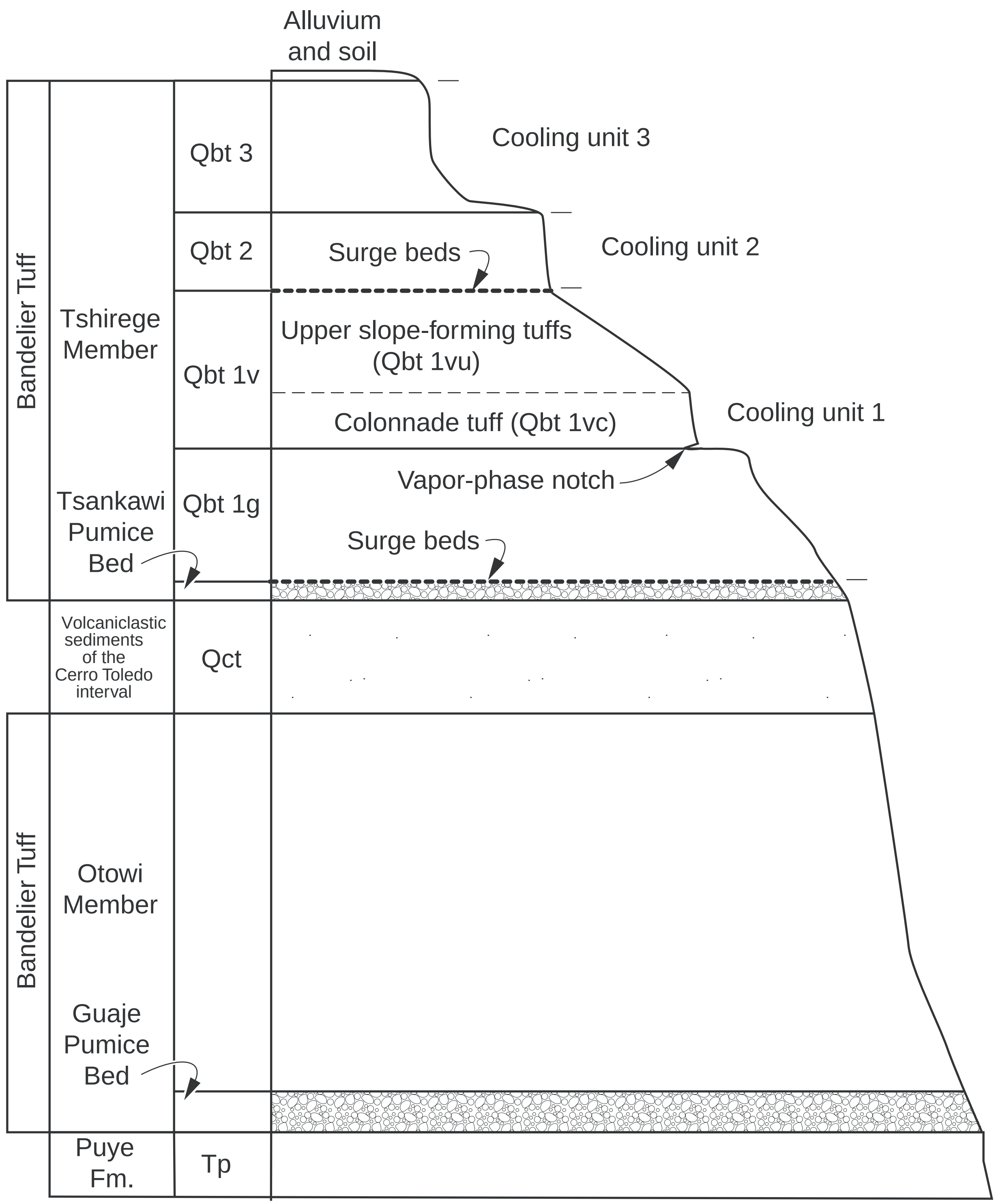
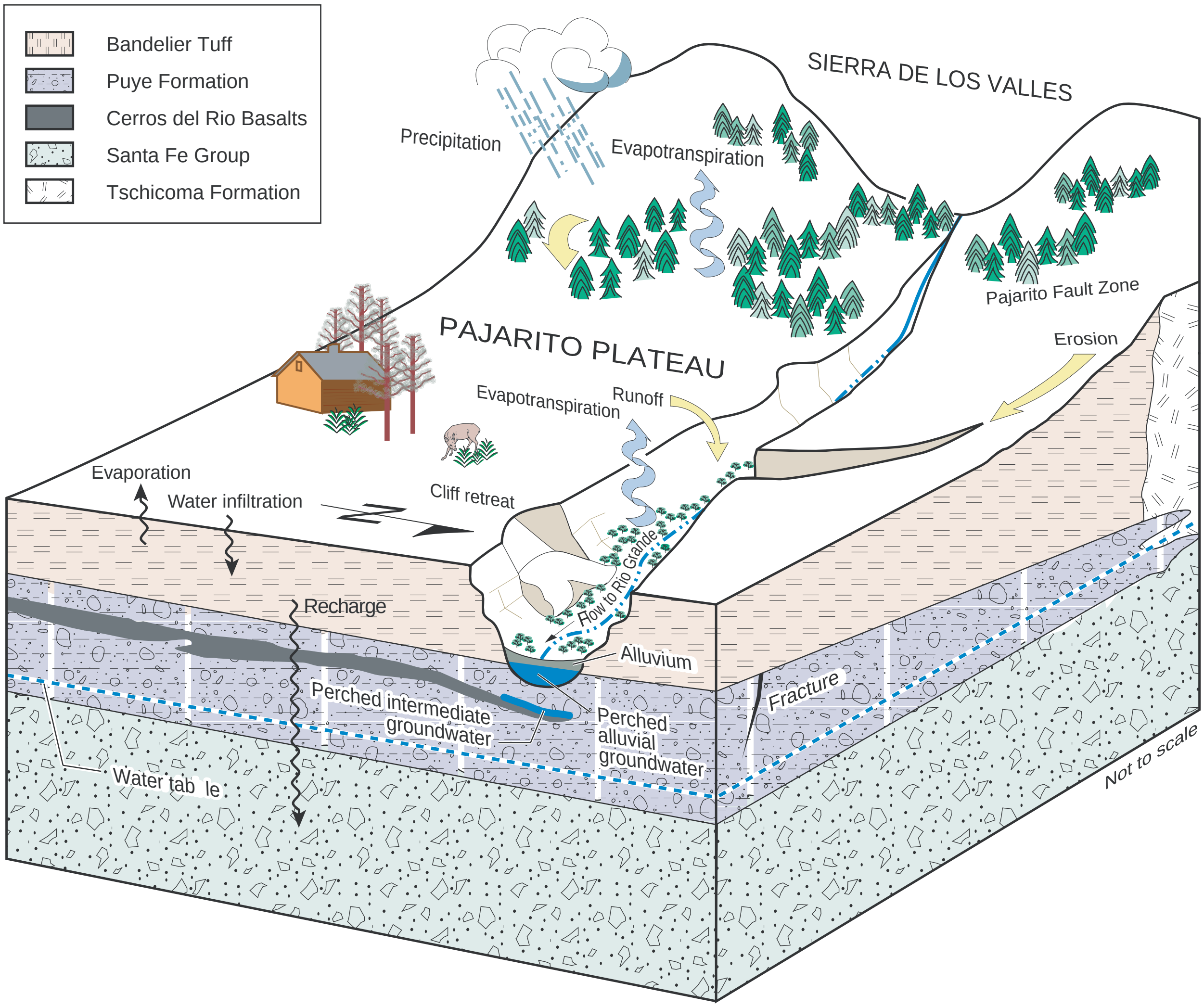


Figure 2.8-7. Tritium bubble plot of soil and sediment samples near MDA A



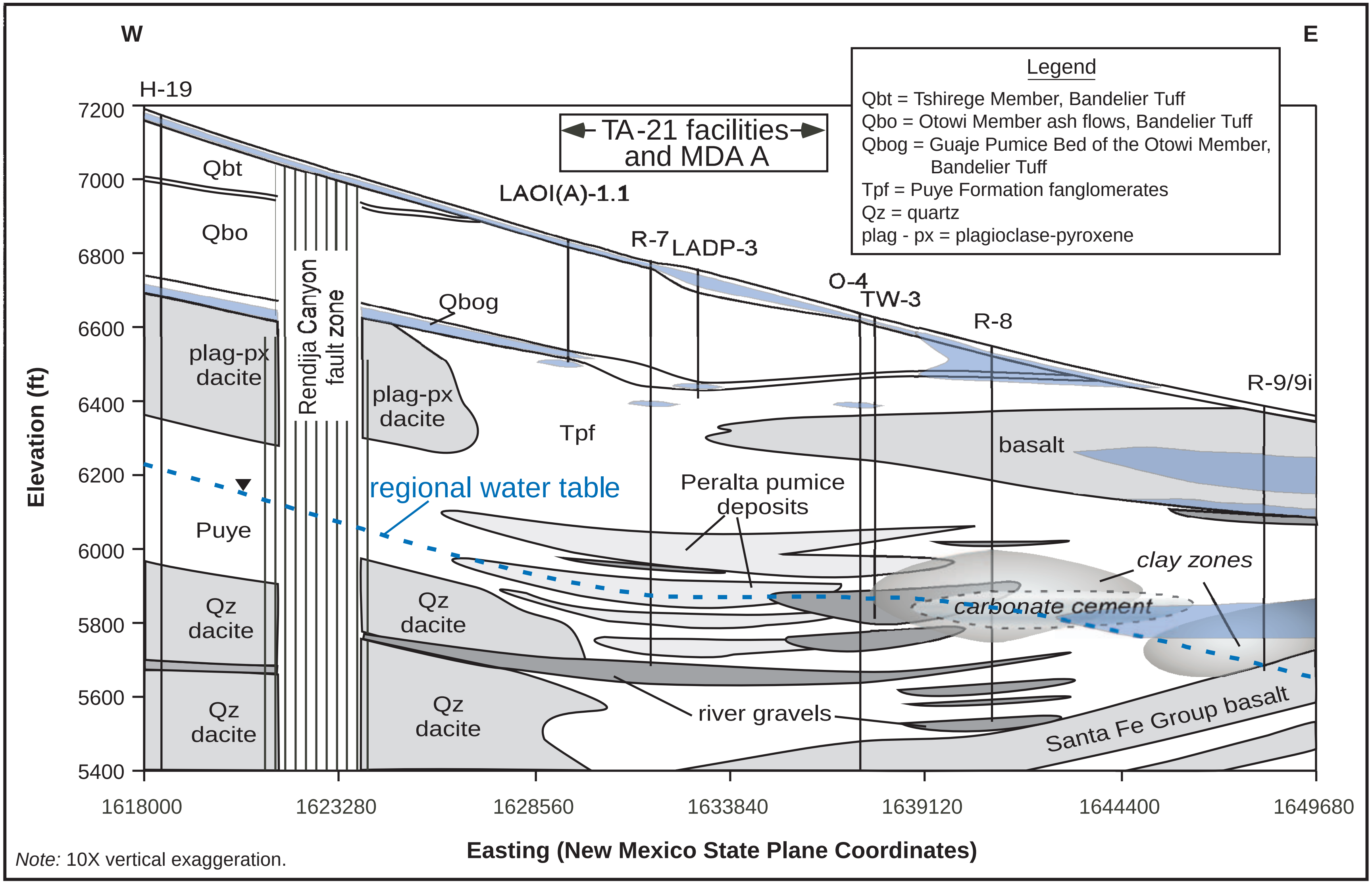
Source: "Investigation Work Plan for Solid Waste Management Unit 21-018(a)-99 Material Disposal Area V, at Technical Area 21," (LANL 2004, 87291, Figure 3.2-1, p. 34)
Figure 3.2-1 (stratigraphy).ai

Figure 3.2-1. Generalized stratigraphy of TA-21



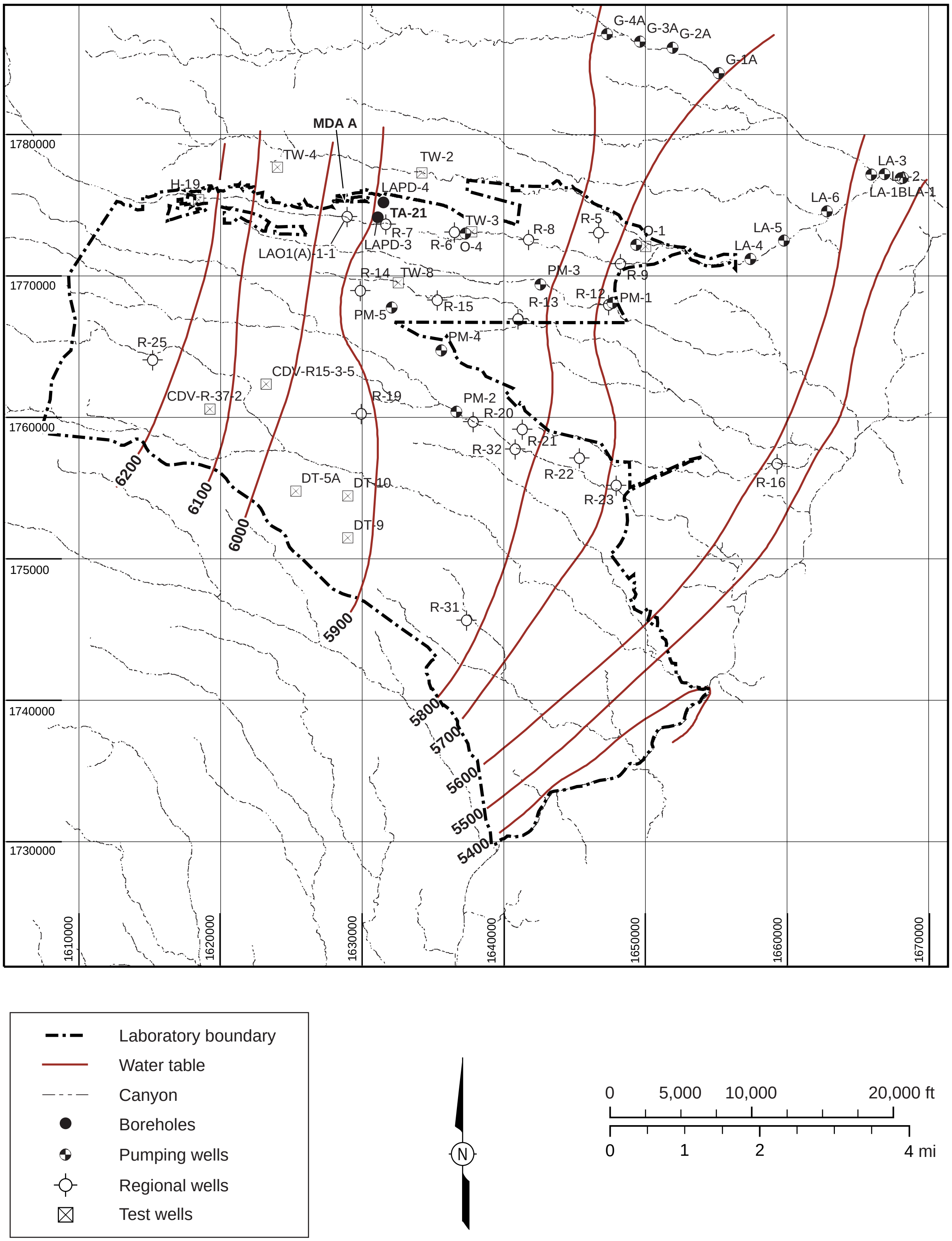
Source: "Investigation Work Plan for Solid Waste Management Unit 21-018(a)-99 Material Disposal Area V, at Technical Area 21," (LANL 2004, 87291, Figure 3.2-2, p. 35)
Figure 3.2-2 (hydrogeo model).ai

