Sandia National Laboratories/New Mexico

PROPOSALS FOR NO FURTHER ACTION ENVIRONMENTAL RESTORATION PROJECT SWMUs 98, 82, 60, 8IA, 81B, 81D, 81E, 81F, 9, AND 117

September 2000

Environmental
Restoration
Project

United States Department of Energy
Albuquerque Operations Office

EXECUTIVE SUMMARY

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Solid Waste Management Units (SWMUs) 98, 82, 60, 81A, 81B, 81D, 81E, 81F, 9, and 117. These SWMUs are proposed for an NFA decision based upon baseline and confirmatory sampling data demonstrating that constituents of concern (COCs) that could have been released from the SWMUs into the environment pose an acceptable level of risk under current and projected future land use, as set forth by the Criterion 5, which states, "The SWMU/AOC [area of concern] has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected land use" (NMED March 1998). This executive summary briefly describes each SWMU and the basis for the NFA proposal.

- SWMU 98 (Building 863 TCA [trichloroethane] and Photochemical Release in Operable Unit [OU] 1302) was constructed in 1950 and in 1951 became the motion picture production and film processing division for SNL/NM. The site was listed as a SWMU because of silver recovery processes and for releases of TCA from a film-cleaning machine. SWMU 98 was characterized through a series of four investigations: 1) a Comprehensive Environmental Assessment and Response Program (CEARP) (1987), 2) an Environmental Restoration (ER) Preliminary Investigation in 1993, 3) a RCRA Facility Investigation (RFI) in 1995, and 4) an Additional RFI Field Investigation in 1999. The four investigations included a background review, a cultural resources survey, a sensitive species survey, and sampling data collection. The building was decontaminated, decommissioned, and demolished in 1999. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs]) were present in concentrations considered hazardous to human health or site ecological receptors for an industrial land-use scenario.

- SWMU 82 (Old Aerial Cable Site in OU 1332) was constructed in 1968 to study problems in an experimental Fuel-Air Explosive weapon. Phillips Laboratories currently uses the site as a High Energy Research Test Facility. SWMU 82 was characterized through a series of four investigations: 1) a CEARP in 1997, 2) an ER Preliminary Investigation in 1992, 3) an ER RFI between 1995 and 1999, and 4) a Voluntary Corrective Action (VCA) conducted in 1999. The four investigations included visual inspections of the site, a background review, radiological surveys, unexploded ordnance (UXO)/high explosives (HE) surveys, a cultural resources survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, SVOCs, HE, or radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 60 (Bunker Area in OU 1333) was a supply bunker and control bunker. The control bunker was destroyed during explosive testing in 1979. During the explosive test two mock weapons containing HE, depleted uranium, and beryllium

were detonated, and the control bunker was destroyed. SWMU 60 was characterized through three investigations: 1) a CEARP in 1985, 2) an ER Preliminary Investigation from 1989 to 1994, and 3) a VCA conducted in 1999. The site investigations included a Phase I site investigation, a background review, a UXO/HE survey, a radiation survey, a cultural resource survey, and a sensitive species survey. The VCA was conducted in 1999 and included radiological surveys to characterize depleted uranium contamination present on remaining structures and debris, demolition and removal of this material, and confirmatory sampling. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 81A (Catcher Box/Sled Track in OU 1333) was constructed in 1970 and is an active subunit of SWMU 81 (New Aerial Cable Facility). The site was constructed to support impact testing on weapons and other test units that could be subject to detonation at SWMU 81. SWMU 81A was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, SVOCs, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 81B (Impact Pad in OU 1333) was constructed in 1970 and is an active subunit of SWMU 81 (New Aerial Cable Facility). The pad was designed to provide an "unyielding surface" for testing the impact of weapons and transportation containers that are designed to house nuclear materials. SWMU 81B was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 81D (Northern Cable Area in OU 1333) was constructed in 1984-1985 and is an active subunit of SWMU 81 (New Aerial Cable Facility). The site was constructed to provide a dedicated area for antiarmor tests. SWMU 81D was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 81E (Gun Impact Area in OU 1333) is an inactive subunit of SWMU 81 (New Aerial Cable Facility). The site is the area impacted from the projectiles shot from portable guns in SWMUs 81A and 81B. SWMU 81E was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 81F (Scrap Yard in OU 1333) is an active subunit of SWMU 81 (New Aerial Cable Facility). The site was constructed in 1970 and has been used for storage of test equipment associated with SWMU 81 subunits. SWMU 81E was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, SVOCs, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 9 (Burial Site/Open Dump [Schoolhouse Mesa] in OU 1334) is an inactive debris disposal area. SWMU 9 was characterized through a series of four investigations: 1) a CEARP in the mid-1980s, 2) an ER Preliminary Investigation in 1992, 3) preliminary RFI sampling in 1991, and 4) a radiological voluntary corrective measure (VCM) to excavate and remove buried materials between 1996 and 1998 followed by confirmatory sampling in 1999. The four investigations included a background review, a UXO/HE survey, radiological surveys and VCM excavations, a cultural resource survey, a sensitive species survey, and soil sampling data collection. Based on the field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, SVOCs, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for an industrial land use scenario.

- SWMU 117 (Trenches [Building 9939] in OU 1335) were disposal trenches that were dug to receive water runoff and reaction products resulting from water sprayed on residual solidified sodium metal in concrete test crucibles. Some solid waste items were also disposed of in one of the trenches. SWMU 117 was characterized through a series of three investigative stages: 1) a CEARP conducted in 1987, 2) ER Preliminary Investigations in 1994, 1995, 1997, and 1998, and 3) a VCA Remediation in 1999/2000. The three investigation stages included a background review, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, a geophysical survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, SVOCs, radionuclides) were present in concentrations or activity levels considered hazardous to human health or the environment for an industrial land use scenario.

REFERENCES

New Mexico Environment Department (NMED), March 1998. "RPMP Document requirement Guide," Hazardous and Radioactive Materials Bureau, RCRA Permits Management Program, New Mexico Environment Department, Santa Fe, New Mexico.

1.0 INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is proposing No Further Action (NFA) recommendations for ten Environmental Restoration Solid Waste Management Units (SWMU). The following SWMUs are listed in the Hazardous and Solid Waste Amendments Module IV of the SNL/NM Resource Conservation and Recovery Act Hazardous Waste Management Facility Permit (NM5890110518) (EPA August 1993). Proposals for each SWMU are located in this document as follows:

Operable Unit 1302

- SWMU 98, Building 863 TCA and Photochemical Release

Operable Unit 1332

- SWMU 82, Old Aerial Cable Site

Operable Unit 1333

- SWMU 60, Bunker Area
- SWMU 81A, Catcher Box/Sled Track
- SWMU 81B, Impact Pad
- SWMU 81D, Northern Cable Area
- SWMU 81E, Gun Impact Area
- SWMU 81F, Scrap Yard

Operable Unit 1334

- SWMU 9, Burial Site/Open Dump (Schoolhouse Mesa)

Operable Unit 1335

- SWMU 117, Trenches (Building 9939)

These proposals each provide a site description, history, summary of investigatory activities, and the rationale for the NFA decision, as determined from assessments predicting acceptable levels of risk under current and projected future land use.

REFERENCES

U.S. Environmental Protection Agency (EPA), August 1993. "Module IV of RCRA Permit No. NM5890110518-1," EPA Region VI, issued to Sandia National Laboratories, Albuquerque, New Mexico.

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11.0 SOLID WASTE MANAGEMENT UNIT 117, TRENCHES (BUILDING 9939)

11.1 Summary

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based No Further Action (NFA) decision for Environmental Restoration (ER) Solid Waste Management Unit (SWMU) 117, Operable Unit (OU) 1335. SWMU 117, Trenches (Building 9939) is located west of Lovelace Road approximately 0.3 miles south of Coyote Springs Road and one mile north of the solar tower on Kirtland Air Force Base (KAFB). Environmental concern for SWMU 117 is primarily based upon burial of solid or hazardous waste and containers with elemental sodium. Burial of materials at the site occurred in conjunction with test operations performed at the Large Melt Facility. Solid waste, hazardous waste, radioactive waste, and mixed waste were removed from SWMU 117 during 1999/2000 voluntary corrective action (VCA) activities.

Review and analysis of all relevant data for SWMU 117 indicate that concentrations of contaminants of concern (COC) are less than applicable risk-assessment action levels. Thus, SWMU 117 is being proposed for an NFA decision based upon confirmatory sampling data demonstrating that COCs released from this SWMU into the environment pose an acceptable level of risk under current and projected future land use, as set forth by NFA Criterion 5, which states, "the SWMU/AOC [area of concern] has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicated that contaminants pose an acceptable level of risk under current and projected future land use" (NMED March 1998).

11.2 Description and Operational History

This section describes SWMU 117 and discusses its operational history.

11.2.1 SWMU Description

The ER site boundary established around the SWMU 117 encompasses approximately 2.5 acres of federally owned land controlled by KAFB and permitted to the DOE (SNL/NM April 1995). SWMU 117 is located west of Lovelace Road about 0.3 miles south of Coyote Springs Road and one mile north of the solar tower (Figure 11.2.1-1).

The terrain in the vicinity of the site is generally flat with a gentle slope to the west and a shallow arroyo about 500 feet to the south. Vegetation is primarily desert grasses and tumbleweeds. The soil type identified in the area of Site 117 is a very fine sandy loam (SNL/NM March 1996).

SWMU 117, located along the western margin of the Manzanita Mountains, is situated on a partially dissected coalescent alluvial fan complex that flanks the mountain front to the west. Late Pleistocene pediment and alluvial fan deposits have been mapped in the area of the site. Depth to bedrock is interpreted to be shallow in this area. Surface exposures of Precambrian bedrock are present in arroyo bottoms and in intervening ridges along the northern edge of OU 1335. A complex structural geologic setting occurs in the vicinity of the site. SWMU 117 is

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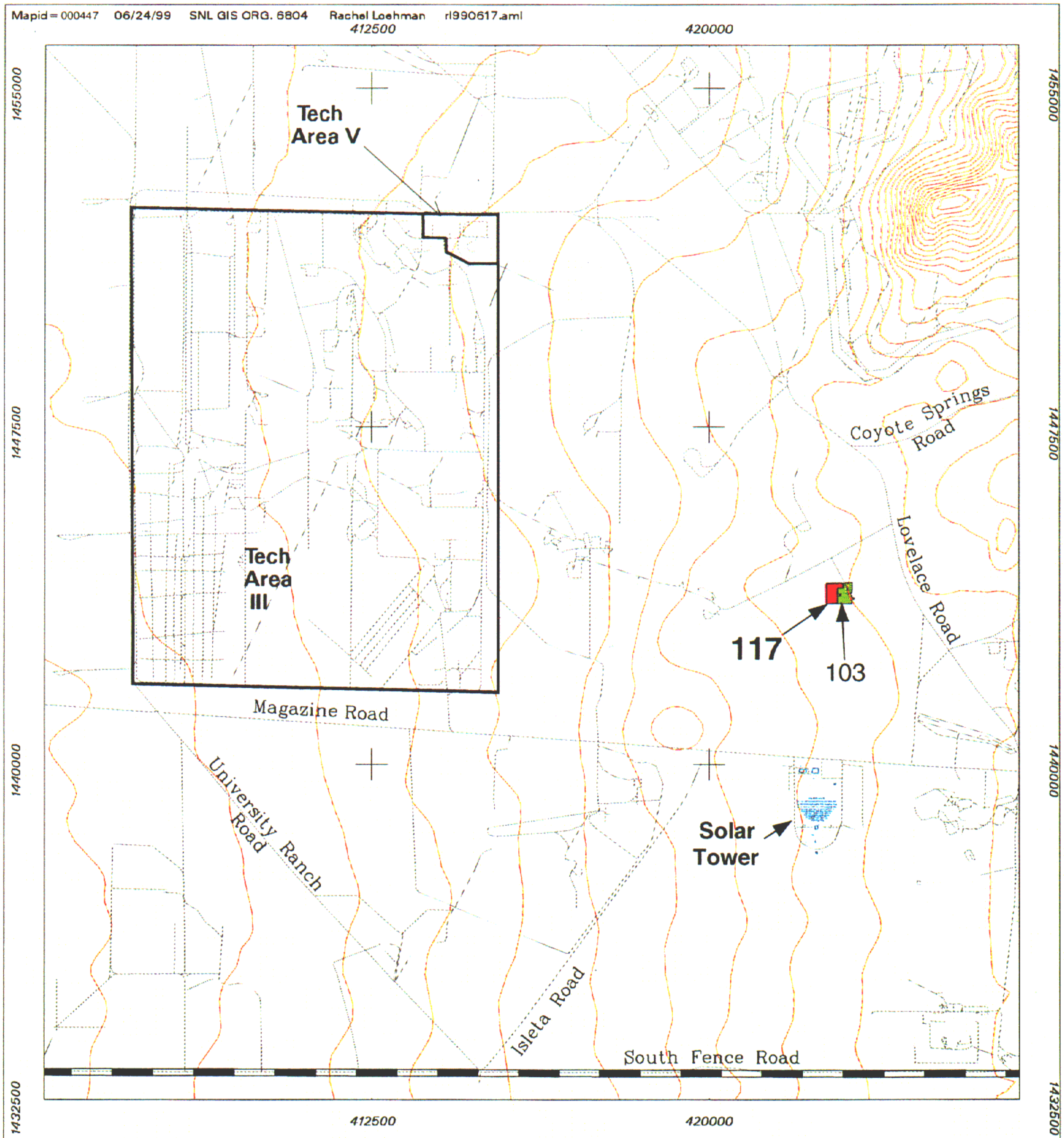


Legend

- 40 Ft Contour
- Road
- KAFB Boundary
- Tech Area Boundary
- SWMU 103
- SWMU 117
- Building/Structure

Figure 11.2.1-1
SWMU 117 Location Map
OU 1335, Southwest Test Area

0 1800 3600
Scale in Feet

0 432 864
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System

located slightly east of a series of north- and northeast-trending faults that occur along the front of the Four Hills and Manzanita Mountains. These faults are part of the major rift-bounding fault complex present along the eastern margin of the Albuquerque Basin (SNL/NM March 1996).

Surface water runoff in the vicinity of the site is minor because the surface slope is flat to gently inclined. No perennial surface water bodies are present in the vicinity of SWMU 117. Average annual rainfall on OU 1335 is 8 to 10 inches. Based on soil samples collected near adjacent SWMU 74 (The Chemical Waste Landfill), soil moisture content in this area is likely in the range of 1 and 10 percent, with 5 or 6 percent a reasonable average (SNL/NM March 1996).

Depth to ground water measured in the closest monitoring well (LMF-1), which is located approximately 1,400 feet north of the site, is 350 feet below ground surface. Groundwater in well LMF-1 (now plugged and abandoned) occurs in the bedrock Abo Sandstone Formation (SNL/NM March 1996). The nearest production well, KAFB-4, is located approximately 5 miles northwest of the site. Additional detailed information concerning the geologic and hydrologic characteristics in the area of Site 117 are presented in the OU 1335 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan (SNL/NM Mach 1996) and Site Wide Hydrogeologic Characterization Report, Calendar Year 1994, Annual Report (SNL/NM March 1995).

Environmental concern for SWMU 117 is primarily based upon burial of solid or hazardous waste and containers with elemental sodium. Burial of materials at the site occurred in conjunction with test operations performed at the Large Melt Facility.

11.2.2 Operational History

The trenches at Building 9939 are associated with the adjacent Large Melt Facility (SWMU 103), an inactive site that was once used to test simulated nuclear reactor meltdown scenarios. Some of the scenario tests monitored concrete interactions with various metal melts. A number of the tests involved pouring molten sodium metal into concrete crucibles. A spray mist of water was used to react and remove any remaining solidified sodium metal in the concrete crucible following testing. Disposal trenches were dug at Site 117 to receive the reacted sodium (i.e., sodium hydroxide) and water mixture that was washed out of the concrete crucibles. Historical site information indicates that two to five sodium disposal trenches were used (Bentz October 1995, DOE September 1987). Following disposal activities the trenches were covered with soil.

Historical records and technical memoranda provide a significant level of process knowledge concerning the operations conducted at the Large Melt Facility. The Large Melt Facility was built in 1971 and was originally designed as an explosives fabrication site but was never used for that purpose. In early 1977, the facility was adapted to conduct molten core concrete interaction studies sponsored by the Nuclear Regulatory Commission (NRC). SNL/NM used the facility to conduct experiments supporting reactor safety programs for customers such as the NRC, the DOE, and Westinghouse Savannah River Laboratories.

The site history for the Large Melt Facility (SWMU 103) is discussed in detail in Section 5.5 of the RFI Work Plan (SNL/NM March 1996). A risk-based NFA proposal (SNL/NM June 1998) has been recommended for approval for SWMU 103 by the New Mexico Environment Department (NMED) (Kieling March 2000).

The Large Melt Facility performed reactor safety studies funded by the NRC. SNL/NM provided the facility for sodium containment and structural integrity tests for the proposed Clinch River Fast Breeder Reactor at Oak Ridge, Tennessee.

Fifteen large-scale tests with sodium metal were conducted at the Large Melt Facility between 1977 and 1981. Each test used from 100 to 200 pounds of sodium. Following the tests, crucibles containing residual sodium were moved to the "Crucible Spray Pit." The residual sodium in the crucibles was rinsed with a spray mist of water. The reacted sodium was washed out of the crucibles and into the spray pits. The elemental sodium metal used for the tests was stored in drums or smaller containers. Historical records indicated that there was a potential for discarded test items (debris) and (a) storage container(s) with elemental sodium to be buried in the disposal pits (trenches) area. Some tests performed at the Large Melt Facility used depleted uranium (DU), but disposal practices associated with these tests were not known to involve use of the sodium disposal trenches.

In July 1999, a VCA was conducted at Site 117 in the sodium disposal trench area (Figure 11.2.2-1). The VCA resulted in the removal of all buried debris within the site, and confirmatory samples were collected to verify that no COCs occurred in the soil associated with or underlying the debris. The buried debris items that were removed consisted mainly of concrete crucible fragments, bricks, scrap metal, electrical wiring, wood, and plastic materials. The excavated debris is discussed in more detail in Section 11.4.4.2.2.

11.3 Land Use

This section discusses the current and projected future land use for SWMU 117.

