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Investigation Work Plan for South Ancho Canyon Aggregate Area

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Responsible project manager:

Printed Name	Signature	Title	Organization	Date
Kent Rich	[signature]	Project Manager	Environmental Remediation Program	7/17/15

Responsible LANS representative:

Printed Name	Signature	Title	Organization	Date
Randall Erickson	[signature] for R. Erickson	Acting Associate Director	Environmental Programs	7/21/15

Responsible DOE representative:

Printed Name	Signature	Title	Organization	Date
Christine Gelles	[signature] for	Acting Manager	DOE-EM-LA	8-4-2015

EXECUTIVE SUMMARY

The South Ancho Canyon Aggregate Area, located in Technical Area 33 at Los Alamos National Laboratory, includes a total of 11 solid waste management units (SWMUs) and 1 area of concern (AOC). Of these 12 sites, 1 site has been approved for no further action. This investigation work plan identifies and describes the activities needed to complete the investigation of the remaining 11 SWMUs and AOC. Details of previous investigations and analytical results for the 11 sites included in this work plan are provided in the historical investigation report for the South Ancho Canyon Aggregate Area.

The objective of this investigation work plan is to evaluate the historical data and, based on that evaluation, propose sampling to define the nature and extent of contamination associated with the sites within the South Ancho Canyon Aggregate Area.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the U.S. Department of Energy (DOE) and managed by Los Alamos National Security, LLC. The Laboratory is located in north-central New Mexico approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 36 mi^2 of the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft above mean sea level (amsl). The location of South Ancho Canyon Aggregate Area with respect to the Laboratory technical areas (TAs) is shown in Figure 1.0-1.

The Laboratory is participating in a national effort by DOE to reduce risk to human health and the environment at its facilities. The goal of the Laboratory effort is to ensure that past operations do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, the Laboratory is currently investigating sites potentially contaminated by past Laboratory operations. The sites under investigation are designated as solid waste management units (SWMUs) and areas of concern (AOCs).

The SWMUs and AOC (the sites) addressed in this investigation work plan are potentially contaminated with hazardous and radioactive components. The New Mexico Environment Department (NMED), pursuant to the New Mexico Hazardous Waste Act, regulates cleanup of hazardous wastes and hazardous constituents. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 458.1, Administrative Change 3, Radiation Protection of the Public and the Environment, and DOE Order 435.1, Radioactive Waste Management. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with DOE policy.

Corrective actions at the Laboratory are subject to a Compliance Order on Consent (the Consent Order). This investigation work plan describes work activities that will be executed and completed in accordance with the Consent Order.

1.1 Work Plan Overview

The South Ancho Canyon Aggregate Area includes 11 SWMUs and 1 AOC located at East Site in TA-33 (Plate 1). Of the 12 sites, nine have been previously investigated and 11 require additional characterization. One site has been approved for no further action (NFA) status (NFA-approval documents are referenced in Table 1.1-1); and is not discussed further in the work plan. Historical details of previous investigations and data for these sites are provided in the historical investigation report (HIR) for South Ancho Canyon Aggregate Area (LANL 2015, 600530). This work plan addresses the 11 sites using the information from previous field investigation or corrective actions to evaluate current conditions at each site.

Section 2 of this investigation work plan presents the general site information, operational history, the preliminary conceptual site model, and a data overview. General site conditions at TA-33 are presented in section 3. Section 4 presents summaries of previous investigations and data collected and describes the scope of proposed investigation activities for each site. Section 5 presents investigation methods for proposed field activities. Ongoing monitoring and sampling programs in the South Ancho Canyon Aggregate Area are presented in section 6. Section 7 is an overview of the anticipated schedule of the investigation and reporting activities. The references cited in this work plan and the map data sources are provided in section 8. Appendix A of this work plan includes a list of acronyms and abbreviations, a metric conversion table, and the data qualifier definitions table. Appendix B describes the investigation-derived waste (IDW) management plan.

1.2 Work Plan Objectives

The objective of the investigation activities described in this work plan is to finalize the nature and extent of contamination at the 11 sites.

To help accomplish this objective, this work plan

- presents historical and background information on the sites,
- describes the rationale for proposed data collection activities, and
- identifies and proposes appropriate methods and protocols for collecting and analyzing data to characterize these sites.

2.0 BACKGROUND

2.1 General Site Information

TA-33 is located in the southeastern portion of the Laboratory and is bounded by Bandelier National Monument to the west, Santa Fe National Forest to the south, TA-70 to the north east, and TA-39 to the north. South Ancho Canyon Aggregate Area is situated on top of a mesa that drains to Ancho Canyon (to the north) and White Rock Canyon (to the east and south).

Five sites comprise TA-33: a laboratory and office complex near the entrance at NM 4 (Main Site); a western firing site (Area 6); a southern firing site (South Site); an eastern firing site (East Site); and the current site of the National Radio Astronomy Observatory (NRAO) antenna (Plate 1). Three material disposal areas (MDAs) are located at TA-33: MDA D at East Site, MDA E at South Site and MDA K at Main Site. In addition, several storage bunkers are located at TA-33. The sites addressed in this investigation work plan are located at East Site within TA-33.

2.2 Operational History

TA-33 was created in 1947 as a test site for weapons experiments using conventional high explosives (HE) and uranium, beryllium, and polonium radiation sources. It was used as a substitute test site for weapons components experiments being conducted at Trinity Site in southern New Mexico. The tests were conducted primarily to verify the design of nuclear weapons' components called initiators. The experiments were performed in underground chambers, on surface firing pads, and at firing sites equipped with large guns that fired projectiles into catcher boxes and berms. These activities ceased in 1972. A high-pressure tritium facility operated at TA-33 Main Site from 1955 to late 1990. Current activities are centered primarily at Main Site with laboratory groups occupying portions of the office buildings. Other small buildings and surface areas are also used. The NRAO Very Long Baseline Array radiotelescope antenna was sited at TA-33 in 1985 and is still operational (LANL 1992, 007671).

At East Site, firing sites were operational between 1948 and 1972. The area was equipped with guns of various sizes that fired nonexploding projectiles containing experimental apparatus into berms and catcher boxes. The equipment and most structures have been removed and the area is no longer in use.

2.3 Conceptual Site Model

The sampling proposed in this investigation work plan uses a conceptual site model to predict areas of potential contamination and allow for adequate characterization of these areas. A conceptual site model describes potential contaminant sources, transport mechanisms, and receptors.

2.3.1 Potential Contaminant Sources

Releases at sites within South Ancho Canyon Aggregate Area may have occurred as results of normal site operations or potential spills/leaks. Previous sampling results, provided in the HIR (LANL 2015, 600530) indicate contamination from inorganic chemicals, organic chemicals, and radionuclides. Additional sampling is needed to determine the nature and extent of contamination.

Potential contaminant sources associated with TA-33 include firing sites, former shot chambers, septic system, drainline and outfall, landfill, former transformer, and surface disposal areas.

2.3.2 Potential Contaminant Transport Mechanisms

Current potential transport mechanisms that may lead to exposure include

- airborne transport of contaminated surface soil,
- dissolution and/or particulate transport of surface contaminants during precipitation and runoff events,
- disturbance of contaminants in shallow soil and subsurface tuff by Laboratory operations,
- continued dissolution and advective/dispersive transport of chemical contaminants contained in subsurface soil and tuff as a result of past operations, and
- disturbance and uptake of contaminants in shallow soil by plants and animals.

2.3.2.1 Surface Processes

Laboratory operations, disturbance and uptake by plants and animals, surface water runoff, and wind can disturb contaminants present in shallow soils. During summer thunderstorms and spring snowmelt, runoff from the mesa top may flow down the hillsides and into the perennial and ephemeral streams present in Ancho and White Rock Canyons. Surface water runoff and erosion of contaminated surface soil could lead to contamination of bench areas on the hillside and contamination of the surface water off-site. Surface water may also access subsurface contaminants exposed by soil erosion. Soil erosion can vary significantly depending on factors that include soil properties, the amount of vegetative cover, the slope of the contaminated area, and the intensity and frequency of precipitation. Surface transport of contaminants represents the dominant transport pathway in the South Ancho Canyon Aggregate Area.

2.3.2.2 Subsurface Processes

Studies have shown that infiltration of natural precipitation is quite low across the mesa tops of the Pajarito Plateau. The average annual potential evapotranspiration rates far exceed precipitation rates. Under these conditions, infiltration events that propagate beneath the root zone are sporadic and occur only when the short-term infiltration rate exceeds the evapotranspiration rate, such as during summer thunderstorms and spring snowmelt. However, these events more commonly produce runoff into neighboring canyons resulting in infiltration rates below the root zone on the order of a few millimeters or less per year for mesa-top sites (Collins et al. 2005, 092028, pp. 2-84−2-88; Kwicklis et al. 2005, 090069).

This slow infiltration rate generally leads to present-day subsurface contaminant migration of only a few meters deep. Geochemical interactions between the contaminants and the rocks generally act to retard migration further. Therefore, groundwater transport of contaminants through the unsaturated zone to the regional aquifer does not represent a dominant pathway for contaminant transport in the South Ancho Canyon Aggregate Area.

2.3.3 Potential Receptors and Pathways

The potential human receptors of contaminants are on-site Laboratory workers who could potentially be exposed to contaminants in soil, tuff, and sediment by direct contact, ingestion, or inhalation. Ecological receptors, such as plants and animals, may also be exposed to soil and sediment contaminants.

The current and reasonably foreseeable future land use at TA-33 is industrial. No residential or recreational land use currently exists or is expected to occur at any of the sites in the foreseeable future.

2.3.4 Cleanup Standards

As specified in section VIII.B.1 of the Consent Order, NMED soil screening levels (SSL) (NMED 2009, 108070) or Laboratory screening action levels (LANL 2009, 107655) will be used as soil cleanup levels unless they are determined to be impractical (details of the process are outlined in the Consent Order, Section VIII.E, Requests for Variance from Cleanup Goal or Cleanup Level) or unless SSLs do not exist for the current and reasonably foreseeable future land use (i.e., neither NMED nor the U.S. Environmental Protection Agency [EPA] has determined SSLs for some analytes under some land use scenarios). If NMED SSLs do not exist, EPA regional screening values will be used (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

2.4 Data Overview

The data from these sites are approximately 20 yr old and are therefore considered screening-level data. Screening-level data are appropriate for applications that require only determination of gross contamination areas and/or for site characterization. Screening-level data are also often used to specify areas where additional data should be collected. Screening-level data are presented in the South Ancho Canyon Aggregate Area HIR (LANL 2015, 600530).

3.0 SITE CONDITIONS

3.1 Surface Conditions

The SWMUs and AOC that comprise the South Ancho Canyon Aggregate Area cover much of the mesa top at TA-33 East Site and a relatively small portion of the adjacent upper canyon slopes and cliffs to the southwest, southeast, and north. The mesa top is surrounded by deep canyons on three sides; Ancho Canyon to the north and White Rock Canyon to the east and south.

TA-33 covers about 3.8 mi^2 and ranges in elevation from 5400 to 6600 ft amsl. A number of canyons dissect the area, including Ancho Canyon, White Rock Canyon, and Chaquehui Canyons. All the TA-33 facilities are located on the mesa top between Ancho and Chaquehui Canyons. Most, if not all of the disturbances associated with TA-33 activities (site development, open-air explosions, and disposal), have been on this mesa top. Topographically, the area consists of the alluvial floodplains, hill slopes, canyon walls, and mesa tops with intermittent streams in the canyon bottoms.

Much of the unpaved areas are overgrown with invasive shrubs. The most common of these is chamisa. A few specimens of mountain mahogany, four-wing saltbush, Apache plume, and wavyleaf oak are also found. Some disturbed areas have only a thin soil layer. The dominant shrub in these areas is snakeweed with some stands of false tarragon. The invasive grass, hidden dropseed, grows on portions of these poorer areas (LANL 1992, 007671, p. 2-11).

3.1.1 Soil

Soil on the Pajarito Plateau was initially mapped and described by Nyhan et al. (1978, 005702). The soil on the slopes between the mesa tops and canyon floors was mapped as mostly steep rock outcrops consisting of approximately 90% bedrock outcrop and patches of shallow, weakly developed colluvial soil. South-facing canyon walls generally are steep and usually have shallow soil in limited, isolated patches between rock outcrops. In contrast, the north-facing canyon walls generally have more extensive areas of shallow, dark-colored soil under thicker forest vegetation. The canyon floors generally contain poorly developed, deep, well-drained soil on floodplain terraces or small alluvial fans (Nyhan et al. 1978, 005702).

A majority of the natural mesa-top surface soil has been altered by anthropogenic activities. Excavation and fill, paved roads, parking lots, landscaped areas, and buildings have changed the natural soil landscape considerably. Soil at East Site are classified as Mesic Rock outcrop land type, containing 65% rock outcrop, 5% undeveloped soil, 5% Hackroy soil, and 25% narrow escarpments (Nyhan et al. 1978, 005702). Most of East Site has been scraped to bedrock to supply material for the berms (LANL 1995, 051903, p. 11).

3.1.2 Surface Water

No natural surface water is present on the mesa top at East Site. During summer thunderstorms and spring snowmelt, runoff flows from the mesa top down the hillsides and into Ancho Canyon to the north and White Rock Canyon to the east and south. Ancho Spring supports perennial surface flow to the Rio Grande. There is no persistent surface water on the east- and south-facing slopes of White Rock Canyon except where regional groundwater emerges at springs near the Rio Grande

3.1.3 Land Use

Currently, land use within the South Ancho Canyon Aggregate Area is industrial. It is anticipated the area will remain industrial through continued use by the Laboratory and will not change in the foreseeable future. Public access to TA-33 is prohibited and is controlled through physical controls, including fencing, and limited access via guard stations.

3.2 Subsurface Conditions

3.2.1 Stratigraphic Units

The stratigraphy of the South Ancho Canyon Aggregate Area is summarized in this section. Stratigraphic units include, in descending order, Tshirege Member of the Bandelier Tuff, volcanic rocks of the Cerros del Rio volcanic field, Puye Formation (including the Totavi Lentil), and the Chamita Formation of the Santa Fe Group. Unit descriptions are based on information provided on the geologic map for the White Rock Canyon 7.5 minute quadrangle (Dethier and Koning 2007, 111612), These descriptions are supplemented by stratigraphic observations in intermediate characterization wells 33-1230, 33-1231, and 33-1232 (LANL 1995, 050113) located 1.2 mi to the west-northwest at the TA-33 Main Site and in regional monitoring well R-31 (Vaniman et al. 2002, 072615) located 2.2 mi to the northwest at TA-39.

Additional information on the geologic setting of this and surrounding areas is provided by Reneau et al. (1995, 054405; Collins et al. 2005, 092028).

3.2.1.1 The Tshirege Member of the Bandelier Tuff

The Tshirege Member is the upper member of the Bandelier Tuff and is the most widely exposed bedrock unit of the Pajarito Plateau (Griggs and Hem 1964, 092516; Smith and Bailey 1966, 021584; Bailey et al. 1969, 021498; Smith et al. 1970, 009752). Emplacement of this unit occurred during eruptions of the Valles Caldera approximately 1.2 million years ago (Izett and Obradovich 1994, 048817; Spell et al. 1996, 055542). The Tshirege Member is a multiple-flow ignimbrite sheet that forms the mesa-top exposures at East Site. On a regional basis, the Tshirege Member consists of at least four cooling subunits that display variable physical properties vertically and horizontally (Smith and Bailey 1966, 021584; Crowe et al. 1978, 005720; Broxton et al. 1995, 050121). The welding and crystallization variability in the Tshirege Member produce recognizable vertical variations in its properties, such as density, porosity, hardness, composition, color, and surface-weathering patterns.

Two of the four Tshirege subunits are present at East Site. Subunit Qbt 2 is a competent tuff that forms the caprock of East Site. Where exposed, unit 2 forms a medium-brown vertical cliff that stands out in marked contrast to the slope-forming lighter-colored tuffs below. It is a moderately welded ignimbrite composed of crystal-rich, devitrified pumice fragments in a matrix of ash, shards, and phenocrysts (primarily sanidine and quartz). Vapor-phase crystallization of shards and pumices is extensive in this unit. Qbt 2 overlies porous, nonwelded, and slope-forming tuffs of Qbt 1. Qbt 1 is further subdivided into upper devitrified and vapor-phase altered tuffs (Qbt 1v) and lower vitric tuffs (Qbt 1g). Together, subunits Qbt 2 and Qbt 1 are approximately 190 ft thick.

East Site is located on the eastern upper flank of a buried cinder cone that is exposed west of the main facilities at TA-33. This constructional volcanic feature stood high above the pre-Bandelier landscape and was only partially buried by the Tshirege Member. The Otowi Member was not deposited on the upper slopes of the cinder cone at TA-33 but is 260 ft thick at well R-31.

3.2.1.2 Volcanic Rocks of the Cerros del Rio Volcanic Field

Volcanic rocks of the Cerros del Rio volcanic field include mafic lava flows, cinder deposits, and phreatomagmatic deposits. At East Site, tholeiite and trachyandesite lava flows form prominent cliffs in the upper parts of White Rock and Ancho Canyons. The lava flows overlie a thick sequence of phreatomagmatic rocks made up of bedded to massive fall, surge, and flow deposits composed of basaltic tuff and cinders (Dethier and Koning 2007, 111612). Cerros del Rio deposits generally overlies the Puye Formation, but the two units interfinger locally. In the vicinity of East Site, Cerros del Rio volcanic rocks are 430 ft to greater than 880 ft thick, reflecting the complex paleotopography on which this unit was deposited.

3.2.1.3 Puye Formation

Outcrops of the Puye Formation are exposed in lower Ancho Canyon north of East Site. The Totavi Lentil, an ancestral Rio Grande riverine deposit, makes up the upper Puye Formation. The Totavi Lentil consists of poorly consolidated conglomerate containing well-rounded cobbles and gravels of Precambrian quartzite, granite, and pegmatite with subrounded to subangular cobbles and boulders of silicic, intermediate, and basaltic volcanic rocks. Precambrian clasts commonly make up greater than 60% of the clasts in the deposits. These deposits also contain subordinate subangular to subrounded clasts of volcanic rocks from the Jemez volcanic field. Loose, well-sorted, fine to coarse, quartz and microcline sands occur as lenses within the conglomerate. Totavi deposits are 60 to 100 ft thick in Ancho Canyon. The Totavi Lentil overlies fanglomerate deposits of the Puye Formation. The fanglomerate is made up of weakly lithified pebble to boulder gravel, boulder-rich debris flows, massive to well-bedded sand, thin beds of dacitic tephra and pumiceous alluvium, and beds of fine sand and silt. Clasts and matrix in the fanglomerate are composed mostly of dacite derived from the Tschicoma Formation of the Jemez Mountains. Fanglomerate deposits are 20 to 100 ft thick in Ancho Canyon.