Figure 3.2-2. Schematic of the hydrogeologic conceptual model for the Pajarito Plateau



Source: D. Vaniman, 090904; modified for F3.2-3, MDA A WP, 091304, ptm

Figure 3.2-3. Hydrogeologic cross-section of the Pajarito Plateau in the vicinity of TA-21 along Los Alamos Canyon



Source: Modified from "Investigation Work Plan for Material Disposal Area B at TA-21, Solid Waste Management Unit 21-015," (LANL 2004, 87290, Figure 5, p. 34)
Figure 3.2-4 (wells).ai

Figure 3.2-4. Locations of groundwater monitoring wells in the vicinity of MDA A

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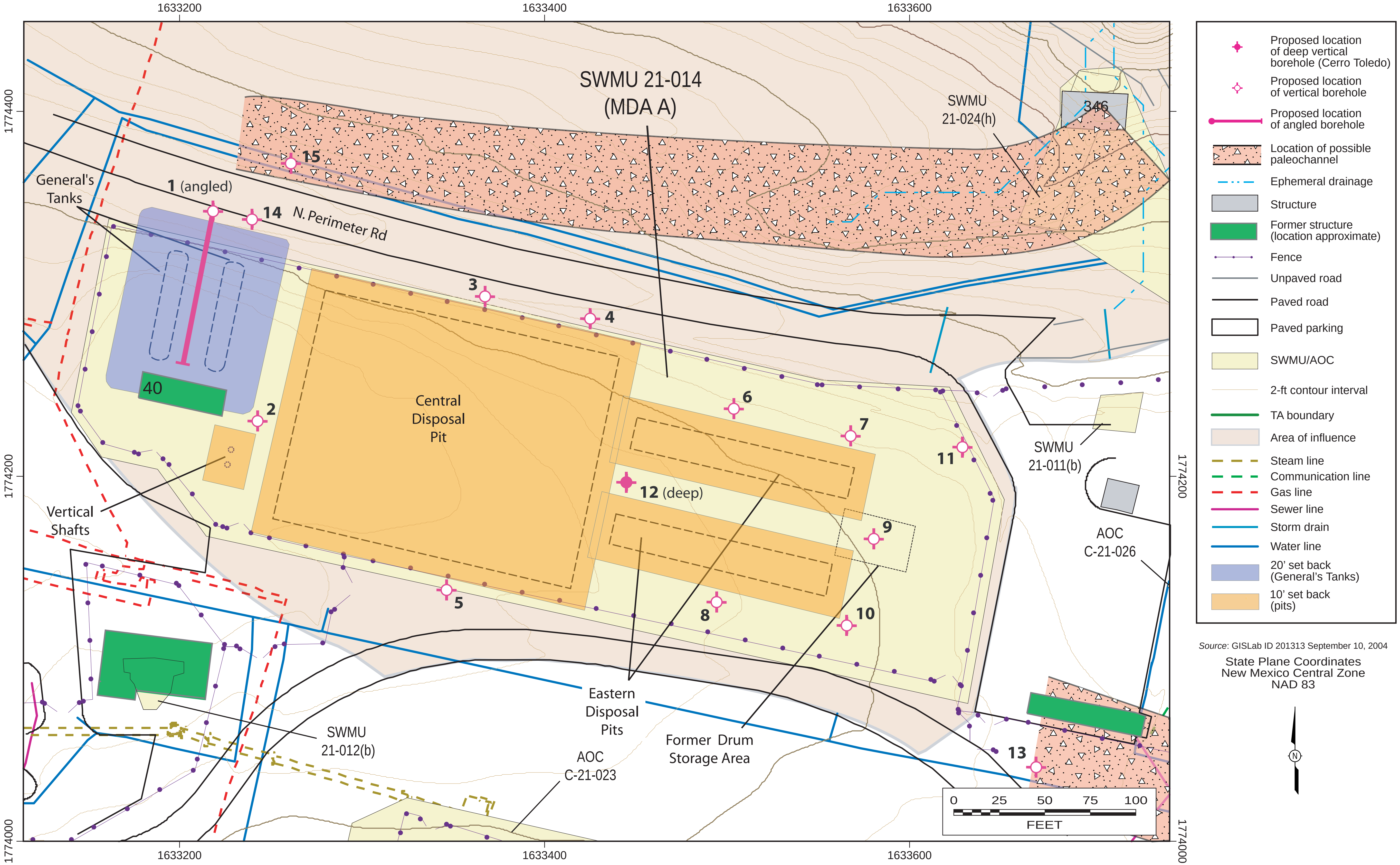

Figure 4.4-1. Locations of proposed boreholes at MDA

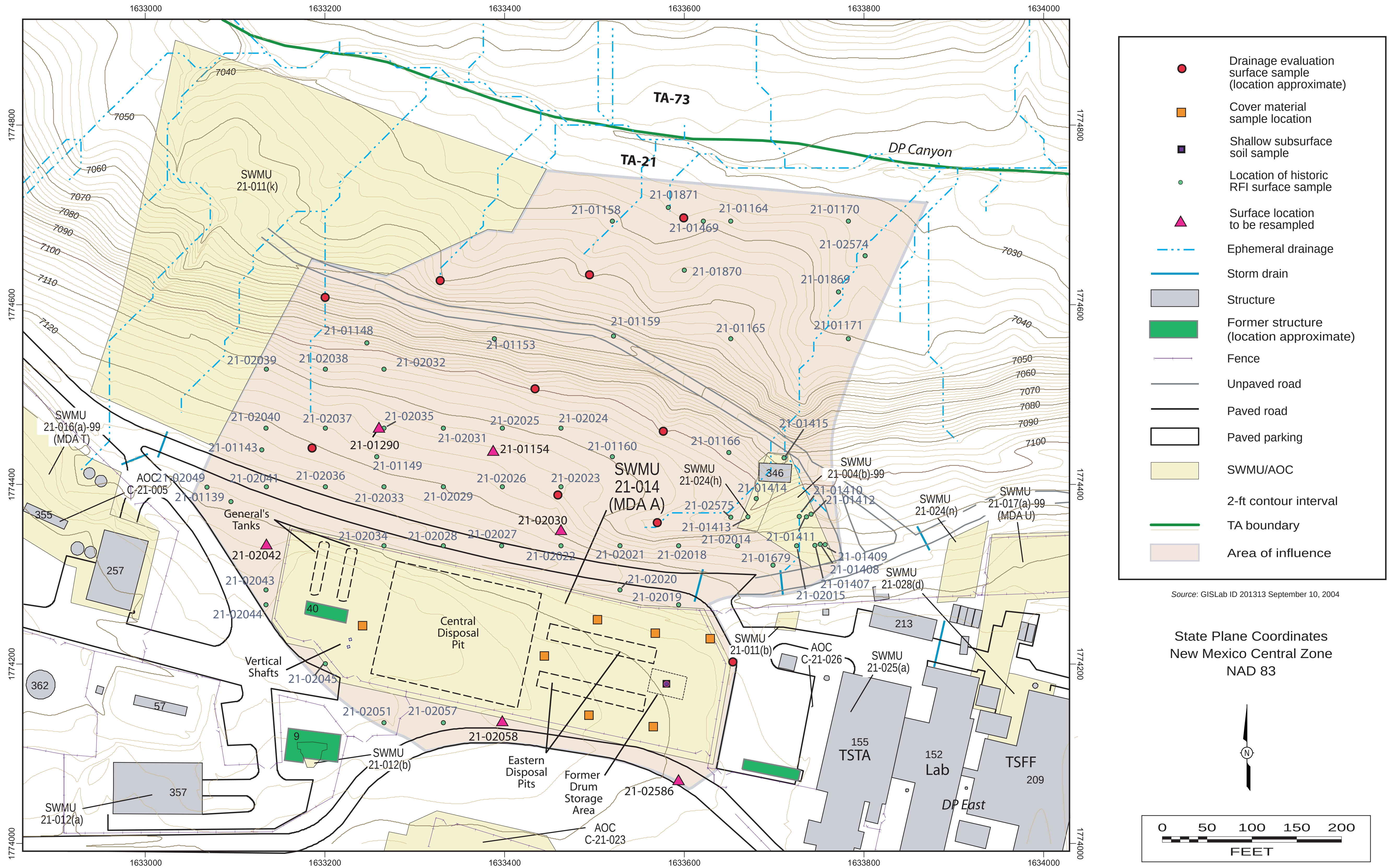

Figure 4.6-1. Proposed surface and near-surface sampling locations for soil at MDA A

Table 2.4-1
Potential TA-21 Process Chemicals

Chemical Name	Formula	CAS Number
Acetone	C_3H_6O	67-64-1
Aluminum nitrate	AlN_3O_9	13473-90-0
Ammonium nitrate	NH_4NO_3	6484-52-2
Ammonium hydroxide	NH_4OH	1336-21-6
Asbestos	n/a[a]	132207-33-1
Beryllium	Be	7440-41-7
Calcium	Ca	7440-70-2
Carbon tetrachloride	CCl_4	56-23-5
Ethyl ether	$(C_2H_5)_2O$	60-29-7
Fluoride	F	16984-48-8
Hydrochloric acid	HCl	7647-01-0
Hydrogen bromide	HBr	10035-10-6
Hydrofluoric acid	HF	7664-39-3
Hydrogen iodide	HI	10034-85-2
Kerosene	n/a	8008-20-6
Lead	Pb	7439-92-1
Methane	CH_4	74-82-8
Nitric acid	HNO_3	7697-37-2
Oxalate	Salt of oxalic acid	n/a
Oxalic acid	$H_2C_2O_4$	144-62-7
Perchlorate	ClO_4	14797-73-0
Phosphoric acid	H_3PO_4	7664-38-2
Sodium acetate	$NaC_2H_3O_2$	127-09-3
Sodium bromotrioxide	$NaBr_2O_3$	n/a[b]
Sodium hydroxide	NaOH	1310-73-2
Sodium nitrate	$NaNO_3$	7631-99-4
Sulfur dioxide	SO_2	7446-09-5
Sulfuric acid	H_2SO_4	7664-93-9
Thenoyl-tri-fluoroacetone	$C_8H_5F_3O_2S$	326-91-0
Tritium	H^3	10028-17-8
Zirconium	Zr	7440-67-7
Zinc	Zn	7440-66-6

Table 2.4-1 (continued)

Chemical Name	Formula	CAS Number
Radionuclides:		
Actinium-227	Ac-227	14952-40-0
Americium-241	Am-241	86954-36-1
Cesium-137	Cs-137	10045-97-3
Neptunium-237	Np-237	13994-20-2
Plutonium-239	Pu-239	15117-48-3
Plutonium-240	Pu-240	14119-33-6
Plutonium-241	Pu-241	14119-32-5
Plutonium-242	Pu-242	13982-10-0
Thorium-232	Th-232	7440-29-1
Strontium-90	Sr-90	10098-97-2
Uranium-234	U-234	13966-29-5
Uranium-235	U-235	15117-96-1
Uranium-238	U-238	7440-61-1
Miscellaneous:		
Corrosive gases (gas cylinders)		
Mineral oils		
Cyanide plating waste		
Anion exchange resin		
Biological waste		
Other organics		
Miscellaneous mixtures and spent chemicals		

[a] n/a = Not applicable.

[b] CAS number is not available for sodium bromotrioxide, which is listed as a COC based on historical documentation.