11.3.1 Current Land Use

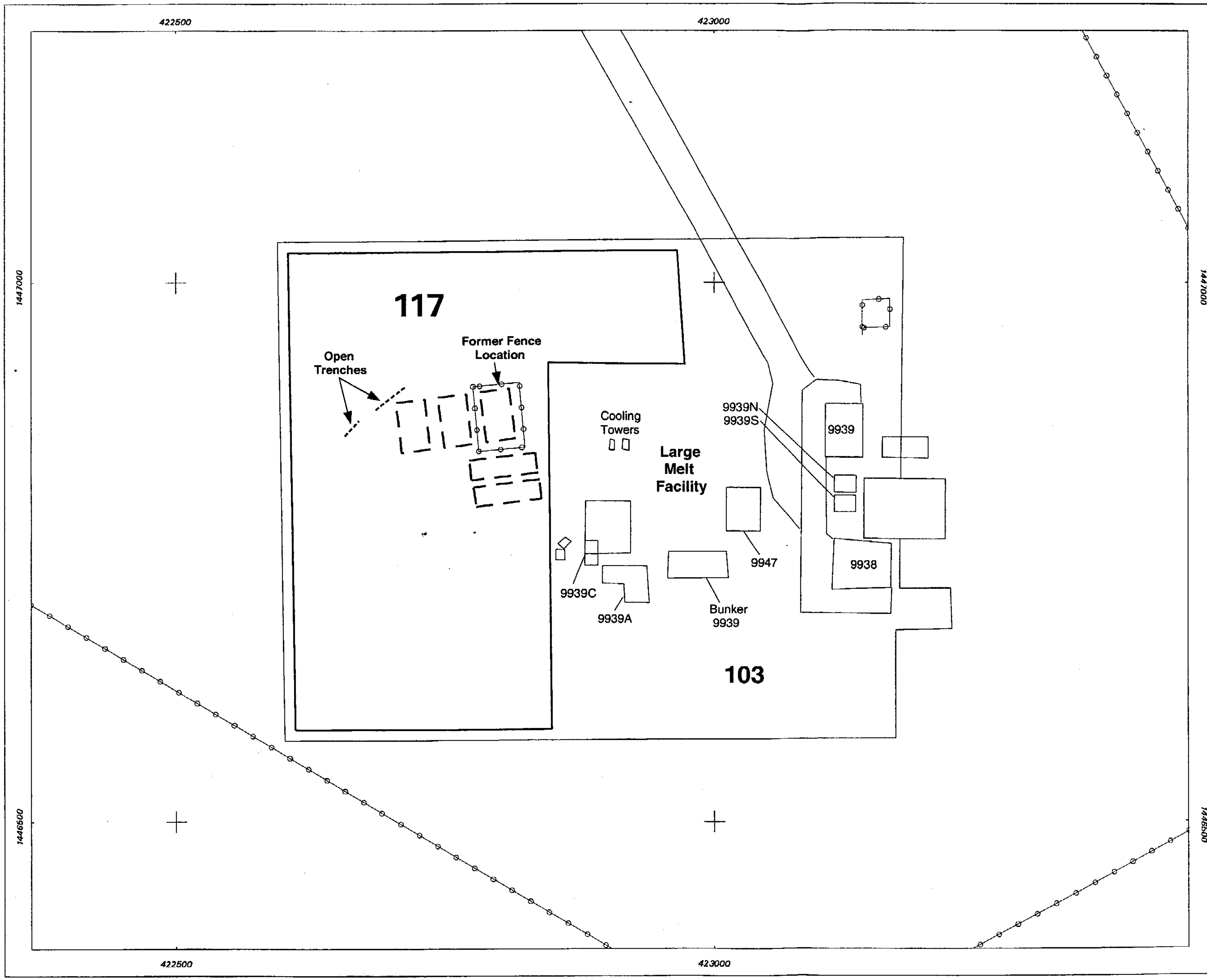
The current land use of SWMU 117, located on federally owned land permitted to the DOE by the U.S. Forest Service within the boundaries of KAFB, is industrial (Figure 11.3.1-1). After the cessation of testing at the Large Melt Facility in 1992, no other land activities have occurred. Discussions are underway to determine the future use of the Large Melt Facility. Except for occasional ER Project activities in the 1990s, SWMU 117 has been inactive. The site is not fenced and, because of its remote location, is infrequently visited by non–ER Project personnel.

11.3.2 Future/Proposed Land Use

The projected land use for SWMU 117 is industrial (DOE et al. September 1995).

11.4 Investigatory Activities

Three principle investigations of SWMU 117 have been conducted. A review of these investigations is included in the following discussion.



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Environmental Operations Geographic Information System

Figure 11.2.2-1
SWMU 117 - Covered Sodium Disposal Trench Locations

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

1"=100'	1:1200	MAPID= 000446
		SNL GIS ORG. 6804
Rachel Loehman	dh960392.aml	6/24/99

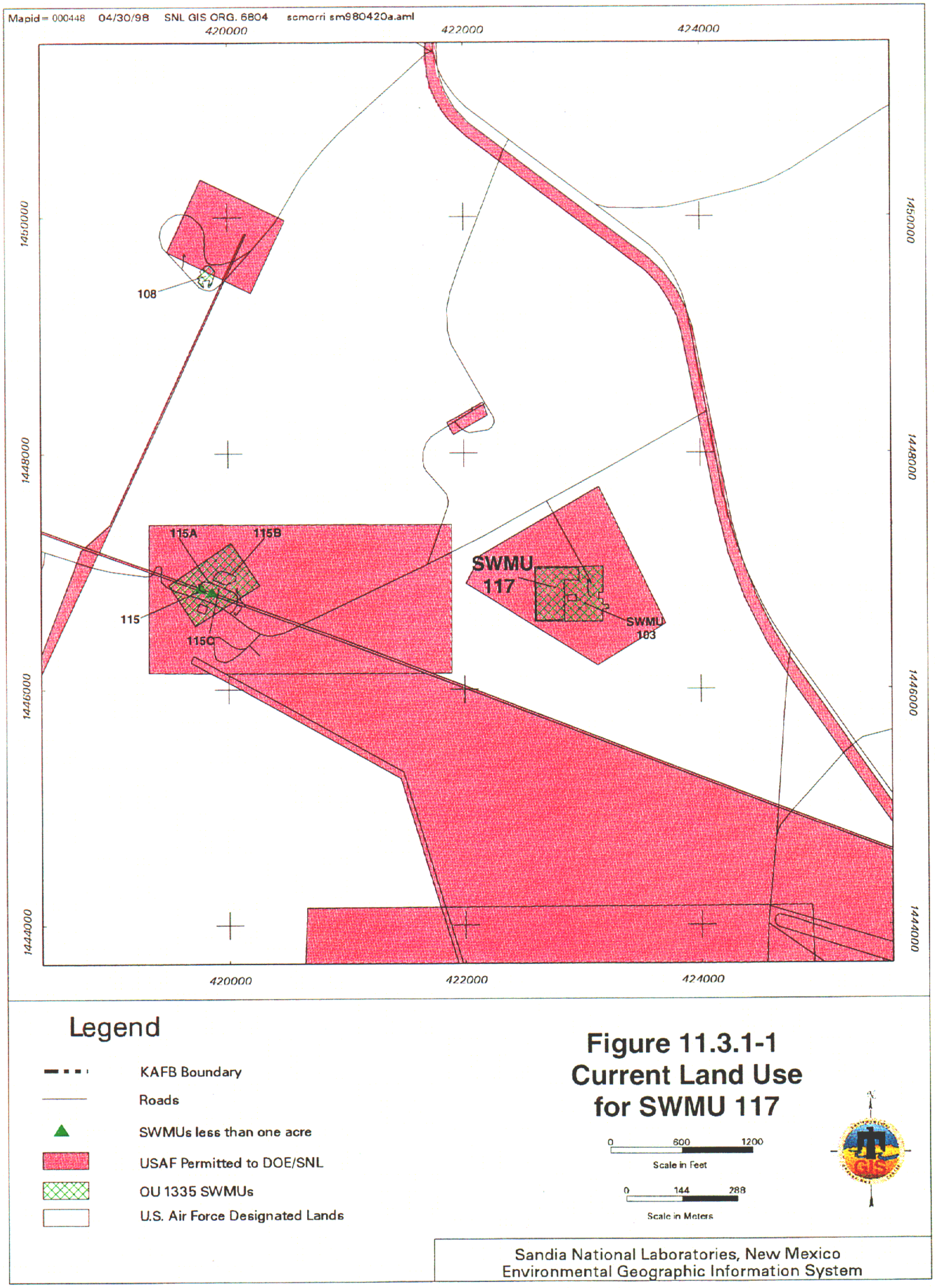

Figure 11.3.1-1
Current Land Use for SWMU 117

11.4.1 Summary

SWMU 117 was initially investigated under the DOE Comprehensive Environmental Assessment and Response Program (CEARP) in the mid-1980s in conformance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (Investigation #1). From 1994 through early 1998, various surveys and sampling activities were conducted as part of SNL/NM ER project preliminary site investigations (Investigation #2). Preliminary ER activities at SWMU 117 included an unexploded ordnance (UXO)/high explosives (HE) survey, cultural resource and sensitive species surveys, surface radiological survey and removal of radioactive surface contamination, surface soil scoping sampling, and a geophysical survey. From mid-1999 through early 2000, a thorough VCA with confirmatory sampling was conducted at SWMU 117 (Investigation #3).

11.4.2 Investigation #1—CEARP

11.4.2.1 Nonsampling Data Collection

SWMU 117 was identified as a potential SWMU in the 1987 CEARP (DOE September 1987) and in the RFA (EPA April 1987).

11.4.2.2 Sampling Data Collection

No sampling activities were conducted at SWMU 117 as part of the CEARP effort.

11.4.2.3 Data Gaps

No data were available to confirm whether hazardous materials or wastes were stored or released to the surrounding environment.

11.4.2.4 Results and Conclusions

The CERCLA findings were uncertain for the Federal Facility Site Discovery and Identification Findings, the Preliminary Assessment, and the Preliminary Site Inspection. As a result, insufficient information was available to calculate a hazard ranking score.

11.4.3 Investigation #2—SNL/NM ER Project Preliminary Investigations

11.4.3.1 Nonsampling Data Collection

The nonsampling data-collection activities included a background review, a UXO/HE survey, cultural resources and sensitive-species surveys, radiological survey, and a geophysical survey.

11.4.3.1.1 Background Review

A background review was conducted to collect available and relevant information regarding SWMU 117. Background information sources included interviews with SNL/NM staff and contractors who were familiar with site operational history and existing historical site records and reports. The study was completely documented and has provided traceable references that sustain the integrity of this proposal. The OU 1335 RCRA Facility Investigation Work Plan provides a complete discussion concerning the sources of background information that were used to assist in the evaluation of SWMU 117 (SNL/NM March 1996).

11.4.3.1.2 Unexploded Ordnance/High Explosives Survey

In February 1994, KAFB Explosive Ordnance Disposal personnel conducted a visual survey for the presence of UXO and HE on the ground surface at SWMUs 117 and 103. No UXO or HE was found as a result of this survey (Young and Byrd September 1994).

11.4.3.1.3 SNL/NM ER Project Surface Radiological Survey

Because the Large Melt Facility (SWMU 103) used DU in its testing operations, RUST-Geotech conducted a surface radiation survey of SWMUs 103 and 117 using sodium iodide detectors for gamma radiation (SNL/NM September 1997). This walk-over survey covered 6.3 acres at 100% coverage (Figure 11.4.3-1). Twelve area source anomalies, two fragment source anomalies, and one fragment area source anomaly were located with gamma radiation activity ranging from 13 to 198 microRoentgens per hour. One of the area sources (103E+06) identified in the survey occurred on the surface in the vicinity of the SWMU 117 sodium trenches (Figure 11.4.3-1). In 1995, SNL/NM implemented a voluntary corrective measure (VCM) for the removal of surface radiation anomalies at SWMUs 103 and 117. All fragments of depleted uranium and surface soil areas with gamma radiation activity of 30 percent or greater than background were removed as part of the Rust Geotech Radiological VCM (SNL/NM September 1997). Gamma spectroscopy analytical results of soil samples collected following the removal of radioactive fragments and soil from SWMUs 103 and 117 are presented in Section 11.4.3.2.2. Based on post-cleanup radiological VCM sampling results, the Large Melt Facility (SWMU 103) was approved for removal from the SNL/NM listing as a radioactive material management area.

11.4.3.1.4 Cultural Resources Survey

A cultural resources survey was conducted as part of the preliminary investigations conducted both at SWMUs 117 and 103. No cultural resources were identified at, or in the vicinity of, SWMU Site 117 (Hoagland and Dello-Russo February 1995).

11.4.3.1.5 Sensitive-Species Surveys

A sensitive-species survey was conducted as part of a biological assessment of SWMUs 117 and 103. No sensitive species were found at or in the vicinity of SWMUs 117 and 103 (DOE March 1996).

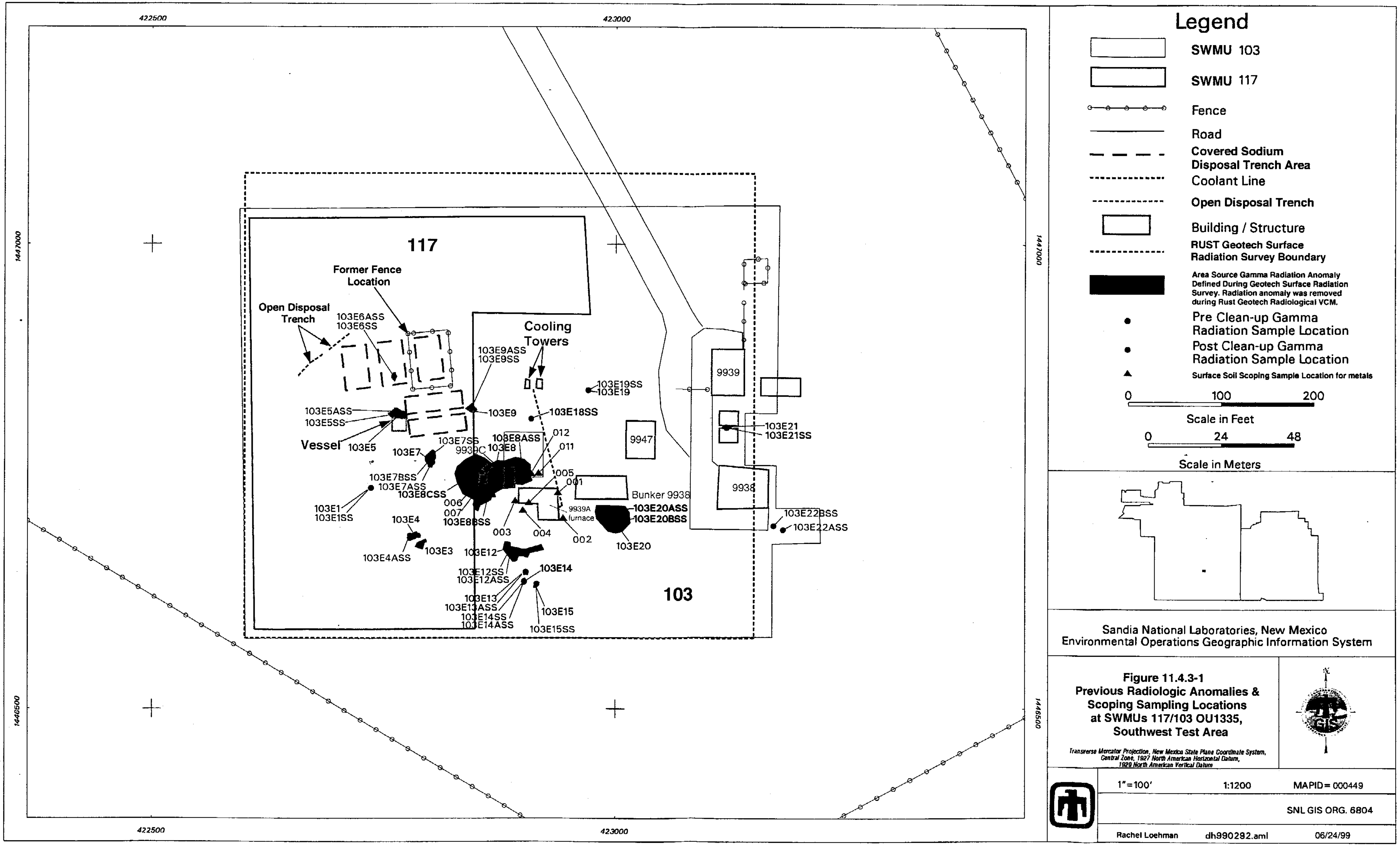

Figure 11.4.3-1
Previous Radiologic Anomalies & Scoping Sampling Locations at SWMUs 117/103 OU1335, Southwest Test Area

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

1"=100'	1:1200	MAPID=000449
		SNL GIS ORG. 6804
Rachel Loehman	dh990292.aml	06/24/99

11.4.3.1.6 Geophysical Surveys

An initial geophysical survey covering SWMU 117 was performed in April 1997. An extension of the original survey was performed in January 1998. The geophysical investigation of SWMU 117 consisted of a high-precision metal detection survey using a Geonics, Ltd., EM-61, and a ground conductivity survey using a Geonics, Ltd., EM-31. The initial EM-61 survey covered an area of 280 by 200 feet. The initial EM-31 survey covered a larger area measuring 470 by 200 feet. Both EM-61 and EM-31 surveys were extended by 72 feet to the south. The surveyed region covered the entire area that was considered for the SWMU 117 VCA. Results of the initial and extension geophysical surveys were presented in a summary report (Hyndman February 1998) and SWMU 117 VCA Plan (SNL/NM July 1999).

The EM-31 ground conductivity survey results showed large anomalies occupying broad areas, suggesting a response to geologic and topographic conditions. They also were not coincident with any of the locations of the sodium disposal trench locations that had been indicated by previous site workers.

Results of the EM-61 metal detection survey, shown in Figure 11.4.3-2, provided useful data, indicating several significant metal anomalies. EM-61 measurements can detect metallic materials to a depth of approximately 10 feet below ground surface (bgs). The largest anomaly identified corresponds to a shallow, open trench that was located northwest of the sodium disposal trenches. On the surface, this open trench consisted of two separate segments (Figure 11.4.3-3); the survey results indicated buried material below the section of ground between the segments. Subsequent excavation of this open trench during the Site 117 VCA confirmed the geophysical results. The two significant metal anomalies located directly south and west of the sodium disposal area represent rebar-reinforced concrete crucibles, a metal box-like structure, and a corrugated steel test vessel that was being stored on-site during the time of the geophysical survey (Figure 11.4.3-2). The open blank (white) display on the geophysical map is present because the survey coverage had to be diverted around these surface features. The crucibles and corrugated steel test vessel have been removed from the site. The metal box-like structure is presently in the same location.

The locations of all the metal anomalies identified in the EM-61 geophysical survey were reconfirmed by resurveying the anomaly areas using a hand-held Shonstedt metal detector (model number GA-72Cv) in December 1998. This device can only locate ferrous metals, can be adjusted to variable sensitivities, and can detect large buried objects such as drums to depths of 7 feet. The surface characteristics of each anomaly were documented, and the shallow anomalies were dug up to determine the sources. During this follow-up survey, small metallic sources such as nails and cans were identified and removed from the site. If the anomaly was large, it was left in place and the location was flagged for removal during the SWMU 117 VCA. Each area also was surveyed for radioactivity using a Geiger-Mueller pancake probe. Information concerning the characteristics of each anomaly that was identified was recorded. Results of this follow-up investigation are presented on Figure 11.4.3-2 and Table 11.4.3-1. A detailed visual inspection of anomaly N, which consisted of materials within the open trench, was performed on March 22, 1999. All of the metal anomalies indicated by the EM-61 geophysical survey were located and associated with surface or shallow subsurface materials. Partially buried item G (pipe stand and rubble pile) and E (crushed and rusted drum) (Figure 11.4.3-4), which were located in two of the sodium disposal trench locations (Figure 11.4.3-2), as well as the items in the shallow open trench, were excavated during the SWMU 117 VCA.

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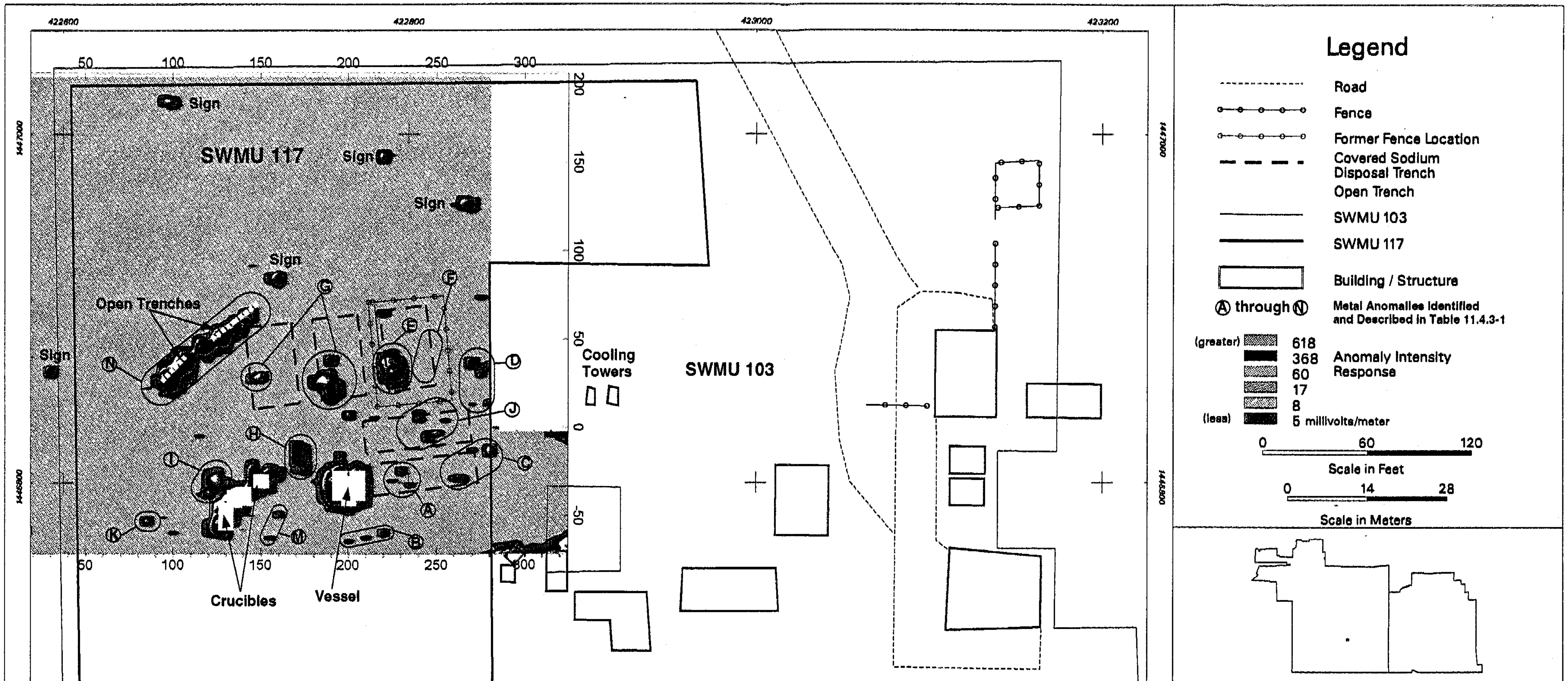

Sandia National Laboratories, New Mexico
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Figure 11.4.3-2
Investigation of EM-61 Metal Detection Results for SWMU 117 OU 1335 Test Area

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

MAPID = 000450

SNL GIS ORG. 6804

Rachel Loehman r990622.aml 06/24/99

Figure 11.4.3-3
Segmented Open Disposal Trench Containing Miscellaneous Test Debris.