3.2.1.4 Chamita Formation, Santa Fe Group

The Chamita Formation of the Santa Fe Group is the oldest rock unit exposed in White Rock Canyon near East Site. The Chamita Formation is composed of fluvial sediments deposited on the basin-floor of the Rio Grande rift. The fluvial deposits consist of weakly cemented sandy-gravelly channel fills intercalated with floodplain deposits of clay, silt, very fine- to fine-grained sand, and silty fine sand. Dethier and Koning (2007, 111612) assign these fluvial sediments to the Vallito Member of the Chamita Formation.

3.2.2 Hydrogeology

The hydrogeology of the Pajarito Plateau is separable in terms of mesas and canyons forming the plateau. Mesas are generally devoid of water, 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. Intermediate-perched groundwater has been found at certain locations at depths ranging between 100 and 700 ft below ground surface (bgs). The regional aquifer is found at depths of about 600 to 1200 ft bgs.

The hydrogeologic conceptual site model for the Laboratory (Collins et al. 2005, 092028) shows that, under natural conditions, relatively small volumes of water move beneath mesa tops because of low rainfall, high evaporation, and efficient water use by vegetation. Atmospheric evaporation may extend into mesas, further inhibiting downward flow.

In the Los Alamos area, groundwater occurs as (1) water in shallow alluvium in some of the larger canyons, (2) an intermediate-perched groundwater body, which lies above a less permeable layer and is separated from the underlying aquifer by an unsaturated zone, and (3) the regional aquifer.

Contamination of the perched water and/or regional groundwater aquifer can only occur by recharge of infiltrating precipitation from contamination at or near the surface to the underlying groundwater. The hydrogeologic conceptual site model for the Laboratory (Collins et al. 2005, 092028) shows that, under natural conditions, relatively small volumes of water move beneath mesa tops because of low rainfall, high evaporation, and efficient water use by vegetation. Atmospheric evaporation may extend into mesas, further inhibiting downward flow.

Vadose Zone

The unsaturated zone from the mesa surface to the top of the regional aquifer is referred to as the vadose zone. The source of moisture for the vadose zone is precipitation, but much of it runs off, evaporates, or is absorbed by plants. The subsurface vertical movement of water is influenced by properties and conditions of the materials that make up the vadose zone.

The Bandelier Tuff is generally dry and does not readily transmit moisture. Most of the pore spaces in the tuff are of capillary size and have a strong tendency to hold water against gravity by surface-tension forces. Vegetation is very effective at removing moisture near the surface. During the summer rainy season when rainfall is highest, near-surface moisture content is variable because of higher rates of evaporation and of transpiration by vegetation, which flourishes during this time.

The various units of the Bandelier Tuff tend to have relatively high porosities. Porosity ranges between 30% and 60% by volume, generally decreasing for more highly welded tuff. Permeability varies for each cooling unit of the Bandelier Tuff. The moisture content of tuff beneath the mesa tops is low, generally less than 5% by volume throughout the profile (Kearl et al. 1986, 015368; Purtymun and Stoker 1990, 007508).

Based on the hydrogeologic conceptual model for mesas (Collins et al. 2005, 092028), moisture movement through the vadose zone in the South Ancho Canyon Aggregate Area is expected to be very slow because of low precipitation, the lack of surface water on the mesa top (including artificial water sources such as ponds), and the drying effect of air exchange along mesa edges. Net infiltration beneath dry mesas is low, with rates generally believed to be less than tens of millimeters per year and commonly on the order of 1 mm/yr or less. Transport times to the regional aquifer beneath dry canyons are expected to exceed hundreds of years (Birdsell et al. 2005, 092048).

Alluvial Groundwater

Intermittent and ephemeral stream flows in the canyons of the Pajarito Plateau have deposited alluvium as thick as 100 ft. The alluvium in canyons that originate from the Jemez Mountains is generally composed of sands, gravels, pebbles, cobbles, and boulders derived from the Tschicoma Formation and Bandelier Tuff on the flank of the mountains. The alluvium in canyons that originate from the plateau (such as Ancho Canyon) is comparatively more finely grained, consisting of clays, silts, sands, and gravels derived from the Bandelier Tuff (LANL 1998, 059599, p. 2-17).

In contrast to the underlying volcanic tuff and sediment, alluvium is relatively permeable. Ephemeral runoff in some canyons infiltrates the alluvium until downward movement is impeded by the less permeable tuff and sediment, which results in the buildup of a shallow alluvial groundwater body (Collins et al. 2005, 092028, p. 2-90). Depletion by evapotranspiration and movement into the underlying rock limit the horizontal and vertical extent of the alluvial water (Purtymun et al. 1977, 011846). The limited saturated thickness and extent of the alluvial groundwater preclude its use as a viable source of water for municipal and industrial needs. Lateral flow of the alluvial perched groundwater is in an easterly, downcanyon direction (Purtymun et al. 1977, 011846).

There is no alluvial groundwater in the South Ancho Canyon Aggregate Area. The site is located on a narrow, isolated mesa 600 to 800 ft above Ancho Canyon and 1000 ft above the Rio Grande in White Rock Canyon. The mesa lacks well-defined drainages and surface-water flow is ephemeral, occurring as overland runoff, primarily following infrequent, intense thunderstorms or during snowmelt.

Intermediate-Perched Water

Identification of perched groundwater systems beneath the Pajarito Plateau comes mostly from direct observation of saturation in boreholes, wells, or piezometers or from borehole geophysics. Perched groundwater is widely distributed across the northern and central part of the Pajarito Plateau with depth-to-water ranging from 118 to 894 ft bgs. The principal occurrences of perched groundwater occur in (1) the relatively wet Los Alamos and Pueblo Canyon watersheds, (2) the smaller watersheds of Sandia and Mortandad Canyons that receive significant volumes of treated effluent from Laboratory operations, and (3) in the Cañon de Valle area in the southwestern part of the Laboratory. Perched water is most often found in Puye fanglomerates, Cerros del Rio basalt, and in units of Bandelier Tuff. Based on a few reported occurrences in the southern part of the Laboratory, a few deep boreholes are located in that area. Additional perched zones probably occur beneath the adjacent watersheds of Pajarito and Water Canyons (Collins et al. 2005, 092028, pp. 2-96–2-97).

There is no evidence to indicate that perched groundwater is present beneath East Site.

Regional Aquifer

The regional aquifer of the Los Alamos area is the only aquifer capable of large-scale municipal water supply (Purtymun 1984, 006513). The surface of the regional aquifer rises westward from the Rio Grande within the Santa Fe Group into the lower part of the Puye Formation beneath the central and western part of the Pajarito Plateau. The depths to groundwater below the mesa tops range between about 1200 ft along the western margin of the plateau and about 600 ft at the eastern margin. The locations of wells and generalized water-level contours on top of the regional aquifer are described in the 2009 General Facility Information report (LANL 2009, 105632). The regional aquifer is typically separated from the alluvial groundwater and intermediate-perched zone groundwater by 350 to 620 ft of tuff, basalt, and sediments (LANL 1993, 023249).

Groundwater in the regional aquifer flows east-southeast toward the Rio Grande. The velocity of groundwater flow ranges from about 20 to 250 ft/yr (LANL 1998, 058841, p. 2-7). Details of depths to the regional aquifer, flow directions and rates, and well locations are presented in various Laboratory documents (Purtymun 1995, 045344; LANL 1997, 055622; LANL 2000, 066802). Groundwater monitoring is conducted under annual updates to the Interim Facility-Wide Groundwater Monitoring Plan (LANL 2014, 256728).

Springs in White Rock Canyon near the Rio Grande in Ancho Canyon are perennial and are discharge points of the regional aquifer. Flows from Ancho Spring in Ancho Canyon regularly reach the Rio Grande. Based on the elevation of Ancho Spring, the regional aquifer lies approximately 650 ft below the South Ancho Canyon Aggregate Area.

4.0 SITE DESCRIPTION AND PROPOSED INVESTIGATION ACTIVITIES

The following section present site descriptions, summaries of previous investigation activities, proposed sampling activities, and proposed remedial activities for each SWMU and AOC. A variety of resources was used to define and revise the boundaries of each site, shown on the related figures. Existing structures, roads, and other features that could readily be observed in the field were of prime importance. If these conditions could still be observed in the field, site boundaries were then established relative to these landmarks. Other types of data references were also used, particularly for former site locations where significant changes have occurred over time. Historic aerial photographs have been an excellent resource. Drawings and sketches were used, particularly for structures and utilities, as well as engineering drawings produced for construction or record purposes. For each site, available information was reviewed, conflicts resolved as satisfactorily as possible, and site locations and boundaries revised accordingly.

4.1 SWMUs 33-003(a), Soil Contamination

4.1.1 Site Description

MDA D consists of SWMUs 33-003(a) and 33-003(b). Both SWMUs are former underground chambers that were used to conduct experiments involving radioactive materials and HE. MDA D is located at the east end of TA-33 (East Site) on a mesa bordered by Ancho and White Rock Canyons.

SWMU 33-003(a) consists of a former underground chamber, designated chamber 1 (structure 33-4), and its associated underground elevator shaft (Figure 4.1-1). The chamber and shaft were constructed to perform experiments on initiators. Construction was completed in January 1948. The octagonal chamber was 18 ft in diameter and 11 ft high, with the top of the chamber located approximately 30 ft bgs. The adjacent elevator shaft was 4 ft × 6 ft × 46 ft deep and shored with timbers (LASL 1952, 025008). Chamber 1 was used to conduct a single experiment in April 1948. The experiment did not vent to the surface, and no radioactivity was detected on the ground surface or in the atmosphere immediately after the test or 24 h later (LANL 1992, 007671, pp. 3-67–3-69). Components used in the experiments included HE, which was consumed in the tests; gram-quantities of beryllium; polonium-210 (half-life 138 d); kg-quantities of steel, copper, and aluminum; and gram-quantities of lead (LANL 1992, 007671, pp. 3-67–3-89). In addition, the chamber contained capacitors which were estimated to contain a total of 5-lb of polychlorinated biphenyls (PCBs) (Morgan 1994, 246105). This experiment is believed to have been the cause of the chamber's collapse. A berm was built over the site some years later. A concrete pad is currently installed at the surface over the chamber.

4.1.2 Previous Investigations

During the 1989 investigation of MDA D, three boreholes were drilled at SWMU 33-003(a): one to the floor of the elevator shaft, one to the concrete roof of the chamber, and one next to the chamber to a depth below the chamber floor. Two samples were collected from each borehole and analyzed for radionuclides, inorganic chemicals, and HE. Data from the 1989 investigation are screening-level; only uranium was detected above the background value (BV) in one sample collected at a depth of 44 ft bgs next to the chamber. No other inorganic chemicals were detected above BVs, no radionuclides were detected or detected above BVs, and no HE was detected. During the 1994 Resource Conservation and Recovery Act facility investigation (RFI), no sampling was performed at SWMU 33-003(a). Based on the 1989 data, the 1995 RFI report recommended NFA for SWMU 33-003(a) because no release to the environment had occurred (LANL 1995, 071300, pp. 21–24). The NFA recommendation was never approved by EPA or NMED.

There are no analytical results for SWMU 33-003(a).

4.1.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. Forty-nine samples will be collected from seven locations (Figure 4.1-1). Four boreholes will be drilled to a depth of 60-ft bgs approximately 5-ft laterally from the chamber walls. An engineering drawing (LASL 1952, 025008) indicates the depths of the chamber and elevator shaft are 46 ft and 48.6 ft bgs, respectively.
Three additional boreholes will be drilled approximately 50 ft laterally from the center of the chamber to a depth of 60 ft bgs to determine lateral extent of potential contamination. At each location, samples will be collected at 0–1 ft, 9–10 ft, 19–20 ft, 29–30 ft, 39–40 ft, 49–50 ft, and 59–60 ft bgs.

All samples will be analyzed for target analyte list (TAL) metals, nitrate, perchlorate, pH, semivolatile organic compounds (SVOCs), explosive compounds, PCBs, dioxins/furans, gamma-emitting radionuclides, and isotopic uranium. Because Chamber 1 was only used once to perform experiments on initiators, and the components of the experiment included HE, radionuclides, and metals, cyanide, and volatile organic compounds (VOCs) will not be analyzed for at this site. Table 4.1-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.2 SWMU 33-003(b), Soil Contamination

4.2.1 Site Description

MDA D consists of SWMUs 33-003(a) and 33-003(b). Both SWMUs are former underground chambers that were used to conduct experiments involving radioactive materials and HE. MDA D is located at the east end of TA-33 (East Site) on a mesa bordered by Ancho and White Rock Canyons.

SWMU 33-003(b) consists of a former underground chamber, designated chamber 2 (structure 33-6) and its associated underground elevator shaft (Figure 4.2-1). Chamber 2 was constructed to perform initiator experiments; construction was completed in October 1948. The octagonal chamber was 18 ft in diameter and 11 ft high, with the top of the chamber located approximately 30 ft bgs. The adjacent elevator shaft was 4 ft × 6 ft × 46 ft deep and shored with timbers (LASL 1952, 025008). Chamber 2 was used to conduct two experiments, one in December 1948 and one in April 1952 (Blackwell 1952, 007857).

Components used in the experiments included HE, which was consumed in the tests; gram-quantities of beryllium; polonium-210 (half-life 138 d); kg-quantities of steel, copper, and aluminum; and gram-quantities of lead. In addition, the chamber contained capacitors, which were estimated to contain less than 5 lb of PCBs (Morgan 1994, 246105).

The second experiment destroyed the chamber, caused debris to be ejected from the shaft onto the ground surface, and formed a 10-ft-deep crater. The crater subsequently was filled with the ejected debris and covered with uncontaminated soil (LANL 1995, 071300). The depression was refilled in 1963 (LASL 1963, 006745). The 1997 RFI report noted a broken 8-ft × 12-ft concrete pad and a 6-ft × 10-ft depression near the shaft location (LANL 1997, 071478). This depression was up to 2 ft deep.

4.2.2 Previous Investigations

Surface sampling was conducted in 1977 as part of the Laboratory’s Environmental Surveillance Program. Sixteen surface samples were collected around the site and analyzed for radionuclides. No elevated levels were detected. During the 1989 investigation of MDA D, three boreholes were drilled at SWMU 33-003(b): one to the floor of the elevator shaft, one to the concrete roof of the chamber, and one next to the chamber to a depth below the chamber floor. Three subsurface samples were collected from each borehole. Seven of the samples were analyzed for total uranium, six for TAL metals, three for VOCs, and seven for HE. Data from the 1989 investigation are screening level; lead, mercury, and zinc were detected above the BVs from the sample collected at the bottom of the elevator shaft. No other inorganic chemicals were detected above BVs, no radionuclides were detected or detected above BVs/fallout values (FVs), and no HE or VOCs were detected (LANL 1995, 071300, pp. 21–24).

A radiation survey was conducted from December 3 to 17, 1993, on a fixed grid with readings taken on contact with the ground surface every 20 ft. No elevated readings were detected (LANL 1995, 048840, pp. 7–8).

During the 1994 Phase I RFI conducted at SWMU 33-003(b), nine surface samples were collected from nine locations on a 100-ft × 100-ft grid around the shaft location. The samples were analyzed for TAL metals, gamma-emitting radionuclides, and HE. In addition, three samples were analyzed for SVOCs and cyanide. The RFI report concluded that surface sampling was not sufficient to characterize debris that might have been used to backfill the crater around the shaft (i.e., the samples may have been representative of clean cover soil) and recommended additional subsurface sampling at SWMU 33-003(b). Samples collected during the 1994 Phase I RFI were not analyzed for PCBs (LANL 1995, 071300, pp. 74–76; LANL 1995, 048840).

During the 1996 Phase II RFI conducted at SWMU 33-003(b), surface samples were collected at each of the eight Phase I RFI sampling locations and field-screened for PCBs. PCBs were detected in two samples within a concentration range of 0.5 mg/kg to 1 mg/kg, which was below the 1-mg/kg screening level that triggered the need for laboratory analysis. Boreholes were drilled at two locations within 3–4 ft of the shaft to a depth of 15 ft bgs. Samples were collected from three depths in each borehole and analyzed for TAL metals. In addition, four samples were analyzed for PCBs (LANL 1997, 071478, pp. 54–63).

The 1997 RFI report recommended NFA for SWMU 33-003(b) because the site had been characterized and available data indicated that contaminants at SWMU 33-003(b) were not present or were present in concentrations that posed no unacceptable risk under projected land use. The report indicated that evaluation of this site for ecological risk concerns would be deferred until an ecological risk assessment methodology had been developed (LANL 1997, 071478, p. 63). The NFA recommendation was never approved by EPA or NMED.

The data collected during these investigations are screening level and are presented in the HIR.

4.2.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. Fifty-six samples will be collected from eight locations (Figure 4.2-1). Four boreholes will be drilled to a depth of 60 ft bgs approximately 5 ft laterally from the chamber walls. An engineering drawing (LASL 1952, 025008) indicates the depths of the chamber and elevator shaft are 46 ft and 48.6 ft bgs, respectively. Four additional boreholes will be drilled approximately 50 ft laterally from the center of the chamber to a depth of 60 ft bgs to determine the lateral extent of potential contamination. At each location, samples will be collected at 0–1 ft, 9–10 ft, 19–20 ft, 29–30 ft, 39–40 ft, 49–50 ft, and 59–60 ft bgs.

All samples will be analyzed for TAL metals, nitrate, perchlorate, pH, SVOCs, explosive compounds, PCBs, dioxins/furans, gamma-emitting radionuclides, and isotopic uranium. Because Chamber 2 was only used twice to perform experiments on initiators and the components of the experiment included HE, radionuclides, and metals, cyanide, and VOC will not be analyzed for at the site. Table 4.2-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.3 SWMU 33-004(c), Septic System

4.3.1 Site Description

SWMU 33-004(c) consists of an inactive septic tank (structure 33-96) and associated drainline and drain field located at TA-33 East Site (Figure 4.3-1). This septic tank received wastewater from building 33-87, which was constructed in June 1955 to serve as the control bunker for the firing site at East Site. The septic tank has a capacity of 768 gal. and is located approximately 100 ft northeast of building 33-87. Wastewater was conveyed to the tank through a 4-in.-diameter vitrified clay pipe, and effluent from the tank flowed through a similar pipe to a small drain field approximately 30 ft east of the septic tank (LASL

1955, 025040). No outfall is or has been associated with this septic tank. Building 33-87 was used as a control bunker for experiments conducted by Group W-3 until 1972. It has since been used for storage and for occasional short-term experiments (LASL 1955, 025040, p. 43). There is no documented use of hazardous or radioactive materials within building 33-87 (Gonzales 1990, 000145). Septic tank 33-96 was operated under NMED Permit Number LA 34; however, no discharges to the septic system have occurred since the late 1980s (LANL 1990, 007513, p. 33-4).

4.3.2 Previous Investigations

During the 1994 Phase I RFI conducted at SWMU 33-004(c), the septic tank was opened and inspected. No sludge was present in the tank. Two liquid samples were collected from the tank. In addition, one surface sample and two subsurface samples were collected from each of four boreholes advanced to depths of 4 ft to 6 ft bgs. One borehole was located 5 ft from the septic tank, and the other three were located in the drain field. Before the boreholes were drilled, a trench was excavated in the drain field to locate the drainage tiles and any drain lines; no drain lines were discovered (LANL 1995, 051903, pp. 43–44).