Table 2.8-1
Historical Analytical Results of Inorganic Chemicals Above BVs for Samples Within the MDA A Area of Influence

Sample ID	Location ID	Depth (ft)	Media	Arsenic	Cadmium	Calcium	Chromium	Copper	Lead	Lithium	Manganese	Mercury	Silver	Sodium	Uranium	Vanadium	Zinc
BV ALLH[a,b]				**8.17**	**0.4**	**6,120**	**19.3**	**14.7**	**22.3**	**na**[c]	**671**	**0.1**	**1**	**915**	**1.82**	**39.6**	**48.8**
BV SED[a,d]				**3.98**	**0.4**	**4,420**	**10.5**	**11.2**	**19.7**	**na**	**543**	**0.1**	**1**	**1,470**	**2.22**	**19.7**	**60.2**
SSL-Res[e]				**3.9**	**74.1**	**na**	**2,100**[f]	**3,130**	**400**	**1,600**[g]	**1,550**	**23**[g]	**391**	**na**	**16**[h]	**548**	**23,500**
SSL-Ind[e]				**17.7**	**1,128**[i]	**na**	**5,000**[f]	**45,400**	**750**	**23,000**[g]	**21,800**	**340**[g]	**5,680**	**na**	**200**[h]	**7,950**	**100,000**[j]
AAA0183	21-01154	0–0.08	ALLH	—[k]	—	—	—	—	—	—	—	—	—	—	5.6	—	—
AAA0187	21-01166	0–0.08	ALLH	—	—	—	—	—	—	—	—	—	—	—	8.06	—	—
AAA0399	21-01170	0–0.08	ALLH	—	—	—	—	—	—	—	—	—	—	—	4.3	—	—
AAA0401	21-01171	0–0.08	ALLH	—	—	—	—	—	—	—	—	—	—	—	4.7	—	—
AAA0402	21-01171	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	3.9	—	—
AAA0403	21-01165	0–0.08	ALLH	—	—	—	—	—	35.1	—	—	—	—	—	8.1	—	—
AAA0404	21-01164	0–0.08	ALLH	—	—	—	—	—	—	—	—	—	—	—	4.2	—	—
AAA0405	21-01164	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	4	—	—
AAA0406	21-01469	0–0.08	ALLH	—	—	—	—	—	—	—	—	—	—	—	4	—	—
AAA0407	21-01469	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	3.8	—	—
AAA0410	21-01158	0–0.08	ALLH	—	—	—	—	—	—	—	—	—	—	—	4.6	—	51.7
AAA0411	21-01159	0–0.08	ALLH	—	—	—	—	—	—	—	—	—	—	—	4.9	—	—
AAA0412	21-01153	0–0.08	ALLH	—	—	—	—	—	—	—	—	—	—	—	4.3	—	—
AAA0598	21-01139	0–0.08	ALLH	—	1.1	—	—	—	—	4	—	—	—	—	2.7	—	—
AAA0802	21-01407	0–0.5	ALLH	—	1.2	—	—	—	—	10.3	—	—	—	—	4.4	—	—
AAA0803	21-01407	0.5–1	ALLH	—	1.3	—	—	—	—	12.5	—	—	—	—	3.5	—	52.1
AAA0804	21-01407	1–1.5	ALLH	—	0.59	—	—	—	—	2.6	—	—	—	—	3.5	—	—
AAA0805	21-01408	0–0.5	ALLH	—	1.1	—	—	—	—	10.2	—	—	—	—	4.5	—	—
AAA0807	21-01408	0.5–1	ALLH	—	1.1	—	—	—	—	20.4	—	—	—	—	5.6	—	51.4
AAA0808	21-01408	1–1.5	ALLH	—	0.64	—	—	—	—	3.4	—	—	—	—	4.1	—	—
AAA0809	21-01409	0–0.5	ALLH	—	1.3	—	—	—	29.6	13.2	—	—	—	—	4.3	—	—

Table 2.8-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Arsenic	Cadmium	Calcium	Chromium	Copper	Lead	Lithium	Manganese	Mercury	Silver	Sodium	Uranium	Vanadium	Zinc
BV ALLH[a,b]				**8.17**	**0.4**	**6,120**	**19.3**	**14.7**	**22.3**	**na[c]**	**671**	**0.1**	**1**	**915**	**1.82**	**39.6**	**48.8**
BV SED[a,d]				**3.98**	**0.4**	**4,420**	**10.5**	**11.2**	**19.7**	**na**	**543**	**0.1**	**1**	**1,470**	**2.22**	**19.7**	**60.2**
SSL-Res[e]				**3.9**	**74.1**	**na**	**2,100[f]**	**3,130**	**400**	**1,600[g]**	**1,550**	**23[g]**	**391**	**na**	**16[h]**	**548**	**23,500**
SSL-Ind[e]				**17.7**	**1,128[i]**	**na**	**5,000[f]**	**45,400**	**750**	**23,000[g]**	**21,800**	**340[g]**	**5,680**	**na**	**200[h]**	**7,950**	**100,000[j]**
AAA0810	21-01409	0.5–1	ALLH	—	1.1	—	—	—	—	10.7	—	—	—	—	4	—	—
AAA0811	21-01409	1–1.5	ALLH	—	0.8	—	—	—	—	15.5	—	—	1.4	—	4.5	—	—
AAA0812	21-01410	0–0.5	ALLH	—	0.73	—	—	—	—	4.1	—	—	—	—	4.1	—	—
AAA0813	21-01410	0.5–1	ALLH	—	0.71	—	—	—	—	2.9	—	—	—	—	3.7	—	—
AAA0814	21-01410	1–1.5	ALLH	—	0.87	—	—	—	—	2.6	—	—	—	—	3.5	—	—
AAA0815	21-01411	0–0.5	ALLH	—	—	—	—	—	—	3.5	—	—	—	—	3.8	—	—
AAA0816	21-01411	0.5–1	ALLH	—	0.53	—	—	—	—	4.7	—	—	—	—	3.8	—	—
AAA0817	21-01411	1–1.5	ALLH	—	0.61	—	—	—	—	8.3	—	—	—	—	3.7	—	—
AAA0818	21-01412	0–0.5	ALLH	—	0.95	—	—	—	—	5	—	—	—	—	6.8	—	—
AAA0819	21-01412	0.5–1	ALLH	—	0.44	—	—	—	—	2.8	—	—	—	—	3.6	—	—
AAA0820	21-01412	1–1.5	ALLH	—	0.57	—	—	—	—	2.3	—	—	—	—	3.7	—	—
AAA0823	21-01413	0–0.5	ALLH	—	0.94	—	—	—	—	4.9	—	—	—	—	2.6	—	51.8
AAA0824	21-01413	0.5–1	ALLH	—	1.2	—	—	—	—	5.6	—	—	—	—	3.5	—	—
AAA0825	21-01413	1–1.5	ALLH	—	0.99	—	—	—	—	5.4	—	—	—	—	38	—	—
AAA0826	21-01414	0–0.5	ALLH	—	1.1	—	—	—	—	7.9	—	—	—	—	3.3	—	—
AAA0828	21-01414	0.5–1	ALLH	—	2.1	—	—	—	—	8.7	—	—	—	—	4.3	—	—
AAA0830	21-01415	0–0.5	ALLH	—	1.1	—	—	—	—	8.2	—	—	—	—	4.2	—	—
AAA0831	21-01415	0.5–1	ALLH	—	0.9	—	—	—	—	5.8	—	—	—	—	3.9	—	—
AAA0832	21-01415	1–1.5	ALLH	—	0.53	—	—	—	—	3.9	—	—	—	—	3.9	—	—
AAA7537	21-01869	0–0.25	SED	4.9	—	—	11.8	12.5 (J)	56.1	—	—	1.4	—	—	6.47 (J)	21.8 (J)	60.4
AAA7538	21-01869	0.25–0.5	SED	5.3	—	—	12.9	13.8 (J)	62.2	—	—	1.5	—	—	8.16 (J)	24.4 (J)	64.7
AAA7539	21-01869	0.5–1	SED	4.5	—	—	—	—	22.3	—	—	0.58	—	—	4.7 (J)	21.8 (J)	—

Table 2.8-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Arsenic	Cadmium	Calcium	Chromium	Copper	Lead	Lithium	Manganese	Mercury	Silver	Sodium	Uranium	Vanadium	Zinc
BV ALLH[a,b]				**8.17**	**0.4**	**6,120**	**19.3**	**14.7**	**22.3**	**na**[c]	**671**	**0.1**	**1**	**915**	**1.82**	**39.6**	**48.8**
BV SED[a,d]				**3.98**	**0.4**	**4,420**	**10.5**	**11.2**	**19.7**	**na**	**543**	**0.1**	**1**	**1,470**	**2.22**	**19.7**	**60.2**
SSL-Res[e]				**3.9**	**74.1**	**na**	**2,100**[f]	**3,130**	**400**	**1,600**[g]	**1,550**	**23**[g]	**391**	**na**	**16**[h]	**548**	**23,500**
SSL-Ind[e]				**17.7**	**1,128**[i]	**na**	**5,000**[f]	**45,400**	**750**	**23,000**[g]	**21,800**	**340**[g]	**5,680**	**na**	**200**[h]	**7,950**	**100,000**[j]
AAA7542	21-01870	0.5–1	ALLH	—	—	—	—	—	27.9	—	—	—	—	—	—	—	—
AAA7543	21-01871	0–0.25	ALLH	—	—	—	—	—	24.7	—	—	—	—	—	2.39 (J)	—	—
AAA7544	21-01871	0.25–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	2.02 (J)	—	—
AAB7293	21-02574	0–0.25	ALLH	—	—	—	36.5	15.1 (J)	68.3	—	699	1.5	—	—	8.78 (J)	—	82.6
AAB7294	21-02574	0.25–0.5	ALLH	—	—	—	19.4	—	36.5	—	—	1.1	—	—	5.04 (J)	—	—
AAB7295	21-02574	0.5–1	ALLH	—	—	—	—	—	—	—	—	1.2	—	—	2.12 (J)	—	—
AAB9125	21-02018	0–0.5	ALLH	—	—	9,630	—	—	—	—	—	—	—	—	—	—	—
AAB9126	21-02019	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	—	—	71.3
AAB9130	21-02023	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	2.6 (J)	—	
AAB9131	21-02024	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	3.44 (J)	—	—
AAB9132	21-02025	0–0.5	ALLH	—	—	—	—	—	23.4	—	—	—	—	—	2.88 (J)	—	—
AAB9133	21-02026	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	2.33 (J)	—	—
AAB9138	21-02031	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	2.41 (J)	—	—
AAB9139	21-02032	0–0.5	ALLH	—	—	—	—	—	24.4	—	—	—	—	—	2.05 (J)	—	—
AAB9140	21-02033	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	2.04 (J)	—	—
AAB9141	21-02034	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	—	—	129
AAB9146	21-02039	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	2.47 (J)	—	—
AAB9149	21-02042	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	—	1.88 (J)	—	—
AAB9158	21-02051	0–0.5	ALLH	—	—	—	—	—	25.8	—	—	—	—	—	—	—	50.5

Table 2.8-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Arsenic	Cadmium	Calcium	Chromium	Copper	Lead	Lithium	Manganese	Mercury	Silver	Sodium	Uranium	Vanadium	Zinc
BV ALLH[a,b]				**8.17**	**0.4**	**6,120**	**19.3**	**14.7**	**22.3**	**na**[c]	**671**	**0.1**	**1**	**915**	**1.82**	**39.6**	**48.8**
BV SED[a,d]				**3.98**	**0.4**	**4,420**	**10.5**	**11.2**	**19.7**	**na**	**543**	**0.1**	**1**	**1,470**	**2.22**	**19.7**	**60.2**
SSL-Res[e]				**3.9**	**74.1**	**na**	**2,100**[f]	**3,130**	**400**	**1,600**[g]	**1,550**	**23**[g]	**391**	**na**	**16**[h]	**548**	**23,500**
SSL-Ind[e]				**17.7**	**1,128**[i]	**na**	**5,000**[f]	**45,400**	**750**	**23,000**[g]	**21,800**	**340**[g]	**5,680**	**na**	**200**[h]	**7,950**	**100,000**[j]
AAB9165	21-02058	0–0.5	ALLH	—	—	—	—	—	—	—	—	0.12 (J)	—	—	—	—	—
AAC0127	21-02586	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—	2,450 (J)	—	—	—

Notes: Units are mg/kg.

[a] Background values from "Inorganic and Radionuclide Background Data for Soil, Canyon Sediment, and Bandelier Tuff at LANL" (LANL 1998, 59730, Table 6.0-1, p. 44).

[b] ALLH = All-soil horizons.

[c] na = Not available.

[d] SED = Sediment.

[e] New Mexico Environment Department, 2004, Technical Background Document for Development of Soil Screening Levels, Revision 2.0, Appendix A: NMED Soil Screening Levels, Table A-1, Hazardous Waste Bureau, Groundwater Quality Bureau, and Voluntary Remediation Program, August.

[f] Based on EPA Region VI MSSL for Chromium (EPA 2003, 81724). Values adjusted to reflect a 10^{-5} target risk.

[g] EPA Region VI MSSL (EPA 2003, 81724).

[h] EPA Region IX PRG value, http://www.epa.gov/Region9/waste/sfund/prg/index.htm.

[i] Published 2004 NMED industrial SSL for Cadmium not correct. Industrial Cadmium SSL recalculated using NMED parameters.

[j] Low toxicity maximum, health based SSL exceeds 10^5 mg/kg.

[k] — = Not analyzed or sample result not above the BV.

Table 2.8-2
Historical Analytical Results of Organic Chemicals
Detected in Samples Within the MDA A Area of Influence

Sample ID	Location ID	Depth (ft)	Medium	Acetone	Bis(2-ethylhexyl)phthalate	Methylene Chloride
SSL-Res[a]				**70,400**	**347**	**165**
SSL-Ind[a]				**100,000**	**1,370**	**440**
AAA0802	21-01407	0–0.5	ALLH[b]	0.014	—[c]	—
AAA0803	21-01407	0.5–1	ALLH	0.045	—	0.018
AAA0804	21-01407	1–1.5	ALLH	0.073	—	—
AAA0805	21-01408	0–0.5	ALLH	0.024	—	0.007
AAA0807	21-01408	0.5–1	ALLH	0.088	—	—
AAA0808	21-01408	1–1.5	ALLH	0.016	—	0.007
AAA0809	21-01409	0–0.5	ALLH	0.028	—	—
AAA0810	21-01409	0.5–1	ALLH	0.047	—	0.008
AAA0811	21-01409	1–1.5	ALLH	0.11	—	—
AAA0812	21-01410	0–0.5	ALLH	0.027	—	0.014
AAA0813	21-01410	0.5–1	ALLH	0.016	—	—
AAA0815	21-01411	0–0.5	ALLH	0.022	—	0.013
AAA0816	21-01411	0.5–1	ALLH	0.017	—	—
AAA0817	21-01411	1–1.5	ALLH	0.018	—	—
AAA0818	21-01412	0–0.5	ALLH	0.012	—	—
AAA0819	21-01412	0.5–1	ALLH	0.013	—	—
AAA0820	21-01412	1–1.5	ALLH	0.029	—	—
AAA0823	21-01413	0–0.5	ALLH	0.015	—	—
AAA0824	21-01413	0.5–1	ALLH	0.019	—	—
AAA0825	21-01413	1–1.5	ALLH	0.032	—	—
AAA0826	21-01414	0–0.5	ALLH	0.019	—	—
AAA0828	21-01414	0.5–1	ALLH	0.018	—	—
AAA0831	21-01415	0.5–1	ALLH	0.014	—	—
AAA0832	21-01415	1–1.5	ALLH	0.016	—	0.016
AAA4167	21-01679	0–2.5	ALLH	—	2.9	—
AAA4169	21-01679	5–10	Qbt3[d]	—	5.5	—
AAB9151	21-02044	0–0.5	ALLH	—	0.43	—

Note: Units are mg/kg.