Table 11.4.3-1
Results of the Follow-up Investigation of EM-61 Metal Detections, SWMU 117 VCA

Location	Finding	Gamma Radiation Survey Results
A	Pin flag from previous survey, buried wire, and nails	Radiation levels at background
B (two areas)	Buried wire and nails, miscellaneous bolts	Radiation levels at background
C	An area of iron-bearing gravel, which appears to be concrete fragments originating from one of the crucibles	Radiation levels at background
D	Rubble pile and partially buried concrete slab with rebar	Radiation levels at background
E	Drum, crushed and rusted in sodium pit area	Radiation levels at background
F	East of partial burial anomaly containing low-grade metallic anomaly, contents unknown	Radiation levels at background
G	Rubble pile near pipe stand containing nails, iron-bearing gravel (see Anomaly C), and bolts	Radiation levels at background
H	Iron-bearing concrete fragments from crucible; several anomalies	Radiation levels at background
I	Rubble pile containing several anomalies, including scrap rusted five-gallon buckets	Radiation levels at background
J	Gravel and concrete from crucibles	Radiation levels at background
K and L	Could not locate these anomalies	Could not locate
M	Gravel and concrete from crucibles	Radiation levels at background
N	Small concrete crucible (~ 2-foot diameter), partially buried metal container (~ 2.5-foot diameter), one-gallon cans, bricks, wood, concrete crucible rubble, metallic slag, concrete plugs with metal pipe at core	Not measured (March 1999)

EM-61 = A high-precision metal detection instrument made by Geonics, Ltd.
VCA = Voluntary corrective action.

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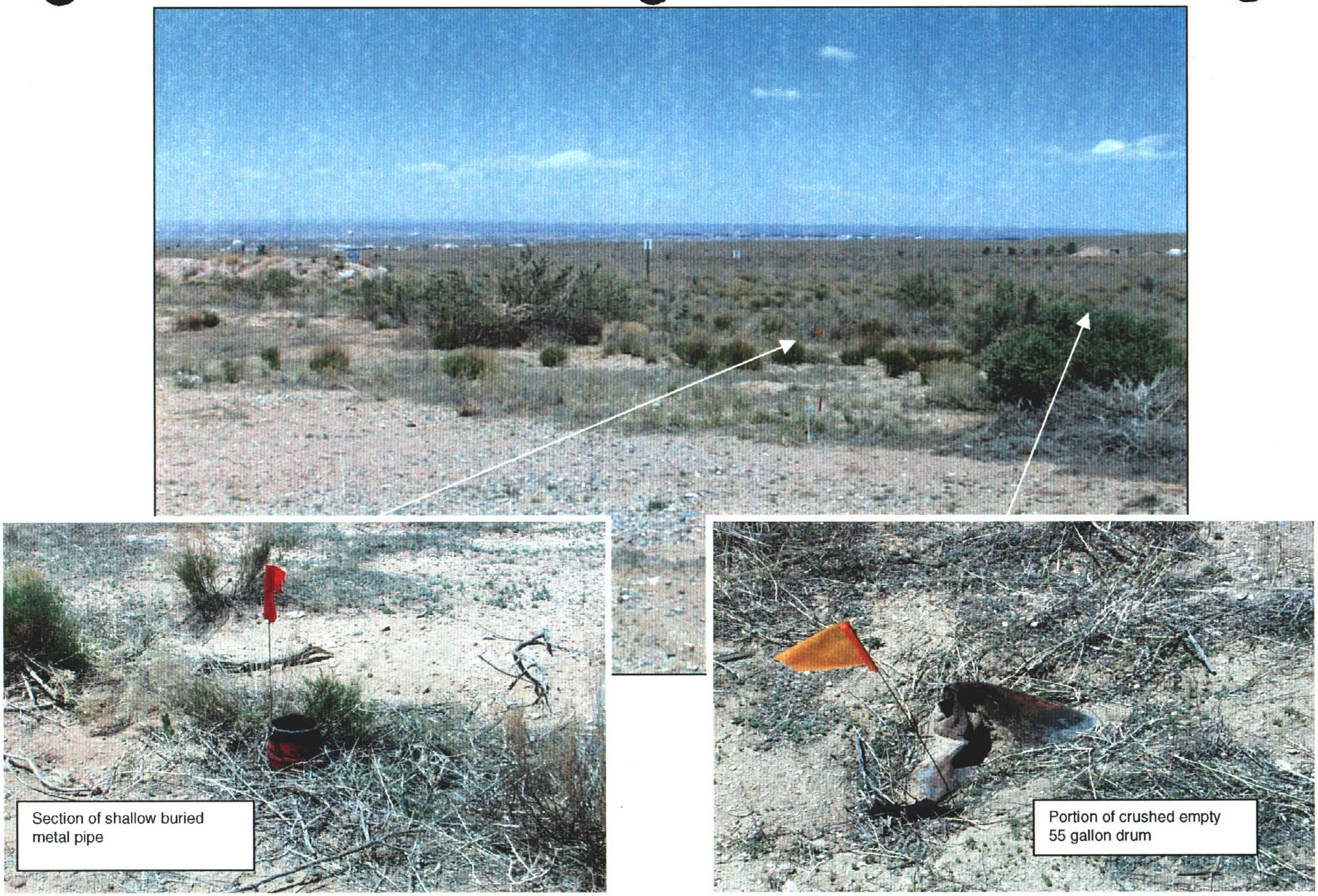

Figure 11.4.3-4
General View of Site and Closeup of Two Partially Buried Debris Items Identified by Geophysics and Removed During the VCA.

11.4.3.2 Project Sampling Data Collection

11.4.3.2.1 Site-Specific Background Sampling

No site-specific background sampling was conducted for SWMU 117; instead, the NMED-approved background values are used for this NFA proposal.

11.4.3.2.2 Post Radiation VCM Verification Sampling

After removal of radiologically contaminated surface soil and depleted uranium fragments at Sites 103 and 117 as part of the RUST-Geotech Radiological VCM, 13 post clean-up (verification) soil samples were collected (SNL/NM September 1997). Surface soil samples were taken from locations where point and area source radiologic anomalies had been removed (see Figure 11.4.3-1).

11.4.3.2.3 Surface Soil Scoping Sampling

SNL/NM conducted a scoping sampling investigation of SWMUs 117 and 103 in July 1995. This sampling program focused on collecting surface soil samples in areas that would have the greatest potential for a release to the environment as the result of testing operations at the Large Melt Facility. Soil samples were collected from a depth of 0 to 6 inches bgs at 12 locations and were analyzed for metals. Nine samples (001, 002, 003, 004, 005, 006, 007, 011, and 012) were collected around test structures or buildings associated with operations at the Large Melt Facility (SWMU 103). Three samples (008, 009, and 010) were collected adjacent to a test structure that was being staged next to the sodium disposal trenches. No surface soil scoping samples were collected in the areas identified as the sodium disposal trenches. Sample locations are shown on Figure 11.4.3-1.

11.4.3.3 Data Gaps

The soil sample investigations focused on collecting analytical data representative of the surface soil in areas adjacent to SWMU 117. Because no subsurface soil samples were collected within SWMU 117, it could not be determined if potential constituents of concern were associated with buried debris. Data gathered from the geophysical survey of SWMU 117 provided information concerning the locations of areas with buried debris, but could not establish the total depth, quantity, or waste characteristics of buried materials.

11.4.3.4 Results and Conclusions

Table 11.4.3-2 summarizes the laboratory gamma spectroscopy analytical results for SWMU 117 from the post-radiation VCM sampling event. Uranium-238 was detected or the minimum detectable activity (MDA) exceeded the background concentration in six surface soil samples collected in the vicinity of SWMU 117. The uranium-238 activity measured ranged from 3.72 to 31.4 picocuries per gram (pCi/g).

Table 11.4.3-2
SWMUs 117 and 103 Post Radiation VCM Clean-Up Gamma Spectroscopy Sampling Results
March–September 1995
(On-Site Laboratory)

Sample Attributes			Activity (pCi/g)			
Record Number[a]	ER Sample ID (Figure 11.4.3-1)	Sample Depth (ft)	Cesium-137	Thorium-232	Uranium-235	Uranium-238
01351	103E1-SS	0–0.5	ND (2.92E-02)	5.16E-01	**8.83E-01**	**3.14E+01**
01305	103E4A-SS	0–0.5	4.71E-02	2.83E-01	ND (3.47E-01)	ND (4.51E+00)
01305	103E5A-SS	0–0.5	ND (5.64E-02)	3.77E-01	ND (4.36E-01)	**1.09E+01**
01305	103E6A-SS	0–0.5	2.24E-02	7.21E-01	ND (4.83E-01)	**3.72E+00**
01305	103E7A-SS	0–0.5	3.69E-02	3.52E-01	ND (4.06E-01)	**8.73E+00**
01305	103E7B-SS (duplicate)	0–0.5	ND (5.85E-02)	2.65E-01	**3.37E-01**	**1.29E+01**
01305	103E9A-SS	0–0.5	2.60E-01	5.52E-01	ND (4.46E-01)	**4.50E+00**
Background Soil Activities—Southwest Test Area[b]			6.64E-01	1.01E+00	ND (1.60E-01)	1.40E+00

Note: Values in **bold** exceed background soil activities.
[a]Analysis request/chain-of-custody record.
[b]Dinwiddie September 1997.
ER = Environmental Restoration.
ft = Foot (feet).
ND ( ) = Not detected at or above the minimum detectable activity, shown in parentheses.
pCi/g = Picocurie(s) per gram.
SS = Surface soil sample.
SWMU = Solid Waste Management Unit.
VCM = Voluntary Corrective Measure.

A radiological risk assessment was performed using the analytical results for the surface soil samples collected from SWMUs 117 and 103. Results of the risk assessment indicated an acceptable risk based on the measured radionuclide concentrations. Both sites have been approved by DOE and the SNL/NM Radioactive Waste Management Department for removal from the SNL/NM's radioactive material management area listing.

Analytical results for metals from the surface soil scoping sampling are presented in Table 11.4.3-3. No elevated metal concentrations were noted in the three samples (008, 009, and 010) that were collected adjacent to the structure located near the sodium disposal trenches.

The analytical results for metals and radionuclides compiled from these sampling events were submitted with a No Further Action Proposal for SWMU 103, which has been recommended for approval by the NMED (Kieling March 2000). Based on the results of samples collected as part of the post-radiation VCM and on surface soil scoping sampling, it was anticipated that no elevated radionuclide or RCRA metal concentrations would be found in the soil within the sodium disposal trenches.

EM-61 metal detection geophysical results identified areas with buried debris in and adjacent to the sodium disposal trench area. These areas were targeted for excavation as part of the SWMU 117 VCA.

11.4.4 Investigation #3—VCA Remediation

11.4.4.1 Nonsampling Data Collection

Investigation #3 consisted of the VCA remediation at SWMU 117.

11.4.4.1.1 Archival Research

Available archival information collected for the Operable Unit 1335 RCRA Facility Investigation (SNL/NM March 1996) was used during development of the SWMU 117 VCA Plan (SNL/NM July 1999). Former facility workers from the Large Melt Facility were consulted to assist in identification of buried materials that were excavated and removed from the site during the VCA.

11.4.4.2 Sampling Data Collection

The sampling data collection activities for Investigation #3 included VCA activities and NFA confirmatory sampling, as described in this section.

11.4.4.2.1 VCA Remediation Activities

The purpose of the SWMU 117 VCA was to remove all solid, hazardous, or radioactive waste buried at the site, rendering it suitable for continued industrial use. Before beginning the VCA remediation, the SWMU 117 VCA Plan was submitted to the NMED in July 1999 (SNL/NM July 1999).

Table 11.4.3-3
Summary of SWMUs 117 and 103 Surface Soil Scoping Metals Analytical Results
July 1995
(On- and Off-Site Laboratories)

Sample Attributes			Metals (EPA Methods 6010 and 7471A)[a] (mg/kg)									
Record Number[b]	ER Sample ID (Figure 11.4.3-1)	Sample Depth (ft)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper
508933	103-GR-001-0-SS (on-site laboratory)	0.0–0.5	9500	ND (10)	ND (50)	**190**	ND (0.11)	ND (10)	51000	ND (10)	ND (10)	**24**
508933	103-GR-002-0-SS (on-site laboratory)	0.0–0.5	5200	ND (10)	ND (50)	**150**	ND (0.11)	ND (10)	53000	ND (10)	ND (10)	**24**
508933	103-GR-003-0-SS (on-site laboratory)	0.0–0.5	4700	ND (10)	ND (50)	**170**	ND (0.11)	ND (10)	58000	**27 J (38)**	ND (10)	ND (20)
508933	103-GR-004-0-SS (on-site laboratory)	0.0–0.5	3200	ND (10)	ND (50)	79	ND (0.11)	ND (10)	25000	**220**	**27**	ND (20)
508933	103-GR-005-0-SS (on-site laboratory)	0.0–0.5	3900	ND (10)	ND (50)	**180**	ND (0.11)	ND (10)	67000	ND (10)	ND (10)	ND (20)
508933	103-GR-006-0-SS (on-site laboratory)	0.0–0.5	5400	ND (10)	ND (50)	130	ND (0.11)	ND (10)	57000	ND (10)	ND (10)	ND (20)
508933	103-GR-007-0-SS (on-site laboratory)	0.0–0.5	4100	ND (10)	ND (50)	**160**	ND (0.11)	ND (10)	61000	ND (10)	ND (10)	ND (20)
508933	103-GR-008-0-SS (on-site laboratory)	0.0–0.5	5700	ND (10)	ND (50)	87	ND (0.11)	ND (10)	22000	ND (10)	ND (10)	ND (20)
508933	103-GR-009-0-SS (on-site laboratory)	0.0–0.5	4200	ND (10)	ND (50)	130	ND (0.11)	ND (10)	25000	ND (10)	ND (10)	ND (20)
508933	103-GR-010-0-SS (on-site laboratory)	0.0–0.5	4400	ND (10)	ND (50)	64	ND (0.11)	ND (10)	12000	ND (10)	ND (10)	ND (20)
508933	103-GR-010-0-SSD (on-site laboratory)	0.0–0.5	4800	ND (10)	ND (50)	77	ND (0.11)	ND (10)	19000	ND (10)	ND (10)	ND (20)
508933	103-GR-011-0-SS (on-site laboratory)	0.0–0.5	3600	ND (10)	ND (50)	90	ND (0.11)	ND (10)	34000	ND (10)	ND (10)	ND (20)
508933	103-GR-012-0-SS (on-site laboratory)	0.0–0.5	3900	ND (10)	ND (50)	**170**	ND (0.11)	ND (10)	71000	ND (10)	ND (10)	ND (20)
03981	103-GR-012-0-SS (off-site laboratory)	0.0–0.5	8900	ND (12)	**6.0**	**220**	ND (1.0)	ND (1.0)	62000	34	ND (10)	**16**
508933	103-GR-012-0-SSD (on-site laboratory)	0.0–0.5	4200	ND (10)	ND (50)	**140**	ND (0.11)	ND (10)	59000	ND (10)	ND (10)	ND (20)
03981	103-GR-012-0-SSD (off-site laboratory)	0.0–0.5	5300	ND (12)	4.1	**130**	ND (1.0)	ND (1.0)	46000	6.9	ND (10)	8.6
Background Soil Concentrations—Southwest Test Area[c]			NA	3.9	5.6	130	0.65	<1	NA	17.3	5.2	15.4

Refer to footnotes at end of table.

Table 11.4.3-3 (Concluded)
Summary of SWMUs 117 and 103 Surface Soil Scoping Metals Analytical Results
July 1995
(On- and Off-Site Laboratories)

Sample Attributes			Metals (EPA Methods 6010 and 7471A)[a] (mg/kg)										
Record Number[b]	ER Sample Location (Figure 11.4.3-1)	Sample Depth (ft)	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
508933	103-GR-001-0-SS (on-site laboratory)	0.0–0.5	12000	16	5600	240	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	14	**100**
508933	103-GR-002-0-SS (on-site laboratory)	0.0–0.5	91000	**28**	5100	200	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	ND (10)	**91**
508933	103-GR-003-0-SS (on-site laboratory)	0.0–0.5	7200	**25**	5900	140	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	11	**84**
508933	103-GR-004-0-SS (on-site laboratory)	0.0–0.5	8600	**52**	26000	180	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	ND (10)	**160**
508933	103-GR-005-0-SS (on-site laboratory)	0.0–0.5	5500	ND (10)	9000	110	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	16	59
508933	103-GR-006-0-SS (on-site laboratory)	0.0–0.5	6300	ND (10)	3600	110	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	14	26
508933	103-GR-007-0-SS (on-site laboratory)	0.0–0.5	5700	ND (10)	4200	120	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	14	43
508933	103-GR-008-0-SS (on-site laboratory)	0.0–0.5	7000	ND (10)	2600	120	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	ND (10)	17
508933	103-GR-009-0-SS (on-site laboratory)	0.0–0.5	6300	10	2600	120	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	ND (10)	41
508933	103-GR-010-0-SS (on-site laboratory)	0.0–0.5	6200	10	2000	130	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	ND (10)	15
508933	103-GR-010-0-SSD (on-site laboratory)	0.0–0.5	6700	10	2300	140	10	10	10	10	10	10	15
508933	103-GR-011-0-SS (on-site laboratory)	0.0–0.5	5300	10	2700	99	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	ND (10)	24
508933	103-GR-012-0-SS (on-site laboratory)	0.0–0.5	5600	10	4100	110	ND (0.02)	ND (4.0)	ND (50)	ND (10)	ND (200)	11	28
03981	103-GR-012-0-SS (off-site laboratory)	0.0–0.5	14000	10	6700	170	10	8.2	10	10	10	27	**120**
508933	103-GR-012-0-SSD (on-site laboratory)	0.0–0.5	7000	10	3600	180	10	10	10	10	10	10	30
03981	103-GR-012-0-SSD (off-site laboratory)	0.0–0.5	8300	10	3700	150	10	10	10	10	10	17	31
Background Soil Concentrations—Southwest Test Area[c]			NA	21.4	NA	NA	<0.1	11.5	<1	<1	<1.1	20.4	62

Note: Values in **bold** exceed background soil concentrations.

[a]EPA November 1986.

[b]Analysis request/chain-of-custody record.

[c]Dinwiddie September 1997.

EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.

mg/kg = Milligram(s) per kilogram(s).
NA = Not applicable for this site; there is no established background concentration.
ND = Not detected.

SS = Surface soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.

Permits

A penetration/dig permit (# 9906-173) was obtained from SNL/NM Facilities Engineering prior to initiating excavation operations.

