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1	Letter	8/31/2004	Submittal of "Investigation Work Plan for Delta Prime Site Aggregate Area at Technical Area 21" (w/enclosures a/s)		
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85	CD	8/1/2004	Target Page for CD: IWP for Delta Prime Site Aggregate at TA 21, August 2004 (Appendix B Data and Electronic Version of Report) LA-UR-04-5009 ER2004-0409 N/A		
88	Engineering Drawing	1/22/1955	Eng4-C805 Toilet Facilities Warehouse DPW-7, TA-21 (Sheet 1 of 1) N/A N/A N/A		
89	Drawing		TA-21-20, DP Laundry Reconstruction of the site of TA-21-20 (Demolished 1968) Dimensioning the proposed sample boring locations. N/A N/A N/A		
90	Engineering Drawing	3/19/1946	Eng-C 2214 Sheet U6, Septic Tanks, DP Site Construction Eng-C 2214 N/A N/A		
91	Engineering Drawing	5/1/1964	Eng-C 31984 Sheet 5 of 49, High Temperature Chemistry Facility (Building DP-209 TA-21) Plot Plan Utilities, Plan & Details ENG-C 31984 N/A N/A		
92	Signature Form	8/25/2004	RRES-RS Document Signature Form re ER2004-0482: Submittal of "IWP for Delta Prime Site Aggregate Area at TA 21" N/A N/A N/A		
94	TIR Form	7/26/2004	LANL Technical Information Release Form: IWP for Delta Prime Site Aggregate Area at TA 21, LA-UR-04-5009 N/A N/A N/A		
95	Signature Form	8/30/2004	RRES-RS Document Signature Form re ER2004-0409: IWP for Delta Prime Site Aggregate Area at TA 21 N/A N/A N/A		

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Los Alamos
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Date: August 31, 2004
Refer To: ER2004-0482

Mr. John Young, Project Leader
Permits Management Program
NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East
Building 1
Santa Fe, NM 87505-6303

SUBJECT: SUBMITTAL OF "INVESTIGATION WORK PLAN FOR DELTA PRIME SITE AGGREGATE AREA AT TECHNICAL AREA 21"

Dear Mr. Young:

Enclosed please find two copies of the "Investigation Work Plan for Delta Prime Site Aggregate Area at Technical Area 21" and the certification by Risk Reduction and Environmental Stewardship – Remedial Services (RRES-RS). Copies of the engineering drawings cited in the work plan are included for your convenience. Additional copies of this work plan are available upon request.

If you have any questions, please contact Mark Thacker (505) 665-5342 or Woody Woodworth at (505) 665-5820.

Sincerely,

David McInroy, Deputy Project Director
Remediation Services
Los Alamos National Laboratory

Sincerely,

David Gregory, Federal Project Director
Department of Energy
Los Alamos Site Operations

DM/DG/MT/jr

Enclosures: 1) Investigation Work Plan for Delta Prime Site Aggregate Area at Technical Area 21 (ER2004-0409)
2) Certification by RRES-RS
3) Engineering drawings (four to be added to TA-21 reference set)

Cy:(w/enc)
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E. Rainey, RRES-ECR, MS M992
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IM-9, MS A150
RPF MS M707

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J. Bearzi, NMED-HWB
C. Voorhees, NMED-OB

CERTIFICATION

CERTIFICATION BY THE RISK REDUCTION AND ENVIRONMENTAL STEWARDSHIP–REMEDIATION SERVICES (RRES-RS) PROJECT TECHNICAL REPRESENTATIVES

Document Title: **INVESTIGATION WORK PLAN FOR DELTA PRIME SITE AGGREGATE AREA AT TECHNICAL AREA 21**

I certify under penalty of law that these documents and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

Name: _____ Date: 8/31/04

David McInroy, Deputy Project Director
Remediation Services
Los Alamos National Laboratory

or

_____ Date: _____

Beverly A. Ramsey, Division Leader
Risk Reduction and Environmental Stewardship Division
Los Alamos National Laboratory

_____ Date: 8/31/04

David Gregory, Federal Project Director
Environmental Restoration Program
Department Of Energy/Los Alamos Site Operations

or

_____ Date: _____

Herman LeDoux,
Assistant Area Manager of
Environmental Projects
Department Of Energy/Los Alamos Site Operations

LA-UR-04-5009
August 2004
ER2004-0409

Investigation Work Plan for Delta Prime Site Aggregate Area at Technical Area 21

Los Alamos
NATIONAL LABORATORY
EST. 1943

CD included with this document

Disclaimer

This document contains data on radioactive materials, including source, special nuclear, and by-product material. The management of these materials is regulated under the Atomic Energy Act and is specifically excluded from regulation under the Resource Conservation and Recovery Act and the New Mexico Hazardous Waste Act. These data are provided to the New Mexico Environment Department for informational purposes only.

Prepared by
Risk Reduction and Environmental Stewardship–Remediation Services

LA-UR-04-5009
ER2004-0409

Investigation Work Plan for Delta Prime Site Aggregate Area at Technical Area 21

August 2004

Responsible project leader:

Mark Thacker		Team Leader	RRES-RS	8/30/04
Printed Name	Signature	Title	Organization	Date

Responsible UC representative:

David McInroy		Deputy Project Director	RRES-RS	8/30/04
Printed Name	Signature	Title	Organization	Date

Responsible DOE representative:

David Gregory		Federal Project Director	DOE-LASO	8/31/04
Printed Name	Signature	Title	Organization	Date

EXECUTIVE SUMMARY

This investigation work plan identifies and describes the activities needed to complete the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) for solid waste management units (SWMUs) and areas of concern (AOCs) located within Delta Prime (DP) Site, also known as Technical Area 21 (TA-21), at Los Alamos National Laboratory (the Laboratory or LANL). DP Site is located in the northern portion of the Laboratory, south of State Road 502 and east-southeast of the Los Alamos townsite. The 155 SWMUs and AOCs in DP Site are collectively referred to as the DP Site aggregate.

Sixty of the SWMUs and AOCs in the DP Site aggregate have previously been investigated or remediated and are not addressed in this work plan. Forty-five of the SWMUs and AOCs in the DP Site aggregate are associated with the five material disposal areas (MDAs) at TA-21 and are addressed in the associated MDA investigation work plans rather than in this work plan. Thirteen other SWMUs and AOCs are associated with active operational facilities or facilities planned for decontamination and decommissioning (D&D). Investigation of these sites is deferred until D&D activities are complete and is not addressed in this work plan.

Thirty-seven SWMUs and one AOC in the DP Site aggregate are addressed in this work plan and have been placed into two categories. The first category contains those sites where additional investigation is needed to determine the nature and extent of contamination and the potential need for corrective action. These sites are referred to as the investigation sites, and this work plan describes their operational history, the results of previous sampling activities and currently available analytical data, and the proposed investigation activities. The second category contains sites associated with corrective actions consisting of removing structures and contaminated soils. These sites are referred to as the corrective action sites. This work plan describes the operational history of the corrective action sites and the scope of activities required to complete the corrective actions, including field activities and confirmation sampling.

The investigation sites include four inactive SWMUs and one inactive AOC:

1. SWMU 21-013(c), a surface disposal area;
2. SWMU 21-003-99, a consolidated SWMU consisting of SWMUs 21-003, a polychlorinated biphenyl container storage area, and 21-013(f), a surface disposal site;
3. SWMU 21-024(c), a septic system and associated outfall that lies within, but is not part of, SWMU 21-003-99;
4. SWMU 21-009, a waste treatment laboratory; and
5. AOC 21-002(b), a drum storage area.

The objectives of the RFI at these sites, as defined in the RFI work plan for Operable Unit 1106, are to determine whether a release of hazardous chemicals and/or radionuclides has occurred and, if so, to establish the nature and extent of the release(s) to the environment. Environmental data generated during historical RFI sampling were analyzed in accordance with these objectives. The review of historical RFI sampling data for SWMUs 21-013(c), 21-003-99, 21-024(c), and AOC 21-002(b) indicates that the nature of contamination has been adequately defined with the exceptions of perchlorates for those four sites and of mercury for SWMU 21-024(c). There are no historical sampling data for SWMU 21-009; therefore, it requires complete characterization. Additional data are needed to define the extent of potential contamination for all five sites.

The corrective action SWMUs include 21-024(a), a septic system; 21-024(b), a septic system; 21-024(d), a septic system; 21-024(e), a septic system; 21-024(g), a septic system; 21-024(h), a septic system; 21-024(j), a septic system; 21-024(k), a septic system; 21-024(l), a septic system; 21-024(n), a drainline; 21-024(o), a drainline; 21-012(b), a dry well and associated septic system; 21-022(f), a sump and pipeline; 21-027(a), surface drainage and an outfall; and 21-027(c), a pipeline and outfall. The corrective action SWMUs also include consolidated SWMUs 21-006(c)-99 (four SWMUs), seepage pits; 21-022(h)-99 (three SWMUs), sumps, a pipeline, and an outfall; 21-023(a)-99 (three SWMUs), septic systems; and 21-026(a)-99 (five SWMUs), a sewage treatment plant.

The objectives of the corrective actions at these SWMUs are to verify the location and surface radiological conditions; to conduct verification sampling and analysis, if necessary, to assist in finalizing the implementation approach to the corrective action; to remove and inspect the structure(s); to remove contaminated material; and to conduct confirmation sampling to ensure that the nature and extent of any residual contamination have been determined and do not pose any potential unacceptable risk to human health or the environment.

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1.0 INTRODUCTION

1.1 General Site Information

Los Alamos National Laboratory (LANL or Laboratory) is a multidisciplinary research facility owned by the US Department of Energy (DOE) and managed by the University of California. The Laboratory (Figure 1.1-1) is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 40 mi^2 of the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation from approximately 6200 to 7800 ft. The Technical Area 21 (TA-21) industrial complex is shown on Figure 1.1-2.

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

This work plan addresses investigations at the following sites:

- Solid Waste Management Unit (SWMU) 21-013(c) (Figures 1.1-3 and 1.1-4);
- consolidated SWMU 21-003-99 (Figures 1.1-5 through 1.1-8), which consists of SWMUs 21-003 and 21-013(f);
- SWMU 21-024(c) (Figures 1.1-9 and 1.1-10);
- SWMU 21-009 (Figures 1.1-11 and 1.1-12); and
- Area of Concern (AOC) 21-002(b) (Figures 1.1-13 and 1.1-14).

This work plan also addresses SWMUs 21-024(a,b,d,e,g,h,j,k,l,n,o), 21-006(c)-99, 21-012(b), 21-022(f), 21-022(h)-99, 21-023(a)-99, 21-026(a)-99, 21-027(a), and 21-027(c) (Figure 1.1-15) and the structures within them that are planned for removal.

Under the New Mexico Hazardous Waste Act, the New Mexico Environment Department (NMED) has authority over cleanup of sites with hazardous waste or certain hazardous constituents, including the hazardous waste portion of mixed waste (i.e., waste contaminated with both radioactive and hazardous constituents). The DOE has authority over cleanup of sites with radioactive contamination. Radionuclides are regulated under DOE Order 5400.5, "Radiation Protection of the Public and the Environment," and DOE Order 435.1, "Radioactive Waste Management."

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

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

1.2 Investigation Objectives

The Delta Prime (DP) Site aggregate area consists of the 155 SWMUs and AOCs located in TA-21. Tables 1.2-1 through 1.2-3 identify the SWMUs and AOCs in TA-21 and indicate their status and disposition. Table 1.2-1 lists the SWMUs and AOCs that will be investigated as described in this work plan. Table 1.2-2 identifies the SWMUs and AOCs that will be addressed under other investigation work plans, including those for the five material disposal areas (MDAs) at TA-21 and sites that have been investigated or remediated previously but are awaiting no further action (NFA) determinations. Table 1.2-3 lists the SWMUs and AOCs for which there has been a determination of NFA.

The SWMUs and AOCs in this work plan are either investigation sites or corrective action sites.

- Investigation sites are not associated with structures scheduled for removal and will be investigated to define the nature and extent of contamination and to determine whether additional corrective actions are necessary.
- Corrective action sites are associated with structures scheduled for removal beginning in fiscal year (FY) 2005 and will undergo screening investigations to collect information for planning and executing the structure removals as well as confirmatory investigations following structure removal.

This work plan does not include

- SWMUs and AOCs being investigated as part of other investigation work plans (e.g., MDA investigation work plans).
- SWMUs and AOCs associated with active facilities. Investigation of these sites will be deferred until de-activation of the facilities.
- SWMUs and AOCs where investigations or remedies have been completed.
- SWMUs associated with industrial waste lines and sumps. Investigation of these sites will be coordinated with decontamination and decommissioning (D&D) of the waste lines and sumps.

The DP Site aggregate area is located within, and is a subset of, the Middle Los Alamos Canyon aggregate area. The SWMUs and AOCs that are located in the Middle Los Alamos Canyon aggregate area, but outside the DP Site aggregate area, will be addressed in a separate investigation work plan to be submitted to NMED at a later date.

This work plan

- describes the rationale for proposed data collection activities; and
- identifies and proposes appropriate methods and protocols for collecting, analyzing, and evaluating data to finalize characterization efforts at these sites.

The purpose and type of investigation to be conducted at each investigation site are summarized as follows:

- SWMU 21-013(c), surface disposal area: determine the extent of contamination by collecting soil samples.
- SWMU 21-003-99, polychlorinated biphenyl (PCB) container storage area: determine the extent of contamination by collecting soil samples.

- SWMU 21-024(c), septic system: determine the extent of contamination by collecting soil samples and assessing structures for excavation.
- SWMU 21-009, waste treatment laboratory: determine the nature and extent of contamination by collecting soil samples and assessing any structures for excavation.
- AOC 21-002(b), drum storage area: determine the extent of contamination by collecting soil samples.

The purposes of the corrective actions at the 19 SWMUs and consolidated units are

- to evaluate existing data and verify surface and subsurface conditions at each site using screening surveys and limited verification sampling, if necessary, to determine the need for and the scope of corrective actions; and
- to remove all subsurface structures and contaminated media to acceptable levels that are protective of human health and the environment.

For the investigation sites, this work plan presents information from previous field investigations and uses this information as a basis for developing additional field activities to define the nature and extent of site contamination. Furthermore, it presents historical and background information on the sites, the site conditions, the scope of activities needed to complete the investigation, and the investigation methods.

Appendix A includes a list of acronyms and abbreviations, a glossary, and a metric conversion table. Appendix B, which can be found on the CD included this work plan, provides data from past investigations. Appendix C describes the management of investigation-derived waste (IDW).

2.0 BACKGROUND

2.1 Operational History and Land Use

TA-21 is located on DP Mesa on the northern boundary of LANL and is immediately east-southeast of the Los Alamos townsite (Figure 1.1-1). It extends from the mesa top to the stream channels in two adjacent canyons, DP Canyon to the north and Los Alamos Canyon to the south (Figure 1.1-2).

During World War II, the Laboratory was established for the research, development, and testing of the first deliverable nuclear weapon. In 1945, the operations for establishing the chemical and metallurgical properties of the nuclear material necessary to achieve and sustain the required nuclear fission reaction were transferred to the newly built facilities at TA-21. The facilities were located in the areas of DP West and DP East (Figure 1.1-2).

DP West operations began in September 1945, primarily to produce metal and alloys of plutonium from the nitrate solution feedstock provided by other production facilities. This procedure involved several acid dissolution and chemical precipitation steps to separate the plutonium and other valuable actinides from the feedstocks. A major research objective at DP West was the development of new purification techniques that would increase the efficiency of the separation processes (Christensen and Maraman 1969, 04779). Details of the purification techniques are discussed in the operable unit (OU) work plan for TA-21 (LANL 1991, 07529). Other operations performed at DP West included nuclear fuel reprocessing. In 1977, a transfer of work to the new plutonium facility at TA-55 began, and much of the DP West complex was vacated.

DP East operations also began in September 1945. These facilities were used to process polonium and actinium and to produce initiators (a nuclear weapons component). In 1964, Building 21-209 was built to house research into high-temperature and actinide chemistry. Building 21-155 currently houses the Tritium Systems Test Assembly for developing and demonstrating effective technology for handling and processing deuterium and tritium fuels for use in fusion reactors.

TA-21 includes five MDAs: A, B, T, U, and V. Process wastes, transuranic wastes, and liquid wastes were disposed of at the MDAs from the early 1940s until the late 1970s; details of the disposal methods are presented in the TA-21 operable unit work plan (LANL 1991, 07529). The major contributors to waste streams at TA-21 were plutonium-processing activities. However, because plutonium was scarce, waste-stream recycling became a common practice to remove as much plutonium as possible from the waste stream. Numerous other chemicals were used for separation techniques and were present in the waste stream. Airborne effluents were released from some of the buildings at DP West and DP East; these are also discussed in the TA-21 operable unit work plan (LANL 1991, 07529).

TA-21 is currently under DOE control. The land has historically been used for industrial applications. Any future use of the land (either by DOE or following land transfer of the property) would still be industrial. Future and current land-use maps can be found in the 1995 update to the Laboratory site development plan (LANL 1995, 57224).

2.1.1 Investigation Sites

The operational histories, since 1940, of the investigation sites are summarized below.

SWMU 21-013(c), Surface Disposal Area:

- The dates of operation are not known.
- 1988—This inactive surface disposal area was identified as a SWMU northeast of the high-temperature chemistry building (Building 21-209) (LANL 1991, 07529, p. 14-65).

Consolidated SWMU 21-003-99, PCB Container Storage Area:

Consolidated SWMU 21-003-99 consists of SWMUs 21-003 and 21-013(f). SWMU 21-003 was a PCB-container storage area inside Building 21-61, including the area immediately outside and east of the building. SWMU 21-013(f) was possibly a surface disposal area, based on a 1949 aerial photograph, and exists within the boundaries of SWMU 21-003.

- 1950—Building 21-61 (a laboratory) was constructed to support classified plutonium research.
- 1956—Building 21-61 was remodeled to coat reactor parts and fuel rods with niobium pentachloride.
- Early 1960s to late 1960s/early 1970s—Building 21-61 was not used.
- 1970 to 1972—Building 21-61 was used as a metal fabrication shop.
- 1978 to 1989—Building 21-61 and the unpaved area directly east of the building were used to store materials/drums containing PCBs. Kerosene and petroleum-based solvents were also used in the area (LANL 1991, 07529, p. 14-16).
- 1981—Part of unpaved area east of Building 21-61 was paved with asphalt and bermed (LANL 1991, 07529, p. 14-16).

- 1989—PCB storage was moved to TA-54, and the interior of Building 21-61 was decontaminated in accordance with the Toxic Substance Control Act (TSCA) 40 CFR 761 (LANL 1991, 07529, pp. 14-16–14-17)
- 2002—Building 21-61 underwent D&D activities (LANL 2002, 85609).

SWMU 21-024(c), Septic System:

- 1945—Building 21-54 (a machine shop and warehouse) was constructed.
- Late 1940s—A septic system was installed to route sewage from Buildings 21-54 and 21-61. The reinforced concrete septic tank measured 4 ft long × 8 ft wide and was located 6 ft below ground surface (bgs). The sewer lines were 4-in.-diameter vitrified clay pipe (VCP).
- 1966—The septic system was left in place.
- 1969—Building 21-54 was demolished (LANL 1991, 07529, p. 15-34).
- 2002—Building 21-61 underwent D&D activities (LANL 2002, 85609).

SWMU 21-009, Waste Treatment Laboratory:

- 1948—Building 21-33 (a waste treatment laboratory) was constructed.
- 1965—Building 21-33 underwent D&D activities (LANL 1991, 07529, p. 17-29).

AOC 21-002(b), Drum Storage Area:

- 1945—Structure 21-38 was built southeast of a shop (Building 21-31) to be used for drum storage; the contents of the drums are not known.
- 1966—Structure 21-38 underwent D&D activities (LANL 1991, 07529, p. 14-58).

2.1.2 Corrective Action Sites

The available operational histories, since 1940, of the corrective action sites are summarized below.

SWMU 21-024(a), Septic System:

- 1945—A steam plant (Building 21-9) was built and the septic system was constructed at the same time (LASL 1946, 24460). The septic system consisted of a 6-in.-diameter VCP inlet line, a concrete septic tank 9 ft long × 5.75 ft wide × 4 ft deep, and a 4-in.-diameter VCP outlet line (LASL 1946, 71281.4).
- 1966—The septic system was left in place.
- 1985—Building 21-9 was removed and replaced with new a steam plant, Building 21-357. The area was regraded, but it is not known whether the piping was removed.

SWMU 21-024(b), Septic System:

- 1945—Building 21-17 (a passageway connecting Buildings 21-4 and 21-5) was constructed, and the sanitary sewer system routed sewage through a reinforced concrete septic tank (Structure 21-55) 4 × 8 × 6.5 ft to the surface soil south of Building 21-5 (LANL 1991, 07529, p.15-34; LASL 1946,

71281.4). The inlet and outlet drainlines are 6-in. and 4-in. VCP, respectively (LASL 1946, 71281.4). The outfall associated with the septic system consists of a cast-iron pipe that emerged from backfill inside the security fence and discharged on a gentle slope (LANL 1994, 31591, p. 8-9).

- 1969—Building 21-17 underwent D&D activities (LANL 1991, 07529, p. 15-34).

SWMU 21-024(d), Septic System:

- 1945—Building 21-1 (an office building) was constructed and the sanitary sewer system routed sewage via 6-in. VCP drainlines (LASL 1946, 71281.4) through a reinforced concrete septic tank (Structure 21-106), which was 16 × 8 × 7.75 ft, to the surface on the south rim of DP Mesa above Los Alamos Canyon (LANL 1991, 07529, p. 15-34).
- 1965—Building 21-1 was removed.
- 1995—The septic tank was filled with pea gravel and left in place. The inlet and outlet lines were grouted with concrete and left in place (LANL 1996, 53789, p. 2).

SWMU 21-024(e), Septic System:

- 1945—Building 21-20 (a laundry facility) was constructed, and the sanitary sewer system routed sewage via 6-in. VCP drainlines (LASL 1958, 71281.6) or via 4-in. cast iron pipe for the first 5 ft from Building 21-20 and then via 4-in. VCP (Francis 1995, 87271) through a 1000-gal. steel septic tank (Structure 21-123), which was 11.33 × 6.33 × 8 ft, and then 18 ft to the surface. The outfall was located approximately 20 ft from the southern edge of DP Mesa above Los Alamos Canyon (LASL 1946, 24460).
- 1965—The laundry facility underwent D&D activities.
- 1996—The septic tank was emptied and filled with pea gravel, inlet and outlet lines were grouted with concrete, and the surrounding area was restored and reseeded.

SWMU 21-024(g), Septic System:

- 1950—The septic system, consisting of a reinforced concrete septic tank (Structure 21-125), which was 9.5 × 18 × 5 ft, was completed (LASL 1946, 87269). It routed sewage via 4-in. VCP drainlines from a warehouse (Building 21-7) and an electronics shop/maintenance building (Building 21-31) to the surface on the north rim of DP Mesa above DP Canyon (LANL 1991, 07529, p. 15-18).
- 1966—The septic tank was left in place (LANL 1991, 07529, p. 15-18).

SWMU 21-024(h), Septic System:

- 1945—Building 21-51 (an administrative building and shop) was constructed and the sanitary sewer system routed sewage through a 6-in. VCP (LASL 1946, 71281.4) and a reinforced concrete septic tank (Structure 21-163), which was 10 × 5 × 7.75 ft, to the surface on the north rim of DP Mesa above DP Canyon (LASL 1945, 24459; LANL 1991, 07529, p. 15-94).
- 1966—The septic tank was left in place (LANL 1991, 07529, p. 15-94).

SWMU 21-024(j), Septic System:

- 1949—Building 21-55 (combined with Buildings 21-206 and 21-207 from 1963 to 1965 to become Building 21-155) was constructed for initiator research and production.
- 1961—A septic system was constructed to route sewage from a warehouse/laboratory (Building 21-155) to a reinforced concrete 5 × 3 × 6 ft septic tank (Structure 21-194) and associated drainlines (LANL 1991, 07529, p. 15-83). The tank is located off the southwest corner of Building 21-155 near the south edge of the perimeter road (LANL 1991, 07529, p. 15-83).
- 1966—The septic tank was left in place (LANL 1991, 07529, p. 15-83).

SWMU 21-024(k), Septic System:

- 1964 to 1965—Building 21-209 (a high-temperature chemistry building) was built and septic system routed sewage through a 6-in. cast iron line to a manhole (Structure 21-217), then through a 6-in. VCP to a manhole (Structure 21-228) and finally to a two-chamber, reinforced concrete, 18.5 × 6.33 × 8.83 ft septic tank (Structure 21-219) (LASL 1964, 71281.8). Overflow from the tank went to a leach field that was 30 × 20 × 5.5 ft (LASL 1964, 71281.8). Two 4-in. VCP lines extend from the downslope edge of the leach field (LASL 1964, 71281.8).
- 1966—The septic system was left in place (LANL 1991, 07529, p. 15-83).

Consolidated SWMU 21-024(l)-99, Septic System:

Consolidated SWMU 21-024(l)-99 consists of SWMUs 21-022(a) (sump), and 21-024(l) (outfall), and AOC 21-004(a) (aboveground tank).

- SWMU 21-022(a) consists of a 5-ft-diameter brick sump located north of Building 21-21 with an inlet line from the building, but it is not known if an outlet line exists.
  - 1946—The sump was constructed.
- SWMU 21-024(l) consists of an outfall that received liquid waste from the floor drain of Building 21-21 mechanical room via a pipeline (LANL 1991, 07529, p. 15-18).
- AOC 21-004(a) consists of a 6000-gal. aboveground steel tank (Structure 21-335), which is 8 ft in diameter and 16 ft long, and a pipeline to Building 21-21.
  - 1974—The tank was installed to receive liquid waste from floor drains in Building 21-21.

SWMU 21-024(n), Drainline:

- 1949—Building 21-55 was constructed with a corrugated metal pipe that exited a concrete bulkhead and discharged onto a gravel road adjacent to MDA U [SWMU 21-017(a)-99] (LANL 1991, 07529, p. 15-56). The effluent flowed north to the ditch paralleling the north perimeter road. From there, it flowed east to a culvert that passes under the north perimeter road and into DP Canyon (LANL 1991, 07529, p. 15-56).

SWMU 21-024(o), Drainline:

- 1947—A diesel power plant (Building 21-46) was constructed, and SWMU 21-024(o) is a 4-in. VCP drainline serving it (LANL 1991, 07529, p. 15-56). The drain discharged south into Los Alamos Canyon (LASL 1958, 71281.6).
- 1957—Building 21-46 was converted to a warehouse/maintenance shop.

Consolidated SWMU 21-006(c)-99, Seepage Pits:

Consolidated SWMU 21-006(c)-99 consists of SWMUs 21-006(a), 21-006(b), 21-006(c), and 21-006(d). These SWMUs are inactive underground seepage pits. In addition to a seepage pit, SWMU 21-006(b) also includes the drainline and outfall from the seepage pit. SWMU 21-006(b) is the only seepage pit with known drainlines.

- SWMU 21-006(a), location not known:
  - 1945 (approximate)—An underground seepage pit was installed to dispose of Hanford container wash water, bomb electrolytic decontamination solution (ethylene glycol, phosphoric acid, and plutonium), and chemical makeup room waste water. Between Building 21-2 and Building 21-3 (either on north or south side of corridor connecting buildings), there is approximately 0.1 acre.
  - 1999—A gamma survey was conducted to identify the location of the pit and concluded that it was probably located south of Building 21-3.
- SWMU 21-006(b):
  - 1945—A drainline, sump, and outfall installed during construction of Building 21-2 (LANL 1991, 07529, p. 15-103) to receive ether waste from the ethyl ether extraction process as part of the original TA-21 plutonium purification process (Christensen and Maraman 1969, 04779). A 3-in. cast iron drainline exited the southeast side of Building 21-2, and extended about 160 ft southward to a settling tank or sump, (Structure 21-118). A 2-in. cast iron outlet line ran about 100 ft southward from the sump to an outfall approximately 8 ft above the surface of a bench below the mesa top.
  - 1945 (September)—The ether extraction process was discontinued.
- SWMUs 21-006(c) and 21-006(d) (assumed to be the same site):
  - 1945 (approximate)—A seepage pit was located 15 ft outside the door to the bomb-cleaning room (Room 322) at Building 21-3, on the south side of the corridor; the pit reportedly received bomb electrolytic decontamination solution from a drain in Room 322. The room may have been contaminated with plutonium. The pit may be partially or entirely beneath Rooms 3131 and 3133 of the addition to Building 21-3.
- SWMU 21-012(b), Dry Well and System:
  - 1945—A steam plant (Building 21-9) was built, and the boiler blowdown (pressurized discharge of gaseous steam from the boiler) was discharged into two concrete steam blowdown pits (TA-21-266 and TA-21-267) adjacent to the south side of the steam plant. A separate 7-in.-diameter steel drainline drained each pit toward the southern edge of DP Mesa.

- 1971—The boiler blowdown was routed to a 2500-gal. blowdown tank that released overflow liquid into a 6 × 6 × 2 ft seepage pit filled with river stones. The seepage pit was centrally located between the two steel drainlines.
- 1980—A dry well (4 × 4 × 54 ft) was installed south of the blowdown tank to replace the seepage pit. Underground piping connected the tank and the well and a 3-in.-diameter perforated pipe hung vertically in the well to a 49-ft depth; the space surrounding the perforated pipe was filled with large gravel.
- 1985—The steam plant was removed and the area regraded. It is not clear whether underground structures were removed during demolition.

SWMU 21-022(f), Sump and Pipeline:

- 1945—Building 21-152 and a sump (Structure 21-173) were constructed to convey liquid effluent from the building's laboratory sinks through a 6-in.-diameter steel pipe to MDA U (Francis 2001, 76211; LASL 1946, 24460). The brick-lined sump was approximately 5 ft 4 in. in diameter and located approximately 13 ft from the northeast corner of Building 21-152 (LASL 1946, 24460; LASL 1945, 01093). The depth of the sump is a minimum of 6 ft 10 in. bgs.
- 1965—The sump, Structure 21-173, was connected to manhole 21-221 which connects to the Waste Disposal Plant (21-257). Another line runs northwest from Building 21-209 into the manhole (Francis 2001, 76211).

Consolidated SWMU 21-022(h)-99, Sumps, Pipeline and Outfall:

Consolidated SWMU 21-022(h)-99 consists of SWMUs 21-022(h) (a sump, drainline, and outfall), 21-022(i) (a sump), and 21-022(j) (a sump).

- SWMU 21-022(h) consists of a sump (Structure 21-202), its drainline, and an outfall.
  - 1961 to 1962—Structure 21-202 was constructed of 36-in. diameter corrugated metal pipe to receive industrial waste water and drainage from the Building 21-150 basement floor and roof drains and route effluent through a 24-in.-diameter pipe that discharged to Los Alamos Canyon.
  - 1991—The outfall discharged only treated cooling water from this time forward, and no documentation of removal of structures exists.
- SWMU 21-022(i) consists of a sump pump in the equipment room at the southeast corner of Building 21-2.
  - 1945—Building 21-2 was constructed, and it is unknown if the sump was constructed at the same time.
  - 1994/1995—Sump was removed during the D&D of Building 21-3. The discharge point for sump effluent is unclear since no drainlines were identified south of the equipment room.

- SWMU 21-022(j) consists of a sump (18 in. × 18 in. × 8 ft) at the south end of Building 21-3 that received drainage from the equipment room.
    - 1945—Building 21-3 was constructed, and it is unknown if the sump was constructed at the same time.
    - 1994/1995—The sump was removed during D&D activities at Building 21-3.

Consolidated SWMU 21-023(a)-99, Septic Systems:

Consolidated SWMU 21-023(a)-99 consists of SWMUs 21-023(a) (a septic tank and drainlines), 21-023(b) (a septic tank and drainlines), and 21-023(d) (a septic tank and drainlines).

- SWMU 21-023(a) consists of a steel-reinforced concrete septic tank (Structure DP-225), which is 5 × 9 × 6 ft, and inlet and outlet lines (connected to existing waste lines to the north).
    - 1945—Building 21-3 was constructed. The date of the septic system construction is not known.
    - 1966—Septic tank and lines were removed when additions were made to Building 21-3 and the new sewage treatment plant opened.
- SWMU 21-023(b) consists of a 500-gal. approximately 6.5-ft-diameter circular septic tank (Building 21-142) and inlet and outlet lines (to Structure 21-84 which connected to existing waste lines to the north).
    - 1945—Building 21-3 and the septic system were constructed.
    - 1966—Septic tank and lines may have been removed when the new sewage treatment plant opened.
- SWMU 21-023(d) consists of a steel-reinforced concrete septic tank (5 × 3 × 5.5 ft) and inlet and outlet lines which were probably connected to the 4-in. line leading to the treatment facilities (Building 21-35).
    - 1966 (approximately)—The septic tank was bypassed, and the sewer line was connected to the new sewage treatment plant.
    - 1966—The septic tank and lines were removed when additions were made to Building 21-3 and the new sewage treatment plant opened.

Consolidated SWMU 21-026(a)-99, Sewage Treatment Plant:

Consolidated SWMU 21-026(a)-99 consists of SWMUs 21-013(a) (a surface disposal area for waste sand from drying beds), 21-026(a) (an inactive sewage treatment plant), and 21-026(b) (drying beds) and AOCs 21-026(c) (a dosing siphon chamber) and 21-026(d) (an outfall).

- SWMU 21-026(a), sewage treatment plant:
    - 1965—Construction began on the treatment plant.
    - 1966—The treatment plant was put into operation, replacing septic systems throughout TA-21; operations consisted of an extended aeration treatment system with a grit chamber, comminuter, digester, aeration tank, and clarifier.
    - 1990—Treatment operations ceased.

- 1990 to 1991—Effluent was sent to dosing siphon chamber, then to sand filter beds, and finally to the outfall into DP Canyon.
- Originally, treated effluent was released at the concrete spill pad and into DP Canyon [see AOC 21-026(d)].

- SWMU 21-026(b), four sludge drying/sand filter beds:
  - 1996 to 1990—The site was used for drying sludge from treatment process; each bed is 14.5 × 23 × 4 ft, with concrete walls.
  - 1990—Sludge drying beds were converted to sand filters, old tile drainlines were removed, and the connections were plugged with concrete.
  - 1966 to 1991—The site received effluent from dosing siphon chamber (former chlorine contact chamber); filtered effluent discharged through gauging station to outfall into DP Canyon.
  - 1991—The beds were filled with clean sand when treatment operations ceased.

- AOC 21-026(c), dosing siphon chamber:
  - 1966 to 1990—A chlorine contact chamber was installed as part of the original treatment plant, a 5 × 7 × 8 ft concrete tank; effluent was pumped through the chamber for chlorine disinfection, and treated effluent was then discharged to the outfall at the mesa edge.
  - 1990—Operations converted to dosing siphon chamber when chlorine disinfection was no longer needed; the lines to the manhole and outfall were plugged with concrete.
  - 1990 to 1991—The dosing siphon chamber pumped effluent to the sand filter beds.
  - 1991—The chamber was left in place when treatment operations ceased.

- AOC 21-026(d), outfall:
  - 1966 to 1991 (approximate)—The outfall received treated liquid effluent from Building 21-227 (an aeration tank) through a chlorine contact chamber and sand filter beds. A concrete spill pad 120 ft north of the manhole at the centerline of sludge/sand filter beds drained into DP Canyon.
  - 1978 to 1998—The outfall was permitted under the National Pollutant Discharge Elimination System (NPDES) as outfall 05S and removed from the NPDES permit on March 10, 1998.

- SWMU 21-013(a), surface disposal area:
  - 1966 to 1991 (approximate)—The top layers of sand from the filter beds at SWMU 21-026(b) were disposed of at this site, an area approximately 45 ft^2.

SWMU 21-027(a), Surface Drainage and Outfall:

- 1945—Floor drains were installed in Equipment Room 3A, southwest corner of Building 21-3. The floor drains connected to two 3-in. pipes that connected to a 4-in. pipe running south and emptied into a 12-in. culvert storm drain. The effluent traveled through the storm drain underground for approximately 50 ft and emptied onto the ground at the southwest corner of the footprint of cooling tower (Structure 21-143, designated as AOC C-21-027). From the location of the cooling tower footprint, effluent flowed in an unlined ditch to a 24-in. corrugated metal pipe (CMP) culvert that carried runoff beneath the south perimeter road to the mesa edge. The CMP extended about 3 ft over the mesa edge (LANL 1991, 07529, p. 15-69).

- 1978 to 1995 (approximate)—The outfall was listed on the Laboratory's NPDES permit (EPA 1994, 65280); it was removed from the permit effective July 11, 1995, after D&D of Building 21-3.
- 1994 to 1995—Building 21-3, its drains and the pipes beneath, and the cooling tower were removed during D&D activities. The 4-in. pipe beneath the paved area was left in place, as was the storm drain, which collects runoff from nearby parking lots.

SWMU 21-027(c), Pipe and Outfall:

- 1945—Building 21-6 (a cafeteria and machine shop) was constructed. SWMU 21-027(c) was reported to be a 4-in. VCP line that exited Building 21-6 and discharged to the south, 50 ft inside the perimeter fence in a broad, gently sloping area with no well-defined channel.
- 1966—Building 21-6 was removed; the VCP line is assumed to have been left in place.

2.2 Summary of Releases and Potential Receptors

Releases from investigation and corrective action sites occurred as a result of normal site operation (e.g., discharges from outfalls). Those sites that have been sampled indicate detected organic chemicals, inorganic chemicals greater than background, and/or radionuclides greater than fallout values (FVs). No documentation exists to estimate the volumes or rates of flow of effluent from septic system outlet pipes to outfalls, or effluent to sumps, or from cooling system blowdown to pits or the dry well.

2.2.1 Potential Contaminant Transport Mechanisms

Potential transport mechanisms that may lead to exposure of potential receptors include

- vaporization and gaseous diffusion and advection of volatile organic compounds (VOCs) and tritium in air;
- dissolution and/or particulate transport of surface contaminants during precipitation and runoff events;
- airborne transport of contaminated surface soils;
- continued dissolution and advective/dispersive transport of chemical and radiological contaminants contained in subsurface soil and bedrock as a result of past waste water disposal activities;
- disturbance and movement of contaminants in shallow soil by plants and animals; and
- future migration of contaminants already in the subsurface media.

2.2.2 Current Contaminant Potential Receptors

Potential receptors to possible contaminant transport at all sites include

- site workers at TA-21,
- trail users in the canyons below the TA-21 mesa, and
- ecological receptors both on-site and immediately surrounding the site.

2.2.3 Current and Proposed Land Use

TA-21 is an industrial-use area. In the future, some parcels at TA-21 may be transferred from DOE control to new ownership, which may result in changes in land use, such as commercial or residential use.

2.3 Summary of Previous Investigations

In 1992, the Laboratory conducted site-wide surface and near-surface sampling at TA-21 as part of the RFI work plan for OU 1106 (LANL 1991, 07529). Samples were collected throughout TA-21; summarized below are the results of analyses for samples collected from within the boundaries of the four investigation sites. In addition, site-specific Phase I and Phase II RFI and other investigations conducted are also summarized herein. SWMU 21-009 is not included in this discussion since no previous sampling occurred at this site.

The site data from previous investigations were compared to the naturally occurring background values (BVs) and the maximum value in the background data set for inorganic chemicals, naturally occurring BVs or FVs, and the maximum value in the background/fallout data set for radionuclides (LANL 1998, 59730), and analytical estimated quantitation limits (EQLs) for organic chemicals (LANL 2000, 71233). The environmental media sampled in previous investigations at these sites are soil ("all horizons" soil is denoted as ALLH), and tuff (denoted as tuff). Only results for the investigation soil samples collected from 1992 through 1995 and analyzed at off-site fixed laboratories were used for decision making. Off-site laboratory analytical results are presented in Tables 2.3-1 through 2.3-11.

2.3.1 SWMU 21-013(c), Surface Disposal Area

Summarized below are previous investigations conducted at this site.

- 1992—TA-21 site-wide surface and near-surface sampling activities (LANL 1994, 26073) included collecting samples at four locations within, or immediately adjacent to, SWMU 21-013(c) (21-01205, -01207, -01213, and -01221) from the 0- to 0.1-ft depth and at six locations (21-01198, -01199, -01206, -01214, -01220, and -01288) from both the 0- to 0.08-ft and 0- to 0.5-ft depths (Figure 2.3-1). The samples were analyzed for inorganic chemicals, organic chemicals, and radionuclides but do not have complete laboratory documentation. Therefore, these data are used only to indicate where additional sampling may be required, but are not used for decision making.
- 1994—Phase I RFI activities included collecting surface and near-surface soil samples at ten locations (21-01908 through 21-01917) from both the 0- to 0.5-ft and 0- to 2.5-ft depths (Figure 2.3-1). These soil samples were analyzed for inorganic chemicals, VOCs, semivolatile organic compounds (SVOCs), and radionuclides (LANL 1996, 54320).
- 1995—Building materials were removed during a voluntary corrective action; the site was restored and reseeded with native grasses. Confirmatory samples were collected at two locations (21-09004 and 21-09005) from the 0- to 0.5-ft depth (Figure 2.3-1) and analyzed for inorganic chemicals, VOCs, and radionuclides. Additionally, the soil sample from location 21-09005 was analyzed for SVOCs.

The site data from 1994 and 1995 were collected from soil and compared with soil BVs (LANL 1998, 59730). Tables 2.3-1, 2.3-2, and 2.3-3 present SWMU 21-013(c) inorganic chemical concentrations greater than soil BVs, detected concentrations of VOCs and SVOCs, and radionuclide activities greater than soil BVs/FVs. Figures 2.3-2, 2.3-3, and 2.3-4 show SWMU 21-013(c) inorganic chemical

concentrations greater than soil BVs, VOC and SVOC detections, and radionuclide activities greater than soil BVs/FVs, respectively. Sample results for inorganic chemicals were compared to the maximum of the range of their respective background data sets. Those inorganic chemicals detected at concentrations greater than BV and range of the background data set were designated as chemicals of potential concern (COPCs). The distribution of sample locations and sample results of the COPCs were then analyzed to determine if extent has been determined.

Inorganic Chemicals

Inorganic Chemicals Detected at Concentrations Greater than BVs. Calcium, mercury, and total uranium were detected at concentrations greater than their respective BVs in soil samples collected from the surface disposal area (Figure 2.3-2).

- Calcium was detected in one soil sample at a concentration of 9400 mg/kg (location 21-01910, 0- to 2.5-ft depth interval), a concentration greater than the soil BV (6120 mg/kg) but less than the maximum of the soil background data set (14,000 mg/kg). Therefore, calcium is not retained as a COPC.
- Mercury was detected in one soil sample at a concentration of 2.6 mg/kg (location 21-09005, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (0.1mg/kg) and greater than the maximum of the soil background data set (0.1 mg/kg). Therefore, mercury is retained as a COPC.
- Total uranium concentrations in 19 soil samples located throughout the site ranged from 1.84 to 4.35 mg/kg (the maximum concentration was from location 21-01913, 0- to 2.5-ft depth interval). These concentrations are greater than the soil BV (1.82 mg/kg). Only one total uranium concentrations (4.35 mg/kg at location 21-01913, 0- to 2.5-ft depth interval) was greater than the maximum of the soil background data set (3.6 mg/kg). Therefore, total uranium is retained as a COPC.

Inorganic Chemicals Not Included in Background Data. Strontium was not included in the background data and, therefore, has no BV for comparison. However, earlier studies (Longmire 1993, 40222.5; Purtymun 1987, 06687) indicate a regional background mean of 120 mg/kg for strontium.

- Strontium was detected in both confirmation samples (locations 21-09004 and 21-09005) at concentrations of 25.0 mg/kg and 20.0 mg/kg, respectively. Neither concentration nor detection limit was greater than the regional background (120 mg/kg). Therefore, strontium is not retained as a COPC.

Inorganic Chemicals with Detection Limits Greater than BVs. Antimony, cadmium, silver, and thallium were not detected at concentrations greater than their respective BVs. However, their detection limits were greater than their respective BVs in some samples.

- Antimony detection limits were greater than the soil BV (0.83 mg/kg) and the maximum of the range of the soil background data set (1.0 mg/kg) in two soil samples (8.4 mg/kg at location 21-09004 and 8.2 mg/kg at location 21-09005). Therefore, antimony is a COPC.
- Cadmium detection limits were greater than the soil BV (0.4 mg/kg), but less than the maximum of the soil background data set (2.6 mg/kg), in two soil samples (1.0 mg/kg at location 21-09004 and 1.0 mg/kg at location 21-09005). Therefore, cadmium is not retained as a COPC.

- Silver detection limits were greater than the soil BV and maximum of the soil background data set (both are 1.0 mg/kg) in two samples (2.1 mg/kg at location 21-09004 and 2.0 mg/kg at location 21-09005). Therefore, silver is a COPC.
- Thallium detection limits were greater than the soil BV (0.73 mg/kg) in 22 soil samples from 12 locations. Three soil samples from three locations were also greater than the maximum of the soil background data set (1.0 mg/kg). The detection limits ranged from 0.84 to 1.8 mg/kg (the maximum detection limit was from location 21-01914). Therefore, thallium is a COPC.

Inorganic Chemical Summary. Mercury and total uranium were the only inorganic COPCs detected at concentrations greater than BV and the range of the background data set. Antimony, silver, and thallium detection limits were elevated above background and will be analyzed for in the inorganic chemical suite for the proposed sampling along with mercury and total uranium.

Vertical extent was not defined for mercury (location 21-09005) and total uranium (location 21-01913). The vertical extent of elevated concentrations of these two inorganic chemicals was not defined in previous sampling since soil was collected at only one depth at location 21-09005, and soil sample depths were not discrete for the other locations (21-01908 through 21-01917).

The lateral extent was not defined for the COPCs because no sample was collected to the west of the locations where the COPCs were detected above the maximum of the soil background data set.

Organic Chemicals

VOCs. Concentrations of VOCs were detected at trace levels at three of twelve sample locations (Figure 2.3-3).

- Acetone was detected at a concentration of 0.01 mg/kg (locations 21-09004 and 21-09005, both at the 0- to 0.5-ft depth interval).
- Methylene chloride was detected at a concentration of 0.005 mg/kg (location 21-09004, 0- to 0.5-ft depth interval).
- Toluene was detected at a concentration of 0.01 mg/kg (location 21-01914, 0- to 0.5-ft depth interval).

SVOCs. Concentrations of SVOCs were detected at nine of twelve sample locations (Figure 2.3-3).

- Bis(2-ethylhexyl)phthalate was detected in eleven samples from eight locations at concentrations ranging from 0.5 to 6.5 mg/kg (the maximum concentration was from location 21-01911, 0- to 2.5-ft depth interval).
- Di-n-butylphthalate was detected at a concentration of 0.18 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Dinitrotoluene(2,4-) was detected at a concentration of 3.3 mg/kg (location 21-01909, 0- to 2.5-ft depth interval).
- Nitrophenol(4-) was detected at a concentration of 4.2 mg/kg (location 21-01909, 0- to 2.5-ft depth interval).
- Pentachlorophenol was detected at a concentration of 3.6 mg/kg (location 21-01909, 0- to 2.5-ft depth interval).

Polycyclic aromatic hydrocarbons (PAHs). PAHs are the product of incomplete combustion (e.g., forest fires, wood-burning stoves, automobile exhaust, etc.) and are a component of asphalt. PAHs are expected to be detected near asphalt roads. Concentrations of PAHs were detected at five of twelve sample locations (Figure 2.3-3):

- Acenaphthene was detected at a concentration of 2.3 mg/kg (location 21-01909, 0- to 2.5-ft depth interval) and 0.4 mg/kg (location 21-01913, 0- to 0.5-ft depth interval).
- Anthracene was detected at a concentration of 0.57 mg/kg (location 21-01913, 0- to 0.5-ft depth interval).
- Benz(a)anthracene was detected at a concentration of 1.1 mg/kg (location 21-01913, 0- to 0.5-ft depth interval) and 0.19 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Benzo(a)pyrene was detected at a concentration of 1.0 mg/kg (location 21-01913, 0- to 0.5-ft depth interval) and 0.22 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Benzo(b)fluoranthene was detected at a concentration of 1.5 mg/kg (location 21-01913, 0- to 0.5-ft depth interval) and 0.32 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Benzo(g,h,i)perylene was detected at a concentration of 0.42 mg/kg (location 21-01913, 0- to 0.5-ft depth interval) and 0.14 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Chrysene was detected at a concentration of 1.1 mg/kg (location 21-01913, 0- to 0.5-ft depth interval) and 0.21 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Fluoranthene was detected at a concentration of 3.0 mg/kg (location 21-01913, 0- to 0.5-ft depth interval) and 0.41 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Indeno(1,2,3-cd)pyrene was detected at a concentration of 0.42 mg/kg (location 21-01913, 0- to 0.5-ft depth interval) and 0.11 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Phenanthrene was detected at a concentration of 2.6 mg/kg (location 21-01913, 0- to 0.5-ft depth interval) and 0.15 mg/kg (location 21-09005, 0- to 0.5-ft depth interval).
- Pyrene was detected at four locations at concentrations ranging from 0.36 to 3.3 mg/kg (the maximum concentration at location 21-01913, 0- to 0.5-ft depth interval).

Organic Chemical Summary. The VOCs acetone, methylene chloride, and toluene were detected at trace levels (near or below the detection limit) in widely dispersed locations; therefore, further sampling for extent is not warranted. The SVOCs bis(2-ethylhexyl)phthalate, di-n-butlyphthalate, 2,3-dinitrotoluene, 4-nitrophenol, pentachlorophenol, and the PAHs are retained as COPCs.

The vertical extent was not defined for organic COPCs since none of the soil sample depths were discrete.

The lateral extent was also not determined for organic COPCs since samples were not collected in all four directions from the samples in which the SVOCs were detected.

Radionuclides

Fallout Radionuclides. Americium-241, plutonium-238, plutonium-239, strontium-90, and tritium were detected at activities greater than their respective FVs in soil samples collected from the surface disposal area (Figure 2.3-4).

- Americium-241 was detected at an activity of 0.2 pCi/g (locations 21-09004 and 21-09005, 0- to 0.5-ft depth interval), an activity greater than both the soil FV (0.013 pCi/g) and the maximum of the soil fallout data set (0.013 pCi/g). Therefore, americium-241 is a COPC.
- Plutonium-238 was detected at an activity of 0.69 pCi/g (location 21-09004, 0- to 0.5-ft depth interval), an activity greater than soil FV (0.023 pCi/g) and the maximum of the soil fallout data set (0.037 pCi/g). Therefore, plutonium-238 is a COPC.
- Plutonium-239 was detected in the 0- to 0.5-ft depth interval in six samples at activities ranging from 0.07 to 0.22 pCi/g (the maximum activity was from locations 21-01913 and 21-01917, 0- to 0.5-ft depth interval), activities greater than both the soil FV (0.054 pCi/g) and the maximum of the soil fallout data set (0.055 pCi/g). Plutonium-239 was detected in the 0- to 2.5-ft depth interval where the FV does not apply in six samples at activities ranging from 0.01 to 0.09 pCi/g (the maximum activity was from location 21-01911). Therefore, plutonium-239 is a COPC.
- Strontium-90 was detected at activities of 0.59 and 0.56 pCi/g (locations 21-01914 and 21-01909, respectively) in the 0- to 2.5-ft depth where the FV does not apply. Therefore, strontium-90 is a COPC.
- Tritium was detected in samples across the site at activities ranging from 0.06 to 0.84 pCi/g (the maximum activity was from location 21-09005). The tritium measurement depends upon the moisture content of each soil sample. In previous investigations, the moisture data were not always collected for every sample. Therefore, any tritium detection is considered to be greater than the FV. Tritium is a COPC.

Naturally Occurring Radionuclides. Uranium-235 was detected in four soil samples at activities ranging from 0.21 to 0.27 pCi/g (the maximum activity was from location 21-01912, 0- to 0.5-ft depth interval), activities slightly greater than the soil BV (0.2 pCi/g). Therefore, uranium-235 is a COPC.

Radionuclide Summary. Americium-241, plutonium-238, plutonium-239, strontium-90, tritium, and uranium-235 are the radionuclide COPCs.

The vertical extent for radionuclide COPCs was not defined since the 1994 soil sample depths were not discrete, and the 1995 confirmation samples (locations 21-09004 and 21-09005) were collected from only one depth (0–0.5 ft).

The lateral extent for radionuclide COPCs was also not defined since the samples were not collected in all four directions from the locations where radionuclides had been detected above the maximum soil background data set or, in the case of tritium, where tritium was detected.

2.3.2 SWMU 21-003-99, PCB Container Storage Area

Summarized below are previous investigations conducted at this site.

- 1988—Soil and asphalt grab samples were collected and analyzed for PCBs. These data indicate that the contamination was not uniform, with concentrations ranging from less than 1.17 to 94,700 mg/kg. The highest concentrations were from stained areas on the paved surface. Since

the data generated during that early sampling activity were not validated or assessed for usability in accordance with former ER Project protocols, they are used only qualitatively in developing this work plan. Therefore, these sample locations are not shown in any of the figures.

- 1992—TA-21 site-wide surface and near-surface sampling activities were conducted (LANL 1994, 26073) included collecting one sample (location 21-01155) each from the 0- to 0.08-ft and 0- to 0.5-ft depth intervals in an area downslope from SWMU 21-003-99 (Figure 2.3-5). The samples were analyzed for inorganic chemicals, organic chemicals and radionuclides but do not have complete laboratory documentation. Therefore, these data are used to indicate where additional sampling may be required but are not used for decision making.
- 1994—Phase I RFI activities were conducted. SWMU 21-013(f) samples (locations 21-01884 through 21-01892) were analyzed for VOCs, SVOCs, inorganic chemicals, and radionuclides. Sample depths at all locations were 0–0.5 ft with the exception of locations 21-01888 and 21-01891, which had an additional sample collected from the 1- to 1.5-ft depth and location 21-01892 which had additional samples collected from the 1- to 1.5-ft and 1.5- to 2.0-ft depths. SWMU 21-003 sample locations 21-02126, -02127, -02134, -02137, -02142, -02143, -02145, -02147, -02148, -02149, -02152, -02154, -02467, -02469, -02470, -02487, and -02495 through -02498 were collected from the 0- to 0.5-ft depth interval and analyzed for VOCs, SVOCs, PCBs, inorganic chemicals, and radionuclides.

The site data from 1994 were collected from soil or fill and compared to soil BVs (LANL 1998, 59730). Tables 2.3-4, 2.3-5, and 2.3-6 present SWMU 21-003-99 inorganic chemical concentrations greater than soil BVs, detected concentrations of VOCs, SVOCs, and PCBs, and radionuclide activities greater than soil BVs or FVs, respectively. Figures 2.3-6 through 2.3-10 show SWMU 21-003-99 inorganic chemical concentrations greater than soil BVs, VOC and SVOC detections, PCB detections, and radionuclide activities greater than soil BV/FVs, respectively.

Inorganic Chemicals

Inorganic Chemicals Detected at Concentrations Greater than BVs. Aluminum, antimony, beryllium, cadmium, calcium, copper, iron, lead, magnesium, mercury, potassium, thallium, total uranium, and zinc were detected at concentrations greater than their respective BVs in soil samples collected from the PCB container storage area (Figure 2.3-6).

- Aluminum was detected in one soil sample at a concentration of 33700 mg/kg (location 21-02496, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (29,200 mg/kg) but less than the maximum of the soil background data set (61,500 mg/kg). Therefore, aluminum is not a COPC.
- Antimony was detected in one soil sample at a concentration of 41.4 mg/kg (location 21-02134, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (0.83 mg/kg) and the maximum of the soil background data set (1.0 mg/kg). Therefore, antimony is a COPC.
- Beryllium was detected in one soil sample at a concentration of 2.1 mg/kg (location 21-02496, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (1.83 mg/kg) but not greater than the maximum of the soil background data set (3.95 mg/kg). Therefore, beryllium is not a COPC.
- Cadmium was detected in one soil sample at a concentration of 1.3 mg/kg (location 21-02497, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (0.4 mg/kg) but less than the maximum of the soil background data set (2.6 mg/kg). Therefore, cadmium is not a COPC.