[a] New Mexico Environment Department, 2004, Technical Background Document for Development of Soil Screening Levels, Revision 2.0, Appendix A: NMED Soil Screening Levels, Table A-1, Hazardous Waste Bureau, Groundwater Quality Bureau, and Voluntary Remediation Program, August.

[b] ALLH = All-soil horizons.

[c] — = Not analyzed or not detected.

[d] Qbt3 = Cooling unit 3 of the Tshirege Member of the Bandelier Tuff.

Table 2.8-3
Historical Analytical Results of Radionuclides
Above BVs or Fallout Values for Samples Within the MDA A Area of Influence

Sample ID	Location ID	Depth (ft)	Medium	Americium-241	Plutonium-238	Plutonium-239	Thorium-228	Tritium	Uranium-235
BV/Fallout Value ALLH[a,b]				**0.013**	**0.023**	**0.054**	**2.28**	**0.76[c]**	**0.20**
BV/Fallout Value SED[a,d]				**0.04**	**0.006**	**0.068**	**2.28**	**0.093**	**0.20**
BV/Fallout Value QBT3[a,e]				**na[f]**	**na**	**na**	**2.52**	**na**	**0.09**
SAL-Res[g]				**39**	**49**	**44**	**2.0**	**890**	**17**
SAL-Ind[g]				**140.3**	**176.4**	**158.9**	**7.201**	**15,140**	**73.09**
AAA0175	21-01143	0–0.08	ALLH	—[h]	0.115	1.673	—	1.2[c]	—
AAA0176	21-01143	0–0.5	ALLH	—	0.059	1.793	—	—	—
AAA0177	21-01148	0–0.08	ALLH	0.411	0.057	1.584	—	—	—
AAA0178	21-01148	0–0.5	ALLH	—	0.102	4.207	—	1.2[c]	—
AAA0179	21-01149	0–0.08	ALLH	0.487	0.058	0.583	—	1.5[c]	—
AAA0180	21-01149	0–0.5	ALLH	0.118	0.032	0.139	—	1.2[c]	—
AAA0181	21-01290	0–0.08	ALLH	1.313	0.284	2.354	—	1.3[c]	—
AAA0182	21-01290	0–0.5	ALLH	0.372	0.038	2.894	—	1.1[c]	—
AAA0183	21-01154	0–0.08	ALLH	—	—	15.31	—	1.8[c]	—
AAA0184	21-01154	0–0.5	ALLH	—	0.038	6.837	—	1.8[c]	—
AAA0185	21-01160	0–0.08	ALLH	0.532	0.09	14.78	—	1.5[c]	—
AAA0186	21-01160	0–0.5	ALLH	0.243	0.062	11.66	—	2.6[c]	—
AAA0187	21-01166	0–0.08	ALLH	1.424	0.187	13.26	—	2.2[c]	—
AAA0188	21-01166	0–0.5	ALLH	—	—	11.96	—	2.5[c]	—
AAA0399	21-01170	0–0.08	ALLH	—	0.037	2.269	—	1.8[c]	—
AAA0401	21-01171	0–0.08	ALLH	—	0.024	2.808	—	2.1[c]	—
AAA0402	21-01171	0–0.5	ALLH	—	—	1.01	—	2.1[c]	—
AAA0403	21-01165	0–0.08	ALLH	0.759	—	12.5	—	2.9[c]	—
AAA0404	21-01164	0–0.08	ALLH	—	—	1.406	—	1.5[c]	—
AAA0405	21-01164	0–0.5	ALLH	0.082	—	1.425	—	1.9[c]	—
AAA0406	21-01469	0–0.08	ALLH	—	—	0.418	—	1.5[c]	—
AAA0407	21-01469	0–0.5	ALLH	—	—	0.11	—	1.2[c]	—
AAA0410	21-01158	0–0.08	ALLH	0.203	0.074	2.424	—	2.9[c]	—
AAA0411	21-01159	0–0.08	ALLH	—	0.028	1.749	—	2.3[c]	—
AAA0412	21-01153	0–0.08	ALLH	—	0.037	3.273	—	1.2[c]	—
AAA0598	21-01139	0–0.08	ALLH	—	0.059	0.344	—	1[c]	—
AAA0802	21-01407	0–0.5	ALLH	—	—	1.47	—	35.2[c]	—
AAA0803	21-01407	0.5–1	ALLH	—	—	0.685	—	152.6[c]	—
AAA0804	21-01407	1–1.5	ALLH	—	—	—	—	115.3[c]	—

Table 2.8-3 (continued)

Sample ID	Location ID	Depth (ft)	Medium	Americium-241	Plutonium-238	Plutonium-239	Thorium-228	Tritium	Uranium-235
BV/Fallout Value ALLH[a,b]				**0.013**	**0.023**	**0.054**	**2.28**	**0.76[c]**	**0.20**
BV/Fallout Value SED[a,d]				**0.04**	**0.006**	**0.068**	**2.28**	**0.093**	**0.20**
BV/Fallout Value QBT3[a,e]				**na[f]**	**na**	**na**	**2.52**	**na**	**0.09**
SAL-Res[g]				**39**	**49**	**44**	**2.0**	**890**	**17**
SAL-Ind[g]				**140.3**	**176.4**	**158.9**	**7.201**	**15,140**	**73.09**
AAA0805	21-01408	0–0.5	ALLH	—	—	4.01	—	78.1[c]	—
AAA0807	21-01408	0.5–1	ALLH	—	—	2.79	—	604.4[c]	—
AAA0808	21-01408	1–1.5	ALLH	—	—	—	—	1700[c]	—
AAA0809	21-01409	0–0.5	ALLH	—	—	2.04	—	19[c]	—
AAA0810	21-01409	0.5–1	ALLH	0.293	—	—	—	78.7[c]	—
AAA0811	21-01409	1–1.5	ALLH	—	—	—	2.99	753.5[c]	—
AAA0812	21-01410	0–0.5	ALLH	—	0.432	—	—	4.4[c]	—
AAA0813	21-01410	0.5–1	ALLH	—	—	—	—	4.2[c]	—
AAA0814	21-01410	1–1.5	ALLH	—	—	—	—	3.2[c]	—
AAA0815	21-01411	0–0.5	ALLH	—	—	0.388	—	6[c]	—
AAA0816	21-01411	0.5–1	ALLH	0.209	—	—	—	4.6[c]	—
AAA0817	21-01411	1–1.5	ALLH	0.252	—	—	—	3.6[c]	—
AAA0818	21-01412	0–0.5	ALLH	0.325	—	1.24	—	6.6[c]	—
AAA0819	21-01412	0.5–1	ALLH	—	—	—	—	5[c]	—
AAA0820	21-01412	1–1.5	ALLH	—	—	—	—	3.8[c]	—
AAA0823	21-01413	0–0.5	ALLH	—	—	—	—	1.6[c]	—
AAA0824	21-01413	0.5–1	ALLH	0.298	0.914	1.84	—	—	—
AAA0825	21-01413	1–1.5	ALLH	—	—		—	1[c]	—
AAA0826	21-01414	0–0.5	ALLH	—	—	1.74	—	1.3[c]	—
AAA0828	21-01414	0.5–1	ALLH	0.677	—	33	—	2.2[c]	—
AAA0830	21-01415	0–0.5	ALLH	—	—	—	—	3.5[c]	—
AAA0831	21-01415	0.5–1	ALLH	—	—	—	—	2[c]	—
AAA0832	21-01415	1–1.5	ALLH	—	—	—	—	2.3[c]	—
AAA4170	21-01679	10–15	QBT3	—	—	—	—	—	0.28
AAA7537	21-01869	0–0.25	SED	0.1859	—	2.8	—	0.403	—
AAA7538	21-01869	0.25–0.5	SED	—	0.0224	3.185	—	0.488	—
AAA7539	21-01869	0.5–1	SED	—	—	2.492	—	0.291	—
AAA7540	21-01870	0–0.25	ALLH	0.2187	—	1.028	—	—	—
AAA7541	21-01870	0.25–0.5	ALLH	—	—	1.09	—	—	—
AAA7542	21-01870	0.5–1	ALLH	—	—	1.146	—	—	—
AAA7543	21-01871	0–0.25	ALLH	0.3802	0.0359	2.901	—	—	—

Table 2.8-3 (continued)

Sample ID	Location ID	Depth (ft)	Medium	Americium-241	Plutonium-238	Plutonium-239	Thorium-228	Tritium	Uranium-235
BV/Fallout Value ALLH[a,b]				**0.013**	**0.023**	**0.054**	**2.28**	**0.76[c]**	**0.20**
BV/Fallout Value SED[a,d]				**0.04**	**0.006**	**0.068**	**2.28**	**0.093**	**0.20**
BV/Fallout Value QBT3[a,e]				**na[f]**	**na**	**na**	**2.52**	**na**	**0.09**
SAL-Res[g]				**39**	**49**	**44**	**2.0**	**890**	**17**
SAL-Ind[g]				**140.3**	**176.4**	**158.9**	**7.201**	**15,140**	**73.09**
AAA7544	21-01871	0.25–0.5	ALLH	0.2789	0.0525	3.292	—	—	—
AAA7545	21-01871	0.5–1	ALLH	—	—	0.358	—	—	—
AAB7293	21-02574	0–0.25	ALLH	0.4062	0.0627	8.781	—	—	0.4855
AAB7294	21-02574	0.25–0.5	ALLH	0.3963	0.0306	7.05	—	—	—
AAB7295	21-02574	0.5–1	ALLH	—	—	0.429	—	—	—
AAB7296	21-02575	0–0.25	ALLH	—	—	1.043	—	—	—
AAB7297	21-02575	0.25–0.5	ALLH	—	—	1.034	—	—	—
AAB7298	21-02575	0.5–1	ALLH	—	0.0444	10.65	—	—	—
AAB9121	21-02014	0–0.5	ALLH	—	—	0.426	—	—	—
AAB9122	21-02015	0–0.5	ALLH	—	—	0.479	—	—	—
AAB9125	21-02018	0–0.5	ALLH	—	—	1.13	—	—	—
AAB9126	21-02019	0–0.5	ALLH	—	0.0302	2.86	—	—	—
AAB9127	21-02020	0–0.5	ALLH	—	—	0.824	—	—	—
AAB9128	21-02021	0–0.5	ALLH	—	—	1.01	—	—	—
AAB9129	21-02022	0–0.5	ALLH	—	—	0.477	—	—	—
AAB9130	21-02023	0–0.5	ALLH	—	0.0708	14	—	—	—
AAB9131	21-02024	0–0.5	ALLH	—	0.0782	10.7	—	—	—
AAB9132	21-02025	0–0.5	ALLH	—	0.0451	6.27	—	—	—
AAB9133	21-02026	0–0.5	ALLH	0.818	0.105	7.07	—	—	—
AAB9134	21-02027	0–0.5	ALLH	—	0.0416	0.264	—	—	—
AAB9135	21-02028	0–0.5	ALLH	—	—	0.218	—	—	—
AAB9136	21-02029	0–0.5	ALLH	—	—	1.58	—	—	—
AAB9137	21-02030	0–0.5	ALLH	0.759	0.072	12.6	—	—	—
AAB9138	21-02031	0–0.5	ALLH	—	—	1.78	—	—	—
AAB9139	21-02032	0–0.5	ALLH	—	0.0374	2.82	—	—	—
AAB9140	21-02033	0–0.5	ALLH	0.321	0.0281	0.818	—	—	—
AAB9141	21-02034	0–0.5	ALLH	0.658	0.0386	5.1	—	—	—
AAB9142	21-02035	0–0.5	ALLH	1.03	0.091	0.89	—	—	—
AAB9143	21-02036	0–0.5	ALLH	—	0.0781	0.152	—	—	—
AAB9144	21-02037	0–0.5	ALLH	—	—	0.255	—	—	—
AAB9145	21-02038	0–0.5	ALLH	—	—	0.53	—	—	—

Table 2.8-3 (continued)

Sample ID	Location ID	Depth (ft)	Medium	Americium-241	Plutonium-238	Plutonium-239	Thorium-228	Tritium	Uranium-235
BV/Fallout Value ALLH[a,b]				**0.013**	**0.023**	**0.054**	**2.28**	**0.76[c]**	**0.20**
BV/Fallout Value SED[a,d]				**0.04**	**0.006**	**0.068**	**2.28**	**0.093**	**0.20**
BV/Fallout Value QBT3[a,e]				**na[f]**	**na**	**na**	**2.52**	**na**	**0.09**
SAL-Res[g]				**39**	**49**	**44**	**2.0**	**890**	**17**
SAL-Ind[g]				**140.3**	**176.4**	**158.9**	**7.201**	**15,140**	**73.09**
AAB9146	21-02039	0–0.5	ALLH	—	0.0417	2.53	—	—	—
AAB9147	21-02040	0–0.5	ALLH	—	—	0.454	—	—	—
AAB9148	21-02041	0–0.5	ALLH	—	0.0351	0.486	—	—	—
AAB9149	21-02042	0–0.5	ALLH	—	—	0.0795	—	—	—
AAB9150	21-02043	0–0.5	ALLH	—	—	0.0911	—	—	—
AAB9151	21-02044	0–0.5	ALLH	—	—	0.108	—	—	—
AAB9152	21-02045	0–0.5	ALLH	0.962	0.136	1.47	—	—	—
AAB9156	21-02049	0–0.5	ALLH	—	—	0.146	—	—	—
AAB9158	21-02051	0–0.5	ALLH	0.56	0.0518	0.5	—	—	—
AAB9164	21-02057	0–0.5	ALLH	0.592	0.0432	1.67	—	—	—
AAB9165	21-02058	0–0.5	ALLH	—	—	0.105	—	—	—

Notes: Units are pCi/g.