Strategy

The principal VCA activities were (1) the excavation of buried test debris, (2) confirmatory sampling of the soil underlying buried debris and the soil piles generated by the excavation, and (3) segregation of waste into hazardous, radioactive, mixed, or solid waste.

Figure 11.4.4-1 shows the location of the target geophysical anomalies, the covered sodium disposal pits, and the exploratory trench locations that were proposed for the SWMU 117 VCA (SNL/NM July 1999). The five covered sodium disposal trench areas delineated on Figure 11.4.4-1, as well as the sodium disposal locations shown on other figures in this report, are based on the site operational information provided by Bentz (1995). Because of the uncertainty surrounding the exact number and the locations of the trenches, each of the outlined disposal trench locations presented in the figures in this document encompass a considerably larger area than the actual size of a disposal trench (i.e., approximately 12 feet deep, 5 feet wide and 20 to 40 feet long). Results of the EM-61 geophysical survey (Section 11.4.3.1.6) that was conducted across SWMU 117 provided additional data concerning potential burial locations.

Before the excavation work began, the potential COCs identified for SWMU 117 were DU and RCRA metals beryllium, nickel, sodium, uranium, and zirconium. These COCs were based upon prior sampling results and an evaluation of the site operational history. DU is the only radionuclide known to have been used at the Large Melt Facility (SNL/NM March 1996). Gamma spectroscopy results from the surface soil radiation VCM had identified DU (uranium-238) as the sole radionuclide of concern. Sodium, zirconium, and uranium metal were included as COCs based on the operational history of the Large Melt Facility. Beryllium and nickel were included for use in risk assessment and waste management decisions, if needed.

The objective for the VCA was to remove all solid waste present at the site and verify through sampling and analysis that no hazards to human health and environment occurred in the former sodium disposal trench areas. Exploratory trenches were dug to a depth of approximately 11.5 feet below ground surface both in the areas identified by geophysical survey to contain buried materials and in other potential disposal areas indicated by former facility workers from the Large Melt Facility (SNL/NM March 1996). Excavation continued until all visible debris was removed. Some of the originally proposed exploratory trench locations were reconfigured during implementation of the VCA in response to subsurface conditions encountered during excavation. The proposed Trench 3 location was reoriented and extended to encompass the removal of all buried debris from the segmented open disposal trench (Figures 11.4.4-1 and 11.4.4-2). Proposed exploratory Trench location 4 was moved to evaluate an adjacent potential disposal area. Trench location 6 was added during the VCA to verify the no buried debris occurred in the two southernmost sodium disposal areas (Figure 11.4.4-2).

Significant buried debris was only encountered in Trench 3 (Figure 11.4.4-2). This trench paralleled the location of the segmented open disposal trench (Figure 11.4.4-1). Within this disposal area, buried debris and soil were well mixed (Figure 11.4.4-3). All the commingled soil and debris encountered as the excavation proceeded were temporally staged in a soil pile

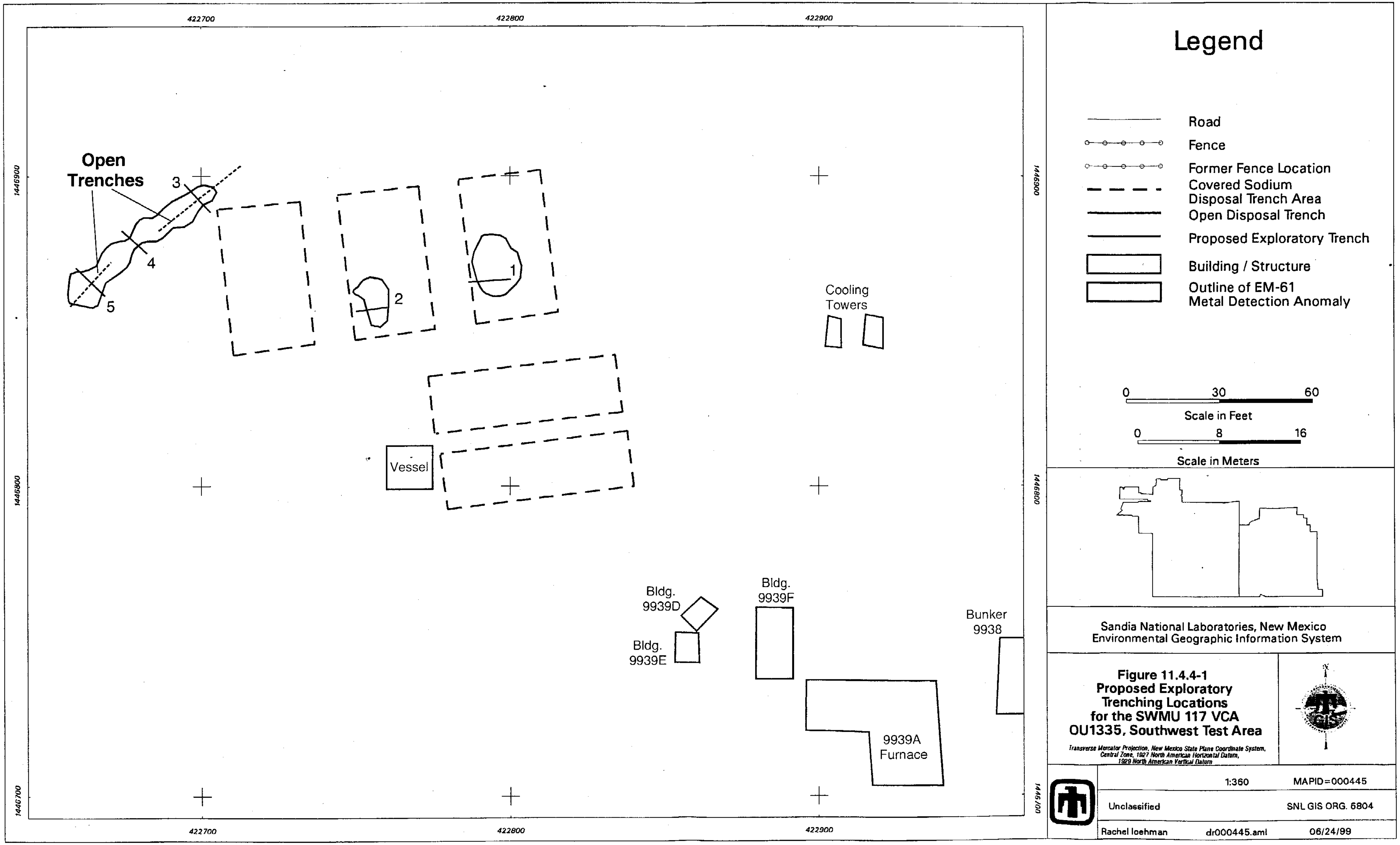

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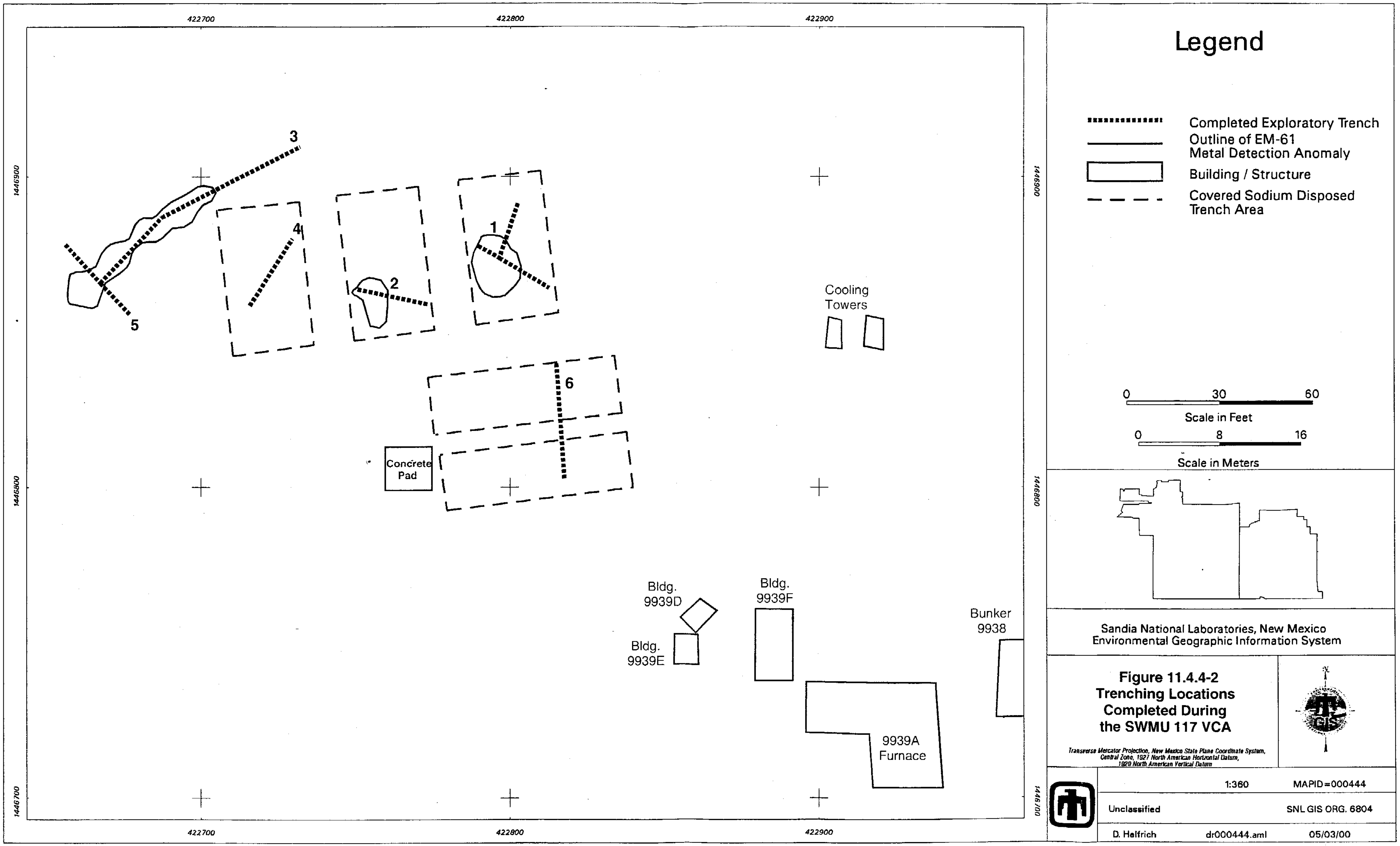
Figure 11.4.4-1
Proposed Exploratory Trenching Locations for the SWMU 117 VCA OU1335, Southwest Test Area

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

	1:360	MAPID=000445
Unclassified		SNL GIS ORG. 6804
Rachel loehman	dr000445.aml	06/24/99



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Environmental Geographic Information System

**Figure 11.4.4-2
Trenching Locations
Completed During
the SWMU 117 VCA**

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

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Unclassified		SNL GIS ORG. 6804
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Figure 11.4.4-3
View Looking Northeast Showing Initial Excavation of Trench 3. Buried Debris Was Mixed With Soil. Debris/Soil Mixture Was Temporarily Placed in a Pile Prior to Segregation.

pending segregation. Segregation activities entailed separation of the soil from debris items larger than 2 inches in diameter. Segregation of debris from soil was accomplished using a large metal mesh screen. Debris and rock greater than 2 inches in diameter were retained on top of a slightly inclined mesh screen, while the soil would be sifted through the screen and accumulate below in a small pile (Figure 11.4.4-4). The screen could be tilted to allow the debris items to rolloff and then be manually sorted. Debris items were segregated by waste matrices (i.e., wood, concrete fragments, bricks, wire and cable, plastic, or metallic material).

During the segregation process, soil and debris were screened for organic compounds using a photoionization detector (ThermoEnvironmental, Inc., Organic Vapor Monitor Model 580B). Initial radiological screening of the soil and debris items was also conducted by site workers during the segregation process. Later, a thorough item by item radiological screening of all debris items removed during the excavation was conducted by radiological control technicians (RCT) from SNL/NM Radiation Protection (Figure 11.4.4-5). A variety of hand-held instruments were used. All material was screened for radioactivity with a Geiger-Mueller (GM) Pancake Probe/Frisker Model ASP-1 with HP-260 and an ASP-1 with AC-3 probe. The GM pancake frisker measured beta/gamma emitters and the AC-3 was used to detect alpha emitters. Later, screening was performed using an Eberline E-600 with a SHP380AB probe. A Bicron Microrem meter and an Eberline RO-3C were used for measuring the dose rate of the material placed in the waste containers. For verification purposes, the field-screening results were compared to debris swipes that were analyzed by the Radiation Protection Sample Diagnostics (RPSD) Laboratory.

Chronology

Following site setup, the excavation work for the VCA remediation began in August 1999. Table 11.4.4-1 presents a chronology of the SWMU 117 VCA activities, which involved about one month total time of fieldwork that extended over a ten-month period.

Trenching, Debris Segregation, and Soil Piles Management

The trenching required to excavate all of the buried debris and to thoroughly evaluate subsurface conditions at the site took three days using a trackhoe excavator. Six exploratory/remediation trenches were completed at the site (Figure 11.4.4-2). Trench 1, which was segmented in two directions, removed the remnants of several old rusted, torn, and crushed empty 55-gallon drums. The drum remnants occurred in several layers extending from the surface to a depth of approximately 5.5 feet (Figure 11.4.3-4). Trench 2 resulted in the removal of an approximately 8-foot-long L-shaped metal pipe buried 6 inches below the surface. The short, approximately 8-inch section of the pipe originally protruded to the surface (Figure 11.4.3-4). No debris was contained in Trenches 4 and 6. Trench 5 contained a few debris items associated within the southwest end of the buried disposal trench. All of the remainder of the debris excavated from the site was removed from Trench 3 (Figure 11.4.4-2). Segregation of debris from the soil removed from Trench 3 was performed using the metal mesh screen (Figure 11.4.4-4) and required about 3 days to complete. Following segregation of debris by matrix, all items were frisked for radiological contamination before being released from the site (Figure 11.4.4-5). Material removed from Trench 3 included approximately 12 cubic yards of solid waste. In addition, approximately 2 cubic yards of material consisting of chromium-contaminated concrete was determined to be hazardous waste; 3 cubic yards of

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Figure 11.4.4-4
Segregation of Debris and Soil Using a Two Inch Mesh Metal Screen. Buckets in Foreground Contain Debris Items Segregated by Composition (e.g., wood, non-asbestos insulation, plastic materials, and metal tubing).

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Figure 11.4.4-5
Radiation Protection Technician Frisking Debris Items For Radioactive Contamination. All Debris Items Were Surveyed For Radiation Levels Prior To Being Removed From the Site.

Table 11.4.4-1
Chronology of VCA Remediation Activities Conducted at SWMU 117

Remediation Activity	Date of Activity
• Excavation of six exploratory/remediation trenches and collection of trench samples • Staging of trench soil piles	8/09/99–8/11/99
• NMED conducts site tour and reviews trenching results • NMED approves back filling of Trenches 2, 4, and 6 with each trench's associated soil	8/12/99
• Start segregation of mixed soil/debris using metal mesh screen • Collect soil pile characterization samples	8/13/99
• Rain event causes excavated metal crucible containing remnants of solidified sodium alloy melt material to react • Sandia Emergency Response/Kirtland Fire Department monitor reaction. Additional water added in an attempt to complete the reaction.	8/14/99–8/15/99
• Cover crucible containing sodium alloy and the sodium hydroxide gel produced by the reaction of sodium with water • Temporarily suspend waste segregation activities • Have former Large Melt Facility site workers inspect all excavated materials and identify any potential hazards • Cover all excavated debris and soil/debris pile • Backfill Trenches 2, 4, and 6	8/16/99–8/20/99
• Develop Restart Plan for conducting remainder of waste segregation operations	8/21/99–11/18/99
• Restart waste segregation operations • Complete segregation of mixed debris and soil from Trench 3 • Complete radiological frisking and swipe sampling of debris items for free-released as solid waste	11/19/99–12/15/99
• Containerization of radioactive and hazardous solid waste • Neutralization of sodium hydroxide in metal crucible that was generated by reaction of sodium metal alloy and water	12/16/99–1/12/00
• Containerization of chromium-contaminated and chromium/DU-contaminated concrete	1/13/00–3/9/00
• Walk-over radiological survey of waste management area to remove radiological restrictions	3/30/00
• Met with NMED to present laboratory analytical data and preliminary risk assessment results for soil samples collected from Trenches 1, 3, and 5 and the associated soil piles • NMED approves backfilling of Trenches 1, 3, and 5 with each trench's associated soil	5/4/00
• Backfill soil piles into open trenches • Grade surface of site back to original level surface	5/13/00

DU = Depleted uranium.
NMED = New Mexico Environment Department.
SWMU = Solid Waste Management Unit.
VCA = Voluntary corrective action.

wood, electrical wiring, cable, bricks and concrete were classified as radioactive-contaminated waste; and 0.5 cubic yards of concrete containing both DU and chromium-contamination was determined to be mixed waste. A round, 3-foot-diameter, 26-inch-deep metal crucible containing a 2- to 3-inch-thick layer of a solidified melt of sodium-alloy metal, which was classified as a RCRA reactive characteristic waste, was also removed from Trench 3.

Because of the logistical limitations associated with placement of the excavator over each trench during digging and the space limitations for piling soil in the small excavation area, one to three soil piles were created for each trench. For some trenches, instead of creating one main soil pile as would have been done if sufficient space had been available in the trenching area, several small subordinate soil piles were established. Each subordinate soil pile was identified separately during staging and for sample collection. Surface-water runoff controls were used while staging the soil piles created from trenching. The controls consisted of straw bales placed around the base of each soil pile to retain runoff during a rain event. Plastic sheeting was also placed over the soil pile that contained debris prior to segregation.

11.4.4.2.2 Waste Management

Tables 11.4.4-2 and 11.4.4-3 summarize the waste streams generated during the segregation effort. Excavated materials in order of abundance consisted of solid radioactive, hazardous, and mixed waste.

Nearly all the excavated materials removed from the site came from Trench 3. This excavation trench followed the location of the original disposal trench that was used during operations conducted at the Large Melt Facility. All buried materials were removed from the original disposal trench (Figure 11.4.4-6). Solid waste items removed consisted mainly of broken concrete pieces from concrete crucibles and building construction bricks. A minor percentage of the solid waste consisted of scrap metal items such as old equipment parts, drum fragments and cans, plastic components, canvas sheet pieces, nonasbestos insulation, and pieces of asphalt.

Items that showed radioactivity above background levels consisted mainly of fire bricks, which have naturally occurring elevated levels of thorium-232 and its decay products. As a precautionary measure, those debris items that did not have elevated radioactivity on their exterior, but had a porous structure such as scrap wood, and those items that could have shielded interior radioactive areas, such as electrical wiring and cable, were disposed of as radioactive waste. Several of the items excavated had been used in conjunction with tests involving the use of DU at the Large Melt Facility. Three pipe sections and some copper metal tubing still contained small amounts of DU and were disposed of as radioactive waste.

Hazardous waste consisted almost exclusively of pieces from concrete crucibles that had a magnesium oxide and chromium formulation used as a binder. These concrete pieces were easily identified by the distinctive yellowish/green coloration on a broken surface.

A metal crucible measuring approximately 3 feet in diameter by 26 inches high, containing a 2-to-3-inch layer of solidified sodium alloy melt material, was also removed from Trench 3. The solidified sodium melt material was disposed of as a reactive characteristic hazardous waste. A layer of sodium hydroxide gel that had formed on the surface of the sodium was removed from the crucible and neutralized with an acid and water solution prior to disposal of the crucible.

Table 11.4.4-2
Types of Waste Removed During VCA from SWMU 117

Waste Classification	Item(s)	Approximate Volume in Cubic Yards
Solid Waste	Concrete, bricks, and scrap metal; minor insulation, asphalt, plastic items	12
Radioactive Waste	Fire bricks, concrete, scrap wood, electrical wiring, and cable; three metal pipes, copper tubing coiled around metal slag, and miscellaneous pieces of plastics, ceramics, wood, and canvas	3.1
Hazardous Waste	Chromium-contaminated concrete; five thermocouples with beryllium oxide in sheathing	2.3
Hazardous Reactive Characteristic Waste	Solidified sodium-alloy melt material	1.5 cubic feet
Mixed Waste	Chromium-contaminated concrete with ¼-inch surficial layer of DU	0.4

DU = Depleted uranium.
SWMU = Solid Waste Management Unit.