- Calcium was detected in one fill and two soil samples at concentrations ranging from 6740 to 26100 mg/kg (the maximum concentration was from location 21-02143, 0- to 0.5-ft depth interval). All concentrations were greater than the soil BV (6120 mg/kg), but only the maximum concentration was greater than the maximum concentration of the soil background data set (14,000 mg/kg). Therefore, calcium is a COPC.
- Copper was detected in eleven soil samples at concentrations ranging from 15.4 to 118 mg/kg (the maximum concentration was from location 21-01884, 0- to 0.5-ft depth interval), all greater than the soil BV (14.7 mg/kg), and all greater than the maximum of the soil background data set (16 mg/kg) with the exception of the lowest concentration. Therefore, copper is a COPC.
- Iron was detected in one soil sample at concentrations of 21,900 mg/kg (location 21-02496, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (21,500 mg/kg) but less than the maximum concentration of the background data set (36,000 mg/kg). Therefore, iron is not a COPC.
- Lead was detected in twelve soil samples and one fill sample at concentrations ranging from 22.5 to 130 mg/kg (the maximum concentration was from location 21-02154, 0- to 0.5-ft depth interval), all greater than the soil BV (22.3 mg/kg), and all greater than the maximum of the soil background data set (28 mg/kg) with the exception of the lowest two concentrations. Therefore, lead is a COPC.
- Magnesium was detected in one soil sample at a concentration of 4740 mg/kg (location 21-02496, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (4610 mg/kg) but not greater than the maximum of the soil background data set (10,000 mg/kg). Therefore, magnesium is not a COPC.
- Mercury was detected in four soil samples at concentrations ranging from 0.21 to 0.37 mg/kg (the maximum concentration was from location 21-01892, 1.0- to 1.5-ft depth interval), at concentrations greater than the soil BV and maximum of the soil background data set (both 0.1 mg/kg). Therefore, mercury is a COPC.
- Potassium was detected in two soil samples at concentrations of 3520 and 4190 mg/kg (the maximum concentration was from location 21-02496, 0- to 0.5-ft depth interval), at concentrations greater than the soil BV (3460 mg/kg) and less than the maximum of the soil background data set (6850 mg/kg). Therefore, potassium is not a COPC.
- Thallium was detected in one soil sample at a concentration of 2.6 mg/kg (location 21-01885, 0- to 0.5-ft depth interval), a concentration greater that the soil BV (0.73 mg/kg) and the maximum of the soil background data set (1.0 mg/kg). Therefore, thallium is a COPC.
- Total uranium was detected in one fill and 24 soil samples at concentrations ranging from 1.84 to 19.3 mg/kg (the maximum concentration was from location 21-02498, 0- to 0.5-ft depth interval), at concentrations greater than soil BV (1.82 mg/kg) and ten of the 24 sample concentrations were greater than the maximum of the soil background data set (3.6 mg/kg). Therefore, total uranium is a COPC.
- Zinc was detected in 16 soil samples at concentrations ranging from 52.6 to 237 mg/kg (the maximum concentration was from location 21-02154, 0- to 0.5-ft depth interval), at concentrations greater than the soil BV (48.8 mg/kg) and 9 of the 16 sample concentrations were greater than the maximum of the soil background data set (75.5 mg/kg). Therefore, zinc is a COPC.

Inorganic Chemicals with Detection Limits Greater than BVs. Antimony, cadmium, and thallium were not detected at concentrations greater than their respective BVs. However, their detection limits were greater than their respective BVs in some samples.

- Antimony detection limits were greater than the soil BV (0.83 mg/kg) and the maximum of the range of the soil background data set (1.0 mg/kg), in three soil samples with detection limits ranging from 0.89 to 2.2 mg/kg (the maximum detection limit was from location 21-02148). Therefore, antimony is a COPC because of detection limits above background as well as its detected concentrations, as described above.
- Cadmium detection limits were greater than the soil BV (0.4 mg/kg) but less than the maximum of the range of the soil background data set (2.6 mg/kg) in one fill and 14 soil samples with detection limits ranging from 0.41 to 0.99 mg/kg (the maximum detection limit was from location 21-02154). Therefore, cadmium is not a COPC.
- Thallium detection limits were greater than the soil BV (0.73 mg/kg) but less than the maximum of the soil background data set (1.0 mg/kg) in 1 fill and 31 soil samples with detection limits ranging from 0.83 to 0.93 mg/kg (the maximum detection limit was from location 21-02496). Therefore, thallium is not a COPC because the detection limits were elevated, but it is retained as a COPC, as described above.

Inorganic Chemical Summary. Antimony, calcium, copper, lead, mercury, thallium, total uranium, and zinc were determined to be COPCs.

The vertical extent was not defined for inorganic COPCs since soil samples were not collected at multiple depths at locations where inorganic COPCs were detected at greater than BV and the maximum of the range of the background data set. However, the vertical extent for mercury was defined at location 21-01892 since sample concentrations showed a decreasing trend with depth.

The lateral extent was also not defined for some inorganic COPCs either because no decreasing trends in concentration were reported or no samples were collected downslope from locations with above background concentrations.

Organic Chemicals

VOCs. VOCs were detected at 23 of 29 sample locations (Figure 2.3-7).

- Acetone was detected at a concentration of 0.07 mg/kg (location 21-01889, 0- to 0.5-ft depth interval).
- Isopropyltoluene(4-) was detected at four locations at concentrations ranging from 0.01 to 0.03 mg/kg (the maximum concentration was from location 21-02137, 0- to 0.5-ft depth interval).
- Toluene was detected at 23 locations at concentrations ranging from 0.01 to 0.08 mg/kg (the maximum concentration was from location 21-02487, 0- to 0.5-ft depth interval).

SVOCs. SVOCs were detected at 5 of 29 sample locations (Figure 2.3-7).

- Bis(2-ethylhexyl)phthalate was detected at two locations at concentrations of 0.41and 62.0 mg/kg (the maximum concentration was from location 21-02152, 0- to 0.5-ft depth interval).
- Di-n-octylphthalate was detected once at 0.56 mg/kg (location 21-02152, 0- to 0.5-ft depth interval).

PCBs. Aroclor-1260 was detected at 17 of 20 sample locations analyzed for PCBs (Figure 2.3-8).

- Aroclor-1260 was detected at 17 locations at concentrations ranging from 0.7 to 17.0 mg/kg (the maximum was from location 21-02127, 0- to 0.5-ft depth interval).

PAHs. PAHs were detected at three of 29 sample locations (Figure 2.3-7).

- Benzo(b)fluoranthene was detected at concentrations of 0.45 and 1.3 mg/kg (the maximum was from location 21-02467, 0- to 0.5-ft depth interval).
- Benzo(g,h,i)perylene was detected at a concentration of 0.5 mg/kg (location 21-02467, 0- to 0.5-ft depth interval).
- Benzo(k)fluoranthene was detected at a concentration of 0.54 mg/kg (location 21-02467, 0- to 0.5-ft depth interval).
- Chrysene was detected at a concentration of 1.2 mg/kg (location 21-02467, 0- to 0.5-ft depth interval).
- Fluoranthene was detected at a concentration of 0.88 mg/kg (location 21-02467, 0- to 0.5-ft depth interval).
- Indeno(1,2,3-cd)pyrene was detected at a concentration of 0.54 mg/kg (location 21-02467, 0- to 0.5-ft depth interval).
- Phenanthrene was detected at a concentration of 0.5 mg/kg (location 21-02467, 0- to 0.5-ft depth interval).
- Pyrene was detected at concentrations of 0.43 and 0.8 mg/kg (the maximum concentration was from location 21-02467, 0- to 0.5-ft depth interval).

Organic Chemical Summary. All detected organic chemicals are retained as COPCs.

The vertical extent was not defined for organic COPCs since soil samples were not collected at multiple depths at all locations.

The lateral extent was also not defined for all organic COPCs since chemical concentrations did not demonstrate a decreasing trend downslope for all organic chemicals. However, PAHs (with the exception of pyrene) and di-n-octylphthlate were not detected in the most downslope samples. The nature of contamination and the lateral extent for PCBs was not demonstrated because downslope samples were not analyzed for PCBs.

Radionuclides

Fallout Radionuclides. Americium-241, cesium-134, cesium-137, cobalt-60, strontium-90, and tritium (Figure 2.3-9) and plutonium-238 and plutonium-239 (Figure 2.3-10) were detected at activities greater than their respective FVs in soil samples collected from the PCB container storage area.

- Americium-241 was detected in one soil sample at 0.84 pCi/g (location 21-01889, 0- to 0.5-ft depth interval), an activity greater than the soil FV and the maximum activity of the soil background data set (both are 0.01 pCi/g). Therefore, americium-241 is a COPC.
- Cesium-134 was detected in one soil sample at an activity of 0.06 pCi/g (location 21-01885, 0- to 0.5-ft depth interval). No background data set is available for comparison; therefore, cesium-134 is a COPC.

- Cesium-137 was detected in two soil samples. Cesium-137 was detected at 3.05 pCi/g (location 21-01889, 0- to 0.5-ft depth interval), an activity greater than the soil FV (1.65 pCi/g) and the maximum activity of the soil background data set (1.7 pCi/g). Cesium-137 was also detected at an activity of 0.17 pCi/g (location 21-01891) at the 1.0- to 1.5-ft depth where the FV does not apply. Therefore, cesium-137 is a COPC.
- Cobalt-60 was detected in one soil sample at an activity of 0.06 pCi/g (location 21-02149, 0- to 0.5-ft depth interval). No background data set is available for comparison; therefore, cobalt-60 is a COPC.
- Strontium-90 was detected at three locations at activities ranging from 1.09 to 4.72 pCi/g (the maximum activity was from location 21-01884, 0- to 0.5-ft depth interval), activities greater than the FV (1.31 pCi/g) and essentially the same as or greater than the maximum activity of the background data set (1.1 pCi/g). Therefore, strontium-90 is a COPC.
- Tritium was detected in 31 fill/soil samples from 27 locations at activities ranging from 0.02 to 2.93 pCi/g (the maximum was from location 21-01891, 1.0- to 1.5-ft depth interval) (Figure 2.3-9). The tritium background is dependent upon the moisture content of each soil sample. In previous investigations, moisture data were not collected for every sample. Therefore, any tritium detection is considered to be greater than background and tritium is a COPC.
- Plutonium-238 was detected in 33 fill/soil samples from 29 locations at activities ranging from 0.03 to 0.22 pCi/g (the maximum activity was from location 21-01885, 0- to 0.5-ft depth interval) (Figure 2.3-10), activities greater than the soil FV (0.023 pCi/g), and all but the least activity was greater than the maximum activity of the soil background data set (0.4 pCi/g). Therefore, plutonium-239 is a COPC.
- Plutonium-239 was detected in 31 fill/soil samples from 27 locations at activities ranging from 0.06 to 10.6 pCi/g (the maximum activity was from location 21-01889, 0- to 0.5-ft depth interval) (Figure 2.3-10), activities greater than the soil FV (0.054 pCi/g) and the maximum activity of the soil background data set (0.056 pCi/g). Therefore, plutonium-239 is a COPC.

Naturally Occurring Radionuclides. Uranium-235 was detected at six locations at activities ranging from 0.22 to 0.54 pCi/g (the maximum activity was from location 21-02470, 0- to 0.5-ft depth interval), activities greater than the soil BV (0.2 pCi/g) and the maximum of the soil background data set (0.16 pCi/g) (Figure 2.3-9). Therefore, uranium-235 is a COPC.

Radionuclide Summary. Americium-241, cesium-134, cesium-137, cobalt-60, plutonium-238, plutonium-239, strontium-90, and tritium are radionuclide COPCs.

The vertical extent was not defined for radionuclides since the 1994 soil samples were not collected at multiple depths at all locations.

The lateral extent was also not defined for radionuclide COPCs since radionuclide activities did not demonstrate a decreasing trend downslope.

Ongoing Data Visualization Effort

A three-dimensional geospatial data visualization model, EarthVision (EarthVision 2002, 85608), was used to display the geologic, chemical, and geophysical data for TA-21. The model may be used by stakeholders (DOE, NMED, Los Alamos County, the public, etc.) to gain a better understanding of the complexities of the planned investigations and remedial actions at individual TA-21 sites.

Figures 2.3-11 and 2.3-12 present the results of the data visualization models for Aroclor-1260 and plutonium-239 at SWMUs 21-003-99 and 21-024(c), respectively. Aroclor-1260 was chosen for modeling since SWMU-21-003-99 stored materials and drums containing PCBs. Additionally, the number of samples collected at SWMU 21-003-99 in the past provides an adequate number of sample locations for the modeling. Plutonium-239 was chosen since it is a pervasive radionuclide on DP Mesa as a result of past plutonium processing. In both figures, the colors represent different concentrations for Aroclor-1260 and activity levels for plutonium-239 in the soil overburden and tuff horizons. A summary table is included in each figure to show the distribution of the raw data for SWMUs 21-003-99 and 21-024(c). Scatter plots illustrate how closely the models match the predicted and observed data. In general, the data appear to show that the higher concentrations of Aroclor-1260 are found in the area between Building 21-61 and the asphalt pad where the containers and materials were moved and stored. In general, higher plutonium-239 activities are shown at the mouth of the SWMU 21-024(c) outfall pipe and at another point to the east, downslope from SWMU 21-003-99. This second point lies in a potential contaminant flow path that may have resulted from emptying the bermed asphalt area through a valve in the southeast corner of the berm.

2.3.3 SWMU 21-024(c), Septic System

Summarized below are previous investigations conducted at this site.

- 1988—A reconnaissance soil sample was collected from a point 8 ft downslope from the end of the outfall pipe in the outfall channel. The sample was analyzed for VOCs, SVOCs, pesticides/PCBs, inorganic chemicals, and radionuclides. The outfall sample contained inorganic chemicals (copper, lead, mercury, and zinc) and radionuclides (americium-241, plutonium-238, plutonium-239, tritium, uranium-234, uranium-235, and uranium-238) above regional background values used at the time, and the detection of oil/grease and the VOC methylene chloride (LANL 1991, 07529, pp. 15-38–15-45).
- 1992—RFI activities included collecting two soil samples (0–0.5 ft and 0.5–1 ft) at each of two locations within the outfall (locations 21-01391 and 21-01392) (Figure 2.3-13). A duplicate sample was collected at location 21-01392, 0- to 0.5-ft depth, resulting in five soil samples (LANL 1994, 31591, p. 8-18). Samples were analyzed for inorganic chemicals and radionuclides.
- 1993—RFI activities included drilling a 20-ft borehole in the vicinity of the reinforced concrete septic tank (Structure 21-56). One sample was collected from each 5-ft depth interval in the borehole (location 21-01669) (Figure 2.3-13), resulting in one fill and three tuff soil samples (LANL 1995, 52350, pp. 7-2–7-3). The samples were analyzed for inorganic chemicals, SVOCs, and radionuclides.

The site data from 1992 and 1993 were collected from soil or tuff at SWMU 21-024(c) and compared with the applicable background concentrations (LANL 1998, 59730). Tables 2.3-7 and 2.3-8 present inorganic chemical concentrations greater BVs and radionuclide activities greater than BVs/FVs. Figures 2.3-14 and 2.3-15 show inorganic chemical concentrations greater than BVs and radionuclide activities greater than BV/FVs, respectively. Organic chemicals were not detected; therefore, no figure or table depicting organic chemicals at SWMU 21-024(c) is included.

Inorganic Chemicals

Inorganic Chemicals Detected at Concentrations Greater than BVs. Inorganic chemicals were detected at concentrations greater than BV in the two outfall locations in soil. Antimony, arsenic, cadmium, calcium, chromium, copper, lead, nickel, silver, vanadium, and zinc were detected at concentrations greater than

their respective BVs (Figure 2.3-14). Calcium and magnesium were detected at concentrations greater than their respective BVs in fill material in the 0- to 5.0-ft depth interval of the borehole. The soil BV is used for comparison to fill. Analysis for mercury was not requested as part of the RFI investigations.

- Antimony was detected in two soil samples from two locations at concentrations ranging from 7.3 to 29.5 mg/kg (the maximum concentration was from location 21-01391, 0- to 0.5-ft depth interval); at concentrations greater than the soil BV (0.83 mg/kg) and the maximum of the soil background data set (1.0 mg/kg). Therefore, antimony is a COPC.
- Arsenic was detected in two soil samples from one location at concentrations of 8.2 and 10 mg/kg (the maximum concentration was from location 21-01391, 0.5- to 1.0-ft depth interval), at concentrations greater than the soil BV (8.17 mg/kg), but only the highest concentration was greater than maximum of the soil background data set (9.3 mg/kg). Therefore, arsenic is a COPC.
- Cadmium was detected in four soil samples from two locations at concentrations ranging from 1.2 to 5.3 mg/kg (the maximum concentration was from location 21-01391, 0.5- to 1.0-ft depth interval), concentrations greater than the soil BV (0.4 mg/kg). However, only the two highest concentrations were greater than the maximum of the soil background data set (2.6 mg/kg). Therefore, cadmium is a COPC.
- Calcium was detected in one soil sample at a concentration of 14,100 mg/kg (21-01669, 0- to 5.0-ft depth interval), a concentration greater than the soil BV (6120 mg/kg) and the maximum of the soil background data set (14000 mg/kg). Therefore, calcium is a COPC.
- Chromium was detected in three soil samples from two locations at concentrations ranging from 44.4 to 415 mg/kg (the maximum concentration was from location 21-01391, 0- to 0.5-ft depth interval), concentrations greater than the soil BV (19.3 mg/kg) and the maximum of the soil background data set (36.5 mg/kg). Therefore, chromium is a COPC.
- Copper was detected in three soil samples from two locations at concentrations ranging from 120 to 1520 mg/kg (the maximum concentration was from location 21-01391, 0- to 0.5-ft depth interval), concentrations greater than the soil BV 14.7 m/kg) and the maximum of the soil background data set (16.0 mg/kg). Therefore, copper is a COPC.
- Lead was detected in four soil samples from two locations at concentrations ranging from 29.8 to 2300 mg/kg (the maximum concentration was from location 21-01391, 0- to 0.5-ft depth interval), concentrations greater than the soil BV (22.3 mg/kg) and the maximum of the range of the soil background data set (28 mg/kg). Therefore, lead is a COPC.
- Magnesium was detected in 1 fill sample at a concentration of 5720 mg/kg (location 21-01669, 0- to 5.0-ft depth interval), a concentration greater than the fill BV (4610 mg/kg) but not the maximum of the fill background data set (10,000 mg/kg). Therefore, magnesium is not a COPC.
- Nickel was detected in two soil samples from one location at concentrations of 17.0 and 43.7 mg/kg (the maximum concentration was from location 21-01391, 0- to 0.5-ft depth interval), concentrations greater than the soil BV (15.4 mg/kg), but only the highest concentration was greater than the maximum of the soil background data set (29.0 mg/kg). Therefore, nickel is a COPC.
- Silver was detected in three soil samples from two locations at concentrations ranging from 3.9 to 105 mg/kg (the maximum concentration was from location 21-01391, 0- to 0.5-ft depth interval), concentrations greater than the soil BV or the maximum of the soil background data set (both are 1.0 mg/kg). Therefore, silver is a COPC.

- Vanadium was detected in one soil sample at a concentration of 53.6 mg/kg (location 21-01391, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (39.6 mg/kg) but not greater than the maximum of the soil background data set (56.5 mg/kg). Therefore, vanadium is not a COPC.
- Zinc was detected in three soil samples from two locations at concentrations ranging from 122 to 201 mg/kg (the maximum concentration was from location 21-01391, 0.5- to 1.0-ft depth interval), concentrations greater than the soil BV (48.8 mg/kg) and the maximum of the soil background data set (75.5 mg/kg). Therefore, zinc is a COPC.

Inorganic Chemicals Not Included in Background Data. Lithium, molybdenum, and strontium were not included in the background data and, therefore, have no BVs for comparison. However, earlier studies (Longmire 1993, 40222.5; Purtymun 1987, 06687) indicate a regional background mean of 0.59 mg/kg for molybdenum and 120 mg/kg for strontium.

- Lithium was detected in all the outfall soil samples at concentrations ranging from 3.8 to 12.6 mg/kg (the maximum concentration was from location 21-01391, 0.5- to 1.0-ft depth interval), in the borehole fill sample at 17.5 mg/kg (location 21-01669, 0- to 5.0-ft depth interval), and while not detected in the deeper borehole samples, had detection limits of 1.7 to 4.2 mg/kg. No established background levels are available for lithium; however, the lithium concentrations for the investigation SWMUs are similar, indicating that the lithium is not elevated as a result of releases from the site. Therefore, lithium is not a COPC.
- Molybdenum was detected twice in one location at 2.8 and 20.1 mg/kg (the maximum concentration was from location 21-01391, 0- to 0.5-ft depth interval) and had detection limits of 2.2–7.0 mg/kg in all other samples. Concentrations and detection limits were greater than the regional background (0.59 mg/kg). Therefore, molybdenum at 20.1 mg/kg is a COPC.
- Strontium was detected in all the outfall samples at concentrations ranging from 15.8 to 39.1 mg/kg (the maximum concentration was from location 21-01391, 0- to 0.5-ft depth interval), in the borehole fill sample at a concentration of 67 mg/kg (21-01669, 0- to 5.0-ft depth interval), and while not detected in the deeper borehole samples, had detection limits of 0.49–13.6 mg/kg. No concentration or detection limit was greater than the regional background (120 mg/kg). Therefore, strontium is not a COPC.

Inorganic Chemicals with Detection Limits Greater than BVs. Antimony, cadmium, and selenium were not detected at concentrations greater than their respective BVs. However, their detection limits were greater than their respective BVs in some samples.

- Antimony detection limits were greater than the soil BV (0.83 mg/kg) and the maximum of the range of the soil background data set (1.0 mg/kg) in two soil samples (5.2 mg/kg at location 21-01391and 4.7 mg/kg at location 21-01392), both at the 0.5- to 1.0-ft depth interval). Therefore, antimony is a COPC.
- Cadmium detection limits were greater than the soil BV (0.4 mg/kg), but less than the maximum of the soil background data set (2.6 mg/kg), in one fill sample at 1.2 mg/kg (location 21-01669, 0- to 5.0-ft depth interval). Therefore, cadmium is not a COPC based on elevated detection limits but is retained as a COPC as described above.
- Selenium detection limits were greater than the tuff BV (0.3 mg/kg) and the maximum of the tuff background data set (0.1 mg/kg) in three samples at 42 mg/kg (location 21-01669, at depth intervals of 6.0 to 10.0 ft, 10.0 to 15.0 ft, and 15.0 to 20.0 ft). Therefore, selenium is a COPC.

Inorganic Chemical Summary. Antimony, arsenic, cadmium, calcium, chromium, copper, lead, molybdenum, nickel, selenium, silver, and zinc are inorganic COPCs.

Vertical extent for all inorganic chemicals was demonstrated in the borehole (location 21-01669). All inorganic chemicals were less than the BV at depths deeper than 5 ft. The vertical extent for arsenic, cadmium, and zinc was not defined at the two outfall locations as concentrations increase with depth. The nature of contamination and extent of mercury was not defined because no analysis was performed for mercury in previous soil samples.

Inorganic chemical concentrations showed a decreasing trend in the downslope direction. However, the two samples do not provide enough spatial coverage to determine lateral extent.

Organic Chemicals

Organic chemicals were not detected in the surface soil samples or the borehole samples.

Organic Chemical Summary. The nature and extent of contamination for PCBs is not defined because PCB analyses were not conducted on the surface samples, although the site is located downslope from a PCB storage area.

Radionuclides

Fallout Radionuclides. Americium-241, plutonium-238, plutonium-239, and tritium were detected at activities greater than their respective FVs in at least one soil sample collected from the outfall area. Plutonium-239 and tritium were detected in the borehole samples (Figure 2.3-15).

- Americium-241 was detected in the two outfall surface samples at activities ranging from 0.54 to 3.24 pCi/g (the maximum activity was from location 21-01391, 0- to 0.5-ft depth interval), activities greater than the soil FV and the soil background data set (both are 0.013 pCi/g). Americium-241 was also detected at activities of 0.07 and 0.25 pCi/g (location 21-01391, 0.5- to 1-ft depth interval) in two outfall subsurface samples where the FV does not apply. Therefore, americium-241 is a COPC.
- Plutonium-238 was detected in the two outfall surface soil samples at activities ranging from 0.09 to 0.21 pCi/g (the maximum activity was from location 21-01391, 0- to 0.5-ft depth interval), activities greater than the soil FV (0.023 pCi/g) and the maximum of the background data set (0.037 pCi/g). Plutonium-238 was also detected at activities of 0.01 and 0.03 pCi/g (locations 21-01392 and 21-01391, respectively, at the 0.5- to 1-ft depth interval) in two outfall subsurface samples where the soil FV does not apply. Therefore, plutonium-238 is a COPC.
- Plutonium-239 was detected in the two outfall surface soil samples at activities ranging from 3.96 to 13.23 pCi/g (the maximum activity was from location 21-01391, 0- to 0.5-ft depth interval), activities greater than the soil FV and the maximum of the background data set (both 0.054 pCi/g). Plutonium-239 was also detected at 0.88 and 1.78 pCi/g in two outfall subsurface soil samples where the FV does not apply. Plutonium-239 was detected in the deepest tuff sample collected from the borehole at an activity of 1.01 pCi/g (location 21-01669, 15- to 20-ft depth interval) where the FV does not apply. Therefore, plutonium-239 is a COPC.
- Tritium was detected in all the borehole samples at activities ranging from 0.05 to 0.19 pCi/g (the maximum activity was from 21-01669, 0- to 5.0-ft depth interval). The tritium background depends upon the moisture content of each soil sample. In previous investigations the moisture data were

not collected for every sample. Therefore, any tritium detection is considered to be greater than background and a COPC.

Radionuclide Summary. Americium-241, plutonium-238, plutonium-239, and tritium are radionuclide COPCs.

The vertical extent was defined for radionuclides in the two outfall surface soil samples since activities decreased with depth. However, the two samples do not provide enough spatial coverage to determine lateral extent. Vertical extent of plutonium-239 was not defined in the borehole since plutonium-239 was detected in the deepest sample. Vertical extent of tritium was not defined in the borehole since the activity increases to the 15-ft depth and decreases slightly in the 15- to 20-ft sampling interval.

Radionuclide activities demonstrated a decreasing trend in the downslope direction. However, the two samples do not provide enough spatial coverage to determine lateral extent.

2.3.4 AOC 21-002(b), Drum Storage Area

Summarized below are previous investigations conducted at this site.

- 1994—Phase I RFI activities included collecting surface soil samples and one duplicate from eight locations at AOC 21-002(b) (locations 21-02501 through 21-02508) at the 0- to 0.5-ft depth (Figure 2.3-16). These soil/tuff samples were analyzed for inorganic chemicals, VOCs, SVOCs, and radionuclides (LANL 1996, 54838).

The site data from 1994 were collected from soil or tuff and compared with the appropriate BVs (LANL 1998, 59730). Tables 2.3-9 through 2.3-11 present AOC 21-002(b) inorganic chemical concentrations greater than BVs, detected concentrations of VOCs and SVOCs, and radionuclide activities greater than BVs or FVs, respectively. Figures 2.3-17, 2.3-18, and 2.3-19 show inorganic chemical concentrations greater than BVs, VOC and SVOC detections, and radionuclide activities greater than BV/FVs, respectively.

Inorganic Chemicals

Inorganic Chemicals Detected at Concentrations Greater than BVs. Barium, calcium, chromium, copper, lead, silver, sodium, total uranium, and zinc were detected at concentrations greater than their respective BVs in soil samples collected from the drum storage area (Figure 2.3-17).

- Barium concentrations in the seven samples ranged from 67.3 to 714.0 mg/kg. The environmental medium of six samples was tuff and the barium concentrations ranged from 67.3 to 714.0 mg/kg (the maximum concentration was from location 21-02506, 0- to 0.5-ft depth interval), concentrations greater than the tuff BV (46 mg/kg) and the maximum of the tuff background data set (51.6 mg/kg). Barium was detected in one soil sample at a concentration of 340 mg/kg (location 21-02507, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (295 mg/kg) but less than the maximum of the soil background data set (410 mg/kg). Therefore, barium is a COPC.
- Calcium was detected in two tuff samples in two samples at concentrations ranging from 3760 to 4530 mg/kg (the maximum concentration was from location 21-02508, 0- to 0.5-ft depth interval), concentrations greater than the tuff BV (2200 mg/kg) and the maximum of the tuff background data set (2230 mg/kg). Therefore, calcium is a COPC.

- Chromium was detected in two tuff samples at 7.6 mg/kg and 16.8 mg/kg (the maximum concentration was from location 21-02505, 0- to 0.5-ft depth interval), concentrations greater than the tuff BV (7.14 mg/kg); however, only the highest concentration was greater than the maximum of the tuff background data set (13 mg/kg). Therefore, chromium is a COPC.
- Copper was detected in five tuff samples at concentrations ranging from 6.2 to 9.5 mg/kg (the maximum concentration was from both locations 21-02508 and 21-02505, 0- to 0.5-ft depth interval), concentrations greater than tuff BV (4.66 mg/kg) and the maximum of the tuff background data set (6.2 mg/kg). Therefore, copper is a COPC.
- Lead concentrations in seven samples ranged from concentrations of 15 to 400 mg/kg. The environmental medium of six samples was tuff, and the lead concentrations ranged from 15 to 163 mg/kg (the maximum concentration was from location 21-02506, 0- to 0.5-ft depth interval), concentrations greater than the tuff BV (11.2 mg/kg) and all concentrations greater than the maximum of the tuff background data set (15.5 mg/kg), with the exception of the lowest concentration. The environmental medium of two samples was soil, and the lead concentrations were 46.8 and 400 mg/kg (the maximum concentration was from location 21-02507, 0 to 0.5-ft depth interval). Concentrations were greater than the soil BV (22.3 mg/kg) and the maximum of the soil background data set (28 mg/kg). Therefore, lead is a COPC.
- Silver was detected in one tuff sample at a concentration of 3.1 mg/kg (location 21-02506, 0- to 0.5-ft depth interval), a concentration greater than the tuff BV (1.0 mg/kg) and the maximum of the tuff background data set (1.9 mg/kg). Therefore, silver is a COPC.
- Sodium was detected in one tuff sample at a concentration of 4470 mg/kg (location 21-02505, 0- to 0.5-ft depth interval), a concentration greater than the tuff BV (2770 mg/kg) but less than the maximum of the tuff background data set (7700 mg/kg). Sodium was detected in one soil sample at a concentration of 20,600 mg/kg (location 21-02504, 0- to 0.5-ft depth interval), a concentration greater than the soil BV (915 mg/kg) and the maximum of the soil background data set (1800 mg/kg). Therefore, sodium is a COPC.
- Total uranium concentrations in five samples ranged from 1.9 to 3.77 mg/kg. The environmental medium for three samples was tuff, and the total uranium concentrations ranged from 2.87 to 3.35 mg/kg (the maximum concentration was at location 21-02508, 0- to 0.5-ft depth interval), concentrations greater than the tuff BV (2.4 mg/kg) but not greater than the maximum of the tuff background data set (5.0 mg/kg). The environmental medium for two locations was soil, and the total uranium concentrations were 1.9 and 3.77 mg/kg (the maximum concentration was from location 21-02507, 0- to 0.5-ft depth interval), concentrations greater than the soil BV (1.82 mg/kg), but only the highest concentration was greater than the maximum of the background data set (3.6 mg/kg). Therefore, uranium is a COPC.
- Zinc concentrations in five samples ranged from 66.3 to 604 mg/kg. The environmental medium for three samples was tuff, and the zinc concentrations ranged from 91.4 to 418 mg/kg (the maximum concentration was from location 21-02506, 0- to 0.5-ft depth interval), concentrations greater than the tuff BV (63.5 mg/kg) and the maximum of the tuff background data set (65.5 mg/kg). The environmental medium for two samples was soil, and the concentrations were 66.3 and 604 mg/kg (the maximum concentration was from location 21-02507, 0- to 0.5-ft depth interval), concentrations greater than the soil BV (48.8 mg/kg), but only the highest concentration was greater than the maximum concentration of the background data set (75.5 mg/kg). Therefore, zinc is a COPC.

Inorganic Chemicals with Detection Limits Greater than BVs. Cadmium, cobalt, selenium, and thallium were not detected at concentrations greater than their respective BVs. However, their detection limits were greater than their respective BVs in some samples.

- Cadmium detection limits were greater than the soil BV (0.4 mg/kg) but less than the maximum of the soil background data set (2.6 mg/kg) in one sample (0.86 mg/kg from location 21-02507). Therefore, cadmium is not a COPC.
- Cobalt detection limits were greater than the tuff BV (3.14 mg/kg) but less than the maximum of the range of the tuff background data set (8.0 mg/kg) in four samples with detection limits ranging from 4.0 to 5.4 mg/kg (the maximum detection limit was from location 21-02506). Therefore, cobalt is not a COPC.
- Selenium detection limits were greater than the tuff BV (0.3 mg/kg) and the maximum of the range of the tuff background data set (0.1 mg/kg) in six samples with detection limits ranging from 0.88 to 1.0 mg/kg (the maximum detection limit was from location 21-02503). Therefore, selenium is a COPC.
- Thallium detection limits were greater than the soil BV (0.73 mg/kg) in two samples (1.2 mg/kg from location 21-02507 and 0.94 mg/kg from location 21-02504) and greater than the maximum of the soil background data set (1.0 mg/kg) in one sample (location 21-02507). The thallium detection limit was greater than the tuff BV (1.1 mg/kg) but less than the maximum of the range of the tuff background data set (1.7 mg/kg) in one sample (1.2 mg/kg from location 21-02508). Therefore, thallium is a COPC.

Inorganic Chemical Summary. Barium, calcium, chromium, copper, lead, selenium, silver, sodium, thallium, uranium, and zinc are inorganic COPCs.

The vertical extent was not defined for all inorganic chemicals since soil samples were not collected at multiple depths and evidence of a decreasing trend cannot be demonstrated.

The lateral extent was also not defined for barium, calcium, chromium, copper, lead, silver, uranium, zinc, since concentrations increased in the downslope direction.

Organic Chemicals

VOCs. Only one VOC, toluene, was detected, at two of eight sample locations (Figure 2.3-18).

- Toluene was detected in two samples at two locations at a concentration of 0.01 mg/kg (locations 21-02507 and 21-02508).

PAHs. PAHs were detected in at two of eight sample locations (Figure 2.3-18).

- Benzo(a)pyrene was detected at a concentration of 0.36 mg/kg (location 21-02507).
- Benzo(b)fluoranthene was detected at two locations at concentrations of 0.51 mg/kg and 0.61 mg/kg (the maximum concentration was from location 21-02505).
- Benzo(g,h,i)perylene was detected at a concentration of 0.38 mg/kg (location 21-02505).

Organic Chemical Summary. The VOC toluene is not a COPC because it was detected at trace levels at only two locations; therefore, further sampling is not warranted. The PAHs are therefore COPCs.

The vertical extent was not defined for the organic COPCs since soil samples were not collected at multiple depths.

The lateral extent was also not defined for the organic COPCs on the eastern side of the SWMU since organic chemicals were detected in this area.

Radionuclides

Fallout Radionuclides. FVs for fallout radionuclides are not available for tuff. Cesium-137, plutonium-238, plutonium-239, ruthenium-106 strontium-90, and tritium were detected in samples collected from the drum storage area (Figure 2.3-19).

- Cesium-137 was detected in five tuff samples at activities ranging from 0.12 to 0.59 pCi/g (the maximum activity was from location 21-02508, 0- to 0.5-ft depth interval). Therefore, cesium-137 is a COPC.
- Plutonium-238 was detected in six tuff samples at activities ranging from 0.07 to 0.13 pCi/g (the maximum activity was from location 21-02506, 0- to 0.5-ft depth interval). Plutonium-238 was detected in two soil samples from two locations at activities of 0.08 and 0.10 pCi/g (the maximum activity was from location 21-02507, 0- to 0.5-ft depth interval), activities greater than the soil FV (0.023 pCi/g) and greater than the range of the soil background data set (0.037 pCi/g). Therefore, plutonium-238 is a COPC.
- Plutonium-239 was detected in six tuff samples at activities ranging from 0.05 to 7.5 pCi/g (the maximum activity was from location 21-02506, 0- to 0.5-ft depth interval). Plutonium-239 was detected in two soil samples from two locations at activities of 0.39 pCi/g and 6.97 pCi/g (the maximum activity was from location 21-02507, 0- to 0.5-ft depth interval), activities greater than the soil FV (0.054 pCi/g) and the range of the soil background data set (0.055 pCi/g). Therefore, plutonium-239 is a COPC.
- Ruthenium-106 (a fission product) was detected at an activity of 9.25 pCi/g (location 21-02501, 0- to 0.5-ft depth interval). No BVs are available for ruthenium-106; therefore, ruthenium-106 is a COPC.
- Strontium-90 was detected in two samples in tuff at activities ranging from 1.23 to 2.39 pCi/g (the maximum activity was at location 21-02505, 0- to 0.5-ft depth interval). Strontium-90 was detected in 1 soil sample at an activity of 1.59 pCi/g (location 21-02504, 0- to 0.5-ft depth interval), an activity greater than the soil FV (1.31 pCi/g), and maximum of the soil background data set (1.1 pCi/g). Therefore, strontium-90 is a COPC.
- Tritium was detected in 4 samples in tuff at activities ranging from 0.03 to 0.06 pCi/g (the maximum activity was from location 21-02502, 0- to 0.5-ft depth interval) and in 1 location in soil at an activity of 0.23 pCi/g (location 21-02504, 0- to 0.5-ft depth interval). The tritium measurement depends upon the moisture content of each soil sample. In previous investigations, the moisture data were not collected for every sample. Therefore, any tritium detection is considered to be greater than background and a COPC.

Radionuclide Summary. Cesium-137, plutonium-238, plutonium-239, ruthenium-106, strontium-90, and tritium are radionuclide COPCs.

The vertical extent of radionuclides was not defined since the 1994 soil samples were not collected at multiple depths.

With the exception of ruthenium-106, the lateral extent was not defined for radionuclide COPCs since radionuclide activities did not demonstrate a decreasing trend downslope.

2.3.5 Corrective Action Sites

The corrective actions planned for the SWMUs consist of removing the structures and any contaminated material, followed by confirmation sampling. The nature and extent of contamination will be determined as part of the corrective action process. As outlined in Section 5.0, the limited existing data set for these SWMUs is being evaluated, additional survey information is being collected, and all this information will be used to finalize the implementation approach to the corrective actions. This information will be transmitted to NMED in a progress report prior to implementing the corrective actions and will be included in the DP Site aggregate area investigation report.

3.0 EXISTING SITE CONDITIONS

3.1 Climate

Los Alamos County has a semiarid, temperate mountain climate. Annual precipitation, including both rain and snow, averages about 18 in. Recorded extremes in annual precipitation range between 6.8 in. and 30.3 in. An average of 40% of the annual precipitation falls during thunderstorms in July and August, often in brief, high-intensity rains. Significant amounts of surface water often run off during these rainfall events. Daily rainfall extremes of 1 in. or greater occur in most years, and the estimated 100-yr daily rainfall extreme is about 2.5 in. Snowstorms with accumulations exceeding 4 in. are common in Los Alamos. Snowfall is greatest from December through March; heavy snowfall is infrequent in other months (Bowen 1990, 06899). The average snowfall is 51 in. annually.

Summers are generally sunny, with moderate, warm days and cool nights. Summer afternoon temperatures in Los Alamos County are typically in the 70s and 80s (°F), infrequently reaching 90°F; nighttime temperatures are typically in the 50s (°F). Typical winter temperatures range between 30°F and 50°F during the day and 15°F and 25°F during the night, occasionally dropping to 0°F or below (Bowen 1990, 06899).

Strong winds occur predominantly in the spring. The predominant wind direction, especially for strong winds, is south-southwest. Because of complex terrain, surface winds in Los Alamos often vary greatly with time of day and location. The winds toward the eastern edge of the Pajarito Plateau near the Rio Grande Valley differ from those at the western edge adjacent to the mountains. Along the eastern edge, the daily wind cycle is a moderate southwesterly up-valley wind during the day and either a light northwesterly to northerly drainage wind or moderate southwesterly wind at night. Along the western edge, the predominant winds are southerly to northwesterly during the day and southwesterly and northeasterly at night toward the Rio Grande Valley. TA-21 is located approximately midway between the western and eastern edges of the Pajarito Plateau. No tornadoes have been reported to have touched down in Los Alamos County. Strong dust devils can produce winds up to 75 mph at isolated spots in the county, especially at lower elevations. Strong winds with gusts exceeding 60 mph are common during the spring.

3.2 Surface Conditions

3.2.1 Soils

Soils on the Pajarito Plateau were initially mapped and described by Nyhan et al. (1978, 05702). The Nyhan study included only Laboratory-controlled lands and certain United States Forest Service lands within Los Alamos County.

Soils were formed in a semiarid climate and were derived from chemical, biological, and physical weathering of local bedrock units, fallout pumice deposits, eolian deposits, and sediments derived from these geological materials (Nyhan et al. 1978, 05702). A large variety of soils have developed on the Pajarito Plateau as the result of interactions of the underlying bedrock, slope, and climate. The mineral components of the soils are in large part derived from the Bandelier Tuff, but dacitic lavas of the Tschicoma Formation, basalts of the Cerros del Rio volcanic field, and sedimentary rocks of the Puye Formation are locally important. Alluvium derived from the Pajarito Plateau and from the east side of the Jemez Mountains contributes to soils in the canyons and also to those on some mesa tops.

The soils on the slopes between the mesa tops and canyon floors have been mapped as mostly steep rock outcrops consisting of approximately 90% bedrock outcrop and patches of shallow, undeveloped colluvial soils. South-facing canyon walls are steep and usually have little or no soil material or vegetation; in contrast, the north-facing walls generally have areas of very shallow dark-colored soils and are more heavily vegetated. The canyon floors generally contain poorly developed, deep, well-drained soils (Nyhan et al. 1978, 05702).

Soils in the vicinity of TA-21 are typical of those across the Pajarito Plateau and are generally poorly developed, derived from Bandelier Tuff bedrock, and formed in a semiarid climate. Soils on the TA-21 mesa top are mainly shallow, well-drained sandy loams of the Hackroy series. As described by Nyhan et al. (1978, 05702), "The surface layer of the Hackroy soils is a brown sand loam, or loam, about 10-cm thick. The subsoil is a reddish brown clay, gravelly clay, or clay loam, about 20-cm thick. The depth to bedrock and the effective rooting depth area 20 to 50 cm." Hackroy soils are classified as Alfisols, in part reflecting the clayey subsurface horizons. Intermixed with the Hackroy soils on the mesa tops are small areas of deeper loams of the Nyjack series and patches of bedrock. The Nyjack soils are texturally similar to Hackroy soils and are distinguished by thicknesses of 7.9 in. (50 cm) to 40.2 in. (102 cm) and by the common presence of pumice fragments in the lower soil (Nyhan et al. 1978, 05702). Areas of exposed rock are predominant toward the east end of the mesa and TA-21 development.

3.2.2 Surface Water

The Rio Grande is the primary river in north-central New Mexico. All surface water drainage and groundwater discharge from the plateau ultimately arrives at the Rio Grande (Figure 3.2-1). Most Los Alamos surface water occurs as ephemeral, intermittent, or interrupted (perennial, ephemeral, and intermittent stretches) streams in canyons cut into the Pajarito Plateau. Ephemeral streams flow in response to precipitation; intermittent streams flow in response to the availability of snowmelt or groundwater discharge; and perennial streams flow at all times except during extreme drought. Springs on the flanks of the Jemez Mountains, west of the Laboratory's western boundary, supply flow to the upper reaches of Cañon de Valle and to Guaje, Los Alamos, Pajarito, and Water Canyons (Purtymun 1975, 11787; Stoker 1993, 56021). These springs discharge water perched in the Bandelier Tuff and Tschicoma Formation at rates from 2 gpm to 135 gpm (Abeele et al. 1981, 06273). The volume of flow from the springs maintains natural perennial reaches of varying lengths in each of the canyons.

Perennial flow occurs in the upper reaches (west of the Los Alamos Reservoir) of Los Alamos Canyon and in the lower reaches east of the confluence with Pueblo Canyon. Typically, the overflow of water from the reservoir during spring snowmelt results in nearly continuous surface water flow between the western Laboratory boundary and TA-2 for several weeks to several months each year (LANL 1995, 50290); the flow does not reach TA-21. For most of the year, the only surface flow in Los Alamos Canyon is in the lower part of the canyon because of discharge from the Los Alamos County Sewage Treatment Plant and discharge from Basalt and Los Alamos Springs east of the Laboratory boundary (LANL 1995, 50290) (Figure 3.2-1). Surface water in Los Alamos Canyon rarely flows across the length of the Laboratory. Most often surface waters are depleted by infiltration into canyon alluvium creating saturated zones of seasonally variable extent (LANL 1995, 50290).

Surface flow in DP Canyon, a tributary to Los Alamos Canyon, is generated by rainfall and snowmelt events. DP Spring, located in DP Canyon (Figure 3.2-2), discharges continuously except for a dry period during the winter and spring of 1996.

At the Laboratory, surface water runoff and sediment transport are among the potential migration pathways by which contaminants might be transported to off-site receptors. Surface water may also access subsurface contaminants exposed by soil erosion. Soil erosion is dependent on several factors, including soil properties, the amount of vegetative cover, the slope of the contaminated area, exposure, the intensity and frequency of precipitation, and seismic activity.

3.3 Subsurface Conditions

3.3.1 Stratigraphy

TA-21 is centrally located on the Pajarito Plateau, approximately midway between the flanks of the Jemez Mountains on the west and the Rio Grande to the east. The stratigraphy of the area is summarized in this section. Additional information on the geologic setting of the TA-21 area and information on the Pajarito Plateau can be found in the ER Project installation work plan (LANL 1998, 62060), the TA-21 operable unit work plan (LANL 1991, 07529), and the hydrogeologic work plan (LANL 1998, 59599). The following sections describe the rock units below TA-21; these units were encountered during environmental restoration investigations at the TA. The descriptions begin with the oldest (deepest) and proceed to the youngest (topmost) (Figure 3.3-1).

Santa Fe Group

The Santa Fe Group consists of predominately fluvial, slightly consolidated sedimentary rocks that crop out in the lower reaches of Los Alamos Canyon, along White Rock Canyon, and in extensive areas east of the Rio Grande. Galusha and Blick (1971, 21526) subdivided the Santa Fe Group into formations and members based on geologic mapping and faunal assemblages of late tertiary mammals. Manley (1979, 11714) refined their stratigraphy based on additional mapping and dates on interbedded volcanic ash layers, lava flows, and dikes. Cavazza (1989, 21501) proposed changes in stratigraphic nomenclature based on sedimentary facies pattern. In the vicinity of the Pajarito Plateau, the Santa Fe Group consists of the Tesuque Formation and overlying Chamita Formation.

Tesuque Formation. The Tesuque Formation is a massive, thick unit consisting of arkosic sediments, derived primarily from Precambrian basement and Tertiary volcanic sources to the east and northeast. This unit is a light pink to buff siltstone and silty sandstone with a few lenses of pebbly conglomerate and clay. It is poorly to moderately consolidated and has an age range of about 7 to 21 million yr (Manley 1979, 11714; Cavazza 1989, 21501). This formation exists in deep well boreholes under the Pajarito

Plateau and is the primary aquifer for municipal and industrial water supply in Los Alamos County. Regional cross sections indicate that it does not exist beneath TA-21.

Chamita Formation. The Chamita Formation overlies and interfingers with the Tesuque Formation. It consists of arkosic siltstones, sandstones, pebbly conglomerate, and includes two prominent beds of white ash. Because of similarities of appearance and interfingering relations, the differentiation of Chamita from Tesuque deposits is difficult in borehole investigations, and it does not outcrop in the area of TA-21. Regional cross sections indicate that it does not exist beneath TA-21. The estimated age ranges between 12 million and 4.5 million yr (MacFadden 1977, 21569; Manley 1979, 11714).

Purtymun (1995, 45344) describes a trough of late Miocene coarse-grained sediments at the top of the Santa Fe Group that postdate the Chamita Formation. Purtymun called these deposits the Chaquehui Formation, and they are important for the development of high-yield, low-drawdown municipal and industrial water supply wells for the Los Alamos area. The trough is 3 to 4 mi wide and extends 7 to 8 mi from the northeast to the southwest. It is filled with up to 1500 ft of gravels, cobbles, and boulders derived from highlands to the north and east. Regional cross sections indicate that it exists beneath TA-21 and most of the Laboratory.

The Puye Formation

The Puye Formation is a fanglomerate deposit consisting of poorly sorted boulders, cobbles, and coarse sands made up of dacitic to latitic debris eroded from the contemporaneous Tschicoma Formation (Turbeville et al. 1989, 21587; Spell et al. 1990, 21586). In the lower reaches of Los Alamos Canyon and along the Rio Grande, the Puye Formation also contains basaltic debris derived from contemporaneous volcanism and erosion of the Cerros del Rio volcanic field. The Puye Formation contains numerous interbedded lapilli tuff beds and laharic deposits. Lacustrine deposits are volumetrically significant in the distal parts of the fan. Regional cross sections show this deposit under TA-21.

The lower part of the Puye Formation includes the Totavi Lentil (Griggs 1964, 08795), a deposit of well-rounded cobbles and boulders of Precambrian quartzites and crystalline rocks. The Totavi Lentil probably represents channel deposits of the ancestral Rio Grande, and it may interfinger with the fanglomerate facies of the Puye Formation along White Rock Canyon.

The Bandelier Tuff

The Bandelier Tuff under TA-21 consists of the Otowi and Tshirege Members, which are stratigraphically separated in many places by the tephras and volcaniclastic sediments of the Cerro Toledo interval. The Bandelier Tuff was emplaced during cataclysmic eruptions of the Valles Caldera between 1.61 and 1.22 million yr ago. The tuff is composed of pumice, minor rock fragments, and crystals supported in an ashy matrix. It is a prominent cliff-forming unit because of its generally strong consolidation. Because the Bandelier Tuff is the most prominent rock type on the Pajarito Plateau, its detailed stratigraphy is of considerable importance and is discussed further below (see also Broxton and Reneau 1995, 49726).

Otowi Member. Griggs (1964, 8795), Smith and Bailey (1966, 21584), Bailey et al. (1969, 21498), and Smith et al. (1970, 09752) describe the nature and extent of the Otowi Member. It consists of moderately consolidated (indurated), porous, and nonwelded vitric tuff (ignimbrite) that forms gentle colluvium-covered slopes along the base of canyon walls. The Otowi ignimbrites contain light gray to orange pumice that is supported in a white to tan ash matrix (Broxton et al. 1995, 50119; Broxton et al. 1995, 50121; Goff 1995, 49682). The ash matrix consists of glass shards, broken pumice and crystal fragments, and fragments of perlite.

The Guaje Pumice Bed occurs at the base of the Otowi Member, making a significant and extensive marker horizon. The Guaje Pumice Bed (Bailey et al. 1969, 21498; Self et al. 1986, 21579) contains well-sorted pumice fragments whose mean size varies between 0.8 and 1.6 in. Its thickness averages approximately 28 ft below most of the plateau with local areas of thickening and thinning. Its distinctive white color and texture make it easily identifiable in borehole cuttings and core, and it is an important marker bed for the base of the Bandelier Tuff.

Tephras and Volcaniclastic Sediments of the Cerro Toledo Interval. The Cerro Toledo interval is an informal name given to a sequence of volcaniclastic sediments and tephras of mixed provenance that separates the Otowi and Tshirege Members of the Bandelier Tuff (Broxton et al. 1995, 50121; Goff 1995, 49682; Broxton and Reneau 1995, 49726). Although it is intercalated between the two members of the Bandelier Tuff, it is not considered part of that formation (Bailey et al. 1969, 21498). Outcrops of the Cerro Toledo interval generally occur wherever the top of the Otowi Member appears in Los Alamos Canyon and in canyons to the north; the interval outcrops in the TA-21 area. The unit contains primary volcanic deposits normally assigned to the Cerro Toledo rhyolite, as described by Smith et al. (1970, 09752), as well as intercalated and reworked volcaniclastic sediments not normally included in the Cerro Toledo rhyolite. The occurrence of the Cerro Toledo interval is widespread; however, its thickness is variable ranging between several feet and more than 100 ft.

The predominant rock types in the Cerro Toledo interval are rhyolitic tuffaceous sediments and tephra at TA-21 (Stix et al 1988, 49680; Heiken et al. 1986, 48638; Broxton et al. 1995, 50121; Goff 1995, 49682). The tuffaceous sediments are the reworked equivalents of Cerro Toledo rhyolite tephra that erupted from the Cerro Toledo and Rabbit Mountain rhyolite domes located in the Sierra de los Valles. At TA-21, oxidation and clay-rich horizons indicate that at least two periods of soil development occurred within the Cerro Toledo deposits. Because these soils are rich in clay, they may act as barriers to the movement of vadose zone groundwater. Some of the epiclastic tuffaceous deposits contain both crystal-poor and crystal-rich varieties of pumice. The ashy matrix of these deposits is commonly rich with crystals and contains subhedral sanadine and quartz. The mixed pumice and the crystal-rich nature of the matrix indicate that these reworked tuffs were derived from both the Cerro Toledo Rhyolite and the underlying Otowi Member. The pumice falls tend to form porous and permeable horizons within the Cerro Toledo interval, and locally, they may provide important pathways for moisture transport in the vadose zone. A subordinate lithology within the Cerro Toledo interval includes clast-supported gravel, cobble, and boulder deposits made up of porphyritic dacite derived from the Tschicoma Formation that are interbedded with the tuffaceous rocks, and in some deposits, dacitic materials are volumetrically more important than rhyolitic detritus (Broxton and Reneau 1996, 55429; Broxton et al. 1995, 50121; Goff 1995, 49682).

Tshirege Member. The Tshirege Member is the upper member of the Bandelier Tuff and is the most widely exposed bedrock unit of the Pajarito Plateau (Griggs 1964, 08795; Smith and Bailey 1966, 21584; Bailey et al. 1969, 21498; Smith et al. 1970, 09752). Emplacement of this unit occurred during eruptions of the Valles Caldera approximately 1.2 million yr ago (Izett and Obradovich 1994, 48817; Spell et al. 1996, 55542). The Tshirege Member is a multiple-flow, ash-and-pumice sheet that forms the prominent cliffs in most of the canyons on the Pajarito Plateau and at TA-21. It is a chemical cooling unit whose physical properties vary vertically and laterally. The consolidation in this member is largely from compaction and welding at high temperatures after the tuff was emplaced. Its light brown, orange brown, purplish, and white cliffs have numerous, mostly vertical fractures (called joints) that average between several feet and several tens of feet. The Tshirege Member includes thin but distinctive layers of bedded, sand-sized particles called surge deposits that demark separate flow units within the tuff. The Tshirege Member is generally over 200 ft thick.

The Tshirege Member differs from the Otowi Member most notably in its generally greater degree of welding compaction. Time breaks between the successive emplacement of flow units caused the tuff to cool as several distinct cooling units. For this reason, the Tshirege Member is a chemical cooling unit, consisting of at least four cooling subunits that display variable physical properties vertically and horizontally (Smith and Bailey 1966, 21584; Crowe et al. 1978, 05720; Broxton et al. 1995, 50121). These variations in physical properties reflect zonal patterns of varying degrees of welding and glass crystallization that accompanies welding (Smith 1960, 48819; Smith 1960, 48820). 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. The subunits are mappable based on a combination of hydrologic properties and lithologic characteristics.