[a] Background values from “Inorganic and Radionuclide Background Data for Soil, Canyon Sediment, and Bandelier Tuff at LANL” (LANL 1998, 59730, Table 6.0-2, p. 45).

[b] ALLH = All-soil horizons.

[c] Units are pCi/mL soil moisture.

[d] SED = Sediment.

[e] QBT3 = Cooling unit 3 of the Tshirege Member of the Bandelier Tuff.

[f] na = Not Available

[g] Values were derived using RESRAD, Version 6.21.

[h] — = Not analyzed or sample result not above the BV.

Table 4.6-1
Proposed Surface and Near-Surface Sample Summary and Sampling Rationale

Location ID	Previous Chemical Concentrations	Previous Radionuclide Concentrations	Sampling Rationale
1992 and 1994 RFI Investigation Resample Locations–Soil Samples			
21-01154 (two samples)	Non detect for all COPCs	Plutonium-239 (15.31 pCi/g)*	Third highest plutonium-239 detection in the area of influence (two highest in drainage below outfall associated with SWMU 21-024(h)
21-02030 (two samples)	Non detect for all COPCs	Plutonium-239 (12.6 pCi/g)*	High plutonium-239 detection immediately downslope of MDA A
21-01290 (two samples)	Non detect for all COPCs	Americium-241 (1.313 pCi/g)* Plutonium-239 (2.894 pCi/g)*	Second highest americium detected in area of influence. Highest detection downslope of SWMU 21-024(h)
21-02586 (two samples)	Non detect for all COPCs	Non detect for all COPCs	Confirmation of previous non detects
21-02058 (two samples)	Only minimal detections at this location	Only minimal detections at this location	Confirmation of previous non detects
21-02042 (two samples)	Only minimal detections at this location	Only minimal detections at this location	Cross gradient point to complete 5% resample commitment
Cover Sample Locations–Soil Samples			
8 locations (16 samples)	No previous data available	No previous data available	Characterization of current MDA A cover material
Downslope Drainage Locations–Sediment Samples			
10 locations (20 samples)	No previous data available	No previous data available	Characterization of surface soils in drainages emanating from MDA A

Notes: The results listed in this table do not represent all of the chemical detections at these sample locations. All analytical results are summarized in the MDA A historical investigation report (LANL 2005, 87452).

All concentrations shown above are established site-wide background values.

*See Table 5.2-4 of LANL 2005, 87452

Table 4.11-1
Summary of Borehole Drilling, Sampling, and Analyses Proposed for MDA A

Site / Issue Addressed	Borehole ID	Location Description	Borehole Declination from Horizontal (degrees)	Borehole Length (ft)	Borehole Total Depth (ft)	Geologic Units Encountered	Minimum Number of Samples Estimated for Fixed -Laboratory Analysis	Fixed-Laboratory Analysis															
								VOCs (SW-846 8260B)	SVOCs (SW-846 8270C)	Dioxins/Furans (SW-846 8290)	Total Iodide (by ICPMS)	pH (SW-846 9045C)	Total Uranium (SW-846 6020)	TAL Metals (SW-846 6010B or SW-846 6020)	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (EPA Method 314 or SW-846 8321A)	Gamma Spectroscopy (EPA Method 901.1)	Americium-241 (HASL-300)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905	Tritium (EPA Method 906)
General's Tanks; release from tanks (base of tanks 12 ft below original ground surface)	**1**	North to south under General's Tanks	45	116	82	Qbt 3, Qbt 2	8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vertical shafts, confirmation of non-use, cover thickness, fracture analysis (total depth 65 ft below original ground surface)	**2**	Northeast of vertical shafts	90	85	85	Qbt 3, Qbt 2	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Central disposal pit; vertical extent, horizontal extent, cover thickness, base of pit 22 ft below original ground surface	**3**	North side of central pit	90	45	45	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Central disposal pit; vertical extent, horizontal extent, cover thickness, base of pit 22 ft below original ground surface	**4**	North side of central pit	90	45	45	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Central disposal pit; vertical extent, horizontal extent, cover thickness, base of pit 22 ft below original ground surface	**5**	South side of central pit	90	45	45	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern pit (north); vertical extent, horizontal extent, cover thickness (base of pit 12.5 ft below original ground surface)	**6**	Adjacent to eastern pits (north)	90	35	35	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern pit (north), vertical extent, horizontal extent, fracture analysis, cover thickness (base of pit 12.5 ft below original ground surface)	**7**	Adjacent to the eastern pits (north)	90	35	35	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern pit (south), vertical extent, horizontal extent, cover thickness, base of pit 12.5 ft below original ground surface	**8**	Adjacent to the eastern pits (south)	90	35	35	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Former drum storage area; vertical extent, horizontal extent from eastern pits, cover thickness	**9**	Center the former drum storage area	90	35	35	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Former drum storage area vertical extent, horizontal extent	**10**	South of former drum storage area	90	35	35	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Former drum storage area vertical extent, horizontal extent	**11**	Northeast of former drum storage area	90	35	35	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MDA A (all units); vertical extent (Cerro Toledo-Deep)	**12**	Between the three pits	90	~335	~335	Qbt 3. Qbt 2, Qct, Qbo	8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern pits; horizontal extent southeast of MDA A, verification of possible paleochannels	**13**	Southeast of MDA A fence corner	90	45	45	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 4.11-1 (continued)

Site / Issue Addressed	Borehole ID	Location Description	Borehole Declination from Horizontal (degrees)	Borehole Length (ft)	Borehole Total Depth (ft)	Geologic Units Encountered	Minimum Number of Samples Estimated for Fixed-Laboratory Analysis	Fixed-Laboratory Analysis															
								VOCs (SW-846 8260B)	SVOCs (SW-846 8270C)	Dioxins/Furans (SW-846 8290)	Total Iodide (by ICPMS)	pH (SW-846 9045C)	Total Uranium (SW-846 6020)	TAL Metals (SW-846 6010B or SW-846 6020)	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (EPA Method 314 or SW-846 8321A)	Gamma Spectroscopy (EPA Method 901.1)	Americium-241 (HASL-300)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905	Tritium (EPA Method 906)
General's Tanks; vertical extent of releases, fracture analysis	**14**	Adjacent to North Perimeter Road immediately north of General's Tanks	90	280	280	Qbt 3, Qbt 2	8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
General's Tanks; horizontal extent, verification of possible paleochannel if contaminants detected in Boreholes 1 and 14	**15**	North of North Perimeter Road; north of MDA A	90	45	45	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Historical RFI Sample Locations Resample 6 locations from 1992/1994 sample events to verify hillslope conditions	n/a	Various (see Table 4.6-1)	n/a	n/a	0.0-0.5 and 1.5-2.0	Soil and sediment	12	—	X	—	X	X	X	X	X	—	X	X	X	X	X	X	X
DP Canyon Hillslope Sample 10 locations downslope of MDA A to define surface impacts related to run-off from MDA A	n/a	Drainages and areas of deposition downslope from MDA A	n/a	n/a	0.0-0.5 and 1.5-2.0	Soil and sediment	20	—	X	—	X	X	X	X	X	—	X	X	X	X	X	X	X
MDA A Cover Sample current MDA A cover material at 10 locations to characterize cover	n/a	Random locations on existing cover	n/a	n/a	0.0-0.5 and 1.5-2.0	Cover material	16	—	X	—	X	X	X	X	X	—	X	X	X	X	X	X	X
Vapor Sampling (Includes percent moisture content)	Boreholes 1 through 15	All Boreholes (minimum of 2 samples each)	n/a	n/a	Beneath nearest waste unit and TD	Varies with borehole Qbt 3, Qbt 2, Qct, Qbo	30	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X
Perched Groundwater Sampling (Includes general chemistry per Section IX.B of Consent Order)	TBD	TBD	n/a	TBD	TBD	Varies with borehole Qbt 3, Qbt 2, Qct, Qbo	TBD	X	X	—	X	X	X	X	X	—	X	X	X	X	X	X	X

Notes:

1. All boreholes will be continuously cored for collection of curation materials to a depth of 40 ft; material for curation will be collected every 10 ft thereafter.
2. From all boreholes, four samples will be collected for fixed-laboratory analysis including (a) base depths of the nearest waste units (pits, vertical shafts, General's Tanks), (b) maximum reading of field screen detection, (c) maximum depth of positive field screening detection, and (d) total depth.
3. From all boreholes less than 100 ft TD, two additional samples will be collected from preferential flow pathways (fractures, fracture fill, moist zones, surge beds/higher permeability zones).
4. From all boreholes greater than 100 ft TD, four additional samples will be collected from preferential flow pathways (fractures, fracture fill, moist zones, surge beds/higher permeability zones).
5. Tuff samples will be collected directly above the Qbt2/Qct contact and analyzed for permeability in boreholes that pass into the Cerro Toledo interval (likely only Borehole 12).
6. All borehole locations will also be sampled at the existing surface, if warranted by the results from walkover radiological surveys.
7. Shallow soil sampling will continue at depths greater than 0.5 ft if positive field screening is detected.
8. Dioxin/furan sampling will be conducted only at the recognized former operational surface in boreholes, and only if dioxin/furan is detected in the MDA T investigation. If MDA T investigation results are not available at the time of the MDA A investigation, dioxin/furan samples will be analyzed.
9. If there are no field-screening detections or zones of potential migration encountered, then samples will be collected from midpoint between the ground surface and base of waste unit and the midpoint between the base of the waste unit and TD.
10. Groundwater samples will also be analyzed for general chemistry (e.g., anions, alkalinity, total organic carbon, total inorganic carbon, and total dissolved solids) and explosive compounds.

n/a = Not applicable.
Qbt 2 = Bandelier Tuff, Tshirege Member, Unit 2.
Qbt 3 = Bandelier Tuff, Tshirege Member, Unit 3.
Qct = Cerro Toledo interval.
Qbo = Bandelier Tuff, Otowi Member.
TBD= To be determined.
X= Analysis to be performed.
— = No analysis to be performed.

Table 4.13-1
Consent Order Specifications and LANL Proposed Alternatives
(Based on September 1, 2004, Draft Compliance Order on Consent)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Disposal Units	**IV.C.2.c.ii MDA A Survey of Disposal Units** In accordance with Section IV.C.2.c.ii, the Respondents shall conduct a survey of the disposal units comprising MDA A. The Respondents shall determine the dimensions and total depth of each disposal trench, absorption bed, shaft, pit, and other unit at MDA A into which waste was disposed; and the base profile, topography, low elevation point, and downslope end of the base of each disposal trench, shaft, pit, and absorption bed at MDA A into which waste was disposed. The dimensions and base elevations of each trench, absorption bed, pit, shaft, and other disposal unit at MDA A shall be determined using as-built construction drawings and boring logs. If unavailable, ground penetrating radar, magnetic surveys, or other methods shall be used. The survey shall be completed prior to implementation of the drilling explorations under Section IV.C.2.c.iii.	There are no as-built drawings or borehole logs available for MDA A. LANL will utilize a combination of design drawings, historical geophysical surveys, and geodetic surveys to identify locations and configurations of each of the disposal units prior to all field investigation activities. Engineering design drawings and numerous geophysical surveys were used to determine the depths and dimensions of the waste units for this investigation work plan.	Four separate geophysical surveys were conducted in 1989, 1996, 1999, and 2003. These geophysical surveys were performed to delineate and confirm subsurface features including pits, tanks, and paleochannels. Several of the geophysical surveys indicate that disposal unit dimensions and locations are only slightly modified from original design drawings. Therefore, a current geodetic survey in combination with historical documentation is adequate to survey the disposal units.