Table 11.4.4-3
Other VCA Waste Management Actions Conducted at SWMU 117

Item Description	Disposal Action	Approximate Volume
Soil piles from Trenches 1, 2, 3, 4, 5, and 6	Redeposited back into trenches	150 cubic yards
Neutralized sodium hydroxide from crucible (water solution)	Discharged down sanitary sewer	3,795 gallons

SWMU = Solid Waste Management Unit.
VCA = Voluntary corrective action.

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Figure 11.4.4-6
Trench 3 After Removal of All Buried Debris, View Looking Southwest.

Neutralization of the sodium hydroxide resulted in generation of 3795 gallons of water with a pH less than 11 that was discharged to the sanitary sewer system (Table 11.4.4-3).

A small volume of mixed waste was also removed from the site. The mixed waste consisted of about one-half cubic yards of chromium-contaminated concrete, with an approximately one-quarter-inch-thick outer layer of DU on one surface. Frisking and swipe sampling of debris items showed that all the radioactive contamination encountered on the mixed waste and the radioactive waste was fixed and nonremovable.

A small amount (less than 1 cubic foot) of black material was observed and sampled during the excavation and showed no organic, metals, or radioactive contamination. It is suspected that this material is composed of graphite or another carbon compound.

Following a meeting with NMED to review the results of the excavation, laboratory analysis of the soil samples that were collected, and outcome of the risk assessment analyses, the soil piles from Trenches 1, 3, and 5 were redeposited back into the open trenches. Soil from Trenches 2, 4, and 6 were redeposited earlier during the VCA after concurrence with NMED in the field. Approximately 150 cubic yards of soil from the six trenches was backfilled (Table 11.4.4-3).

11.4.4.2.3 VCM Remediation Confirmatory Work

To verify that SWMU 117 was adequately remediated during the VCM, confirmatory soil sampling, laboratory analyses, and a radiological survey were conducted.

<u>Confirmatory Soil Sampling</u>

In conjunction with the excavation of buried debris, confirmatory sampling was performed to determine whether potential COCs were present at levels exceeding background limits and/or at levels sufficient to pose a risk to human health or the environment. The sampling activities were performed in accordance with the rationale and procedures described in the SWMU 117 VCA Plan (see Annex 11-C). SNL/NM chain-of-custody and sample documentation procedures (SNL/NM May 1995) were followed for all samples that were collected.

The list of COCs for the confirmatory sampling was based upon the information available when the SWMU 117 VCA Plan (SNL/NM July 1999) was written. Identification of debris items by previous facility workers and verification by laboratory analyses showed that chromium was present in a portion of the concrete that was excavated. DU was detected with field screening radiological instrumentation on the surface of some of the concrete pieces that were excavated. Radionuclide composition associated with DU was verified by laboratory gamma spectroscopy and radiochemical analyses.

Confirmatory soil samples were collected from 15 locations as part of the SWMU 117 VCA. Seven soil samples were collected in the trenches below where debris was removed from the trenches. Eight samples were collected from the soil piles created by trenching.

Sampling activities at ER Site 117 included: (1) collection of subsurface soil samples directly underlying isolated individual debris items or more extensive debris layers encountered during trenching, (2) collection of a subsurface soil sample from an area of black material encountered in one exploratory trench, and (3) collection of soil samples from the soil piles created as the result of trenching. Table 11.4.4-4 summarizes the soil sampling performed to meet the data quality objectives. In addition, swipe samples were collected from approximately 10 percent of the solid waste items excavated during the VCA for analysis of radiological constituents (alpha/beta emitters) by SNL/NM Radiation Protection. Radiological analyses were reviewed prior to removal of the solid waste materials from the site.

The sampling strategy for the VCA was designed to verify that no release of contaminants had occurred to the soil underlying the solid waste buried in the sodium disposal area. Samples collected from the soil piles generated from the exploratory trenches were used to verify that COC concentrations did not exceed background or risk-based levels of concern and that the soil could be placed back in the exploratory trenches at the completion of the project.

Concurrent with excavation operations, confirmatory samples were collected from within the trenches and from the soil piles generated from each completed trench (Table 11.4.4-5). Confirmatory samples were collected from seven locations within three trenches (Figure 11.4.4-7). Samples were collected below buried debris encountered in Trenches 1, 3, and 5. Trench 4 encountered an 8-foot metal pipe that was buried only about 8 inches below the surface. After consultation with NMED in the field, it was agreed that no samples would need to be collected below the pipe. Trenches 4 and 6, which transected three of the sodium disposal pit areas, encountered no debris. One soil sample was collected from the bottom of Trench 4 for comparison of analytical results with the soil samples taken from the three trenches that did contain debris. Eight soil samples were collected from the soil piles associated with the three trenches that encountered debris items. Samples collected from the trenches ranged in depth from 1 to 11.5 bgs. The two samples taken from within Trench 3, the longest trench with the most extensive debris, were taken approximately 25 feet laterally apart and directly below the bottom of the debris zone. Samples collected from Trench 5 were taken from a portion of the black material encountered at a depth of approximately 1 foot bgs (SWT-117-TR5-001-1.0-S) and from the bottom of the excavation at 11 feet bgs (SWT-117-TR5-001-1.0-S). Trench 5 verified that the debris present at the westernmost end of the former disposal trench extended down to a depth of approximately 5 feet bgs.

Samples collected from the exploratory trenches were taken from soil removed from the trench after it was dumped from the excavator bucket. One to two samples were also taken from each soil pile that was generated by trenching depending on the size of the pile. One sample was taken from each of the small subordinate soil piles that were created when one main trench soil pile could not be constructed. Where two samples were collected from a main soil pile, they were taken on opposite sides of the pile. All samples were taken from a depth of 0.0 to 0.5 feet below the surface of the pile. Soil samples taken from the trenches and from the soil piles were collected following SNL/NM standard field operation procedure (FOP 94-52), "Spade and Scoop Method for Collection of Soil Samples" (SNL/NM December 1994).

The SWMU 117 confirmatory samples were analyzed for all potential COCs, which included RCRA metals, beryllium, nickel, sodium, uranium, zirconium, and DU-related radionuclides (uranium-234, uranium-235 and uranium-238). Analysis for semivolatile organic compounds (SVOCs) was also included for the black material encountered in Trench 5. All confirmatory soil samples were analyzed by two analytical laboratories. Metals analyses were performed by General Engineering Laboratories, Inc. (GEL). Radionuclide analyses were performed on site

Table 11.4.4-4
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 117 Sampling Areas	Potential COC Source	Number of Sampling Locations	Sample Density	Sampling Location Rational
Exploratory Trenches	Buried test materials and/or debris from sodium tests or other Large Melt Facility testing	7	Two samples underlying debris item or debris layer. One sample from each area of soil staining.	Confirm the presence or absence of chemical or radiological contamination
Soil Piles Generated from Exploratory Trenches	Residue or release from buried test materials	8	Two samples per trench soil pile	Confirm the presence or absence of chemical or radiological contamination

COC = Constituent of concern.
SWMU = Solid Waste Management Unit.

Table 11.4.4-5
Number of Confirmatory Soil Samples Collected During the SWMU 117 VCA

Sample Type	Number of Samples	Radionuclides	RCRA Metals, Beryllium, Nickel, Sodium, Uranium, and Zirconium	SVOCs
Confirmatory Trench	7	7	7	1
Confirmatory Soil Pile	8	8	8	--
Duplicates	3	3	3	--
Equipment Blanks	3	--	3	--
Total Samples	21	18	21	1
Analytical Laboratory	--	RPSD	GEL	GEL

Note: Sampling dates: 08/09/99-08/13/99, 11/30/99
Chain-of-custody forms: 602214, 602215, 602217, 602982, 602983
GEL = General Engineering Laboratories, Inc.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostic.
SWMU = Solid Waste Management Unit.
VCA = Voluntary corrective measure.
SVOC = Semivolatile Organic Compounds.

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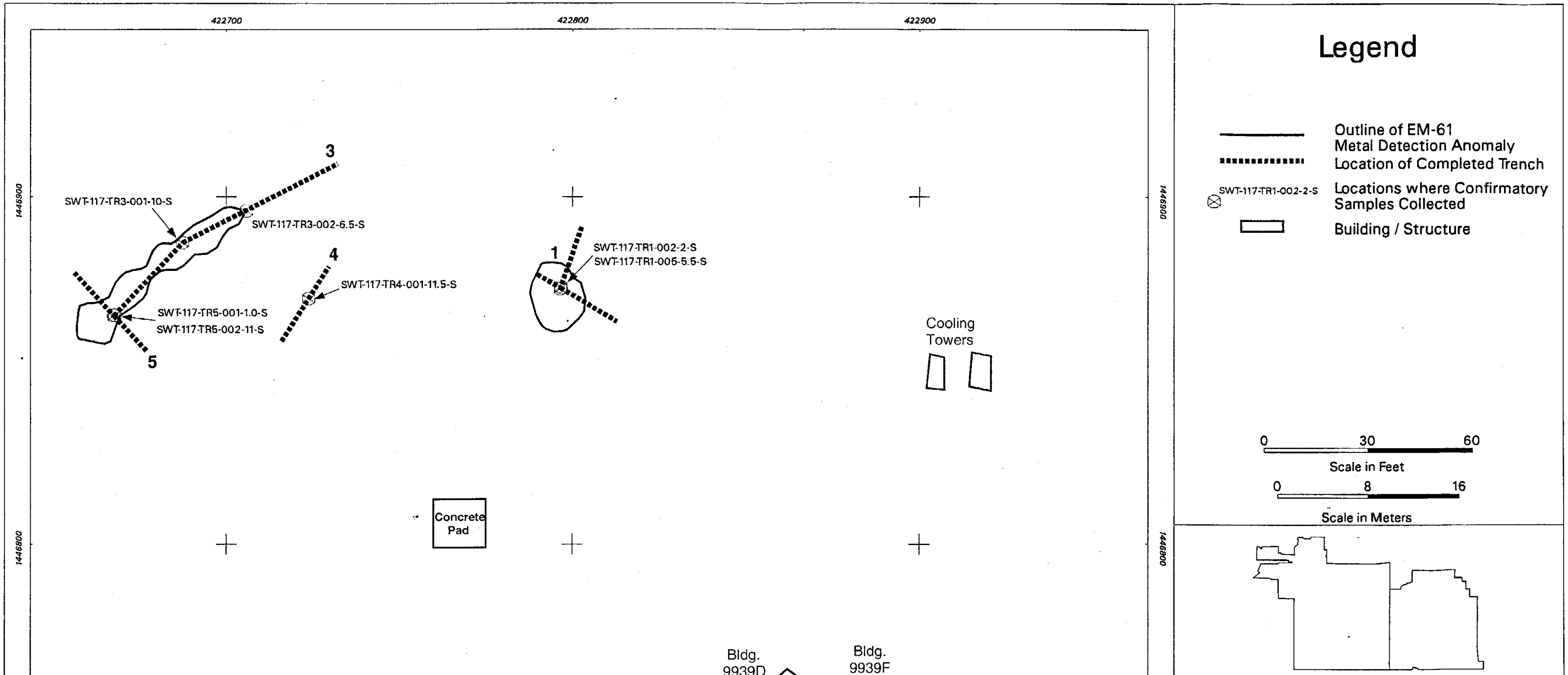

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Figure 11.4.4-7
Trench Confirmatory Samples
OU1335, Southwest Test Area

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

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D. Helfrich	dr000442.aml	05/02/00

at the SNL/NM RPSD Laboratory. Table 11.4.4-6 summarizes the analytical methods and data quality levels for the analytical data that was collected.

Six field Quality Assurance/Quality Control (QA/QC) samples were collected as part of the confirmatory-sampling effort in accordance with the ER Project Quality Assurance Project Plan (SNL/NM 1999). The QA/QC samples consisted of three duplicate soil samples and three sampling equipment rinsate blanks. No QA/QC problems were identified in the field QA/QC sampling results. All the confirmatory-soil sample results were verified/validated by SNL/NM. The off-site laboratory results from GEL were reviewed according to "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM January 2000). The data validation assessment reports for the off-site laboratory analyses are presented in Annex 11-B. The gamma spectroscopy data from the RPSD Laboratory were reviewed according to "Laboratory Data Review Guidelines," Procedure No: RPSD-02-11, Issue No: 02 (SNL/NM July 1996). The RPSD verification/validation reports are presented along with the gamma-spectroscopy results in Annex 11-A. The data quality assessment reports confirmed that the analytical data from the laboratories are acceptable for use in this NFA proposal. Therefore, the data quality objectives have been fulfilled.

Table 11.4.4-6
Summary of Data Quality Requirements

Analytical Requirement	Data Quality Level	GEL	RPSD Laboratory
RCRA Metals, Beryllium, Nickel, Sodium, Uranium, and Zirconium EPA Methods 6010/6020/7471	Level 3	15	Not applicable
Gamma Spectroscopy EPA Method 901.1	Level 2	Not analyzed	15
SVOCs EPA Method 8270	Level 3	1	Not applicable

Note: The number of samples does not include QA/QC samples such as duplicates and equipment blanks.
EPA = U.S. Environmental Protection Agency.
GEL = General Engineering Laboratories Inc.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostic.
SVOC = Semivolatile Organic Compounds.

Final Radiological Survey

Following the completion of waste segregation activities and removal of waste items from the site, a final radiological survey was conducted over the surface of the entire operational area (i.e., trenching area and waste segregation area). The main intent of the survey was to verify that no radiological materials such as DU fragments remained in the waste segregation area that was established for SWMU 117. The walkover radiological survey was conducted by an RCT using a sodium iodide detector and an approximately 3-foot line-traverse spacing that ensured 100 percent coverage of the ground surface. The radiological survey confirmed that no radioactive anomalies occurred on the surface at SWMU 117 (SNL/NM March 2000).

Final Site Backfilling and Grading

After the soil sample results were reviewed and the final site walkover radiological survey was completed, the open trenches at SWMU 117 were backfilled and the site was graded. Approximately 95 cubic yards of soil from Trenches 1, 3, and 5 were used as backfill for the open trenches. The final grading at SWMU 117 was performed to restore the site to its original surface gradient (Figure 11.4.4-8).

11.4.4.3 Data Gaps

Analytical data from confirmatory sampling are sufficient to characterize the nature and extent of historical releases of COCs, if any, occurred at this SWMU. There are no further data gaps remaining for SWMU 117.

11.4.4.4 Results and Conclusions

Representative soil samples were collected from 15 confirmatory locations at SWMU 117. Tables 11.4.4-7, 11.4.4-8, 11.4.4-9, and 11.4.4-10 summarize the metals and radionuclide (gamma spectroscopy) analytical results. Table 11.4.4-11 lists the SVOCs that were analyzed and the associated method detection limit for each analyte. Annex 11-A contains complete results for the gamma spectroscopy. Confirmatory samples were collected from within the trenches below the debris that was removed and from the soil piles generated from the trenches. The soil piles were later used to backfill the open trenches, and the site was regraded. This section presents the laboratory analytical results for the confirmatory samples that were collected. For each analyte group, the site-confirmatory trench sampling results summary table is followed by the soil piles summary table.

An example sample identification (ID) in the ER sample ID column of the data summary tables for trench samples is SWT-117-TR1-002-2-S. This ID indicates that the sample was collected from SWMU 117 within the Southwest Test Operable Unit (SWT). The soil sample (S) was the second sample (002) collected from trench #1 (TR1) at a depth of 2 feet below ground surface.

An example sample identification number in the ER sample ID for a soil pile sample is SWT-117-GP5-001-0.0-S. This ID indicates that the sample was collected from SWMU 117 within the SWT. The soil sample (S) was grab sample #1 (001) collected from soil pile # 5

Figure 11.4.4-8
SWMU 117 Following Backfilling of Trenches and Grading to Original Surface Gradient.

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Table 11.4.4-7
Summary of SWMU 117 Confirmatory Trench Soil Sampling for RCRA Metals, Beryllium, Nickel, Sodium, Uranium, and Zirconium Analytical Results August 1999 (Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010/7000)[a] (mg/kg)												
Record Number[b]	ER Sample ID (Figure 11.4.4-7)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Sodium	Uranium	Zirconium
602214	SWT-117-TR1-002-2-S	8/9/99	2	3.07	170 J	0.343 J (0.463)	ND (0.0352)	4.83	5.41	**0.0111 J** (0.0295)	5.92	**0.269 J** (0.463)	ND (0.0556)	1780 J	0.491 J	3.32 J
602214	SWT-117-TR1-005-5.5-S	8/9/99	5.5	3.41	**220 J**	0.273 J (0.5)	ND (0.038)	4.28	3.65	**0.00304 J** (0.0256)	4.3	ND (0.27)	ND (0.06)	1660 J	1.53 J	3.62 J
602214	SWT-117-TR3-001-10.0-S	8/11/99	10	3.37	51.3 J	0.258 J (0.485)	0.0707 J (0.485)	3.33	4.95	ND (0.00213J)	4.02	ND (0.262)	ND (0.0583)	875 J	0.543 J	2.67 J
602214	SWT-117-TR3-002-6.5-S	8/11/99	6.5	**5.33**	157 J	0.363 J (0.495)	ND (0.0376)	5.42	4.56	**0.00464 J** (0.0322)	5	ND (0.267)	ND (0.0594)	2090 J	0.623 J	3.54 J
602214	SWT-117-TR4-001-11.5-S	8/11/99	11.5	3.51	53.2 J	0.242 J (0.481)	0.0503 J (0.481)	3.48	5.19	ND (0.00218J)	3.32	ND (0.26)	ND (0.0577)	187 J	1.7 J	3.68 J
602214	SWT-117-TR4-002-11.5-SD	8/11/99	11.5	4.1	64.2 J	0.285 J (0.49)	ND (0.0373)	3.58	4.44	ND (0.00224J)	4.12	ND (0.265)	ND (0.0588)	199 J	1.75 J	3.28 J
602214	SWT-117-TR5-001-1.0-S	8/18/99	1	1.88	93.8 J	0.318 J (0.49)	0.0571 J (0.49)	15.3	6.02	**0.00662 J** (0.0307)	10.3	ND (0.265)	ND (0.0588)	1130 J	**3.4 J**	8.28 J
602214	SWT-117-TR5-002-11.0-S	8/10/99	11	**6.17**	144 J	0.277 J (0.481)	ND (0.0365)	4.1	4.12	ND (0.00203J)	4.22	ND (0.26)	ND (0.0577)	1480 J	1.04 J	4.23 J
Quality Assurance/Quality Control Sample (mg/L)																
602214	SWT-117-TR4-001-0.0-EB	8/11/99	NA	ND (0.00451)	0.00741	ND (0.00026J)	ND (0.00044)	0.00065 J (0.005)	ND (0.00159)	ND (0.00004)	ND (0.00129)	ND (0.00271)	0.00404 J	0.895	0.0002 J (0.01)	0.00238 J (0.01)
Background Soil Concentrations—Southwest Test Area[c]				4.4	214	0.65	0.9	15.9	11.8	<0.1	11.5	<1	<1	17,000	2.3	9.2

Note: Values in **bold** exceed background soil concentrations.
[a]EPA November 1986.
[b]Analysis request/chain-of-custody record.
[c]From Dinwiddie September 1997. The Hazardous and Radioactive Materials Bureau maximum subsurface background concentrations are reported.

EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J ( ) = Estimated value, laboratory reporting limit shown in parentheses.
J = Estimated value, see data validation report
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
ND (#J) = Not detected above the method detection limit shown in parentheses, associated value is an estimate.
RCRA = Resource Conservation and Recovery Act.
S = Soil sample.
SD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
SWT = Southwest Test Area
TR = Trench.