Twelve samples were submitted to on-site and off-site contract analytical laboratories for analysis of cyanide, gamma-emitting radionuclides, TAL metals, and SVOCs. One of the 12 samples was also analyzed for isotopic uranium, and 8 of the 12 samples were also analyzed for VOCs.

The data collected during this investigation are screening level and are presented in the HIR.

4.3.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. The septic tank and its contents will be removed, characterized, and disposed of at an appropriate waste facility. Site characterization will be performed following removal of the septic system using the methods discussed in section 5.12. Sampling locations will be targeted at the locations of the septic tank, inlet and outlet drainlines, and leach field to define the nature and extent of contamination (Figure 4.3-1). After the tank has been removed, three samples will be collected from one location below the tank. Samples will be collected from three depths (0–1 ft, 2–3 ft, and 5–6 ft below the base of the tank). Four samples will be collected below the septic tank inlet and outlet lines. Samples will be collected from two depths (0–1 ft and 4–5 ft below the base of inlet and outlet lines). The inlet line cannot be sampled near building 33-87 because the bunker-style building is covered with approximately 15 ft of soil. Twenty samples will be collected from five locations beneath the leach field. Samples will be collected from four depths (0–1 ft, 0–1 ft, 2–3 ft, and 5–6 ft below the base of the leach field). Nine samples will also be collected from three locations around the leach field boundary. Samples will be collected from three depths (0–1 ft, 2–3 ft, and 5–6 ft bgs). One location will be sampled approximately midway from beneath the inlet line from building 33-87 to the septic tank. Samples will be collected from three depths (0–1 ft, 2–3 ft, and 5–6 ft below the inlet line).

All samples will be analyzed for TAL metals, cyanide, nitrate, perchlorate, pH, VOCs, SVOCs, explosive compounds, gamma-emitting radionuclides, and isotopic uranium. Because building 33-87 was used as a control building for shot test experiments and the septic tank only received waste water from a sink and toilet, PCBs and dioxins/furans will not be analyzed for at this site. Table 4.3-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.4 SWMU 33-004(k), Drainline and Outfall

4.4.1 Site Description

SWMU 33-004(k) is described in the 1990 SWMU report as two parallel drainlines for building 33-87 that merged and discharged to a single outfall located near gun mount 33-116 (Figure 4.4-1). The outfall reportedly received discharge from a toilet, sink, floor drains, and an electrical water cooler within the building. The engineering drawing for building 33-87 depicts a cast-iron drainpipe exiting the south wall of the building, and extending approximately 125 ft southeast of the building (LASL 1955, 600499). Building 33-87 was constructed in 1955 to support firing site experiments that were conducted until the early 1970s. Attempts to locate the drainline and outfall in 1994 and 1995 using geophysics and test trenches were unsuccessful. An inspection of the building performed in 1996 revealed that no floor drains existed in the building. The sink and toilet in the building discharge to septic tank 33-96 [SWMU 33-004(c)], located north of the building. Therefore, it is likely that the drainline and outfall never existed.

4.4.2 Previous Investigations

A radiation survey was conducted from December 3 to 17, 1993, on a fixed grid and readings were taken on contact with the ground surface every 20 ft. A 50-ft grid was established over the SWMU 33-004(k) outfall area. No elevated readings were detected (LANL 1995, 048840, pp. 7–8).

During the 1994 Phase I RFI conducted at SWMU 33-004(k), electromagnetic (EM) surveys were performed east of the bunker where the drainline was shown on the engineering drawing. The EM surveys did not indicate the presence of a drainline at the surveyed locations. In 1995, a ground-penetrating radar survey was conducted, and two anomalies at the southeast corner of the building were noted. Eleven trenches were dug to the top of bedrock both parallel and perpendicular to the anomalies; however, no drainline was encountered (LANL 1997, 071478, Figure 5.4.2.1). Based on the results of the Phase I RFI activities for SWMU 33-004(k), the RFI report recommended NFA because the SWMU could not be located or may have never existed (LANL 1997, 071478, pp. 81–82). The NFA recommendation was never approved by EPA or NMED.

There are no analytical results for SWMU 33-004(k).

4.4.3 Proposed Activities

The location of the drainline could not be confirmed during the 1994 Phase I RFI. Two additional trenches will be excavated on both sides of the access road to verify if the drainline exists (Figure 4.4-1). If the drainline is not located, no samples will be collected at this site, and the conclusion will be the drainline was never installed. If the drainline is located, sampling locations will be targeted at the locations of the drainline and outfall to define the nature and extent of contamination. Nineteen samples will be collected from 7 locations (Figure 4.4-1). Four samples will be collected at 2 locations below the drainline. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft below the drainline. Three samples will also be collected from 1 location at the outfall and 12 samples will be collected from 4 locations downgradient of the outfall. Samples will be collected at depth intervals of 0–1 ft, 2–3 ft, and 5–6 ft bgs.

All samples will be analyzed for TAL metals, cyanide, nitrate, perchlorate, pH, VOCs, SVOCs, explosive compounds, gamma-emitting radionuclides, and isotopic uranium. Because building 33-87 was used as a control building for shot test experiments and the outfall purportedly received discharge from a toilet and sink, PCBs and dioxins/furans will not be analyzed for at this site. Table 4.4-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.5 SWMU 33-006(b), Firing Site

4.5.1 Site Description

SWMU 33-006(b) is a former gun-firing site that consists of two inactive concrete firing pads and associated berms (Figure 4.5-1). The firing pads were used to conduct tests of gun-type initiators and consisted of 20-ft × 30-ft concrete pads (former structures 33-97 and 33-98) (LANL 1992, 007671, pp. 3-70–3-71; LASL 1955, 600499). The firing pads are located in the centers of two adjacent, crescent-shaped south facing berms constructed of soil and crushed tuff (LANL 1995, 051903, p. 77). The double berm is located on the northern edge of East Site near the rim of Ancho Canyon.

Guns formerly mounted on the pads were used to fire uranium projectiles containing beryllium and polonium-210 into the berms. Cobalt-60 was used as a tracer in some of the projectiles. Projectiles were not detonated but were fired intact into the berms for recovery and investigation (LANL 1992, 007671, pp. 3-70–3-71). Some neutron detectors used at East Site may have contained liquid organic scintillation fluids. Operations at East Site began in June 1955 (LANL 1992, 007671, pp. 3-70–3-71). The operating dates of SWMU 33-006(b) were not reported, but firing tests at East Site were conducted until 1972. A general cleanup of the site was conducted in 1984 (Buhl 1988, 035754).

4.5.2 Previous Investigations

A radiation survey was conducted from December 3 to 17, 1993, on a fixed grid and readings were taken on contact with the ground surface every 20 ft. No elevated readings were detected (LANL 1995, 048840, pp. 7–8).

During the 1994 Phase I RFI conducted at SWMU 33-006(b), a geophysical survey was conducted over the berms in an attempt to locate buried metallic objects. Numerous anomalies were detected. Subsequent trenching indicated that the anomalies were associated with large pieces of buried tuff. The only metallic object identified was a piece of an artillery gun breech. A surface soil sample was collected at each of two locations near each firing pad (four samples total). Soil samples were also collected from a 5-ft-deep trench cut into each berm at a location directly in front of each gun mount. Three samples were collected from the east trench and six samples were collected from the west trench. Three of the samples from the west trench were collected from the areas around metal projectiles found in the berm (LANL 1995, 048840, p. 24; LANL 1995, 051903, pp. 77–84).

At total of 13 samples were collected from 6 locations at depths ranging from 0–8 ft bgs. The samples were submitted to on-site and off-site contract analytical laboratories for analysis of gamma-emitting radionuclides, TAL metals, SVOCs, and HE. Four of the 13 samples were also analyzed for uranium and another 4 of the 13 samples were also analyzed for isotopic uranium.

The data collected during this investigation are screening level and are presented in the HIR.

4.5.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. Eighty-three samples will be collected from 25 locations (Figure 4.5-1). Sampling locations will be targeted at the locations of the firing points and the berm to define nature and extent of contamination. Samples will be collected next to the former firing pads, in front and on top of the berm, and at the base of the berm. Eight samples will be collected from four sampling locations adjacent to the two firing pads (structures 33-97 and 33-98). Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs. Twenty-four samples will be collected from six sampling locations on the slope of the berm next to the two firing pads. Samples will be collected at depth intervals of 0–1 ft, 2–3 ft, 4–5 ft, and 9–10 ft bgs. Thirty-five samples will be collected from seven sampling locations on top of the berm. Samples will be collected at depth intervals 0–1 ft, 2–3 ft, 4–5 ft, 9–10 ft, and 14–15 ft bgs. Sixteen samples will be collected from eight locations along the base of the berm. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs.

All samples will be analyzed for TAL metals, nitrate, perchlorate, pH, SVOCs, explosive compounds, gamma-emitting radionuclides, and isotopic uranium. Because this is a former gun firing site using uranium projectiles containing beryllium and polonium-210, cyanide, PCBs, dioxins/furans, and VOCs will not be analyzed for at this site. Table 4.5-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.6 SWMU 33-007(a), Firing Site

4.6.1 Site Description

SWMU 33-007(a) is a gun firing site that consists of three gun mounts (structures 33-116 and 33-135 and former structure 33-117), two former catcher boxes (structures 33-118 and 33-136), and a recoil box (LANL 1990, 007513) (Figure 4.6-1). Concrete gun mounts 33-116 and 33-135 were located at the west end of the site, and the catcher boxes were located at the east end. A sandbag barricade was located east of the catcher boxes. The recoil box was located immediately west of gun mount 33-116. Firing site activities began in the mid-1950s and included firing projectiles from large cannons into the catcher boxes filled with vermiculite and sand (LANL 1995, 051903, pp. 84–85). Other activities included experiments using scintillation fluids and x-rays. Cobalt-60 was used in some of the firing site activities (LANL 1992, 007671, pp. 3-70–3-71). Firing site activities ceased in 1972 (LANL 1995, 051903, pp. 84–85). In 1984, the catcher boxes and their contents were removed and disposed of in a landfill [SWMU 33-008(b)] located at East Site (Buhl 1988, 035754).

4.6.2 Previous Investigations

A radiation survey was conducted at the site from December 3 to 17, 1993, on a fixed grid and readings were taken on contact with the ground surface every 20 ft. No elevated readings were detected (LANL 1995, 048840, pp. 7–8).

During the 1994 Phase I RFI, geophysical surveys were performed to determine the presence of subsurface metal objects. Trenches were excavated over two anomalies, but no projectiles or debris was found (LANL 1995, 051903, p. 85).

As part of the Phase I RFI, sampling was conducted at SWMU 33-007(a) in 1994 (LANL 1995, 051903). Surface sampling at SWMU 33-007(a) consisted of randomized grid sampling designed to determine the distribution of potential surface contamination resulting from firing activities. In addition, biased samples were collected from a trench in the berm at the west end of the firing area and from north and south of the culvert draining the central part of the area. Thirty-one samples were collected from 28 locations at depths ranging from 0–8 ft bgs. The samples were submitted for on-site analyses and off-site contract analytical laboratories for analysis of HE and metals. Four of the 31 samples were also analyzed for herbicides, 12 of the 31 samples were also analyzed for SVOCs, and 28 of the 31 samples were also analyzed for uranium and gamma-emitting radionuclides. Arsenic, calcium, chromium, copper, lead, mercury, and uranium were detected above BVs; 21 organic chemicals were detected; cesium-137 was detected above the FV; and cobalt-60 was detected.

The data collected during this investigation are screening level and are presented in the HIR.

4.6.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. A total of 114 samples will be collected from 43 locations (Figure 4.6-1). Sampling locations will be targeted at the locations around the former barricade, former catcher boxes areas, recoil box, and areas surrounding gun mounts to define the nature and extent of contamination. Two samples will be collected from one location along the base of the berm below the former barricade. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs. Twenty-eight samples will be collected from 7 sampling locations on the slope of the berm below the former barricade. Samples will be collected at depth intervals of 0–1 ft, 2–3 ft, 4–5 ft, and 9–10 ft bgs. Fifteen samples will be collected from three sampling locations on top of the berm where the former barricade was located. Samples will be collected at depth intervals of 0–1 ft, 2–3 ft, 4–5 ft, 9–10 ft, and 14–15 ft bgs. Thirty-two samples will be collected from 16 sampling locations adjacent to the recovery catcher boxes (structures 33-118 and 33-136). Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs.

Twenty-two samples will be collected from 11 sampling locations around the gun mounts (structures 33-116, former 33-117, and 33-135). Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs. Samples collected around former gun mount 33-117 will also be used to determine the nature and extent of potential contamination for SWMU 33-008(b) (section 4.7).

Six samples will be collected from three sampling locations in and around the recoil box. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs. Four samples will be collected from one sampling location on the slope of the berm next to the recoil box. Samples will be collected at depth intervals of 0–1 ft, 2–3 ft, 4–5 ft, and 9–10 ft bgs. Five samples will be collected from one location on top of the berm adjacent to the recoil box. Samples will be collected at depth intervals of 0–1 ft, 2–3 ft, 4–5 ft, 9–10 ft, and 14–15 ft bgs.

All samples will be analyzed for TAL metals, nitrate, perchlorate, pH, SVOCs, explosive compounds, gamma-emitting radionuclides, and isotopic uranium. Because this is a former gun firing site, cyanide, PCBs, dioxin/furans, and VOCs will not be analyzed for at this site. Table 4.6-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.7 SWMU 33-008(b), Landfill

4.7.1 Site Description

SWMU 33-008(b) consists of a landfill that was created at East Site in 1984 during a major cleanup of the former TA-33 firing sites (Buhl 1988, 035754) (Figure 4.7-1). The landfill is located between the two large gun mounts and the former recovery catcher boxes associated with SWMU 33-007(a) (Figure 4.6-1).

This landfill was used to dispose of uncontaminated debris, including large items such as telephone poles, timbers, and railroad ties (LANL 1997, 071478, p. 86). Additional materials buried in the landfill may have included timbers, sawdust, and vermiculite contaminated with small amounts of lead, beryllium, and HE (LANL 1992, 007671, pp. 3-70–3-71). All debris from the cleanup was screened for radioactivity. Radioactively contaminated materials were disposed of at MDA G at TA-54. Uncontaminated salvageable materials were also removed from the site rather than deposited in the landfill (Buhl 1988, 035754). Upon completion of site cleanup activities, the surface of the landfill was graded to prevent ponding of storm water and the four corners of the fill area were marked with metal posts (LANL 1997, 071478, p. 82).

4.7.2 Previous Investigations

During the 1996 Phase I RFI conducted at SWMU 33-008(b), boreholes were advanced into the landfill at six locations to depths ranging from 4.5–7.5 ft bgs or approximately 3 ft into tuff (LANL 1997, 071478, pp. 85–97). Twenty-one samples were collected from six locations at depths ranging from 0–16 ft bgs. The samples were submitted to an off-site contract analytical laboratory for analysis of metals and SVOCs. Depth to tuff varied between 1.5 ft and 4.5 ft bgs. None of the debris was collected as samples because of its large and solid nature. Instead, soil surrounding the debris was collected (LANL 1997, 071478, pp. 88–86).

The data collected during this investigation are screening level and are presented in the HIR.

4.7.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. Ninety-six samples will be collected from 24 locations (Figure 4.7-1). Sampling locations will be targeted at locations in and around the landfill to define nature and extent of potential contamination. Samples will be collected on a 50-ft grid system in and around the landfill and adjacent to the landfill.

Eighty samples will be collected from 16 sampling locations in and around the landfill. Samples will be collected at depth intervals 0–1 ft, 2–3 ft, 4–5 ft, and 8–9 ft bgs, and 1 ft into tuff. Samples collected around former gun mount 33-117 associated with SWMU 33-007(a) will also be used to determine the nature and extent of potential contamination for this site (Figure 4.6-1). Sixteen samples will be collected from 8 locations in the drainage south of the landfill to the toe of the slope. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs (or 1 ft into tuff).

Because historical documentation indicates massive items such as telephone poles and railroad ties may be tightly packed within the landfill, an auger-drilling rig will be used to collect samples in and around the landfill. If proposed sampling locations are found to be impacted by buried debris, resulting in drilling refusal, sampling locations will be moved to a nearby location.

All samples will be analyzed for TAL metals, cyanide, nitrate, perchlorate, pH, VOCs, SVOCs, explosive compounds, PCBs, dioxins/furans, gamma-emitting radionuclides, and isotopic uranium. Table 4.7-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.8 SWMU 33-010(a), Surface Disposal Site

4.8.1 Site Description

SWMU 33-010(a) is a surface disposal site located southeast of structure 33-151 on the slope at the eastern edge of East Site (Figure 4.8-1). Much of the debris disposed of at this site was associated with the initial clearing of East Site and included dead tree trunks, rocks, and scraped earth. Other debris, such as metal scrap, timber, and plastic foam, is associated with firing site operations conducted from 1955 to 1972. Debris was scattered at the rim of the canyon and extends to approximately 15 ft below the rim.

4.8.2 Previous Investigations

During the 1994 Phase I RFI at SWMU 33-010(a), surface soil samples were collected at four locations from 0.0–0.5 ft bgs. The samples were submitted to an off-site contract analytical laboratory for analysis of gamma-emitting radionuclides, TAL metals, and uranium (LANL 1995, 051903). The data collected during this investigation are screening level and are presented in the HIR.

A voluntary corrective action (VCA) was implemented in 1995. All debris was field-screened to detect alpha, beta, and gamma radiation. Eight cubic yards of nonhazardous, nonradioactive debris and 0.2 yd^3 of radioactive debris were removed from the surface of the site. No confirmation samples were collected (LANL 1996, 054755, pp. 2, 15). No hazardous waste was encountered during the VCA activities.

4.8.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. Fifty-two samples will be collected from 26 locations. Samples will be collected every 25 ft from east-west transects within the disposal area. Sampling locations will also be located around the disposal area. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs. Samples in the drainage channel below this site will be collected as part of the sampling for SWMU 33-008(b) (Figure 4.7-1).

All samples will be analyzed for TAL metals, cyanide, nitrate, perchlorate, pH, VOCs, SVOCs, explosive compounds, PCBs, dioxins/furans, gamma-emitting radionuclides, and isotopic uranium. Table 4.8-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.9 SWMU 33-010(b), Surface Disposal Site

4.9.1 Site Description

SWMU 33-010(b) is a former canyon-side disposal site that was located on a narrow ledge in the middle of a 60-ft cliff at the southern edge of East Site at TA-33 (Figure 4.9-1). This disposal area consisted of a large pile of metal turnings, strapping strips, timbers, and asbestos boards (LANL 1996, 063065, pp. 1–2). The debris was likely disposed of between 1947 and 1972 (LANL 1996, 063065, pp. 1–2). The ledge is approximately 10 ft to 15 ft wide. At the base of the cliff, a succession of steep slopes and cliffs extend into White Rock Canyon.