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Drilling Explorations	**IV.C.2.c.ii MDA A Drilling Explorations** The Respondents shall conduct subsurface explorations as specified in the approved work plan in order to obtain sufficient data to characterize the extent of contamination, and to characterize fracture density, fracture orientation, and fracture fill material or the absence of fracture fill material in bedrock underlying MDA A. The fracture characterization of the rock formations underlying MDA A shall be completed utilizing data acquired from outcrops, cores, and downhole geophysical and video log data. A discussion of the sampling methods and potential locations for collecting rock fracture data shall be included within the required Investigation Work Plan for MDA A. The Department, prior to field investigation and data collection activities, shall approve the methods and locations for the fracture investigation activities. Pursuant to the procedures in Section III.M of this Consent Order, the Respondents shall submit to the Department for review and written approval a work plan for subsurface investigation activities at MDA A. Implementation of the approved work plan shall meet the following requirements, subject to the procedures in Section III.M of this Consent Order:	Vertical and angled boreholes are proposed for the subsurface characterization of MDA A. The one angled borehole is proposed beneath the General's Tanks where access is limited. The angled borehole will be paired with a deep vertical borehole to determine vertical extent beneath the General's Tanks. The angled borehole will allow characterization of the area beneath the tanks without buried utility obstructions and will provide a sufficient safety factor margin to adequately address the radiological concerns associated with tank integrity. If physical obstructions or slope angles prevent drilling as listed, the Permittees will work with NMED to determine appropriate drilling locations. As part of this investigation, a fracture analysis will be conducted in each of the boreholes. Previous fracture studies have been conducted at MDA A and TA-21 (Woehletz, 1995, 58845; Purtymun 1969, 00519). Geophysical and video logging will be performed on selected boreholes.	Not applicable (n/a)

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Drilling Explorations (continued)	1. Fifteen (15) borings, or the number defined in the Department-approved MDA A Investigation Work Plan, shall be advanced using hollow-stem auger drilling methods where practical or other drilling methods approved by the Department. Three of the borings shall be advanced to the base of the Cerro Toledo interval. All borings shall be drilled in accordance with Section IX of this Consent Order. The Department, prior to drilling, shall approve the location of the borings and the drilling method.	1. Fifteen boreholes (one angled and fourteen vertical), including one deep vertical borehole advanced through the Cerro Toledo interval are proposed.	1. Since no liquid waste was associated with the MDA A waste units, only one deep borehole to the Cerro Toledo (instead of three) is proposed directly in the center of the MDA. The proposed Boreholes 2 and 3 in the MDA T investigation are less than 300 and 500 ft west of the MDA A perimeter, respectively, and will penetrate the Cerro Toledo interval (LANL 2004, 85641). The proposed borehole, BH-4, at MDA U is located 430 ft. east of MDA A and will penetrate the Cerro Toledo interval (LANL 2004, 87454.3)
	2. Selected boreholes shall be characterized using geophysical logging techniques approved by the Department.	2. No deviation.	2. n/a
	3. A monitoring well shall be installed if groundwater (perched or regional) is encountered during drilling activities or if geophysical results indicate possible zone(s) of saturation. The wells shall be constructed in accordance with Section X of this Consent Order.	3. No deviation.	3. n/a
	4. Vapor monitoring wells shall be installed in the borings if vapor-phase contamination is detected during drilling activities.	4. No deviation.	4. n/a
	5. All borings not completed as monitoring wells (vapor or groundwater monitoring wells) shall be properly plugged and abandoned as described in Section X.D. Documentation of proper well abandonment shall be submitted to the Department as an appendix to the investigation report.	5. No deviation.	5. n/a

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Soil and rock sampling	**IV.C.2.c.iv MDA A Soil and Rock Sampling** Pursuant to Section IV.C.2.c.i and the procedures in Section III.M of this Consent Order, the Respondents shall submit to the Department for review and written approval a work plan for conducting soil and rock sampling during subsurface explorations activities at MDA A. Implementation of the approved work plan shall meet the following requirements, subject to the procedures in Section III.M of this Consent Order:	n/a	n/a
	1. Soil samples shall be collected continuously for the first 40 ft and at ten-ft intervals there after.	1. All boreholes will be continuously core sampled to the total depth of each borehole.	1. Continuous coring is preferable for fracture analysis, identification of perched zones, and provides better stratigraphic data than sample collection at discrete intervals.
	2. Samples shall be collected and screened in accordance with the methods described in Section IX.B of this Consent Order.	2. Samples will be field screened for volatile organic compounds (VOCs) and radioactivity. X-ray fluorescence (XRF) screening for metals will not be conducted on any samples.	2. XRF screening for metals will not be conducted due to low concentrations detected in historical samples.
	3. A minimum of four core samples from the tuff overlying the Cerro Toledo shall be collected and submitted for laboratory permeability testing in accordance with Section IX.B of this Consent Order.	3. One core sample from Borehole 12 will be submitted for permeability analyses.	3. No other boreholes are proposed with target depths anticipated to penetrate Qbt2 (directly above the Cerro Toledo interval). Permeability data will be available from deep Boreholes 2 and 3 at MDA T, less than 300 and 500 ft west of MDA A, respectively, (LANL 2004, 85641) and BH-4 at MDA U, located 430 ft. east of MDA A (LANL 2004, 87454.3)

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Soil and rock sampling (continued)	4. Field screening and laboratory sample selection shall be biased toward evidence of contamination, lithologic contacts, fractures, fracture fill material, surge beds and other higher permeability units identified during investigation activities. The samples shall be collected and screened in accordance with the methods described in Section IX.B of this Consent Order.	4. No deviation.	4. n/a
	5. Sediment, soil, and rock samples shall be obtained from the intervals described in Paragraph 1 above and from the bedrock directly below the base elevation of each absorption bed or shaft. A sample also shall be obtained at the maximum depth of each boring.	5. No deviation.	5. n/a
	6. A minimum of four samples shall be selected from each boring for submittal to a laboratory for analysis of VOCs, SVOCs, explosive compounds, pH, PCBs, dioxins, furans, nitrates, perchlorate, TAL metals, and cyanide. The sample exhibiting the highest field screening detection; the sample obtained from the maximum depth in each boring that displays field screening evidence of contamination; the sample located immediately below the base of any pit, tank or other structure; and the sample from the total boring depth shall be submitted for laboratory analysis.	6. Four samples will be analyzed from each borehole. In addition to the four samples specified herein, additional samples (2 from boreholes less than 100 ft TD and 4 from boreholes greater than 100 ft TD) will be collected from fracture zones, fracture fill, moist zones, and/or surge beds/high permeability zones. Dioxin/furan analyses will only be performed if detected during the MDA T investigation. All samples will be also be analyzed for specified radionuclides and total iodide. PCBs and explosive compounds will not be analyzed.	6. There are no historical data to indicate that explosive compounds, PCBs, or dioxin/furans are chemicals of potential concern at MDA A. Therefore, a modified analytical suite is proposed. Additional analyses are required for radiological COPCs and total iodide.

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Sediment sampling	**IV.C.2.c.v MDA A Sediment Sampling** The Respondents shall investigate contaminant transport from MDA A to canyon alluvial sediments through the implementation of the Work Plan for Los Alamos and Pueblo Canyons, dated November 1995, and the addendum to the Work Plan, dated February 2002, as described in Section IV.B.1.b.i of this Consent Order. The work plan and addendum were approved by the Department in June 1997 and May 2002, respectively. Pursuant to the EPA-approved RFI Work Plan for OU 1106, the Respondents investigated sediments in drainage channels leading from MDA A to DP Canyon. The investigation work plan shall include requirements for sediment sampling and characterization of drainages at MDA A in accordance with Section IV.A.4 of this Consent Order. If, after completion of the investigation of canyon sediments pursuant to the Work Plan for Los Alamos and Pueblo Canyons and addendum, the nature and extent of contaminant releases from MDA A drainages to DP Canyon have not been established, the Department will require additional sediment investigations of the drainages leading from MDA A.	To supplement the Work Plan for Los Alamos and Pueblo Canyons surface/drainage impacts downslope of MDA A will be characterized by collecting additional soil samples at ten locations (2 samples each) within obvious drainages and depositional areas north of MDA A. Another six sample locations from historical RFI sampling events will be resampled to determine if surface conditions (via soil erosion) have changed significantly.	The Work Plan for Los Alamos and Pueblo Canyons does not characterize minor drainages contributing to DP Canyon.

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Vapor monitoring	**IV.C.2.c.vi MDA A Subsurface Vapor Monitoring** Pursuant to Section IV.C.2.c.i and the procedures in Section III.M of this Consent Order, the Respondents shall submit to the Department for review and written approval a work plan to collect subsurface vapor samples from discrete zones in each subsurface vapor monitoring well or boring at MDA A, at depths approved by the Department, for field and laboratory analyses. The samples shall be collected and analyzed in accordance with Section IX.B of this Consent Order. Implementation of the approved work plan shall meet the following requirements, subject to the procedures in Section III.M of this Consent Order:		
	1. Subsurface vapor samples shall be collected from all newly drilled borings during site investigation activities.	1. No deviation.	1. n/a
	2. An investigation vapor monitoring and sampling plan shall be prepared in accordance with the format described in Section XI.B of this Consent Order and submitted by the Respondents to the Department for approval.	2. No deviation.	2. n/a
	3. Subsurface vapor sampling shall be conducted at MDA A in each existing and newly constructed vapor well and boring specified in the approved work plan.	3. No deviation.	3. n/a
	4. Samples of subsurface vapors shall be collected by the Respondents from subsurface vapor monitoring points at discrete zones selected based on investigation and monitoring results. The monitoring points must be approved by the Department prior to sample collection.	4. No deviation.	4. n/a
	Based on the results of the investigation vapor monitoring, a long-term subsurface vapor monitoring and sampling work plan shall be submitted to the Department for review and approval.		

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Intermediate groundwater	**IV.C.2.c.vii MDA A Intermediate Groundwater Well Installation** If intermediate zone groundwater is encountered or if geophysical or other evidence suggests the presence of intermediate perched groundwater during the required subsurface investigations for MDA A, the Department may require a work plan for the installation of intermediate groundwater monitoring well(s). The minimum depth of the subsurface investigations for MDA A will be the base of the Cerro Toledo interval. If groundwater is detected, these monitoring wells shall target all potential intermediate perched water bearing intervals identified during subsurface explorations at MDA A. If perched groundwater is encountered in sufficient quantities to allow sampling, the Respondents shall sample and analyze the water in accordance with the characterization requirements in the approved work plan and provide recommendations for a long-term groundwater monitoring plan in the MDA A investigation report required under Section IV.C.2.c.x.	No deviation. Monitoring well(s) will be installed if perched groundwater is encountered in quantities sufficient for sample collection in the deep borehole installed through the Cerro Toledo	n/a
Regional groundwater	**IV.C.2.c.viiii MDA A Regional Groundwater Well Installation** If the Department determines the need for additional wells intersecting the regional groundwater aquifer associated with TA-21 based on investigation data, the Respondents shall submit to the Department for review and written approval a work plan for the installation of such wells. The wells shall be installed according to the requirements in Section X of this Consent Order.	No regional groundwater investigations will be performed as part of this work plan. Regional groundwater investigations are being conducted in accordance with the Hydrogeologic Work Plan (LANL 1998, 59599) approved by NMED and the Los Alamos Canyon and Pueblo Canyon Intermediate and Regional Groundwater Work Plan (LANL 2003, 82612)	Installation of regional groundwater wells would be duplicative of work being done under the Hydrogeologic Work Plan (LANL 1998, 59599) and the Los Alamos Canyon and /Pueblo Canyon Intermediate and Regional Groundwater Work Plan (LANL 2003, 82612)

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Groundwater monitoring	**IV.C.2.c.ix MDA A Groundwater Monitoring** The Respondents shall monitor and sample all wells specified below containing alluvial, intermediate, and regional groundwater in accordance with the Interim Plan approved by the Department under Section IV.A.3.b that meets the requirements listed below, subject to the procedures in Section III.M of this Consent Order. Such monitoring and sampling shall also be conducted in accordance with Section IX of this Consent Order. Based on the results of the investigations and after completing the installation of all additional monitoring wells in the Los Alamos Canyon watershed as described in Section IV.B and subject to the procedures in Section III.M of this Consent Order, the Respondents shall submit to the Department for review and written approval a watershed-specific long-term groundwater monitoring plan for Los Alamos Canyon. Upon Department approval of the long-term monitoring plan for the Los Alamos Canyon watershed, the requirements of the long-term monitoring plan shall apply and shall supersede the requirements of the Los Alamos Canyon watershed section of the Interim Plan.	n/a	n/a

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Groundwater monitoring (continued)	1. Groundwater samples shall be obtained from Los Alamos Canyon monitoring wells LAO-1.6(g), LAO-2, LAO-3A, LAO-4.5C, LAO-5, LAO-6, LAO-6A, LAUZ-1, LAUZ-2, LADP-3, R-9i, R-5, R-7, R-8, R-9, TW-3, and any wells installed in the future determined by the Department to be required and at the frequency described in Section XII of this Consent Order. As described in Section IV.B.1.b.iv,, TW-3 shall be plugged and abandoned according to the procedures in Section X.D. Groundwater shall be monitored from TW-3 until the well is properly abandoned. 2. The groundwater sampling shall be conducted in accordance with Section IX.B of this Consent Order. 3. Groundwater samples shall be collected from the Los Alamos Canyon monitoring wells for submittal to a laboratory for analysis of general chemistry parameters as described in Section IX.B of this Consent Order, perchlorate, TAL metals, cyanide, VOCs, SVOCs, explosive compounds, and for other analytes specified by the Department.	1. No groundwater sampling of existing wells will be performed as part of this work plan. The wells identified in IV.C.2.c.ix.1 will be monitored as specified in the facility-wide groundwater monitoring plan required under Section IV.A.3 of the Consent Order. 2. See alternative 1 above. 3. See alternative 1 above.	1. Groundwater investigations would be duplicative of work required under Section IV.A.3 of the Consent Order 2. See justification 1above. 3. See justification 1 above.

Table 5.0-1
Summary of Applicable SOPs and QPs

Procedure	Title	Summary
SOP-1.01	General Instructions for Field Investigations	Provides an overview of instructions regarding activities to be performed before, during, and after field investigations completed by the ENV-RS project. It is assumed that field investigations involve standard sampling equipment, personal protective equipment, waste management, and site-control equipment/materials. The procedure covers pre-mobilization activities, mobilization to the site, documentation and sample-collection activities, sample media evaluation, surveying, and completing lessons learned.
SOP-1.02	Sample Containers and Preservation	Describes the specific requirements/process for sample containers, preservation techniques, and holding times as specified by field regulations and guidance documents. The use of specific types of sample containers and preservation techniques is mandatory for hazardous site investigations because the integrity of any sample is diminished over time. Physical factors (light, pressure, temperature, etc.), chemical factors (changes in pH, volatilization, etc.), and biological factors may alter the original quality of the sample. Because the various target parameters are uniquely altered at varying rates, distinct sample containers, preservation techniques, and holding times have been established to maintain sample integrity for a reasonable and acceptable period of time. The procedure covers documenting SOP deviations, using proper sample containers and preservatives, performing data entry, implementing containment procedures, preserving samples, implementing holding times, completing documentation, implementing post-operation activities, and performing lessons learned.
SOP-1.03	Handling, Packaging and Transporting Field Samples	Directs field team members in the preparation of environmental and waste characterization samples for transportation to the SMO or an approved radiation screening laboratory. In general, samples taken for the RS project are expected to have a low concentration of potential contaminants, although higher concentrations will be present in some cases. These low-concentration samples that do not satisfy the DOT hazard-class definitions are classified as environmental samples and are not subject to DOT regulations. Historical data, knowledge of processes, and field-screening results will assist the team members in making decisions as to whether a sample can be designated as “environmental” or needs to be treated as a DOT-regulated material. The procedure covers transportation of environmental and DOT-regulated samples.
SOP-1.04	Sample Control and Field Documentation	Describes the process for documenting samples collected for the ENV-RS project using sample control and field documentation. More specifically, it covers container labels, sample collection logs, chain of custody (COC)/request-for-analysis forms, and daily activity log forms or field notebooks. The procedure covers performing request notification, generating sample control and field documentation, completing sample collection logs, using field COC forms, delivering samples to the SMO, delivering samples to another analytical laboratory, using custody seals, collecting the samples, completing sample control and field documentation, completing field investigation summaries, and performing field closeouts.