Table 11.4.4-8
Summary of SWMU 117 Confirmatory Soil Pile Sampling Analytical Results for RCRA Metals, Beryllium, Nickel, Sodium, Uranium, and Zirconium
August and November 1999
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010/7000)[a] (mg/kg)												
Record Number[b]	ER Sample ID	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Sodium	Uranium	Zirconium
602214	SWT-117-GP1-001-0.0-S	8/11/99	0.0–0.5	2.89	**133**	0.3 J (0.467)	0.0514 J (0.476)	4.21	4.55	**0.0118 J**	5.3	ND (0.257)	ND (0.0571)	423 J	0.533 J	2.66 J
602214	SWT-117-GP1A-002-0.0-S	8/11/99	0.0–0.5	4.04	**189 J**	0.273 J (0.476)	0.0366 J (0.476)	4.07	3.99	**0.00856 J**	4.8	ND (0.257)	ND (0.0571)	483 J	0.808 J	2.61 J
602214	SWT-117-GP3-001-0.0-S	8/13/99	0.0–0.5	**5.59**	99 J	0.235 J (0.495)	0.103 J (0.495)	3.75	4.61	**0.00725 J**	3.91	ND (0.267)	ND (0.0594)	805 J	0.804 J	3.58 J
602214	SWT-117-GP3A-002-0.0-S	8/13/99	0.0–0.5	**4.65**	**236 J**	0.32 J (0.495)	0.0575 J (0.495)	5.66	4.33	**0.0111 J (0.0292)**	5.87	ND (0.267)	ND (0.0594)	477 J	1.39 J	2.74 J
602982	SWT-117-GP3B-001-0.0-S	11/30/99	0.0–0.5	**7**	**143**	0.422 J (0.495)	0.221 J (0.495)	10.3	9.57 J	ND (0.0152)	8.55	ND (0.146)	ND (0.101)	1410	1.06 J	5.5 J
602982	SWT-117-GP3B-002-0.0-S	11/30/99	0.0–0.5	4.1	**188**	0.371 J (0.481)	0.176 J (0.481)	10.5	9.33 J	ND (0.0152)	7.45	ND (0.146)	ND (0.101)	1630	1.23 J	6.38 J
602982	SWT-117-GP3B-002-0.0-SD	11/30/99	0.0–0.5	3.56	**141**	0.364 J (0.5)	0.142 J (0.5)	12.2	11 J	ND (0.0152)	8.26	ND (0.146)	ND (0.101)	1480	1.53 J	7.03 J
602214	SWT-117-GP5-001-0.0-S	8/13/99	0.0–0.5	4.25	**132 J**	0.264 J (0.467)	ND (0.0355)	3.42	3.89	ND (0.0018 J)	3.79	ND (0.252)	ND (0.0594)	1400 J	0.676 J	3.21 J
602214	SWT-117-GP5-001-0.0-SD	8/13/99	0.0–0.5	4.06	**138 J**	0.268 J (0.467)	0.0548 J (0.467)	3.52	5.16	ND (0.00211 J)	4.18	ND (0.252)	ND (0.0561)	1270 J	0.723 J	3.47 J
602214	SWT-117-GP5-002-0.0-S	8/13/99	0.0–0.5	4.36	**214 J**	0.361 J	ND (0.0373)	5.42	5.21	**0.00477 J**	6.39	**0.5 J**	ND (0.0588)	1820 J	0.709 J	3.84 J
Quality Assurance/Quality Control Samples (mg/L)																
602982	SWT-117-GP3B-002-0.0-EB	11/30/99	NA	ND (0.00257)	0.00754	ND (0.00047)	ND (0.00063)	0.00186 J (0.005)	ND (0.00183)	ND (0.0006 J)	ND (0.00309)	ND (0.00236)	ND (0.00053)	0.537	0.000019 J	0.00024 J
602214	SWT-117-GP5-001-0.0-EB	8/13/99	NA	ND (0.00451)	0.00363 J	ND (0.00026 J)	ND (0.00044)	ND (0.00056)	ND (0.00159)	ND (0.00004)	ND (0.00129)	ND (0.0027)	0.004 J	0.672	0.00009 J	ND (0.001)
Background Surface/Subsurface Soil Concentrations—Southwest Test Area[c]				5.6/4.4	130/214	0.65/0.65	<1/0.9	17.3/15.9	21.4/11.8	<0.25/<0.1	11.5/11.5	<1/<1	<0.25/<0.1	17,000	3.42/2.3	9.2/9.2

Note: Values in **bold** exceed background soil concentrations.

[a]EPA November 1986.

[b]Analysis request/chain-of-custody record.

[c]From Dinwiddie September 1997. The Hazardous and Radioactive Materials Bureau maximum subsurface background concentrations are reported.

EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GP = Soil pile.
ID = Identification.
J ( ) = Estimated value, laboratory reporting limit shown in parentheses.
J = Estimated value, see data validation report.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
ND (J) = Not detected above the method detection limit shown in parentheses; associated value is an estimate.
RCRA = Resource Conservation and Recovery Act.
S = Soil sample.
SD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
SWT = Southwest Test Area.

Table 11.4.4-9
Summary of SWMU 117 Confirmatory Trench Soil Sampling Gamma Spectroscopy Analytical Results
August 1999
(On-Site Laboratory)

Sample Attributes				Activity (pCi/g)							
				Cesium-137		Thorium-232		Uranium-235		Uranium-238	
Record Number[a]	ER Sample ID[b] (Figure 11.4.4-7)	Date Sampled	Sample Depth (ft)	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
602217	SWT-117-TR1-002-2-S	8/9/99	2	ND (0.0537)	--	0.469	0.270	ND (0.184)	--	ND (0.610)	--
602215	SWT-117-TR1-005-5.5-S	8/9/99	5.5	ND (0.0257)	--	0.563	0.338	ND (0.192)	--	ND (0.669)	--
602217	SWT-117-TR3-001-10.0-S	8/11/99	10	ND (0.0270)	--	ND (0.122)	--	0.0762	0.151	ND (0624)	--
602215	SWT-117-TR3-002-6.5-S	8/11/99	6.5	**0.143**	0.0438	0.604	0.344	ND (0.196)	--	1.04	0.578
602217	SWT-117-TR4-001-11.5-S	8/11/99	11.5	ND (0.0247)	--	ND (0.118)	--	ND (0.186)	--	ND (0.621)	--
602215	SWT-117-TR4-002-11.5-SD	8/11/99	11.5	ND (0.0252)	--	0.604	0.334	ND (0.181)	--	ND (0.634)	--
602215	SWT-117-TR5-001-1.0-S	8/18/99	1	0.0531	0.0348	0.508	0.332	0.126	0.154	ND (0.683)	--
602217	SWT-117-TR5-002-1.0-S	8/13/99	11	ND (0.0294)	--	0.603	0.327	ND (0.218)	--	ND (0.702)	--
Background Soil Activities—Southwest Test Area[c]				0.079		1.01		0.16		1.4	

Note: Values in **bold** exceed background soil activities.
[a]Analysis request/chain-of-custody record.
[b]Two standard deviations about the mean detected activity.
[c]From Dinwiddie September 1997.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
ND ( ) = Not detected at or above the minimum detectable activity, shown in parentheses.
pCi/g = Picocurie(s) per gram.
S = Soil sample.
SD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
SWT = Southwest Test Area.
TR = Trench.
-- = Error not calculated for nondetectable results.

Table 11.4.4-10
Summary of SWMU 117 Confirmatory Soil Pile Sampling Gamma Spectroscopy Analytical Results
August and November 1999
(On-Site Laboratory)

Sample Attributes				Activity (pCi/g)							
Record Number[a]	ER Sample ID (Figure 11.4.4-7)	Date Sampled	Sample Depth (ft)	Cesium-137		Thorium-232		Uranium-235		Uranium-238	
				Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
602215	SWT-117-GP1-001-0.0-S	8/11/99	0.0–0.5	0.0473	0.0265	0.572	0.350	ND (0.176)	--	ND (0.595)	--
602215	SWT-117-GP1A-002-0.0-S	8/11/99	0.0–0.5	ND (0.022)	--	0.370	0.244	ND (0.177)	--	ND (0.600)	--
602215	SWT-117-GP3-001-0.0-S	8/13/99	0.0–0.5	ND (0.025)	--	0.585	0.343	ND (0.196)	--	ND (0.639)	--
602215	SWT-117-GP3A-002-0.0-S	8/13/99	0.0–0.5	ND (0.015)	0.009	0.500	0.310	ND (0.186)	--	ND (0.630)	--
602983	SWT-117-GP3B-001-0.0-S	11/30/99	0.0–0.5	0.0564	0.0335	0.668	0.376	**0.221**	0.150	ND (0.661)	--
602983	SWT-117-GP3B-002-0.0-S	11/30/99	0.0–0.5	0.0602	0.0414	0.523	0.320	**0.107**	0.148	ND (0.688)	--
602983	SWT-117-GP3B-002-0.0-SD	11/30/99	0.0–0.5	0.0593	0.0519	0.582	0.492	ND (0.211)	--	ND (0.761)	--
602215	SWT-117-GP5-001-0.0-S	8/13/99	0.0–0.5	ND (0.0257)	--	0.474	0.413	ND (0.184)		ND (0.616)	--
602215	SWT-117-GP5-001-0.0-SD	8/13/99	0.0–0.5	ND (0.0243)	--	ND (0.112)	--	**0.0825**	0.144	ND (0.603)	--
602217	SWT-117-GP5-002-0.0-S	8/13/99	0.0–0.5	0.0169	0.0172	0.418	0.267	ND (0.158)	--	ND (0.686)	--
Background Soil Activities—Southwest Test Area[c]				0.079		1.01		0.079		1.4	

Note: Values in **bold** exceed background soil activities.
[a]Analysis request/chain-of-custody record.
[b]Two standard deviations about the mean detected activity.
[c]From Dinwiddie September 1997.
ER = Environmental Restoration.
ft = Foot (feet).
GP = Soil pile.
ID = Identification.
ND ( ) = Not detected at or above the minimum detectable activity, shown in parentheses.
pCi/g = Picocurie(s) per gram.
S = Soil sample.
SD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
SWT = Southwest Test Area.
-- = Error not calculated for nondetectable results.

Table 11.4.4-11
SVOC Analytical Method Detection Limits (EPA Method 8270) Used For SWMU 117
Confirmatory Sampling
August 1999
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
1,2,4-Trichlorobenzene	187
1,2-Dichlorobenzene	170
1,2-Diphenylhydrazine	56.7
1,3-Dichlorobenzene	130
1,4-Dichlorobenzene	61
2,4,5-Trichlorophenol	153
2,4,6-Trichlorophenol	76.7
2,4-Dichlorophenol	177
2,4-Dimethylphenol	110
2,4-Dinitrophenol	367
2,4-Dinitrotoluene	117
2,6-Dinitrotoluene	140
2-Chloronaphthalene	173
2-Chlorophenol	157
2-Methylnaphthalene	203
2-Nitroaniline	66.7
2-Nitrophenol	180
3,3'-Dichlorobenzidine	277
3-Nitroaniline	83.3
4-Bromophenyl phenyl ether	117
4-Chloro-3-methylphenol	127
4-Chlorobenzenamine	153
4-Chlorophenyl phenyl ether	147
4-Nitroaniline	103
4-Nitrophenol	110
Acenaphthene	160
Acenaphthylene	147
Anthracene	86.7
Benzo(a)anthracene	66.7
Benzo(a)pyrene	73.3
Benzo(b)fluoranthene	143
Benzo(g,h,i)perylene	80
Benzo(k)fluoranthene	133
Butylbenzyl phthalate	90
Carbazole	153
Chrysene	53.3
Di-n-butyl phthalate	73.3
Di-n-octyl phthalate	173
Dibenz(a,h)anthracene	83.3
Dibenzofuran	133
Diethylphthalate	76.7
Dimethylphthalate	110
Dinitro-o-cresol	100
Fluoranthene	66.7

Refer to footnotes at end of table.

Table 11.4.4-11 (Concluded)
SVOC Analytical Method Detection Limits (EPA Method 8270) Used For SWMU 117
Confirmatory Sampling
August 1999
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
Fluorene	113
Hexachlorobenzene	70
Hexachlorobutadiene	153
Hexachlorocyclopentadiene	193
Hexachloroethane	133
Indeno(1,2,3-c,d)pyrene	80
Isophorone	147
Naphthalene	157
Nitrobenzene	133
Pentachlorophenol	56.7
Phenanthrene	60
Phenol	56.7
Pyrene	73.3
bis(2-Chloroethoxy)methane	170
bis(2-Chloroethyl)ether	53.3
bis(2-Ethylhexyl)phthalate	300
bis-Chloroisopropyl ether	103
m,p-Cresol	153
n-Nitrosodiphenylamine	20.7
n-Nitrosodipropylamine	130
o-Cresol	63.3

EPA = U.S. Environmental Protection Agency.
MDL = Method detection limit.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
µg/kg = Microgram(s) per kilogram.

(GP5). For Trench 1, two subordinate soil piles (GP1 and GP1A) were created instead of one main pile. Each subordinate pile had one sample collected. Trench 3 was the largest trench created because it followed the original extent of a buried disposal trench. For Trench 3, two subordinate soil piles (GP3 and GP3A) were created from the nondebris-containing soil removed from the trench, with one sample collected from each pile. Soil pile GP3B was created after the mixed soil and debris removed from Trench 3 had been segregated through the metal mesh screen. Two samples were collected from soil pile GP3B. The soil pile created from Trench 5 (GP5) was also a large individual pile and had two samples collected. All samples collected from the soil piles were collected from a depth of 0.0 to 0.5 feet below the surface of the pile. The depth indicator in the sample ID (e.g., 0.0), designates the top of the collection depth interval.

The following section briefly describes the results of confirmatory sampling at SWMU 117.

Metals

Tables 11.4.4-7 and 11.4.4-8 summarize the off-site metals analytical results for both the trench confirmatory sampling (seven subsurface soil samples, one duplicate sample, and one equipment blank sample) and the soil pile sampling (eight surface soil samples, two duplicate samples, and two equipment blank samples).

For the evaluation of analytical results to background values (Dinwiddie September 1997), samples collected from below a depth of 0.5 feet within the trenches were compared to subsurface soil background concentrations. The majority of the soil excavated from the trenches and placed into piles represents soil taken from a depth below 0.5 feet. When this soil is redeposited back into the open trenches, a small percentage of the soil will lie within the surface soil interval (0.0 to 0.5 feet bgs). Thus, as a conservative approach for assessing the soil pile sampling analytical results, the lowest soil background value (surface or subsurface soil background) was used for comparison to background concentrations.

Beryllium, cadmium, chromium, lead, nickel, silver, sodium, and zirconium were not detected above the background concentrations in any of the soil samples collected at SWMU 117. Arsenic was detected at levels slightly above background concentrations in trench samples SWT-117-TR3-002-6.5-S and SWT-117-TR5-002-11.0-S, and in soil pile samples SWT-117-GP3-001-0.0-S, SWT-117-GP3A-002-0.0-S, and SWT-117-GP3B-001-0.0-S. Arsenic concentrations above background levels ranged from 4.65 to 7 mg/kg. Barium was detected at a concentration of 220 J mg/kg, which is slightly above background, in one trench sample (SWT-117-TR1-005-5.5-S). When comparing barium concentrations in the soil piles to subsurface background values, only one sample (SWT-117-GP3A-002-0.0-S), which had a concentration 236 J mg/kg, exceeded the background value. If barium concentrations in the soil piles are compared to surface soil background levels, all samples except one are greater than the background value. Barium values exceeding surface soil background concentrations ranged from 133 to 236 J mg/kg. Selenium was detected in trench sample SWT-117-TR1-002-2-S (0.269 J mg/kg) and in soil pile sample SWT-117-GP5-002-0.0-S (0.5 J mg/kg). Whether the measured estimated values are actually greater than background is uncertain because the background value is a nonquantified concentration (i.e., <1 mg/kg). Uranium was only detected above the background concentration in trench sample SWT-117-TR5-001-1.0-S (3.4 J mg/kg). Very low estimated concentrations of mercury, ranging from 0.00304 J to 0.0118 J mg/kg, were detected below the nonquantified background concentration (i.e., <0.1 mg/kg) in four of the trench samples and five of the soil pile samples.

SVOCs

One sample (SWT-117-TR5-001-1.0-S) was collected for SVOC analysis at an off-site laboratory. A discrete isolated area of dark black material was encountered in Trench 5 at a depth of approximately 1 foot bgs. Photoionization measurements detected no volatile organic compounds. In addition to SVOC analyses, the material was analyzed for metals and gamma-emitting radionuclides. No SVOCs were detected in the sample that was collected from this material. Physical characteristics and analytical results suggest the material is probably composed of a inorganic (e.g., graphite or carbon) compound. Table 11.4.4-11 summarizes the SVOCs analyzed and the associated method detection limits used for this analysis.

Radionuclides

Tables 11.4.4-9 and 11.4.4-10 summarize the on-site gamma spectroscopy analysis results for both the confirmatory trench sampling (seven subsurface soil samples and one duplicate sample) and the soil pile sampling (eight surface soil samples and two duplicate samples). Uranium-238 and thorium-232 were not detected at levels above the background activity limit in any of the confirmatory trench or soil pile samples. In soil pile sample SWT-117-GP3B-001-0.0-S, uranium-235 was detected at an activity of 0.221 pCi/g, which exceeds the NMED-approved background activity limit of 0.16 pCi/g. No other analytical results for uranium-235 exceeded the NMED-approved background concentration. However, the MDA exceeded the NMED-approved background concentration in many cases. Although this inhibits any direct comparison to background, uranium-238 and uranium-235 results can be compared because they both coexist in DU. As a result, any elevated uranium-238 activity would be accompanied by a corresponding elevation in uranium-235 activity. Using this comparison, the nondetectable results obtained for uranium-235 that have MDAs above background do not show corresponding elevated activities in the results for uranium-238. The measured activity in trench sample SWT-117-TR3-002-6.5-S for cesium-137 (0.143 pCi/g) exceeded the background activity of 0.079 pCi/g.

Data Quality

Tables 11.4.4-7, 11.4.4-8, 11.4.4-9, and 11.4.4-10 show the analytical results of the metals and radionuclide QA/QC samples that were collected during the confirmatory sampling at SWMU 117. QA/QC samples consisted of three equipment blanks for metals analyses and three duplicate samples for metals and gamma spectroscopy analyses. All of the equipment blanks and duplicate samples were analyzed off site. The equipment blank samples for metals yielded either no detections or extremely low concentrations.

To assess the variability in analytical results within the sampled matrix, three field duplicate samples were collected and analyzed for metals and gamma spectroscopy analyses. Relative percent differences (RPD) calculated from the metals data are included in Table 11.4.4-12. Because some of the sample pairs are nondetects, RPDs could not be calculated for selenium,

Table 11.4.4-12
Summary of SWMU 117 Field Duplicate Relative Percent Differences
(Off-Site Laboratory)

Sample Attributes				Relative Percent Difference												
Record Number[a]	ER Sample ID (Figure 11.4.4-7)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Sodium	Uranium	Zirconium
602982	SWT-117-GP3B-002-0.0-S, SWT-117-GP3B-002-0.0-SD	11/30/99	0–0.5	14.10	28.57	1.90	21.38	14.98	14.32	NC	10.31	NC	NC	9.65	21.74	9.69
602214	SWT-117-GP5-001-0.0-S, SWT-117-GP5-001-0.0-SD	8/13/99	0–0.5	4.57	4.44	1.50	NC	2.88	28.07	NC	9.79	NC	NC	9.74	6.72	7.78
602214	SWT-117-TR4-001-11.5-S, SWT-117-TR4-002-11.5-SD	8/11/99	11.5	15.51	18.74	16.32	NC	2.83	15.58	NC	21.51	NC	NC	6.22	2.90	11.49

[a]Analysis request/chain-of-custody record.
ER = Environmental Restoration.
ft = Foot (feet).
GP = Soil pile.
ID = Identification.
NC = Not calculated for estimated values or nondetected results.
S = Soil sample.
SD = Sample duplicate.
SWMU = Solid Waste Management Unit.
SWT = Southwest Test Area.
TR = Trench.

mercury, or silver. RPDs were not calculated for gamma spectroscopy results because the sample pairs were nondetects or the reported activities had relatively large error values.