4.9.2 Previous Investigations

During the 1994 Phase I RFI conducted at SWMU 33-010(b), three samples were collected beneath the metal turnings pile on the face of the slope below the debris area (LANL 1996, 063065, pp. 2–3). The three samples collected were submitted to an off-site contract analytical laboratory for analysis of gamma-emitting radionuclides, TAL metals, and uranium.

During the 1996 VCA conducted at SWMU 33-010(b), the metal turnings pile and associated debris were removed along with contaminated soil beneath and around the pile. In addition, other debris located along the canyon rim was removed. Waste generated during the VCA included 0.5 yd^3 of asbestos tiles, 12 yd^3 of nonhazardous/nonradioactive debris, less than 1 yd^3 of hazardous and mixed waste debris, and 6 yd^3 of mixed waste soil (LANL 1996, 063065, p. 11). Removal was based on screening with a sodium iodide scintillation detector system for uranium and an x-ray fluorescence detector for cadmium, lead, and chromium.

Two composite confirmation samples were collected from the former metal turnings pile location, and 2 composite confirmation samples were collected from the slope below the former metal turnings pile. Each sample was composited from subsamples collected at 10 locations. All 4 samples were analyzed for TAL metals and 1 of the 4 samples was also analyzed for uranium. The 1996 VCA report recommended NFA for SWMU 33-010(b) because the site had been characterized and available data indicated contaminants at SWMU 33-010(b) were not detected or were present in concentrations that posed no unacceptable risk under projected land use (LANL 1996, 063065 pp. 7–8). The NFA recommendation was never approved by EPA or NMED.

The data collected during these investigations are screening level and are presented in the HIR.

4.9.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. Eighteen samples will be collected from nine locations (Figure 4.9-1). Six samples will be collected from three locations on top of the mesa along the canyon rim. Twelve samples will be collected from six locations within the disposal area. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs (or 1 ft into tuff).

All samples will be analyzed for TAL metals, pH, SVOCs, explosive compounds, PCBs, gamma-emitting radionuclides, isotopic uranium, and asbestos. Because the materials at the disposal site consisted of metal turnings and strapping strips, timbers, and asbestos boards, cyanide, nitrate, perchlorate, VOCs, and dioxins/furans will not be analyzed for at this site. Table 4.9-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.10 SWMU 33-010(d), Surface Disposal Site

4.10.1 Site Description

SWMU 33-010(d) is a former canyon-side disposal area situated in the northeastern portion of East Site at TA-33 (Figure 4.10-1). This site is located on a steep slope directly north of the former gun-firing site berms [SWMU 33-006(b)] (Figure 4.5-1). Debris scattered along the canyon rim and in a small drainage leading to Ancho Canyon consisted of concrete blocks, empty glass specimen vials, pieces of foam, cable, and metal cans. The date this debris was deposited at the site is not known, but operations at East Site occurred between 1948 and 1972 (LANL 1995, 243475, p. 10). During the 1995 VCA implemented at the site, 2 yd^3 of nonhazardous/nonradioactive debris and 0.1 yd^3 of radioactive debris were removed from the site (LANL 1996, 054755, p. 15).

4.10.2 Previous Investigations

During the 1994 Phase I RFI at SWMU 33-010(d), surface-soil samples were collected from four locations on the canyon edge and two locations in the drainage (LANL 1995, 048840, Exhibit 1, p. 7). All samples were submitted for laboratory analysis of TAL metals, uranium, and gamma-emitting radionuclides. The data collected during this investigation are screening level and are presented in the HIR.

A VCA was performed in 1995 to remove debris from the ground surface and the drainage. All debris was field-screened for radioactivity and inorganic chemicals. Natural materials and debris smaller than 3 in. in diameter were not removed unless field-screening results indicated that radioactivity was above background. A total of 2 yd^3 of nonhazardous/nonradioactive debris and 0.1 ft^3 of radioactive debris was removed (LANL 1996, 054755, p. 15).

4.10.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. Sixty-six samples will be collected at 33 locations (Figure 4.10-1). Forty-two samples will be collected from 21 locations in and around the disposal area. Twenty-four samples will be collected downgradient of the disposal area. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs (or 1 ft into tuff).

All samples will be analyzed for TAL metals, cyanide, nitrate, perchlorate, pH, VOCs, SVOCs, explosive compounds, PCBs, dioxins/furans, gamma-emitting radionuclides, and isotopic uranium. Table 4.10-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

4.11 AOC C-33-002, Former Transformer

4.11.1 Site Description

AOC C-33-002 is the location of a former electrical transformer (former structure 33-95) that was located next to building 33-87, a former firing site bunker (Figure 4.11-1). The transformer was located within a concrete-walled vault covered by a soil berm (LASL 1955, 600499). The berm was constructed to provide protection from nearby gun firing sites [SWMUs 33-006(b) and 33-007(a)].

Because this transformer was placed into service in the 1950s, the oil in the transformer may have contained PCBs. Oil stains were visible on the concrete floor of the vault. However, active leaks from the transformer were not observed during inspections conducted in September 1985 and March 1992 (LANL 1992, 007671, p. 3-71). In 1992, under the Toxic Substances Control Act, the transformer was replaced with a non-PCB transformer (Morales 1992, 065600). Sampling performed during transformer replacement was limited to the areas where the transformer had been placed temporarily during removal (Morales 1992, 009745).

4.11.2 Previous Investigations

The 1992 RFI work plan states that the transformer pad would be cleaned and sampled during transformer replacement and proposed no additional sampling (LANL 1992, 007671, p. 3-71). During 1993 Phase I RFI activities, it was determined that the sampling conducted during transformer replacement did not meet RFI objectives. The 1995 RFI report, therefore, recommended additional sampling to determine whether historic releases of PCBs had occurred. Sampling was conducted at AOC C-33-002 in 1996 (ICF Kaiser Engineers 1997, 600529, p. 20). Four surface samples were collected from four locations in the drainage downgradient of the transformer vault and analyzed for PCBs. The data collected during this investigation are screening level and are presented in the HIR.

4.11.3 Proposed Activities

The nature and extent of contamination have not been defined at this site. Twenty samples will be collected from 10 locations (Figure 4.11-1). Four samples will be collected from 2 locations along the concrete pad in front of building 33-95. Sixteen samples will be collected from 8 locations in the drainage area downgradient of the transformer vault. Samples will be collected at depth intervals of 0–1 ft and 2–3 ft bgs.

Because this site is the location of a former electrical transformer, samples will only be analyzed for PCBs and pH. Table 4.11-1 provides a summary of the proposed sampling locations, depths, and analytical suites.

5.0 INVESTIGATION METHODS

A summary of investigation methods to be implemented is presented in Table 5.0-1. The standard operating procedures (SOP) used to implement these methods are listed at: http://www.lanl.gov/community-environment/environmental-stewardship/_assets/docs/external-plans-procedures.pdf and can be downloaded from http://eprr.lanl.gov/oppie/service. Summaries of the field investigation methods are provided below. Additional procedures may be added as necessary to describe and document activities affecting quality.

Chemical analyses will be performed in accordance with the analytical statement of work (LANL 2000, 071233) Accredited off-site contract analytical laboratories will use the most recent EPA and industry-accepted extraction and analytical methods for chemical analyses of analytical suites.

5.1 Establishing Sampling Locations

Proposed sampling locations are identified for each site based on engineering drawings, surveyed locations of existing structures, previous sampling locations, and topography or other features identified in the field, such as drainage channels and sediment accumulation areas. The coordinates of proposed locations will be obtained by georeferencing the points from the proposed sampling maps. The coordinates will be used to locate flags or other markers in the field using a differential global positioning system (GPS) unit. If any proposed sampling locations are moved because of field conditions, utilities, or other unexpected reasons, the new locations will be surveyed immediately following sample collection as described in section 5.2.

5.2 Geodetic Surveys

Geodetic surveys will be conducted in accordance with the latest version of EP-ERSS-SOP-5028, Coordinating and Evaluating Geodetic Surveys, to locate historical structures and to document field activities such as sampling and excavation locations. The surveyors will use a Trimble GeoXT handheld GPS or equivalent for the surveys. The coordinate values will be expressed in the New Mexico State Plane Coordinate System (transverse mercator), Central Zone, North American Datum 1983. Elevations will be reported as per the National Geodetic Vertical Datum of 1929. All GPS equipment used will meet the accuracy requirements specified in the SOP.

5.3 Field Screening

The primary field-screening methods to be used on samples include radiological screening and vapor screening using a Photo Ionizing Detector (PID).

5.3.1 Organic Vapors

Based on the previous RFI and VCA results, VOC contamination is not expected to be encountered. Organic vapor screening of surface and subsurface samples will be conducted using a PID with an 11.7-electron-volt lamp. All samples will be screened in accordance with SOP-06.33, Headspace Vapor Screening with a Photo Ionization Detector. Before each day’s field work begins, the PID will be calibrated to the manufacturer’s standard for instrument operation. All instrument background checks, background ranges, and calibration procedures will be documented daily in field logbooks.

5.3.2 Radioactivity

Radiological field-screening will be conducted to meet of U.S. Department of Transportation requirements for shipping samples. Each sample will be field-screened by a radiological control technician for gross-alpha, -beta, and -gamma radioactivity before transporting the samples to the Sample Management Office (SMO) for processing as determined by the Laboratory’s Environment, Safety, and Health (ESH) Deployed Services Division. Instruments used for field-screening will be calibrated in accordance with the ESH Deployed Services Division procedures or equivalent procedures. All instrument calibration activities will be documented daily in the field logbooks.

5.4 Sampling

Soil, fill, sediment, and tuff samples will be collected by the most efficient and least invasive method practicable. The methods will be determined by the field team based on site conditions, such as topography, the nature of the material to be sampled, the depth intervals required, accessibility, and level of disruption to laboratory activities. Typically, samples will be collected using spade and scoop, hand auger, or drill rig.

5.4.1 Surface Sampling

5.4.1.1 Spade and Scoop Method

Surface and shallow subsurface soil and sediment samples will be collected in accordance with SOP-06.09, Spade and Scoop Method for the Collection of Soil Samples. Stainless-steel shovels, spades, scoops, and bowls will be used for ease of decontamination. If the surface location is at bedrock, an axe or hammer and chisel may be used to collect samples. Samples collected for analyses will be placed in the appropriate sample containers depending on the analytical method requirement.

5.4.1.2 Sediment Samples

Sediment samples will be collected from areas of sediment accumulation that include sediments judged representative of the historical period of Laboratory operations post-1943. The proposed sediment sampling locations will be selected based on geomorphic relationships in areas likely to have been affected by discharges from Laboratory operations. Selected sediment sampling locations shown in proposed sampling location figures are based on map contours. However, because sediment is dynamic and subject to redistribution by runoff events, some locations may need to be adjusted when this work plan is implemented.

In the course of collecting sediment samples, it may be determined, based on field conditions, that the selected location is not appropriate—for example, the sediment is much shallower than anticipated, the sediment is predominantly coarse-grained, or the sediment shows evidence of being older than the target age. Sediment sampling locations will be adjusted as appropriate, any revised locations will be surveyed, and the updated coordinates will be submitted to the Laboratory for inclusion in the Sample Management Database.

5.4.2 Subsurface Samples

Subsurface sampling is proposed to include soil, fill, sediment, and tuff. Any adjustments to sampling locations or sampling intervals will be noted on sample collection logs and recorded in the subsequent investigation report as deviations from this investigation work plan. Subsurface samples will be collected following the current version of SOP-06.24, Sample Collection from Split-Spoon Samplers and Shelby Tube Samplers, and SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials. If encountered, alluvial groundwater will be sealed off before the borehole is advanced to the desired sampling depths.

5.4.2.1 Hand Auger

Hand augers or power-assisted augers may be used to drill shallow holes (at locations that can be sampled without the use of a drill rig and at locations inaccessible by a drill rig). The hand auger is advanced by turning the auger into the soil or tuff until the barrel is filled. The auger is removed and the sample is placed in a stainless-steel bowl. Hand-auger samples will be collected in accordance with ER-SOP-20069, Soil, Tuff, and Sediment Sampling.

5.4.2.2 Hollow-Stem Auger

Boreholes will be drilled using a drill rig equipped with a hollow-stem auger. The hollow-stem auger consists of a hollow-steel shaft with a continuous spiraled steel flight welded onto the exterior of the stem. The stem is connected to an auger bit; when the bit is rotated, it transports cuttings to the surface. The hollow stem of the auger allows insertion of drill rods, split-spoon core barrels, Shelby tubes, and other samplers through the center of the auger so that samples may be retrieved during drilling operations. The hollow stem also acts to case the borehole core temporarily so a well casing (a riser) may be inserted down through the center of the auger when 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 auger to keep out most of the soil and/or water that tends to clog the bottom of the augers during drilling. Drilling without a center plug is acceptable if the soil plug, formed in the bottom of the auger, is removed before sampling or installing a well casing. The soil plug can be removed by washing out the plug using a side-discharge rotary bit or auguring out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger.

During sampling, the auger will be advanced to just above the desired sampling interval. The sample will be collected by driving a split-spoon sampler into undisturbed soil/tuff to the desired depth. Samples will be collected in accordance with SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials.

If samples are collected for VOC analysis, the sampler will be lined with brass sleeves. Immediately upon retrieval of the sampler, it will be opened and a sleeve from the desired depth interval will be collected for VOC analysis. The ends of the sleeve will be covered immediately with Teflon film and capped with plastic caps. Tape will then be used to seal the ends of the cap to the sleeve. Material from the remaining sleeves will be field screened, visually inspected, and placed in a stainless-steel bowl. Samples for the remaining analysis will be transferred to appropriate sample containers, depending upon the analytical method requirement.

Field documentation will include detailed borehole logs for each borehole drilled using the hollow-stem auger method. 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.

5.4.3 Borehole Abandonment

All hollow-stem auger boreholes will be properly abandoned in accordance with SOP-5034, Monitor Well and RFI Borehole Abandonment. Shallow boreholes, with a total depth of 20 ft or less, will be abandoned by filling the borehole with bentonite chips and then hydrating the chips in 1- to 2-ft lifts. The borehole will be visually inspected while the bentonite chips are being added to ensure bridging does not occur.

Boreholes greater than 20 ft in depth will be pressure-grouted from the bottom of the borehole to the surface using the tremie pipe method. Acceptable grout materials include cement or bentonite grout, neat cement, or concrete.

The use of backfill materials such as bentonite and grout will be documented in a field logbook with respect to volumes (calculated and actual), intervals of placement, and additives used to enhance backfilling. All borehole abandonment information will be presented in the investigation report.

5.5 Excavation

Excavations will be completed using a track excavator or backhoe at selected site(s). Excavated soil will be staged a minimum of 3 ft from the edge of the excavation, and excavations deeper than 4 ft bgs will be properly benched to allow access and egress, if necessary. After completion of confirmatory sampling and any necessary overexcavation work, the excavations and/or trenches will be backfilled with clean fill material or overburden, if they are not contaminated. Excavators may also be used to collect grab samples.

5.6 Chain of Custody for Samples

The collection, screening, and transport of samples will be documented on standard forms generated by the SMO. These include sample collection logs, chain-of-custody forms, and sample container labels. Sample collection logs will be completed at the time of sample collection and signed by the sampler and a reviewer who will verify the logs for completeness and accuracy. Corresponding labels will be initialed and applied to each sample container, and custody seals will be placed around container lids or openings. Chain-of-custody forms will be completed and signed to verify that the samples are not left unattended.

5.7 Quality Assurance/Quality Control Samples

Quality assurance and quality control samples will include field duplicate, equipment rinsate, and field trip blank samples. These samples will be collected following the current version of SOP 5059, Field Quality Control Samples. Field duplicate samples will be collected at an overall frequency of at least 1 for every 10 regular samples as directed by Section IX.C.3.b of the Consent Order.

5.8 Laboratory Analytical Methods

Analytical suites vary by site as indicated in Tables 4.1-1 through 4.1-11. All analytical methods are presented in the statement of work for analytical laboratories (LANL 2000, 071233). Sample collection and analysis will be coordinated with the SMO.

5.9 Health and Safety

The field investigations described in this investigation work plan will comply with all applicable requirements pertaining to worker health and safety. An integrated work document and a site-specific health and safety plan will be in place before fieldwork is performed.

5.10 Equipment Decontamination

Equipment for drilling and sampling will be decontaminated before and after sampling activities to minimize the potential for cross-contamination. Dry decontamination methods will be used to avoid the generation of liquid waste and to minimize the IDW. Dry decontamination uses disposable paper towels and over-the-counter cleaner, such as Fantastik or equivalent. All sampling and measuring equipment will be decontaminated in accordance with SOP-5061, Field Decontamination of Equipment.

Dry decontamination may be followed by wet decontamination, if necessary. Wet decontamination may include washing with a nonphosphate detergent and water, followed by a water rinse and a second rinse with deionized water. Alternatively, drilling/exploration equipment that may come in contact with the borehole will be decontaminated by steam cleaning, by hot water pressure-washing, or by another method before each new borehole is drilled. The equipment will be pressure-washed with a high-density polyethylene liner on a temporary decontamination pad. 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.

5.11 Investigation-Derived Waste

IDW generated by the proposed investigation activities may include, but is not limited to, drill cuttings, excavated soil or other environmental media, contact waste such as personal protective equipment, decontamination fluids, and all other waste that has potentially come into contact with contaminants.

All IDW generated during field investigation activities will be managed in accordance with applicable EPA and NMED regulations, DOE orders, and Laboratory requirements. Appendix B presents the IDW management plan.

5.12 Removal Activities

Removal of the inactive septic tank associated with SWMU 33-004(c) is proposed under this investigation work plan. Excavation of potentially contaminated media, waste disposition, and confirmation sampling will be completed during removal activities.

Soil, fill, or other material covering the septic tank will be excavated and stockpiled next to the excavation. Once exposed, the location of the septic tank and its dimensions will be surveyed. The contents will be sampled and characterized for waste management purposes. The septic tank and its contents will be removed and disposed of at an appropriate waste disposal facility. The inlet and outlet drainlines to the tank will be plugged. Potentially contaminated soil beneath the tank will be excavated, characterized, and disposed of at an appropriate waste disposal facility.

After the septic tank has been removed, confirmation samples will be collected from beneath the inlet and outlet, and below the tank. Samples will be collected from two depths below the septic tank inlet and outlet lines (0–1 ft and 4–5 ft below the base of inlet and outlet lines). Samples will be collected from three depths below the septic tank (0–1 ft, 2–3 ft, and 5–6 ft below base of tank). All samples will be analyzed for TAL metals, cyanide, nitrate, perchlorate, pH, VOCs, SVOCs, explosive compounds, gamma-emitting radionuclides, and isotopic uranium. The excavated area will be backfilled with clean fill and material excavated from the surface of the septic tank. Table 4.3-1 provides a summary of the proposed locations, depths, and analytical suites.

6.0 MONITORING PROGRAMS

Groundwater, sediment, and surface water monitoring within the South Ancho Canyon Aggregate Area is being performed as part of other environmental activities. This monitoring is described briefly below.