Table 5.0-1 (continued)

Procedure	Title	Summary
SOP-1.05	Field Quality Control Samples	Describes the requirements for the collection of field QC samples to ensure the reliability and validity of field and laboratory data. Field QC samples shall be collected as described in this procedure and taken to the LANL SMO with the regular field samples for subsequent chemical and physical testing. The procedure covers pre-operation activities and collecting and preparing each type of QC sample, including equipment rinsate blank, field duplicate, and trip blank.
SOP-1.06	Management of Environmental Restoration Project Wastes	Describes the process for managing waste generated during corrective action activities. This procedure outlines the preparation, approval, and retention of all required documents associated with waste generation. The procedure covers waste identification and characterization, waste minimization/recycling, waste generation/storage, segregation, waste treatment, authorized release limits, packaging/transportation, disposal options, and specific ENV-RS project policies, including area of contamination policy, environmental media, and contained-in policy.
SOP-1.08	Field Decontamination of Drilling and Sampling Equipment	Describes the process for the general field decontamination of drilling and sampling equipment. It is intended to help ensure the integrity of soil, sediment, rock, water, and other samples collected from potentially contaminated sites and to minimize the potential for cross-contamination between sampling locations. Implementation of this procedure will help protect site and community personnel, requiring that equipment not be removed from a controlled area without proper decontamination. The procedure covers setup of dry and wet decontamination areas, drilling/excavation equipment decontamination, and sampling equipment decontamination.
SOP-1.10	Waste Characterization	Describes the development of a strategy for characterizing wastes generated during projects performed at LANL. Specifically, the SOP (1) identifies the steps involved in waste identification and characterization as delineated by LANL requirements, and (2) provides instructions for completing a Waste Characterization Strategy Form (WCSF). A WCSF is required for projects that include, but are not limited to, site investigations, corrective actions, drilling, closures, and decommissioning projects.
SOP-2.01	Surface Water Site Assessments	Describes the process for determining whether a site has the potential to adversely affect surface water quality. The procedure identifies responsible participants and provides a detailed checklist to evaluate the erosion potential at a site that does not meet the criterion for NFA. SWMUs with highest priority are those adjacent to drainages and canyon systems or those with an erosion matrix score greater than 40 based on an evaluation of erosion/sediment transport potential. Erosion matrix scores range from 1 to 100 and are qualitatively determined based on a systematic assessment of the site. The assessment involves an evaluation of the site setting, examination of the site for evidence of runoff and erosion, and documentation of structures and/or operations that are directing stormwater onto the site.
SOP-3.11	Coordinating and Evaluating Geodetic Surveys	Describes the methodology for coordinating and evaluating geodetic surveys and establishing QA and control for geodetic survey data. The procedure covers evaluating geodetic survey requirements, preparing to perform a geodetic survey, performing geodetic survey field activities, preparing geodetic survey data for QA review, performing QA review of geodetic survey data, and submitting geodetic survey data.

Table 5.0-1 (continued)

Procedure	Title	Summary
SOP-4.01	Drilling Methods and Drill Site Management	Describes the drilling methods and drilling-package implementation to meet subsurface sampling requirements. Various drilling methods have been developed to achieve successful subsurface contact for retrieving suitable formation, gas, and water samples. These include, but are not limited to, solid-stem augering, hollow-stem augering, direct rotary drilling, reverse rotary drilling, cable-tool drilling, and hand augering.
SOP-4.04	Contract Geophysical Logging	States the responsibilities and describes the general process for obtaining borehole logging data of acceptable quality regardless of logging system or logging contractor, to meet site-characterization and/or subsurface-sampling requirements of the investigation. Borehole logging techniques are used in situ to determine physical, chemical, geological, and hydrological conditions in an open borehole. The procedure covers pre-contract considerations, pre-operation activities, borehole geophysical logging activities, and post-operation activities. The main concerns during logging activities are monitoring the logging equipment as it emerges from the borehole or before it leaves the work site for contamination, verifying field calibration both immediately before and immediately after a logging run or runs with a given logging tool, and ensuring that the logging equipment is decontaminated between sampling events.
SOP-5.03	Monitoring Well and RFI Borehole Abandonment	Describes the process for monitoring well and RFI borehole abandonment. The procedures described in this SOP are consistent with acceptable practice for monitoring well and borehole abandonment under RFI guidance. The procedure covers monitoring well and RFI borehole abandonment, placement of the appropriate sealing and fill material, options for destroying monitoring wells and RFI boreholes in urban areas and near active technical areas, and reporting requirements.
SOP-5.07	Operation of LANL-Owned Borehole Logging Trailer	Describes the process for operation and maintenance of the borehole video/geophysics logging trailer. The procedure covers running the following tools: borehole video camera system, borehole caliper tool, borehole conductivity/resistivity (induction) tool, gamma tool, and borehole spontaneous potential/single-point resistance tool.
SOP-6.01	Purging and Sampling Methods for Single Completion Wells	Describes methods used for evacuating stagnant water from a well bore in sufficient quantities so that the water samples collected afterward are representative of the formation interval open to the well bore. Groundwater that is stagnant in the well bore is subject to chemical reactions that may significantly alter the composition of the formation water. Prior to collecting a representative groundwater sample for laboratory analysis, groundwater must be purged. The procedure covers preliminary activities, pre-operation field activities, well purging operations, water sampling operations, and post-operation activities.
SOP-6.03	Sampling for Volatile Organic Compounds in Groundwater	States the responsibilities and describes the process for sampling for VOCs in groundwater. This SOP also describes the selection of equipment and materials used in the sampling process. The objectives are to collect valid samples for volatile organic analysis (VOA) and to subject samples to the least amount of turbulence and subsequent possible aeration. The procedure covers conducting pre-operation activities, sampling, preparing documentation, and conducting post-operation activities.
SOP-6.09	Spade-and-Scoop Method for the Collection of Soil Samples	Describes the process for spade-and-scoop collection of shallow (i.e., typically 0 to 12 in.) soil samples. The spade-and-scoop method involves digging a hole to the desired depth, as prescribed in the sampling and analysis plan, and collecting a discrete grab or portion of a composite sample. The procedure covers pre-sampling activities, sampling activities, and post-sampling activities.

Table 5.0-1 (continued)

Procedure	Title	Summary
SOP-6.10	Hand Auger and Thin-Wall Tube Sampler	States the responsibilities and describes the process for collecting surface and subsurface (up to about 15 ft) soil samples with a hand auger and thin-wall tube sampler. This procedure describes the selection and use of sampling methods and equipment at sites that may include contamination with hazardous or radioactive materials. The procedure covers pre-sampling activities, sampling activities, collecting field duplicates, and post-sampling activities.
SOP-6.24	Sample Collection from Split-Spoon Samplers and Shelby-Tube Samplers	States the responsibilities and describes the process for collecting soil and sediment samples using either split-spoon samplers or Shelby-tube samplers. A split-spoon sampler is used to take subsurface soil or sediment samples by forcefully driving the sampler into the soil or sediment at the bottom of a borehole. The Shelby tube is a similar type of sampling apparatus. The split spoon is a multi-piece sampler; the Shelby tube is a single-piece metal tube of thinner gauge. The procedure covers pre-sampling activities, sampling activities, and post-sampling activities.
SOP-6.26	Core-Barrel Sampling for Subsurface Earth Materials	Describes the process for collecting core-barrel samples of subsurface earth materials. This procedure is limited to sampling of subsurface sediments for radionuclides (including tritium), metals, PCBs, total petroleum hydrocarbons, and VOCs and SVOCs. The field team may sample for other constituents under this SOP (or modifications thereof) at the discretion of the field team leader and project leader. The procedure covers pre-sampling activities, sampling activities, and post-sampling activities.
SOP-6.31	Sampling of Subatmospheric Air	Describes the process of sampling subatmospheric air from vapor ports in monitoring wells and boreholes. The procedure covers pre-sampling activities, B&K sampling to detect and quantify gaseous organic concentration in air, SUMMA sampling (a passive collection and containment system of laboratory-quality air samples), adsorbent column sampling, sampling through the packer system (a sampling system that uses inflatable bladders to seal off a desired interval in an open borehole, or at the end of drill casing, in order to obtain a sample from a discrete section), and post-sampling activities.
SOP-6.33	Headspace Vapor Screening with a Photoionization Detector	Describes the process for screening headspace vapor for VOCs in soil samples with a photoionization detector (PID). The PID is a portable, nonspecific, vapor/gas detector that uses the principle of photoionization to detect and measure real-time concentrations of a variety of chemical compounds, both organic and inorganic, in air. The procedure covers performing field calibration, operating, and post-operating activities.
SOP-7.05	Subsurface Moisture Measurements Using a Neutron Probe	Describes the process of collecting subsurface moisture measurements for the ENV-RS project using a neutron probe. A neutron probe measures the subsurface moisture using a probe containing a source of high-energy neutrons and a slow neutron detector. The procedure covers performing a daily field standard count, preparing the instrument for field measurements, taking a field measurement, and documenting the results of the field measurement.
SOP-10.14	Performing and Documenting Gross Gamma Radiation Scoping Surveys	Describes the process for performing and documenting gross gamma radiation scoping surveys in buildings and soils. Scoping surveys are conducted after an assessment of the site history is completed and consist of judgmental measurements based on historical site information and data. If the scoping survey locates contamination, a characterization survey is typically performed.

Table 5.0-1 (continued)

Procedure	Title	Summary
SOP-12.01	Field Logging, Handling, and Documentation of Borehole Materials	Prescribes the specific borehole material management methods to be followed, and documentation to be prepared, during handling and field logging of selected borehole materials identified in the site guidance documents and WCSF. This procedure is limited to the activities necessary to take custody of core and cuttings from drill rig personnel; conduct field screening; remove time-sensitive analytical samples and subsamples for preliminary characterization; complete photo documentation when necessary; perform field structural and lithologic description; and mark, package, and temporarily store the borehole materials at a drill-site borehole material storage trailer. This procedure describes the handling of the subset of borehole materials to be curated from the time they are withdrawn from the borehole to the time they are ready to be transported to the RS project's Field Support Facility for curating and archiving. For the purposes of this SOP, borehole material may also refer to other solid materials such as drive samples or augered materials. The procedure covers borehole material staging, temporary packaging of time-sensitive analytical samples, measurement and determination of material loss, marking core (depth notation and stripes), core photography, core logging, removal of analytical samples (core), and core box loading and storing.
QP-4.4	Record Transmittal to the Records Processing Facility	Describes the responsibilities for transmitting records to the Records Processing Facility (RPF) for the ENV-RS project and describes the process for transmitting documents to the RPF. The procedure defines what types of information the term *records* includes, which records should be submitted, and details the steps necessary to submit records.
QP-5.3	Readiness Planning and Reviews	Describes the responsibilities and defines the process for conducting readiness planning and reviews for the ENV-RS project. The procedure is used as a planning tool for preparing fieldwork, as a method to ensure compliance with all identified requirements, and to gain consensus on key preparations before field activities can proceed. The QP defines the personnel responsible for the various readiness planning and review activities. The procedure also presents the criteria for determining if a readiness review meeting is necessary, as well as details the process for conducting such a meeting. A readiness review checklist is required in order to assure that all requirements are met and to assign responsible personnel for meeting the requirements.
QP-5.7	Notebook Documentation for Environmental Restoration Technical Activities	Describes the responsibilities and process for properly documenting environmental restoration technical activities performed for the ENV-RS project. The procedure defines the requirements for documenting field activities including the requirements for notebooks, notebook entries, notebook attachments, notebook data evaluation, technical review of notebooks, Quality Integration and Improvement review of notebooks, and notebook submission as a record.
QP-7.1	Procurement	Describes the responsibilities and process for procuring quality-affecting items and services for the ENV-RS project. The QP details the processes for initiating a procurement, procuring built-to-order items, procuring nonanalytical services, procuring internal and external analytical services, procuring calibration standards, reviewing documents for the procurement of services, purchase requisitions, and material receipt inspection. The procedure necessitates a graded approach in implementing its requirements. The QP provides a sample services statement of work (SOW) checklist and a "guidance document" statement of technical and quality requirements for purchase requisitions, to be used when following the procedure's requirements.

Table 5.0-1 (continued)

Procedure	Title	Summary
QP-7.2	Supplier Evaluation	Describes the requirements and process for evaluating and approving potential suppliers of items and/or services to the ENV-RS project. The QP also describes the requirements and process for implementing and maintaining the ENV-ECR Qualified Suppliers List. The procedure specifically excludes certain items to which the QP does not apply.

Appendix A

Acronyms, Glossary, and Metric Conversion Table

ACRONYMS

AA	administrative authority
AK	acceptable knowledge
AOC	area of concern
asl	above sea level
ASTM	American Society for Testing and Materials
bgs	below ground surface
BV	background value
CFR	Code of Federal Regulations
COPC	chemical of potential concern
CSM	conceptual site model
DOE	Department of Energy (US)
DOT	Department of Transportation
DP	Delta Prime
DSA	Documented Safety Analysis
EPA	Environmental Protection Agency (US)
ENV-RS	Environmental Stewardship–Remediation Services
ER ID	Environmental Restoration Project identification number
ER	environmental restoration
GPS	global positioning system
HE	high explosive(s)
HIR	historical investigation report
IDW	investigation-derived waste
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (designation of the Laboratory before January 1, 1981)
LIR	Laboratory Implementation Requirement
LLW	low-level waste
MDA	material disposal area
NFA	no further action
NMED	New Mexico Environment Department
NOI	notice of intent
OU	operable unit
PCB	polychlorinated biphenyl
PID	photo-ionization detector
PPE	personal protective equipment
QA	quality assurance

QC	quality control
QP	quality procedure
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RPF	records processing facility
RQD	rock quality designation
SAL	screening action level
SMO	Sample Management Office
SOP	standard operating procedure
SSL	soil screening level (NMED)
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area
TAL	target analyte list (EPA)
TCLP	toxicity characteristic leaching procedure
TD	total depth
TSTA	Tritium System Test Assembly
VOC	volatile organic compound
WAC	waste acceptance criteria
WCSF	waste characterization strategy form
XRF	x-ray fluorescence

GLOSSARY

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

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

Groundwater—Water in a subsurface saturated zone; water beneath the regional water table.