The RPDs range from 4.57 to 15.51 percent for arsenic, 4.44 to 28.57 percent for barium, 1.50 to 16.32 percent for beryllium, 21.38 percent for cadmium, 2.83 to 14.98 percent for chromium, 14.32 to 28.07 percent for lead, 9.79 to 21.51 percent for nickel, 6.22 to 9.65 percent for sodium, 2.90 to 21.74 percent for uranium, and 7.78 to 11.49 percent for zirconium. In general, the results obtained for the sample duplicates are in satisfactory agreement for a soil matrix.

Data Validation

All off-site laboratory results were reviewed and verified/validated according to SNL/NM data validation procedure AOP 00-03 (January 2000). In addition, all on-site laboratory gamma spectroscopy results were reviewed according to SNL/NM laboratory radiological data review guidelines (July 1996). Annex 11-B contains summaries of the off-site data validation results. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 117.

11.5 Site Conceptual Model

The site conceptual model for SWMU 117 is based upon the residual COCs identified in the soil samples collected from below the buried debris and from the soil piles generated by the excavation. Remediation activities also contribute to the site conceptual model for SWMU 117. This section summarizes the nature and extent of contamination and the environmental fate of COCs.

11.5.1 Nature and Extent of Contamination

The COCs at SWMU 117 were DU, sodium, and other metals associated with disposal in the sodium spray pits and/or from debris that had been buried at the site (Section 11.2). Because background concentrations for SVOCs were not applicable, any detectable SVOCs were considered potential contamination. One sample collected for analysis of SVOC compounds, radionuclides, and metals taken from an area of dark black material encountered during excavation had no detectable SVOC compounds (Section 11.4.4.4). It is suspected that the material is composed of an inert graphite compound.

Metal and radionuclide COCs were determined by comparing sample results to background concentrations and activities that had been established for the surface and subsurface soils in the Southwest Test Area (Dinwiddie September 1997). Any metals or radionuclides found to exceed background in any sample were considered potential COCs for the site. Consequently, metal COCs included arsenic, barium, selenium, uranium and mercury. The radiological COCs include uranium-235 and cesium 137. Table 11.5.1-1 summarizes the COCs for SWMU 117.

The confirmatory soil samples collected from the trenches ranged in depth from 1 foot bgs to 11.5 feet bgs. Samples were collected below the debris items or debris layers encountered during excavation. The trench samples were collected to verify that no release of contaminants

Table 11.5.1-1
Summary of Residual COCs for SWMU 117

COC Type	Number of Samples	COCs Greater Than Background	Maximum Background Limit/Southwest Test Area[a] (mg/kg, except where noted)	Maximum Concentration (mg/kg, except where noted)	Average Concentration[b] (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded[c]
Metals	15 environmental; 3 duplicates	Arsenic	4.4	7	4.2	SWT-117-GP3-001-0.0-S SWT-117-GP3A-002-0.0-S SWT-117-GP3B-001-0.0-S SWT-117-TR3-002-6.5-S SWT-117-TR5-002-11.0-S
		Barium	130	236 J	143	SWT-117-GP1-001-0.0-S SWT-117-GP1A-002-0.0-S SWT-117-GP3A-002-0.0-S SWT-117-GP3B-001-0.0-S SWT-117-GP3B-002-0.0-S SWT-117-GP3B-002-0.0-SD SWT-117-GP5-001-0.0-S SWT-117-GP5-001-0.0-SD SWT-117-GP5-002-0.0-S SWT-117-TR1-005-5.5-S
		Beryllium	0.65	0.422 J	0.31	None
		Cadmium	0.9	0.221 J	0.07	None
		Chromium	15.9	15.3	5.9	None
		Lead	11.8	11 J	5.6	None
		Mercury	<0.1	0.0118 J	0.01	SWT-117-GP1-001-0.0-S SWT-117-GP1A-002-0.0-S SWT-117-GP3-001-0.0-S SWT-117-GP3A-002-0.0-S SWT-117-GP5-002-0.0-S SWT-117-TR1-002-2-S SWT-117-TR1-005-5.5-S SWT-117-TR3-002-6.5-S SWT-117-TR5-001-1.0-S

Refer to footnotes at end of table.

Table 11.5.1-1 (Concluded)
Summary of Residual COCs for SWMU 117

COC Type	Number of Samples	COCs Greater Than Background	Maximum Background Limit/Southwest Test Area[a] (mg/kg except where noted)	Maximum Concentration (mg/kg except where noted)	Average Concentration[b] (mg/kg except where noted)	Sampling Locations Where Background Concentration Exceeded[c]
Metals		Nickel	11.5	10.3	5.5	None
		Selenium	<1	0.5 J	0.25	SWT-117-GP5-002-0.0-S SWT-117-TR1-002-2-S
		Silver	<1	ND (0.06)	0.07	All samples below nonquantified background value
		Sodium	17,000	2090 J	1144	None
		Uranium	2.3	3.4 J	1.1	SWT-117-TR5-001-1.0-S
		Zirconium	9.2	8.28 J	4.1	None
Radionuclides	21 environmental; 4 duplicates	Cesium-137	0.664 pCi/g	0.26 pCi/g	Not calculated[d]	103E9A-SS
		Thorium-232	1.01 pCi/g	0.721 pCi/g	Not calculated[d]	103E6A-SS
		Uranium-235	0.16 pCi/g	0.883 pCi/g	Not calculated[d]	103E1-SS
		Uranium-238	1.4 pCi/g	31.4 pCi/g	Not calculated[d]	103E1-SS

[a]From Dinwiddie September 1997. The lowest value between the surface and subsurface soil background concentration is presented.
[b]Average concentration includes all samples. For nondetectable results, the detection limit is used to calculate the average.
[c]Includes all samples with nondetectable results where the MDA exceeds background (radionuclides).
[d]An average MDA is not calculated because of the variability in instrument counting error and the number of reported nondetectable activities.

COC = Constituent of concern.
GP = Soil pile.
J = Estimated value.
MDA = Minimum detectable activity.
mg/kg = Milligram(s) per kilogram.
ND ( ) = Not detected at or above the MDL shown in parenthesis.
pCi/g = Picocurie(s) per gram.
S = Soil sample.
SD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
SWT = Southwest Test Area.
TR = Trench.

had occurred from the buried debris to the underlying soil. The soil removed from excavated areas and placed into piles was also sampled to verify that no contaminants were present. The confirmatory soil samples are considered to be representative of the soil potentially contaminated with COCs and sufficient to determine the extent, if any, of COCs.

Metal COCs slightly exceeded background activities or concentrations in several soil samples. Radionuclide concentrations only exceeded background concentrations in one sample, although the MDAs for uranium-235 slightly exceeded background concentrations in most samples. The analysis for SVOCs in the black material encountered during trenching showed no detectable constituents. Field screening using a hand-held photoionization detector indicated that no VOCs were associated with the soil or buried debris items. The extent of residual contamination is limited to areas where debris items were buried. No horizontal or vertical trend to the distribution of contaminants is evident at the site.

11.5.2 Environmental Fate

The primary source of COCs for SWMU 117 was the disposal of debris in an open trench. The primary release mechanism of COCs to the subsurface soils is the degradation of debris that occurred prior to debris removal during the VCA.

After the removal of debris, possible secondary release mechanisms include suspension and/or dissolution of trace levels of residual COCs and percolation to the vadose zone, direct contact with soil (radionuclides only), dust emissions, and uptake of COCs in the soil by biota (Figure 11.5.1-1). The depth to groundwater at the site (at approximately 360 feet bgs) precludes migration of residual COCs to the shallow groundwater system. The pathways to receptors are soil ingestion, inhalation, and direct exposure (radionuclides). Plant uptake was also considered as a pathway for the residential scenario only. Annex 11-E provides additional discussion of the fate and transport of COCs at SWMU 117.

Table 11.5.1-1 summarizes residual COCs for SWMU 117. Based upon the nature and extent of contamination at the site (Section 11.5.1), metals and radionuclide COCs occur sporadically at low concentrations in some trenched areas or associated soil piles. No distinct vertical or horizontal distribution of contamination is present in the subsurface soil. All potential COCs were retained in the conceptual model and were evaluated in the human health and ecological risk assessments.

The current land use for SWMU 117 is industrial. The future land use for SWMU 117 is also industrial (DOE et al. September 1995).

The potential human receptor is considered an industrial worker at the site. For all applicable pathways, the exposure route for the industrial worker is dermal contact and ingestion/inhalation. Major exposure routes modeled in the human health risk assessment include soil ingestion for nonradiological and radiological COCs and direct gamma exposure for the radiological COCs. The inhalation pathway for both nonradiological and radiological COCs is also included because of the potential to inhale dust. Soil ingestion is included for the radiological COCs as well. Only soil ingestion is considered a primary contributor to exposure for the industrial worker.

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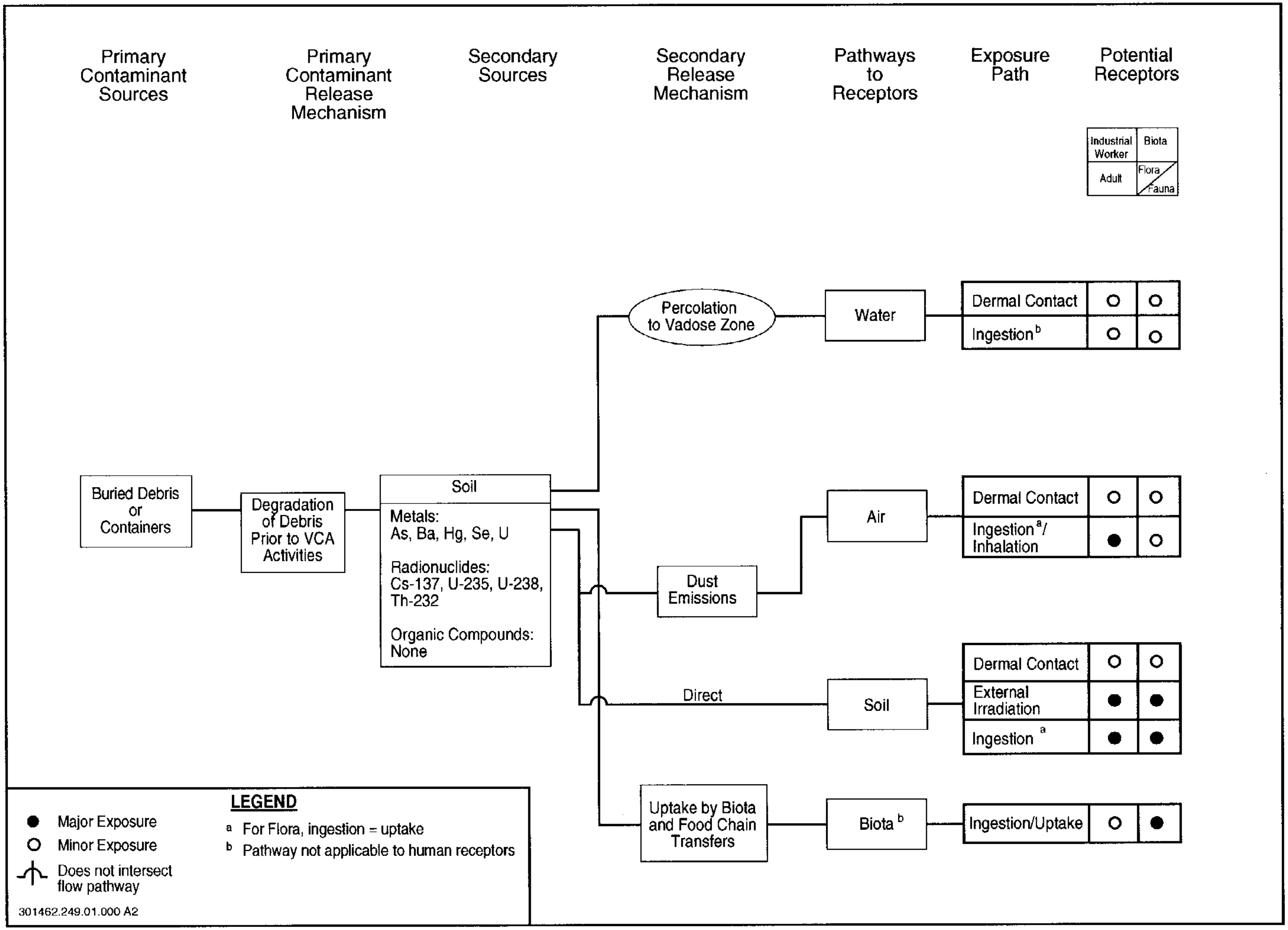

Figure 11.5.1-1

Conceptual Model Flow Diagram for SWMU 117, Trenches (Building 9939)

Potential biota receptors include flora and fauna at the site. Major exposure routes for biota include direct soil ingestion, ingesting COCs through food chain transfers, the direct contact with COCs in soil, and direct gamma exposure from radiological COCs. Annex 11-E (Section V) provides additional discussion of the exposure routes and receptors at SWMU 117.

11.6 Site Assessments

Site assessment at SWMU 117 includes risk screening assessments followed by risk baseline assessments (as required) for both human health and ecological risk. This section briefly summarizes the site assessment results, and Annex 11-E provides details of the site assessment.

11.6.1 Summary

The site assessment concludes that SWMU 117 has no significant potential to affect human health under the industrial land-use scenario recommended by DOE et al. (September 1995). After considering the uncertainties associated with the available data and modeling assumptions, ecological risks associated with SWMU 117 were found to be very low. Section 11.6.2 briefly describes and Annex 11-E provides details of the site assessments.

11.6.2 Screening Assessments

Risk screening assessments were performed for both human health risk and ecological risk for SWMU 117. This section summarizes the results.

11.6.2.1 Human Health

SWMU 117 has been recommended for industrial land-use (DOE et al. September 1995). Annex 11-E provides a complete discussion of the risk assessment process, results, and uncertainties. Because of the presence of COCs in concentrations or activities greater than background levels, it was necessary to perform a health risk assessment analysis for the site. This assessment included metals and radionuclide COCs detected above background. The risk assessment process provides a quantitative evaluation of the potential adverse human health effects caused by constituents in soil at the site. The Risk Screening Assessment Report calculated the hazard index (HI) and excess cancer risk for an industrial land-use setting. The excess cancer risk from nonradiological COCs and the radiological COCs is not additive (EPA 1989).

In summary, for the industrial land-use setting the HI calculated for SWMU 117 nonradiological COCs is 0.02, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). Excess cancer risk was estimated at 4E-06 for SWMU 117 nonradiological COCs for an industrial land-use setting. Guidance from the NMED indicates that excess lifetime risk of developing cancer by an individual must be less than 1E-06 for Class A and B carcinogens and less than 1E-05 for Class C carcinogens (NMED March 1998). For this risk assessment, the excess cancer risk was driven by arsenic, which is a Class A carcinogen. Thus, the excess cancer risk for SWMU 117 was above the suggested acceptable risk value of 1E-06. Incremental risk was determined by subtracting risk associated with background from potential COC risk. The incremental HI is 0.01. Incremental cancer risk was 2.00E-06 for the industrial land-use scenario, a value above the proposed guidelines.

The calculated HI for the nonradiological COCs was within the human health acceptable range for the industrial land-use scenario compared to established numerical guidance. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated by using maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations were more representative of actual site conditions. If the upper 95% confidence limit of the mean for arsenic (4.69) is used in place of the maximum concentration, the incremental excess cancer risk is reduced to 2E-07, which is within proposed guidelines considering an industrial land-use scenario.

The incremental total effective dose equivalent for radionuclides for an industrial land-use setting for SWMU 117 is 9.1E-1 millirems (mrem)/year (yr), which is significantly less than the recommended dose limit of 15 mrem/yr found in EPA (August 1997), reflected in SNL/NM (February 1998b).

The residential land-use scenarios for this site are provided only for comparison in the Risk Screening Assessment Report (Annex 11-E). The report concludes that SWMU 117 does not have potential to affect human health under a residential land-use scenario.

A close examination of the exposure assumptions revealed an overestimation of risk from nonradiological COCs, primarily attributable to the use of maximum exposure concentrations. Based upon an evaluation of this uncertainty, human health risks associated with this site are expected to be within the proposed guidelines and do not have the potential to affect human health under an industrial land-use scenario (see Sections VI.8 and VI.9, Annex 11-E).

11.6.2.2 Ecological

An ecological screening assessment that corresponds with the screening procedures in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997) was performed as set forth by the NMED Risk-Based Decision Tree (NMED March 1998). An early step in the evaluation is comparing COC concentrations to background and identifying potentially bioaccumulative constituents (see Annex 11-E, Sections V, VII.2, and VII.3). This methodology also requires that a site conceptual model and a food web model be developed and that ecological receptors be selected. Each of these items is presented in IT (July 1998) and will not be duplicated here. The screening also includes the estimation of exposure and ecological risk.

Annex 11-E presents the results of the ecological risk assessment screen. Site-specific information was incorporated into the screening assessment when such data were available. Hazard quotients greater than unity were initially predicted for arsenic and barium. A close examination of the exposure assumptions revealed an overestimation of risk, primarily attributable to treatment of exposure concentration, conservative exposure modeling assumptions, and conservative toxicity benchmark values. Based upon an evaluation of these uncertainties, ecological risks associated with this site are expected to be low.

11.6.3 Baseline Risk Assessments

This section discusses the baseline risk assessments for human health and ecological risk.

11.6.3.1 Human Health

Based upon the fact that human health results of the screening assessment summarized in Section 11.6.2.1 indicate that SWMU 117 does not have potential to affect human health under an industrial land use setting, a baseline human health risk assessment is not required for SWMU 117.

11.6.3.2 Ecological

Based upon the fact that ecological results of the screening assessment summarized in Section 11.6.2.2 indicates that SWMU 117 has very low ecological risk, a baseline ecological risk assessment is not required for SWMU 117.

11.6.4 Other Applicable Assessments

A Surface Water Site Assessment was conducted at SWMU 117 June 2000. The surface water assessment guidance was developed jointly by Los Alamos National Laboratory and the NMED Surface Water Quality Bureau. The assessment evaluated the potential for erosion at SWMU 117, which received a score of 8.8, indicating that it has low erosion potential. SWMU 117 is generally flat with minor localized sloping. There is no natural drainage directing storm water onto the site.

11.7 No Further Action Proposal

11.7.1 Rationale

Based upon field investigation data and the human-health risk assessment analysis, an NFA decision is being recommended for SWMU 117 for the following reasons:

- The VCA remediation resulted in removal all buried debris.
- The soil has been sampled for all relevant COCs.
- No residual nonradiological or radiological COCs are present in soil at levels considered hazardous to human health for an industrial land-use scenario.
- None of the nonradiological or radiological COCs warrant ecological concern.

11.7.2 Criterion

Based upon the evidence provided above, SWMU 117 is proposed for NFA according to Criterion 5, which states, "the SWMU/AOC has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicated that contaminants pose an acceptable level of risk under current and projected future land use" (NMED March 1998).

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ANNEX 11-C
SWMU 117 VCA Plan

Sandia National Laboratories

VOLUNTARY CORRECTIVE ACTION PLAN EXCAVATION AND DEBRIS REMOVAL AT ENVIRONMENTAL RESTORATION SWMU 117 TRENCHES (BUILDING 9939)

OPERABLE UNIT 1335, SOUTHWEST TEST AREA

July, 1999

Environmental Restoration Project

United States Department of Energy
Albuquerque Operations Office

Voluntary Corrective Action Plan Excavation and Debris Removal at Environmental Restoration SWMU 117 Trenches (Building 9939)

Operable Unit 1335, Southwest Test Area

July 1999

(Revision 0)

Prepared by
Sandia National Laboratories/New Mexico
Environmental Restoration Project

Voluntary Corrective Action Plan
Excavation and Debris Removal at Environmental Restoration SWMU 117 Trenches (Building 9939)

Operable Unit 1335, Southwest Test Area

Prepared for:

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July 20, 1999

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LIST OF ACRONYMS

AFB	Air Force Base
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	contract laboratory program
COC	contaminant of concern
DOE	Department of Energy
DOU	Document of Understanding
DQO	data quality objectives
EM	electromagnetic
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ES&H	Environmental Safety and Health
FOP	Field Operating Procedure
ft	Foot or feet
gal	Gallon
HASP	health and safety plan
HHRB	human health risk-based
HSWA	Hazardous and Solid Waste Amendments
mR/hr	micro roentgens per hour
MS/MSD	matrix spike/matrix spike duplicate
ND	not detected
NEPA	National Environment Policy Act
NFA	No Further Action
NMED	New Mexico Environment Department
OU	Operable Unit
OSHA	Occupational Safety and Health Administration
PARCC	precision, accuracy, representative, completeness, and comparability
PIP	Project Implementation Plan
PPE	personal protective equipment

LIST OF ACRONYMS

(Continued)

QA	quality assurance
QAPjP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RMMA	Radioactive Material Management Area
RPO	Radiation Protection Office
SNL/NM	Sandia National Laboratories/ New Mexico
SWMU	solid waste management unit
UXO	unexploded ordnance
VCA	voluntary corrective action

1 Introduction

This document describes the proposed plan for conducting a Voluntary Corrective Action (VCA) at Sandia National Laboratories, New Mexico (SNL/NM) Environmental Restoration (ER) Solid Waste Management Unit (SWMU) 117, Trenches (Building 9939). ER Site 117 is located within Operable Unit (OU) 1335, the Southwest Test Area (Figure 1-1). Organization of this document follows the outline for sampling and analysis plans/work plans specified in the New Mexico Environment Department Hazardous and Radioactive Materials Bureau "Standard Operating Procedures Manual Volume 1 – External" (NMED March 1998).