6.1 Groundwater

Section IV.B.6.b.iii of the Consent Order, as implemented under the Laboratory's annual Interim Facility-Wide Groundwater Monitoring Plan, requires monitoring and sampling of all wells that contain alluvial, intermediate, and regional groundwater located in the South Ancho Canyon Aggregate Area. No alluvial and intermediate groundwater monitoring wells are located in the aggregate area. Regional monitoring well R-31 is located approximately 2.5 mi north of the East Site in TA-39. This well is monitored as part of the annual Interim Facility-Wide Groundwater Monitoring Plan (LANL 2014, 256728).

6.2 Sediment and Surface Water

Three site monitoring areas (SMAs), A-SMA-4, A-SMA-5, and A-SMA-6, are located within East Site. These SMAs are used to monitor storm water discharges from SWMUs 33-004(k), 33-007(a), 33-010(a), and 33-010(d) that are included in the Laboratory's National Pollutant Discharge Elimination System individual permit. Plate 1 shows the locations of these SMAs at East Site. Rain gage 340 is located about 1.25 mi northwest of the East Site.

7.0 SCHEDULE

Preparation for investigation activities is anticipated to take approximately 3 mo. Fieldwork is expected to take 3–4 mo and preparation of the investigation report is anticipated to take approximate 6 mo after field work activities are completed. The total duration to implement the investigation and submit the final report is approximately 1 yr.

8.0 REFERENCES AND MAP DATA SOURCES

8.1 References

The following list includes all documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ER ID or ESH ID. This information is also included in text citations. ER IDs were assigned by the Environmental Programs Directorate's Records Processing Facility (IDs through 599999), and ESH IDs are assigned by the ESH Directorate (IDs 600000 and above). IDs are used to locate documents in the Laboratory's Electronic Document Management System and, where applicable, in the master reference set.

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

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8.2 Map Data Sources

Sampling location: er_location_ids_pnt; ER Project Locations; Los Alamos National Laboratory, ESH&Q Waste and Environmental Services Division, 2010-2E; 1:2,500 Scale Data; 04 October 2010.

SWMU or AOC: er_res_all_reg; Potential Release Sites; Los Alamos National Laboratory, ESH&Q Waste & Environmental Services Division, Environmental Data and Analysis Group, EP2010-1C; 1:2,500 Scale Data; 02 December 2010.

Structure or building: ksl_structures_ply; Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Fence: ksl_fences_arc: Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Paved road: ksl_paved_rds_arc; Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Unpaved road: ksl_dir_rds_arc; Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 29 November 2010.

Contours (Site Maps, East Site Inset): generated from 2014 LIDAR DATA

Communication line: ksl_comm_arc; Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 08 August 2002; as published 29 November 2010.

Surface Water Sampling Station: er_location_ids_pnt; ER Project Locations; Los Alamos National Laboratory, ESH&Q Waste and Environmental Services Division, 2010-2E; 1:2,500 Scale Data; 04 October 2010.

Former structure [33-006(b)]: digitized from engineering drawing C-34651, sheet 1; May, 2015.

Former structure [33-007(a)]: digitized from engineering drawing C-34651, sheet 1; May, 2015.

Storm drain [33-003(c)]: based on field observations by McCrory, email 14 May, 2015.

Drainline (33-004(c), 33-004(k)): digitized from engineering drawing C-3304, sheet 3; May, 2015.

South Ancho Canyon Aggregate Area (Plate, Inset): er_agg_areas_ply; Aggregate Areas; Los Alamos National Laboratory, ENV Environmental Remediation & Surveillance Program, ER2005-0496; 1:2,500 Scale Data; 22 September 2005.

Technical area boundary (Plate, Inset): plan_tecareas_arc; Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 13 August 2010.

LANL boundary (Inset): plan_tecareas_ply; Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 13 August 2010.

River (Plate, Inset): wqh_drainage_arc: WQH Drainage_arc; Los Alamos National Laboratory, ENV Water Quality and Hydrology Group; 1:24,000 Scale Data; 03 June 2003.

Spring: er_springs_pt (Plate): Locations of Springs; Los Alamos National Laboratory, Waste and Environmental Services Division in cooperation with the New Mexico Environment Department, Department of Energy Oversight Bureau, EP2008-0138; 1:2,500 Scale Data; 17 March 2008.

Surface Water Monitoring Station (Plate): er_location_ids_pnt; ER Project Locations; Los Alamos National Laboratory, ESH&Q Waste and Environmental Services Division, 2010-2E; 1:2,500 Scale Data; 04 October 2010.

Primary paved road (Inset): ksl_centerline_arc; Road Centerlines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 15 December 2005; Unknown publication date.

Secondary paved road (Inset): ksl_centerline_arc; Road Centerlines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 15 December 2005; Unknown publication date.

Contours (Plate 1): lanl_contour1991_; Hypsography, 2, 10, 20, 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

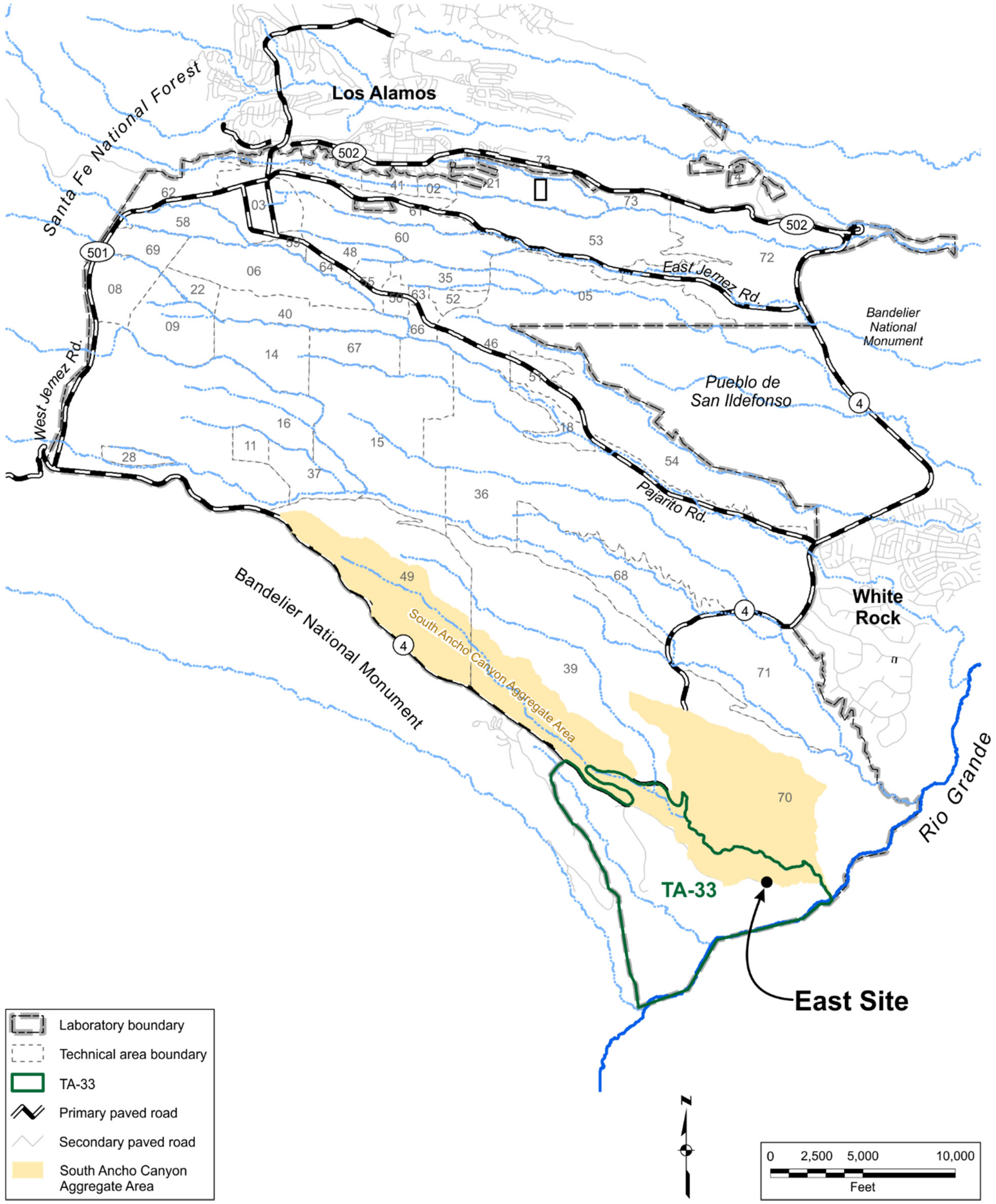

Figure 1.0-1 South Ancho Canyon Aggregate Area with respect to Laboratory TAs and surrounding land holdings

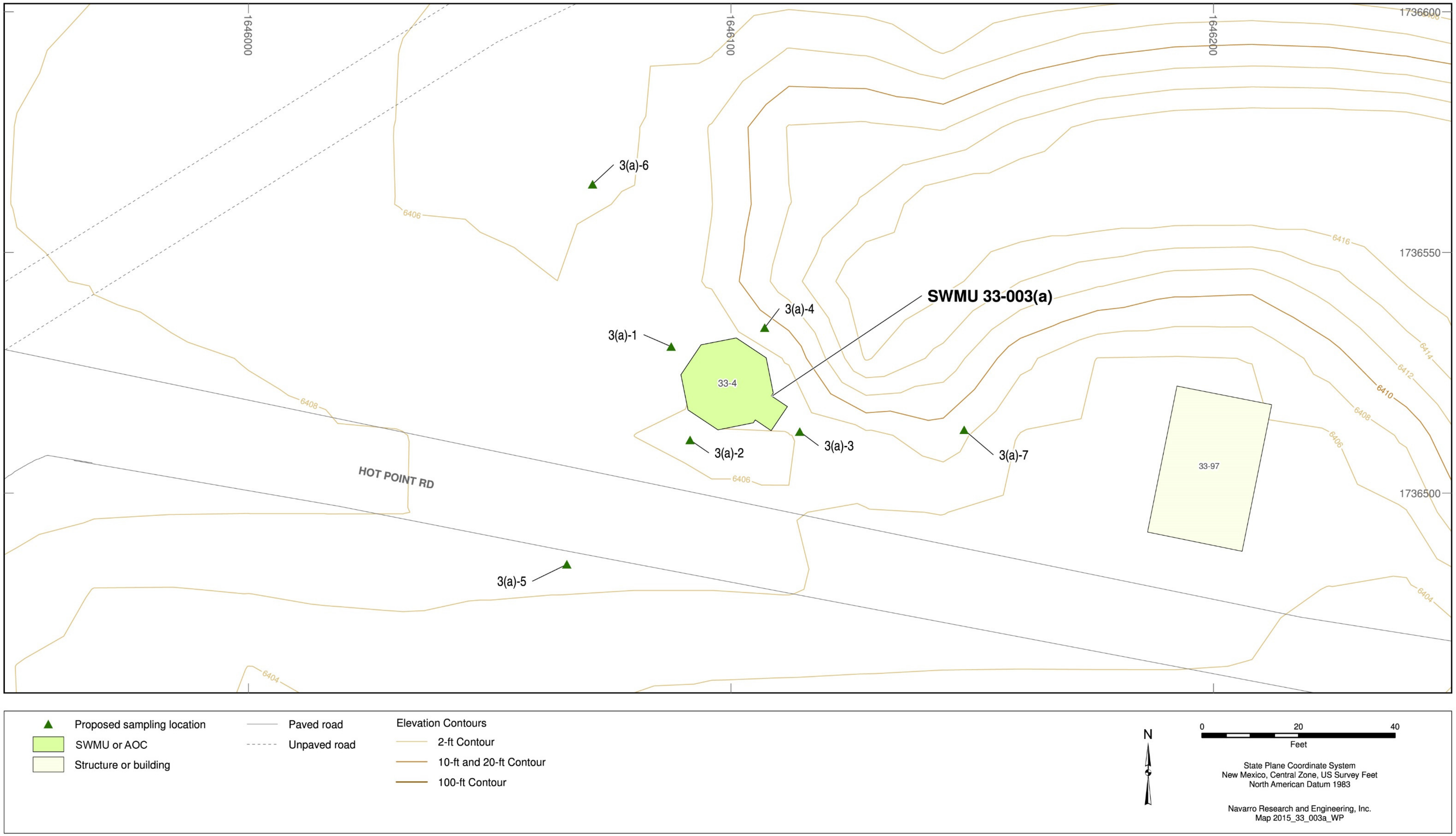

Figure 4.1-1 Proposed sampling locations at SWMU 33-003(a)

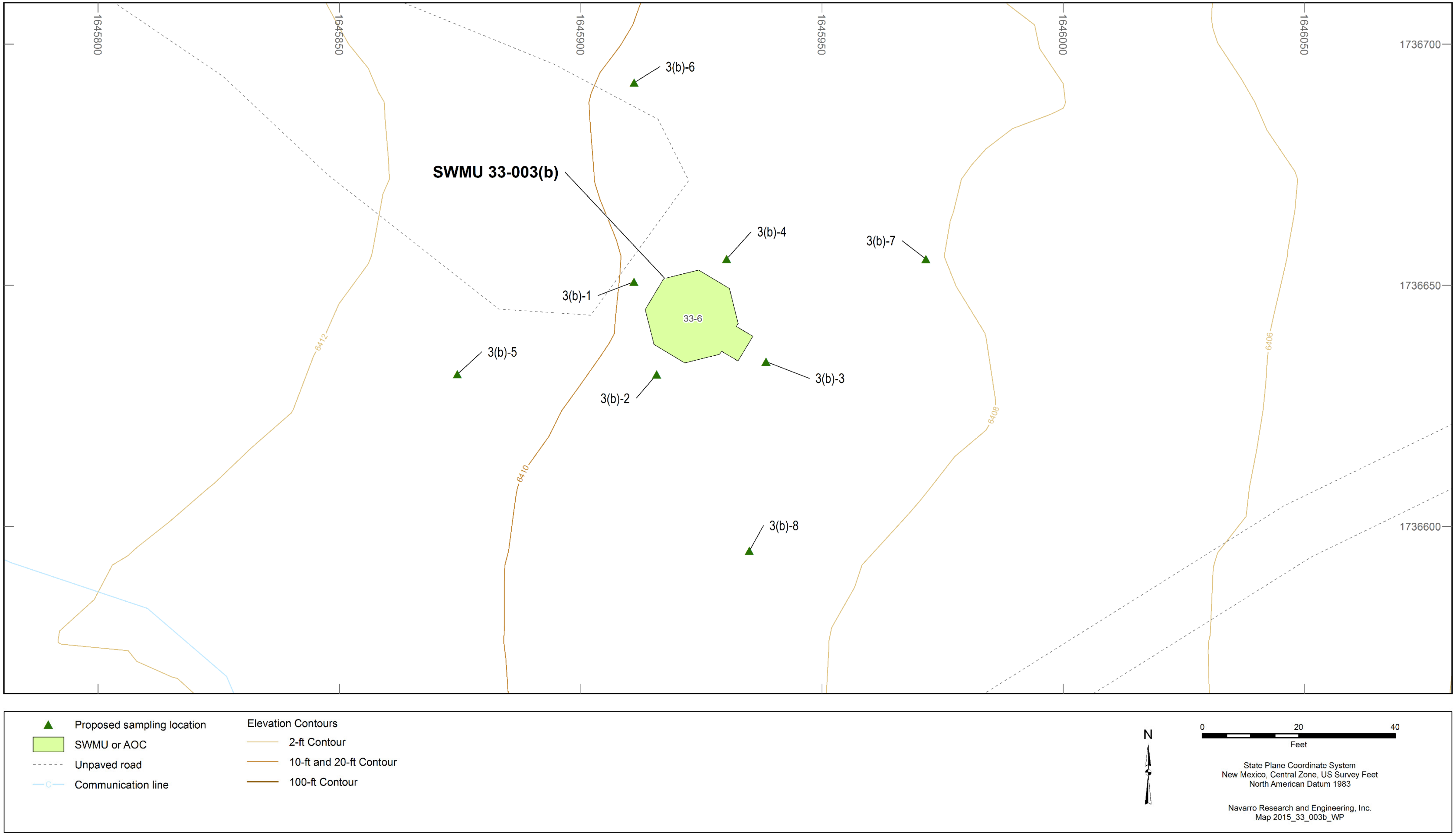

Figure 4.2-1 Proposed sampling locations at SWMU 33-003(b)

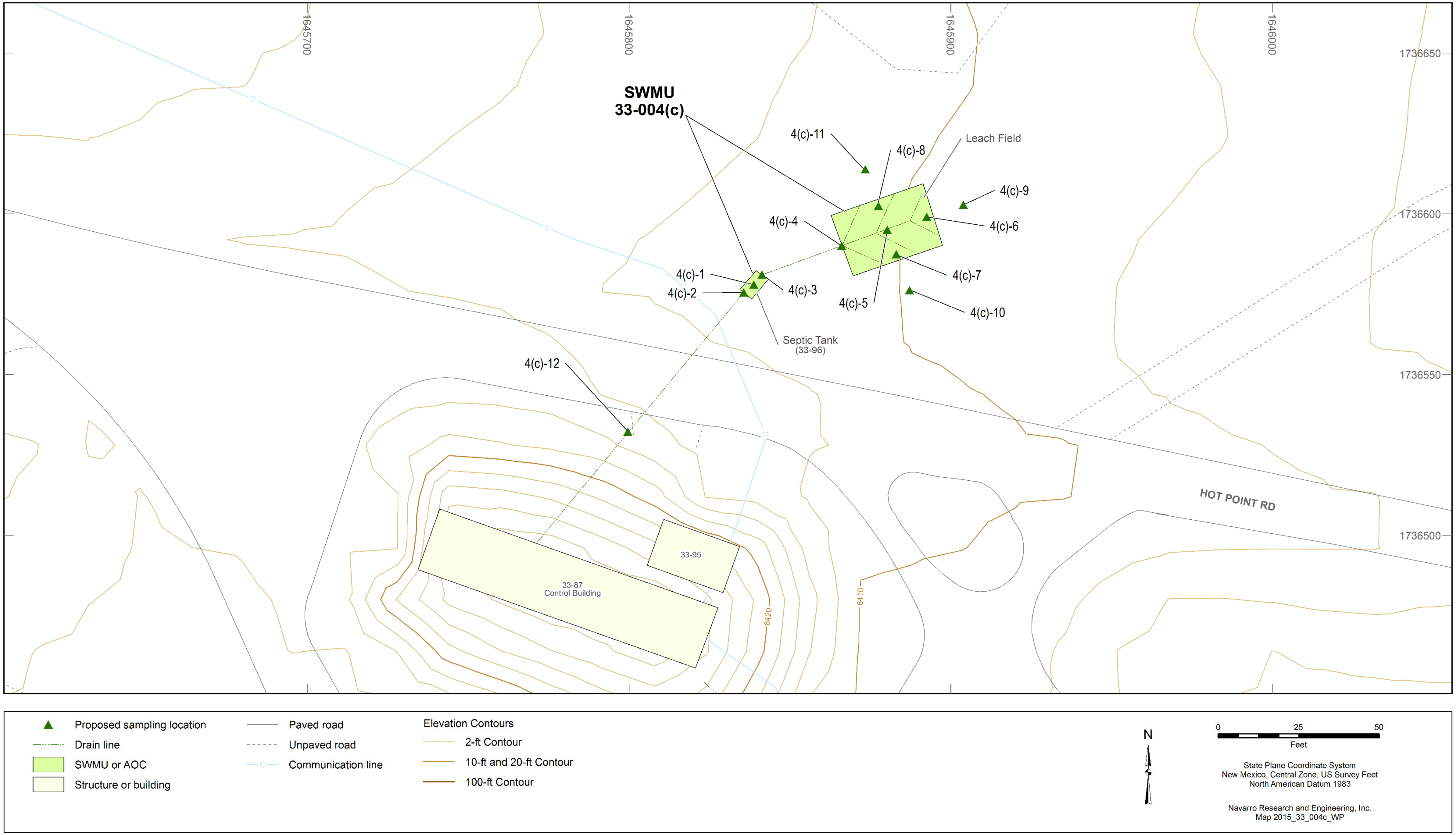

Figure 4.3-1 Proposed sampling locations at SWMU 33-004(c)