Broxton et al. (1995, 50121) provide extensive descriptions of the Tshirege Member cooling units. The follow paragraphs describe, in ascending order, subunits of the Tshirege Member.

The Tsankawi Pumice Bed forms the base of the Tshirege Member. Where exposed, it is commonly 20 in. to 30 in. thick. This pumice-fall deposit contains moderately well-sorted pumice lapilli (diameters reaching about 2.5 in.) in a crystal-rich matrix. Several thin ash beds are interbedded with the pumice-fall deposits.

Qbt 1g is the lowermost subunit of the thick ignimbrite sheet overlying the Tsankawi Pumice Bed. It consists of porous, nonwelded, and poorly sorted ash-flow tuffs. The *g* in this designation stands for glass because none of the glass in ash shards and pumices shows crystallization by devitrification or vapor-phase crystallization. This unit is poorly indurated but nonetheless forms steep cliffs because of a resistant bench near the top of the unit; the bench forms a harder, protective cap over the softer underlying tuffs. A thin (4 in. to 10 in.), pumice-poor, surge deposit commonly occurs at the base of this unit.

Qbt 1v forms alternating cliff-like and sloping outcrops composed of porous, nonwelded, crystallized tuffs. The *v* stands for vapor-phase crystallization which, together with in situ crystallization devitrification, has converted much of the glass in shards and pumices into microcrystalline aggregates. The base of this unit is a thin, horizontal zone of preferential weathering that marks the abrupt transition from glassy tuffs below (in Unit 1g) to the crystallized tuffs above. This feature forms a widespread marker horizon (locally termed the vapor-phase notch) throughout the Pajarito Plateau, which is readily visible in canyon walls at TA-21. The lower part of Qbt 1v is orange brown, resistant to weathering, and has distinctive columnar (vertical) joints; hence, the term *colonnade tuff* is appropriate for its description. A distinctive white band of alternating cliff- and slope-forming tuffs overlies the colonnade tuff. The tuffs of Qbt 1v are commonly nonwelded (pumices and shards retain their initial equant shapes) and have an open, porous structure.

Qbt 2 forms a distinctive, medium-brown, vertical cliff that stands out in marked contrast to the slope-forming, lighter-colored tuffs above and below at TA-21. It displays the greatest degree of welding in the Tshirege Member. A series of surge beds commonly mark its base. It is typically nonporous and has low permeability relative to the other units of the Tshirege Member. Vapor-phase crystallization of flattened shards and pumice is extensive in this unit.

Qbt 3 is a nonwelded to partially welded, vapor-phase altered tuff, which forms many of the upper cliffs in the TA-21 area. Its base consists of a purple-gray, unconsolidated, porous, and crystal-rich nonwelded tuff that underlies a broad, gently sloping bench developed on top of Qbt 2. This basal, nonwelded portion forms relatively soft outcrops that weather into low rounded mounds with a white color, which contrast with the cliffs of partially welded tuff in the middle and upper portions of Qbt 3.

3.3.2 Geochemistry

Certain minerals present in Bandelier Tuff are important in terms of sorption of chemical species from water. Among them are alkali feldspar and a combination of three silica polymorphs (i.e., quartz, cristobalite, and tridymite). These minerals are found throughout the thickness of the Bandelier Tuff, and their abundance throughout the tuff can have a significant effect on the retardation of several constituents in the TA-21 MDA inventories. Less important in terms of transport are organic materials, which can react with certain constituents to form relatively mobile chemicals. The organic content of geologic materials on the Pajarito Plateau mesas is typically less than 1 wt%; however, the fractures can contain higher organic concentrations than the tuff matrix.

In addition to the minerals found in the tuff matrix, clay minerals are found in abundance in fractures and interbeds in the Bandelier Tuff. The primary clay minerals are smectites, with lesser amounts of kaolinite. The clay minerals have high sorptive capacity for many TA-21 inventory constituents. Hematite (i.e., iron oxide) coatings are also found but with less frequency than clay coatings. Hematite has a very large surface area for binding certain metals and is therefore also important to transport in fractures.

3.3.3 Seismology and Fractures

Three major faults are considered significant with respect to seismic potential across the Laboratory complex: the Pajarito, the Guaje Mountain, and the Rendija Canyon faults. Figure 3.3-2 shows the location of major faults in the Laboratory complex with respect to TA-21.

The Pajarito fault system has experienced Holocene movement and historic seismicity (Gardner and House 1987, 06682; Gardner et al. 1990, 48813). Characterized by northerly trending normal faults that intertwine along their traces, the Pajarito fault system shows dominantly down-to-the-east movement and produces a series of prominent fault scarps west of the Laboratory. The vertical throw on this fault system is over several hundred feet south and west of the Laboratory but decreases northward of Los Alamos Canyon where the fault system is less prominent.

The Rendija Canyon and Guaje Mountain faults are also normal faults, are downthrown to the west, and are considered secondary faults within the Pajarito fault system. The Rendija Canyon fault is located 3 mi east of the Pajarito fault, and the Guaje Mountain fault is located about 1.2 mi east of the Rendija Canyon fault. The Rendija Canyon fault crosses Pueblo Canyon near its confluence with Acid Canyon and Los Alamos Canyon near TA-41 but does not have clear surface expression south of Sandia Canyon. The Guaje Mountain fault parallels the Rendija Canyon fault and is projected to cross Los Alamos Canyon near TA-2, although no clear offset of the Tshirege Member occurs south of North Mesa. North of the Laboratory, both faults have zones of gouge and breccia up to several meters wide and produce visible offset of stratigraphic horizons and recognizable scarps. However, these features are not apparent within most of the Laboratory and TA-21. Vaniman and Wohletz (1990, 21589) and Wohletz (1995, 54404) project these faults south of Los Alamos Canyon based on Tshirege Member rock fracture density variations, orientations, and size.

Geologic evidence indicates that the Pajarito fault has ruptured within the past 1.2 million yr, perhaps as recently as 50,000 yr ago. Field investigations show that the Rendija Canyon fault has ruptured within the past 10,000 yr and that the Guaje Mountain fault has ruptured within the past 6000 yr. The recurrence interval of seismic events along the Rendija Canyon and Guaje Mountain faults is estimated to be between 10,000 and 150,000 yr.

A number of small to moderate earthquakes not associated with mapped faults (termed *background earthquakes*) have occurred in north-central New Mexico within the past 100 yr. Since 1973, local

seismicity has been monitored by the Los Alamos Seismograph Network. Measured events have not exceeded a magnitude of 4, which is relatively weak compared with earthquakes producing damage to buildings and structures. A seismic hazard evaluation completed for the Laboratory can be found in a report by Wong et al. (1995, 70097), Chapters 8 through 11.

Abundant fractures extend through the upper units of the Bandelier Tuff, including the Tshirege Unit 3 ignimbrite. The origin of the fractures has not been fully determined, but the most probable cause is brittle failure of the tuff caused by cooling contraction soon after initial emplacement (Vaniman 1991, 9995; Wohletz 1995, 54404). It is probable that past tectonic activity on the Pajarito fault system and the Guaje Mountain Fault Zone has also caused fracture development, reorientation, and extension (Wohletz 1995, 54404).

Fractures at TA-21

An extensive field survey of fractures in the Bandelier Tuff at TA-21 was conducted in 1992. Wohletz (1995, 54404) measured strike, dip, and aperture in 1662 fractures in Unit 2 of the Tshirege Member of the Bandelier Tuff (Qbt 2) exposed on cliffs below TA-21 in Los Alamos Canyon. Fractures were plotted on photomosaic maps of the canyon wall and their horizontal position calculated relative to the starting point of the fracture traverse. Linear fracture densities for 10-ft and 100-ft intervals, cumulative fracture width (sum of all fracture apertures within a given interval) for 10-ft and 100-ft intervals, and the relative fracture dips from vertical were calculated from the field data.

The average background fracture spacing at TA-21 is about 5 ft. A 1500-ft-wide zone starting near MDA V and extending to the east has a fracture spacing of 1 ft to 2 ft. The spacing decreases abruptly near MDA V and then increases gradually, reaching the 5-ft background value about 1500 ft to the east. Wohletz indicated that this fracture zone represents a fabric of the Pajarito Fault Zone. Measured strikes show that the fractures in this zone make up two conjugate sets: one trending northwest and the other northeast. The northeast-trending set (988 fractures) has a mean strike of N43E, and the northwest-trending set (674 fractures) has a mean strike of N33W. Fracture dips range between nearly horizontal and vertical, although most are steeply dipping. The majority of fractures in both the northeast- and northwest-trending sets dip steeply toward the north, with mean dips of 73° and 74° from the horizontal, respectively.

Fracture apertures range between 0 cm and 15 cm. The northeast and northwest sets of fractures have mean apertures of 0.82 cm and 0.93 cm, respectively. These mean apertures increase to 1.1 cm and 1.5 cm within the fracture zone. The background cumulative fracture width is about 0.5 m of fracture opening per 100-ft interval. This increases to about 1.4 m per 100-ft interval within the fracture zone. Fracture apertures decreased both above and below Unit 2, although no data were recorded for those units. Fracture fillings were described as sparse to absent in Unit 2 but prominent in Unit 3 (Qbt 3).

3.3.4 Hydrogeology

The hydrogeology of the Pajarito Plateau is generally 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 contain perennial groundwater in the canyon-bottom alluvium. Dry canyons have only occasional streamflow and may lack alluvial groundwater. Intermediate perched groundwater has been found at certain locations on the plateau at depths ranging between 100 ft and 400 ft (30 m and 122 m). The regional aquifer is found at depths of about 600 ft to 1200 ft (180 m and 360 m).

The hydrogeologic conceptual model (Figure 3.3-3) 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 deeper into mesas, further inhibiting downward flow.

The amount of mesa-top recharge along the western portion of the Laboratory is uncertain. Higher rainfall, increased vegetative cover, and increased welding and jointing of the tuff might lead to different recharge rates than those observed in better-studied portions of the Laboratory. If surface conditions are disturbed, mesa-top recharge can be locally significant. Such change occurs when the soil is compacted, when the vegetation is disturbed, or when more water is artificially added to the hydrologic system by features such as blacktop, lagoons, or effluent disposal. Fractures within mesas do not enhance the movement of dissolved contaminants unless saturated conditions develop. Contaminants in vapor form readily migrate through mesas. Vapors denser than air will sink.

3.3.4.1 Groundwater

In the Los Alamos area, groundwater occurs as (1) water in shallow alluvium in some of the larger canyons, (2) intermediate perched groundwater (a perched groundwater body lies above a less permeable layer and is separated from the underlying aquifer by an unsaturated zone), and (3) the regional aquifer of the Los Alamos area. Numerous wells have been installed over the past several decades at the Laboratory and in the surrounding area to investigate the presence of groundwater in these zones and to monitor groundwater quality. The locations of the existing wells around TA-21 are shown in Figure 3.2-4.

The Laboratory formulated a comprehensive groundwater protection plan (LANL 1995, 50124) for an enhanced set of characterization and monitoring activities. The hydrogeologic work plan (LANL 1998, 59599) details the implementation of extensive groundwater characterization across the Pajarito Plateau within an area potentially affected by past and present Laboratory operations, such as those at TA-21.

Alluvial Water

Intermittent and ephemeral streamflows in the canyons of the Pajarito Plateau have deposited alluvium that can be as much as 100 ft thick. The alluvium in canyons that head on the Jemez Mountains is generally composed of sands, gravels, pebbles, cobbles, and boulders derived from the Tschicoma Formation and Bandelier Tuff. The alluvium in canyons that head on the plateau is comparatively finer grained, consisting of clays, silts, sands, and gravels derived from the Bandelier Tuff. Saturated hydraulic conductivity of the alluvium typically ranges between 10^{-2} cm/s for sand and 10^{-4} cm/s for silty sand (Abeele et al. 1981, 06273).

In contrast to the underlying volcanic tuff and sediments, alluvium is relatively permeable. Ephemeral runoff in some canyons infiltrates the alluvium until downward movement is impeded by the less permeable tuff and sediments and results in the buildup of a shallow alluvial groundwater body. Depletion by evapotranspiration and movement into the underlying rocks limit the horizontal and vertical extent of the alluvial water (Purtymun et al. 1977, 11846). 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 groundwaters is in an easterly, down canyon direction.

Two saturated zones are known to exist in the alluvium of Los Alamos Canyon. The first is in the upper part of Los Alamos Canyon and extends eastward from the Los Alamos Reservoir to the vicinity of observation well LAO-4.5 west of State Road 4. The second is in the lower part of Los Alamos Canyon

and extends from Basalt Spring to the Rio Grande. In middle and upper Los Alamos Canyon, the saturated thickness in the alluvium varies seasonally from a few feet in the winter months to 25 ft in the spring and summer months when recharge is the greatest (Environmental Protection Group 1994, 45363).

Alluvial groundwater has been found in DP Canyon at wells LAUZ-1 and LAUZ-2 which were installed for investigations at TA-21 by personnel from the former ER Project. The wells were drilled to a depth of 15 ft. Alluvial water was encountered in both wells at approximately 4.5 ft below the surface. The saturated zone at the time was approximately 3.5-ft thick.

Intermediate Perched Water

Two intermediate perched zones, one beneath the other, have been encountered in Los Alamos Canyon between TA-2 and the confluence with DP Canyon. The upper intermediate perched zone occurs within the Guaje Pumice Bed. This zone was encountered in boreholes LADP-3 (at 325 ft) and LAOI(A)-1.1 (at 295 ft) (Broxton et al. 1995, 50119; Longmire et al. 1996, 54168). The saturated thickness of this zone decreases from west to east, ranging between 22 ft at LAOI(A)-1.1 and 5 ft at LADP-3.

A deeper intermediate perched zone was encountered in LAOI(A)-1.1 in the Puye Formation at about 317 ft. Possibly the same zone was also observed at a depth of 253 ft in the Puye Formation during development of water supply well O-4 (Figure 3.2-4) (Stoker et al. 1992, 12017). However, no intermediate perched zone was found at LADP-3 in the approximately 19 ft of the Puye Formation that was penetrated. Another hole was drilled from the mesa top at MDA V in TA-21 to investigate the lateral extent of the Guaje Pumice intermediate perched zone under DP Mesa; the location of this well is approximately midway between LAOI(A)-1.1 and LADP-3. There was no perched water in the hole.

Regional Aquifer

The regional aquifer of the Los Alamos area is the only aquifer capable of large-scale municipal water supply (Purtymun 1984, 06513). 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. Figure 3.3-4 shows the location of wells and generalized water-level contours on top of the regional aquifer. The regional aquifer is typically separated from the alluvial groundwater and intermediate perched zone groundwater by 350 ft to 620 ft of tuff, basalt, and sediments (Environmental Protection Group 1993, 23249).

The regional aquifer beneath TA-21 is at an elevation of approximately 5900 ft or approximately 1100 ft below the surface and is located chiefly within sediments of the Puye and Tesuque Formations (Broxton and Eller 1995, 58207). Thus, for mesa-top sites at TA-21, more than 1100 ft of tuff and volcaniclastic sediments separate the surface from the regional aquifer.

3.3.4.2 Vadose Zone

The region beneath the mesa surface and above 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 the remaining water (often referred to as recharge) is influenced by properties and conditions of the vadose zone.

Two properties of rock that influence fluid flow are the degree of welding and devitrification; both are effects of prolonged presence of residual gases and high temperatures when the rock was deposited. Because different units of the Bandelier Tuff were deposited at different temperatures and because individual units were laid out in variable thicknesses over different landscapes, cooling was not uniform. Consequently, welding varies spatially, both between and within separate depositional layers. Welded tuffs tend to be more fractured than nonwelded tuffs. While water moves slowly through the unsaturated tuff matrix, it can move relatively rapidly through fractures if nearly saturated conditions exist (LANL 1997, 63131). Modeling studies indicate that when fractures disappear at contacts between stratigraphic subunits, when fracture fills are encountered, or when coatings are disturbed or broken, moisture is absorbed into the matrix. Thus, fractures may provide conduits for fluid flow but only in discrete, disconnected intervals of the subsurface. Because they are open to the passage of both air and water, fractures can have both wetting and drying effects, depending on the relative abundance of water in the fractures and matrix. Devitrification is vapor-phase crystallization. The variability of welding and crystallization in the Tshirege Member produces recognizable vertical variations in its properties such as density, porosity, hardness, composition, color, and surface weathering patterns.

As a rule, the Bandelier Tuff is very 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. Moisture content is generally more variable near the top of the mesa than in the central portions because of variations in temperature, humidity, and evapotranspiration. 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. Values for the Tshirege Member of the Bandelier Tuff at TA-54, determined using in situ vacuum and water injection tests and laboratory analyses of cores range between 0.1 and 0.6 Darcies. No specific TA-21 data are available. The moisture content of native tuff is low, generally less than 5% by volume throughout the profile. Previous studies at TA-21 disposal areas where liquid has been added have shown that moisture content changes little below 40 ft. The specific retention of the tuff ranges between 18% and 38% by volume, indicating a considerable field capacity for holding moisture (Purtymun and Stoker 1990, 07508; Kearl et al. 1986, 15368).

Hydraulic conductivity is dependent on the porous medium and the fluid. Saturated tuff has a hydraulic conductivity in the range of 0.02 cm/hr for welded tuff to 1.12 cm/hr for nonwelded tuff. The hydraulic conductivity of unsaturated tuff varies with moisture content and has values two to five orders of magnitude lower than saturated tuff (Purtymun and Stoker 1990, 07508).

The moisture characteristic curve is important in unsaturated porous media in relating water content to suction, tension, or negative pressure head. However, tests have only been done on crushed Bandelier Tuff, and the applicability of these results to intact tuff remains in question.

3.4 Ecological Resources

Biological resource field surveys were conducted within OU 1106 (TA-21) and OU 1078 (TA-1) for compliance with the Federal Endangered Species Act of 1973; New Mexico Wildlife Conservation Act; Executive Order 11990, "Protection of Wetlands"; Executive Order 11988, "Floodplain Management"; CFR Title 10 Part 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements"; and DOE Order 5400.1, "General Environmental Protection Program" (Bennett 1996, 58236).

The Pajarito Plateau is a biologically diverse area. This diversity is partly the result of the 5000-ft elevation gradient from the Rio Grande to the Jemez Mountains (a distance of 12 mi) and the many steep canyons dissecting the area. The pronounced east-west canyon and mesa orientations, with concomitant differences in soils, moisture, and solar radiation, produce an interlocking finger effect among ecological life zones, resulting in many transitional overlaps of plant and animal communities within small areas.

Flora

The elevation of TA-21 ranges between 6680 and 7220 ft above mean sea level. The topography is varied, ranging from steep canyon walls or cliffs to gently sloping mesa tops. Mesa tops are characterized by development and disturbance. Canyon areas are relatively free from development and disturbance.

TA-21 is primarily a mesa-top site in a developed, industrialized area. The preurban natural overstory of the mesa was a ponderosa pine community; no overstory now exists at the site. The understory currently present includes grasses and forbs commonly found in disturbed soils: western wheat grass, Canada bluegrass, bottlebrush squirrel tail, cheat grass, sand dropseed, summer cypress, prickly lettuce, and horseweed; it is similar to the understory that existed before the site became industrialized.

The overstory of Los Alamos Canyon is described as a ponderosa pine forest with a variety of shrubs. The understory for Los Alamos Canyon is characterized by numerous grasses such as mountain muhly, brome grass, bluegrass and blue grama, and a variety of composites and other forbs.

The overstory of DP Canyon is a ponderosa pine forest with a dominant shrub species of Gambel's oak and codominance of mountain mahogany. The understory of DP Canyon is characterized by numerous grasses (brome grass, mountain muhly, and bluegrass), upland sedges, and a variety of forbs.

Fauna

The mesa top provides limited habitat for biota and does not contain sensitive habitats. Threatened or endangered species are not present on the mesa top or in Los Alamos and DP Canyons (Bennett 1996, 58236).

Floodplains and Wetlands

Los Alamos Canyon has stretches of riverine and palustrine wetlands. There is a palustrine wetland immediately south of the west end of MDA B in Los Alamos Canyon and a riverine wetland immediately south of MDA V in Los Alamos Canyon. Floodplains also exist within Los Alamos Canyon.

3.5 Cultural Resources

Pursuant to the National Historic Preservation Act of 1966 (amended), a cultural resource survey was conducted at OU 1106 during the summer of 1991 (McGehee et al. 1992, 28310). There are no archeological sites in the TA-21 area that are eligible for inclusion in the National Register of Historic Places.

4.0 SCOPE OF ACTIVITIES FOR INVESTIGATION SITES

The sampling activities will be tailored to each SWMU/AOC. Erosion control measures may be required, and structure removal activities will be required depending upon field evaluation of each site during the investigation.

Results of previous investigations were used to evaluate existing site soil conditions to determine whether additional data are needed.

4.1 Sampling and Analysis of SWMU 21-013(c), Surface Disposal Area

The proposed sample locations at SWMU 21-013(c) are shown on Figure 4.1-1. Soil samples will be collected from the 0- to 0.5-ft and 2.5- to 3.0-ft depths. Table 4.1-1 provides a summary of the proposed sample locations, depths, the objectives each sample addresses, and the proposed analytical suites. Sampling at SWMU 21-013(c) will consist of the following activities:

- *Resampling of previous sample locations.* Soil sampling will focus on locations where the 1994/1995 sample results indicated elevated levels of metals, SVOCs and radionuclides. Previous sample locations 21-01917, 21-09005, 21-01913, 21-01914, 21-01909, and 21-09004 will be resampled. Samples will be collected at locations off-set approximately 1 ft downslope from the 1994/1995 locations (Figure 4.1-1, locations 0 through 5). These samples will be collected at two depths to define vertical extent.
- *Grid Sampling.* The grid used to position the 1994 RFI samples will be extended to the east and south to further determine the nature and extent of contamination (Figure 4.1-1, locations 6 through 15).
- *Nature and extent of contamination delineation.* These soil samples will be collected around the perimeter of the site (Figure 4.1-1, locations 16 through 22).
- Additional or deeper samples will be collected as necessary based on field screening results (see Section 6.1.4 for description of field-screening methods).

4.2 Sampling and Analysis of SWMU 21-003-99, PCB Storage Site

The proposed sample locations at SWMU 21-003-99 are shown on Figure 4.2-1. Soil samples will be collected from the 0- to 0.5-ft, 0.5- to 1.0-ft, and 1.5- to 2.0-ft intervals. Table 4.2-1 provides a summary of the planned sample locations, depths, the objectives each sample addresses, and the proposed analytical suites. Sampling at SWMU 21-003-99 will consist of the following activities:

- *Surface and shallow subsurface soil sampling focusing on locations of interest.* These samples will be collected from within the footprint of the recently removed Building 21-61 (Figure 4.2-1, locations 1–5); under the asphalt pad at locations with cracks in the asphalt to the east of the removed building (locations 6 through 10); to the west, north, and south of the asphalt (Figure 4.2-1, locations 35 through 37), and immediately downslope of the drain valve for the bermed area (Figure 4.2-1, location 38).
- *Resampling of previous sample locations.* Soil sampling will focus on locations 21-02134, 21-2154, 21-02467, 21-02149, 21-01889, 21-02487, 21-02142, 21-02127, 21-01885, 21-01884, 21-02497, where previous studies indicated elevated activities of radionuclides and detections of PCBs and cleaning solvents (e.g., Figure 4.2-1, locations 11 through 21). Samples will be collected at three depths to define vertical and lateral extent.
- *Nature and extent of contamination delineation.* These soil samples will be collected from within the drainage of the valve for the bermed area (locations 22 through 29) and around the perimeter of the site (Figure 4.2-1, locations 30 through 37).
- Additional or deeper samples will be collected as necessary based on field screening results.

4.3 Sampling and Analysis of SWMU 21-024(c), Septic System

The proposed sample locations at SWMU 21-024(c) are shown in Figure 4.3-1. Table 4.3-1 provides a summary of the proposed sample locations, depths, the objectives each sample addresses, and the proposed analytical suites. SWMU 21-024(c) is not included in the corrective action site SWMUs since portions of this SWMU underlie SWMU 21-003-99, requiring that these SWMUs be investigated together. Sampling at SWMU 21-024(c) will consist of the following activities:

- *Septic tank TA-21-56 excavation.* The septic tank will be carefully excavated and inspected for evidence of leaks (e.g., stained soil, holes in the tank). One sample will be collected from the center of the floor of the excavation beneath the tank (Figure 4.3-1, location AH-1). One auger hole will be advanced in the center of the excavation and a sample collected from 10 ft below the bottom of the tank. Soil samples will be collected immediately beneath the septic tank inlet (Figure 4.3-1, location E) and outlet (Figure 4.3-1, location F) connections to the sewer line at the 0- to 0.5-ft and 1.5- to 2.0-ft depth intervals, and beneath the septic tank connections.
- *Sewer line excavation and sampling.* The sewer line that runs from former Buildings 21-54 and 21-61 to the septic tank and from the septic tank to the cliff edge will be carefully excavated and inspected for evidence of leaks. Where visible evidence of a leak is found (e.g., stained soil, break in the pipe), soil samples will be collected immediately beneath the pipe to define vertical extent. If no visible evidence of a leak is found, samples will be collected from locations beneath the sewer line immediately south of each of the former buildings (beneath a joint, if present), at approximately 50 ft south of former Building 21-54, at the connection of the sewer line from former Building 21-54 and the sewer line from former Building 21-61, and at approximately half the distance between the septic tank and outfall (Locations A, B, C, and D, Figure 4.3-1). At each location, a soil or tuff sample will be collected at the 0- to 0.5-ft and 1.5- to 2.0-ft depth intervals and field-screened. The zero depth is defined as immediately beneath the pipe.
- *Outfall Investigation.* One auger hole will be advanced in the center of the outfall as close to the edge of the canyon as feasible (location AH-2) and soil samples will be collected from the 0- to 0.5-ft, 1.5- to 2.0-ft, and 5.0- to 5.5-ft depth intervals. Soil samples will be collected 0.5 ft downslope from the mouth of the outfall pipe (Figure 4.3-1, location 1, previous location 21-01391), at three depth intervals (0–0.5, 1.5–2 and 3–3.5 ft) to verify the 1992 sample results and define the vertical extent of contamination. Samples will be collected 2 ft to the east and to the west of this location (Figure 4.3-1, locations 2 and 3, respectively) at the 0- to 0.5-ft and 1.5- to 2-ft depth intervals to bound the lateral and vertical extent of contamination. Samples will be collected downslope from the mouth of the pipe and at depths of 0–0.5 ft and 1.5–2 ft to establish the lateral extent downslope from the point of release to the edge of the cliff. One sample location, 10 ft from the mouth of the pipe (Figure 4.3-1, location 4), will be flanked by sample locations 10 ft to the east and west to provide information on lateral extent (Figure 4.3-1, locations 5 and 6). Sample location 20 ft directly downslope from the mouth of the pipe (Figure 4.3-1, location 7) is previous sample location 21-01392. Samples will be collected 20 ft to the east and west of sample location 20 (Figure 4.3-1, locations 8 and 9). A sample location will be established at each additional 20-ft distance from the mouth of the outfall pipe until the edge of the cliff is reached.
- *Bench Investigation.* On the bench beneath the cliff edge (Figure 4.3-2), two sample locations will be established downslope from the mouth of the pipe, in the center of a distinguishable drainage, or in a catchment basin aligned with the mouth of the pipe (Figure 4.3-1, locations 10 and 13). These sample locations will each be flanked by one sample location 20 ft to the east and one

sample location 20 ft to the west (Figure 4.3-1, locations 11, 12 and 14, 15). Samples will be collected at depths of 0–0.5 ft and 1.5–2 ft.

- Additional or deeper samples will be collected as necessary based on field-screening results.

4.4 Sampling and Analysis of SWMU 21-009, Waste Treatment Laboratory

The proposed sample locations at SWMU 21-009 are shown on Figure 4.4-1. Soil samples will be collected at the 0- to 0.5-ft and 1.5- to 2.0-ft depth intervals. Table 4.4-1 provides a summary of the planned sample locations, depths, the objectives each sample addresses, and the proposed analytical suites. Sampling at SWMU 21-009 will consist of the following activities:

- *Surface and shallow subsurface soil sampling focusing on locations of interest.* These samples will be collected from within the footprint of the removed Building 21-33 (Figure 4.4-1, locations 1–5).
- Additional or deeper samples will be collected as necessary based on field-screening results.
- *Gas line excavation and sampling.* The gas line that runs from the former Building 21-33 south to the former location of an aboveground gas tank (Structure 21-64) will be carefully excavated and inspected for evidence of leaks. Where visible evidence of a leak is found (e.g., stained soil, break in the pipe), soil samples will be collected immediately beneath the pipe to define vertical extent. If no visible evidence of a leak is found, samples will be collected from locations beneath the gas line immediately south of the former building, 25 ft south of the former building and at the end of the pipeline where the connection to the former gas tank was located (Figure 4.4-1, locations 6–8). At each location, a soil or tuff sample will be collected at the 0- to 0.5-ft and 1.5- to 2.0-ft depth intervals and field-screened. The zero depth is defined as immediately beneath the pipe.

4.5 Sampling and Analysis of AOC 21-002(b), Drum Storage Area

The proposed sample locations at AOC 21-002(b) are shown on Figure 4.5-1. Soil samples will be collected at the 0- to 0.5-ft and 2.5- to 3.0-ft depth intervals. Table 4.5-1 provides a summary of the planned sample locations, depths, the objectives each sample addresses, and the proposed analytical suites. Sampling at AOC 21-002(b) will consist of the following activities:

- *Resampling of previous sample locations.* Soil sampling will focus on locations where the 1994 sample results indicated elevated levels of metals, SVOCs and radionuclides. Previous sample locations 21-02501, 02505, -02506, -02507, and -02508, will be resampled by collecting samples at locations off-set approximately 1 ft downslope from the 1994 locations (Figure 4.5-1, locations 1–5) and analyzed for chemicals previously detected at elevated levels. Samples will be collected to define vertical extent.
- *Nature and extent of contamination delineation.* These soil samples will be collected around the perimeter of the site (Figure 4.5-1, locations 6–17).
- Additional or deeper samples will be collected as necessary based on field-screening results.

5.0 SCOPE OF ACTIVITES FOR CORRECTIVE ACTION SITES

The scope of activities is dependent on the current knowledge of operational history and the degree of prior characterization of each of the corrective action sites. A phased approach will be used to determine the activities for each site, including site reconnaissance, radiological and geophysical surveys,

verification sampling, excavation, confirmation sampling, and evaluation of survey and sample data. This approach will allow for the acquisition of confirmation data and review of the results prior to demobilization so additional removal actions/confirmation sampling can be conducted to ensure that the investigation objectives are met. The phased approach is illustrated in the decision flowchart, Figure 5.0-1 and is discussed in the following sections.

5.1 Site Reconnaissance

The site reconnaissance will consist of evaluations of engineering drawings and a preliminary site walkover during which the surface conditions and access restrictions will be evaluated. The site walkover will also be used to identify visible portions of structures (e.g., outfall pipes, manholes, etc.) to maximize the effectiveness of the subsequent radiological and geophysical surveys.

5.2 Radiological Survey

A radiological survey will be conducted encompassing each of the corrective action sites to determine the extent of corrective actions. This survey will identify any areas of elevated radiological contamination. Survey results will indicate the need for surface soil sampling to verify the presence and extent of areas of elevated contamination. Surveys of outfalls and other areas where drainlines have terminated or discharged will provide a means of quickly identifying areas requiring verification sampling.

Radiological survey instruments will include gamma (2x2 sodium iodide) for high energy emitters, field instrument for the detection of low-energy radiation (FIDLER), and in situ screening of soil, as appropriate, to identify classes (alpha, beta, gamma) of radiological contaminants.

The radiological survey data will be evaluated in conjunction with existing sample data to ascertain potential data gaps and the need for verification sampling, to identify the location and extent of potential areas of elevated contamination, and to refine the areas of planned excavations.

5.3 Geophysical Surveys

Geophysical surveys will be performed to verify the location of structures planned for removal or requiring investigation during the corrective actions. The surveys will verify locations determined from engineering drawings and site reconnaissance, identify previously unknown or undocumented locations, and refine estimates of material to be removed.

Geophysical methods used will include electromagnetic (EM-61, EM-31 instruments) to detect metallic objects (cast iron or steel pipes, tanks), ground-penetrating radar (GPR) to detect nonmetallic structures (e.g., concrete tanks, VCPs, and cobble-lined pits), or a combination of the methods, based on consultation with the geophysical subcontractor.

The geophysical survey data will be evaluated to confirm or establish locations of underground structures and to refine estimates of the volume of material (concrete, piping) to be removed at each site.

5.4 Exploratory Trenching

If the geophysical surveys do not locate the structure, exploratory trenching will be conducted to identify the location. Trenching will be conducted with a backhoe and will progress from the surface to approximately 5 ft below grade. The trench will be visually logged for evidence of non-native materials, disturbed bedding horizons and areas of visible staining or elevated radiological or organic vapor field-

screening results. Trenching will continue in the historically identified area until the structure is located and the boundary of the structure has been determined or the absence of a structure at that location has been verified.

5.5 Site Prioritization

Sites will be prioritized based on the type and complexity of the expected corrective action, and on the amount and quality of existing site data. Sites will be grouped so that similar activities will be performed in as efficient a manner as possible. Details and results of this process and rationale for the planned sequence of events will be presented in a progress report (see Section 5.6).

5.6 Progress Reporting

After the sites have been prioritized and corrective actions have been clearly defined, a progress report will be prepared summarizing all existing data and detailing the proposed actions for each site. Maps will be included showing results of radiological and geophysical surveys and all sample data. Proposed confirmation sample locations and the associated analytical suites will also be presented. The progress report will be used to update NMED with the latest site information and the specific actions planned for each site to obtain agreement that individual remedies at each SWMU satisfy regulatory requirements.

5.7 Structure Excavation and Removal

The septic tanks, sumps, and other subsurface structures will be carefully unearthed and inspected, to the extent possible, for structural flaws or evidence of releases (e.g., stained soil, cracks in the tank or associated piping, and elevated field screening results from the floor and sidewalls of the excavation, etc.). Areas with structural flaws will be noted for confirmation sampling once the structure is removed.

Pipelines, including inlet and outlet lines, sewer, and drainlines will be carefully excavated and inspected for evidence of leaks, particularly at pipe connections.

During removal all excavated material will be field screened for radiological and organic vapor contamination (see Sections 6.1 and 6.2 for methods). These results will be used to segregate the material into potential waste streams and minimize the amount of waste requiring disposal at an approved disposal facility. Final waste disposition will be dependent on thorough release surveys, waste sampling, and requirements for the approved disposal facility. The plan for management of investigation-derived waste (IDW) is included as Appendix C.

5.8 Characterization and Confirmation Sampling

If evaluation of the radiological survey data indicates the presence of areas of elevated contamination, samples will be collected in those areas to quantify the level of contamination and to determine whether corrective action is necessary. The analytical suites of these samples will take into consideration any data needs for each site, including the need to collect inorganic and organic chemical data. Samples will be collected at depth and by stepping out approximately 5 ft in each direction until screening results indicate that the area of contamination has been bounded to define the vertical extent of contamination.

As part of the same sampling effort, samples will be collected as necessary to address data needs at any site, regardless of the absence or presence of areas of elevated contamination identified by the radiological survey. Similarly, in cases where no data exist, samples will be collected to determine the nature and extent of potential contamination. Using this approach, all areas requiring corrective action

should be identified before mobilizing equipment to excavate structures and contaminated material. All the data for each site, including existing sample data, survey data, and new sample data, will be evaluated to plan the corrective action and any additional sampling at the site.

Where tanks or sumps are removed, samples will be collected from any area of visible staining or elevated radiological or organic vapor field screening. At a minimum, one sample will be collected from the center of the floor of the excavation immediately beneath the tank or sump. One auger hole will be advanced in the center of the excavation and a sample collected from 5 ft and 10 ft below the bottom of the tank (if the area of the tank is large, additional sample locations may be selected within the footprint to provide additional coverage). Samples will be collected immediately beneath the inlet and outlet connections to the tank or sump, at the 0- to 0.5-ft and 1.5- to 2.0-ft depth intervals below the lines. Samples will also be collected, as appropriate, from locations at or near the four corners of tanks or sumps. Field screening will be used to guide additional sampling.

Where pipelines are removed, sampling will focus primarily on locations where evidence or strong likelihood of leakage is found. Where visible evidence of a leak from a pipe is found (e.g., stained soil, breaks in the pipe), samples will be collected at 0- to 0.5-ft and 1.5- to 2.0-ft depth intervals. If no visible evidence of a leak is found and the integrity of the pipe has been verified, samples will be collected from locations beneath the pipeline joints at approximately 50-ft intervals along the length of the pipeline and at approximately half the distance between the septic tank and outfall. At each location, a soil or tuff sample will be collected at the 0- to 0.5-ft and 1.5- to 2.0-ft depth intervals. The zero depth is defined as immediately beneath the pipe. Field screening for potential radiological or organic vapor contamination will be conducted along the entire length of the pipeline excavation, and confirmation samples will be collected from all locations indicating a possible release.

Leach fields will be sampled in a grid pattern, with the size and spacing of the grid dependent upon the size of the leach field. Samples will be collected at 0–0.5 ft and 1.5–2.0 ft below the level of the main distribution and any lateral lines in the leach field.

As confirmation samples are collected, field screening for radiological and organic vapor contamination will be conducted and the confirmatory sampling will be conducted at 5-ft intervals (beyond the depths specified above), if warranted by field screening results, until the extent of contamination is defined. If contamination is suspected on the sidewalls of the excavations based on visual inspection or field screening, step-out samples will be collected at 5-ft intervals laterally until the extent of contamination is defined. If step-out sampling is conducted the vertical extent of contamination at those locations will also be defined.

At the dry well location, confirmation sampling will be conducted directly below the historically documented base of the dry well and at 5 ft and 10 ft below that depth. Using field instrumentation, sampling will continue until the depth of contamination has been defined. If contamination is suspected based on field screening results, the lateral extent will be defined by installing additional borings.

5.9 Contaminated Material Excavation

If confirmation sample data indicate that any remaining contaminated material warrants further excavation, the excavation and confirmatory sampling process will be repeated to ensure the objectives of the corrective action are met.

6.0 INVESTIGATION METHODS

The current versions of RRES-RS standard operating procedures (SOPs) and quality procedures (QPs) presented below are applicable to the investigation methods proposed in this plan.

- LANL-ER-SOP-01.01, General Instructions for Field Investigations
- LANL-ER-SOP-01.02, Sample Containers and Preservation
- LANL-ER-SOP-01.03, Handling, Packaging, and Shipping of Samples
- LANL-ER-SOP-01.04, Sample Control and Field Documentation
- LANL-ER-SOP-01.05, Field Quality Control Samples
- LANL-ER-SOP-01.06, Management of Environmental Restoration Project Waste
- LANL-ER-SOP-01.08, Field Decontamination of Drilling and Sampling Equipment
- LANL-ER-SOP-01.10, Waste Characterization
- LANL-ER-SOP-03.11, Coordination and Evaluating Geodetic Surveys
- LANL-ER-SOP-04.01, Drilling Methods and Drill-Site Management
- LANL-ER-SOP-05.03, Monitoring Well and RFI Borehole Abandonment
- LANL-ER-SOP-06.09, Spade and Scoop Method for the Collection of Soil Samples
- LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler
- LANL-ER-SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials
- LANL-ER-SOP-12.01, Field Logging, Handling, and Documentation of Borehole Materials
- LANL-ER-SOP-15.09, Chain of Custody for Analytical Data Packages
- LANL-ER-QP-02.2, Personnel Training Management
- LANL-ER-QP-03.4, Corrective Action Process
- LANL-ER-QP-04.4, Records Transmittal to the Records Processing Facility
- LANL-ER-QP-05.3, Readiness Planning and Review
- LANL-ER-QP-05.7, Notebook Documentation for Environmental Restoration Technical Activities
- LANL-ER-QP-05.12, Integrating Work with Other Organizations
- LANL-ER-QP-07.1, Procurement
- LANL-ER-QP-07.2, Supplier Evaluation
- LANL-ER-QP-10.5, Planning, Performing, and Managing Surveillances

The procedures listed above are available at the following Internet address: http://erproject.lanl.gov/documents/procedures.html. Additional procedures may be added as necessary or appropriate to describe and document activities. All work will be performed in accordance with all applicable SOPs, QPs, and the RRES Quality Management Program.

6.1 Methods for Investigation Sites

6.1.1 Establish Sampling Locations

Subsurface structures (septic tank, inlet and outlet piping, etc.) will be located by means of appropriate geophysical survey techniques before sampling or excavation is performed. GPR will be used to identify the approximate locations of the corners of the septic tank and the paths of all associated underground piping at SWMU 21-024(c), as well as any underground piping within the footprint of SWMU 21-009 and the associated gas line. The GPR unit will be configured for use in the 200 MHz to 500 MHz signal range, or otherwise as appropriate for detecting concrete, piping, or similar structures in the subsurface, to a depth of approximately 10 ft bgs. Identified points and traces obtained by GPR will be physically marked with paint, pin flags, or other appropriate markers and surveyed using a global-positioning system (GPS).

6.1.2 Drilling

The 10-ft-deep auger hole (AH-1) at SWMU 21-024(c) and any other boreholes ten or more ft deep will be drilled with a rotary drill rig capable of core retrieval. The goal is to obtain data to determine vertical extent of potential contamination. Core will be field screened for radioactivity and organic vapors (see Section 6.1.4), visually inspected, and geologically logged. Additional samples may be collected for analysis at additional depths as necessary based on field screening results. All drilling activities will refer to appropriate SOPs, QPs, Laboratory guidance documents, and protocol to ensure health and safety issues are reviewed and addressed during field operations.

6.1.3 Collecting Soil and Rock Samples

The most common method for surface and shallow subsurface sampling is the spade-and-scoop method, described in LANL-ER-SOP-6.09. Stainless-steel shovels, spades, scoops, and bowls will be used due to ease of decontamination. Disposable tools made of polystyrene or Teflon may also be used. In some cases, hand-augering tools may be used to collect shallow subsurface samples if geologic material conditions permit. The use of tools and their applicability are described in LANL-ER-SOP-6.10. If a surface sample location is in bedrock, an axe or hammer and chisel may be used to collect samples.

Samples will be field screened for radioactivity and organic vapors (see Section 6.1.4), photographed, then placed in Ziploc bags and/or sample jars as grab samples derived from hand augers, scoops, or chiseling devices in accordance with the sampling guidance document and appropriate SOPs (see Section 5.0, LANL-ER-SOP-01.01–01.08 series). If field screening detects radioactivity at a depth beyond the reach of standard surface methods, drilling will be conducted to define the vertical extent of the contamination.

Core samples will be collected per LANL-ER-SOP-6.26, examined for lithologic and structural features, field screened for radioactivity and organic vapors (see Section 6.1.4), photographed, after which they will be removed from the split-barrel sampler and placed into seam-sealed plastic sleeves or protec-core heat sealed bags to preserve the core moisture content. Sample jars and/or Ziploc bags will be filled with discrete segments of the core.

All samples (surface and subsurface) will be shipped through the Sample Management Office (SMO) to off-site fixed laboratories for analysis. Samples will be sent to laboratories that are on the RRES-Environmental Characterization and Remediation (ECR)-approved suppliers list. All samples will be collected and handled in compliance with LANL-ER-SOP-15.09, Chain of Custody for Analytical Data Record Packages. The analytical suites for each borehole and surface sample location are described in the sections pertaining to the individual site, and listed in Tables 4.1-1 through 4.5-1.

Quality assurance/quality control (QA/QC) samples will include field duplicate samples collected in accordance with LANL-ER-SOP-1.05. Field duplicate samples will be collected at a frequency of at least one for every 20 regular samples, or as directed by LANL-ER-SOP-01.05. Rinsate blanks will also be collected to confirm decontamination of sampling equipment.

Auger holes will be continuously cored to total depth and geologically logged, (i.e., lithology, apparent moisture, structural features, specifically the occurrence of fracture, orientation, and density), and core recovery compared to the footage drilled per LANL-ER-SOP-12.01 and LANL-ER-SOP-04.01. The moisture content samples will be collected and placed in glass sample jars. Backfilling of the investigation auger hole and placement of backfill materials, such as bentonite and cement, will be documented with regard to volume (calculated and actual), intervals of placement, and additives used to enhance backfilling.

6.1.4 Field Screening

Samples will be field screened for gross alpha radiation using a model 139 rate meter and for beta/gamma radiation using an ESP-1. Samples will be field screened for organic vapors using a photoionization detector (PID). Cores collected by split-spoon core barrel will be screened immediately upon opening the core barrel, and any visibly stained or discolored zones, fractures, or clay-rich weathered zones will be noted. Samples collected by spade-and-scoop or hand-auger methods will be screened in the collection bowl or sample container soon after the sample is collected. Screening values will be recorded in the appropriate spaces on the corresponding sample collection logs at the time of sample collection. If field-screening results are used to change the planned sample interval or to collect additional samples, the modification will be recorded in the appropriate sample collection log and in the field notebook. Field-screening instruments will be checked at least daily for proper operation and checked at least daily against calibration standards as appropriate.

6.1.5 Geodetic Surveying

Geodetic surveying of all sampling locations will be conducted in accordance with LANL-ER-SOP-3.11. Horizontal coordinates and elevations will be determined by a registered New Mexico professional land surveyor using the New Mexico State Plane Coordinate System. The survey results will be presented as part of the investigation report. Sample coordinates will be reported to the SMO representative.

6.1.6 Equipment Decontamination

Following investigation activities, project personnel will decontaminate all equipment. Residual material adhering to the equipment will be removed using dry decontamination methods, including wire-brushing and scraping (LANL-ER-SOP-01.08). If equipment cannot be free-released following dry decontamination, a high-pressure sprayer, along with long-handled brushes and rods, will be used to remove contaminated material from equipment more effectively. Residual media adhering to equipment will be removed using dry decontamination methods, including wire-brushing and scraping (LANL-ER-SOP-01.08). Pressure washing of equipment will be performed on a temporary wash pad with a high-density polyethylene liner. Cleaning solutions and wash water will be collected and contained for proper disposal. Decontamination solutions are then sampled to determine final disposition. All parts of the equipment, including the undercarriage, wheels, tracks, chassis, and cab, will be thoroughly cleaned. Air filters on equipment operating in the exclusion zone will be considered contaminated and will be removed and replaced before the equipment leaves the site. Equipment ready for demobilization will be surveyed by an HSR-1 RCT before being released from the site.

6.2 Methods for Corrective Action Sites

The methods described in Section 6.1 for activities at the investigation sites also apply to activities at the corrective action sites. Additional methods that apply to activities at the corrective action sites are described in the following sections.

6.2.1 Geophysical Surveys

Geophysical surveys will be conducted to assist in accurately locating subsurface structures. The surveys may be conducted in unbiased and biased modes. Unbiased surveys will collect geophysical data to detect anomalies across large areas. If the location of the structure is not known, these surveys will be conducted at low resolution. Biased surveys will be conducted at a closer line spacing to collect higher resolution data of specific targets or anomalies identified by the unbiased surveys. The methods used will be selected in consultation with the geophysics contractor and will include electromagnetic surveys (EM-61 and EM-31 instruments), and GPR surveys (see Section 6.1.1). The results of the geophysical surveys will be included in progress reports and/or investigation reports submitted to NMED.

6.2.2 Radiological Surveys

Radiological surveys will be conducted to obtain data on potentially elevated areas of radiological contamination associated with the sites. Radiation survey methods will be determined in consultation with the radiological survey contractor, but will include gamma (2x2 sodium iodide) for high energy emitters, FIDLER, and in situ screening of soil, as appropriate, to identify classes (alpha, beta, gamma) of radiological contaminants. These surveys will locate areas where surface soil sampling is required to determine levels of radionuclide concentration and the need for removal actions.

6.2.3 Excavation

Excavations will be completed using a standard backhoe. Structures will be exposed and inspected for cracks or other signs of potential release to the environment, and then disposed of in accordance with Laboratory procedures. Excavation methods will vary among locations but the primary method employed will be to advance from the ground surface to remove material in lifts until the structure is unearthed and removed.

6.2.4 Trenching

Trenching will be completed using the same protocols and equipment as the excavations. Trenching will assist in locating subsurface structures if geophysical surveys are inconclusive. Trenching will be conducted to remove lifts of soil in areas of suspected subsurface features to allow identification of disturbed soil of non-native material.

6.2.5 Waste Management

Materials identified as waste will be segregated into their specific waste types for appropriate disposal. Investigation activities will minimize the waste generated by following the RRES-RS Waste Minimization Awareness Plan (LANL 2002, 73901.4). Methods managing investigation-derived waste, including soil, tuff, concrete and other structural material, protective personal equipment, and other miscellaneous materials used, is described in Appendix C.

6.2.6 Excavation Backfilling and Trench Cover Replacement

The excavations and trenches will be backfilled, compacted, and clean soil cover material will be replaced over the affected area. The clean fill material will be shipped from off-site. All affected surfaces will be restored to original grade, reseeded, and straw mulch will be applied to help stabilize the surface. To prevent future subsidence, the replaced material will be compacted to the extent practical and will be mounded slightly in anticipation of settling.

6.2.7 Borehole Abandonment

Backfilling (abandonment) of investigation boreholes will be conducted according to procedures outlined in LANL-ER-SOP-05.03. The use of backfill materials, such as bentonite and cement, will be documented in a field logbook with regard to volume (calculated and actual), intervals of placement, and additives used to enhance backfilling.

7.0 MONITORING AND SAMPLING PROGRAM

No monitoring is currently performed at any of the investigation or corrective action sites. It is anticipated that no further sampling or monitoring will be required at all the sites after these work plan activities are completed.

8.0 SCHEDULE

An investigation work plan for SWMUs and AOCs in the Middle Los Alamos Canyon aggregate area not addressed in the DP Site aggregate area investigation work plan will be submitted to NMED by December 31, 2005. The results of both the DP Site aggregate area and the Middle Los Alamos Canyon aggregate area investigations will be presented in the Middle Los Alamos Canyon/DP Site aggregate area investigation report. The date for the submittal of this investigation report will be proposed in the Middle Los Alamos Canyon aggregate area investigation work plan.

9.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author, publication date, and ER identification (ID) number. This information is also included in text citations. ER ID numbers are assigned by the RRES-RS Records Processing Facility (RPF) and are used to locate the document at the RPF.