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

Model—A mathematical approximation of a physical, biological, or social system.

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

Quality assurance (QA)—All those planned and systematic actions necessary to provide adequate confidence that a facility, structure, system, or component will perform satisfactorily in service.

Quality control (QC). (1) All those actions necessary to control and verify the features and characteristics of a material, process, product, or service to specified requirements. QC is the process through which actual quality performance is measured and compared with standards. (2) All methods and procedures used to obtain accurate and reliable results from environmental sampling and analysis. Includes rules for when, where, and how samples are taken; sample storage, preservation and transport; and the use of blanks, duplicates, and split samples during the analysis.

Radionuclide—A nuclide (species of atom) that exhibits radioactivity.

RCRA facility investigation (RFI)—The investigation that determines if a *release* has occurred and the nature and extent of the contamination from such a release at a hazardous waste facility. The RFI is generally equivalent to the remedial investigation portion of the Comprehensive Environment Response, Compensation, and Liability Act (CERCLA) process.

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.

Release—Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of hazardous waste or hazardous constituents into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles that contain any hazardous wastes or hazardous constituents).

Resource Conservation and Recovery Act (RCRA)—The Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976. (40 CFR 270.2)

Sample—A portion of a material (e.g., rock, soil, water, air), which, alone or in combination with other samples, is expected to be representative of the material or area from which it is taken. Samples are typically 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.

Screening action level (SAL)—Medium-specific concentration level for a chemical derived using conservative criteria below which it is generally assumed that there is no potential for unacceptable *risk* to human health. The derivation of a SAL is based on conservative exposure and land-use assumptions. However, if an applicable regulatory standard exists that is less than the value derived by risk-based computations; it will be used as the SAL.

Sediment—(1) A mass of fragmented inorganic solid that comes from the weathering of rock and is carried or dropped by air, water, gravity, or ice; or a mass that is accumulated by any other natural agent and that forms in layers on the earth’s surface such as sand, gravel, silt, mud, fill, or loess. (2) A solid material that is not in solution and either is distributed through the liquid or has settled out of the liquid.

Soil screening level (SSL)—Medium-specific concentration level for a chemical corresponding to a human health carcinogenic risk level of one-in-one hundred thousand (1E-05) or a noncarcinogenic hazard quotient of 1. SSLs are derived for residential and industrial land use scenarios using conservative default exposure parameters.

Standard operating procedure (SOP)—A document that details the method for an operation, *analysis*, or action with thoroughly prescribed techniques and steps, and is officially approved as the method for performing certain routine or repetitive tasks.

Target analyte—An element, chemical, or parameter, the concentration, mass, or magnitude of which is designed to be quantified by use of a particular test method.

Technical area (TA)—The Laboratory established technical areas as administrative units for all its operations.

Topography—The physical configuration of the land surface in an area.

Tuff—A compacted deposit of volcanic ash and dust that contains rock and mineral fragments accumulated during an eruption.

US Department of Energy (DOE)—Federal agency that sponsors energy research and regulates nuclear materials for weapons production. [Already listed under DOE]

US Environmental Protection Agency (EPA)—Federal agency responsible for enforcing environmental laws. While state regulatory agencies may be authorized to administer some of this responsibility, the EPA retains oversight authority to ensure protection of human health and the environment. [Already listed under EPA]

Vadose zone—The unsaturated zone. Portion of the subsurface above the water table in which pores are not fully saturated.

Metric to English Conversions

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

Appendix B

Management Plan for Investigation-Derived Waste

This appendix describes how investigation-derived waste (IDW) generated during the investigation of Material Disposal Area (MDA) A at Los Alamos National Laboratory (LANL or the Laboratory) will be managed. IDW is waste generated by field-investigation activities and it may include, but is not limited to, drill cuttings; purge water; contaminated personal protective equipment (PPE), sampling supplies, and plastic; fluids from the decontamination of PPE and sampling equipment; and all other waste potentially contacting contaminants.

Certain field-investigation activities may also displace environmental media, which are defined as naturally occurring materials indigenous to the environment, including groundwater, surface water, surface and subsurface soil, rock, bedrock, and gravel. In most cases, environmental media are not subject to Resource Conservation and Recovery Act (RCRA) regulation because they do not meet the definition of solid waste (i.e., they are not discarded, abandoned, recycled, or inherently waste-like). According to the US Environmental Protection Agency (EPA) area of contamination (AOC) policy, environmental media are not considered to be waste (and, hence, not IDW) if they are returned to their points of origin (EPA 1996, 82288). EPA AOC guidance indicates that moving hazardous waste from an AOC into a drum, followed by replacing it in the AOC, does not constitute "land disposal" for RCRA purposes (Wehling 1991, 87382). Therefore, nonhazardous media will be returned to their points of origin. The Laboratory does not expect any of the environmental media or IDW generated under this investigation to be characterized as hazardous waste. IDW generated during the investigation of MDA A will be managed in a manner that protects human health and the environment, complies with applicable regulatory requirements, and adheres to the Laboratory waste-minimization goals.

All IDW generated during the MDA A field-investigation activities will also be managed in accordance with applicable Environmental Stewardship–Remediation Services (ENV-RS) standard operating procedures (SOPs). These SOPs incorporate the requirements of all applicable EPA and New Mexico Environment Department (NMED) regulations, Department of Energy (DOE) orders, and Laboratory Implementation Requirements (LIRs). The ENV-RS SOPs applicable to the characterization and management of IDW are

- SOP-01.06, Management of Environmental Restoration Project Waste, and
- SOP-01.10, Waste Characterization.

These SOPs are among the SOPs applicable to the investigation at MDA A and are available at http://erproject.lanl.gov/documents/procedures.html.

Investigation activities will be conducted in a manner that minimizes the generation of waste. Waste minimization will be accomplished by implementing the requirements of the ENV-RS portion of the "2003 Pollution Prevention Roadmap" (LANL 2003, 85205). The roadmap is updated annually to meet a requirement of Module VIII of the Laboratory's Hazardous Waste Facility Permit, which was issued by the EPA on May 23, 1990, and modified on May 19, 1994 (EPA 1990, 01585; EPA 1994, 44146).

The waste streams that will be generated and managed during the field investigation at MDA A are described below.

Drill cuttings. The drill cuttings waste stream will consist of cuttings from boreholes that will be drilled and instrumented for vapor monitoring at MDA A. Drill cuttings will be collected and placed in containers at the point of generation (i.e., at the drill rig). The drill cuttings waste stream will be characterized using analytical results from core samples which will be augmented by direct sampling of the containerized waste, if needed. Contaminants of concern are expected to include radionuclides and possibly inorganic metals and volatile organic compounds. The maximum detected concentrations of radionuclides will be compared with background/fallout values. If maximum concentrations are above background/fallout values, the waste cuttings will be designated as low-level radioactive waste. Maximum concentrations of toxicity characteristic leaching procedure (TCLP) constituents will be compared with 20 times the TCLP regulatory limit. If concentrations are less than 20 times the regulatory limit, the waste cuttings will be designated nonhazardous by characteristic. If concentrations exceed 20 times the regulatory limit, the waste will be sampled and analyzed using the TCLP to determine if it is hazardous by characteristic. If listed waste constituents are detected in tuff samples, the maximum concentrations will be compared to NMED soil screening levels (SSLs) (NMED 2004, 85615). If concentrations are less than SSLs, a "no-longer-contained-in" determination will be requested from NMED. If concentrations exceed SSLs, the wastes will be designated as listed hazardous waste. Based on the results of previous investigations, the Laboratory expects these wastes to be designated as nonhazardous waste that will either be used for cover material at Technical Area (TA) 54 or be disposed of at the Waste Management Landfill in Rio Rancho, New Mexico.

Spent PPE. The spent PPE waste stream will consist of PPE that has "contacted" contaminated environmental media (e.g., core and/or drill cuttings) and cannot be decontaminated. The bulk of this waste stream will consist of protective clothing such as coveralls, gloves, shoe covers, and (if required) respirator cartridges. Spent PPE will be collected in containers at personnel decontamination stations. Characterization of this waste stream will be performed through acceptable knowledge (AK) of the waste materials, the methods of generation, and the levels of contamination observed in the environmental media. The Laboratory expects these wastes to be designated as nonhazardous waste that will be disposed of at the Waste Management Landfill in Rio Rancho, New Mexico.

Disposable sampling supplies. The disposable sampling supplies waste stream will consist of all equipment and materials needed for collection of samples that come into direct contact with contaminated environmental media and cannot be decontaminated. This waste stream also includes wastes associated with dry decontamination activities. This waste stream will consist primarily of paper and plastic items collected in bags at the sampling location and transferred to accumulation drums. Characterization of this waste stream will be performed through AK of the waste materials, the methods of generation, and the levels of contamination observed in the environmental media. The Laboratory expects these wastes to be designated as nonhazardous waste which will be disposed of at the Waste Management Landfill in Rio Rancho, New Mexico.

Decontamination fluids. The decontamination fluids waste stream will consist of liquid wastes from decontamination activities (e.g., decontamination solutions and rinse waters). Following waste-minimization practices, the Laboratory employs dry decontamination methods to the extent possible. If dry decontamination cannot be performed, liquid decontamination wastes will be collected in containers at the point of generation and transferred to accumulation drums. If less than 6 gal. of decontamination fluids are generated per day and these are determined to be nonhazardous, they may be disposed of by discharge to the ground in accordance with an existing notice of intent (NOI) for discharge to groundwater approved by the NMED Ground Water Quality Bureau (LANL 1996, 87472). Otherwise, the decontamination fluids waste stream will be accumulated in drums and characterized using analytical results from direct sampling of the containerized waste. The Laboratory expects that these wastes would be designated as nonhazardous liquid waste that would be sent to the Radioactive Liquid Waste Treatment Facility at TA-50 for disposal.

All wastes will be managed in accordance with applicable federal, state, DOE, and Laboratory requirements. Waste streams, expected waste types, estimated waste volumes, and other data are listed in Table B-1.

All waste drums will remain on-site until analytical results have been received and a waste characterization has been conducted. Drill cuttings and other IDW will be managed as low-level waste in a radioactive waste storage area within the AOC boundary, due to the possible presence of radionuclides in the waste streams.

Prior to the start of field-investigation activities, a waste characterization strategy form (WCSF) will be prepared and approved per the requirements in the current revision of SOP-01.10. The WCSF will provide detailed information about IDW characterization, management, containerization, and potential volume generation.

IDW characterization will be achieved through existing data and/or documentation, direct sampling of the IDW, or sampling of the media being investigated (e.g., surface soil, subsurface soil, etc.). If sampling is necessary, it will be described in a sampling and analysis plan that will be developed in conjunction with the WCSF.

Some wastes will be characterized on the basis of AK rather than direct waste analysis. AK will consist of the results of analyzing the environmental media associated with each waste stream. For example, spent PPE and disposable sampling supplies that have potentially come in contact with contaminated media will be characterized by the results of analyzing that media. Similarly, borehole cuttings will be characterized by the analytical results of the core samples from that borehole. If decontamination fluids are to be sent off-site for disposal, they will be sampled to demonstrate compliance with the waste acceptance criteria of the receiving facility. Otherwise, quantities less than 6 gal. per day of decontamination fluid can be discharged to the ground in accordance with the existing NOI.

The selection of waste containers will be based on the appropriate Department of Transportation (DOT) requirements, and on the type and amount of IDW that is planned to be generated. Immediately following containerization, each waste container will be individually labeled as to the waste classification, item identification number, radioactivity (if applicable), and date of generation. Waste containers will be managed in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on IDW type and classification. Container and storage requirements will be detailed in the WCSF, based on requirements outlined in the most recent versions of LIR 404-00-03, Hazardous and Mixed Waste Requirements; LIR 404-00-04, Managing Solid Waste; LIR 404-00-05, Managing Radioactive Waste; and LIR 405-10-01, Packaging and Transportation. Prior to waste generation, the WCSF will be approved by the process detailed in SOP-01.10, Waste Characterization.

Transportation of IDW will comply with appropriate DOT requirements. Depending upon waste classification, disposal of solid IDW will take place either on-site at TA-54 Area G or at an approved off-site disposal facility. Liquid IDW may be processed at the TA-50 Radioactive Liquid Waste Treatment Facility or at the TA-46 Sanitary Wastewater Systems Plant. Hazardous and/or mixed waste may be transported to, and stored at, TA-54 Area L prior to off-site disposal. Transportation and disposal requirements will be detailed in the WCSF and approved prior to the generation of waste.

Table B-1
Summary of Estimated IDW Generation and Management

Waste Stream	Expected Waste Type	Estimated Volume	Characterization Method	On-Site Management	Expected Disposition
Drill cuttings*	Solid, low-level waste (LLW)	25 yd^3	Analytical results from waste samples	55-gal. drums, covered roll-off containers, or cubic-yard soft-sided containers	LANL, TA-54, Area G
Spent PPE and disposable sampling supplies	Solid, LLW	9 yd^3	AK	Accumulation in 55-gal. drums	LANL, TA-54, Area G
Decontamination fluids (< 6 gal./day)	Liquid, LLW	< 6 gal./day	AK	Discharge to ground	Discharge to ground
Decontamination fluids (> 6 gal./day)	Liquid, LLW	300 gal.	Analytical results from waste samples	Accumulation in 55-gal. drums	LANL, TA-50, Radioactive Liquid Waste Treatment Facility

*Estimated *total* volume of cuttings expected to be generated.