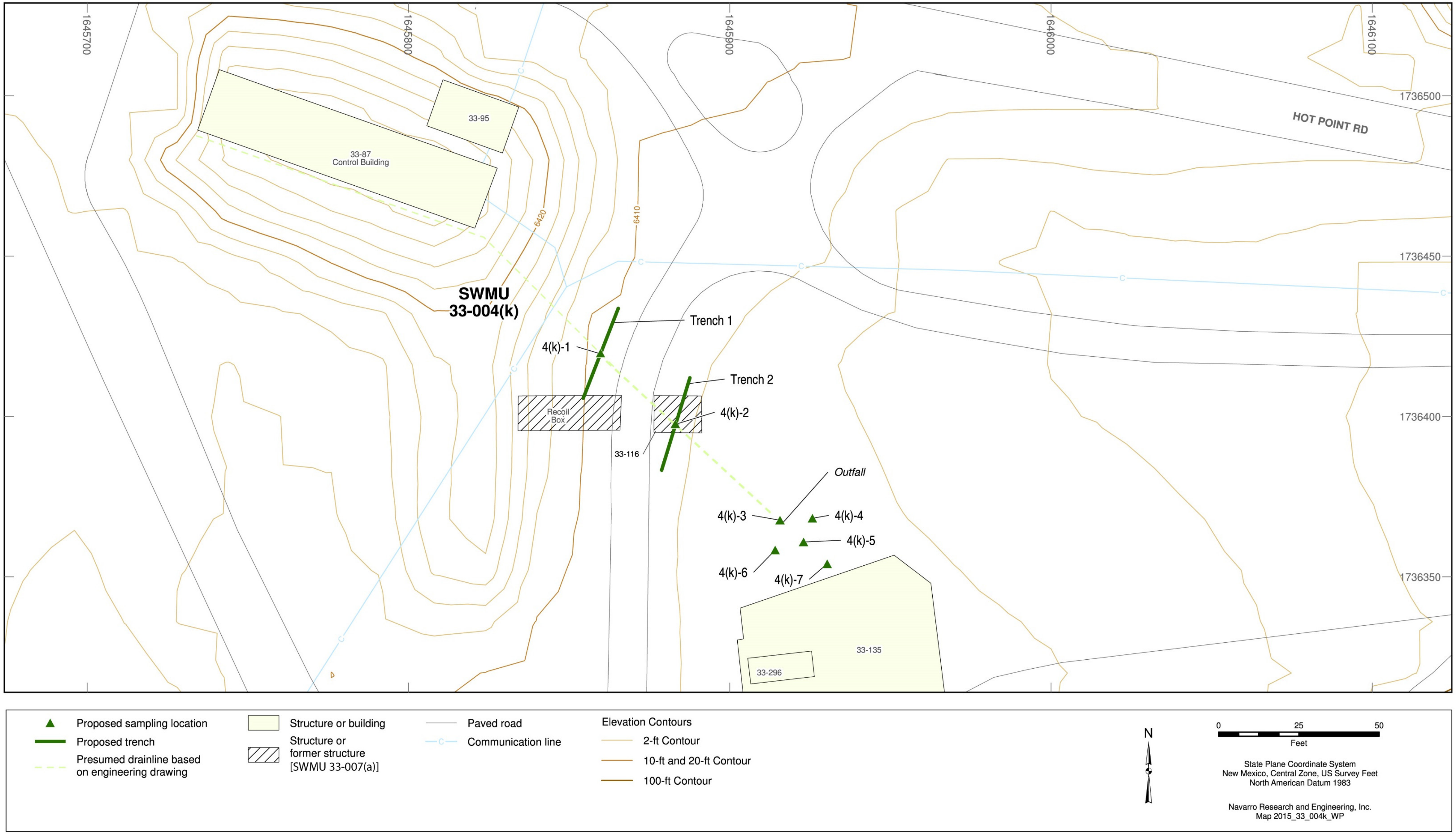

Figure 4.4-1 Proposed sampling locations at SWMU 33-004(k)

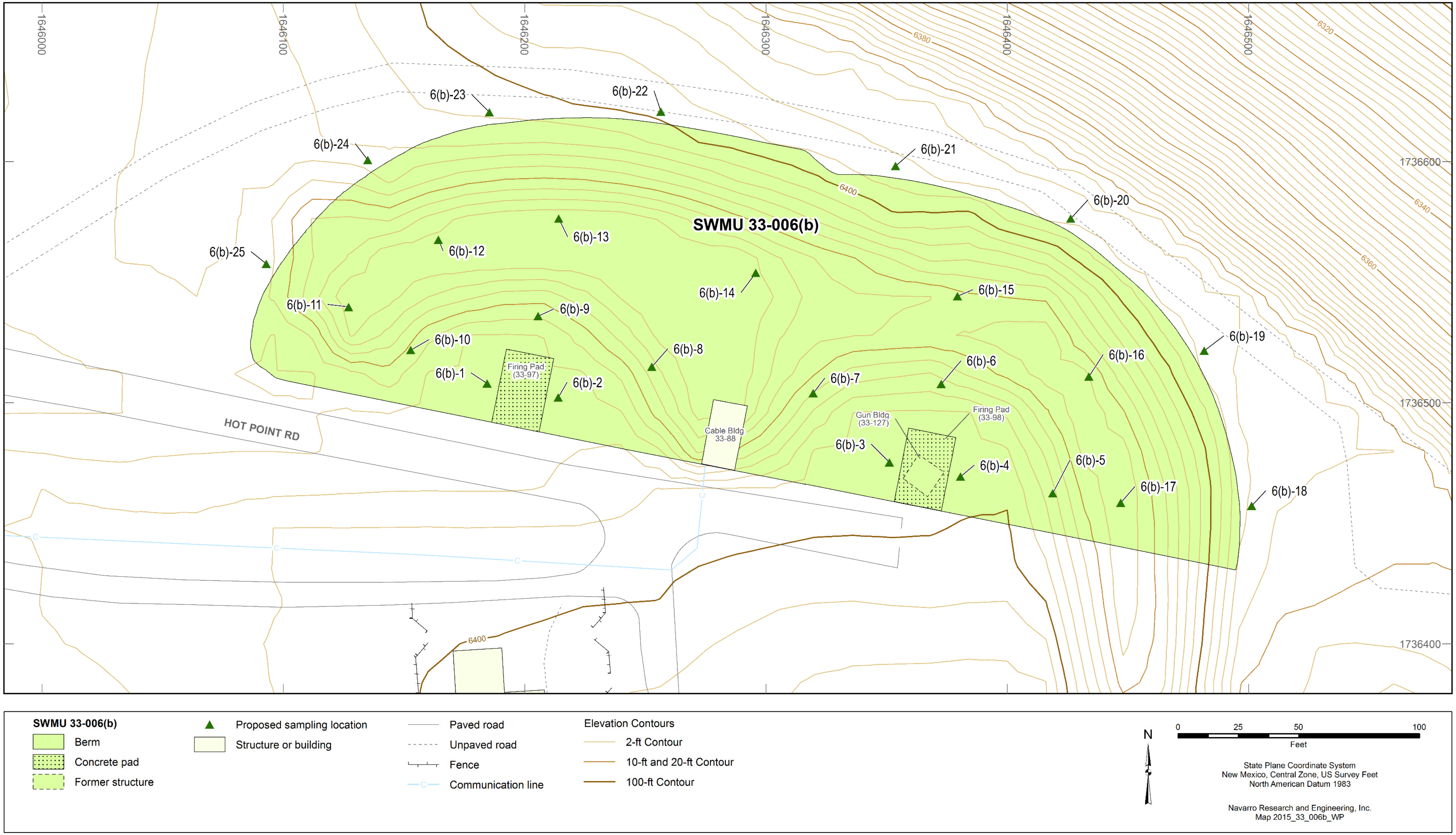

Figure 4.5-1 Proposed sampling locations at SWMU 33-006(b)

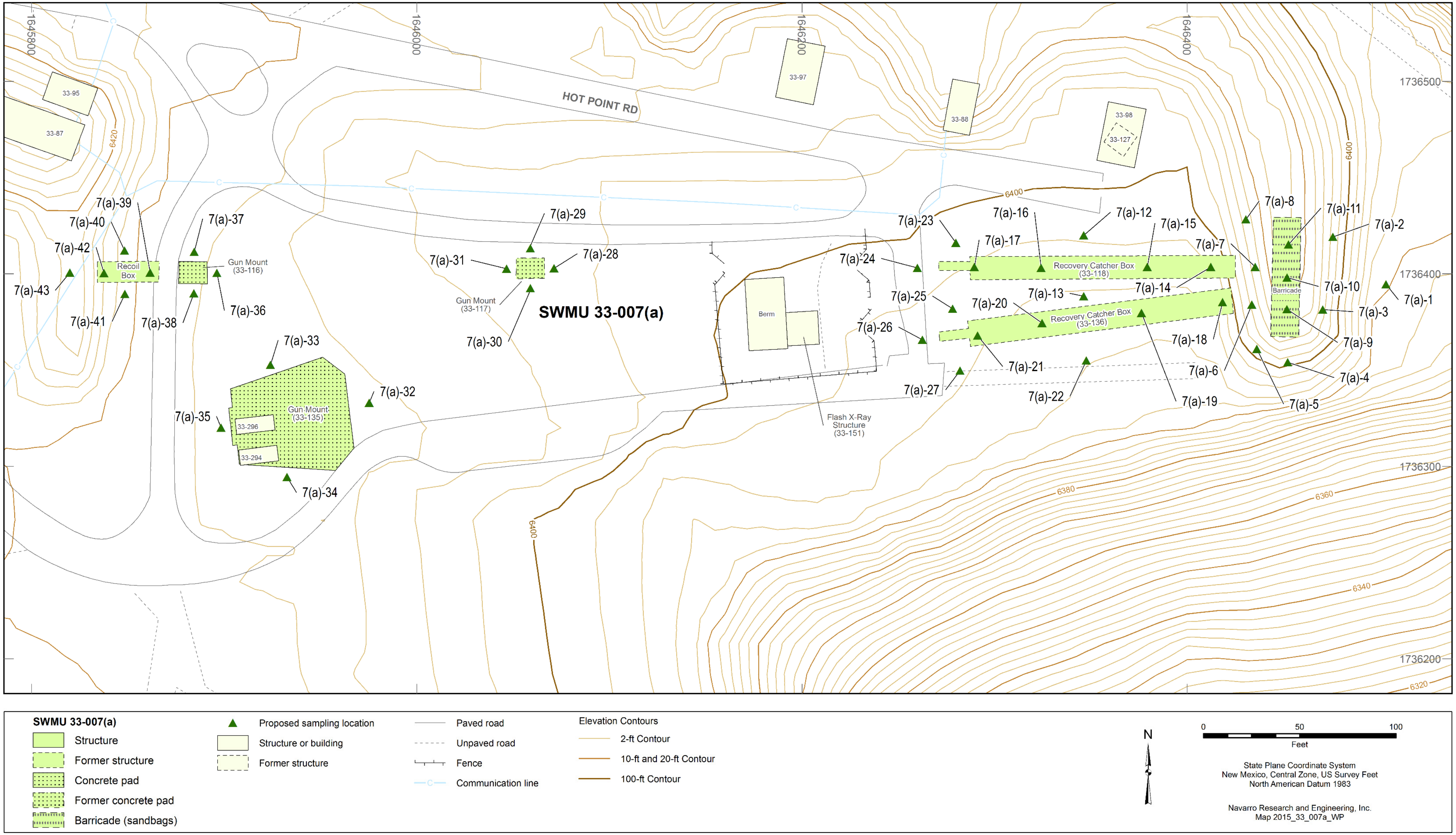

Figure 4.6-1 Proposed sampling locations at SWMU 33-007(a)

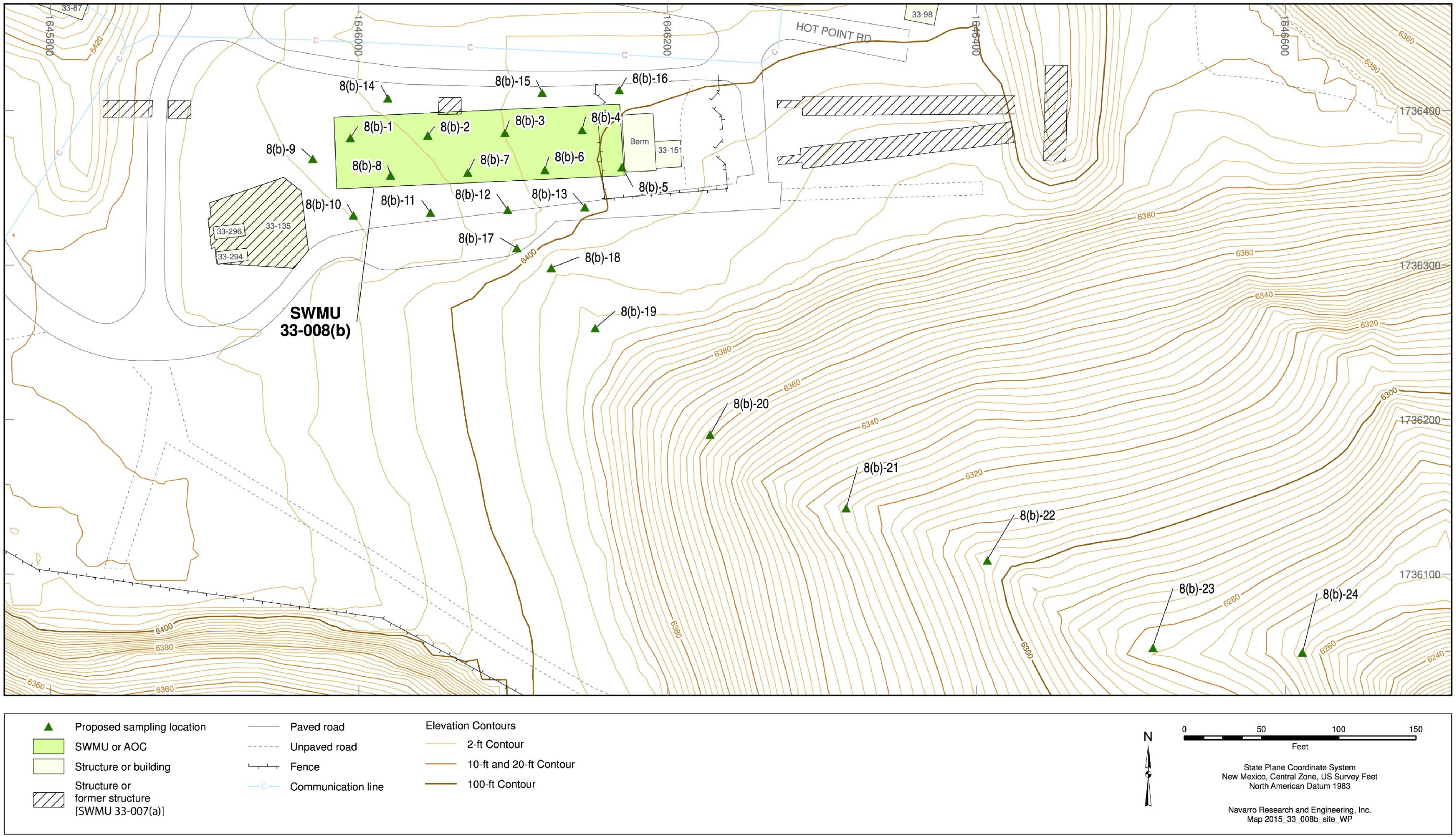

Figure 4.7-1 Proposed sampling locations at SWMU 33-008(b)

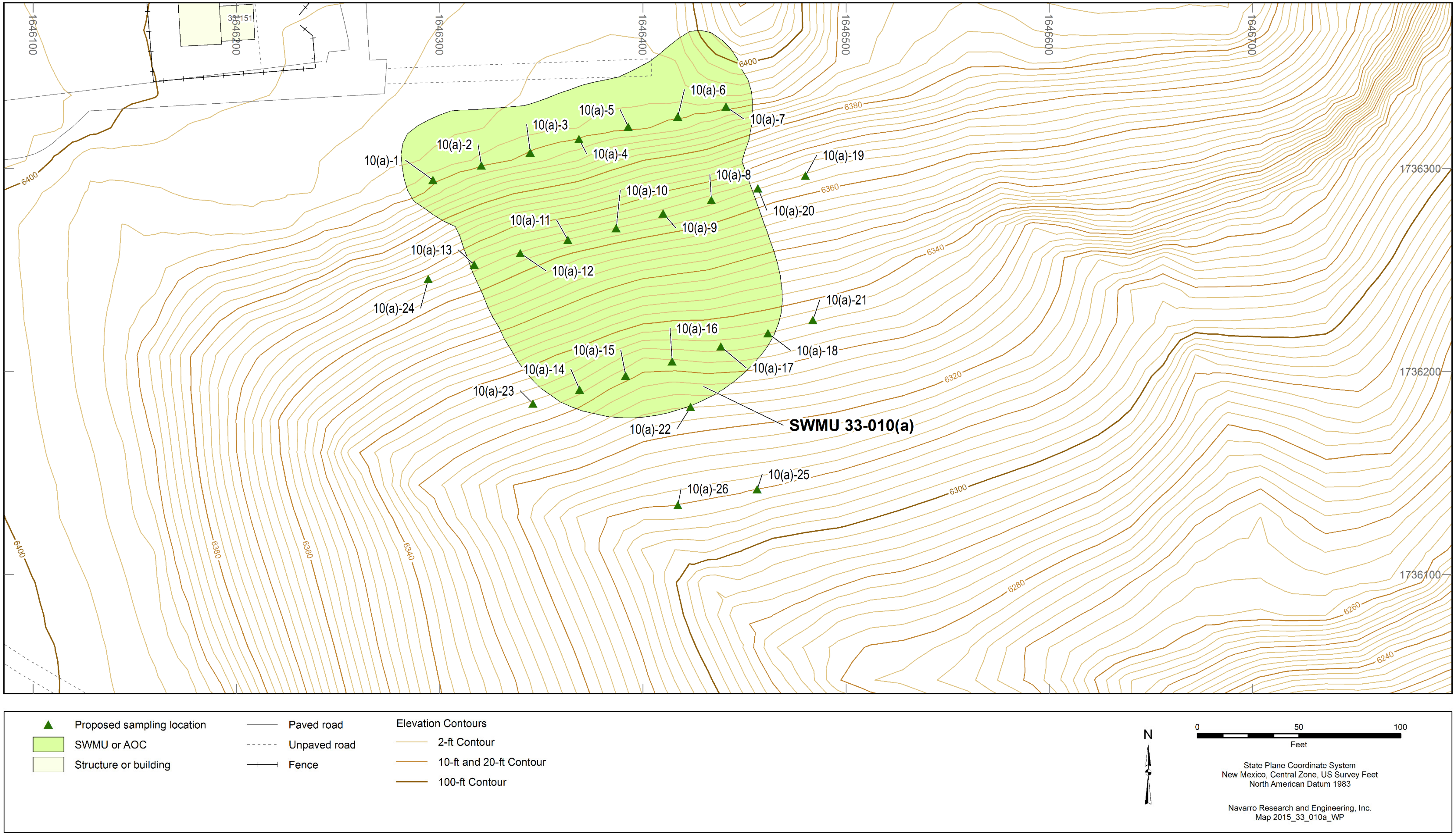

Figure 4.8-1 Proposed sampling locations at SWMU 33-010(a)