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

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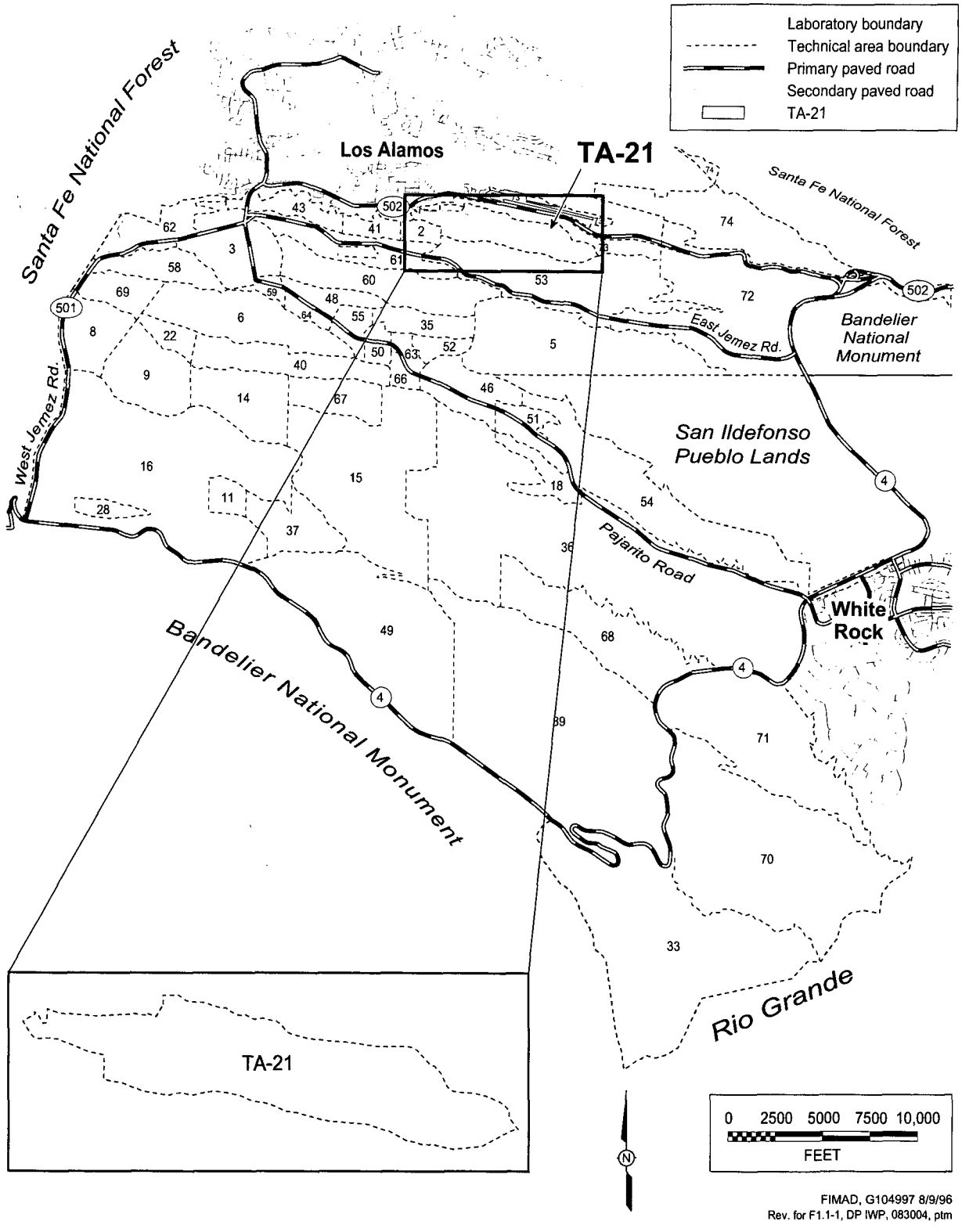

Figure 1.1-1. Location of TA-21 with respect to Laboratory technical areas and surrounding land holdings

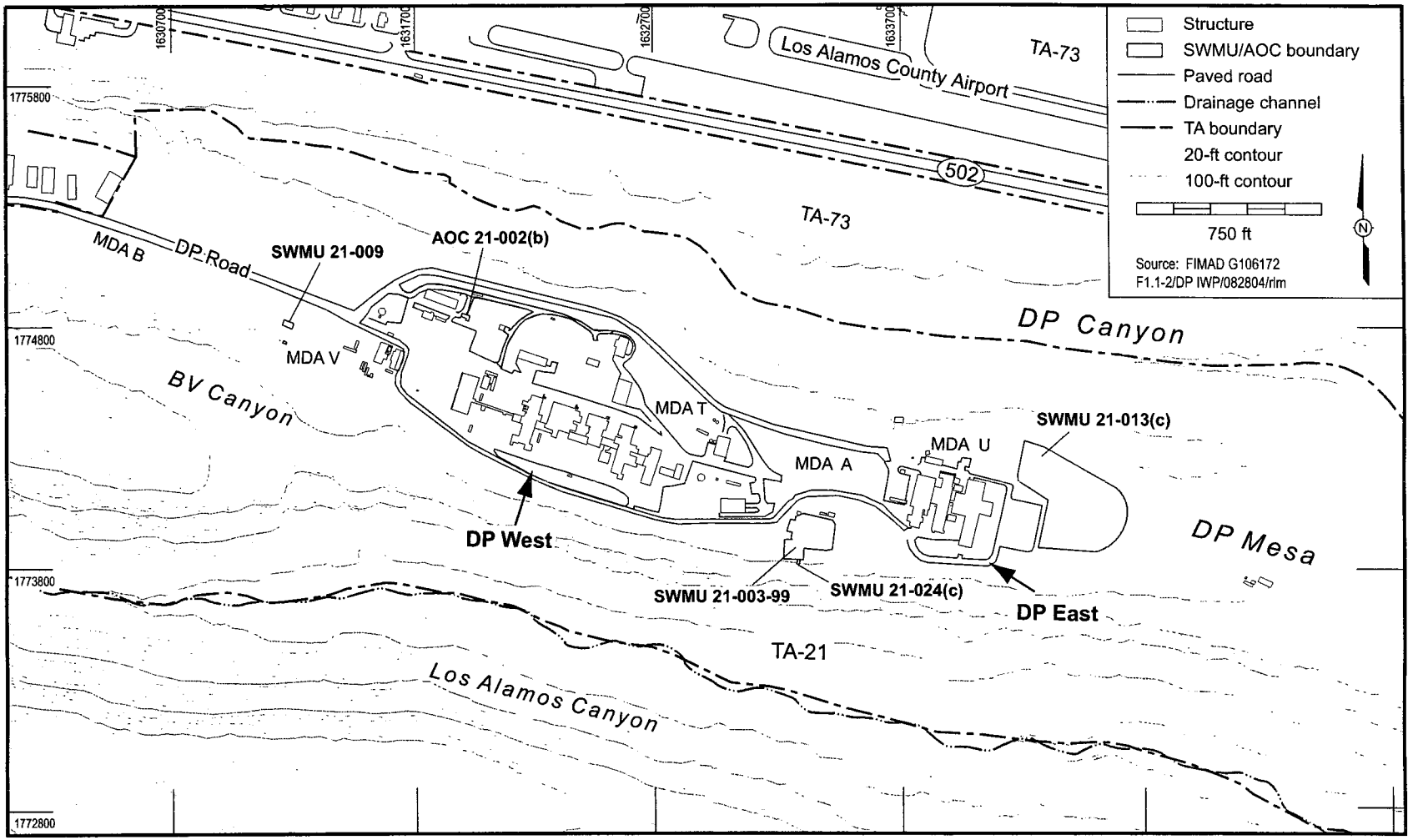

Figure 1.1-2. Locations of SWMUs/AOC, DP East, and DP West in TA-21

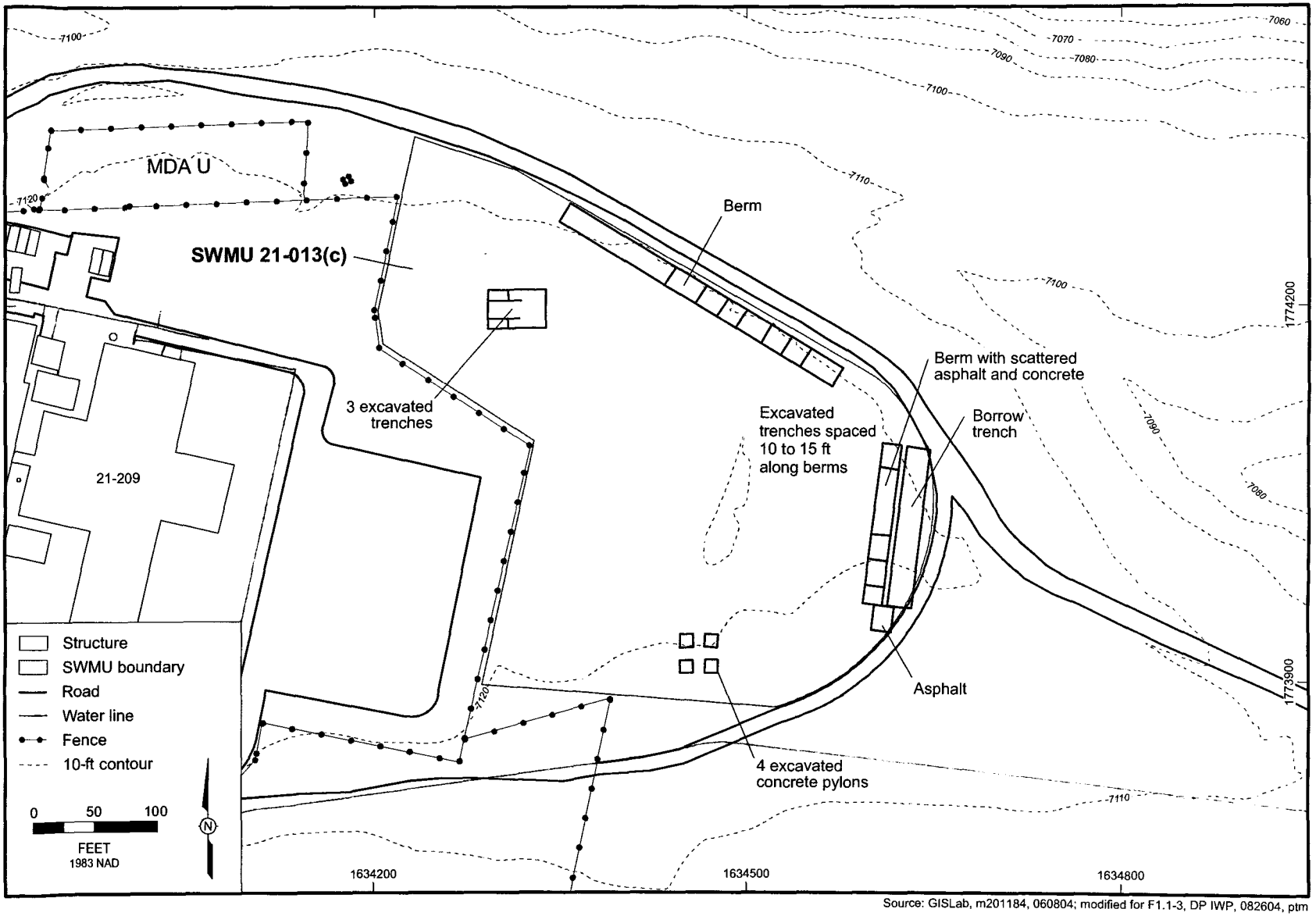

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Figure 1.1-3. SWMU 21-013(c), surface disposal area site

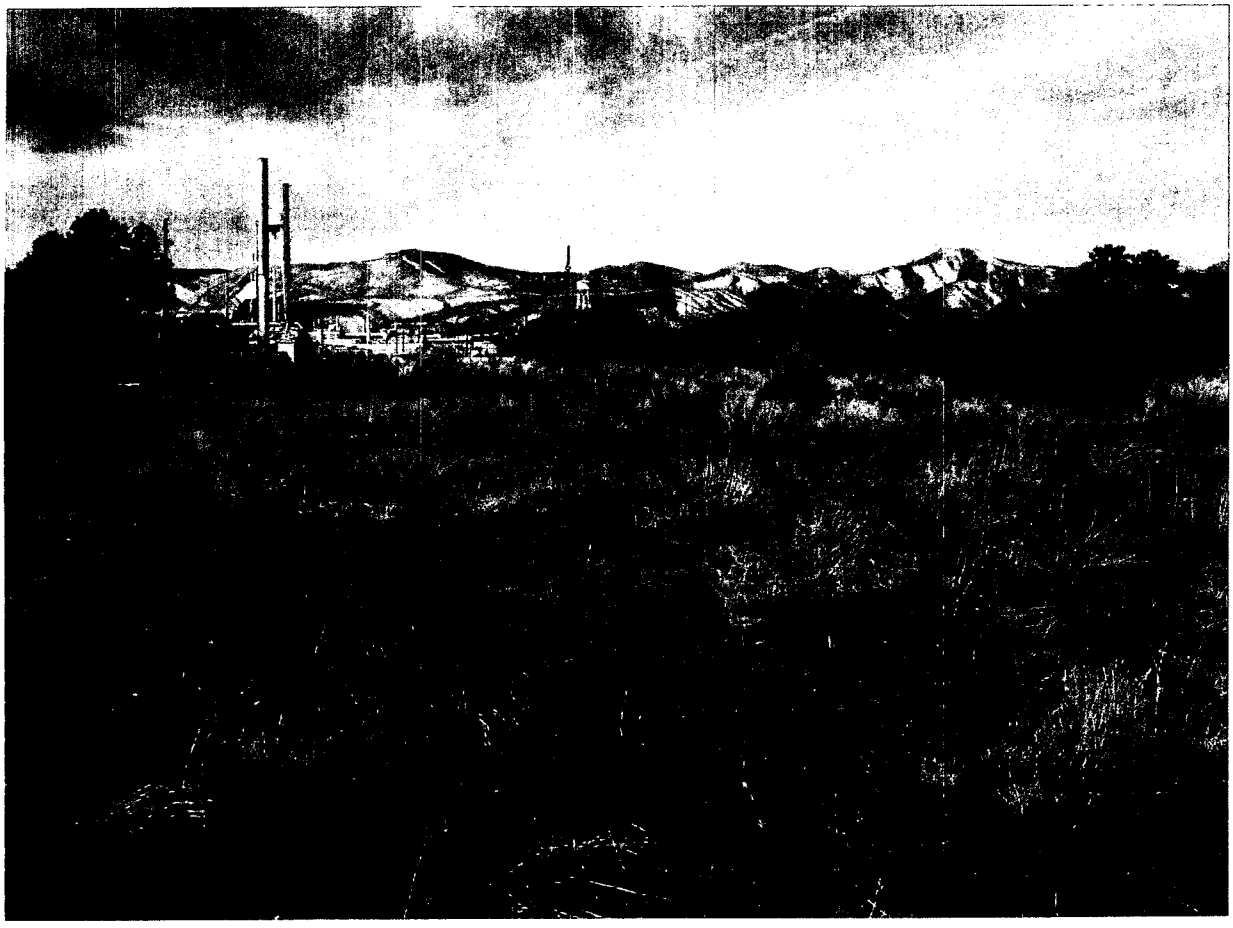

Figure 1.1-4. SWMU 21-013(c), surface disposal area, view to the west

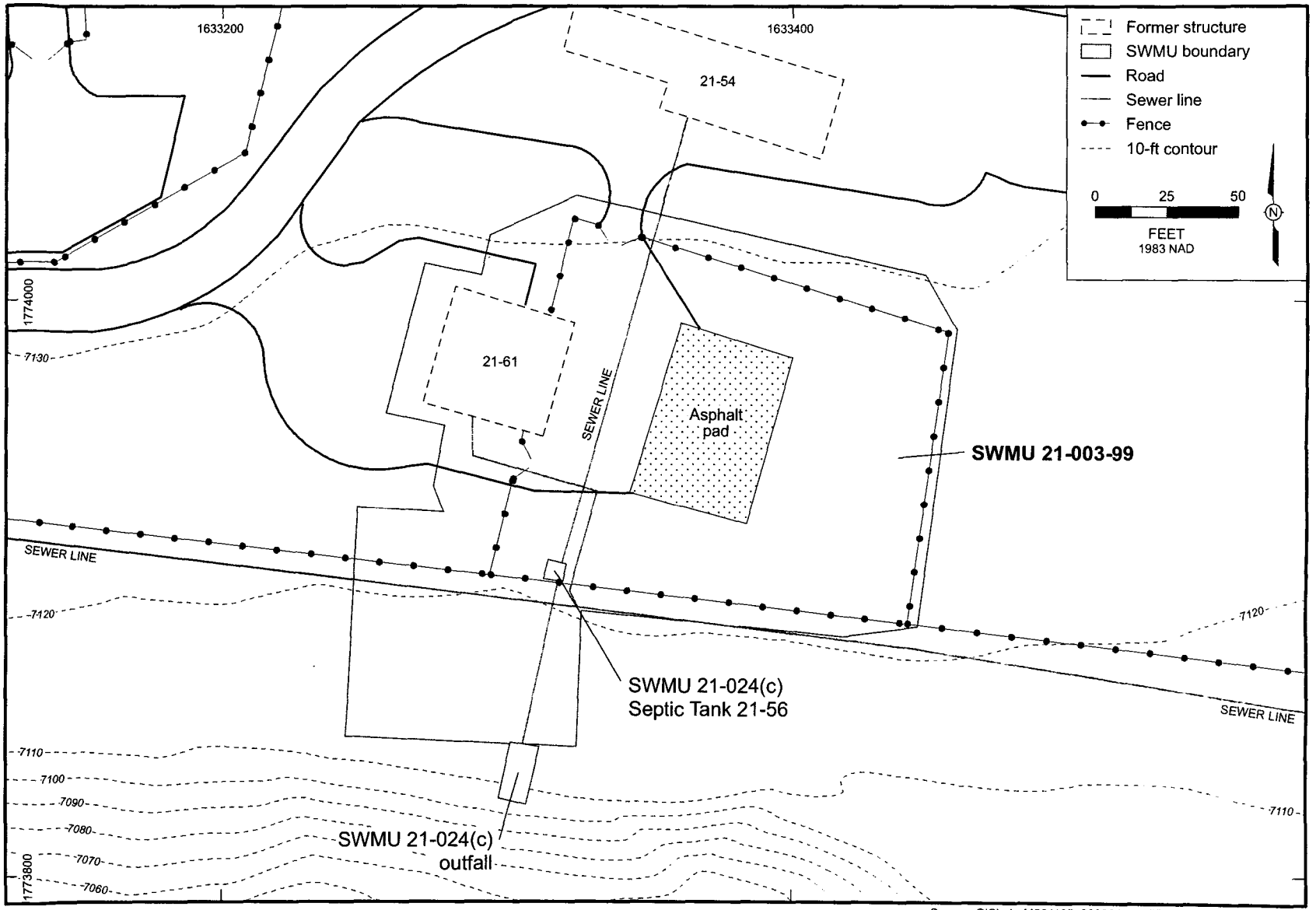

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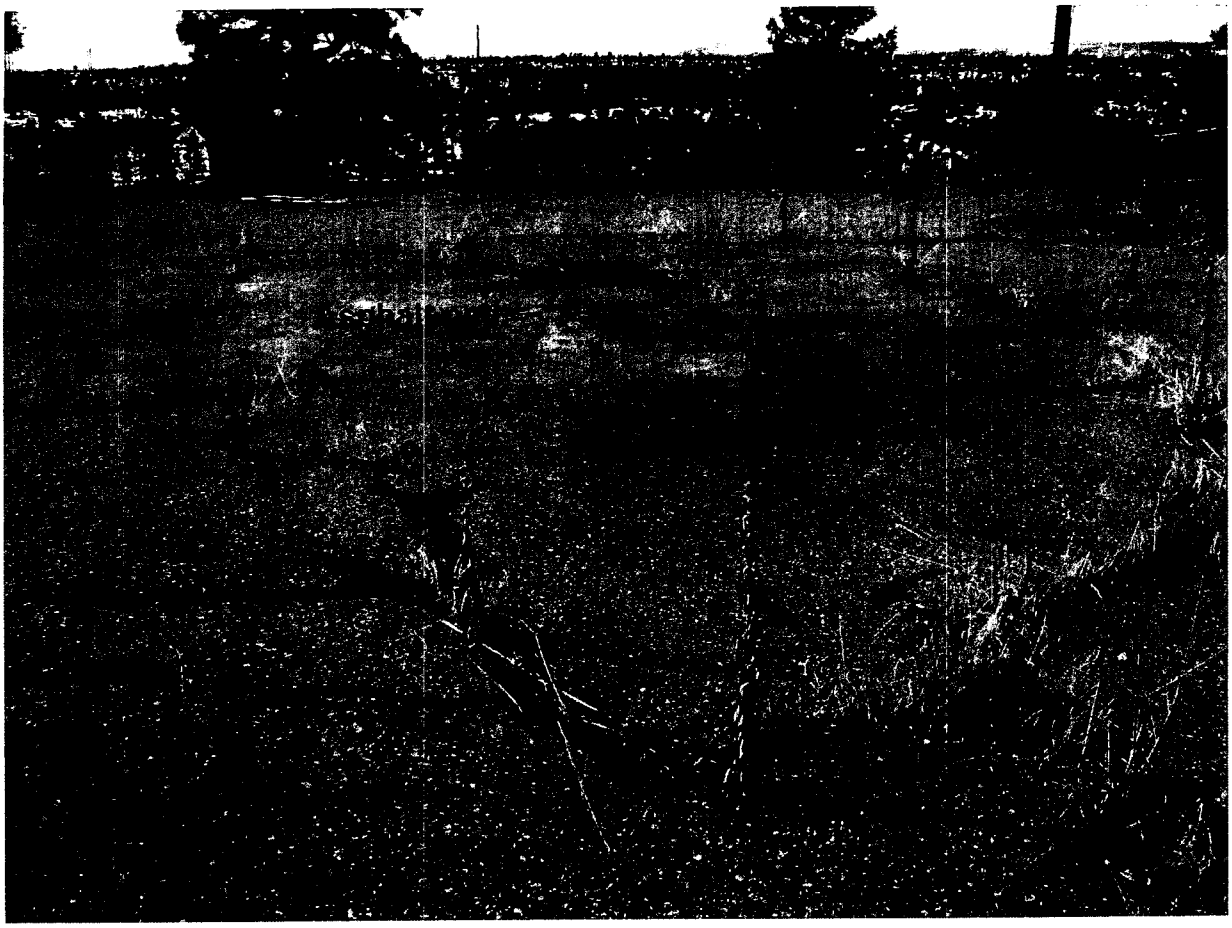
Figure 1.1-5. SWMU 21-003-99, PCB drum storage area site



Note: The condition of the asphalt pad is cracked and degraded.

Figure 1.1-6. SWMU 21-003-99, PCB drum storage area, view to the south

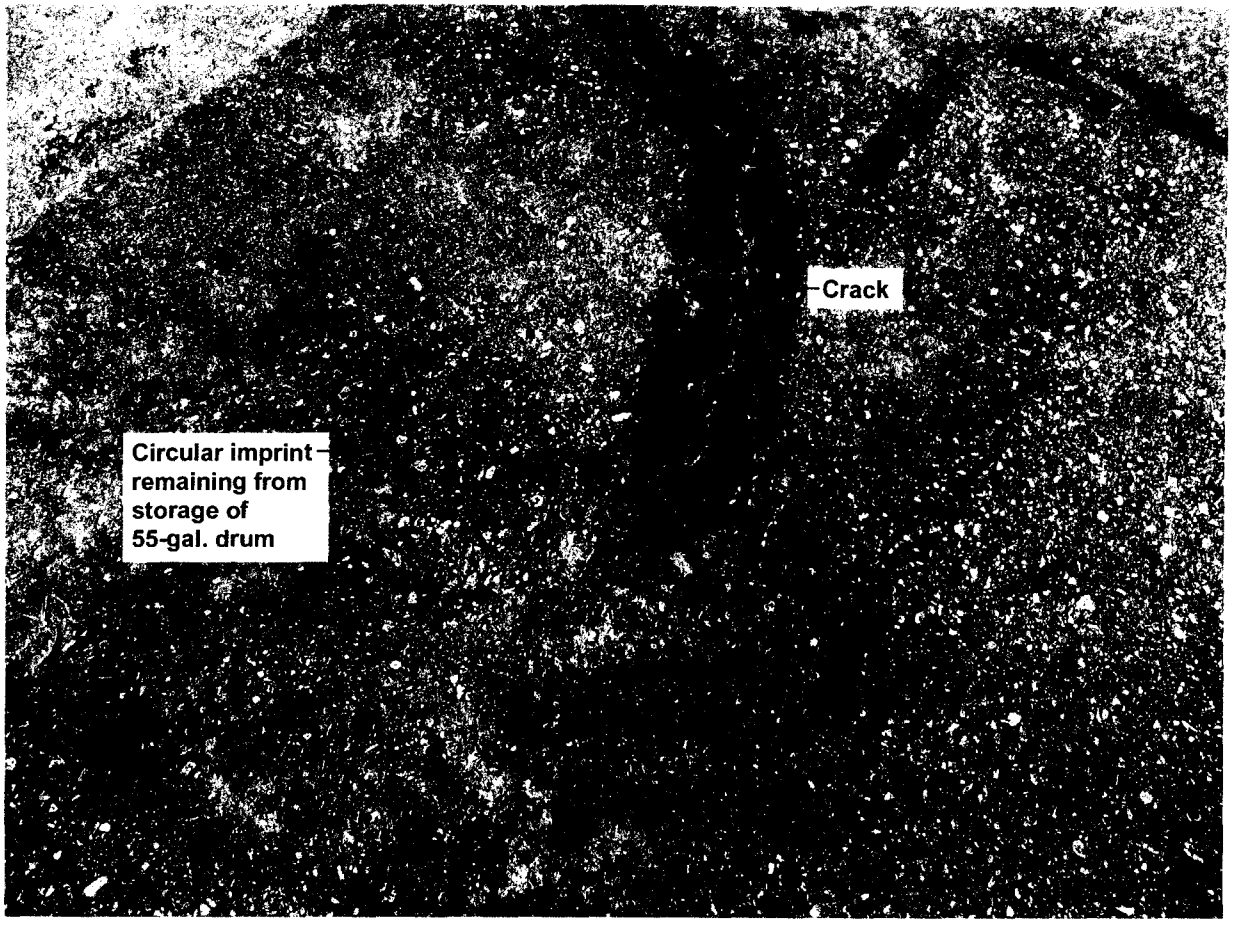


Figure 1.1-7. SWMU 21-003-99, PCB drum storage area, view looking down at the surface of the asphalt pad

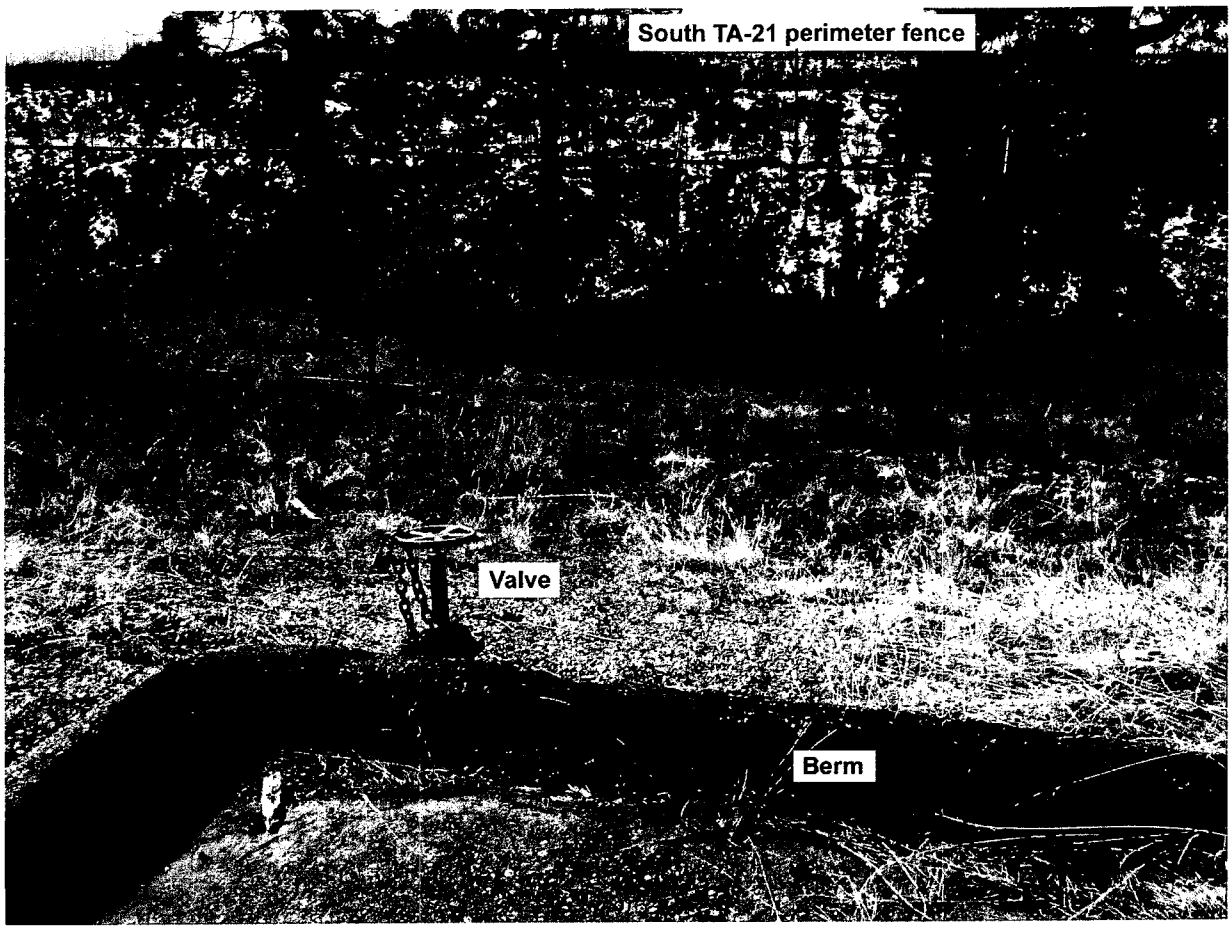
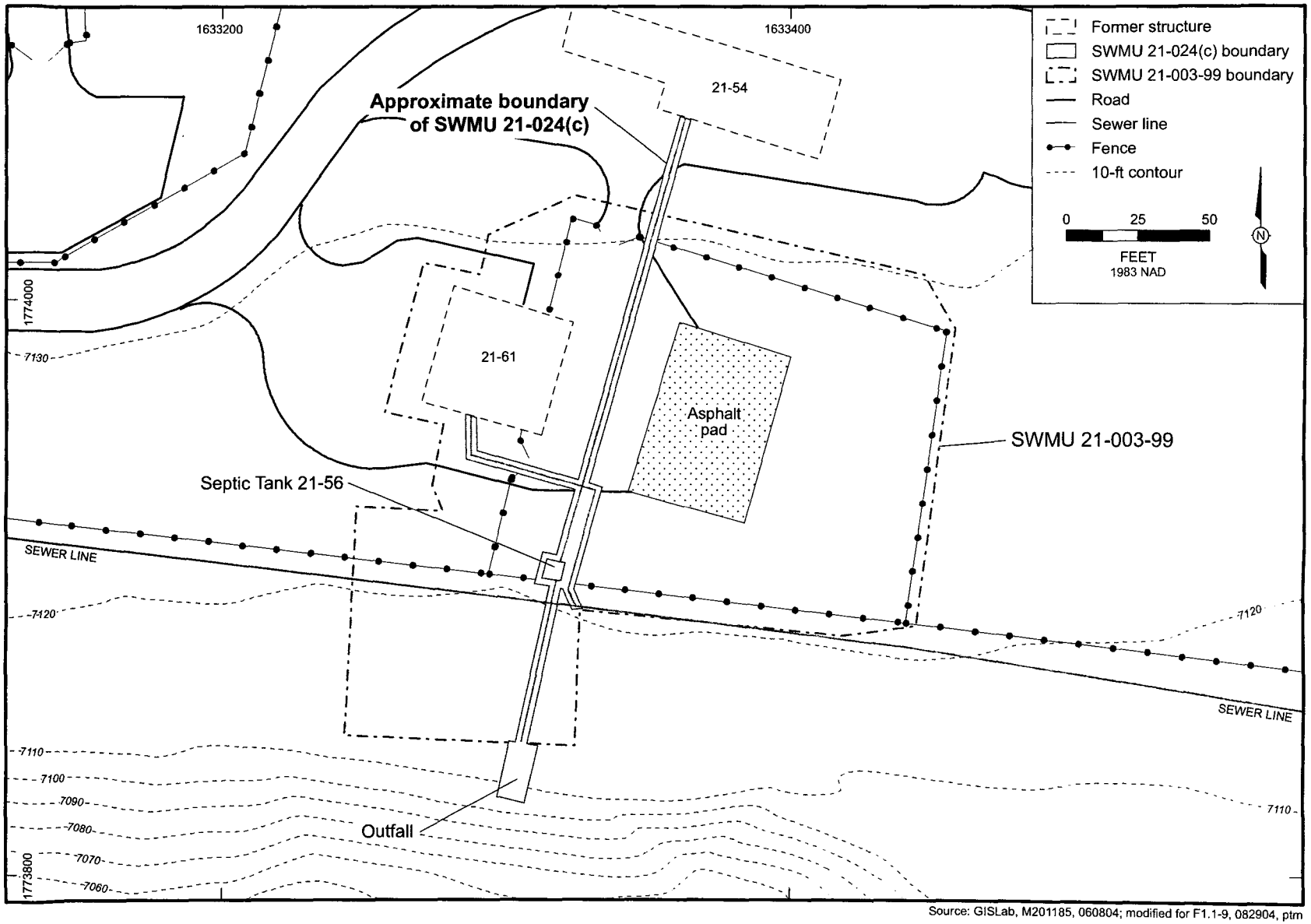
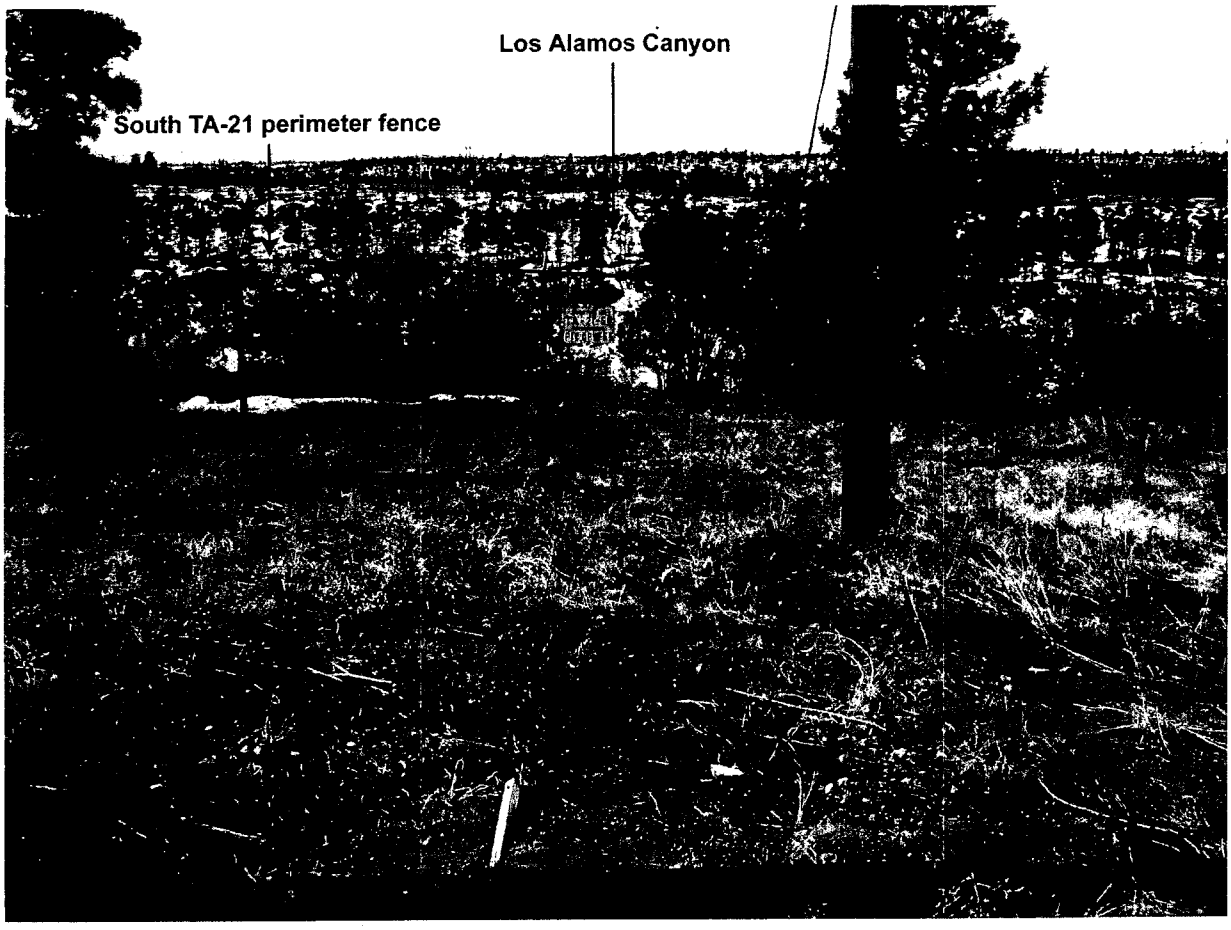


Figure 1.1-8. SWMU 21-003-99, PCB drum storage area, view to the south near TA-21 perimeter fence



Source: GISLab, M201185, 060804; modified for F1.1-9, 082904, ptm

Figure 1.1-9. SWMU 21-024(c), septic system site



Note: The septic tank and outfall are not visible.

Figure 1.1-10. SWMU 21-024(c), septic system, view to the south

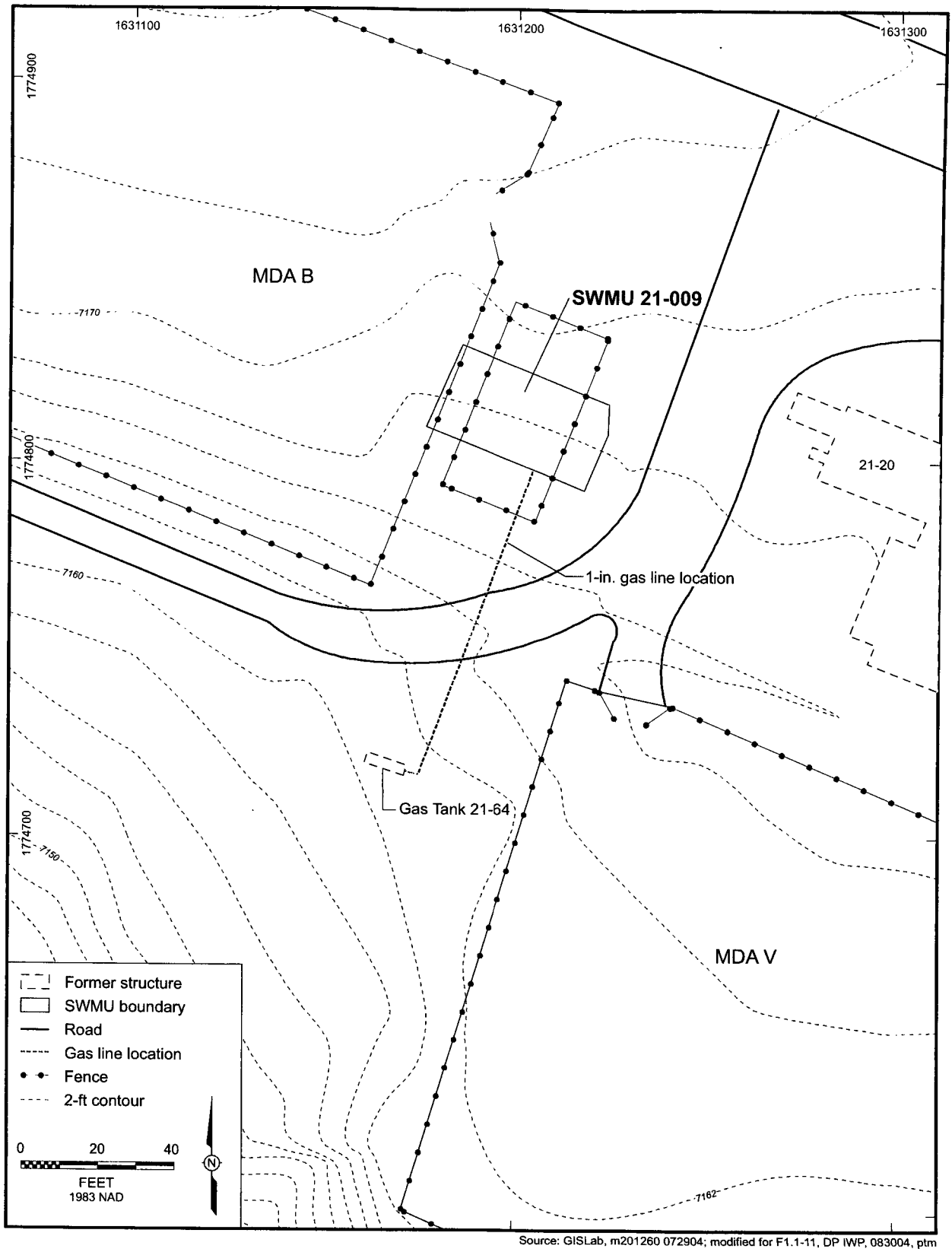


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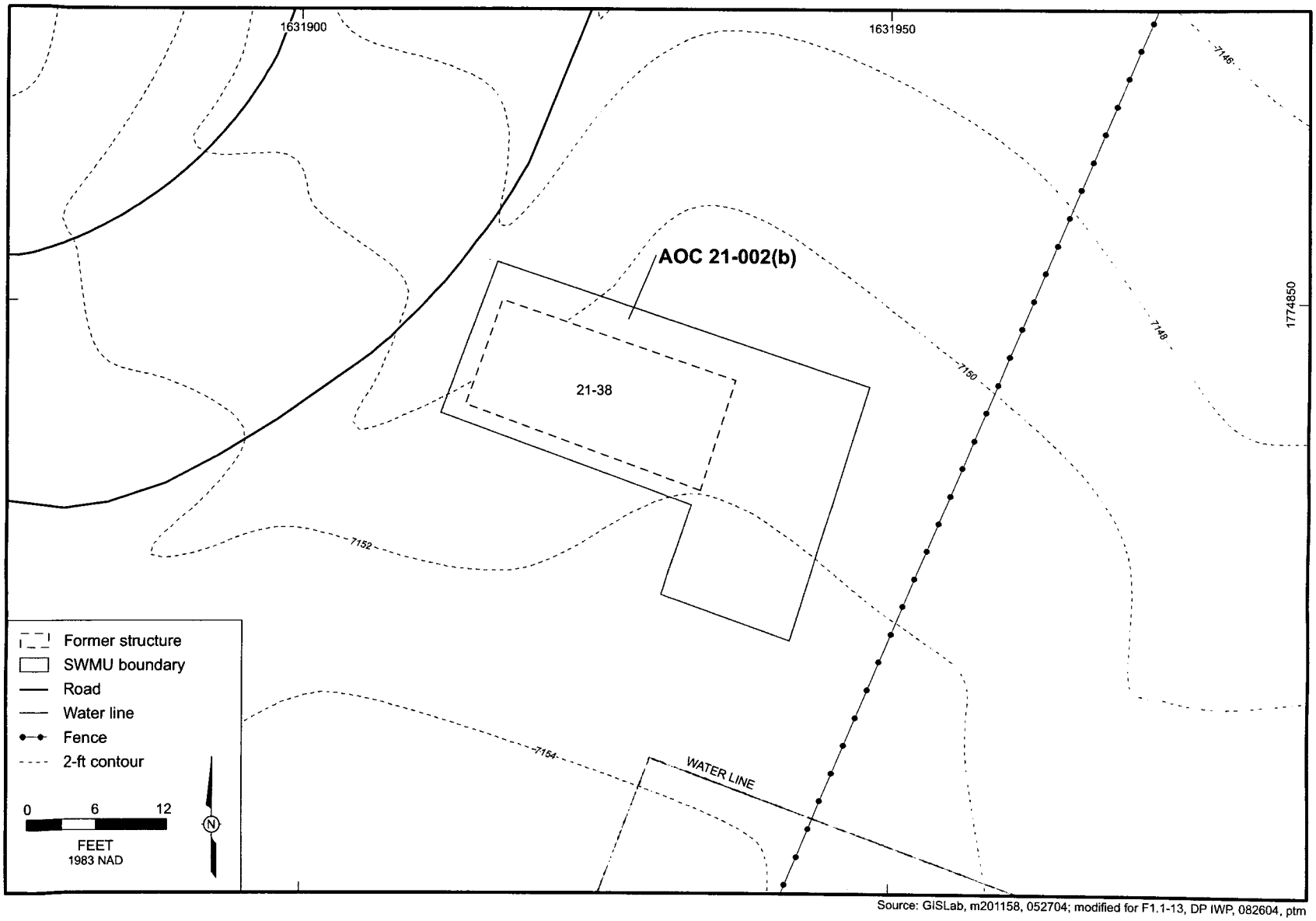
Figure 1.1-11. SWMU 21-009, waste treatment laboratory site

Figure 1.1-12. SWMU 21-009, waste treatment laboratory, view to the south



Source: GISLab, m201158, 052704; modified for F1.1-13, DP IWP, 082604, ptm

Figure 1.1-13. AOC 21-002(b), drum storage area site

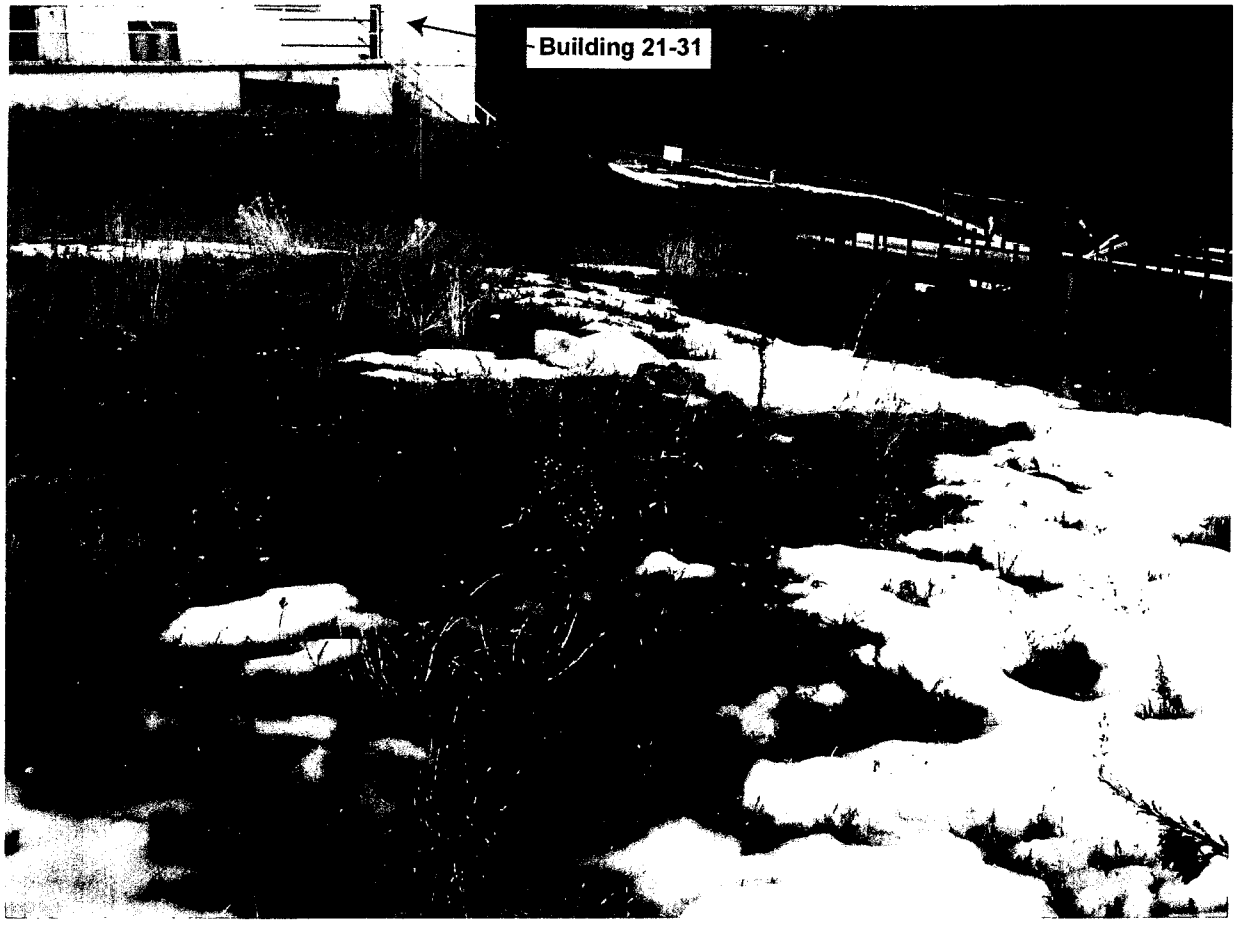


Figure 1.1-14. AOC 21-002(b), drum storage area, view to the northwest

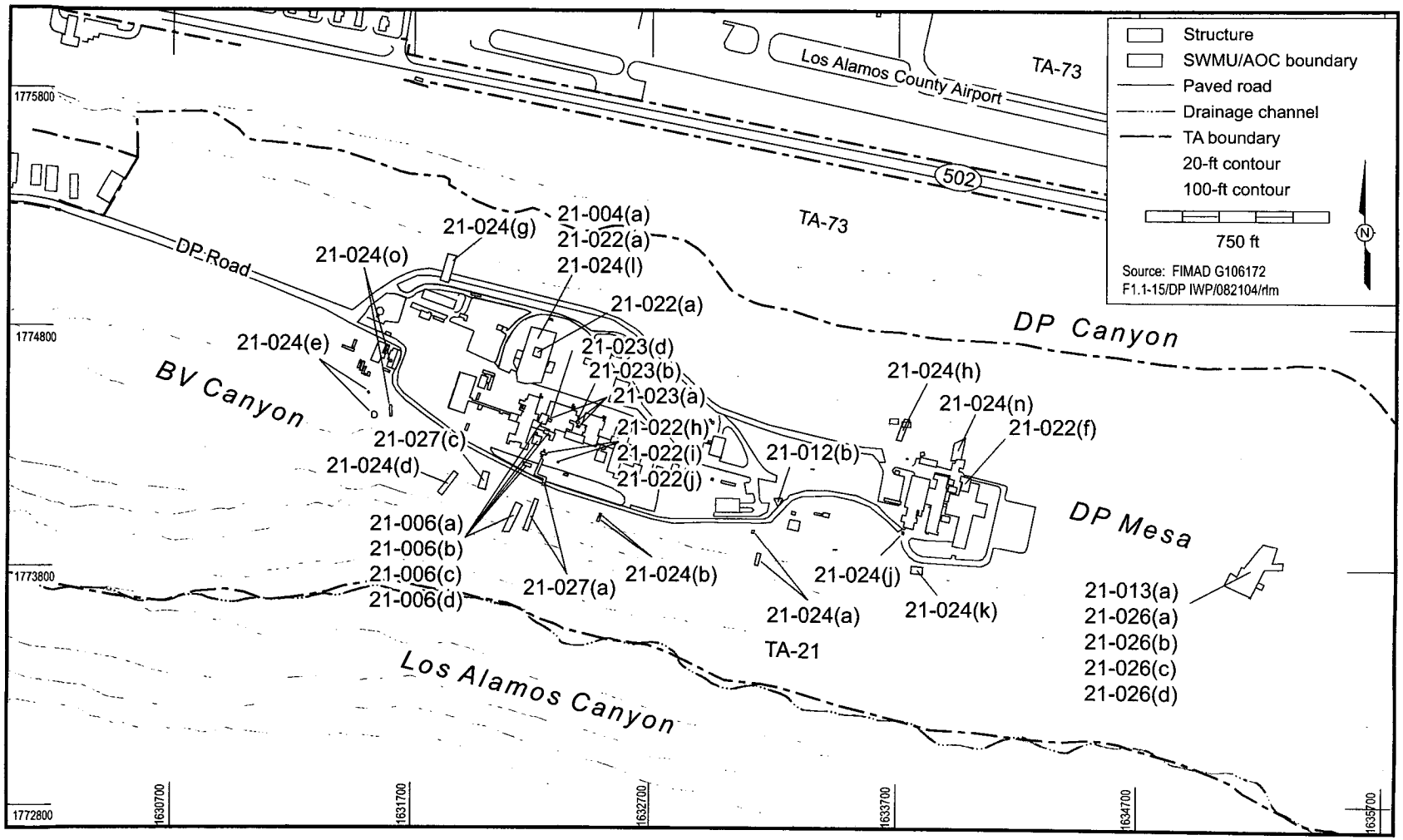
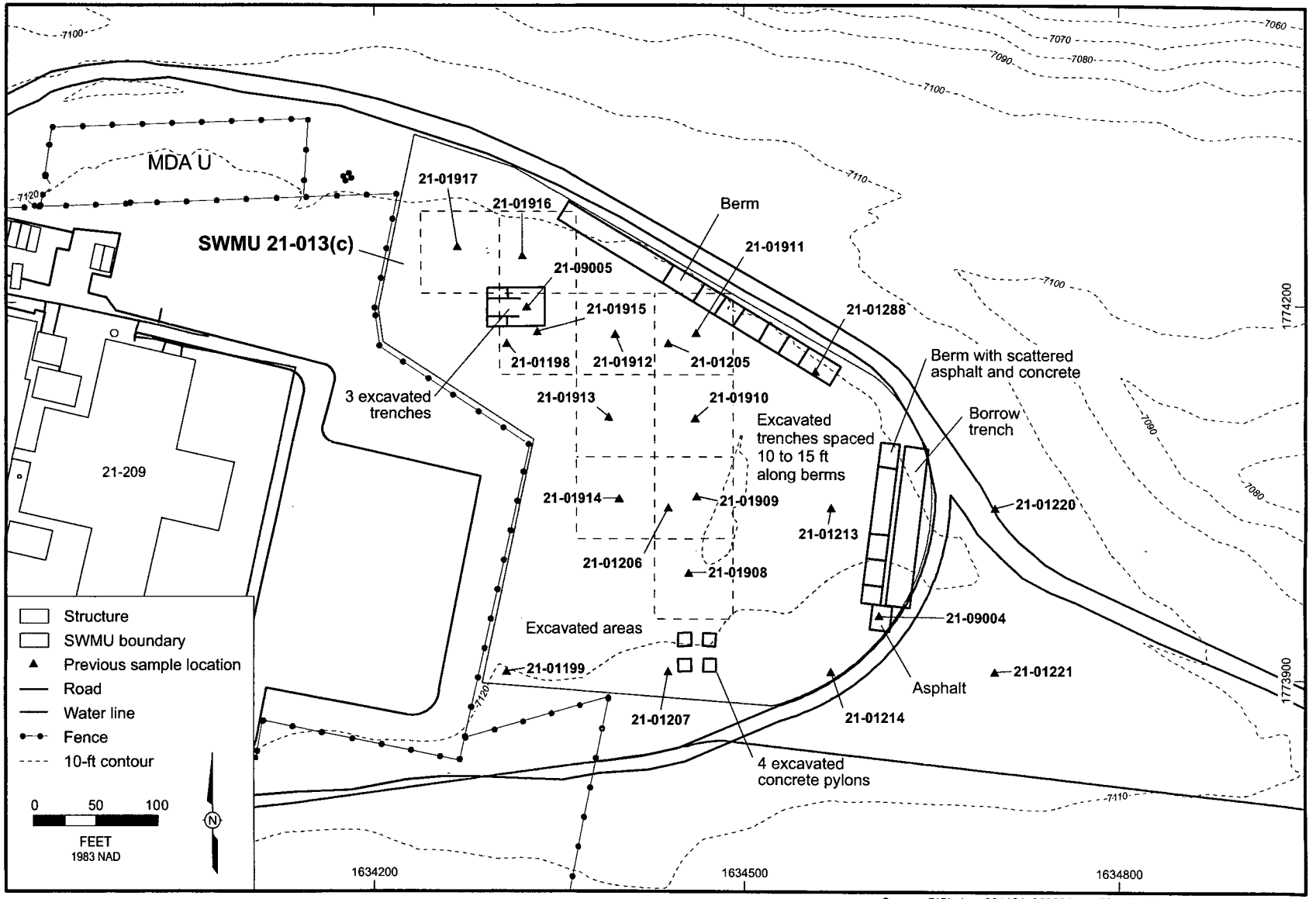
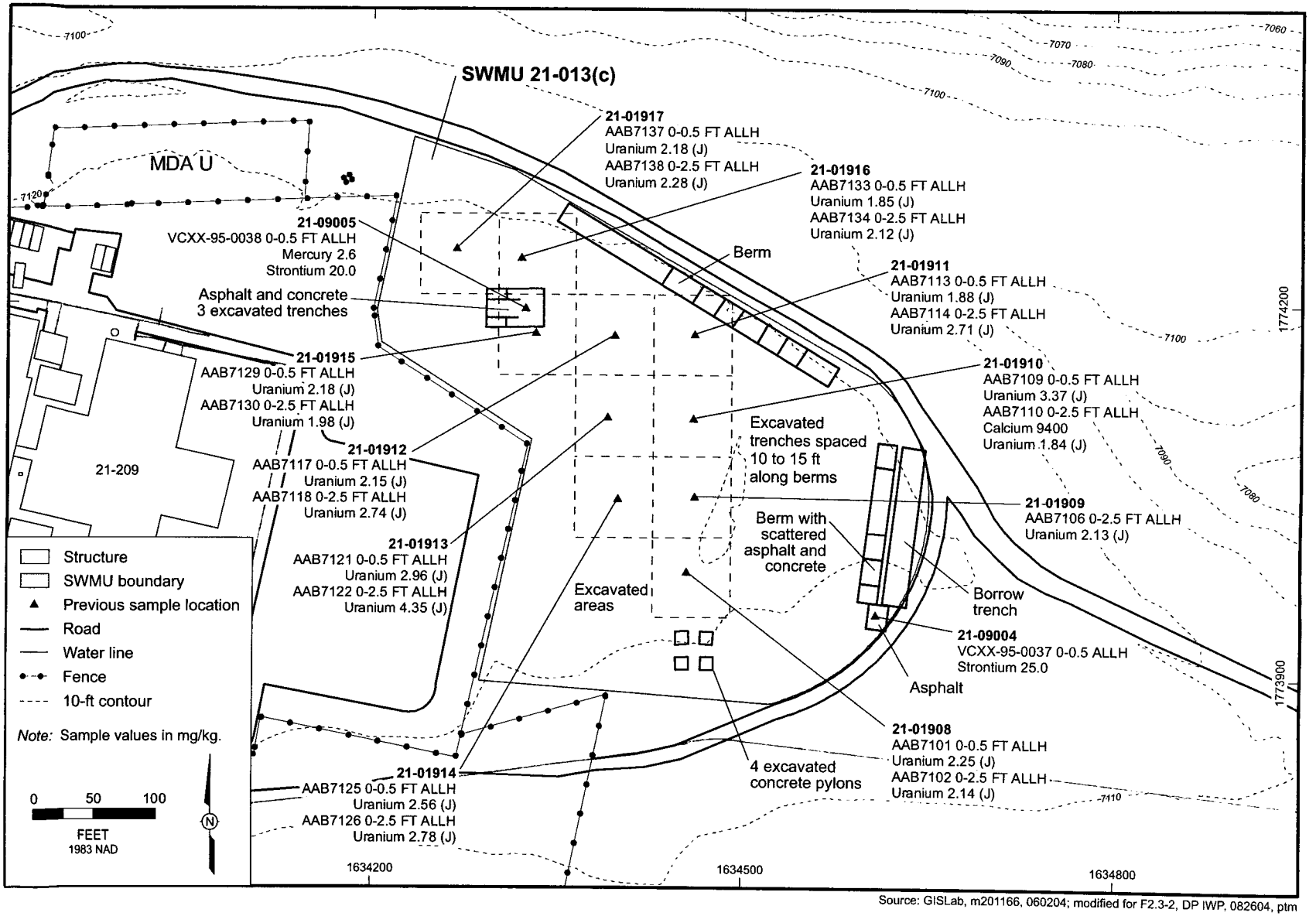