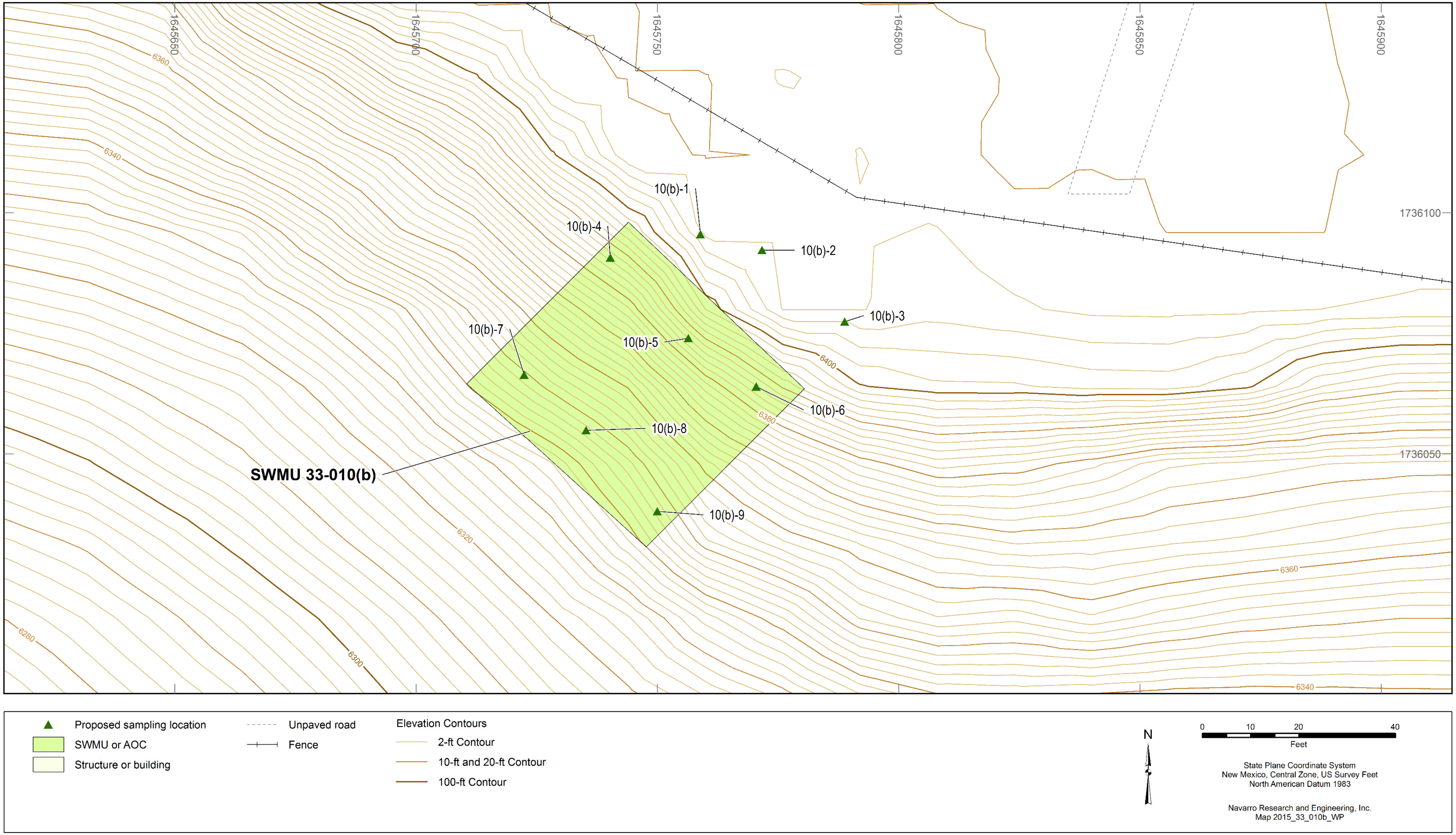

Figure 4.9-1 Proposed sampling locations at SWMU 33-010(b)

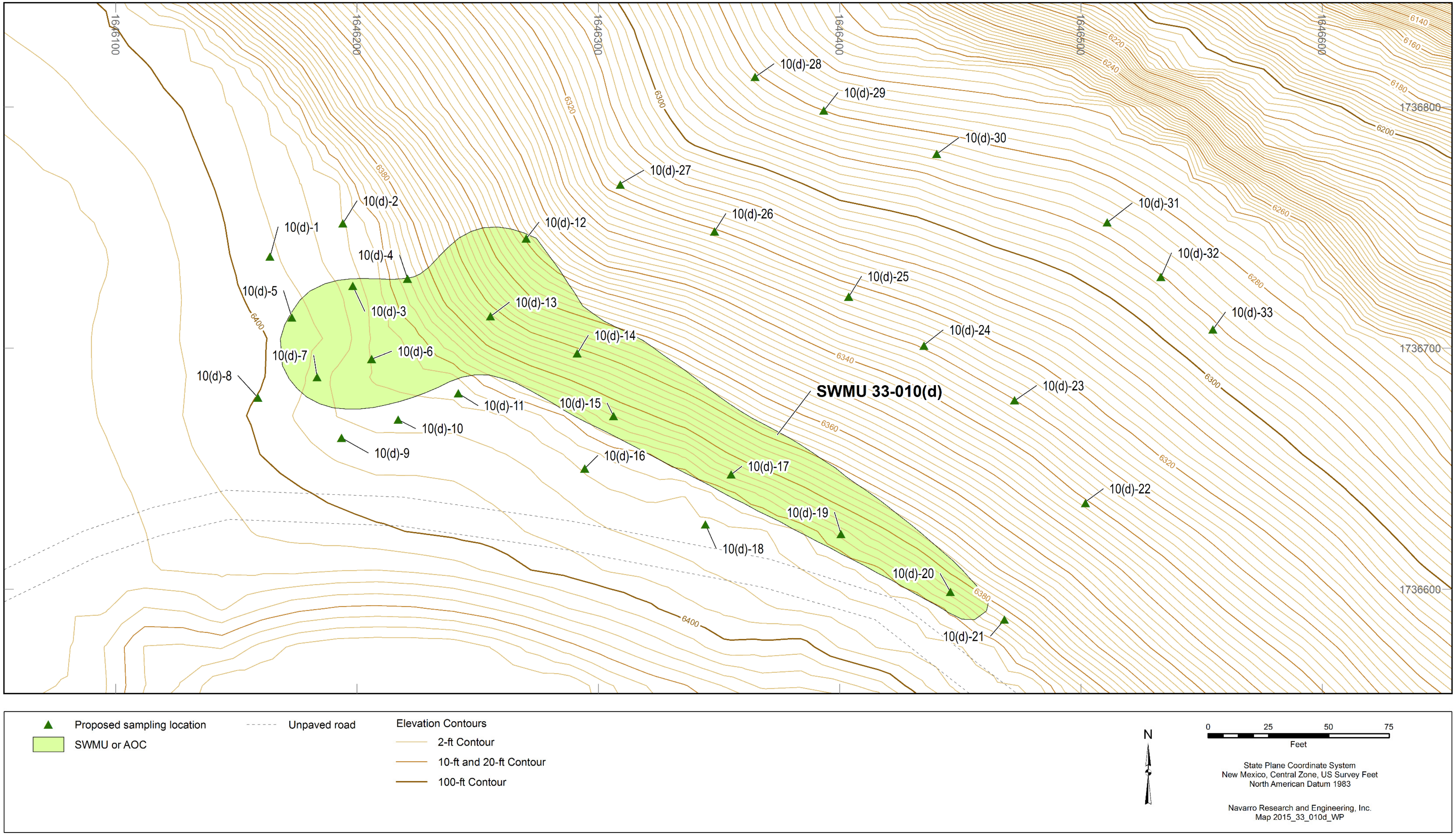

Figure 4.10-1 Proposed sampling locations at SWMU 33-010(d)

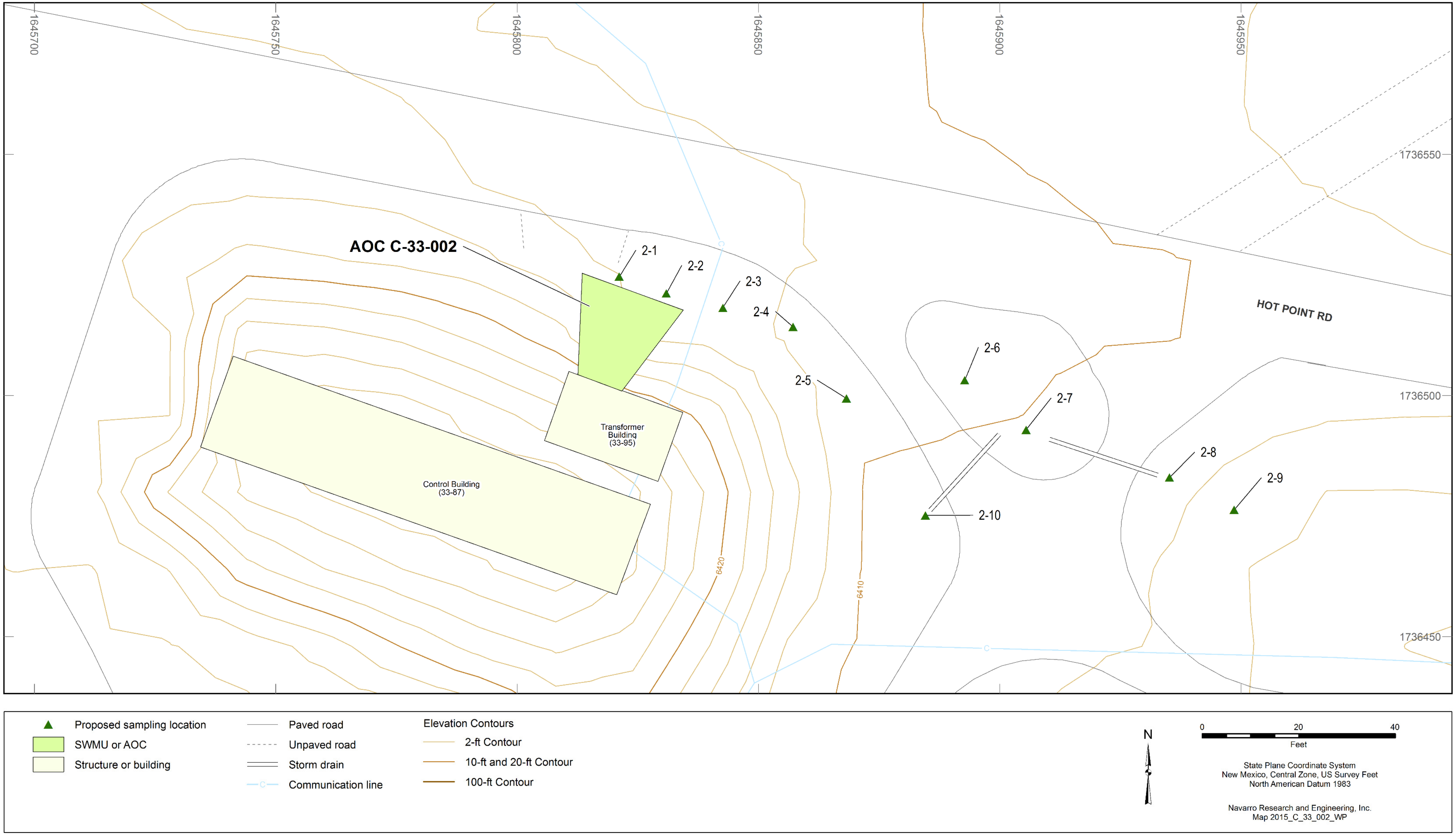

Figure 4.11-1 Proposed sampling locations at AOC C-33-002

Table 1.1-1
Status of SWMUs and AOC in South Ancho Canyon Aggregate Area

Site ID	Brief Description	Site Status	Reference
TA-33			
SWMU 33-003(a)	Soil Contamination	Under investigation	Work plan section 4.1
SWMU 33-003(b)	Soil Contamination	Under investigation	Work plan section 4.2
SWMU 33-004(c)	Septic System	Under investigation	Work plan section 4.3
SWMU 33-004(k)	Drainline and Outfall	Under investigation	Work plan section 4.4
SWMU 33-006(b)	Firing Site	Under investigation	Work plan section 4.5
SWMU 33-007(a)	Firing Site	Under investigation	Work plan section 4.6
SWMU 33-008(b)	Landfill	Under investigation	Work plan section 4.7
SWMU 33-010(a)	Surface Disposal Site	Under investigation	Work plan section 4.8
SWMU 33-010(b)	Surface Disposal Site	Under investigation	Work plan section 4.9
SWMU 33-010(d)	Surface Disposal Site	Under investigation	Work plan section 4.10
AOC C-33-002	Former Transformer	Under investigation	Work plan section 4.11
SWMU 33-004(l)	Outfall	NFA Approved, 07/15/1993	EPA 1993, 027049

Table 4.1-1
Proposed Sampling at SWMU 33-003(a)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	PCBs (EPA SW-846:8082)	Dioxins/Furans (EPA SW-846:8290)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	3(a)-1 through 3(a)-4	West, south, east, and north of chamber 1 (structure 33-4)	0–1 ft bgs	X*	X	X	X	X	X	X	X	X	X
			9–10 ft bgs	X	X	X	X	X	X	X	X	X	X
			19–20 ft bgs	X	X	X	X	X	X	X	X	X	X
			29-30 ft bgs	X	X	X	X	X	X	X	X	X	X
			39-40 ft bgs	X	X	X	X	X	X	X	X	X	X
			49-50 ft bgs	X	X	X	X	X	X	X	X	X	X
			59-60 ft bgs	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	3(a)-5 through 3(a)-7	50 ft laterally from center of Chamber 1 (structure 33-4)	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X
			9–10 ft bgs	X	X	X	X	X	X	X	X	X	X
			19–20 ft bgs	X	X	X	X	X	X	X	X	X	X
			29-30 ft bgs	X	X	X	X	X	X	X	X	X	X
			39-40 ft bgs	X	X	X	X	X	X	X	X	X	X
			49-50 ft bgs	X	X	X	X	X	X	X	X	X	X
			59-60 ft bgs	X	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.2-1
Proposed Sampling at SWMU 33-003(b)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	PCBs (EPA SW-846:8082)	Dioxins/Furans (SW-846:8290)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	3(b)-1 through 3(b)-4	West, south, east, and north of chamber 2 (structure 33-6)	0–1 ft bgs	X*	X	X	X	X	X	X	X	X	X
			9–10 ft bgs	X	X	X	X	X	X	X	X	X	X
			19–20 ft bgs	X	X	X	X	X	X	X	X	X	X
			29-30 ft bgs	X	X	X	X	X	X	X	X	X	X
			39-40 ft bgs	X	X	X	X	X	X	X	X	X	X
			49-50 ft bgs	X	X	X	X	X	X	X	X	X	X
			59-60 ft bgs	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	3(b)-5 through 3(b)-8	50 ft laterally from center of Chamber 2 (structure 33-6)	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X
			9–10 ft bgs	X	X	X	X	X	X	X	X	X	X
			19–20 ft bgs	X	X	X	X	X	X	X	X	X	X
			29-30 ft bgs	X	X	X	X	X	X	X	X	X	X
			39-40 ft bgs	X	X	X	X	X	X	X	X	X	X
			49-50 ft bgs	X	X	X	X	X	X	X	X	X	X
			59-60 ft bgs	X	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.3-1
Proposed Sampling at SWMU 33-004(c)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	VOCs (SW EPA 846:8260B)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	4(c)-1	Below base of septic tank after removal	0–1 ft below septic tank	X*	X	X	X	X	X	X	X	X	X
			2–3 ft below septic tank	X	X	X	X	X	X	X	X	X	X
			5–6 ft below septic tank	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	4(c)-2 and 4(c)-3	Below septic tank inlet and outlet lines	0–1 ft below inlet pipe at septic tank	X	X	X	X	X	X	X	X	X	X
			4–5 ft below outlet pipe at septic tank	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	4(c)-4 through 4(c)-8	In leach field	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X
			0–1 ft below leach field	X	X	X	X	X	X	X	X	X	X
			2–3 ft below leach field	X	X	X	X	X	X	X	X	X	X
			5–6 ft below leach field	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	4(c)-9 through 4(c)-11	Laterally around leach field	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X	X	X
			5–6 ft bgs	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	4(c)-12	Below inlet line	0–1 ft below inlet line	X	X	X	X	X	X	X	X	X	X
			2–3 ft below inlet line	X	X	X	X	X	X	X	X	X	X
			5–6 ft below inlet line	X	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.4-1
Proposed Sampling at SWMU 33-004(k)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	VOCs (SW EPA 846:8260B)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Verify location of drainline and determine nature and extent of contamination	4(k)-1 and 4(k)-2 associated with Trench 1 and Trench 2	West and east of access road below drainline	0–1 ft below drainline	X*	X	X	X	X	X	X	X	X	X
			2–3 ft below drainline	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	4(k)-3	Outfall	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X	X	X
			5–6 ft bgs	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	4(k)-4 through 4(k)-7	Downgradient of outfall	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X	X	X
			5–6 ft bgs	X	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.5-1
Proposed Sampling at SWMU 33-006(b)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	6(b)-1 through 6(b)-4	East and west of firing pads 33-97 and 33-98	0–1 ft bgs	X*	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	6(b)-5 through 6(b)-10	Slope of berm	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
			4–5 ft bgs	X	X	X	X	X	X	X	X
			9–10 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	6(b)-11 through 6(b)-17	Top of berm	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
			4-5 ft bgs	X	X	X	X	X	X	X	X
			9-10 ft bgs	X	X	X	X	X	X	X	X
			14-15 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	6(b)-18 through 6(b)-25	Base of berm	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.6-1
Proposed Sampling at SWMU 33-007(a)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	7(a)-1	Base of berm	0–1 ft bgs	X*	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	7(a)-2 through 7(a)-8	Slope of berm	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
			4-5 ft bgs	X	X	X	X	X	X	X	X
			9-10 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	7(a)-9 through 7(a)-11	Top of berm where former barricade was located	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
			4-5 ft bgs	X	X	X	X	X	X	X	X
			9-10 ft bgs	X	X	X	X	X	X	X	X
			14-15 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	7(a)-12 and 7(a)-27	Recovery catcher boxes	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X

Table 4.6-1 (continued)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	7(a)-28 through 7(a)-31	Former gun mount 33-117	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	7(a)-32 through 7(a)-35	Gun mount 33-135	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	7(a)-36 through 7(a)-38	Gun mount 33-116	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	7(a)-39 through 7(a)-41	Recoil box west of 33-116	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	7(a)-42	Slope of berm near recoil box	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
			4-5 ft bgs	X	X	X	X	X	X	X	X
			9-10 ft bgs	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	7(a)-43	Top of berm near recoil box	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X
			4–5 ft bgs	X	X	X	X	X	X	X	X
			9–10 ft bgs	X	X	X	X	X	X	X	X
			14–15 ft bgs	X	X	X	X	X	X	X	X

*X = Analysis will be performed.