Figure 1.1-15. Locations of corrective action sites in TA-21



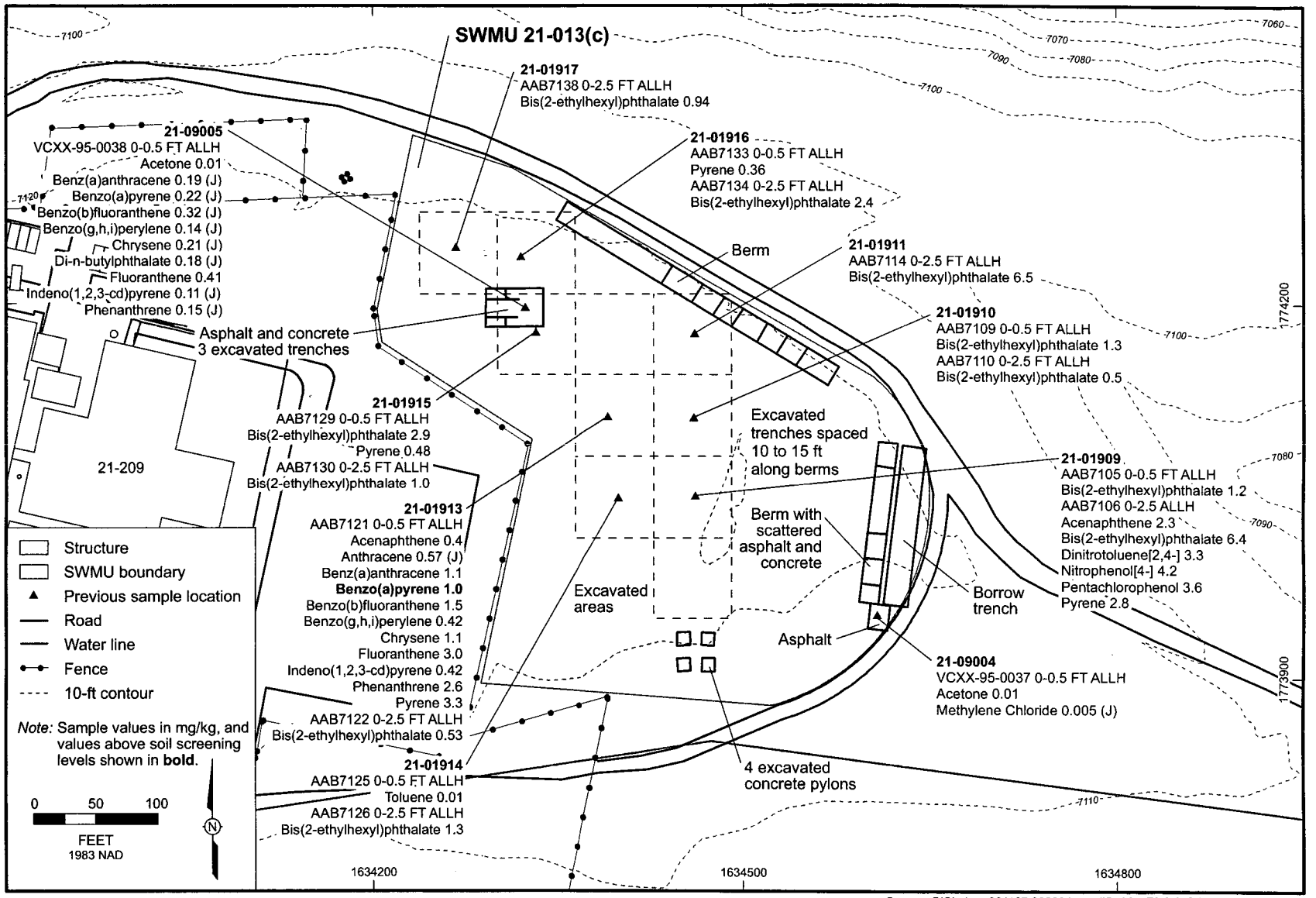
Source: GISLab, m201164, 060204; modified for F2.3-1, DP IWP, 082604, ptm

Figure 2.3-1. SWMU 21-013(c) previous investigation sample locations



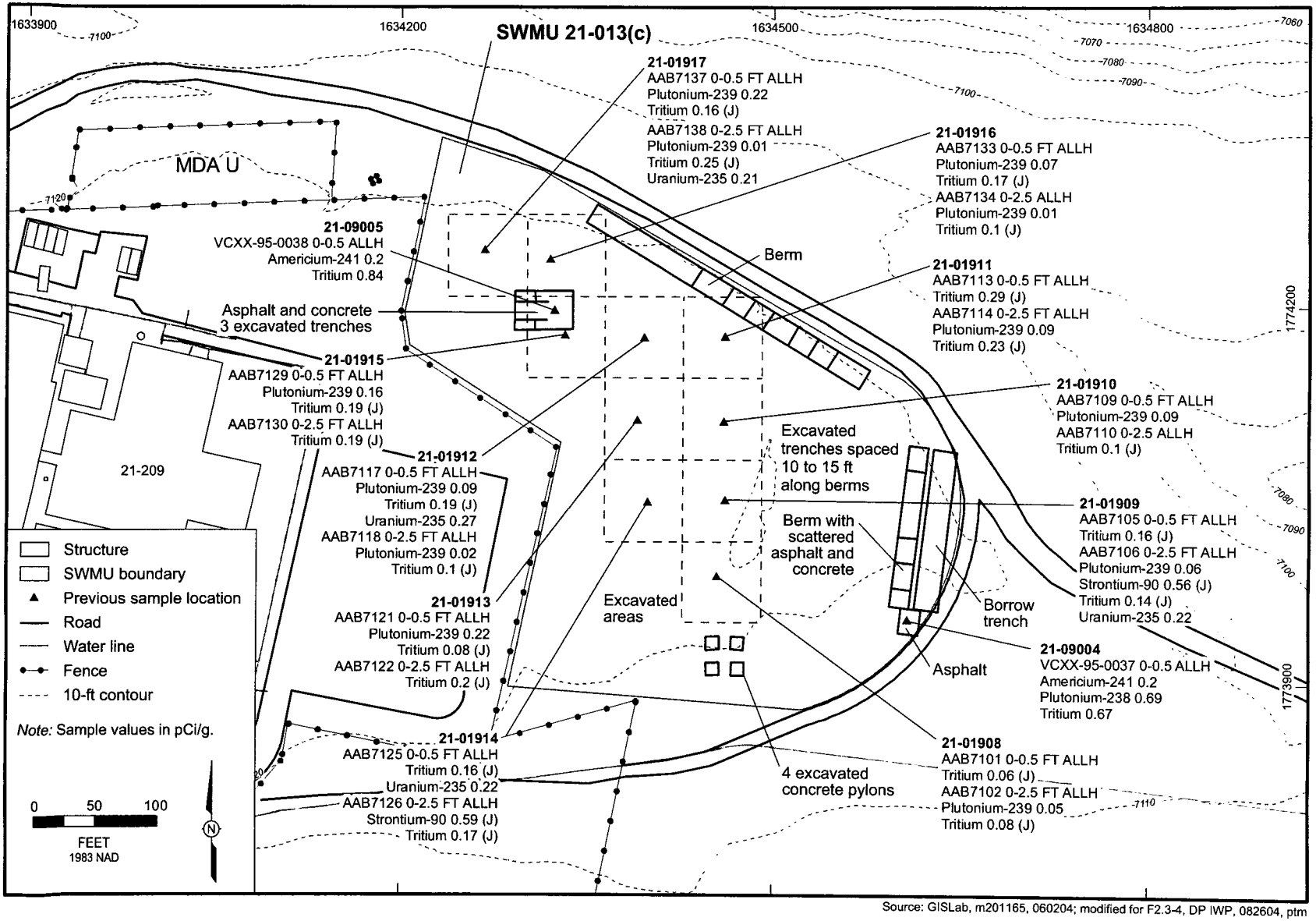
Source: GISLab, m201166, 060204; modified for F2.3-2, DP IWP, 082604, ptm

Figure 2.3-2. SWMU 21-013(c) sample locations with inorganic chemicals detected greater than background values



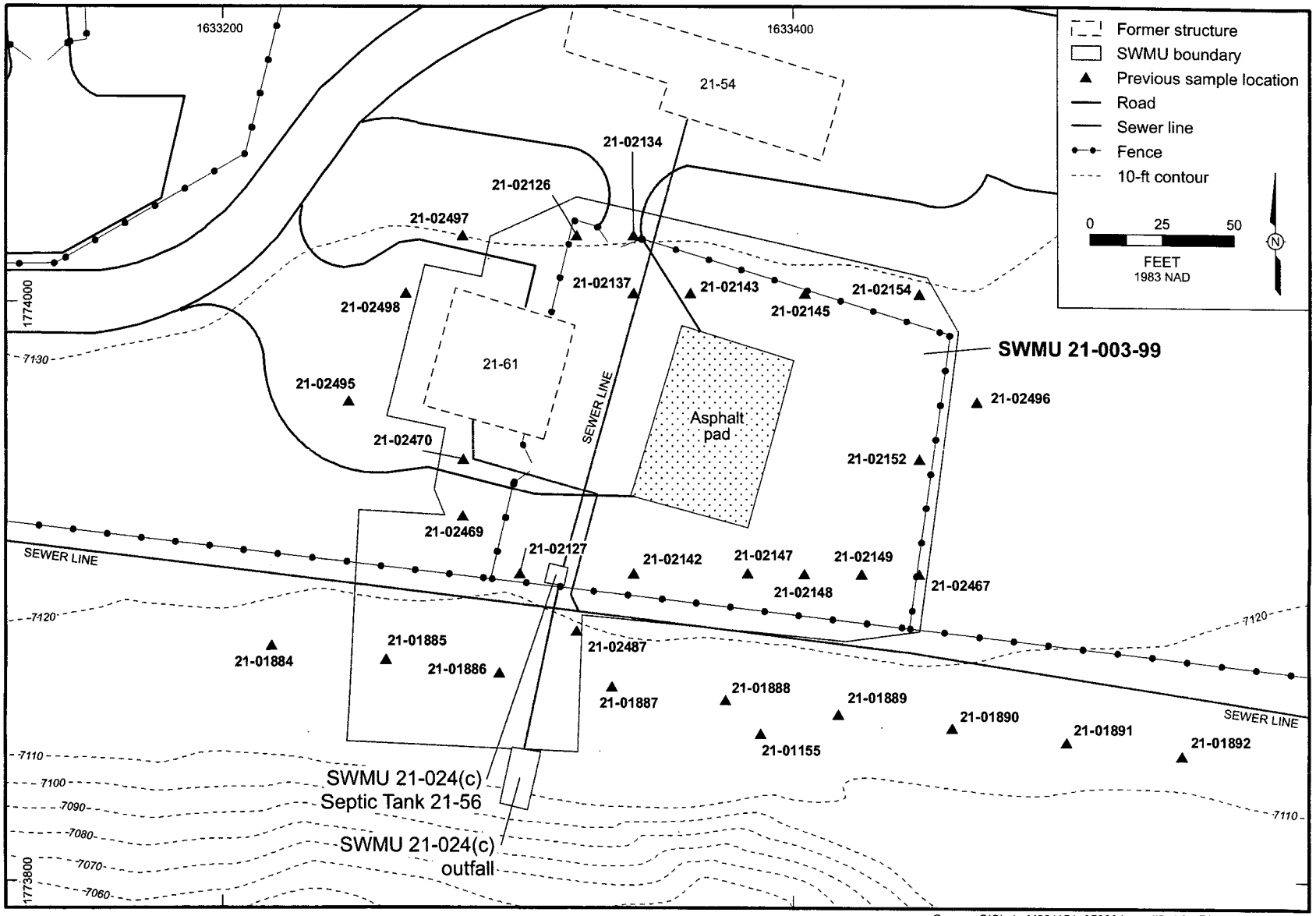
Source: GISLab, m201167 080904; modified for F2.3-3, DP IWP, 082704, ptm

Figure 2.3-3. SWMU 21-013(c) sample locations with detected organic chemicals



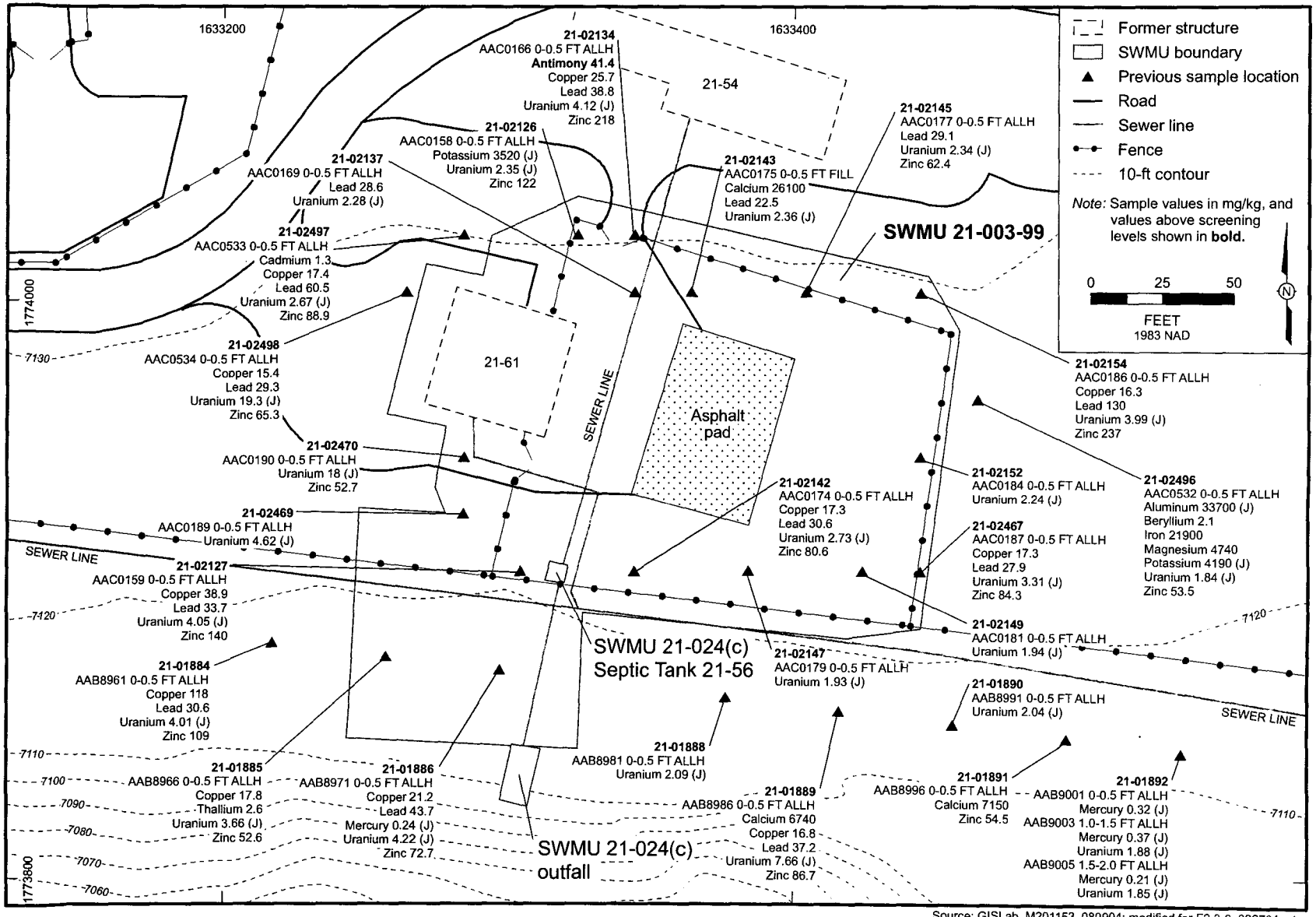
Source: GISLab, m201165, 060204; modified for F2.3-4, DP IWP, 082604, ptm

Figure 2.3-4. SWMU 21-013(c) sample locations with radionuclides detected greater than background or fallout values



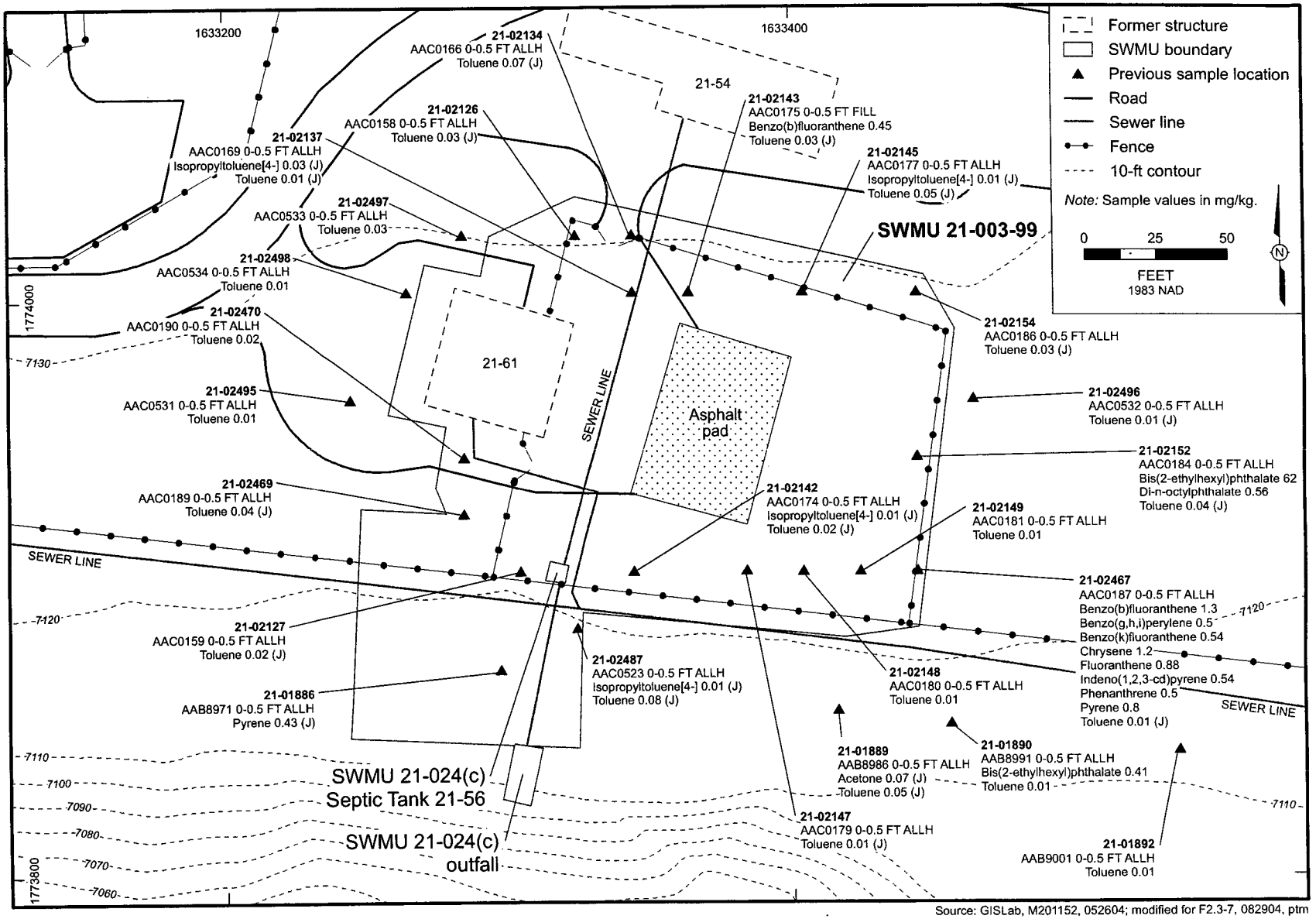
Source: GISLab, M201154, 052604; modified for F2.3-5, 082904, ptm

Figure 2.3-5. SWMU 21-003-99 previous investigation sample locations



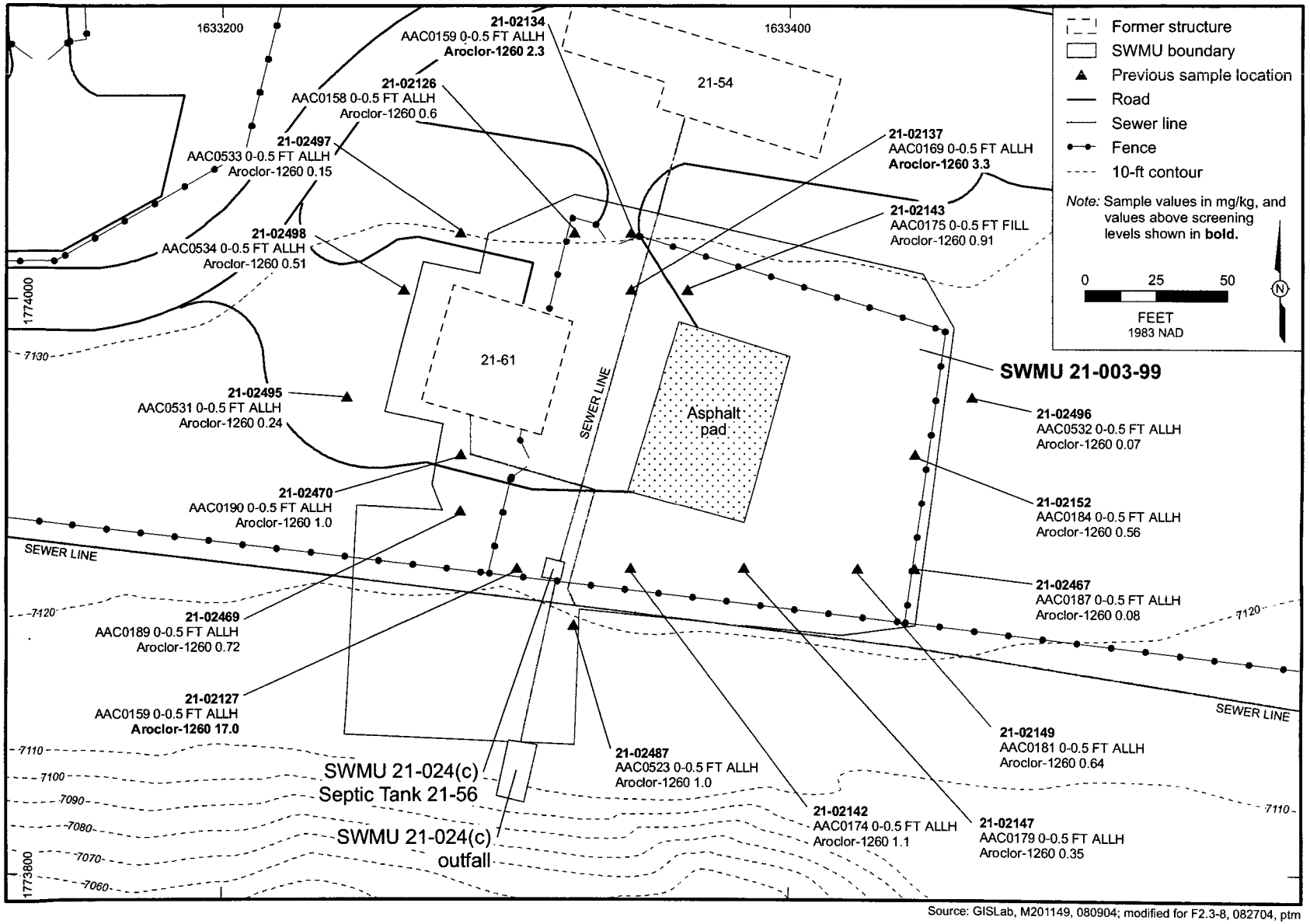
Source: GISLab, M201153, 080904; modified for F2.3-6, 082704, ptm

Figure 2.3-6. SWMU 21-003-99 sample locations with inorganic chemicals detected greater than background values



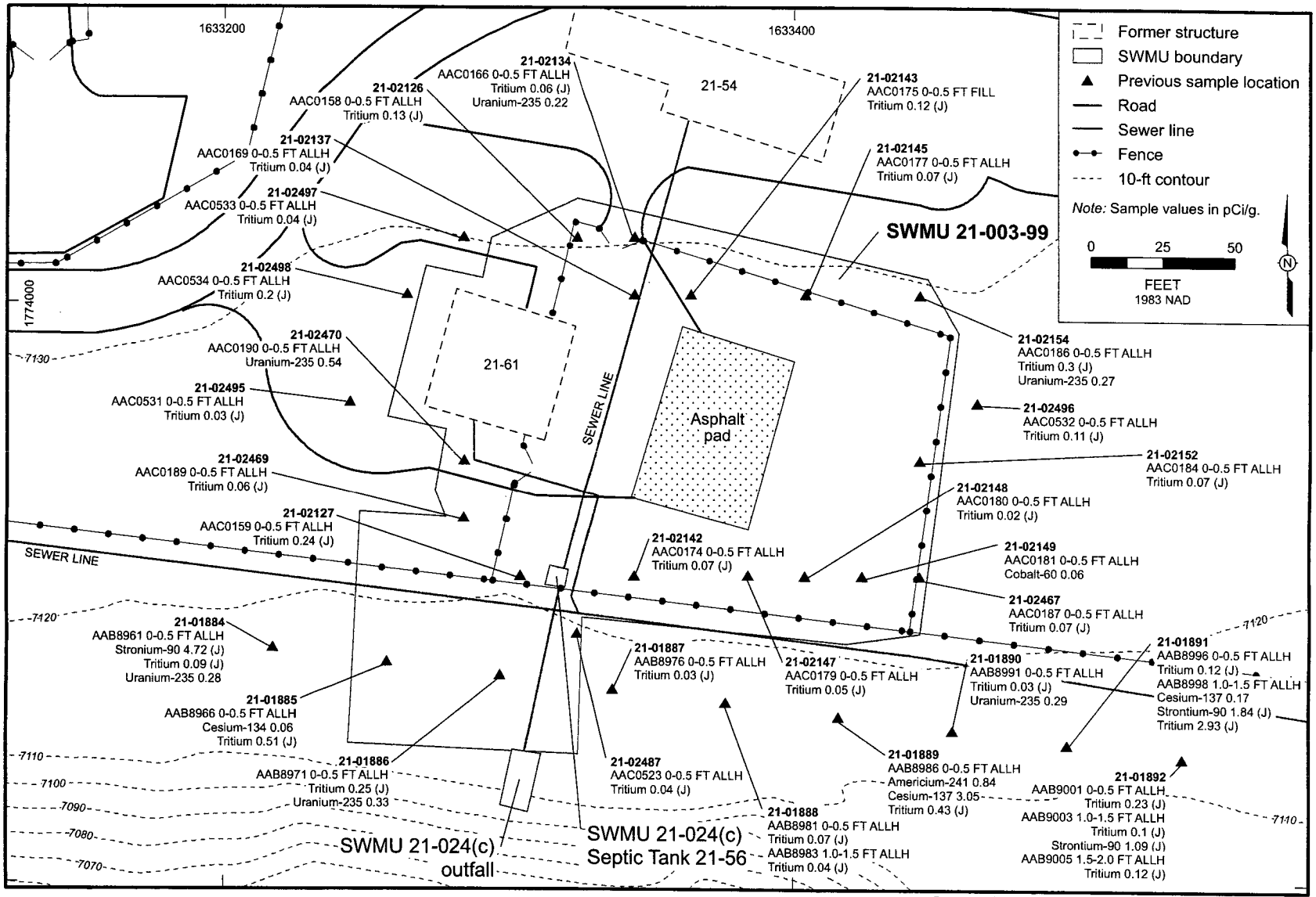
Source: GISLab, M201152, 052604; modified for F2.3-7, 082904, ptm

Figure 2.3-7. SWMU 21-003-99 sample locations with detected organic chemicals (except Aroclor-1260)



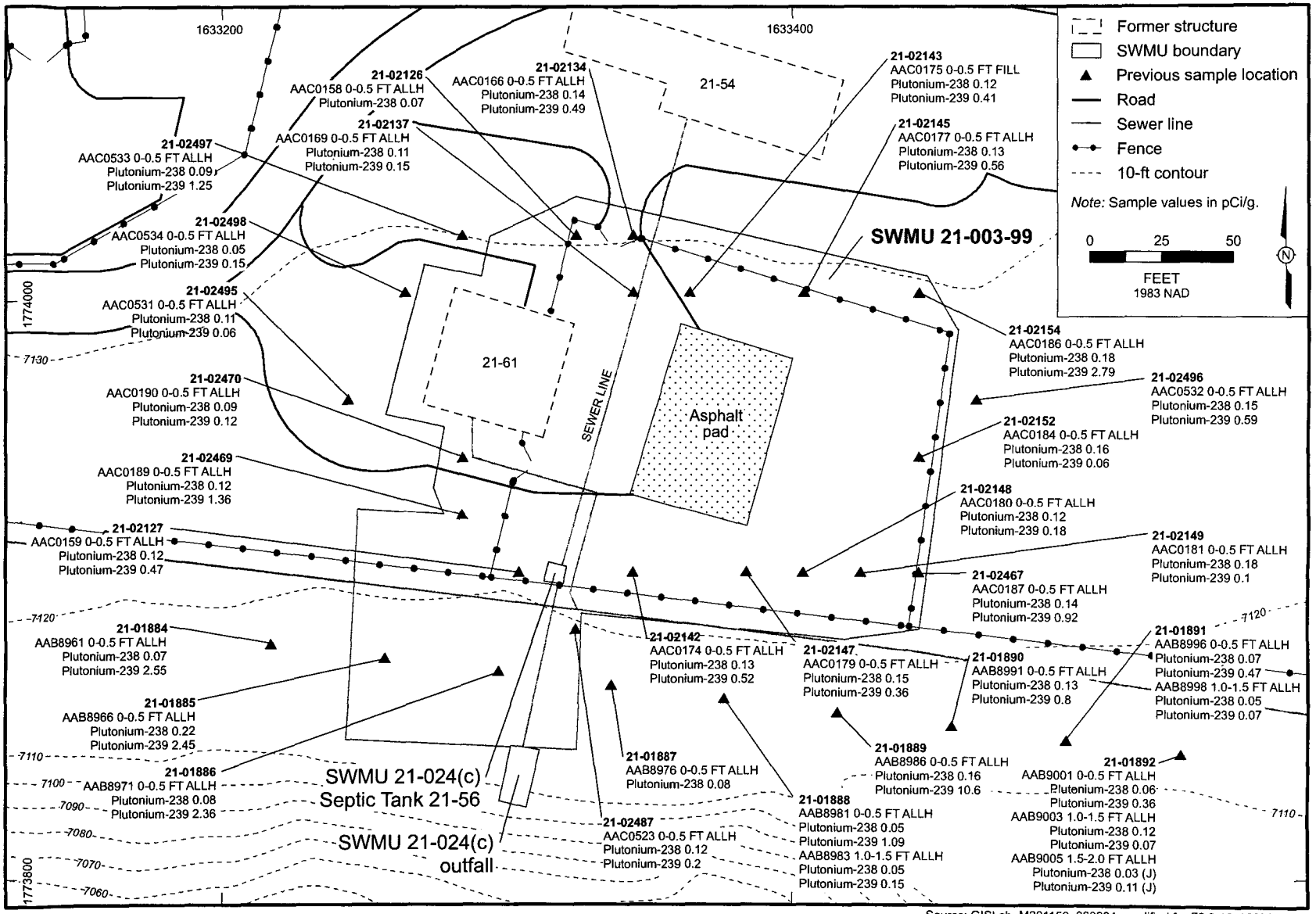
Source: GISLab, M201149, 080904; modified for F2.3-8, 082704, ptm

Figure 2.3-8. SWMU 21-003-99 sample locations with Aroclor-1260 detections



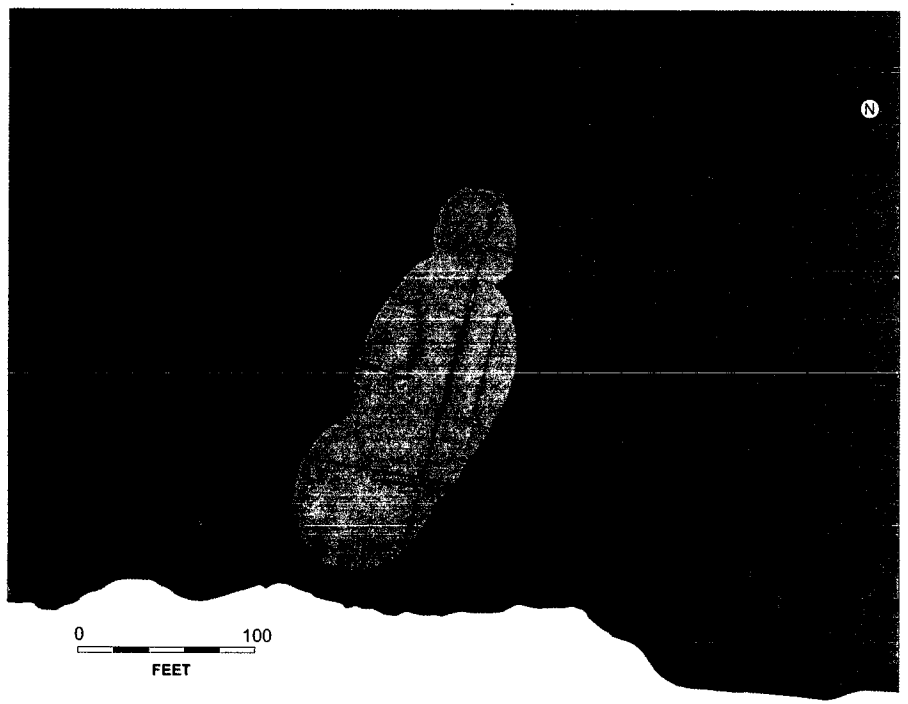
Source: GISLab, M201151, 052604; modified for F2.3-9, 082704, ptm

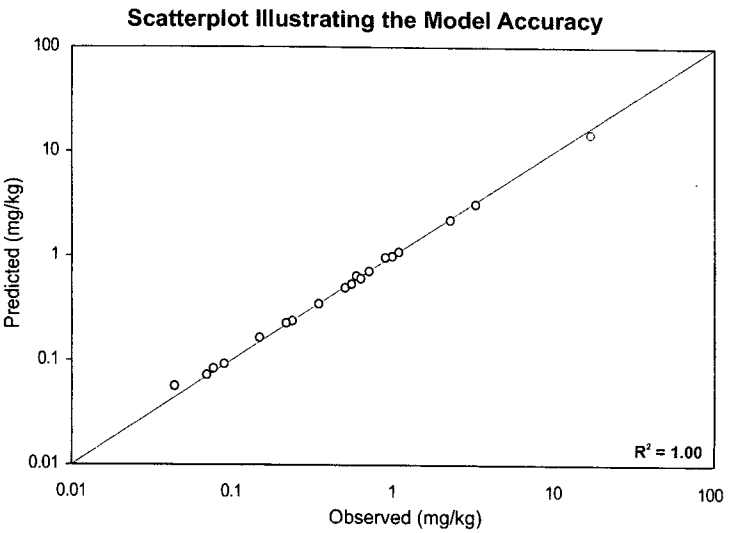
Figure 2.3-9. SWMU 21-003-99 sample locations with radionuclides (except plutonium-238 and plutonium-239) detected greater than background or fallout values

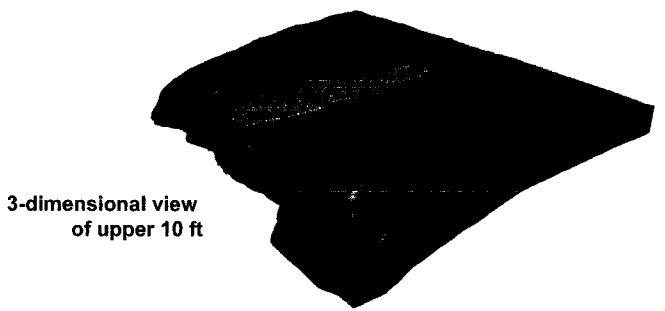


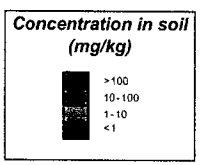
Source: GISLab, M201150, 080904; modified for F2.3-10, 082704, ptm

Figure 2.3-10. SWMU 21-003-99 sample locations with plutonium-238 and plutonium-239 detected greater than fallout values







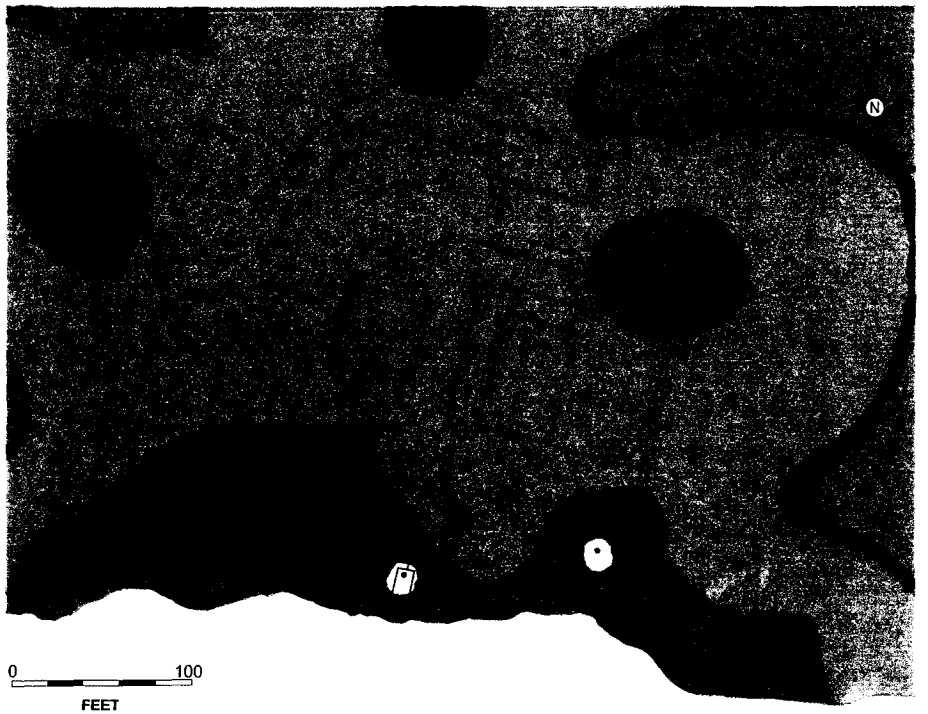


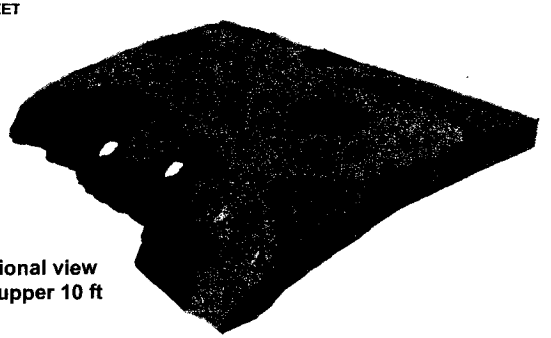
Sample Statistics for 21-003-99 and 21-024(c) Grid Area

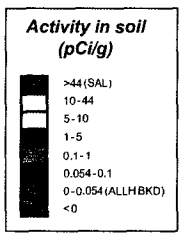
Media	Count	Max	Min.	# BKD	# BKD Exceedances	Count of SSL Exceedances (0.22 mg/kg)
QAL	0	0	0	0	0	0
ALLH	19	17	0.044	0	19	14
FILL	1	0.91	0.91	0	1	1
SED	0	0	0	0	0	0
QBT3	0	0	0	0	0	0
QBT2	0	0	0	0	0	0
QBT1V	0	0	0	0	0	0
QBTQG	0	0	0	0	0	0

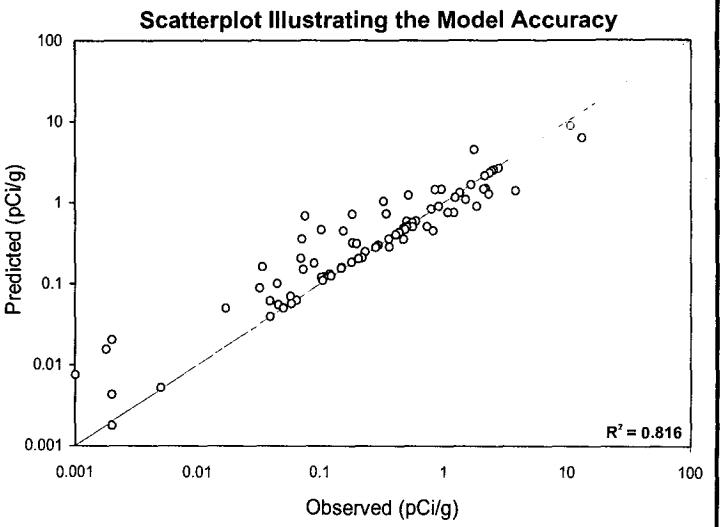
F2.3-11/DP IWP/082804/rlm

Figure 2.3-11. Aroclor-1260 distribution at SWMUs 21-003-99 and 21-024(c)







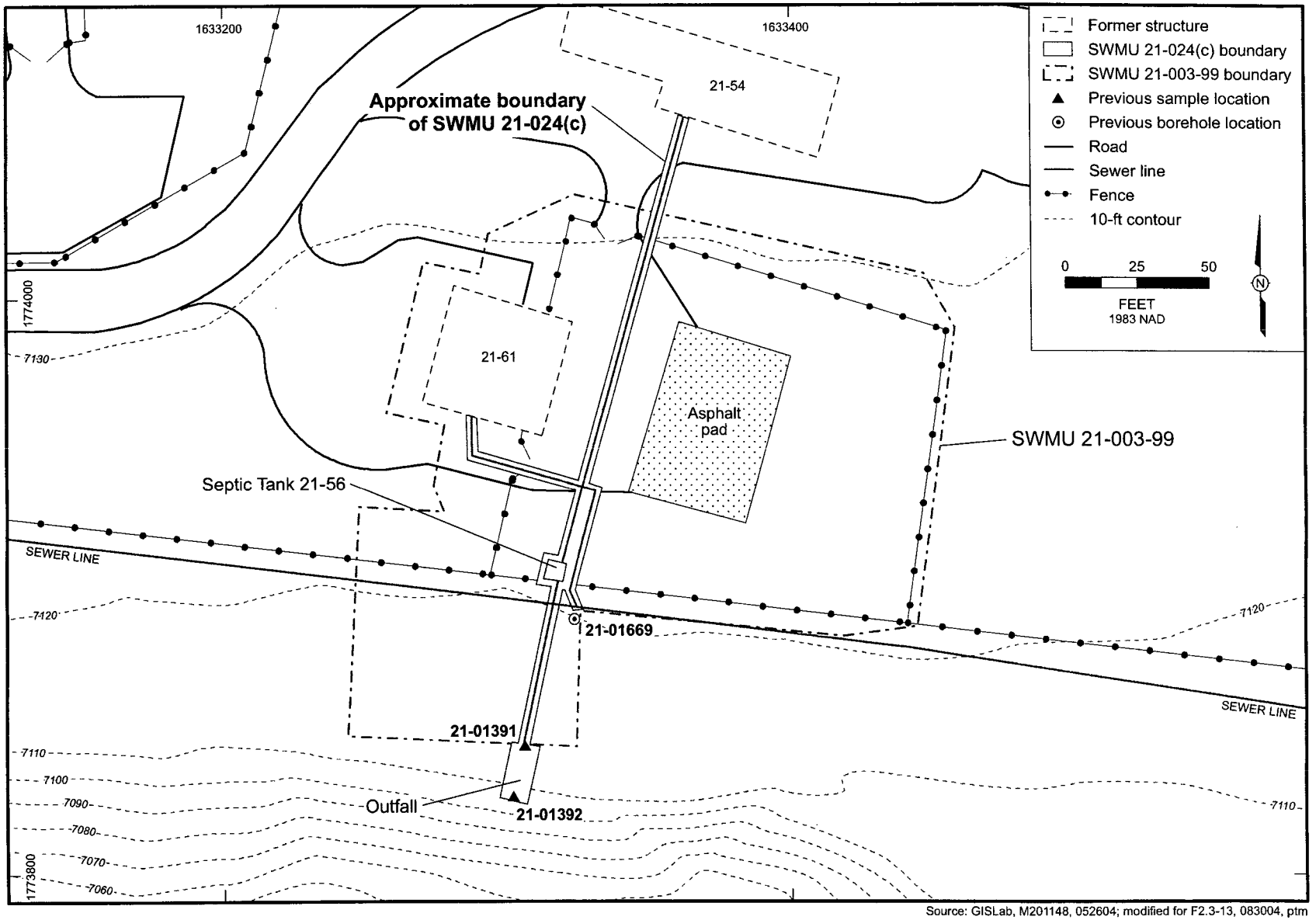


Sample Statistics for 21-003-99 and 21-024(c) Grid Area

Media	Count	Max	Min.	# BKD	# BKD Exceedances	Count of Exceedances (44 pCi/g)
QAL	0	13.23	0	0	0	0
ALLH	77	0.41	0.0018	0.054	68	0
FILL	2	0	0.002	0.054	1	0
SED	0	0	0	0	0	0
QBT3	5	0.005	0.001	0	5	0
QBT2	0	0	0	0	0	0
QBT1V	0	0	0	0	0	0
QBT1G	0	0	0	0	0	0

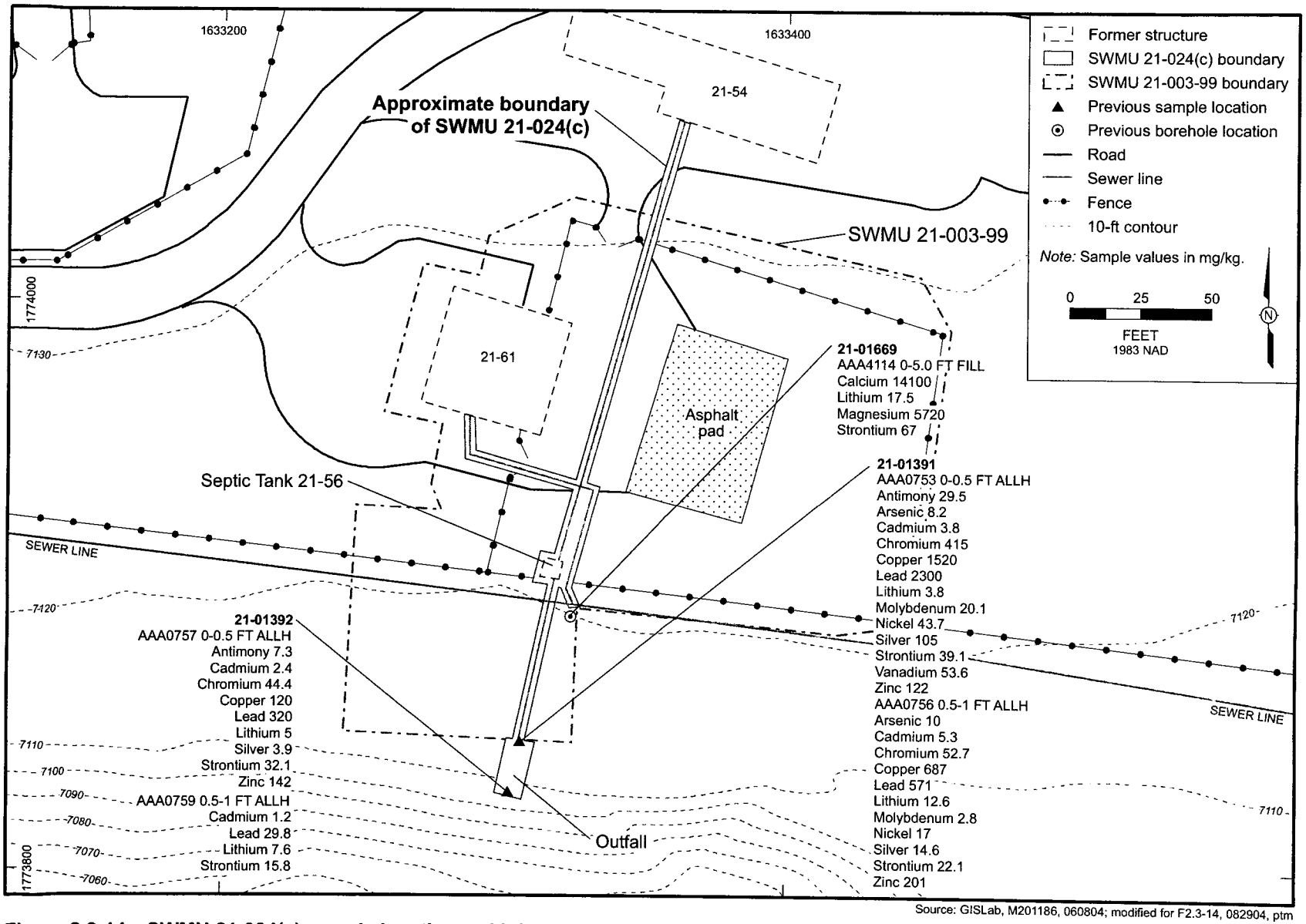
F2.3-12/DP IWP/082804/rlm

Figure 2.3-12. Plutonium-239 distribution at SWMUs 21-003-99 and 21-024(c)



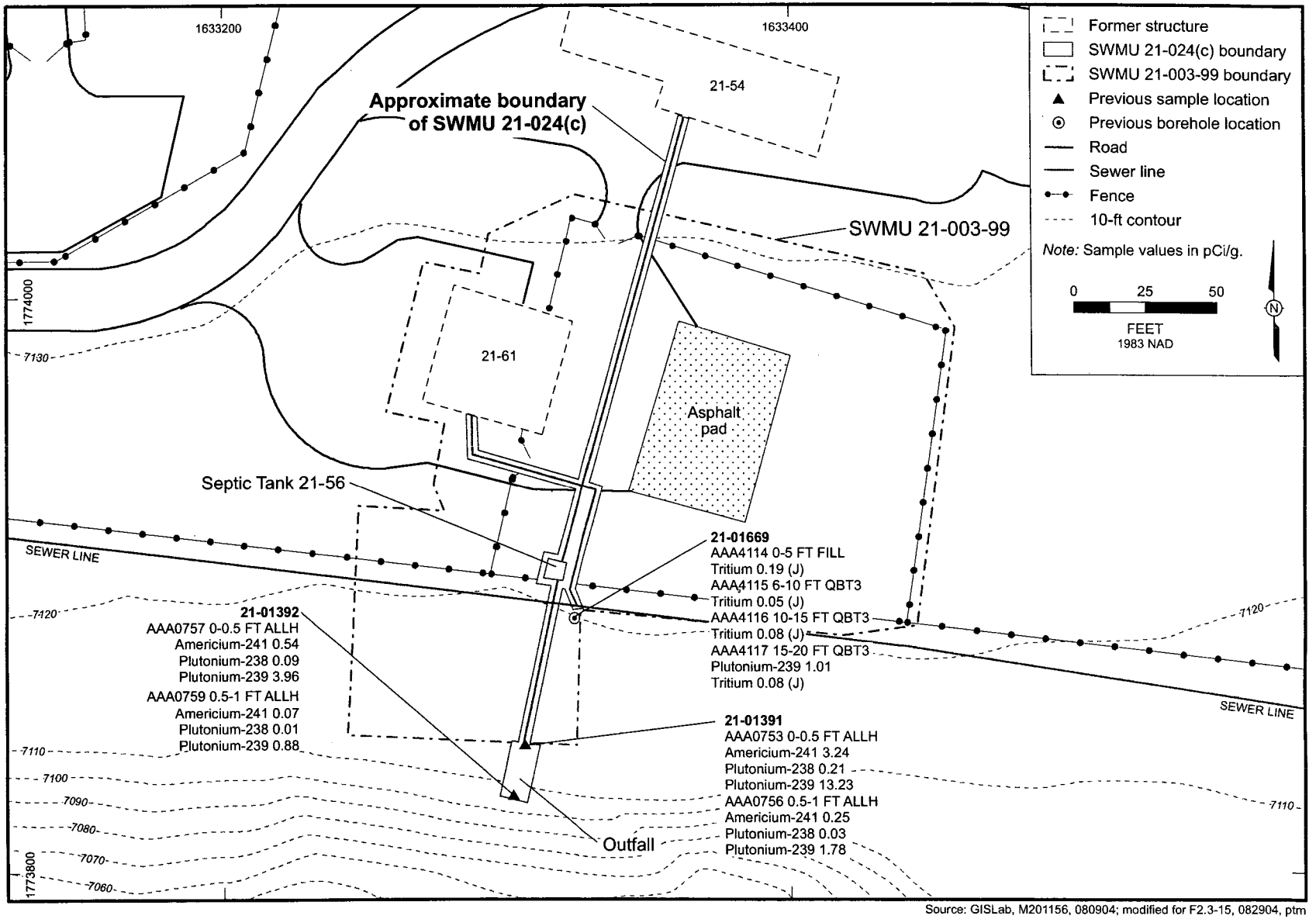
Source: GISLab, M201148, 052604; modified for F2.3-13, 083004, ptm

Figure 2.3-13. SWMU 21-024(c) previous investigation sample locations



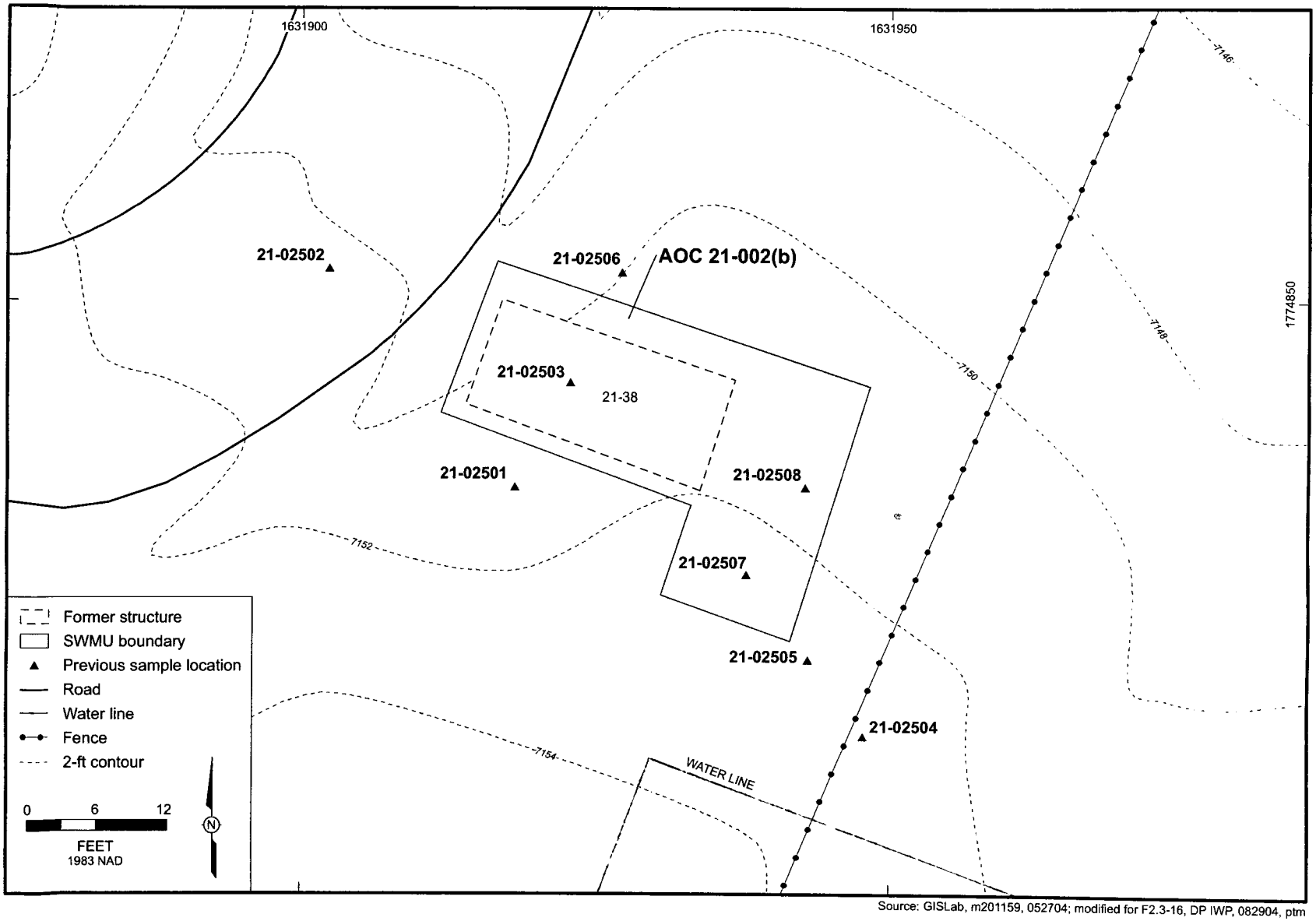
Source: GISLab, M201186, 060804; modified for F2.3-14, 082904, ptm