Table 4.7-1
Proposed Sampling at SWMU 33-008(b)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	VOCs (SW EPA 846:8260B)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	PCBs (EPA SW-846:8082)	Dioxins/Furans (EPA SW 846:8290)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	8(b)-1 through 8(b)-16	In and around fill	0–1 ft bgs	X*	X	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X	X	X	X	X
			4–5 ft bgs	X	X	X	X	X	X	X	X	X	X	X	X
			8–9 ft bgs	X	X	X	X	X	X	X	X	X	X	X	X
			1 ft into tuff	X	X	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	8(b)-17 through 8(b)-24	Drainage area to toe of slope	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs or 1 ft into tuff	X	X	X	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.8-1
Proposed Sampling at SWMU 33-010(a)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	VOCs (SW EPA 846:8260B)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	PCBs (EPA SW-846:8082)	Dioxins/Furans (EPA SW 846:8290)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	10(a)-1 through 10(a)-18	25-ft spacing on east-west lines within the disposal area	0–1 ft bgs	X*	X	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	10(a)-19 through 10(a)-26	Laterally around disposal area	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs	X	X	X	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.9-1
Proposed Sampling at SWMU 033-010(b)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	pH (SW-846:9045C)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	PCBs (EPA SW-846:8082)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)	Asbestos (PMM: 300)
Determine nature and extent of contamination	10(b)-1 through 10(b)-3	Canyon rim	0–1 ft bgs	X*	X	X	X	X	X	X	X
			2–3 ft bgs or 1 ft into tuff	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	10(b)-4 through 10(b)-9	Disposal area	0–1 ft bgs	X	X	X	X	X	X	X	X
			2–3 ft bgs or 1 ft into tuff	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.10-1
Proposed Sampling at SWMU 33-010(d)

Objective Addressed	Location Number	Location	Sample Interval	TAL Metals (EPS SW-846:6010B/6020)	Cyanide (EPA SW-846:9012A)	Nitrate (EPA 300)	Perchlorate (EPA SW-846:6850)	pH (SW-846:9045C)	VOCs (SW EPA 846:8260B)	SVOCs (EPA SW-846:8270C)	Explosive Compounds (EPA SW 846:8231A_MOD)	PCBs (EPA SW-846:8082)	Dioxins/Furans (SW-846:8290)	Gamma-Emitting Radionuclides (EPA 901.1)	Isotopic Uranium (HASL-300)
Determine nature and extent of contamination	10(d)-1 through 10(d)-21	Disposal area	0–1 ft bgs	X*	X	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs or 1 ft into tuff	X	X	X	X	X	X	X	X	X	X	X	X
Determine nature and extent of contamination	10(d)-22 through 10(d)-33	Below disposal area	0–1 ft bgs	X	X	X	X	X	X	X	X	X	X	X	X
			2–3 ft bgs or 1 ft into tuff	X	X	X	X	X	X	X	X	X	X	X	X

* X = Analysis will be performed.

Table 4.11-1
Proposed Sampling at AOC C-33-002

Objective Addressed	Location Number	Location	Sample Interval	PCBs (EPA SW-846:8082)	pH (SW-846:9045C)
Determine nature and extent of contamination	2-1 through 2-2	Adjacent to concrete pad	0–1 ft bgs	X*	X
			2–3 ft bgs	X	X
Determine nature and extent of contamination	2-3 through 2-10	Drainage areas	0–1 ft bgs	X	X
			2–3 ft bgs	X	X

* X = Analysis will be performed.

Table 5.0-1
Summary of Investigation Methods

Method	Summary
Geodetic Surveys	This method describes the method for coordinating and evaluating geodetic surveys and establishing quality assurance (QA) and quality 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.
Spade and Scoop Collection of Soil Samples	This method is typically used to collect shallow (e.g., approximately 0-12 in.) soil or sediment 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 sample. The sample is typically placed in a clean, stainless-steel bowl for transfer into various sample containers.
Hand-Auger Sampling	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but may in some cases be used for collecting samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically 3–4-in. inner diameter), creating a vertical hole which can be advanced to the desired sample depth. When the desired depth is reached, the auger is decontaminated before advancing the hole through the sample depth. The sample material is transferred from the auger bucket to a stainless-steel sampling bowl before filling the various required sample containers.
Hollow-Stem Auger Drilling Methods	In this method, hollow-stem augers (sections of seamless pipe with auger flights welded to the pipe) act as a screw conveyor to bring cuttings of sediment, soil, and/or rock to the surface. Auger sections are typically 5 ft in length and have outside diameters of 4.25 to 14 in. Drill rods, split-spoon core barrels, Shelby tubes, and other samplers can pass through the center of the hollow-stem auger sections for collection of discrete samples from desired depths. Hollow-stem augers are used as temporary casings when setting wells to prevent cave-ins of the borehole walls.

Table 5.0-1 (continued)

Method	Summary
Handling, Packaging, and Shipping of Samples	Field team members seal and label samples before packing and ensure that the sample containers and the containers used for transport are free of external contamination. Field team members package all samples so as to minimize the possibility of breakage during transportation. After all environmental samples are collected, packaged, and preserved; a field team member transports the samples to either the SMO or an SMO-approved radiation screening laboratory under chain of custody. The SMO arranges for shipping of samples to analytical laboratories. The field team member must inform the SMO and/or the radiation screening laboratory coordinator when levels of radioactivity are in the action-level or limited-quantity ranges.
Containers and Preservation of Samples	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on EPA guidance for environmental sampling, preservation, and QA. Specific requirements for each sample are printed on the sample collection logs provided by the SMO (size and type of container (glass, amber glass, polyethylene, preservative, etc.). All samples are preserved by placing in insulated containers with ice to maintain a temperature of 4˚C. Other requirements such as nitric acid or other preservatives may apply to different media or analytical requests.
Sample Control and Field Documentation	The collection, screening, and transport of samples are documented on standard forms generated by the SMO. These include sample collection logs, chain-of-custody forms, and sample container labels. Collection logs are completed at the time of sample collection and are signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. Corresponding labels are initialed and applied to each sample container, and custody seals are placed around container lids or openings. Chain-of-custody forms are completed and assigned to verify that the samples are not left unattended. Site attributes (e.g., former and proposed soil sampling locations, sediment sampling locations) are located by using a global positioning system. Horizontal locations will be measured to the nearest 0.5 ft. The survey results for this field event will be presented as part of the investigation report. Sample coordinates will be uploaded into the Laboratory's database system.
Field Quality Control Samples	Field quality control samples are collected as follows: *Field Duplicate*: At a frequency 10%; collected at the same time as a regular sample and submitted for the same analyses. *Equipment Rinsate Blank*: At a frequency of 10%; collected by rinsing sampling equipment with deionized water, which is collected in a sample container and submitted for laboratory analysis. *Trip Blanks*: Required for all field events that include the collection of samples for VOC analysis. Trip blanks containers of certified clean sand that are opened and kept with the other sample containers during the sampling process.
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination is the preferred method to minimize generating liquid waste. Dry decontamination may include the use of a wire brush or other tool to remove soil or other material adhering to the sampling equipment, followed by use of a commercial cleaning agent (nonacid, waxless) and paper wipes. Dry decontamination may be followed by wet decontamination if necessary. Wet decontamination may include washing with a nonphosphate detergent and water, followed by a water rinse and a second rinse with deionized water. Alternatively, steam cleaning may be used.

Table 5.0-1 (continued)

Method	Summary
Management, Characterization, and Storage of IDW	IDW is managed, characterized, and stored in accordance with an approved waste characterization strategy form that documents site history, field activities, and the characterization approach for each waste stream managed. Waste characterization shall be adequate to comply with on-site or off-site waste acceptance criteria. All stored IDW will be marked with appropriate signage and labels, as appropriate. Drummed IDW will be stored on pallets to prevent the containers from deterioration. Generators are required to reduce the volume of waste generated as much as technically and economically feasible. Means to store, control, and transport each potential waste type and classification shall be determined before field operations that generate waste begin. A waste storage area shall be established before waste is generated. Waste storage areas located in controlled areas of the Laboratory shall be controlled as needed to prevent inadvertent addition or management of wastes by unauthorized personnel. Each container of waste generated shall be individually labeled as to waste classification, item identification number, and radioactivity (if applicable), immediately following containerization. All waste shall be segregated by classification and compatibility to prevent cross-contamination. Appendix B presents additional information regarding IDW.

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

AK	acceptable knowledge
amsl	above mean sea level
AOC	area of concern
bgs	below ground surface
BV	background value
Consent Order	Compliance Order on Consent
DOE	Department of Energy (U.S.)
EM	electromagnetic
EPA	Environmental Protection Agency (U.S.)
ESH	Environment, Safety, and Health
FV	fallout value
GPS	global positioning system
HE	high explosives
HIR	historical investigation report
IDW	investigation-derived waste
LANL	Los Alamos National Laboratory (the Laboratory)
LASL	Los Alamos Scientific Laboratory
LLW	low-level waste
MDA	material disposal area
NDA	no detectable activity
NFA	no further action
NMED	New Mexico Environment Department
NRAO	National Radio Astronomy Observatory
PCB	polychlorinated biphenyl
PID	photo ionizing detector
QA	quality assurance
RFI	Resource Conservation and Recovery Act facility investigation
SMA	site monitoring area
SMO	sample management office
SOP	standard operating procedure
SSL	soil screening level
SVOC	semivolatile organic compound

SWMU	solid waste management unit
TA	technical area
TAL	target analyte list
VCA	voluntary corrective action
VOC	volatile organic compound
WAC	waste acceptance criteria
WCSF	waste characterization strategy form

A-2.0 METRIC CONVERSION TABLE

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

A-3.0 DATA QUALIFIER DEFINITIONS

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

Appendix B

Management Plan for Investigation-Derived Waste

B-1.0 INTRODUCTION

This appendix describes how investigation-derived waste (IDW) generated during the South Ancho Canyon Aggregate Area investigation will be managed. IDW may include, but is not limited to, drill cuttings, excavated media, contact waste, decontamination fluids, and all other waste that has potentially come into contact with contaminants.

B-2.0 IDW

Area of Contamination request(s) may be submitted for approval to the New Mexico Environment Department (NMED) for remediation sites in which excavation and/or drilling is planned.

All IDW generated during investigation activities will be managed in accordance with applicable standard operating procedures (SOP). These SOPs incorporate the requirements of all applicable U.S. Environmental Protection Agency and NMED regulations, U.S. Department of Energy (DOE) orders, and Laboratory requirements. The SOP applicable to the characterization and management of IDW is EP-DIR-SOP-10021, Characterization and Management of Environmental Programs Waste, available at http://permalink.lanl.gov/object/tr?what=info:lanl-repo/eprr/ERID-213463.

The most recent version of Los Alamos National Laboratory's (the Laboratory's or LANL's) Hazardous Waste Minimization Report will be implemented during the investigation to minimize waste generation. The report is updated annually as a requirement of the Laboratory's Hazardous Waste Facility Permit.

A waste characterization strategy form (WCSF) will be prepared and approved per requirements of EP-DIR-SOP-10021. The WCSF will provide detailed information on IDW characterization methods, management, containerization, and potential volumes. IDW characterization is completed through review of investigation data and/or documentation or by direct sampling. Waste characterization may include a review of historical information and process knowledge to identify whether listed hazardous waste may be present (i.e., due diligence reviews). If low levels of listed hazardous waste are identified, a "contained in" determination may be submitted for approval to NMED.

Wastes will be containerized and placed in clearly marked and appropriately constructed waste accumulation areas. If IDW is generated within the boundary of an area of potential contamination, it will be managed as nonhazardous within those boundaries in designated, properly constructed waste management areas. If hazardous, the IDW will be managed in accordance with hazardous waste requirements once it is removed from the area of contamination. If IDW is generated outside of area of contamination boundaries, the initial management of the waste will rely on the data from previous investigations and/or process knowledge. If the analytical data change the expected waste category, the waste will be managed in accumulation areas appropriate to the final waste determination. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on the type of IDW and its classification. Container and storage requirements, as well as transportation and disposal requirements, will be detailed in the WCSF and approved before waste is generated. Table B-2.0-1 summarizes the estimated IDW waste streams, waste types, waste volumes, and other data.

The waste streams that are anticipated to be generated during work plan implementation are described below.

B-2.1 Drill Cuttings

This waste stream consists of soil and rock chips generated by the drilling of boreholes with the intent to sample. Drill cuttings include excess core sample not submitted for analysis and any returned samples sent for analysis. Drill cuttings will be containerized in 20 yd^3 rolloff containers, 55 gal. drums, B-12 containers, or other appropriate containers at the point of generation.

This waste stream will be characterized based either on direct sampling of the waste in each container or on the results from core samples collected during drilling. If directly sampled, the samples will be analyzed for the same analytical suites as identified for each site, and, if needed, toxicity characteristic metals. Other constituents may be analyzed as necessary to meet the waste acceptance criteria (WAC) for a receiving facility or if visual observations indicate that additional contaminants may be present. All wastes will be treated/disposed of at an authorized off-site facility appropriate for the waste classification.

B-2.2 Excavated Environmental Media

Layback and overburden spoils will consist of soil and rock removed from within or next to areas within the solid waste management unit (SWMU) or area of concern that is to be excavated. The excavated material will be field-screened and examined for high explosives, radioactivity, and/or organic vapors during the excavation process. If the contamination is not detected during screening, the spoils will be stored either in rolloff bins, in other suitable containers, or on the ground surface with appropriate best management practices. If field screening indicates the potential for contamination, the layback and overburden spoils will be placed in rolloff bins or other suitable containers. The excavated material will remain within the boundary of the site, when possible, from which it was excavated.

Incremental samples of the spoils will be collected as the spoils area excavated or the media may be sampled in piles or containers. A minimum of one direct sample will be collected from each 50 yd^3 or each container of material excavated and will be submitted for laboratory analyses for the same analytical suites as identified for each site, and, if needed, toxicity characteristic metals. Other constituents may be analyzed as necessary to meet the WAC for a receiving facility. If the spoils are determined to be suitable for reuse (i.e., meets residential cleanup standards as determined by using NMED's and DOE's soil screening guidance), the Laboratory may use the soil to backfill the bottom of the excavations. If the spoils are not suitable for reuse, they will be treated/disposed of at an authorized facility appropriate for the waste regulatory classification. The Laboratory expects most of the excavated environmental media to be designated as nonhazardous, nonradioactive waste.

B-2.3 Excavated Manmade Debris

Excavated manmade debris will be generated at SWMU 33-004(c) during excavation of the septic tank. To the extent possible, debris will be segregated as it is excavated. If present, the contents of the septic tank will be sampled and analyzed for metals, cyanide, nitrate, perchlorate, pH, volatile organic compounds, semivolatile organic compounds, explosive compounds, gamma-emitting radionuclides, isotopic uranium, and, if needed, toxicity characteristic metals. If the septic tank is empty, swipe samples will be collected. The exact sampling method will have to be identified by qualified sampling personnel, and all decisions will be documented in the field activity notebook. Waste minimization will be implemented, where practicable, through segregation of waste materials. Nonhazardous materials that can be shown to meet no detectable activity (NDA) for radionuclides or that can be decontaminated to meet NDA will be recycled, if practicable.

B-2.4 Contact Waste

The contact waste stream consists of potentially contaminated materials that “contacted” waste during sampling and excavation. This waste stream consists primarily of, but is not limited to, personal protective equipment such as gloves; decontamination wastes such as paper wipes; and disposable sampling supplies. Contact waste will be stored in containers and managed in accordance with the applicable Laboratory waste management requirements based on the waste characterization results.

Characterization of this waste stream will use acceptable knowledge (AK) based on data from the media with which it came into contact (e.g., drill cuttings, soil, sumps, etc.). The Laboratory expects most of the contact waste to be designated as nonhazardous, nonradioactive waste that will be disposed of at an authorized on-site or off-site facility.

B-2.5 Decontamination Fluids

Decontamination fluids consist of liquid wastes generated from decontamination of excavation, sampling, and drilling equipment. All sampling and measuring equipment, including but not limited to stainless-steel sampling tools and split-barrel or core samplers, will be decontaminated in accordance with EP-ERSS-SOP-5061, Field Decontamination of Equipment.

Consistent with waste minimization practices, the Laboratory uses dry decontamination methods to the greatest extent possible. If dry decontamination cannot be performed, liquid decontamination wastes will be collected in containers at the point of generation. The fluids will be characterized through AK of the waste materials, the level of contamination measured in the environmental media (e.g., the results of the associated drill cuttings), and, if necessary, direct sampling of the containerized waste. If directly sampled, the samples will be analyzed for the same analytical suites as identified for each site, and, if needed, toxicity characteristic metals and other analytes required by the receiving facility (i.e., total suspended solids, Microtox, chemical oxygen demand, oil and grease, pH, nitrates). The Laboratory expects most of these wastes to be nonhazardous liquid waste that will be sent to one of the Laboratory’s wastewater treatment facilities where the WAC allows the waste to be received.

Table B-2.0-1
Summary of Estimated IDW Generation and Management

Waste Stream	Expected Waste Type	Expected Disposition
Drill Cuttings	Nonhazardous or low-level waste (LLW)	Treatment/disposal at an authorized off-site facility
Excavated Environmental Media	Nonhazardous or low-level waste (LLW)	Reused as fill at the excavation location or treated/disposed of at an authorized on-site or off-site facility
Excavated Man-made Debris	Industrial, hazardous, LLW, or mixed LLW	Disposal at an approved off-site facility, recycled
Contact Waste	Nonhazardous or LLW	Disposal at an approved on-site or off-site facility
Decontamination Fluids	Nonhazardous or LLW	Treatment at an on-site wastewater treatment facility