Figure 2.3-14. SWMU 21-024(c) sample locations with inorganic chemicals detected greater than background values



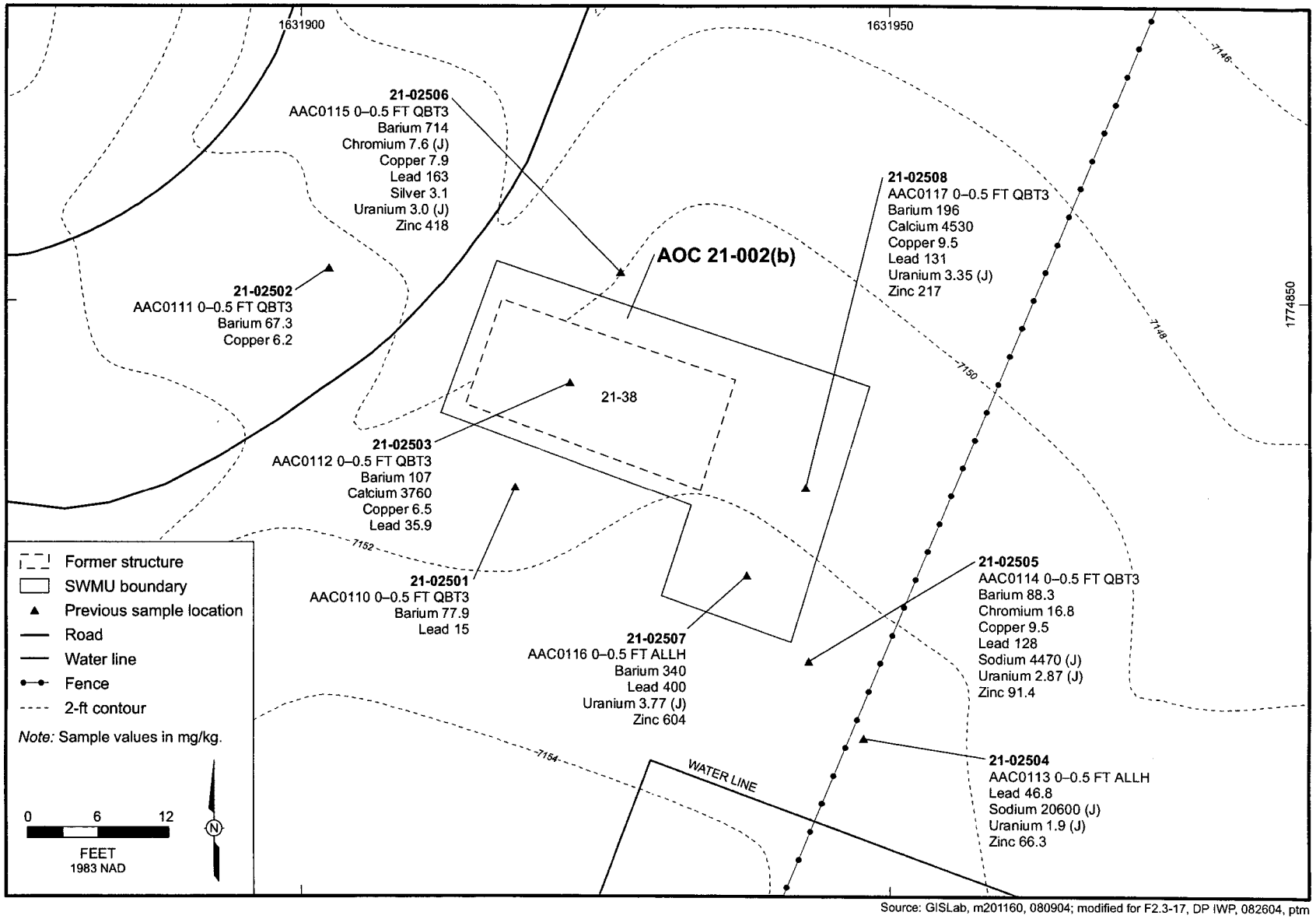
Source: GISLab, M201156, 080904; modified for F2.3-15, 082904, ptm

Figure 2.3-15. SWMU 21-024(c) sample locations with radionuclides detected greater than fallout values



Source: GISLab, m201159, 052704; modified for F2.3-16, DP IWP, 082904, ptm

Figure 2.3-16. AOC 21-002(b) previous investigation sample locations



Source: GISLab, m201160, 080904; modified for F2.3-17, DP IWP, 082604, ptm

Figure 2.3-17. AOC 21-002(b) sample locations with inorganic chemicals detected greater than background values

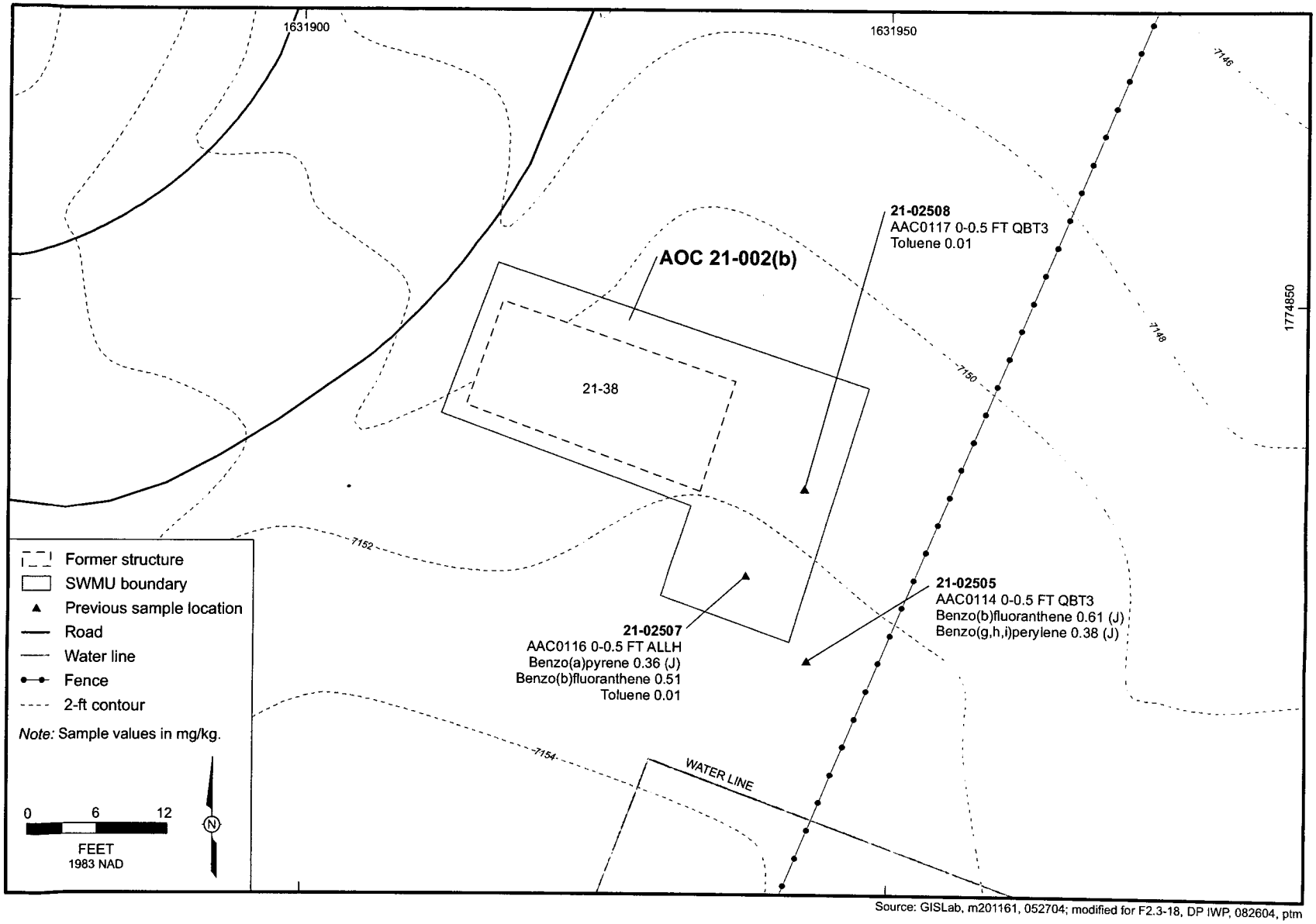
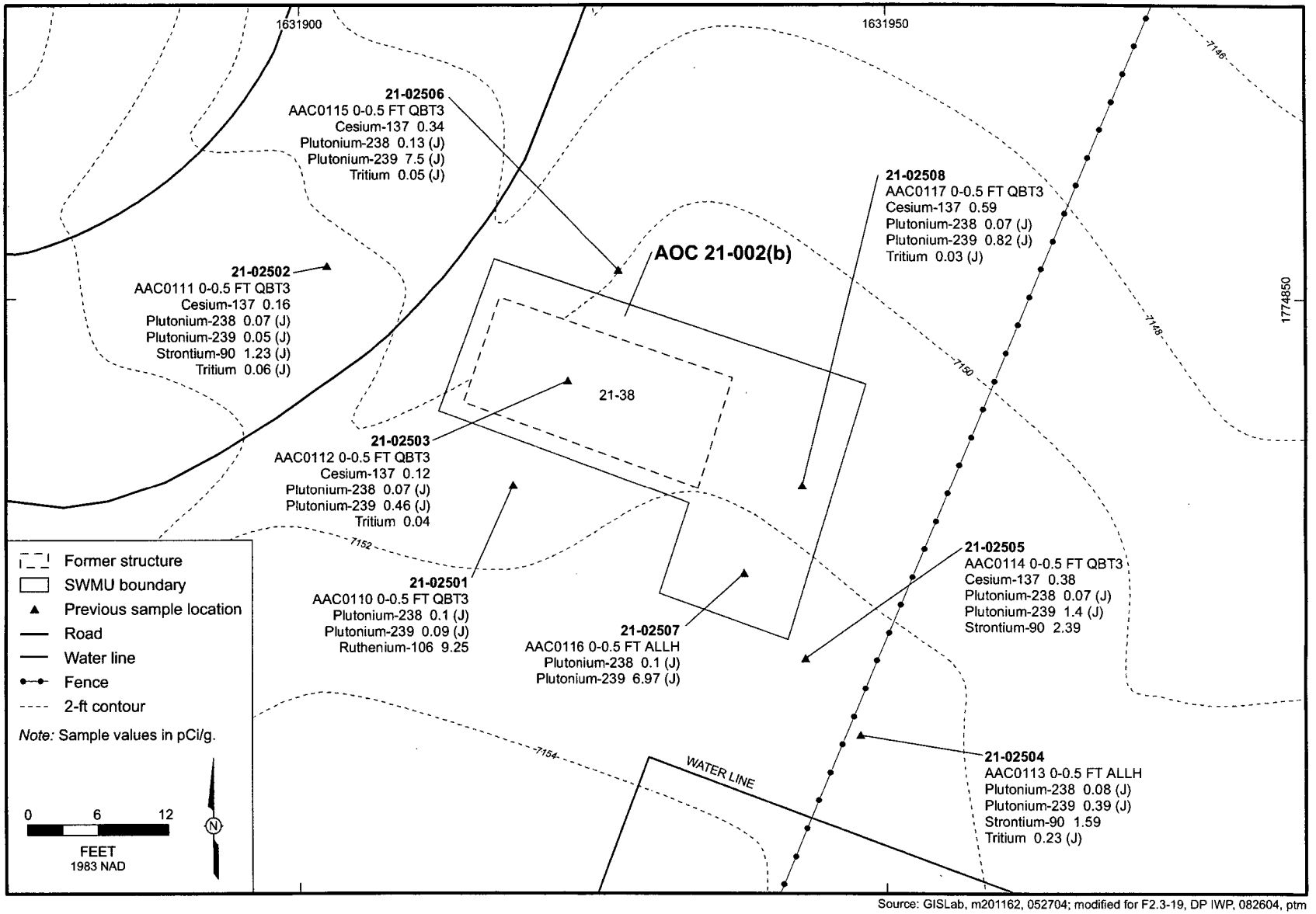
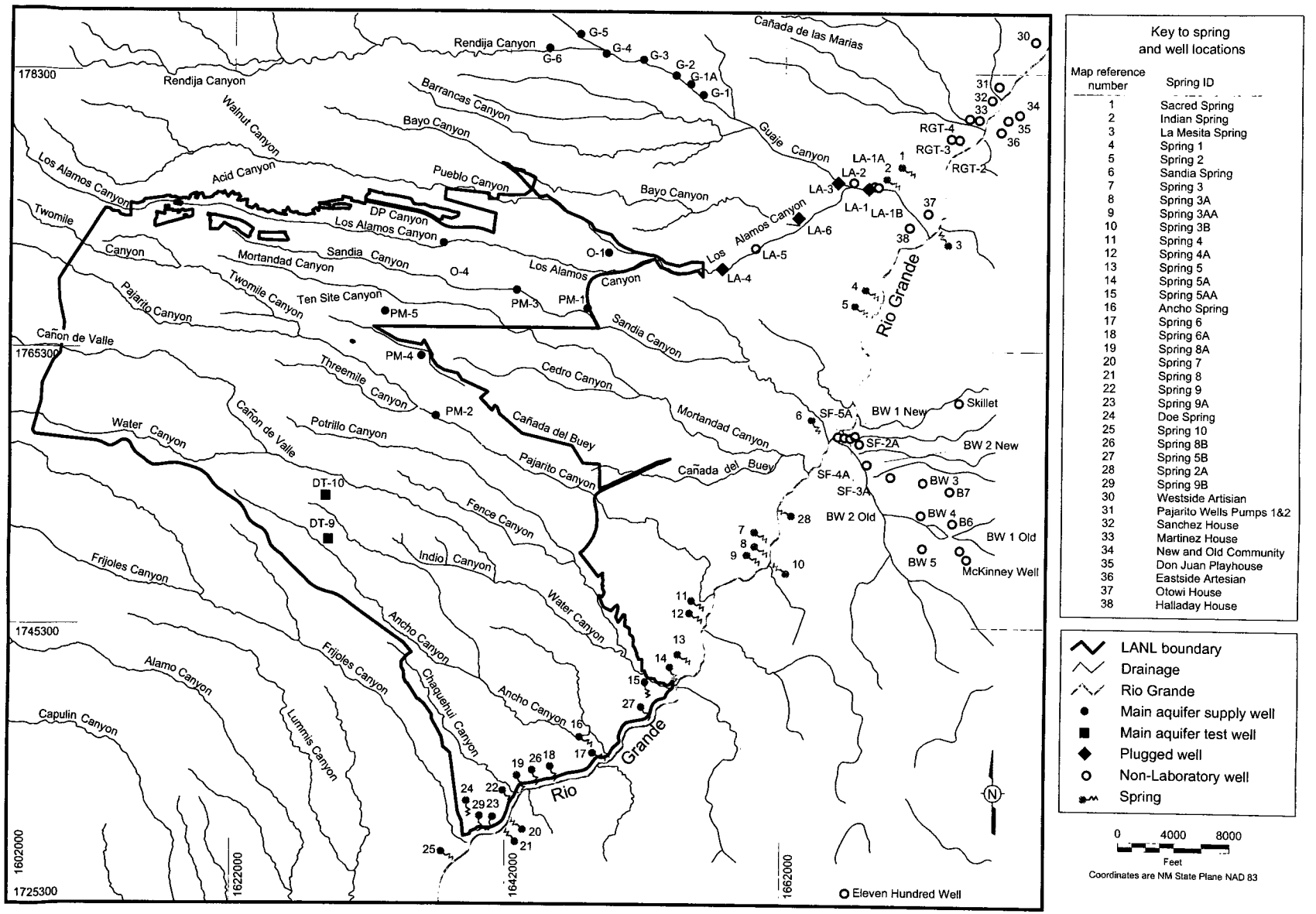


Figure 2.3-18. AOC 21-002(b) sample locations with detected organic chemicals



Source: GISLab, m201162, 052704; modified for F2.3-19, DP IWP, 082604, ptm

Figure 2.3-19. AOC 21-002(b) sample locations with radionuclides detected greater than fallout values



F3.2-1/DP IWP/081304/rlm

Figure 3.2-1. Surface water drainage to the Rio Grande and well locations

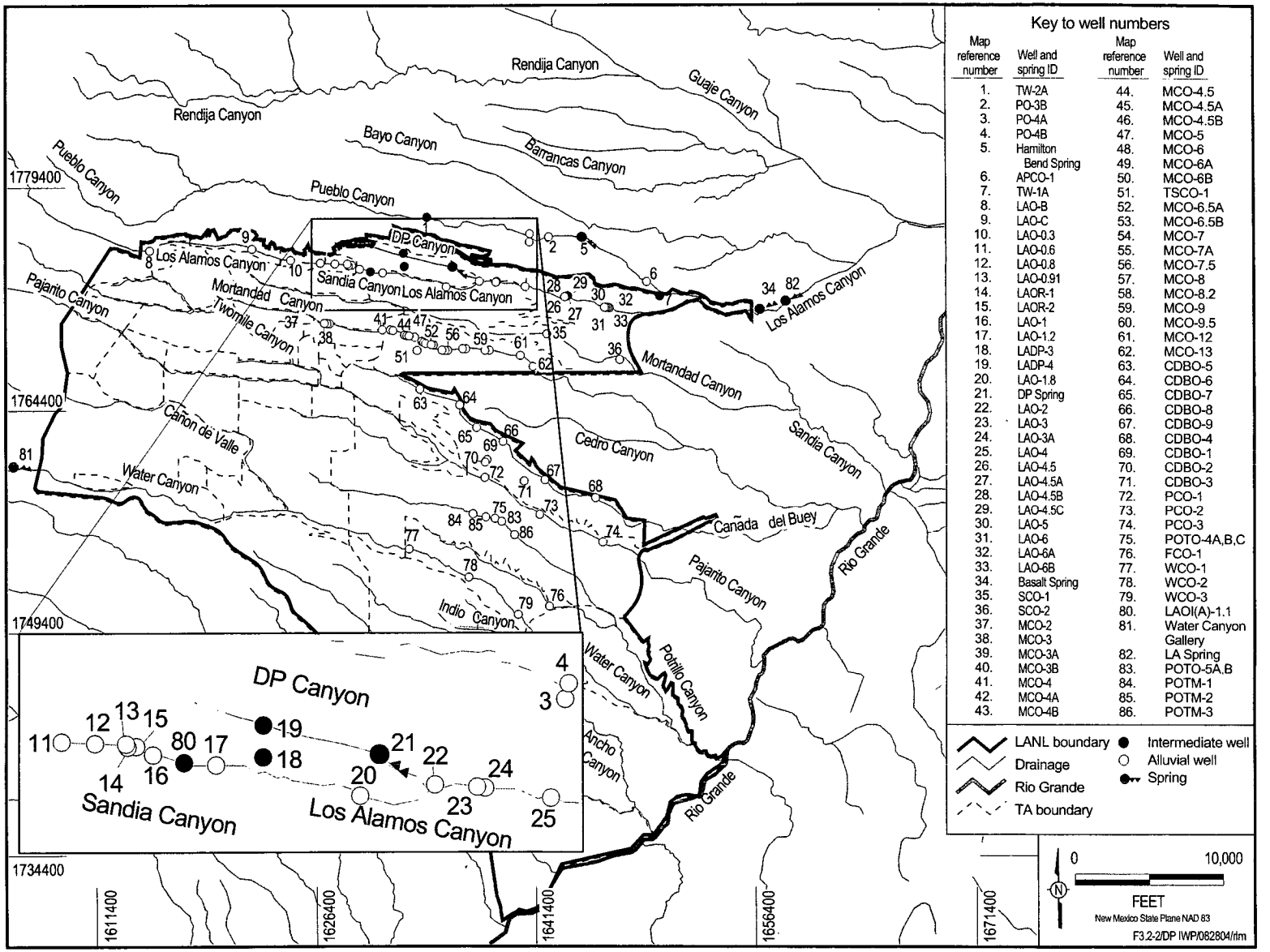
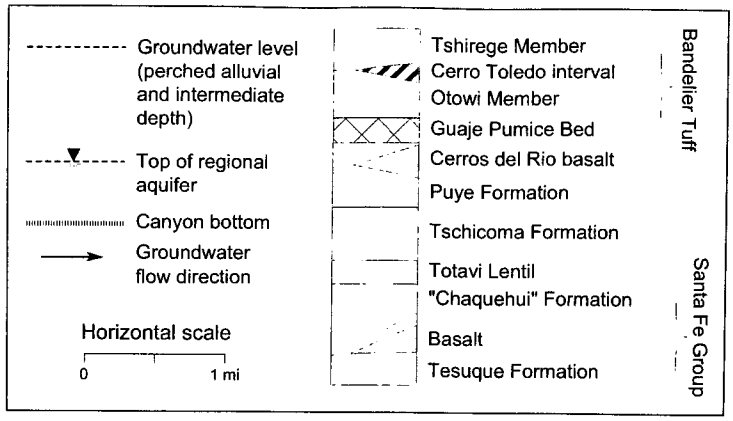


Figure 3.2-2. Locations of wells and springs near TA-21



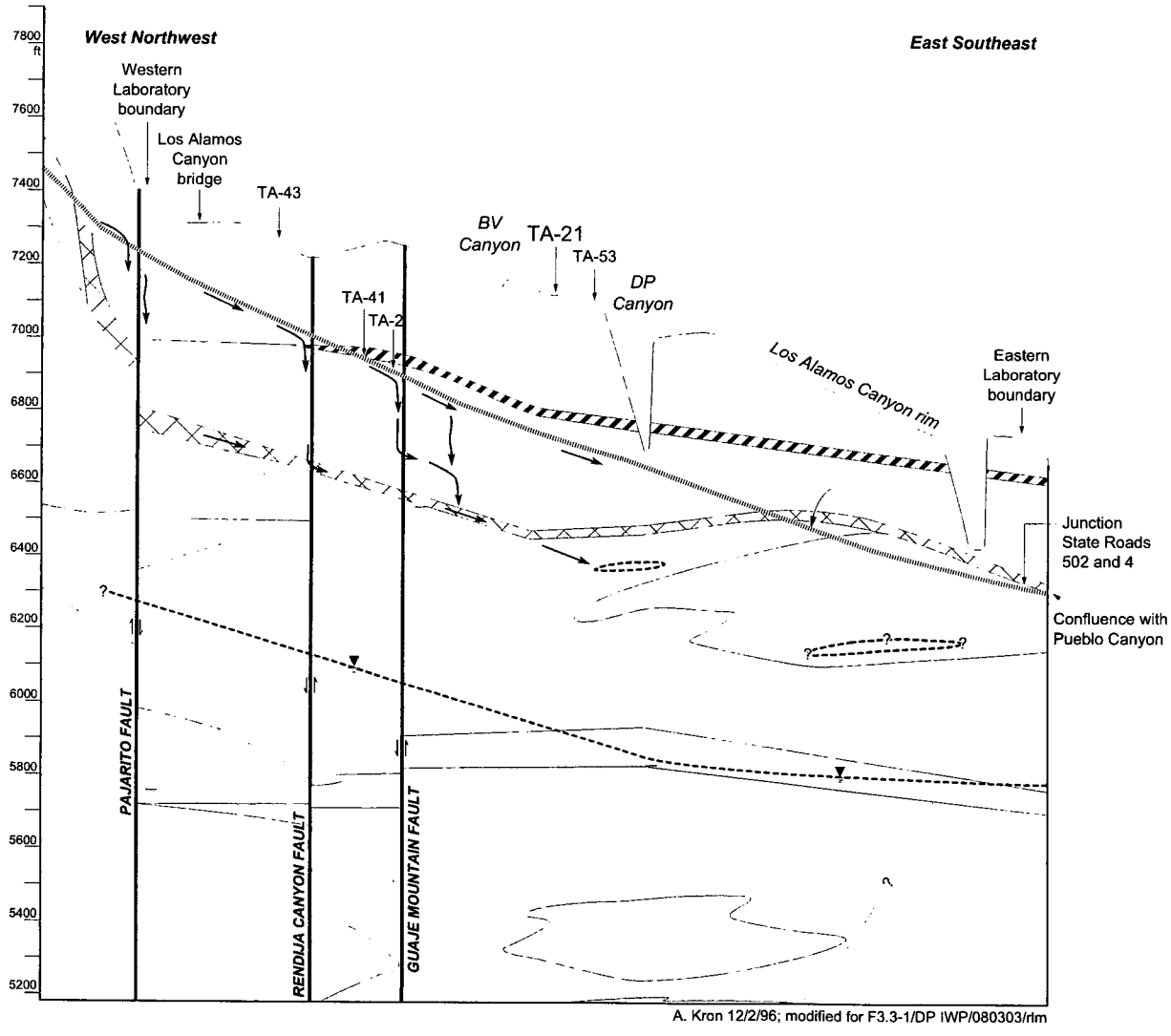
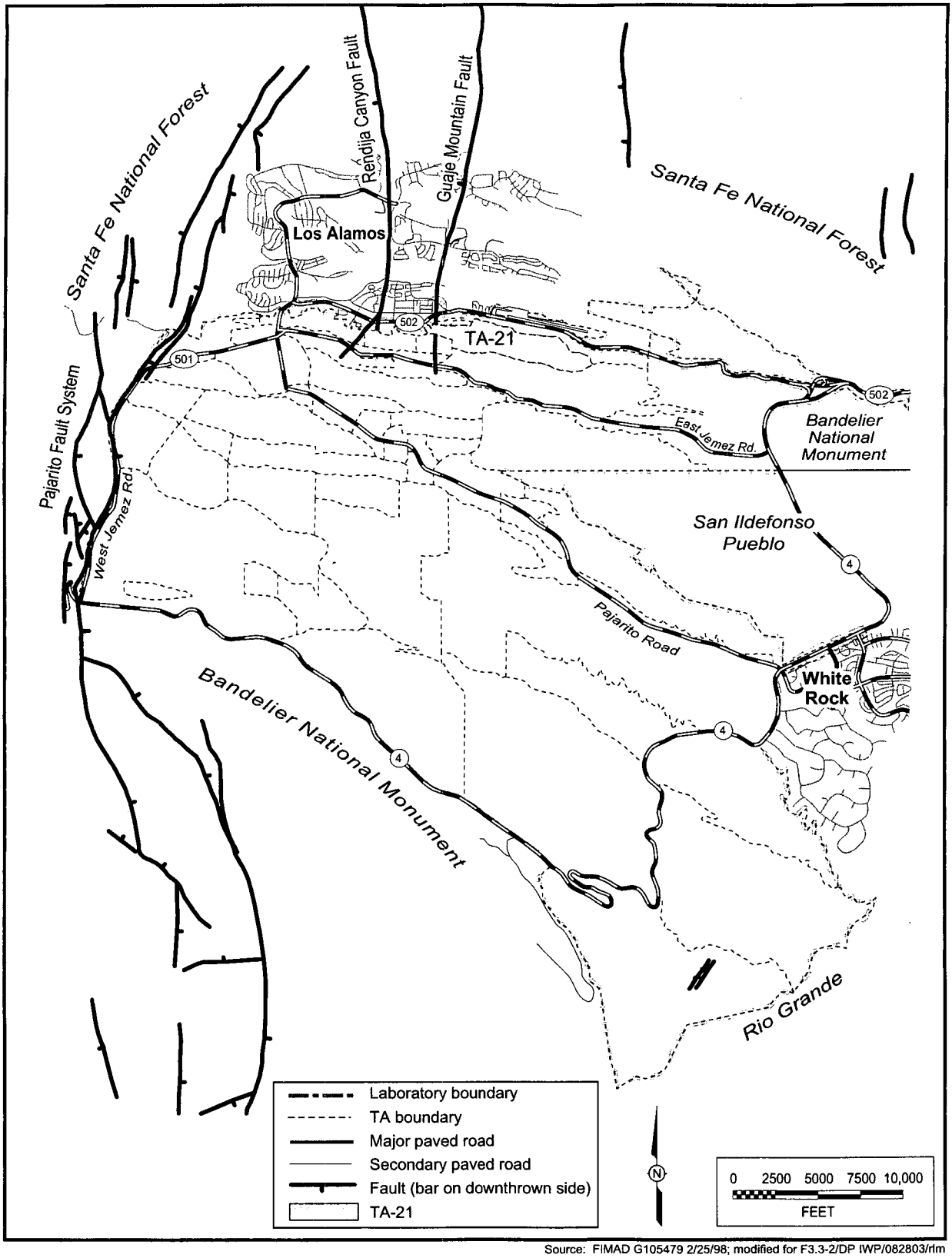


Figure 3.3-1. Generalized stratigraphy beneath TA-21



Source: FIMAD G105479 2/25/98; modified for F3.3-2/DP IWP/082803/rlm

Figure 3.3-2. Locations of major faults in the Laboratory complex

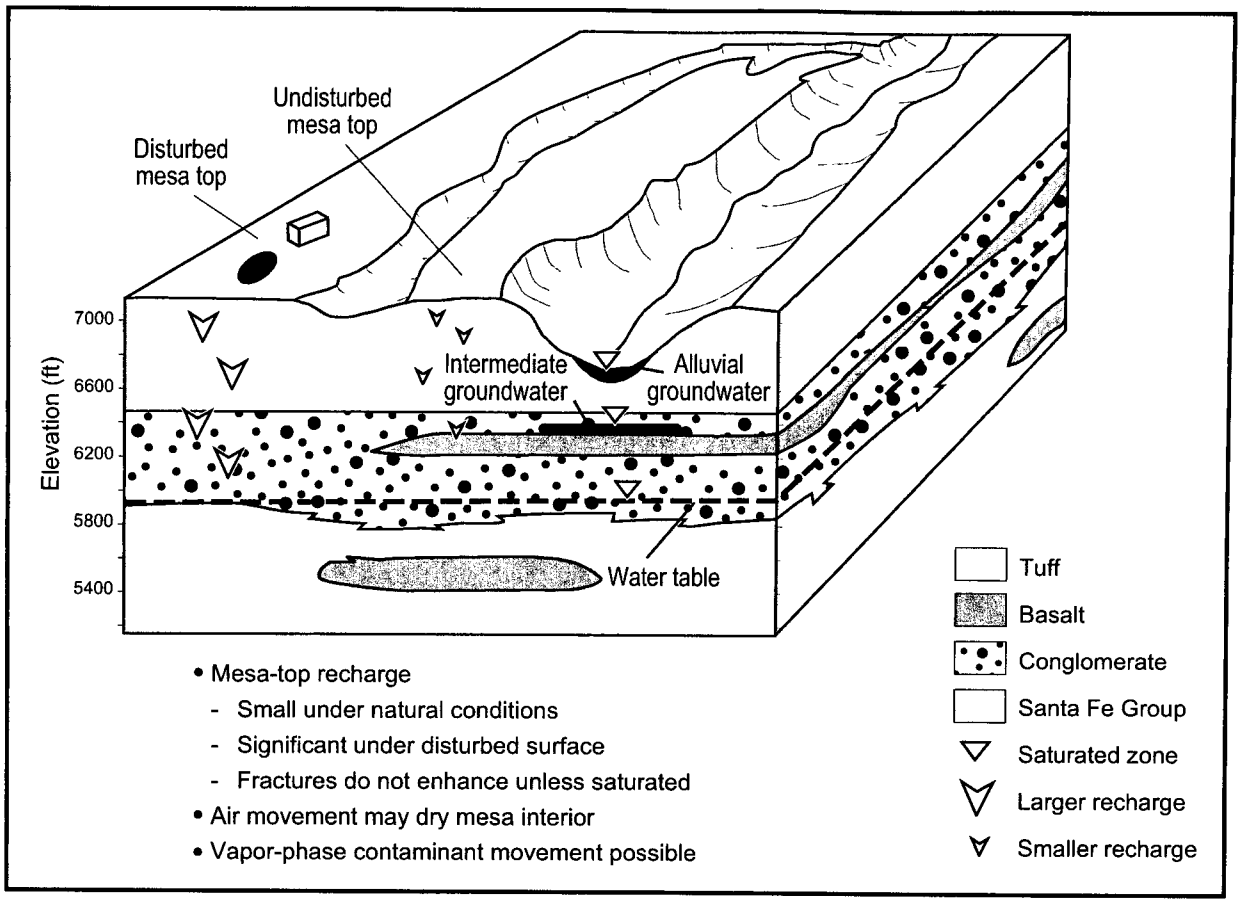
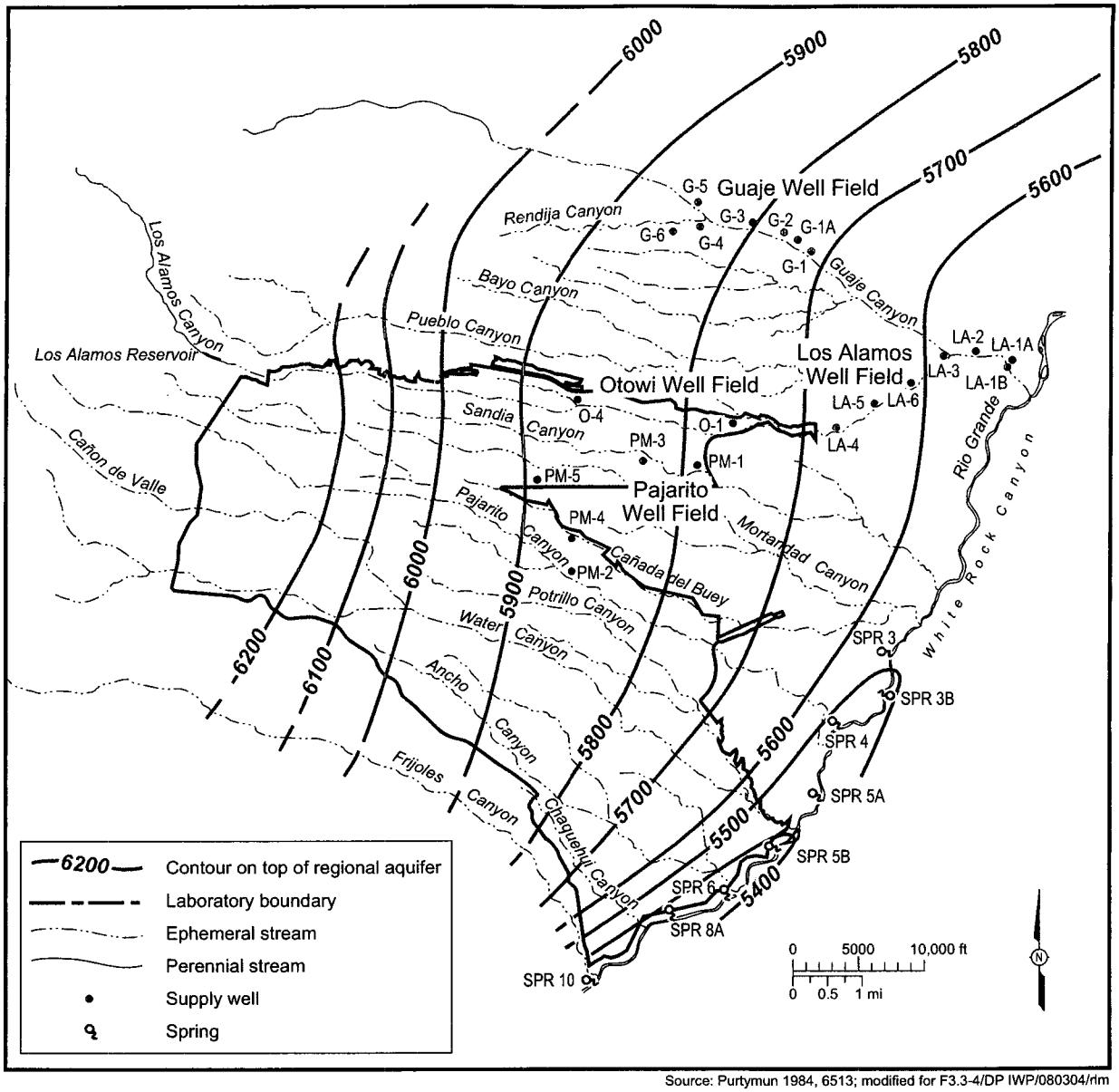
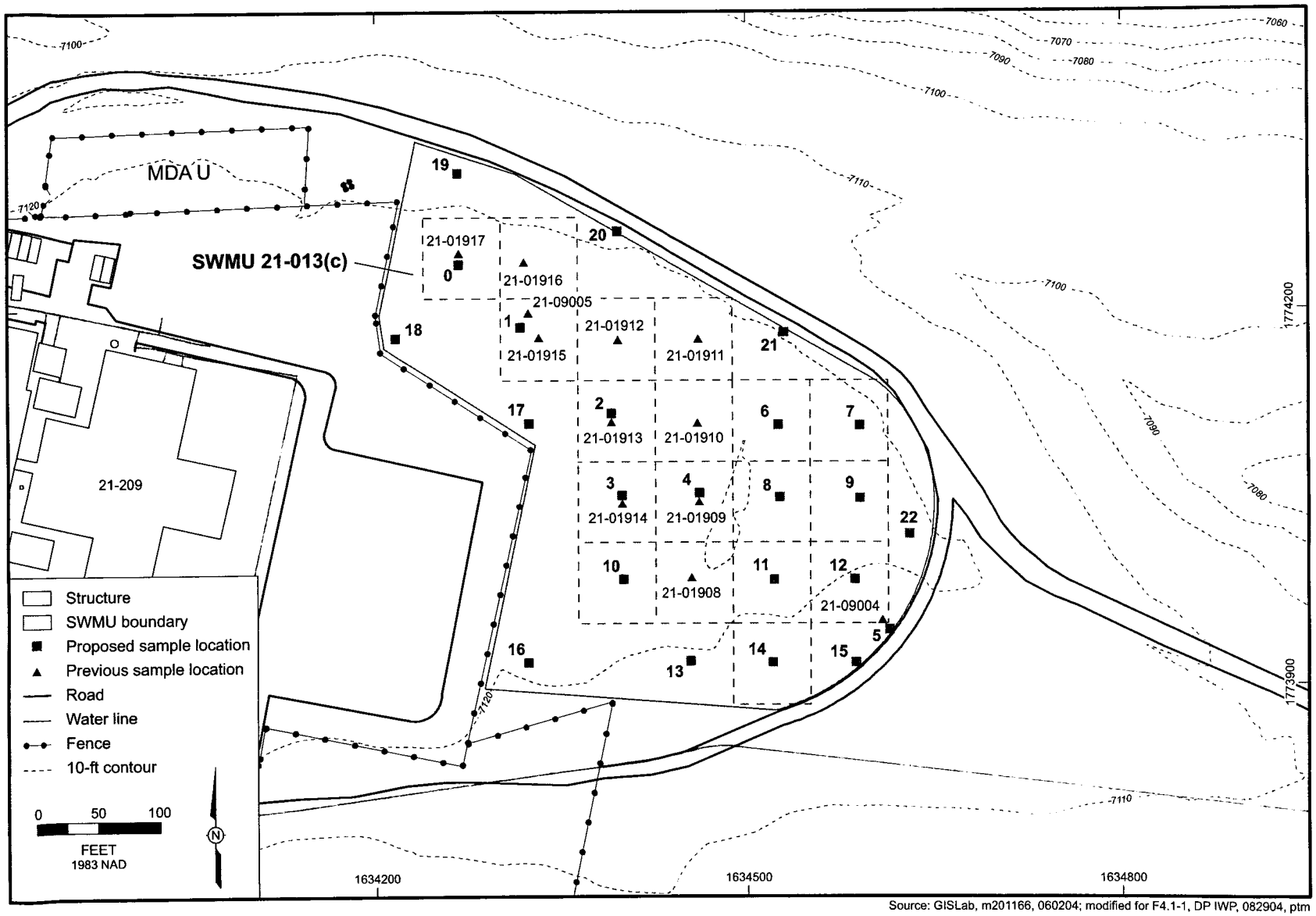


Figure 3.3-3. Hydrogeologic conceptual model for mesas



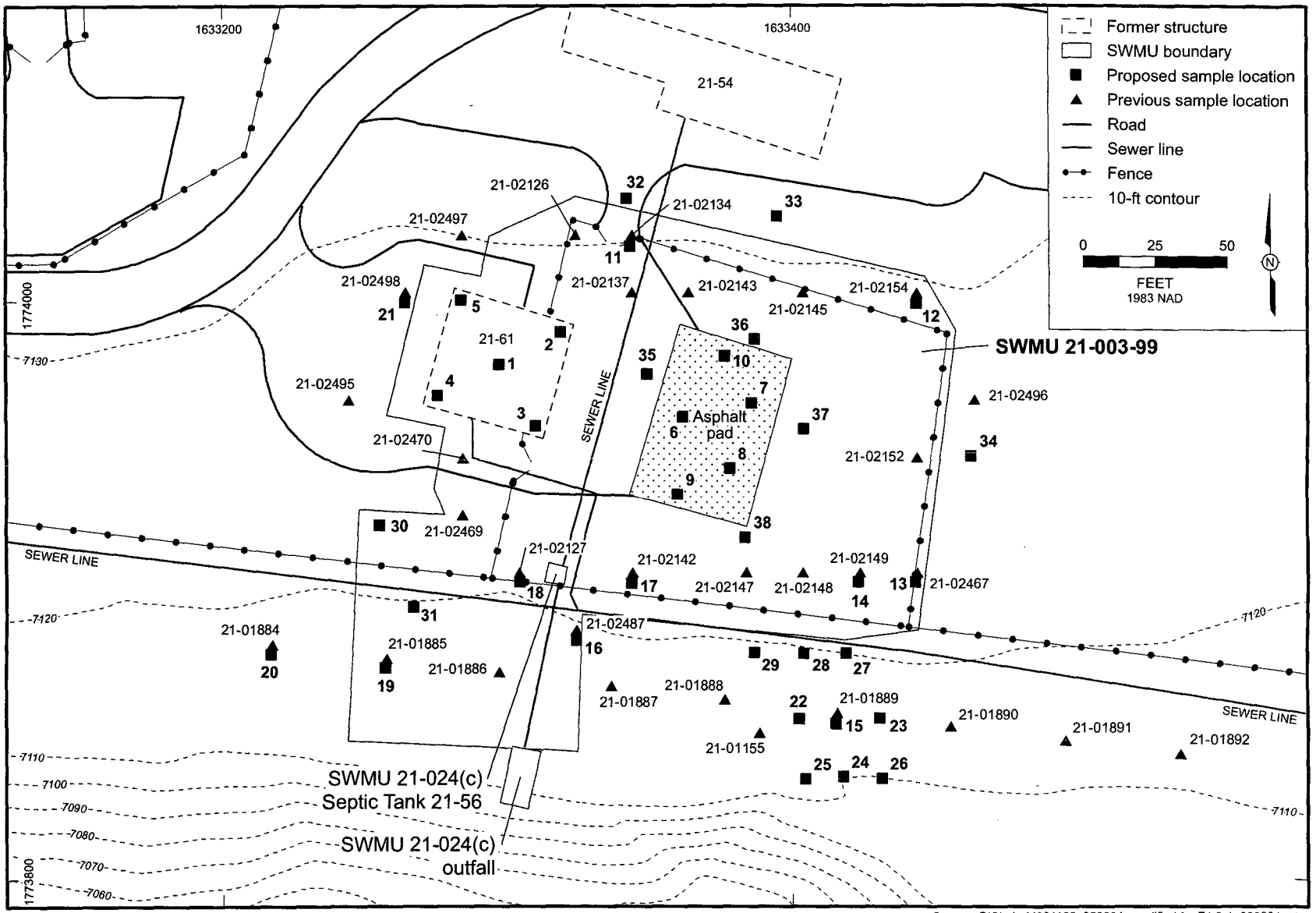
Source: Purtymun 1984, 6513; modified for F3.3-4/DP IWP/080304/rlm

Figure 3.3-4. Locations of wells and generalized water-level contours on top of the regional aquifer



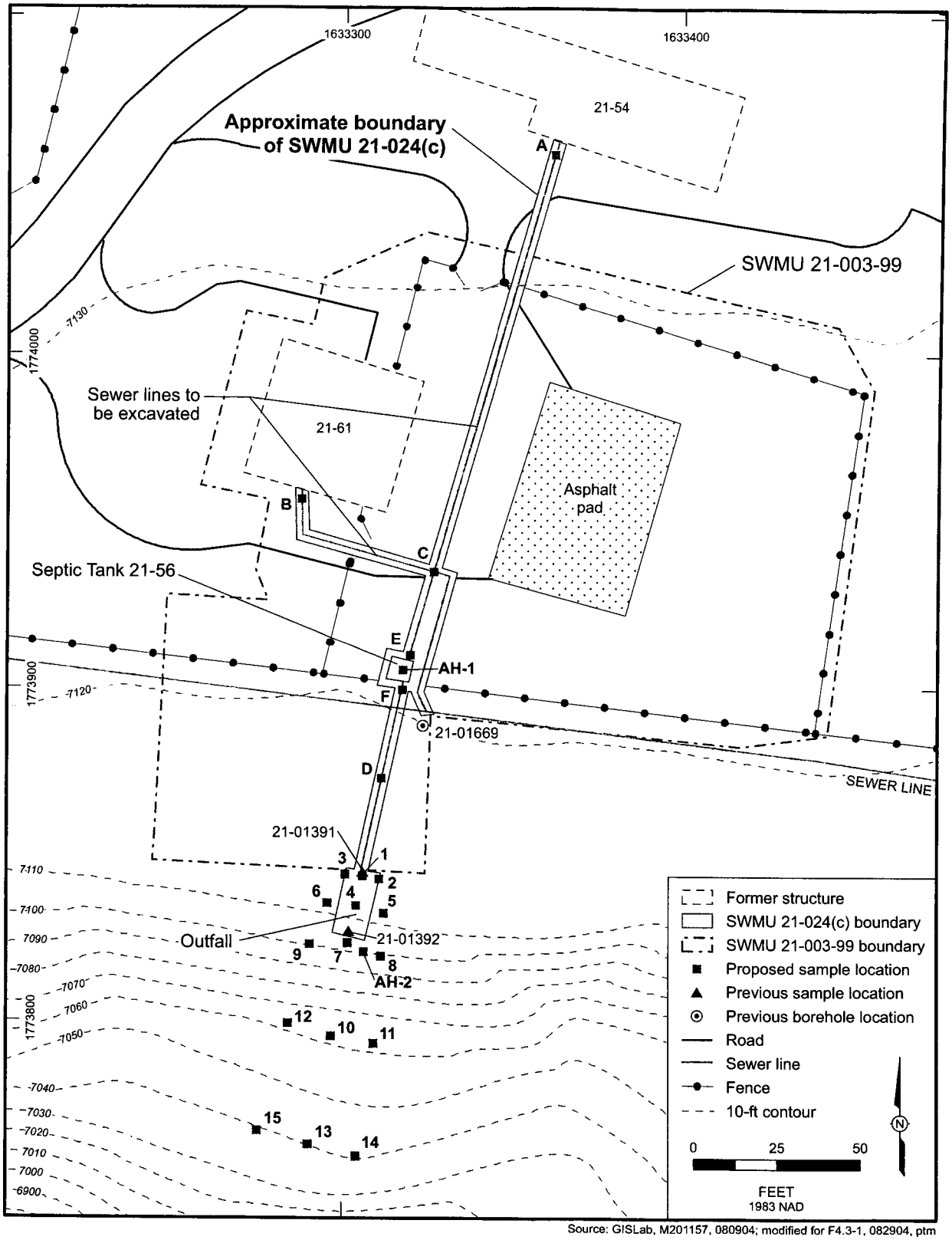
Source: GISLab, m201166, 060204; modified for F4.1-1, DP IWP, 082904, ptm

Figure 4.1-1. SWMU 21-013(c) proposed sample locations



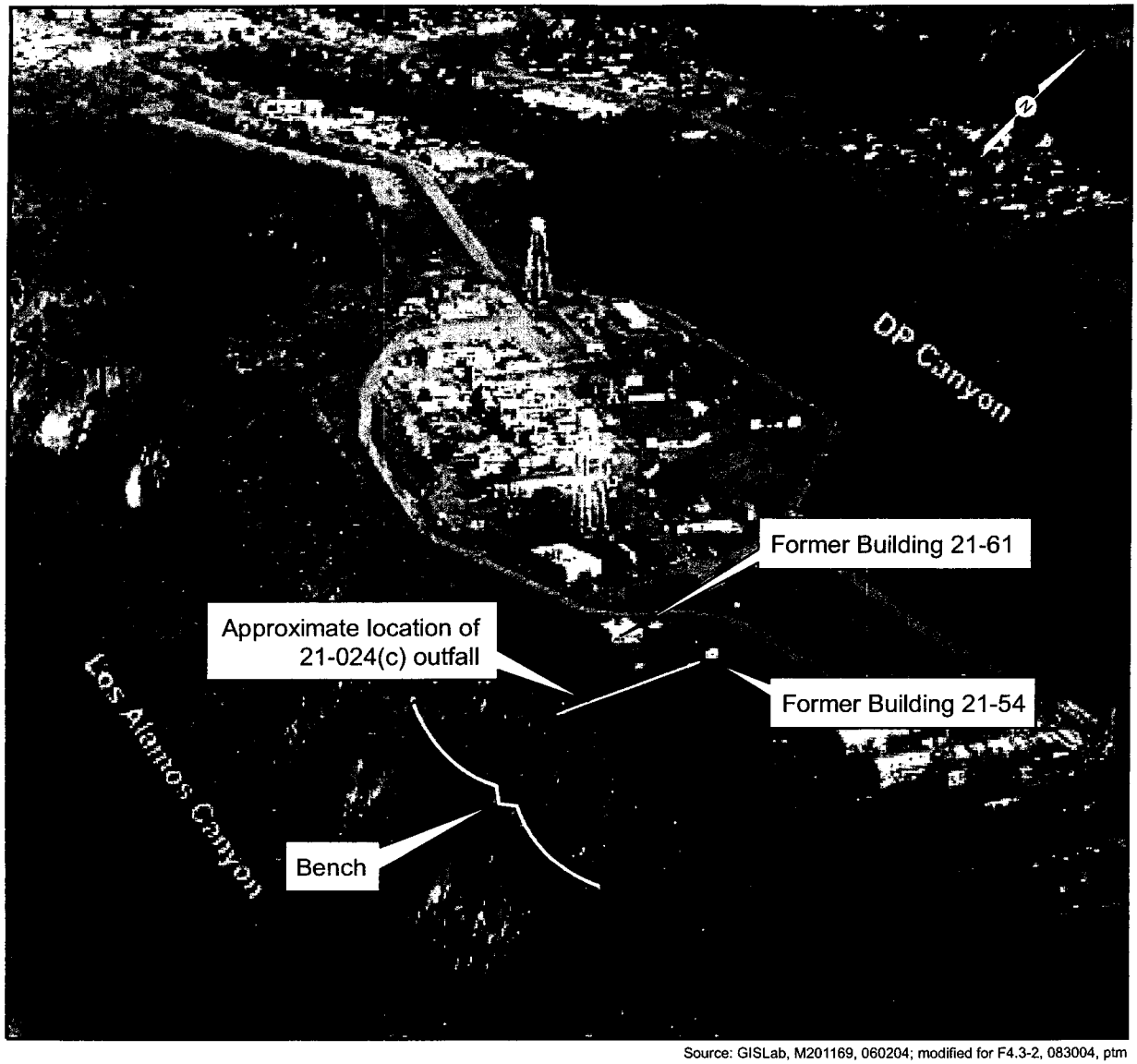
Source: GISLab, M201155, 052604; modified for F4.2-1, 082904, ptm

Figure 4.2-1. SWMU 21-003-99 proposed sample locations



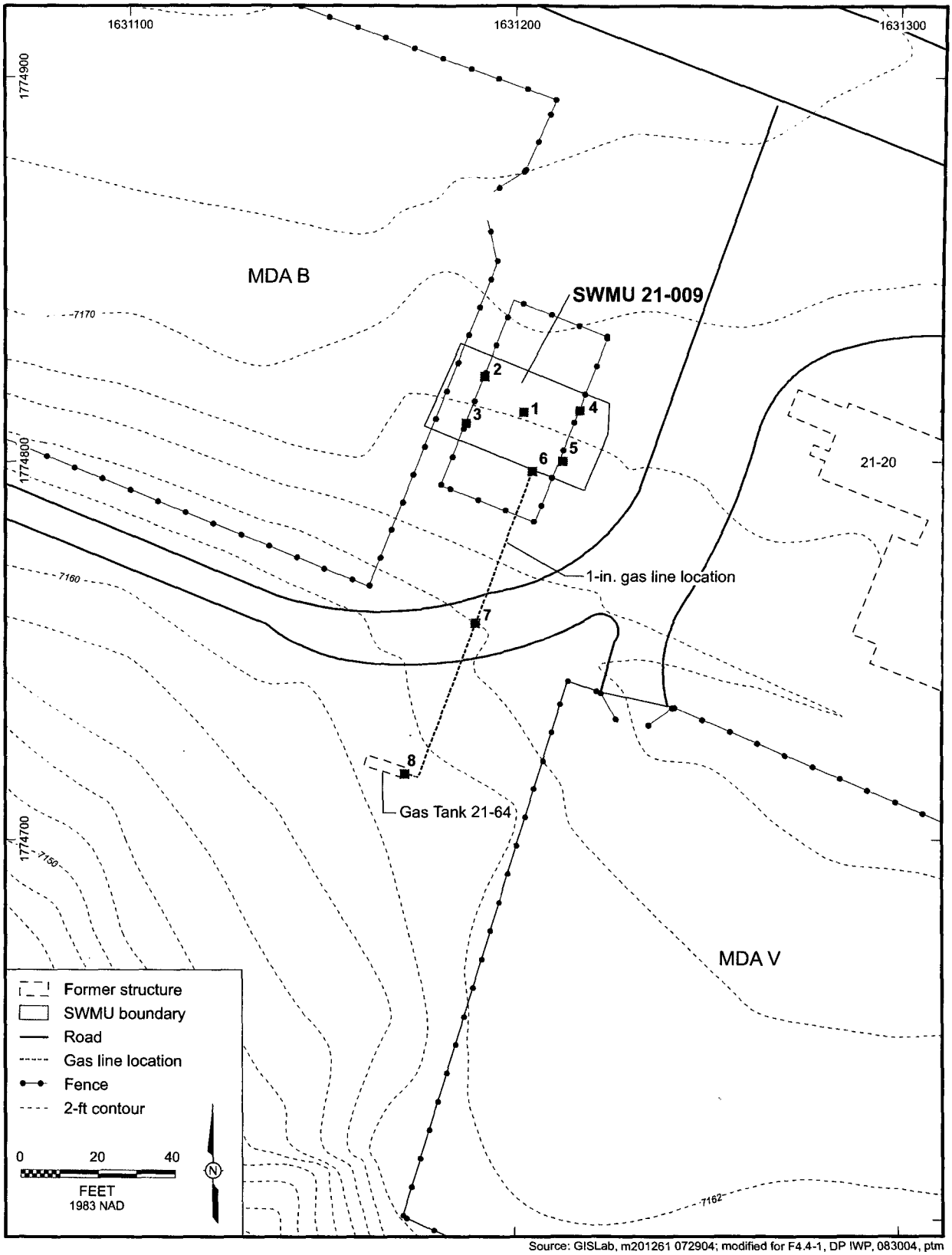
Source: GISLab, M201157, 080904; modified for F4.3-1, 082904, ptm

Figure 4.3-1. SWMU 21-024(c) proposed sample locations



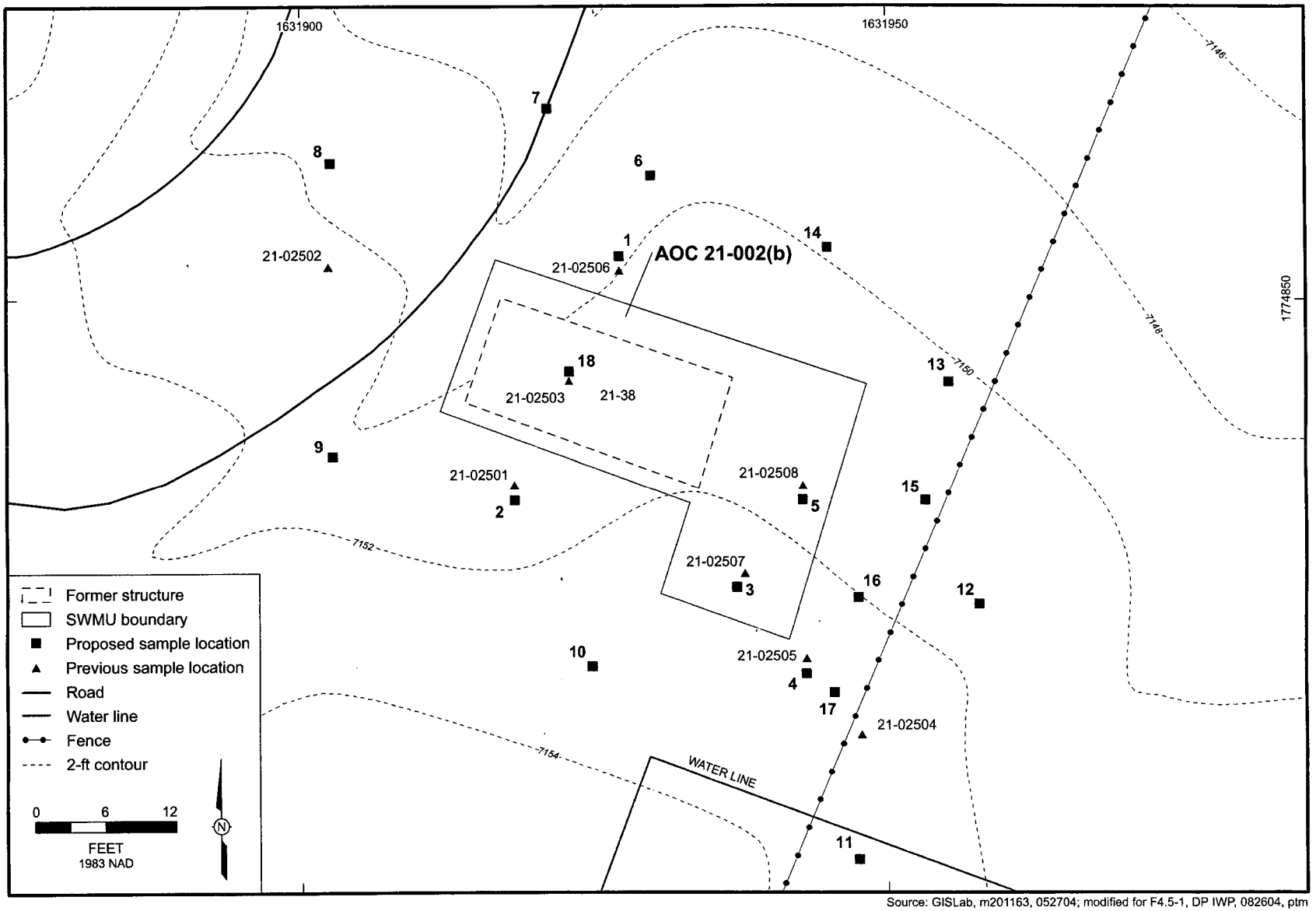
Source: GISLab, M201169, 060204; modified for F4.3-2, 083004, ptm

Figure 4.3-2. SWMU 21-024(c) bench



Source: GISLab, m201261 072904; modified for F4.4-1, DP IWP, 083004, ptm

Figure 4.4-1. SWMU 21-009 proposed sample locations



Source: GISLab, m201163, 052704; modified for F4.5-1, DP IWP, 082604, ptm

Figure 4.5-1. AOC 21-002(b) proposed sample locations

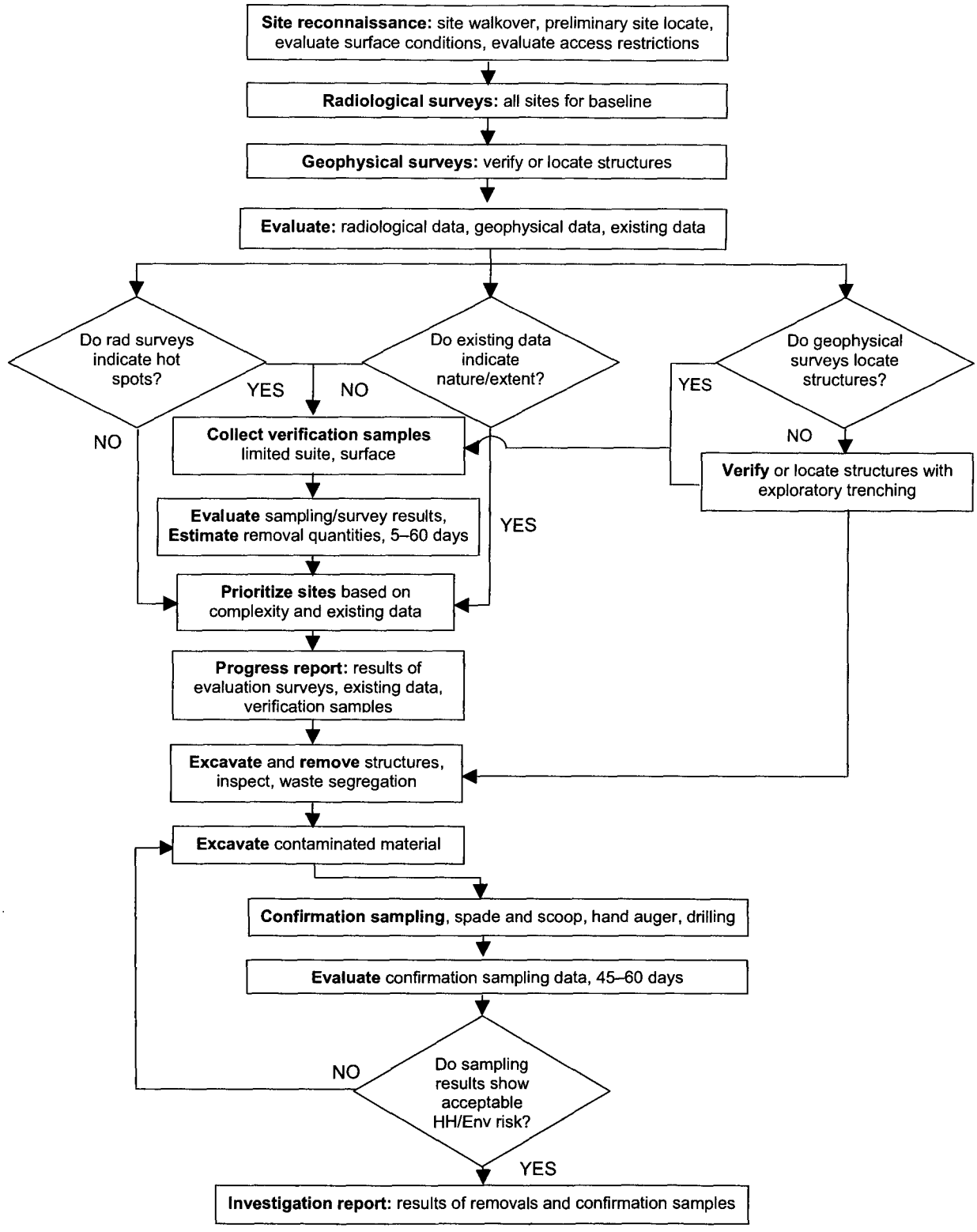


Figure 5.0-1. Decision flowchart for DP Site corrective actions

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Table 1.2-1
SWMUs and AOCs Included in This Work Plan

Consolidation Unit	SWMU/AOC Number	Site Description	HSWA SWMU?	Site in This Work Plan	Site Status
	21-002(b)	Container storage area	No	Yes	Investigation
21-003-99	21-003	Container storage area	Yes	Yes	Investigation
	21-013(f)	Surface disposal site	No	Yes	Investigation
21-006(c)-99	21-006(a)	Seepage pits	Yes	Yes	Corrective action
	21-006(b)	Seepage pits	Yes	Yes	Corrective action
	21-006(c)	Seepage pits	Yes	Yes	Corrective action
	21-006(d)	Seepage pits	Yes	Yes	Corrective action
	21-009	Waste treatment laboratory	No	Yes	Investigation
	21-012(b)	Dry well and system	Yes	Yes	Corrective action
	21-013(c)	Surface disposal area	Yes	Yes	Investigation
21-017(a)-99	21-022(f)	Sump and pipeline	Yes	Yes	Corrective action
21-022(h)-99	21-022(h)	Sump, pipeline, and outfall	Yes	Yes	Corrective action
	21-022(i)	Sump pump	Yes	Yes	Corrective action
	21-022(j)	Sump pump	Yes	Yes	Corrective action
21-023(a)-99	21-023(a)	Septic system, Building 21-3	Yes	Yes	Corrective action
	21-023(b)	Septic system, Building 21-3	Yes	Yes	Corrective action
	21-023(d)	Septic system, Building 21-3	Yes	Yes	Corrective action
	21-024(a)	Septic system	Yes	Yes	Corrective action
	21-024(b)	Septic system	Yes	Yes	Corrective action
	21-024(c)	Septic system	Yes	Yes	Investigation
	21-024(d)	Septic system	Yes	Yes	Corrective action
	21-024(e)	Septic system	Yes	Yes	Corrective action
	21-024(g)	Septic system	Yes	Yes	Corrective action
	21-024(h)	Septic system	Yes	Yes	Corrective action
	21-024(j)	Septic system	Yes	Yes	Corrective action
	21-024(k)	Septic system	Yes	Yes	Corrective action
21-024(l)-99	21-004(a)	Aboveground tank	No	Yes	Corrective action
	21-022(a)	Waste line and sump	Yes	Yes	Corrective action
	21-024(l)	Outfall	Yes	Yes	Corrective action
	21-024(n)	Drainline	Yes	Yes	Corrective action
	21-024(o)	Drainline	Yes	Yes	Corrective action
21-026(a)-99	21-013(a)	Surface disposal area	Yes	Yes	Corrective action
	21-026(a)	Sewage treatment plant	Yes	Yes	Corrective action
	21-026(b)	Sludge drying/sand filter beds	Yes	Yes	Corrective action
	21-026(c)	Dosing siphon chamber	No	Yes	Corrective action
	21-026(d)	Outfall	No	Yes	Corrective action
	21-027(a)	Surface drainage and outfalls	Yes	Yes	Corrective action
	21-027(c)	Pipe and outfall	Yes	Yes	Corrective action

Note: Shading denotes SWMUs/AOCs that are not consolidated.

Table 1.2-2
SWMUs and AOCs Not Included in This Work Plan

Consolidation Unit	SWMU/AOC Number	Site Description	HSWA SWMU?	Site in This Work Plan	Site Status
	21-002(a)	Container storage areas	Yes	No	Other work plans
21-004(b)-99	21-004(b)	Tank and/or associated equipment	Yes	No	Deferred, active site
	21-004(c)	Tank and/or associated equipment	Yes	No	Deferred, active site
21-006(e)-99	21-006(e)	Surface disposal site, Building 21-4	Yes	No	Deferred investigation
	21-006(f)	Disposal pit, Building 21-4	No	No	Deferred investigation
	21-011(b)	Sump	Yes	No	Deferred, active site
	21-011(k)	Outfall	Yes	No	Remedy complete
21-013(d)-99	21-013(d)	Surface disposal site (cold dump)	Yes	No	Remedy complete
	21-013(e)	Surface disposal site	Yes	No	Remedy complete
	21-014	Material disposal area (MDA A)	Yes	No	Other work plan (MDA A)
	21-015	Material disposal area (MDA B)	Yes	No	Other work plan (MDA B)
21-016(a)-99	21-001	Container storage	No	No	Other work plan (MDA T)
	21-007	Incinerators	Yes	No	Other work plan (MDA T)
	21-010(a)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-010(b)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-010(c)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-010(d)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-010(e)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-010(f)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-010(g)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-010(h)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-011(a)	Waste treatment facility	Yes	No	Other work plan (MDA T)
	21-011(c)	Tank and sump	Yes	No	Other work plan (MDA T)
	21-011(d)	Aboveground tank	Yes	No	Other work plan (MDA T)
	21-011(e)	Aboveground tank	Yes	No	Other work plan (MDA T)
	21-011(f)	Aboveground tank	Yes	No	Other work plan (MDA T)
	21-011(g)	Aboveground tank	Yes	No	Other work plan (MDA T)
	21-011(h)	Aboveground tank	No	No	Other work plan (MDA T)
	21-011(i)	Aboveground tank	Yes	No	Other work plan (MDA T)
	21-011(j)	Aboveground tank	Yes	No	Other work plan (MDA T)
	21-016(a)	MDA T	Yes	No	Other work plan (MDA T)
	21-016(b)	MDA T	Yes	No	Other work plan (MDA T)
	21-016(c)	MDA T	Yes	No	Other work plan (MDA T)
	21-028(a)	Container storage	No	No	Other work plan (MDA T)
	C-21-009	One-time spill	No	No	Other work plan (MDA T)
	C-21-012	One-time spill	No	No	Other work plan (MDA T)

Table 1.2-2 (continued)

Consolidation Unit	SWMU/AOC Number	Site Description	HSWA SWMU?	Site in This Work Plan	Site Status
21-017(a)-99	21-017(a)	MDA U	Yes	No	Other work plan (MDA U)
	21-017(b)	MDA U	Yes	No	Other work plan (MDA U)
	21-017(c)	MDA U	Yes	No	Other work plan (MDA U)
21-018(a)-99	21-013(b)	Surface disposal site	Yes	No	Other work plan (MDA V)
	21-013(g)	Surface disposal site	No	No	Other work plan (MDA V)
	21-018(a)	MDA V	Yes	No	Other work plan (MDA V)
	21-018(b)	MDA V laundry facility	Yes	No	Other work plan (MDA V)
	21-023(c)	Septic system	Yes	No	Other work plan (MDA V)
21-021-99	21-021	Systematic release (site -wide)	Yes	No	Investigation complete
21-022(b)-99	21-022(b)	Waste lines, Building 21-2	Yes	No	Deferred investigation
	21-022(c)	Waste lines, Building 21-3	Yes	No	Deferred investigation
	21-022(d)	Waste lines, Building 21-4	Yes	No	Deferred investigation
	21-022(e)	Waste lines, Building 21-5	Yes	No	Deferred investigation
	21-022(g)	Waste lines, Building 21-150	Yes	No	Deferred investigation
	21-024(f)	Septic system	Yes	No	Remedy complete
	21-024(i)	Septic system	Yes	No	Remedy complete
21-027(d)-99	21-027(d)	Drainline	Yes	No	Remedy complete
	21-028(c)	Container storage Building 21-3	No	No	Deferred investigation
	21-030	Sump	No	No	Remedy complete
	C-21-001	One-time spill Building 21-17	No	No	Deferred investigation
	C-21-002	Non-intentional release area	No	No	Other work plan (MDA T)
	C-21-005	One-time spill	No	No	Other work plan (MDA T)
	C-21-006	Non-intentional release area Building 21-2	No	No	Deferred investigation
	C-21-007	Non-intentional release area	No	No	Other work plan (MDA T)
	C-21-027	Machinery	No	No	Remedy complete
	C-21-033	One-time spill	No	No	Other work plan (MDA T)
	C-21-034	Tank	No	No	Other work plan (MDA T)
	C-21-035	Aboveground tank	No	No	Other work plan (MDA T)
	C-21-036	Aboveground tank	No	No	Other work plan (MDA T)
	C-21-037	Aboveground tank	No	No	Other work plan (MDA T)

Note: Shading denotes SWMUs/AOCs that are not consolidated.

Table 1.2-3
SWMUs and AOCs with NFA Decisions

SWMU/AOC Number	HSWA SWMU?	NFA Approval from AA?	ER ID Number of Request or Approval Document
21-004(d)	No	Yes	EPA 2004, 87296
21-005	Yes	Yes	NMED 2001, 70236
21-008	No	Yes	EPA 2004, 87296
21-012(a)	Yes	Yes	NMED 1998, 63042
21-019(a)	No	Yes	EPA 2004, 87296
21-019(b)	No	Yes	EPA 2004, 87296
21-019(c)	No	Yes	EPA 2004, 87296
21-019(d)	No	Yes	EPA 2004, 87296
21-019(e)	No	Yes	EPA 2004, 87296
21-019(f)	No	Yes	EPA 2004, 87296
21-019(g)	No	Yes	EPA 2004, 87296
21-019(h)	No	Yes	EPA 2004, 87296
21-019(i)	No	Yes	EPA 2004, 87296
21-019(j)	No	Yes	EPA 2004, 87296
21-019(k)	No	Yes	EPA 2004, 87296
21-019(l)	No	Yes	EPA 2004, 87296
21-019(m)	No	Yes	EPA 2004, 87296
21-020(a)	No	Yes	EPA 2004, 87296
21-020(b)	No	Yes	EPA 2004, 87296
21-024(m)	Yes	Yes	NMED 1998, 63042
21-025(a)	No	Yes	EPA 2004, 87296
21-025(b)	No	Yes	EPA 2004, 87296
21-027(b)	Yes	Yes	NMED 1998, 63042
21-028(b)	No	Yes	EPA 2004, 87296
21-028(d)	No	Yes	LANL 1992, 21104
21-028(e)	No	Yes	EPA 2004, 87296
21-029	Yes	Pending	NMED 2003, 85615
C-21-003	No	Yes	EPA 2004, 87296
C-21-004	No	Yes	EPA 2004, 87296
C-21-008	No	Yes	EPA 2004, 87296
C-21-010	No	Yes	EPA 2004, 87296
C-21-011	No	Yes	EPA 2004, 87296
C-21-013	No	Yes	EPA 2004, 87296
C-21-014	No	Yes	EPA 2004, 87296
C-21-015	No	Yes	EPA 2004, 87296
C-21-016	No	Yes	EPA 2004, 87296
C-21-017	No	Yes	EPA 2004, 87296

Table 1.2-3 (continued)

SWMU/AOC Number	HSWA SWMU?	NFA Approval from AA?	ER ID Number of Request or Approval Document
C-21-018	No	Yes	EPA 2004, 87296
C-21-019	No	Yes	EPA 2004, 87296
C-21-020	No	Yes	EPA 2004, 87296
C-21-021	No	Yes	EPA 2004, 87296
C-21-022	No	Yes	EPA 2004, 87296
C-21-023	No	Yes	EPA 2004, 87296
C-21-024	No	Yes	EPA 2004, 87296
C-21-025	No	Yes	EPA 2004, 87296
C-21-026	No	Yes	EPA 2004, 87296
C-21-028	No	Yes	EPA 2004, 87296
C-21-029	No	Yes	EPA 2004, 87296
C-21-030	No	Yes	EPA 2004, 87296
C-21-031	No	Yes	EPA 2004, 87296
C-21-032	No	Yes	EPA 2004, 87296

Table 2.3-1
SWMU 21-013(c) 1994/1995 Investigation, Inorganic Chemical Results Above BVs

Sample ID	Location ID	Depth (ft)	Media	Antimony	Cadmium	Calcium	Mercury	Molybdenum	Silver	Strontium	Thallium	Uranium
ALLH Background Value[a]				**0.83**	**0.4**	**6120**	**0.1**	**15.4**	**1**	**na**[b]	**0.73**	**1.82**
Soil Screening Level[c]				**31.3**	**74.1**	**na**	**23**[d]	**391**	**391**	**46900**	**5.16**	**16**[e]
AAB7101	21-01908	0–0.5	ALLH	—[f]	—	—	—	—	—	—	0.85 (U)[g]	2.25 (J)[h]
AAB7102	21-01908	0–2.5	ALLH	—	—	—	—	—	—	—	0.87 (U)	2.14 (J)
AAB7105	21-01909	0–0.5	ALLH	—	—	—	—	—	—	—	0.88 (U)	—
AAB7106	21-01909	0–2.5	ALLH	—	—	—	—	—	—	—	1 (U)	2.13 (J)
AAB7109	21-01910	0–0.5	ALLH	—	—	—	—	—	—	—	0.87 (U)	3.37 (J)
AAB7110	21-01910	0–2.5	ALLH	—	—	9400	—	—	—	—	1.4 (U)	1.84 (J)
AAB7113	21-01911	0–0.5	ALLH	—	—	—	—	—	—	—	1 (U)	1.88 (J)
AAB7114	21-01911	0–2.5	ALLH	—	—	—	—	—	—	—	0.9 (U)	2.71 (J)
AAB7117	21-01912	0–0.5	ALLH	—	—	—	—	—	—	—	1.1 (U)	2.15 (J)
AAB7118	21-01912	0–2.5	ALLH	—	—	—	—	—	—	—	0.89 (U)	2.74 (J)
AAB7121	21-01913	0–0.5	ALLH	—	—	—	—	—	—	—	0.84 (U)	2.96 (J)
AAB7122	21-01913	0–2.5	ALLH	—	—	—	—	—	—	—	0.93 (U)	4.35 (J)
AAB7125	21-01914	0–0.5	ALLH	—	—	—	—	—	—	—	1.8 (U)	2.56 (J)
AAB7126	21-01914	0–2.5	ALLH	—	—	—	—	—	—	—	0.89 (U)	2.78 (J)
AAB7129	21-01915	0–0.5	ALLH	—	—	—	—	—	—	—	0.91 (U)	2.18 (J)
AAB7130	21-01915	0–2.5	ALLH	—	—	—	—	—	—	—	0.91 (U)	1.98 (J)
AAB7133	21-01916	0–0.5	ALLH	—	—	—	—	—	—	—	0.84 (U)	1.85 (J)
AAB7134	21-01916	0–2.5	ALLH	—	—	—	—	—	—	—	0.86 (U)	2.12 (J)
AAB7137	21-01917	0–0.5	ALLH	—	—	—	—	—	—	—	0.85 (U)	2.18 (J)
AAB7138	21-01917	0–2.5	ALLH	—	—	—	—	—	—	—	0.89 (U)	2.28 (J)

Table 2.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Antimony	Cadmium	Calcium	Mercury	Molybdenum	Silver	Strontium	Thallium	Uranium
ALLH Background Value[a]				**0.83**	**0.4**	**6120**	**0.1**	**15.4**	**1**	**na**[b]	**0.73**	**1.82**
Soil Screening Level[c]				**31.3**	**74.1**	**na**	**23**[d]	**391**	**391**	**46900**	**5.16**	**16**[e]
VCXX-95-0037	21-09004	0–0.5	ALLH	8.4 (U)	1 (U)	—	—	4.2 (U)	2.1 (U)	25.0	1 (U)	—
VCXX-95-0038	21-09005	0–0.5	ALLH	8.2 (U)	1 (U)	—	2.6	4.1 (U)	2.0 (U)	20.0	1 (U)	—

Note: Values are in units of mg/kg.

[a] Background values from "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (LANL 1998, 59730).

[b] na = Not available.

[c] Screening levels from "Technical Background Document for Development of Soil Screening Levels, Revision 2.0" (NMED 2004, 85615).

[d] Screening level from "EPA Region 6 Human Health Medium-Specific Screening Levels" (EPA 2003, 81724).

[e] Screening level from "EPA Region 9 PRGs Table," http://www.epa.gov/region09/waste/sfund/prg/files/02table.pdf (EPA 2002, 76866).

[f] — = No value greater than the background value was detected.

[g] U = Undetected.

[h] J = Estimated value.

Table 2.3-2
SWMU 21-013(c) 1994/1995 Investigation, Detected Organic Chemicals

Sample ID	Location ID	Depth (ft)	Media	Acenaphthene	Acetone	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Bis(2-ethylhexyl)phthalate	Chrysene	Di-n-butylphthalate
Soil Screening Level[a]					**70400**	**23500**	**6.21**	**0.621**	**6.21**	**2300**[b]	**347**	**621**	**6000**
AAB7105	21-01909	0–0.5	ALLH	—[c]	—	—	—	—	—	—	1.2	—	—
AAB7106	21-01909	0–2.5	ALLH	2.3	—	—	—	—	—	—	6.4	—	—
AAB7109	21-01910	0–0.5	ALLH	—	—	—	—	—	—	—	1.3	—	—
AAB7110	21-01910	0–2.5	ALLH	—	—	—	—	—	—	—	0.5	—	—
AAB7114	21-01911	0–2.5	ALLH	—	—	—	—	—	—	—	6.5	—	—
AAB7121	21-01913	0–0.5	ALLH	0.4	—	0.57 (J)[d]	1.1	1	1.5	0.42	—	1.1	—
AAB7122	21-01913	0–2.5	ALLH	—	—	—	—	—	—	—	0.53	—	—
AAB7125	21-01914	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—
AAB7126	21-01914	0–2.5	ALLH	—	—	—	—	—	—	—	1.3	—	—
AAB7129	21-01915	0–0.5	ALLH	—	—	—	—	—	—	—	2.9	—	—
AAB7130	21-01915	0–2.5	ALLH	—	—	—	—	—	—	—	1	—	—
AAB7133	21-01916	0–0.5	ALLH	—	—	—	—	—	—	—	—	—	—
AAB7134	21-01916	0–2.5	ALLH	—	—	—	—	—	—	—	2.4	—	—
AAB7138	21-01917	0–2.5	ALLH	—	—	—	—	—	—	—	0.94	—	—
VCXX-95-0037	21-09004	0–0.5	ALLH	—	0.01	—	—	—	—	—	—	—	—
VCXX-95-0038	21-09005	0–0.5	ALLH	—	0.01	—	0.19 (J)	0.22 (J)	0.32 (J)	0.14 (J)	—	0.21 (J)	0.18 (J)

Table 2.3-2 (continued)

Sample ID	Location ID	Depth (ft)	Media	2,4-Dinitrotoluene	Fluoranthene	Indeno(1,2,3-cd)pyrene	Methylene Chloride	4-Nitrophenol	Pentachlorophenol	Phenanthrene	Pyrene	Toluene
Soil Screening Level[a]				**120**	**2250**	**6.21**	**165**	**490[e]**	**29.8**	**1800**	**2300**	**248**
AAB7105	21-01909	0–0.5	ALLH	—	—	—	—	—	—	—	—	—
AAB7106	21-01909	0–2.5	ALLH	3.3	—	—	—	4.2	3.6	—	2.8	—
AAB7109	21-01910	0–0.5	ALLH	—	—	—	—	—	—	—	—	—
AAB7110	21-01910	0–2.5	ALLH	—	—	—	—	—	—	—	—	—
AAB7114	21-01911	0–2.5	ALLH	—	—	—	—	—	—	—	—	—
AAB7121	21-01913	0–0.5	ALLH	—	3.0	0.42	—	—	—	2.6	3.3	—
AAB7122	21-01913	0–2.5	ALLH	—	—	—	—	—	—	—	—	—
AAB7125	21-01914	0–0.5	ALLH	—	—	—	—	—	—	—	—	0.01
AAB7126	21-01914	0–2.5	ALLH	—	—	—	—	—	—	—	—	—
AAB7129	21-01915	0–0.5	ALLH	—	—	—	—	—	—	—	0.48	—
AAB7130	21-01915	0–2.5	ALLH	—	—	—	—	—	—	—	—	—
AAB7133	21-01916	0–0.5	ALLH	—	—	—	—	—	—	—	0.36	—
AAB7134	21-01916	0–2.5	ALLH	—	—	—	—	—	—	—	—	—
AAB7138	21-01917	0–2.5	ALLH	—	—	—	—	—	—	—	—	—
VCXX-95-0037	21-09004	0–0.5	ALLH	—	—	—	0.005 (J)	—	—	—	—	—
VCXX-95-0038	21-09005	0–0.5	ALLH	—	0.41	0.11 (J)	—	—	—	0.15 (J)	—	—

Note: Values are in units of mg/kg.

[a] Screening levels from "Technical Background Document for Development of Soil Screening Levels, Revision 2.0" (NMED 2004, 85615).

[b] Soil screening level for pyrene was used as a surrogate for benzo(g,h,i)perylene (LANL 2002, 72639).

[c] — = No value was detected greater than the estimated quantitation limit.

[d] J = Estimated value.

[e] Screening level from "EPA Region 6 Human Health Medium-Specific Screening Levels" (EPA 2003, 81724).

Table 2.3-3
SWMU 21-013(c) 1994/1995 Investigation, Radionuclides Greater than BVs or FVs

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Plutonium-238	Plutonium-239	Strontium-90	Tritium	Uranium-235
ALLH Background Value[a]				**0.013**	**0.023**	**0.054**	**1.31**	**0.766**	**0.2**
Screening Action Level[b]				**39**	**49**	**44**	**5.7**	**890**	**17**
AAB7101	21-01908	0–0.5	ALLH	—[c]	—	—	—	0.06 (J)[d]	—
AAB7102	21-01908	0–2.5	ALLH	—	—	0.05	—	0.08 (J)	—
AAB7105	21-01909	0–0.5	ALLH	—	—	—	—	0.16 (J)	—
AAB7106	21-01909	0–2.5	ALLH	—	—	0.06	0.56 (J)	0.14 (J)	0.22
AAB7109	21-01910	0–0.5	ALLH	—	—	0.09	—	—	—
AAB7110	21-01910	0–2.5	ALLH	—	—	—	—	0.1 (J)	—
AAB7113	21-01911	0–0.5	ALLH	—	—	—	—	0.29 (J)	—
AAB7114	21-01911	0–2.5	ALLH	—	—	0.09	—	0.23 (J)	—
AAB7117	21-01912	0–0.5	ALLH	—	—	0.09	—	0.19 (J)	0.27
AAB7118	21-01912	0–2.5	ALLH	—	—	0.02	—	0.1 (J)	—
AAB7121	21-01913	0–0.5	ALLH	—	—	0.22	—	0.08 (J)	—
AAB7122	21-01913	0–2.5	ALLH	—	—	—	—	0.2 (J)	—
AAB7125	21-01914	0–0.5	ALLH	—	—	—	—	0.16 (J)	0.22
AAB7126	21-01914	0–2.5	ALLH	—	—	—	0.59 (J)	0.17 (J)	—
AAB7129	21-01915	0–0.5	ALLH	—	—	0.16	—	0.19 (J)	—
AAB7130	21-01915	0–2.5	ALLH	—	—	—	—	0.19 (J)	—
AAB7133	21-01916	0–0.5	ALLH	—	—	0.07	—	0.17 (J)	—
AAB7134	21-01916	0–2.5	ALLH	—	—	0.01	—	0.1(J)	—
AAB7137	21-01917	0–0.5	ALLH	—	—	0.22	—	0.15 (J)	—
AAB7138	21-01917	0–2.5	ALLH	—	—	0.01	—	0.25 (J)	0.21
VCXX-95-0037	21-09004	0–0.5	ALLH	0.2	0.69	—	—	0.67	—
VCXX-95-0038	21-09005	0–0.5	ALLH	0.2	—	—	—	0.84	—

Note: Values are in units of pCi/g.

[a] Background values from "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (LANL 1998, 59730). Fallout values apply to the 0 to 0.5 ft depth interval only.

[b] Screening levels from "Updates to the Radionuclide Screening Action Levels (SALs) based on RESRAD 6.21" (LANL 2002, 73705).

[c] — = No value greater than the fallout value was detected.

[d] J = Estimated value.

Table 2.3-4
SWMU 21-003-99 1994 Investigation, Inorganic Chemical Results Above BV

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Antimony	Beryllium	Cadmium	Calcium	Copper	Iron
ALLH/Fill Background Value[a]				**29200**	**0.83**	**1.83**	**0.4**	**6120**	**14.7**	**21500**
Soil Screening Level[b]				**77800**	**31.3**	**156**	**74.1**	**na[c]**	**3130**	**23500**
AAB8961	21-01884	0–0.5	ALLH	—[d]	—	—	—	—	118	—
AAB8966	21-01885	0–0.5	ALLH	—	—	—	—	—	17.8	—
AAB8971	21-01886	0–0.5	ALLH	—	—	—	—	—	21.2	—
AAB8976	21-01887	0–0.5	ALLH	—	—	—	—	—	—	—
AAB8981	21-01888	0–0.5	ALLH	—	—	—	—	—	—	—
AAB8983	21-01888	1–1.5	ALLH	—	—	—	—	—	—	—
AAB8986	21-01889	0–0.5	ALLH	—	—	—	0.47 (U)[e]	6740	16.8	—
AAB8991	21-01890	0–0.5	ALLH	—	—	—	—	—	—	—
AAB8996	21-01891	0–0.5	ALLH	—	—	—	—	7150	—	—
AAB8998	21-01891	1–1.5	ALLH	—	—	—	—	—	—	—
AAB9001	21-01892	0–0.5	ALLH	—	—	—	—	—	—	—
AAB9003	21-01892	1–1.5	ALLH	—	—	—	—	—	—	—
AAB9005	21-01892	1.5–2	ALLH	—	—	—	—	—	—	—
AAC0158	21-02126	0–0.5	ALLH	—	—	—	0.52 (U)	—	—	—
AAC0159	21-02127	0–0.5	ALLH	—	—	—	0.82 (U)	—	38.9	—
AAC0166	21-02134	0–0.5	ALLH	—	41.4	—	0.67 (U)	—	25.7	—
AAC0169	21-02137	0–0.5	ALLH	—	1.5 (U)	—	0.41 (U)	—	—	—
AAC0174	21-02142	0–0.5	ALLH	—	—	—	0.47 (U)	—	17.3	—
AAC0175	21-02143	0–0.5	Fill	—	—	—	0.59 (U)	26100	—	—
AAC0177	21-02145	0–0.5	ALLH	—	—	—	0.51 (U)	—	—	—
AAC0179	21-02147	0–0.5	ALLH	—	—	—	0.42 (U)	—	—	—
AAC0180	21-02148	0–0.5	ALLH	—	2.2 (U)	—	—	—	—	—
AAC0181	21-02149	0–0.5	ALLH	—	—	—	0.55 (U)	—	—	—
AAC0184	21-02152	0–0.5	ALLH	—	—	—	—	—	—	—
AAC0186	21-02154	0–0.5	ALLH	—	0.89 (U)	—	0.99 (U)	—	16.3	—
AAC0187	21-02467	0–0.5	ALLH	—	—	—	0.53 (U)	—	17.3	—
AAC0189	21-02469	0–0.5	ALLH	—	—	—	0.45 (U)	—	—	—
AAC0190	21-02470	0–0.5	ALLH	—	—	—	0.62 (U)	—	—	—
AAC0523	21-02487	0–0.5	ALLH	—	—	—	—	—	—	—
AAC0531	21-02495	0–0.5	ALLH	—	—	—	—	—	—	—
AAC0532	21-02496	0–0.5	ALLH	33700 (J)[f]	—	2.1	0.6 (U)	—	—	21900
AAC0533	21-02497	0–0.5	ALLH	—	—	—	1.3	—	17.4	—
AAC0534	21-02498	0–0.5	ALLH	—	—	—	—	—	15.4	—

Table 2.3-4 (continued)

Sample ID	Location ID	Depth (ft)	Media	Lead	Magnesium	Mercury	Potassium	Thallium	Uranium	Zinc
ALLH/Fill Background Value[a]				**22.3**	**4610**	**0.1**	**3460**	**0.73**	**1.82**	**48.8**
Soil Screening Level[b]				**400**	**na**	**23[g]**	**na**	**5.16**	**16[h]**	**23500**
AAB8961	21-01884	0–0.5	ALLH	30.6	—	0.11 (UJ)[i]	—	0.87 (U)	4.01 (J)	109
AAB8966	21-01885	0–0.5	ALLH	—	—	0.11 (UJ)	—	2.6	3.66 (J)	52.6
AAB8971	21-01886	0–0.5	ALLH	43.7	—	0.24 (J)	—	0.87 (U)	4.22 (J)	72.7
AAB8976	21-01887	0–0.5	ALLH	—	—	—	—	0.85 (U)	—	—
AAB8981	21-01888	0–0.5	ALLH	—	—	—	—	0.84 (U)	2.09 (J)	—
AAB8983	21-01888	1–1.5	ALLH	—	—	—	—	0.87 (U)	—	—
AAB8986	21-01889	0–0.5	ALLH	37.2	—	—	—	0.88 (U)	7.66 (J)	86.7
AAB8991	21-01890	0–0.5	ALLH	—	—	—	—	0.84 (U)	2.04 (J)	—
AAB8996	21-01891	0–0.5	ALLH	—	—	—	—	0.85 (U)	—	54.5
AAB8998	21-01891	1–1.5	ALLH	—	—	—	—	0.88 (U)	—	—
AAB9001	21-01892	0–0.5	ALLH	—	—	0.32 (J)	—	0.84 (U)	—	—
AAB9003	21-01892	1–1.5	ALLH	—	—	0.37 (J)	—	0.85 (U)	1.88 (J)	—
AAB9005	21-01892	1.5–2	ALLH	—	—	0.21 (J)	—	0.85 (U)	1.85 (J)	—
AAC0158	21-02126	0–0.5	ALLH	—	—	—	3520 (J)	0.87 (U)	2.35 (J)	122
AAC0159	21-02127*	0–0.5	ALLH	33.7	—	—	—	0.86 (U)	4.05 (J)	140
AAC0166	21-02134	0–0.5	ALLH	38.8	—	—	—	0.83 (U)	4.12 (J)	218
AAC0169	21-02137	0–0.5	ALLH	28.6	—	—	—	0.84 (U)	2.28 (J)	—
AAC0174	21-02142	0–0.5	ALLH	30.6	—	—	—	0.84 (U)	2.73 (J)	80.6
AAC0175	21-02143	0–0.5	Fill	22.5	—	—	—	0.9 (U)	2.36 (J)	—
AAC0177	21-02145	0–0.5	ALLH	29.1	—	—	—	0.84 (U)	2.34 (J)	62.4
AAC0179	21-02147	0–0.5	ALLH	—	—	—	—	0.83 (U)	1.93 (J)	—
AAC0180	21-02148	0–0.5	ALLH	—	—	—	—	0.83 (U)	—	—
AAC0181	21-02149	0–0.5	ALLH	—	—	—	—	0.83 (U)	1.94 (J)	—
AAC0184	21-02152	0–0.5	ALLH	—	—	—	—	0.86 (U)	2.24 (J)	—
AAC0186	21-02154	0–0.5	ALLH	130	—	—	—	0.85 (U)	3.99 (J)	237
AAC0187	21-02467	0–0.5	ALLH	27.9	—	—	—	0.84 (U)	3.31 (J)	84.3
AAC0189	21-02469	0–0.5	ALLH	—	—	—	—	0.83 (U)	4.62 (J)	—
AAC0190	21-02470	0–0.5	ALLH	—	—	—	—	0.83 (U)	18 (J)	52.7
AAC0523	21-02487	0–0.5	ALLH	—	—	—	—	0.83 (U)	—	—
AAC0531	21-02495	0–0.5	ALLH	—	—	—	—	0.83 (U)	—	—
AAC0532	21-02496	0–0.5	ALLH	—	4740	—	4190 (J)	0.93 (U)	1.84 (J)	53.5

Table 2.3-4 (continued)

Sample ID	Location ID	Depth (ft)	Media	Lead	Magnesium	Mercury	Potassium	Thallium	Uranium	Zinc
ALLH/Fill Background Value[a]				**22.3**	**4610**	**0.1**	**3460**	**0.73**	**1.82**	**48.8**
Soil Screening Level[b]				**400**	**na**	**23[g]**	**na**	**5.16**	**16[h]**	**23500**
AAC0533	21-02497	0–0.5	ALLH	60.5	—	—	—	0.83 (U)	2.67 (J)	88.9
AAC0534	21-02498	0–0.5	ALLH	29.3	—	—	—	0.85 (U)	19.3 (J)	65.3

Note: Values are in units of mg/kg.

[a] Background values from "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (LANL 1998, 59730).

[b] Screening levels from "Technical Background Document for Development of Soil Screening Levels, Revision 2.0" (NMED 2004, 85615).

[c] na = Not available.

[d] — = No value greater than the background value was detected.

[e] U = Undetected.

[f] J = Estimated value.

[g] Screening level from "EPA Region 6 Human Health Medium-Specific Screening Levels" (EPA 2003, 81724).

[h] Screening level from "EPA Region 9 PRGs Table," http://www.epa.gov/region09/waste/sfund/prg/files/02table.pdf. (EPA 2002, 76866).

[i] UJ = Undetected, estimated value.

Table 2.3-5
SWMU 21-003-99 1994 Investigation, Detected Organic Chemicals

Sample ID	Location ID	Depth (ft)	Media	Acetone	Aroclor-1260	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Bis(2-ethylhexyl)phthalate	Chrysene
Soil Screening Level[a]				**70400**	**2.22**	**6.21**	**2300[b]**	**62.1**	**347**	**621**
AAB8971	21-01886	0–0.5	ALLH	—[c]	—	—	—	—	—	—
AAB8986	21-01889	0–0.5	ALLH	0.07 (J)[d]	—	—	—	—	—	—
AAB8991	21-01890	0–0.5	ALLH	—	—	—	—	—	0.41	—
AAB9001	21-01892	0–0.5	ALLH	—	—	—	—	—	—	—
AAC0158	21-02126	0–0.5	ALLH	—	0.6	—	—	—	—	—
AAC0159	21-02127	0–0.5	ALLH	—	17	—	—	—	—	—
AAC0166	21-02134	0–0.5	ALLH	—	2.3	—	—	—	—	—
AAC0169	21-02137	0–0.5	ALLH	—	3.3	—	—	—	—	—
AAC0174	21-02142	0–0.5	ALLH	—	1.1	—	—	—	—	—
AAC0175	21-02143	0–0.5	Fill	—	0.91	0.45	—	—	—	—
AAC0177	21-02145	0–0.5	ALLH	—	—	—	—	—	—	—
AAC0179	21-02147	0–0.5	ALLH	—	0.35	—	—	—	—	—
AAC0180	21-02148	0–0.5	ALLH	—	—	—	—	—	—	—
AAC0181	21-02149	0–0.5	ALLH	—	0.64	—	—	—	—	—
AAC0184	21-02152	0–0.5	ALLH	—	0.56	—	—	—	62	—
AAC0186	21-02154	0–0.5	ALLH	—	—	—	—	—	—	—
AAC0187	21-02467	0–0.5	ALLH	—	0.08	1.3	0.5	0.54	—	1.2
AAC0189	21-02469	0–0.5	ALLH	—	0.72	—	—	—	—	—
AAC0190	21-02470	0–0.5	ALLH	—	1	—	—	—	—	—
AAC0523	21-02487	0–0.5	ALLH	—	1	—	—	—	—	—
AAC0531	21-02495	0–0.5	ALLH	—	0.24	—	—	—	—	—
AAC0532	21-02496	0–0.5	ALLH	—	0.07	—	—	—	—	—
AAC0533	21-02497	0–0.5	ALLH	—	0.15	—	—	—	—	—
AAC0534	21-02498	0–0.5	ALLH	—	0.51	—	—	—	—	—

Table 2.3-5 (continued)

Sample ID	Location ID	Depth (ft)	Media	Di-n-octylphthalate	Fluoranthene	Indeno(1,2,3-cd)pyrene	4-Isopropyltoluene	Phenanthrene	Pyrene	Toluene
Soil Screening Level[a]				**1200[e]**	**2250**	**6.21**	**700[f]**	**1800**	**2300**	**248**
AAB8971	21-01886	0–0.5	ALLH	—	—	—	—	—	0.43 (J)	—
AAB8986	21-01889	0–0.5	ALLH	—	—	—	—	—	—	0.05 (J)
AAB8991	21-01890	0–0.5	ALLH	—	—	—	—	—	—	0.01
AAB9001	21-01892	0–0.5	ALLH	—	—	—	—	—	—	0.01
AAC0158	21-02126	0–0.5	ALLH	—	—	—	—	—	—	0.03 (J)
AAC0159	21-02127	0–0.5	ALLH	—	—	—	—	—	—	0.02 (J)
AAC0166	21-02134	0–0.5	ALLH	—	—	—	—	—	—	0.07 (J)
AAC0169	21-02137	0–0.5	ALLH	—	—	—	0.03 (J)	—	—	0.01 (J)
AAC0174	21-02142	0–0.5	ALLH	—	—	—	0.01 (J)	—	—	0.02 (J)
AAC0175	21-02143	0–0.5	Fill	—	—	—	—	—	—	0.03 (J)
AAC0177	21-02145	0–0.5	ALLH	—	—	—	0.01 (J)	—	—	0.05 (J)
AAC0179	21-02147	0–0.5	ALLH	—	—	—	—	—	—	0.01 (J)
AAC0180	21-02148	0–0.5	ALLH	—	—	—	—	—	—	0.01
AAC0181	21-02149	0–0.5	ALLH	—	—	—	—	—	—	0.01
AAC0184	21-02152	0–0.5	ALLH	0.56	—	—	—	—	—	0.04 (J)
AAC0186	21-02154	0–0.5	ALLH	—	—	—	—	—	—	0.03 (J)
AAC0187	21-02467	0–0.5	ALLH	—	0.88	0.54	—	0.5	0.8	0.01 (J)
AAC0189	21-02469	0–0.5	ALLH	—	—	—	—	—	—	0.04 (J)
AAC0190	21-02470	0–0.5	ALLH	—	—	—	—	—	—	0.02
AAC0523	21-02487	0–0.5	ALLH	—	—	—	0.01 (J)	—	—	0.08 (J)
AAC0531	21-02495	0–0.5	ALLH	—	—	—	—	—	—	0.01
AAC0532	21-02496	0–0.5	ALLH	—	—	—	—	—	—	0.01 (J)
AAC0533	21-02497	0–0.5	ALLH	—	—	—	—	—	—	0.03
AAC0534	21-02498	0–0.5	ALLH	—	—	—	—	—	—	0.01

Note: Values are in units of mg/kg.

[a] Screening levels from "Technical Background Document for Development of Soil Screening Levels, Revision 2.0" (NMED 2004, 85615).

[b] Soil screening level for pyrene was used as a surrogate for benzo(g,h,i)perylene (LANL 2002, 72639).

[c] — = No value greater than the estimated quantitation limit was detected.

[d] J = Estimated value.

[e] Screening level from "EPA Region 6 Human Health Medium-Specific Screening Levels" (EPA 2003, 81724).

[f] Soil screening level for cumene (isopropylbenzene) was used as a surrogate for 4-isopropyltoluene (LANL 2002, 72639).

Table 2.3-6
SWMU 21-003-99 1994 Investigation, Radionuclides Greater than BVs or FVs

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-134	Cesium-137	Cobalt-60	Plutonium-238	Plutonium-239	Strontium-90	Tritium	Uranium-235
ALLH/Fill Fallout/Background Value[a]				**0.013**	**na**[b]	**1.65**	**na**	**0.023**	**0.054**	**1.31**	**na**	**0.2**
Screening Action Level[c]				**39**	**320**	**5.3**	**1.2**	**49**	**44**	**5.7**	**890**	**17**
AAB8961	21-01884	0–0.5	ALLH	—[d]	—	—	—	0.07	2.55	4.72 (J)[e]	0.09 (J)	0.28
AAB8966	21-01885	0–0.5	ALLH	—	0.06	—	—	0.22	2.45	—	0.51 (J)	—
AAB8971	21-01886	0–0.5	ALLH	—	—	—	—	0.08	2.36	—	0.25 (J)	0.33
AAB8976	21-01887	0–0.5	ALLH	—	—	—	—	0.08	—	—	0.03 (J)	—
AAB8981	21-01888	0–0.5	ALLH	—	—	—	—	0.05	1.09	—	0.07 (J)	—
AAB8983	21-01888	1–1.5	ALLH	—	—	—	—	0.05	0.15	—	0.04 (J)	—
AAB8986	21-01889	0–0.5	ALLH	0.84	—	3.05	—	0.16	10.6	—	0.43 (J)	—
AAB8991	21-01890	0–0.5	ALLH	—	—	—	—	0.13	0.8	—	0.03 (J)	0.29
AAB8996	21-01891	0–0.5	ALLH	—	—	—	—	0.07	0.47	—	0.12 (J)	—
AAB8998	21-01891	1–1.5	ALLH	—	—	0.17	—	0.05	0.07	1.84 (J)	2.93 (J)	—
AAB9001	21-01892	0–0.5	ALLH	—	—	—	—	0.06	0.36	—	0.23 (J)	—
AAB9003	21-01892	1–1.5	ALLH	—	—	—	—	0.12	0.07	1.09 (J)	0.1 (J)	—
AAB9005	21-01892	1.5–2	ALLH	—	—	—	—	0.03 (J)	0.11 (J)	—	0.12 (J)	—
AAC0158	21-02126	0–0.5	ALLH	—	—	—	—	0.07	—	—	0.13 (J)	—
AAC0159	21-02127	0–0.5	ALLH	—	—	—	—	0.12	0.47	—	0.24 (J)	—
AAC0166	21-02134	0–0.5	ALLH	—	—	—	—	0.14	0.49	—	0.06 (J)	0.22
AAC0169	21-02137	0–0.5	ALLH	—	—	—	—	0.11	0.15	—	0.04 (J)	—
AAC0174	21-02142	0–0.5	ALLH	—	—	—	—	0.13	0.52	—	0.07 (J)	—
AAC0175	21-02143	0–0.5	Fill	—	—	—	—	0.12	0.41	—	0.12 (J)	—
AAC0177	21-02145	0–0.5	ALLH	—	—	—	—	0.13	0.56	—	0.07 (J)	—

Table 2.3-6 (continued)

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-134	Cesium-137	Cobalt-60	Plutonium-238	Plutonium-239	Strontium-90	Tritium	Uranium-235
ALLH/Fill Fallout/Background Value[a]				**0.013**	**na[b]**	**1.65**	**na**	**0.023**	**0.054**	**1.31**	**na**	**0.2**
Screening Action Level[c]				**39**	**320**	**5.3**	**1.2**	**49**	**44**	**5.7**	**890**	**17**
AAC0179	21-02147	0–0.5	ALLH	—	—	—	—	0.15	0.36	—	0.05 (J)	—
AAC0180	21-02148	0–0.5	ALLH	—	—	—	—	0.12	0.18	—	0.02 (J)	—
AAC0181	21-02149	0–0.5	ALLH	—	—	—	0.06	0.18	0.1	—	—	—
AAC0184	21-02152	0–0.5	ALLH	—	—	—	—	0.16	0.06	—	0.07 (J)	—
AAC0186	21-02154	0–0.5	ALLH	—	—	—	—	0.18	2.79	—	0.3 (J)	0.27
AAC0187	21-02467	0–0.5	ALLH	—	—	—	—	0.14	0.92	—	0.07 (J)	—
AAC0189	21-02469	0–0.5	ALLH	—	—	—	—	0.12	1.36	—	0.06 (J)	—
AAC0190	21-02470	0–0.5	ALLH	—	—	—	—	0.09	0.12	—	—	0.54
AAC0523	21-02487	0–0.5	ALLH	—	—	—	—	0.12	0.2	—	0.04 (J)	—
AAC0531	21-02495	0–0.5	ALLH	—	—	—	—	0.11	0.06	—	0.03 (J)	—
AAC0532	21-02496	0–0.5	ALLH	—	—	—	—	0.15	0.59	—	0.11 (J)	—
AAC0533	21-02497	0–0.5	ALLH	—	—	—	—	0.09	1.25	—	0.04 (J)	—
AAC0534	21-02498	0–0.5	ALLH	—	—	—	—	0.05	0.15	—	0.2 (J)	—

Note: Values are in units of pCi/g.

[a] Fallout/background values from "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (LANL 1998, 59730). Fallout values apply to the 0 to 0.5 ft depth interval only.

[b] na = Not available.

[c] Screening levels from "Updates to the Radionuclide Screening Action Levels (SALs) based on RESRAD 6.21" (LANL 2002, 73705).

[d] — = No value greater than the fallout/background value was detected.

[e] J = Estimated value.

Table 2.3-7
SWMU 21-024(c) 1992/1993 Investigation, Inorganic Chemical Results Above BVs

Sample ID	Location ID	Depth (ft)	Media	Antimony	Arsenic	Cadmium	Calcium	Chromium	Copper	Lead	Lithium	Magnesium	Molybdenum	Nickel	Selenium	Silver	Strontium	Vanadium	Zinc
ALLH/Fill Background Value[a]				**0.83**	**8.17**	**0.4**	**6120**	**19.3**	**14.7**	**22.3**	**na[b]**	**4610**	**na**	**15.4**	**1.52**	**1**	**na**	**39.6**	**48.8**
Qbt 2,3,4 Background Value[a]				**0.5**	**2.79**	**1.63**	**2200**	**7.14**	**4.66**	**11.2**	**na**	**1690**	**na**	**6.58**	**0.3**	**1**	**na**	**17**	**63.5**
Soil Screening Levels[c]				**31.3**	**3.9**	**74.1**	**na**	**2100[d]**	**3130**	**400**	**1600[d]**	**na**	**391**	**1560**	**391**	**391**	**46900**	**548**	**23500**
AAA0753	21-01391	0–0.5	ALLH	29.5	8.2	3.8	—[e]	415	1520	2300	3.8	—	20.1	43.7	—	105	39.1	53.6	122
AAA0756	21-01391	0.5–1	ALLH	5.2 (U)[f]	10	5.3	—	52.7	687	571	12.6	—	2.8	17	—	14.6	22.1	—	201
AAA0757	21-01392	0–0.5	ALLH	7.3	—	2.4	—	44.4	120	320	5	—	2.3 (U)	—	—	3.9	32.1	—	142
AAA0759	21-01392	0.5–1	ALLH	4.7 (U)	—	1.2	—	—	—	29.8	7.6	—	2.2 (U)	—	—	—	15.8	—	—
AAA4114	21-01669	0–5	Fill	—	—	1.2 (U)	14100	—	—	—	17.5	5720	7 (U)	—	—	1.2 (U)	67	—	—
AAA4115	21-01669	6–10	Qbt 3	—	—	—	—	—	—	—	4.2 (U)	—	6 (U)	—	0.42 (U)	—	13.6 (U)	—	—
AAA4116	21-01669	10–15	Qbt 3	—	—	—	—	—	—	—	1.7 (U)	—	6.1 (U)	—	0.42 (UJ)[g]	—	0.72 (U)	—	—
AAA4117	21-01669	15–20	Qbt 3	—	—	—	—	—	—	—	3 (U)	—	6.1 (U)	—	0.42 (UJ)	—	0.49 (U)	—	—

Note: Values are in units of mg/kg.

[a] Background values from "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (LANL 1998, 59730).

[b] na = Not available.

[c] Screening levels from "Technical Background Document for Development of Soil Screening Levels, Revision 2.0" (NMED 2004, 85615).

[d] "Screening level from EPA Region 6 Human Health Medium-Specific Screening Levels" (EPA 2003, 81724).

[e] — = No value greater than the background value was detected.

[f] U = Undetected.

[g] UJ = Undetected, estimated value.

Table 2.3-8
SWMU 21-024(c) 1994 Investigation, Radionuclides Greater than BVs or FVs

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Plutonium-238	Plutonium-239	Tritium
ALLH/Fill Fallout Value[a]				**0.013**	**0.023**	**0.054**	**na[b]**
Qbt 2,3,4 Fallout Value[a]				**na**	**na**	**na**	**na**
Screening Action Level[c]				**39**	**49**	**44**	**890**
AAA0753	21-01391	0–0.5	ALLH	3.24	0.21	13.23	—[d]
AAA0756	21-01391	0.5–1	ALLH	0.25	0.03	1.78	—
AAA0757	21-01392	0–0.5	ALLH	0.54	0.09	3.96	—
AAA0759	21-01392	0.5–1	ALLH	0.07	0.01	0.88	—
AAA4114	21-01669	0–5	Fill	—	—	—	0.19 (J)[e]
AAA4115	21-01669	6–10	Qbt 3	—	—	—	0.05 (J)
AAA4116	21-01669	10–15	Qbt 3	—	—	—	0.08 (J)
AAA4117	21-01669	15–20	Qbt 3	—	—	1.01	0.08 (J)

Note: Values are in units of pCi/g.

[a] Background values from "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (LANL 1998, 59730). Fallout values apply to the 0 to 0.5 ft depth interval only.

[b] na = Not available.

[c] Screening levels from "Updates to the Radionuclide Screening Action Levels (SALs) based on RESRAD 6.21" (LANL 2002, 73705).

[d] — = No value greater than the fallout value was detected.

[e] J = Estimated value.

Table 2.3-9
AOC 21-002(b) 1994 Investigation, Inorganic Chemical Results Above BVs

Sample ID	Location ID	Depth (ft)	Media	Barium	Cadmium	Calcium	Chromium	Cobalt	Copper	Lead	Selenium	Silver	Sodium	Thallium	Uranium	Zinc
ALLH Background Value[a]				**295**	**0.4**	**6120**	**19.3**	**8.64**	**14.7**	**22.3**	**1.52**	**1**	**915**	**0.73**	**1.82**	**48.8**
Qbt 2,3,4 Background Value[a]				**46**	**1.63**	**2200**	**7.14**	**3.14**	**4.66**	**11.2**	**0.3**	**1**	**2770**	**1.1**	**2.4**	**63.5**
Soil Screening Level[b]				**5450**	**74.1**	**na[c]**	**2100[d]**	**1520**	**3130**	**400**	**391**	**391**	**na**	**5.16**	**16[e]**	**23500**
AAC0110	21-02501	0–0.5	Qbt 3	77.9	—[f]	—	—	5 (U)[g]	—	15	0.88 (U)	—	—	—	—	—
AAC0111	21-02502	0–0.5	Qbt 3	67.3	—	—	—	—	6.2	—	0.93 (U)	—	—	—	—	—
AAC0112	21-02503	0–0.5	Qbt 3	107	—	3760	—	—	6.5	35.9	1 (U)	—	—	—	—	—
AAC0113	21-02504	0–0.5	ALLH	—	—	—	—	—	—	46.8	—	—	20600 (J)[h]	0.94 (U)	1.9 (J)	66.3
AAC0114	21-02505	0–0.5	Qbt 3	88.3	—	—	16.8 (J)	4 (U)	9.5	128	0.91 (U)	—	4470 (J)	—	2.87 (J)	91.4
AAC0115	21-02506	0–0.5	Qbt 3	714	—	—	7.6 (J)	5.4 (U)	7.9	163	0.89 (U)	3.1	—	—	3 (J)	418
AAC0116	21-02507	0–0.5	ALLH	340	0.86 (U)	—	—	—	—	400	—	—	—	1.2 (U)	3.77 (J)	604
AAC0117	21-02508	0–0.5	Qbt 3	196	—	4530	—	4.3 (U)	9.5	131	0.89 (U)	—	—	1.2 (U)	3.35 (J)	217

Note: Values are in units of mg/kg.

[a] Background values from "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (LANL 1998, 59730).

[b] Screening levels from "Technical Background Document for Development of Soil Screening Levels, Revision 2.0" (NMED 2004, 85615).

[c] na = Not available.

[d] Screening levels from "EPA Region 6 Human Health Medium-Specific Screening Levels" (EPA 2003, 81724).

[e] Screening levels from "EPA Region 9 PRGs Table." http://www.epa.gov/region09/waste/sfund/prg/files/02table.pdf. (EPA 2002, 76866).

[f] — = No value greater than the background value was detected.

[g] U = Undetected.

[h] J = Estimated value.

Table 2.3-10
AOC 21-002(b) 1994 Investigation, Detected Organic Chemicals

Sample ID	Location ID	Depth (ft)	Media	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Toluene
Soil Screening Level[a]				**0.621**	**6.21**	**2300[b]**	**248**
AAC0114	21-02505	0–0.5	Qbt 3	—[c]	0.61 (J)[d]	0.38 (J)	—
AAC0116	21-02507	0–0.5	ALLH	0.36 (J)	0.51	—	0.01
AAC0117	21-02508	0–0.5	Qbt 3	—	—	—	0.01

Note: Values are in units of mg/kg.

[a] Screening levels from "Technical Background Document for Development of Soil Screening Levels, Revision 2.0" (NMED 2004, 85615).

[b] Soil screening level for pyrene was used as a surrogate for benzo(g,h,i)perylene (LANL 2002, 72639).

[c] — = No value greater than the estimated quantitation limit was detected.

[d] J = Estimated value.

Table 2.3-11
AOC 21-002(b) 1994 Investigation, Radionuclides Greater than BVs or FVs

Sample ID	Location ID	Depth (ft)	Media	Cesium-137	Plutonium-238	Plutonium-239	Ruthenium-106	Strontium-90	Tritium
ALLH Fallout Value[a]				**1.65**	**0.023**	**0.054**	**na[b]**	**1.31**	**na**
Qbt 2,3,4 Fallout Value[a]				**na**	**na**	**na**	**na**	**na**	**na**
Screening Action Level[c]				**5.3**	**49**	**44**	**19**	**5.7**	**890**
AAC0110	21-02501	0–0.5	Qbt 3	—[d]	0.1 (J)[e]	0.09 (J)	9.25	—	—
AAC0111	21-02502	0–0.5	Qbt 3	0.16	0.07 (J)	0.05 (J)	—	1.23 (J)	0.06 (J)
AAC0112	21-02503	0–0.5	Qbt 3	0.12	0.07 (J)	0.46 (J)	—	—	0.04
AAC0113	21-02504	0–0.5	ALLH	—	0.08 (J)	0.39 (J)	—	1.59	0.23 (J)
AAC0114	21-02505	0–0.5	Qbt 3	0.38	0.07 (J)	1.4 (J)	—	2.39	—
AAC0115	21-02506	0–0.5	Qbt 3	0.34	0.13 (J)	7.5 (J)	—	—	0.05 (J)
AAC0116	21-02507	0–0.5	ALLH	—	0.1 (J)	6.97 (J)	—	—	—
AAC0117	21-02508	0–0.5	Qbt 3	0.59	0.07 (J)	0.82 (J)	—	—	0.03 (J)

Note: Values are in units of pCi/g.

[a] Background values from "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (LANL 1998, 59730). Fallout values apply to the 0 to 0.5 ft depth interval only.

[b] na = Not available.

[c] Screening levels from "Updates to the Radionuclide Screening Action Levels (SALs) based on RESRAD 6.21" (LANL 2002, 73705).

[d] — = No value greater than the fallout value was detected.

[e] J = Estimated value.

Table 4.1-1
Summary of Proposed Soil Sampling at SWMU 21-013(c)

Objective Addressed	Location Number	Location	Sample Depths (ft)	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture	High Explosives
Determine extent of total U, and other previously sampled chemicals/rads for which nature and/or extent have not been defined	0	1 ft downslope of 21-01917	0 to 0.5 2.5 to 3				X X	X X						X X	X X	
Determine extent of Hg, Am-241, Pu-238, H3, acetone, PAHs, and other previously sampled chemicals/rads for which nature and/or extent have not been defined	1	1 ft downslope of 21-09005	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Determine extent of Pu-239, total U, several PAHs, and other previously sampled chemicals/rads for which nature and/or extent have not been defined	2	1 ft downslope of 21-01913	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X			X X	X X		X X	X X	
Determine extent of Sr-90, thallium, toluene and other previously sampled chemicals/rads for which nature and/or extent have not been defined	3	1 ft downslope of 21-01914	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X				X X	X X	X X	X X	
Determine extent of detected organic chemicals that were not PAHs and Sr-90.	4	1 ft downslope of 21-01909	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X					X X	X X	X X	X X
Determine extent of Am-241, Pu-238 and other previously sampled chemicals/rads for which nature and/or extent have not been defined. Determine if SVOCs are present.	5	1 ft downslope of 21-09004	0 to 0.5 2.5 to 3	X X	X X	X X		X X		X X	X X			X X	X X	
Extend grid (in meters) to the east	6	20 m east of 21-01910	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Extend grid (in meters) to the east	7	40 m east of 21-01910	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Extend grid (in meters) to the east	8	20 m east of 21-01909	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Extend grid (in meters) to the east	9	40 m east of 21-01909	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Extend grid (in meters) to the west	10	20 m west of 21-01908	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	

Table 4.1-1 (continued)

Objective Addressed	Location Number	Location	Sample Depths (ft)	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture	High Explosives
Extend grid (in meters) to the east	11	20 m east of 21-01908	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Extend grid (in meters) to the east	12	40 m east of 21-01908	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Extend grid (in meters) to the south and define southern boundary	13	20 m south of 21-01908	0 to 0.5 0.5 to 1 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Extend grid (in meters) to the south and east and define southern boundary	14	20 m east of location 13	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Extend grid (in meters) to the south and east and define southern boundary	15	40 m east of location 13	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Define southwestern boundary	16	40 m west of location 13	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Define western boundary	17	20 m west of 21-01913	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Define western boundary	18	35 m west of 21-01915	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Define northwestern boundary	19	20 m north of 21-01917	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Define northern boundary	20	27 m north of 21-01912	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Define northern boundary	21	20 m east of 21-01911	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	
Provide characterization of "borrow" trench	22	10 m south of location 9 and 15 m east	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	

Table 4.2-1
Summary of Proposed Soil Sampling at SWMU 21-003-99

Objective Addressed	Location Number	Location	Sample Depth (ft)	PCBs	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Determine if evidence of release is beneath the center of Building 21-61	1	Midway between 21-02497 and 21-02470	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine if evidence of release is beneath the northeast area of Building 21-61	2	15 ft to the northeast of location 1	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine if evidence of release is beneath the southeast area of Building 21-61	3	15 ft to the southeast of location 1	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine if evidence of release is beneath the southwest of Building 21-61	4	15 ft to the southwest of location 1	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine if a release occurred beneath the northwest of Building 21-61	5	15 ft to the northwest of location 1	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine evidence of release beneath the asphalt pad	6	At a crack in the asphalt (to be determined in the field)	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine evidence of release beneath the asphalt pad	7	At a crack in the asphalt (to be determined in the field)	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine evidence of release beneath the asphalt pad	8	At a crack in the asphalt (to be determined in the field)	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine evidence of release beneath the asphalt pad	9	At a crack in the asphalt (to be determined in the field)	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Determine evidence of release beneath the asphalt pad	10	At a crack in the asphalt (to be determined in the field)	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 4.2-1 (continued)

Objective Addressed	Location Number	Location	Sample Depth (ft)	PCBs	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Define vertical extent of elevated concentrations of antimony, copper, lead, total U, Zn, PCBs, toluene, Pu-238, Pu-239, and U-235	11	1 ft downslope (south) of 21-02134	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	X X	X X	X X	X X			X X	X X		X X	X X
Determine vertical extent of elevated Zn, Pb, Pu-238, and Pu-239	12	1 ft downslope (south) of 21-02154	0 to 0.5 0.5 to 1 1.5 to 2	X X X			X X					X X			X X	X X
Determine vertical extent of 8 PAHs and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	13	1 ft downslope (south) of 21-02467	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X			X X	X X			X X			X X	X X
Determine vertical extent of Pu-238, Co-60 and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	14	1 ft downslope (south) of 21-02149	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	 X			X X	X X					X X	X X
Determine vertical extent of acetone, Pu-239, Pu-238 and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	15	1 ft downslope (south) of 21-01889	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X		X X	X X	X X	X X	X X	X X			X X	X X
Determine vertical extent of PCBs, toluene and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	16	1 ft downslope (south) of 21-02487	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X				X X			X X			X X	X X
Determine vertical extent of toluene, isopropyltoluene, PCBs, Pu-238, Pu-239, and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	17	1 ft downslope (south) of 21-02142	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X				X X			X X			X X	X X
Determine vertical extent of PCBs, Pu-238, Pu-239, Cu, Pb, total U, Zn, and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	18	1 ft downslope (south) of 21-02127	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X		X X	X X	X X			X X			X X	X X
Determine vertical extent of thallium, Cs-134, Pu-138, Pu-139, Hg, Tl, and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	19	1 ft downslope (south) of 21-01885	0 to 0.5 0.5 to 1 1.5 to 2	X X X			X X	X X	X X	X X		X X			X X	X X

Table 4.2-1 (continued)

Objective Addressed	Location Number	Location	Sample Depth (ft)	PCBs	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Determine vertical extent of Pu-238, Pu-239, Cu, Pb, Hg, Zn, toluene, PCBs, and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	20	1 ft downslope (south) of 21-01884	0 to 0.5 0.5 to 1 1.5 to 2	X X X			X X	X X	X X			X X			X X	X X
Determine vertical extent of Pb, total U, Pu-238, Pu-239, and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	21	1 ft downslope (south) of 21-02498	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X		X X	X X	X X			X X			X X	X X
Define lateral extent of drainage from asphalt pad	22	15 ft west of 21-01889	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define lateral extent of drainage from asphalt pad	23	15 ft east of 21-01889	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define downslope extent of drainage from asphalt pad	24	20 ft downslope (south) of 21-01889	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define lateral extent of drainage from asphalt pad	25	15 ft west of location 24	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define lateral extent of drainage from asphalt pad	26	15 ft east of location 24	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define lateral extent of drainage from asphalt pad	27	20 ft upslope (north) of 21-01889	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define lateral extent of drainage from asphalt pad	28	15 ft west of location 27	0 to 0.5 0.5 to 1 1.5 to 2	X X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X

Table 4.2-1 (continued)

Objective Addressed	Location Number	Location	Sample Depth (ft)	PCBs	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Define lateral extent of drainage from asphalt pad	29	30 ft west of location 27	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define southern lateral extent boundary	30	30 ft west of 21-02469	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define southern lateral extent boundary	31	On a line between 21-01885 and 21-02469, 20 ft upslope from 21-01885	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define northern lateral extent boundary	32	50 ft east of location 33	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define northern lateral extent boundary	33	20 ft upslope (north) of 21-02145	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define eastern lateral extent boundary	34	20 ft east of 21-02152	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define the extent of PCB contamination to the west of the asphalt pad	35	Outside western side of asphalt pad	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define the extent of PCB contamination to the north of the asphalt pad	36	Outside northern side of asphalt pad	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define the extent of PCB contamination to the east of the asphalt pad	37	Outside eastern side of asphalt pad	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X
Define vertical extent of contamination at drain valve	38	Immediately downslope of the drain valve	0 to 0.5	X	X	X	X	X	X	X	X	X	X	X	X	X
			0.5 to 1	X												
			1.5 to 2	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 4.3-1
Summary of Proposed Borehole Drilling and Soil Sampling at SWMU 21-024(c)

Objective Addressed	Location Number	Location	Sample Depth (ft)	PCBs	VOCs	SVOCs	TAL Metals	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Augerhole Sampling															
Determine if evidence of a leak in the tank is present	AH-1	Center of the septic tank footprint	Tank bottom, 10 ft below tank	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine vertical extent of contamination in the outfall	AH-2	Center of the outfall, as close to the canyon edge as feasible	0 to 0.5 1.5 to 2 5 to 5.5	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
Soil Sampling															
Determine if releases have occurred from the sewer line	A	Beneath the sewer line immediately south of Building 21-54	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the sewer line	B	Beneath the sewer line immediately south of Building 21-61	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the sewer line	C	At the connection of the sewer line from Building 21-54 and the sewer line from Building 21-61	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the sewer line	D	At approximately half the distance between the septic tank and outfall	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if a release occurred at the connection of the sewer line and the inlet to the septic tank	E	At the connection of the sewer line and the inlet of the septic tank	Beneath connection (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if a release occurred at the connection of the sewer line and the outlet to the septic tank	F	At the connection of the sewer line and the outlet of the septic tank	Beneath connection (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine vertical extent of release	1	Outfall pipe mouth	Beneath pipe (0 to 0.5), 1.5 to 2, 2.5 to 3	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X

Table 4.3-1 (continued)

Objective Addressed	Location Number	Location	Sample Depth (ft)	PCBs	VOCs	SVOCs	TAL Metals	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Determine eastern extent	2	2 ft east of outfall pipe mouth	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine western extent	3	2 ft west of outfall pipe mouth	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine lateral extent of release	4	10 ft downslope of outfall pipe mouth	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine eastern extent	5	10 ft east of location 4	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine western extent	6	10 ft west of location 4	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine lateral extent of release	7	1 ft downslope of 21-01392	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine eastern extent	8	20 ft east of 21-01392	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine western extent	9	20 ft west of 21-01392	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine downslope extent (on the topographical bench)	10	Directly downslope from pipe mouth, beside cliff	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine eastern extent	11	20 ft east of location 14	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine western extent	12	20 ft west of location 14	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine downslope extent	13	On the topo bench, directly downslope from pipe mouth, beside southern cliff edge	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine eastern extent	14	20 ft east of location 17	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine western extent	15	20 ft west of location 17	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X

Table 4.4-1
Summary of Proposed Soil Sampling at SWMU 21-009

Objective Addressed	Location Number	Location	Sample Depths (ft)	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Determine if releases have occurred within the footprint of the removed building	1	Center of the footprint	0 to 0.5, 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the pipeline from Tank 21-47 within the footprint of the removed building	2	Under pipeline at northern edge of the footprint of the removed building	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the pipeline from Tank 21-47 within the footprint of the removed building	3	Under pipeline at southern edge of the footprint of the removed building	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the sewer line within the footprint of the removed building	4	Under sewer line at northern edge of the footprint of the removed building	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the sewer line within the footprint of the removed building	5	Under sewer line at southern edge of the footprint of the removed building	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the gas line to Gas Tank 21-64	6	Under the gas line at the connection to removed Building 21-33	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the gas line to Gas Tank 21-64	7	Under the gas line 25 ft south of removed Building 21-33	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Determine if releases have occurred from the gas line to Gas Tank 21-64	8	Under the gas line at the connection to the removed Gas Tank 21-64	Beneath pipe (0 to 0.5), 1.5 to 2	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X

Table 4.5-1
Summary of Proposed Soil Sampling at AOC 21-002(b)

Objective Addressed	Location Number	Location	Sample Depths (ft)	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Determine vertical extent of Ag, Zn, Pu-238, Pu-239, and other previously analyzed inorganic chemicals/rads for which nature and/or extent have not been defined	1	1 ft downslope (north) of 21-02506	0 to 0.5 2.5 to 3		X X	X X		X X	X X		X X		X X	X X	X X
Determine vertical extent of Ru-106, Pu-238, and Pu-239	2	1 ft downslope (north) of 21-02501	0 to 0.5 2.5 to 3						X X		X X			X X	X X
Determine vertical extent of benzo(a)pyrene, Pb, Tl, total U, Zn, Pu-239, and other previously analyzed chemicals/ rads for which nature and/or extent have not been defined	3	Immediately adjacent to and downslope from 21-2507	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X			X X			X X	X X
Determine vertical extent of PAHs, Cr, total U, Sr-90, Cs-137, Pu-238, Pu-239, and other previously analyzed chemicals/rads for which nature and/or extent have not been defined	4	1 ft downslope (south) of 21-02505	0 to 0.5 2.5 to 3	X X	X X	X X	X X		X X		X X		X X	X X	X X
Determine vertical extent of Cu, toluene, total U, Zn, Cs-137, Pu-238, Pu-239, Sr-90 and other previously analyzed chemicals /rads for which nature and/or extent have not been defined	5	1 ft downslope (south) of 21-02508	0 to 0.5 2.5 to 3	X X		X X	X X		X X		X X		X X	X X	X X
Define the northern lateral extent of SWMU	6	9 ft downslope (north) of 21-02506	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the northern lateral extent of SWMU	7	15 ft north west of 21-02506 in topographical depression	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the northern lateral extent of SWMU	8	10 ft downslope (north) of 21-02502	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the southwest lateral extent of SWMU	9	15 ft upslope (south) of 21-02502.	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the southern lateral extent of SWMU	10	12 ft upslope (south) of the mid point of a line between 21-02501 and 21-02507	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X

Table 4.5-1 (continued)

Objective Addressed	Location Number	Location	Sample Depths (ft)	VOCs	SVOCs	TAL Metals	Total Uranium	Perchlorate	Gamma Spectroscopy	Americium-241	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium	Moisture
Define the southern lateral extent of SWMU	11	10 ft upslope (south) of 21-02504	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the eastern lateral extent of SWMU	12	20 ft east of 21-2507	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the northern lateral extent of SWMU	13	15 ft northeast of 21-02508	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the northern lateral extent of SWMU	14	20 ft north of 21-02508	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the eastern lateral extent of SWMU	15	10 ft east of 21-02508	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the lateral extent of inorganic chemicals, organic chemicals & radionuclides	16	10 ft east of 21-2507	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
Define the lateral extent of inorganic chemicals, inorganic chemicals, and radionuclides	17	Midway between 21-2505 and 21-2504	0 to 0.5 2.5 to 3	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X

Appendix A

Acronyms and Abbreviations, Glossary, and Metric Conversion Table

A-1.0 ACRONYMS AND ABBREVIATIONS

ALLH	all horizons
AOC	area of concern
bgs	below ground surface
BV	background value
CMP	corrugated metal pipe
COPC	chemical of potential concern
D&D	decontamination and decommissioning
DOE	Department of Energy (US)
DOT	Department of Transportation
DP	Delta Prime
EM	electromagnetic
EPA	Environmental Protection Agency (US)
EQL	estimated quantitation limit
ER	Environmental Restoration (as in *former ER Project*)
FIDLER	field instrument for the detection of low-energy radiation
FV	fallout value
FY	fiscal year
GPR	ground-penetrating radar
GPS	global-positioning system
HSWA	Hazardous and Solid Waste Amendments
ID	identification
IDW	investigation-derived waste
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory
LIR	Laboratory Implementation Requirement
LLW	low-level waste
MDA	material disposal area
NFA	no further action
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
PPE	personal protective equipment

QA/QC	quality assurance/quality control
QP	quality procedure
RCRA	Resource Conservation and Recovery Act
RFI	RCRA field investigation
RLWTF	Radioactive Liquid Waste Treatment Facility
RPF	Records Processing Facility
RRES-ECR	Risk Reduction and Environmental Stewardship–Environmental Characterization and Remediation
RRES-RS	Risk Reduction and Environmental Stewardship–Remediation Services
RSI	request for supplemental information
SMO	Sample Management Office
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA	technical area
TBD	to be determined
TSCA	Toxic Substance Control Act
VCA	voluntary corrective action
VCP	vitrified clay pipe
VOC	volatile organic compound
WCSF	waste characterization strategy form

A-2.0 GLOSSARY

administrative authority (AA) — The New Mexico Environment Department, the US Environmental Protection Agency, or the US Department of Energy, as appropriate.

analysis — Includes physical analysis, *chemical analysis*, and knowledge-of-process determinations. (Laboratory Hazardous Waste Facility Permit)

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

aquifer — Body of permeable geologic material whose saturated portion is capable of readily yielding *groundwater* to wells.

area of concern (AOC) — Areas at the Laboratory that might warrant further investigation for *releases* based on past facility waste-management activities.

background level — Naturally occurring concentrations (levels) of an inorganic *chemical* and naturally occurring *radionuclides* in soil, *sediment*, and *tuff*.

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

background value (BV) — A threshold used to identify site *sample* results that may be greater than *background levels*.

chemical — Any naturally occurring or man-made substance characterized by a definite molecular composition, including molecules that contain *radionuclides*.

chemical analysis — Process used to measure one or more attributes of a *sample* in a clearly defined, controlled, systematic manner. Often requires treating a *sample* chemically or physically before measurement.

Code of Federal Regulation (CFR) — A codification of all regulations developed by federal government agencies and finalized by publication in the *Federal Register*.

collocated sample — One of two or more *samples* collected within close proximity of each other meant to represent the same immediate area.

contaminant — Any *chemical* (including *radionuclides*) present in environmental *media* or on structural debris.

decommissioning — Permanent removal from service of facilities and their components, after the discontinued use of structures or buildings deemed no longer useful, in accordance with regulatory requirements and environmental policies.

decontamination — Removal of unwanted material from the surface of or from within another material.

detection limit — Minimum concentration that can be determined by a single measurement by an instrument; implies a specified statistical confidence that the analytical concentration is greater than zero.

discharge — Accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying, or dumping of *hazardous waste* into or on any land or water. (*RCRA*, 40 CFR 260.10)

disposal — The discharge, deposit, injection, dumping, spilling, leaking, or placing of any *solid waste* or *hazardous waste* into or on any land or water so that such *solid waste* or *hazardous waste* or any constituent thereof may enter the environment or be emitted into the air or *discharged* into any waters, including *groundwaters*. (40 CFR Part 260.10)

DOE — See *US Department of Energy*

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

ecological screening level (ESL) — An organism's exposure-response threshold for a given *chemical* constituent. The concentration of a substance in a particular *medium* corresponds to a *hazard quotient* (HQ) of 1.0 for a given organism below which no *risk* is indicated.

EPA — See *US Environmental Protection Agency*

equipment blank (or *rinsate blank*) — A *blank sample* that is used to rinse the *sample* collection equipment and is then transferred to a sampling container. The equipment blank is collected after equipment *decontamination* is completed but before collection of another *field sample*.

ER data — Data derived as a result of *samples* that are collected and paid for by ER Project funding.

Estimated quantitation limit (EQL) — The lowest concentration that can be reliably achieved within specified limits of *precision* and *accuracy* during routine analytical laboratory operating conditions. The low point on the *calibration* curve should reflect this quantitation limit. The EQL is not used to establish

detection status. *Sample* estimated quantitation limits are highly *matrix*-dependent, and the specified estimated quantitation limits might not always be achievable. See the statement of work for analytical services (RFP No. 9-Xs1-Q4257) for a more complete definition.

exposure pathway — Mode by which a *receptor* may be exposed to *contaminants* in environmental media (e.g., drinking water, ingesting food, or inhaling dust).

Federal Register — The official daily publication for Rules, Proposed Rules, and Notices of federal agencies and organizations, as well as Executive Orders and other Presidential Documents.

field blank (also known as *field reagent blank*) — A *blank sample* either prepared in the field or carried to the sampling site, exposed to sampling conditions (e.g., bottle caps removed, preservatives added), and returned to a laboratory for *analysis* in the same manner in which environmental *samples* are analyzed. Used to identify the presence of contamination potentially added during the sampling and *analysis* process.

field duplicate (replicate) **samples** — Two separate, independent *samples* taken from the same source that are collected in such a manner that they are *collocated samples*, equally representative of the *sample matrix* at a given location and time.

field reagent blank — See *field blank*.

field sample — See *sample*.

field split — A *field sample* that has been homogenized and divided in the field into equally representative portions that are submitted for *analysis* (see also *split sample*).

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

grab sample — A specimen collected by a single application of a field sampling

procedure to a target *population* (e.g., the surface soil from a single hole collected following the spade and scoop sampling procedure or a single air filter left in the field for three months).

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

Hazardous and Solid Waste Amendments (HSWA) — The Hazardous and Solid Waste Amendments of 1984 (Public Law No. 98-616, 98 Stat. 3221), which amended the *Resource Conservation and Recovery Act* of 1976, 42 U.S.C. § 6901 et seq.

hazardous constituent — Those constituents listed in Appendix VIII to 40 CFR Part 261.

hazardous waste — Any *solid waste* is generally a hazardous waste if it

- is not excluded from regulation as a hazardous waste,
- is listed in the regulations as a hazardous waste,
- exhibits any of the defined characteristics of hazardous waste (ignitability, corrosivity, reactivity, or toxicity), or
- is a mixture of *solid waste* and hazardous waste.

See 40 CFR 261.3 for a complete definition of hazardous waste.

HSWA module — Module VIII of the Laboratory's Hazardous Waste Facility Permit. This permit allows the Laboratory to operate as a *treatment, storage, and disposal facility*.

industrial-use scenario — Industrial use is the scenario in which current Laboratory operations continue. Any necessary *remediation* involves cleanup to standards designed to ensure a safe and healthy work environment for Laboratory workers.

laboratory duplicate sample — The portions of a *sample* taken from the same sample container, prepared for *analysis* and analyzed independently but under identical conditions; used to assess or demonstrate acceptable laboratory method precision at the time of analysis. Each duplicate *sample* is expected to be equally representative of the original material. Duplicate analyses also are performed to generate data, to determine the long-term precision of an analytical method on various matrices.

laboratory qualifier (or laboratory flag) — Codes applied to the data by the contract analytical laboratory to indicate, on a gross scale, a verifiable or potential data deficiency. These flags are applied using the *Environmental protection Agency (EPA)* contract laboratory program (CLP) guidelines.

LANL data validation qualifiers — The data qualifiers defined by the Laboratory (LANL) and used in the ER Project baseline-validation process. For a complete list of data qualifiers applicable to any particular analytical suite, consult the appropriate ER Project *standard operating procedure* (ER-SOPs 15.01–15.06).

method detection limit (MDL) — The minimum concentration of a substance that can be measured and reported with a known statistical confidence that the *analyte* concentration is greater than zero. The MDL is determined from *analysis* of *samples* of a given *matrix* type that contain the *analyte* after subjecting the *sample* to the usual preparation and analyses. The MDL is used to establish detection status.

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

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

minimum detectable activity — For the *analysis* of *radionuclides*, the minimum detectable activity is the lowest detectable radioactivity for a given analytical technique. The following equation shall be used to calculate the MDA unless otherwise noted or approved by the Laboratory:

where

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

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

mixed waste — Waste that contains both *hazardous waste* (as defined by *RCRA*) and *radioactive waste* (as defined by the Atomic Energy Act [AEA] and its amendments).

no further action (NFA) — A recommendation that not further investigation or *remediation* is warranted based on specific criteria.

non-ER data — Data derived as a result of *samples* collected and paid for by sources other than the ER Project.

outfall — The vent or end of a drain, pipe, sewer, ditch, or other conduit that carries wastewater, sewage, storm runoff or other *effluent* into a stream.

perched groundwater — *Groundwater* that lies above the regional *water table* and is separated from it by one or more *unsaturated zones*.

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

quality assessment sample — A *sample* submitted for *analysis*, the data from which are used to assess the quality of performance of a sampling or *analysis* process. May include *performance-evaluation samples*, *field duplicates*, *field blanks*, etc.

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

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

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

radiation — Energy emitted in the form of rays or particles that are thrown off by disintegrating atoms. The rays or particles emitted may consist of neutrons, positrons, *alpha particles*, *beta particles*, or *gamma radiation*.

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

RCRA facility assessment (RFA) — Usually the first step in the *RCRA corrective action* process, to identify potential and actual *releases* from *solid waste management units* and make preliminary determinations about *releases*, the need for *corrective action*, and *stabilization measures*.

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

receptor — A person, plant, animal, or geographical location that is exposed to a *chemical* or physical agent *released* to the environment by human activities.

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

regulatory standard — Media-specific *contaminant* concentration levels of potential concern that are mandated by federal or state legislation or regulation (e.g., the Safe Drinking Water Act, New Mexico Water Quality Control Commission regulations).

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

remediation — The process of reducing the concentration of a *contaminant* (or *contaminants*) in air, water, or soil media to a level that poses an acceptable *risk* to human health and the environment; the act of restoring a contaminated area to a usable condition based on specified standards.

request number — An identifying number assigned by the ER Project to a group of *samples* that are submitted for *analysis.*

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

routine analysis — The *analysis* categories of inorganics, metals, organics, radiochemistry, and high explosives as defined in the current contract laboratory statement of work.

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

- to estimate the technical quality of the data relative to minimum national standards adopted by the ER Project and
- to indicate to data users the technical data quality at a gross level by assigning *LANL qualifiers* to environmental data whose quality indicators do not meet acceptance criteria.

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

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

site characterization — Defining the pathways and methods of *migration* of the *hazardous waste* or *constituents*, including the *media* affected, the extent, direction and speed of the *contaminants*, complicating factors influencing movement, concentration profiles, etc. (US Environmental Protection Agency, May 1994. "RCRA Corrective Action Plan, Final," Publication EPA-520/R-94/004, Office of Solid Waste and Emergency Response, Washington, DC)

solid waste — Any garbage; refuse; sludge from a waste *treatment* plant, water-supply *treatment* plant, or air-pollution-control facility; and other discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities.

solid waste management unit (SWMU) — Any discernible unit at which *solid wastes* have been placed at any time, irrespective of whether the unit was intended for the management of *solid or hazardous waste.* Such units include any area at a facility at which *solid wastes* have been routinely and systematically *released.* This definition includes regulated units (i.e., landfills, surface impoundments, waste piles, and land *treatment* units) but does not include passive leakage or one-time spills from production areas and units in which wastes have not been managed (e.g., product storage areas).

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

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

stratigraphy — The science dealing with the succession, age, composition, and history of strata.

trip blank — A *sample* of *analyte*-free media taken to the sampling site and returned to the analytical laboratory unopened along with *samples* taken in the field. Used to monitor cross contamination of *samples* during handling and storage both in the field and in the analytical laboratory.

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

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

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

water content — (Also *gravimetric moisture content*) The amount of water in an unsaturated *medium*, expressed as the ratio of the weight of water in a *sample* to the weight of the oven-dried *sample*; often expressed as a percent.

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

A-3.0 METRIC CONVERSION TABLE

Metric to US Customary Unit Conversions

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

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Appendix B

DP Site Aggregate Area Analytical Data
(CD included with this report)

Appendix C

Management Plan for Investigation-Derived Waste

C-1.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

This appendix to the work plan describes how investigation-derived waste (IDW) generated during the investigation of four Delta Prime (DP) Site aggregate area solid waste management units (SWMUs) and one area of concern (AOC) will be managed. IDW is solid waste generated as a result of field investigation activities and may include, but is not limited to, drill cuttings; excavated material; purge water; contaminated personal protective equipment (PPE), sampling supplies, and plastic; fluids from decontamination of PPE and sampling equipment; and all other wastes potentially contacting contaminants. Certain field investigation activities may also displace environmental media, which is defined as naturally occurring material indigenous to the environment including groundwater, surface water, surface and subsurface soils, rocks, bedrock, and gravel. Consistent with the US Environmental Protection Agency (EPA) "area of contamination" policy, environmental media are not considered to be a waste (and hence not IDW) if they are returned to their point of origin. IDW generated during the investigation of DP Site aggregate area SWMUs/AOC will be managed in a way that is protective of human health and the environment, compliant with applicable regulatory requirements, and consistent with the waste-minimization goals of Los Alamos National Laboratory (the Laboratory or LANL).

All IDW generated during field investigation activities will be managed in accordance with applicable Risk Reduction and Environmental Stewardship—Remediation Services (RRES-RS) project standard operating procedures (SOPs). These SOPs incorporate the requirements of all applicable EPA and New Mexico Environment Department regulations, Department of Energy (DOE) orders, and Laboratory implementation requirements. RRES-RS SOPs applicable to the characterization and management of IDW are

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

These SOPs are among the SOPs applicable to the investigation at the DP Site aggregate area SWMUs/AOC and are available at the following internet address: http://erproject.lanl.gov/documents/procedures.html.

Investigation activities will be conducted in a manner that minimizes the generation of waste. Waste minimization is accomplished by implementing the requirements of the RRES-RS Waste Minimization Awareness Plan, which is updated annually as a requirement of Module VIII of the Laboratory's Hazardous Waste Facility Permit.

The following waste streams will be generated and managed during the work plan implementation at the DP Site aggregate area SWMUs and AOC:

- drill cuttings
- excavated soil and rock
- pipe lines
- concrete septic tank, sump
- PPE, plastic, and other IDW
- decontamination fluids

All wastes will be managed in accordance with applicable federal, state, DOE, and Laboratory requirements. Waste streams, regulatory classification, amounts, and disposal pathways are shown in Table C-1. The amount of waste to be managed has not been determined at this time. The quantities will

be estimated as part of finalizing the implementation approach and will be included in the progress report outlined in section 5.0 of this investigation work plan.

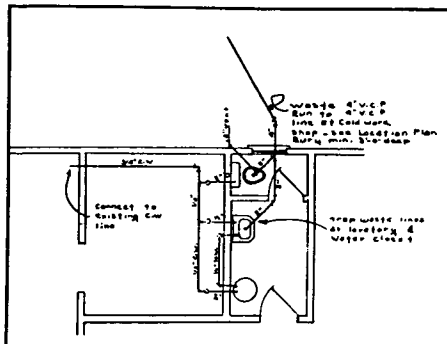
Prior to the start of field investigation activities, a waste characterization strategy form (WCSF) will be prepared and approved per requirements of LANL-ER-SOP-01.10. The WCSF will provide detailed information on IDW characterization, management, containerization, and potential volume generation. IDW characterization will be achieved through existing data and/or documentation and through direct sampling of the IDW, or sampling of the media being investigated (i.e., surface soil, subsurface soil/tuff, etc.).

The selection of waste containers will be based on the appropriate Department of Transportation (DOT) requirements and the type and amount of IDW that is planned to be generated. Each waste container will be individually labeled as to the waste classification, item identification number, radioactivity (if applicable), and date of generation, immediately following containerization. Waste containers will be managed in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on IDW type and classification. Container and storage requirements will be detailed in the WCSF and approved prior to the generation of waste.

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

Table C-1
Waste Streams from Implementation of the DP Site Aggregate Area Investigation Work Plan

Waste Stream	Waste Type	Volume	Shipped To
Drill cuttings	Solid, low-level waste (LLW)	TBD (to be determined)	LANL, Technical Area 54 (TA-54), Area G
Soil and rock	Solid, LLW	TBD	LANL, TA-54, Area G
Sewer line	Solid, LLW	TBD	LANL, TA-54, Area G
Septic tank	Solid, LLW	TBD	LANL, TA-54, Area G
PPE, plastic, and other IDW	Solid, LLW	TBD	LANL, TA-54, Area G
Decontamination fluids	Liquid, LLW	TBD	LANL, TA-50, Radioactive Liquid Waste Treatment Facility (RLWTF)



Mechanical Plan

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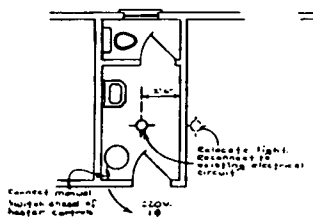
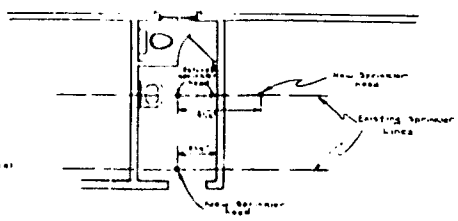


Electrical Plan

Scale 1/8"=1'-0"



Sprinkler Plan

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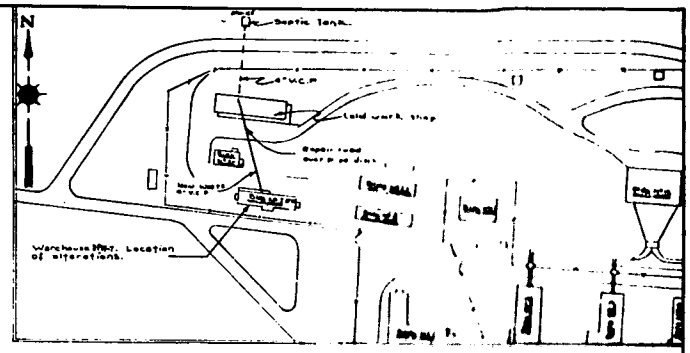
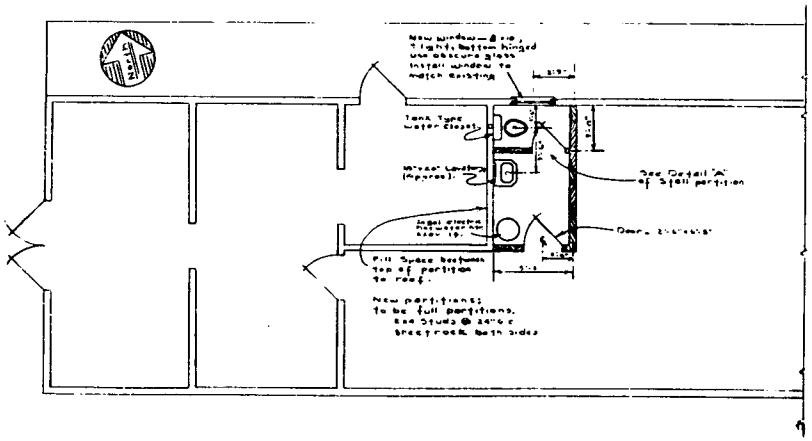


Location Plan

Warehouse [illegible]

U.P. West [illegible]



Floor Plan

Warehouse [illegible]-7, 1A-21

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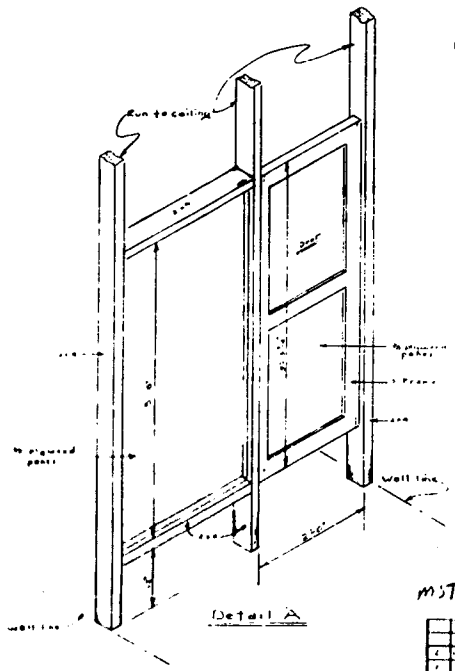


Detail A

RECORD DRAWING AS BUILT CONSTRUCTION

MST OFFICIAL USE ONLY

U. S. ATOMIC ENERGY COMMISSION

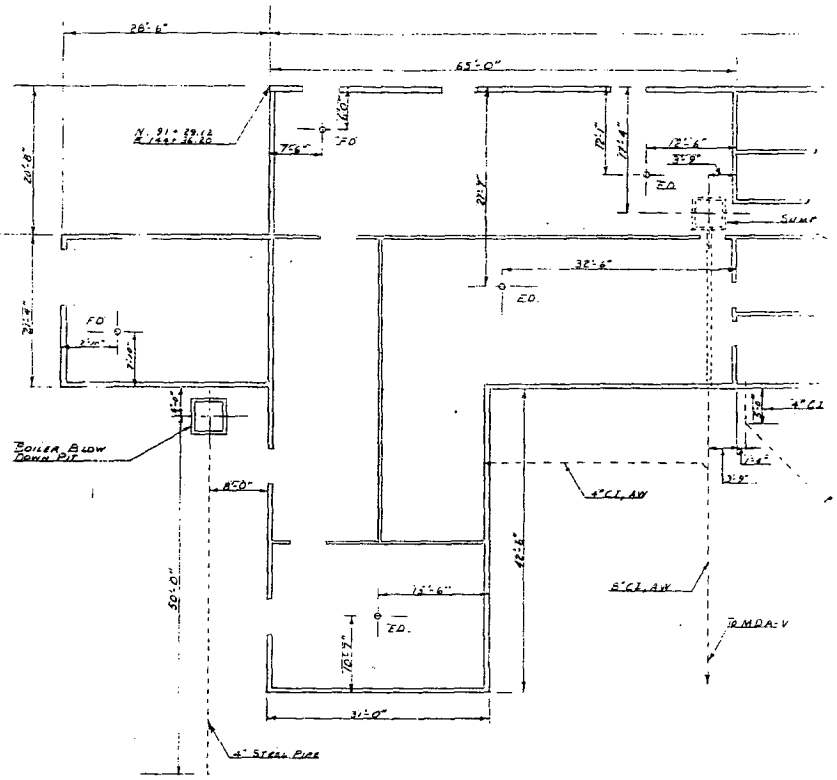
Joliet Par Office

Warehouse [illegible]

1A-21

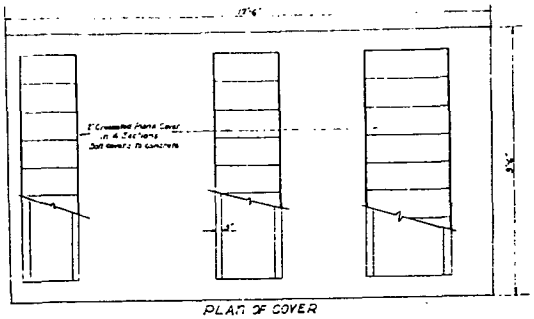
J.O. 204001

AUTHORIZED FOR

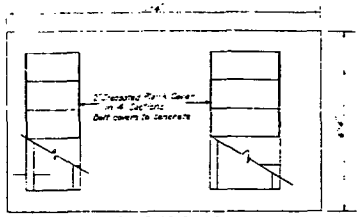


LEGEND

———	VISIBLE CONSTRUCTION
- - - -	HIDDEN OR UNDERGROUND
MDA - -	MATERIAL DISPOSAL AREA
VCP - -	VITRIFIED CLAY PIPE
FD - - -	FLOOR DRAIN
CI - - -	CAST IRON
AW - - -	ACID WASTE



PLAN OF COVER



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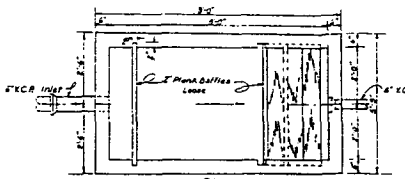
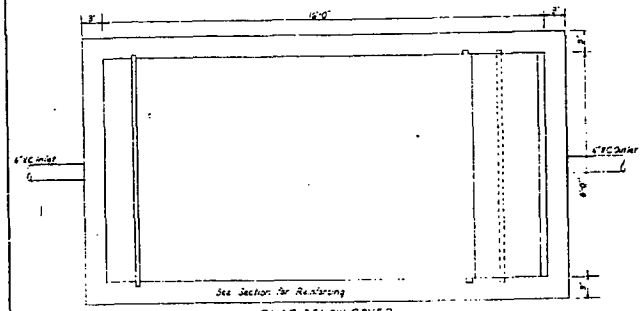


PLAN



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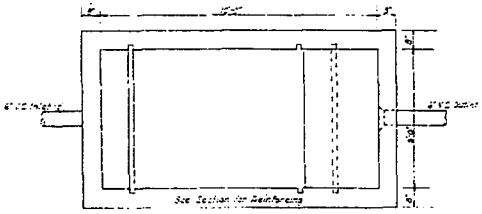

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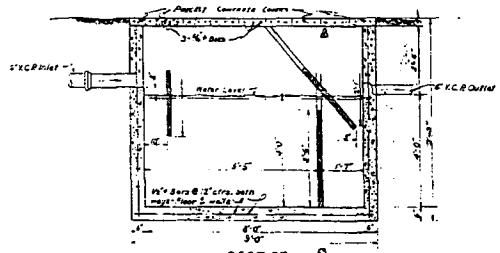
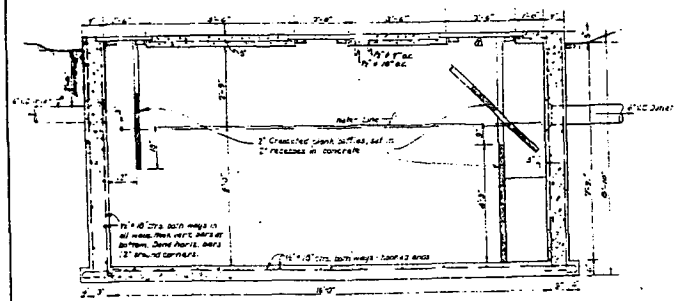


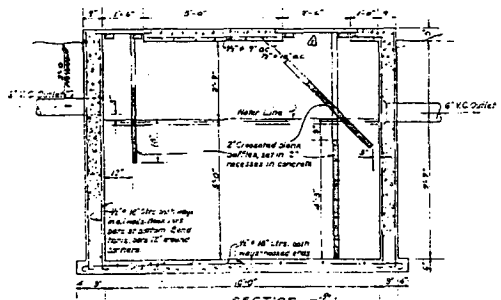
SECTION

TANKS Nos. 3, 5 & 6 - SPM-56
For Bldg. 3 and between Bldgs. 4 and 5
Scale: ½" = 1'0"



SECTION

TANK Nos. 1 & 2 - SPM-
For Bldg. No. 1
Scale ½"=1'0"



SECTION

TANKS Nos. 1-4 & 5a - SPM-
For Bldgs. Nos. 5a-1&2, & 1&2
Scale: ½"=1'0"

NOTES:
All wood construction to be rift sawed creosote, after cutting out to size.
Paint under side of concrete covers, and inside to level of Outlet Water Line, with one coat of Inertol Standard Black, or equal.

19 Nov 45	B	Revised Plan of Septic Tanks	C.E.M.	
Date	No.	REVISIONS	By	Remarks

SEPTIC TANKS

W.C. KRUGER - ARCHITECT | "DP" SITE CONSTRUCTION | SHEET No. U 6

DRAWN: J.G. | CHECKED: T.O.R. | DATE: 6-1-45

U.S. ENGINEER OFFICE
SANTA FE, N. M.

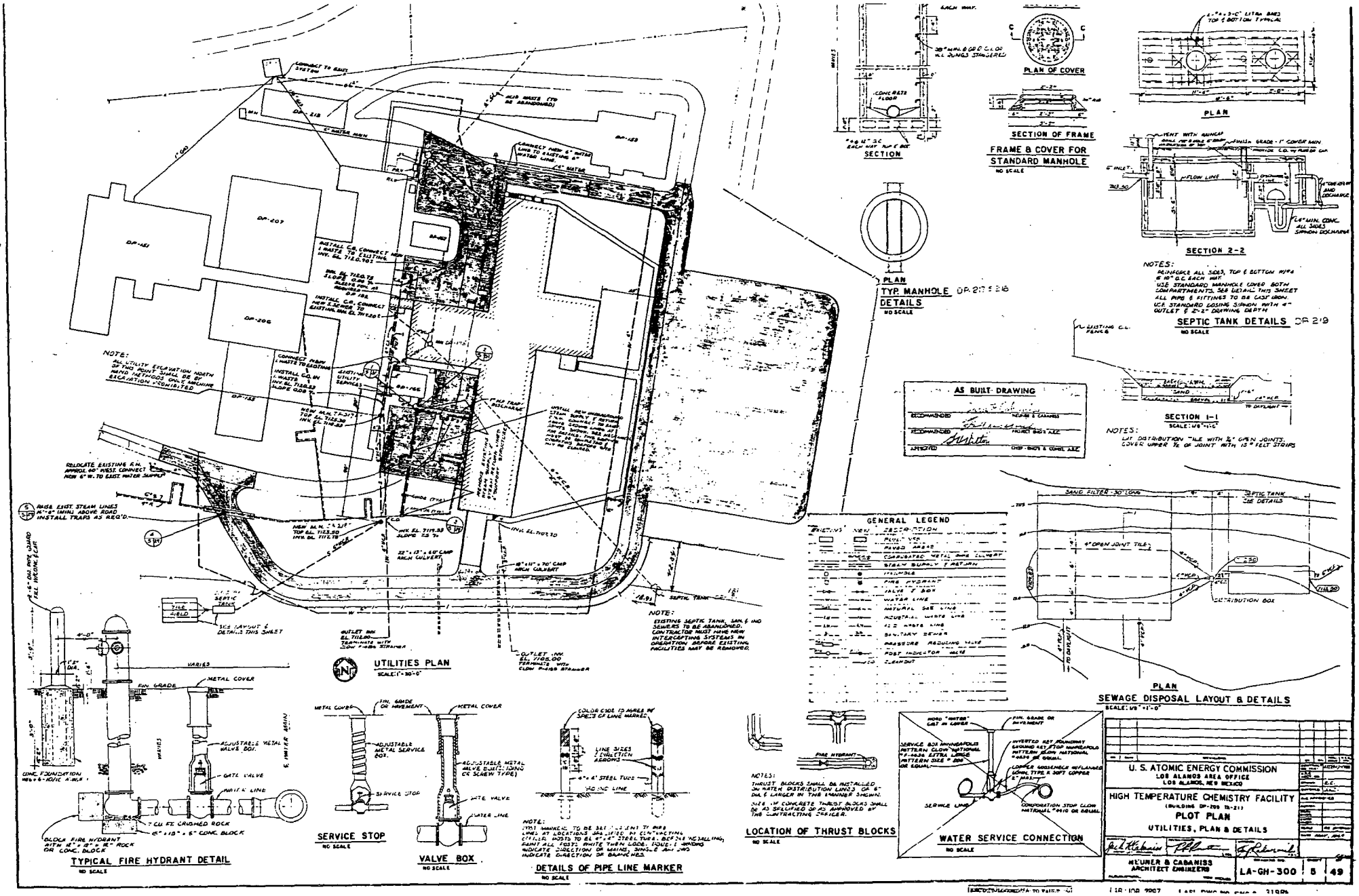
APPROVED FOR USING SERVICE
By: [signature]

SUBMITTED: [signature]

RECOMMENDED: [signature]

APPROVED: [signature]

L.A.S.L. DWG. NO. ENG-C 2214 23,014


UTILITIES PLAN
SCALE: 1" = 30'-0"
NOTE:
ALL UTILITY EXCAVATION WIDTH OF TWO FOOT SHALL BE BY HAND METHODS ONLY. MACHINE EXCAVATION PROHIBITED
RELOCATE EXISTING R.R. APPROX. 60' WEST. CONNECT NEW 6" W. TO EXIST. WATER SUPPLY
RAISE EXIST. STEAM LINES 16"-0" (MIN.) ABOVE ROAD INSTALL TRAPS AS REQ'D.
SEE LAYOUT & DETAILS THIS SHEET
OUTLET INV. EL. 715.00 TERMINATE WITH CLOW F-1758 STRAINER
NOTE:
EXISTING SEPTIC TANK, SAN. & IND SEWERS TO BE ABANDONED. CONTRACTOR MUST HAVE NEW INTERCEPTING SYSTEMS IN OPERATION BEFORE EXISTING FACILITIES MAY BE REMOVED.
TYPICAL FIRE HYDRANT DETAIL
NO SCALE
SERVICE STOP
NO SCALE
VALVE BOX
NO SCALE
DETAILS OF PIPE LINE MARKER
NO SCALE
LOCATION OF THRUST BLOCKS
NO SCALE
WATER SERVICE CONNECTION
NO SCALE
FRAME & COVER FOR STANDARD MANHOLE
NO SCALE
SECTION OF FRAME
PLAN OF COVER
SECTION
PLAN
TYP. MANHOLE DETAILS
NO SCALE
SECTION 2-2
SEPTIC TANK DETAILS
NO SCALE
SECTION 1-1
SCALE: 1/8"=1'-0"
PLAN
SEWAGE DISPOSAL LAYOUT & DETAILS
SCALE: 1/8" = 1'-0"
AS BUILT DRAWING
GENERAL LEGEND
U. S. ATOMIC ENERGY COMMISSION
LOS ALAMOS AREA OFFICE
LOS ALAMOS, NEW MEXICO
HIGH TEMPERATURE CHEMISTRY FACILITY
(BUILDING DP-209 TA-21)
PLOT PLAN
UTILITIES, PLAN & DETAILS
HEUNER & CABANISS
ARCHITECT ENGINEERS
LA-GH-300
5 49

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SUBJECT: Investigation Work Plan (IWP) for Delta Prime Site Aggregate Area at Technical Area (TA) 21, August 2004 (Appendix B data and electronic version of report)

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Associated Document Catalog Number(s)	None
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INVESTIGATION WORK PLAN FOR DELTA PRIME SITE AGGREGATE AREA AT TECHNICAL AREA 21

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- ☐ Abstract ☑ Full Paper
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