1.1 Objectives and Scope

The objective of the VCA at ER Site 117 is to remove all solid waste present at the site and verify through sampling and analysis that no hazards to human health and the environment occur in the former sodium disposal trenches. The Site 117 disposal trenches received reacted sodium that had been used in concrete interaction tests performed at the Large Melt Facility (SWMU 103). This action entails the removal of solid waste and exploratory trenching in the sodium disposal area, sampling and analysis to verify presence or absence of any contaminants, and disposal of solid waste and any hazardous and/or radioactive waste (if generated). This action is designed to remove all solid waste from the site and verify that the soil directly underlying the solid waste is not contaminated. Exploratory trenching will verify that no containers with elemental sodium metal are buried at the site. Safety protocols have been established in the event of encountering a container(s) with elemental sodium metal. Any waste (i.e., debris or soil)

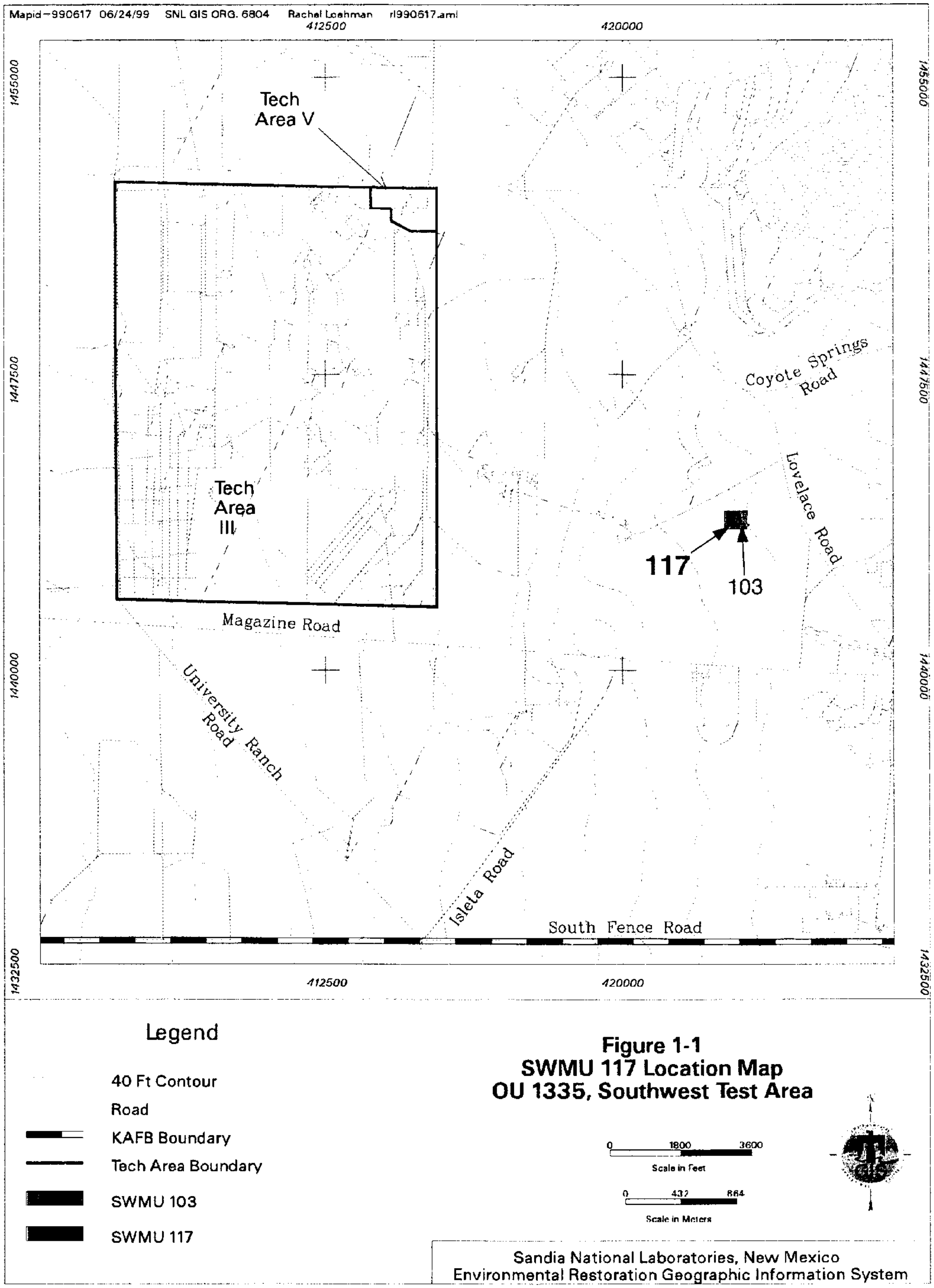


Figure 1-1
SWMU 117 Location Map
OU 1335, Southwest Test Area

Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System

identified as hazardous and/or radioactive will also be removed from the site. This action is intended to compress the characterization and clean-up schedule, rendering the site available for future industrial land use. SNL/NM considered several factors in determining the need for a VCA at ER Site 117. These factors are:

- Removal of solid nonhazardous waste is required by NMED at ER sites as specified in the New Mexico Solid Waste Regulations (20NMAC9.1),
- Both the site assessment and cleanup of solid waste would necessitate excavation, and
- Significant cost savings and environmental safety and health (ES&H) risk reduction would be achieved by combining characterization and cleanup into one action.

1.2 Approach and Implementation

This VCA will address removal of solid waste and verification that contaminated soil and buried containers of sodium do not occur in the former disposal area. Exploratory trenching will be conducted to a depth of approximately 12 feet below ground surface (bgs) in all areas identified by geophysical survey to contain buried materials. Excavated material will be screened for radioactivity with real-time field instrumentation. Soil samples will be collected from below any debris encountered in the exploratory trenches. A minimum of ten soil samples, plus associated quality control (QC) samples, will be collected from five exploratory trenches. Samples will be analyzed for RCRA metals, total uranium (U), beryllium (Be), sodium (Na), nickel (Ni), zirconium (Zr), depleted uranium (DU) and other gamma-emitting radionuclides. All soil, and any debris removed from the former disposal area will be staged on-site until waste characterization analyses are completed.

1.3 Background Issues

This VCA is being conducted as proposed in the Sandia National Laboratories New Mexico (SNL/NM) Southwest Test Area RCRA Facility Investigation (RFI) Work Plan (SNL/NM March1996).

1.3.1 Regulatory Issues

This VCA is being undertaken in partial fulfillment of the Hazardous and Solid Waste Amendments (HSWA) Module IV of the SNL/NM RCRA Hazardous Waste Management Facility Permit (NM5890110518).

1.3.2 Other Issues

No other issues are applicable to this VCA.

1.4 Data Quality Objectives Process

This VCA will be conducted in accordance with the data quality objectives (DQOs) development process specified in the RFI Workplan for Operable Unit 1335, the Southwest Test Area. The primary objectives of this VCA include:

- Removal and disposal of solid waste
- Sampling and analysis of soil directly underlying solid waste to verify the presence or absence of chemical and/or radiological contamination
- Sampling and analysis of stained soils encountered in exploratory trenches

- Verify absence of buried containers with elemental sodium
- Conduct the necessary site cleanup and collect sampling analytical data that will support the preparation of a No Further Action Proposal

The waste characteristics of all debris and soil excavated during the course of this investigation will be determined through field instrument measurements and sampling and analysis. Additional detailed information concerning analytical data quality requirements and data uses for this project are provided in Section 3.1.

A thorough evaluation of the SWMU 117 operational history and an evaluation of the results of prior sampling and analysis of soil in the vicinity of the site was conducted to develop the objectives for this VCA. The following sections present the site history, existing characterization data, and the conceptual model developed for Site 117.

2 Description of SWMU 117 – Trenches (Building 9939)

This section presents the site description, operational history, and waste characteristics associated with ER SWMU 117.

2.1 Characterization and Setting

SWMU 117 is identified as the Trenches (Building 9939) in the Hazardous and Solid Waste Amendments (HSWA) Module of SNL/NM's RCRA Permit. The ER site boundary established around the trenches encompasses approximately 2.5 acres (SNL/NM April 1995) of United States Air Force (USAF) land permitted to the DOE. ER Site 117 is located west of Lovelace Road about 0.3 miles south of Coyote Springs Road, and one mile north of the Solar Tower (Figure 1-1).

The terrain in the vicinity of the site is generally flat with a gentle slope to the west and a shallow arroyo about 500 feet to the south. Vegetation is primarily desert grasses and tumbleweeds. The soil type identified in the area of Site 117 is a very fine sandy loam (SNL/NM March 1996).

Site 117 is located along the western margin of the Manzanita Mountains and is situated on a partially dissected coalescent alluvial fan complex that flanks the mountain front to the west. Late Pleistocene pediment and alluvial fan deposits have been mapped in the area of the site. Depth to bedrock is interpreted to be shallow in this area. Surface exposures of Precambrian bedrock are present in arroyo bottoms and intervening ridges along the northern edge of OU 1335

(SNL/NM March 1996). A complex structural geologic setting occurs in the vicinity of the site. Site 117 is located slightly east of a series of north- and northeast-trending faults that occur along the front of the Four Hills and Manzanita Montains. These faults are part of the major rift-bounding fault complex present along the eastern margin of the Albuquerque Basin (SNL/NM March 1996).

Surface water runoff in the vicinity of the site is minor, since the surface slope is flat to gently inclined. Average annual rainfall on OU 1335 is about 8 to 10 inches. Based on soil samples collected near adjacent ER Site 74 (The Chemical Waste Landfill), soil-moisture content in this area is likely in the range between 1 and 10 percent, with 5 or 6 percent a reasonable average (SNL/NM March 1996).

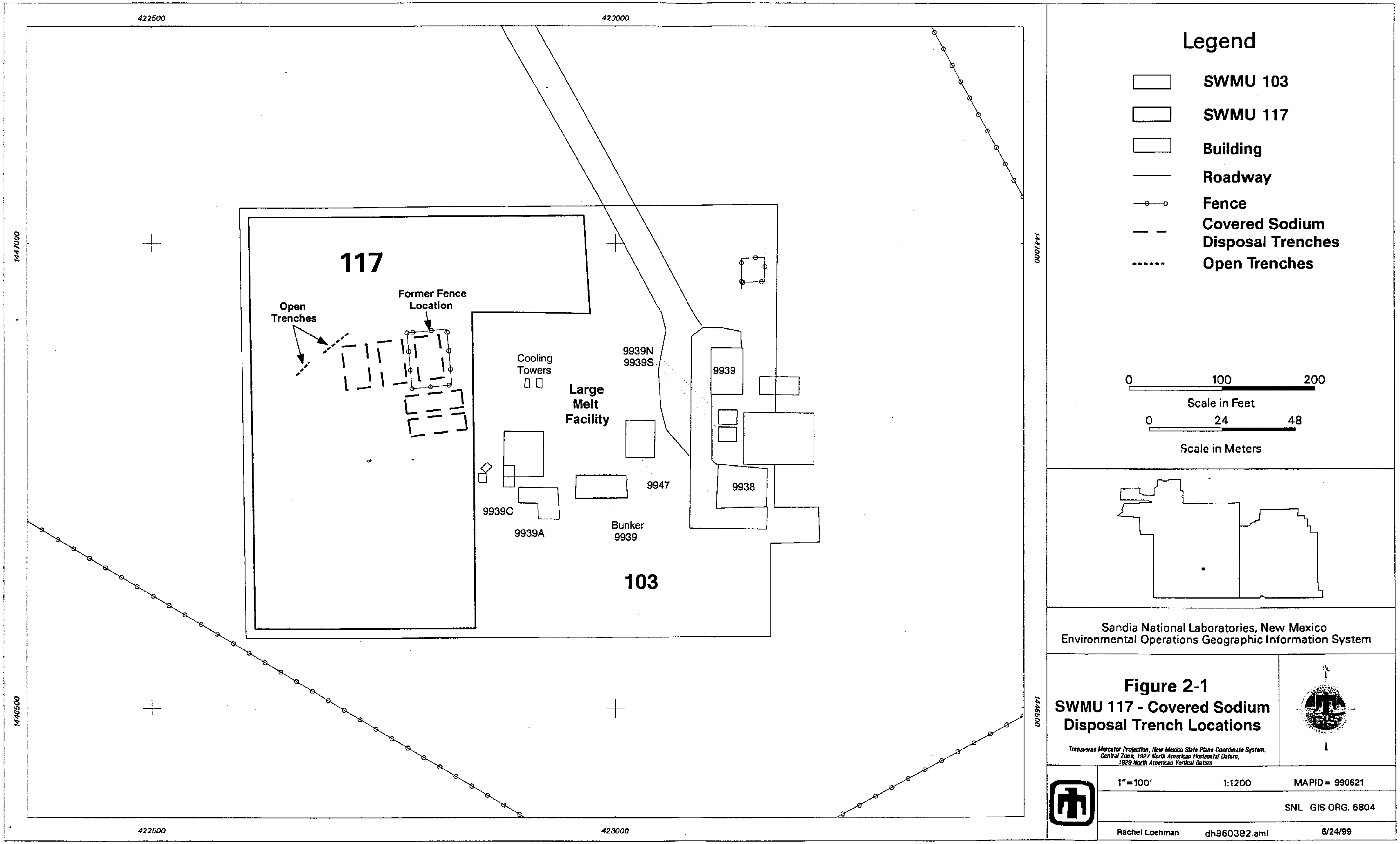
The vadose zone underlying the Site 117 may be as little as 50 ft thick or less (SNL/NM March 1996). Depth to ground water measured in the closest monitoring well (LMF-1), which is located approximately 1400 feet north of the site, is 350 ft below ground surface. Ground water in well LMF-1 occurs in the bedrock Abo Sandstone Formation (SNL/NM March 1996). Additional detailed information concerning the geologic and hydrologic characteristics in the area of Site 117 are presented in the OU 1335 RFI Work Plan (SNL/NM Mach 1996) and Site Wide Hydrogeologic Characterization Report, Calendar Year 1994, Annual Report (SNL/NM March 1995).

2.1.1 Site History of SWMU 117 – Trenches (Building 9939)

The trenches at Building 9939 (Figure 2-1) are associated with the adjacent Large Melt Facility (SWMU 103), an inactive site, once used to test simulated nuclear reactor meltdown scenarios. The trenches were required for the disposal of residual sodium that was washed out of the concrete crucibles that were used in the tests.

The Large Melt Facility was built in 1971 and was originally designed as an explosive fabrication site, but was never used for that purpose. In early 1977, the facility was adapted to conduct molten core concrete interaction studies sponsored by the Nuclear Regulatory Commission (NRC) (Hyde May 1992). SNL used the facility to conduct experiments supporting reactor safety programs for customers such as NRC, DOE and Westinghouse Savannah River Laboratories (Hyde May 1992). SNL/NM Organization 7500 provided the facility for sodium containment and structural integrity tests for the proposed Clinch River Fast Breeder Reactor at Oak Ridge, Tennessee.

The site history for the Large Melt Facility (SWMU 103) is discussed in detail in Section 5.5 of the RFI Work Plan (SNL/NM March1996). A risk-based No Further Action (NFA) proposal has been submitted for SWMU 103 (SNL/NM June 1998) and is pending approval from the New Mexico Environmental Department.


422500
423000
1447000
1446500
117
Open
Trenches
Former Fence
Location
Cooling
Towers
Large
Melt
Facility
9939N
9939S
9939
9938
9947
9939C
9939A
Bunker
9939
103
Legend
SWMU 103
SWMU 117
Building
Roadway
Fence
Covered Sodium
Disposal Trenches
Open Trenches
0
100
200
Scale in Feet
0
24
48
Scale in Meters
Sandia National Laboratories, New Mexico
Environmental Operations Geographic Information System
Figure 2-1
SWMU 117 - Covered Sodium
Disposal Trench Locations
Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum
1"=100'
1:1200
MAPID= 990621
SNL GIS ORG. 6804
Rachel Loehman
dh960392.aml
6/24/99

Fifteen large-scale tests with sodium were conducted at the Large Melt Facility. Each test used from 100 to 200 pounds of sodium (SNL/NM March 1990). In some of the tests, most of the sodium was consumed, in others, hardly any (SNL/NM March 1990). For these tests, the elemental sodium, which came in 55-gal barrels, was heated up to 120^0 Fahrenheit and then transferred to a "Dump Tank" for further heating (SNL/NM March 1990). At the start of the test, the Dump Tank contents were poured into the test crucible. Photographs of some of the concrete crucibles that were used for testing are shown in Figure 2-2.

Following the tests, the crucible was moved to the "Crucible Spray Pit" (i.e., sodium disposal trench). The residual sodium in the crucibles was reacted with a spray mist of water. A steel piece was used to tilt the crucible so that the spray mist runoff would go into the pit. It typically took 2 to 3 weeks of spraying continually during the day to get rid of the residue (Byrd November 1992). The reacted sodium that washed out of the crucibles and into the spray pits (i.e., sodium disposal trenches) was further treated in one of three ways (SNL/NM March 1990):

1. After the sodium was washed out of the crucible into the disposal trench, the material in the trench was covered with soil.

2. After the sodium was washed into the disposal trench, the material in the trench was covered with soil and soaked with water; or

3. After the sodium was washed into the disposal trench, the material in the trench was soaked with water, then covered with soil.

Figure 2-2A

Figure 2-2B

Figure 2-2

Examples of the concrete crucibles used for concrete interaction tests. The crucibles shown here are approximately five feet in diameter. These previously used crucibles are being stored in an area adjacent to the SWMU 117 trenches at the Large Melt Facility.

When the trench was filled with sodium-rich mud to within 5-6 feet from the surface, its use was terminated and it was completely filled in with clean soil (Powers June 1988). The pits (i.e., trenches) were estimated to be 12 feet deep, 5 feet wide, and 20 to 40 feet long (SNL/NM March 1990). According to personnel familiar with the activities at Site 117, there were possibly five pits used over the course of the program (Bentz October 1995). Another reference states that only two pits were used (DOE September 1987). No pits are visible on the available historical aerial photographs of the area. Other materials such as non-sodium scrap metal and equipment may have also been placed in the pits.

Figure 2-3 is a photograph of the site with superimposed markings delineating the estimated locations of the covered disposal trenches, if five trenches were used during historical sodium disposal operations. The five trench disposal locations shown on Figure 2-3, as well as those displayed on other figures presented in this plan, are based on the information provided by Bentz (1995). Because of the uncertainty surrounding the exact number and locations of the trenches, each of the outlined trench locations presented on the figures in this document encompass a considerably larger area than the actual size of each disposal trench (i.e., approximately 12 feet deep, 5 feet wide, and 20 to 40 feet long). Results of the EM-31 and EM-61 geophysical surveys that were conducted in the area to assist in identifying the disposal trench locations are presented in section 2.2.1.1.

Subsequent to the sodium interaction tests and post-test crucible cleaning and disposal of reacted sodium into disposal trenches, that occurred at the Large Melt Facility between 1977 and 1981, an incident was reported involving the improper storage/disposal of a container of elemental

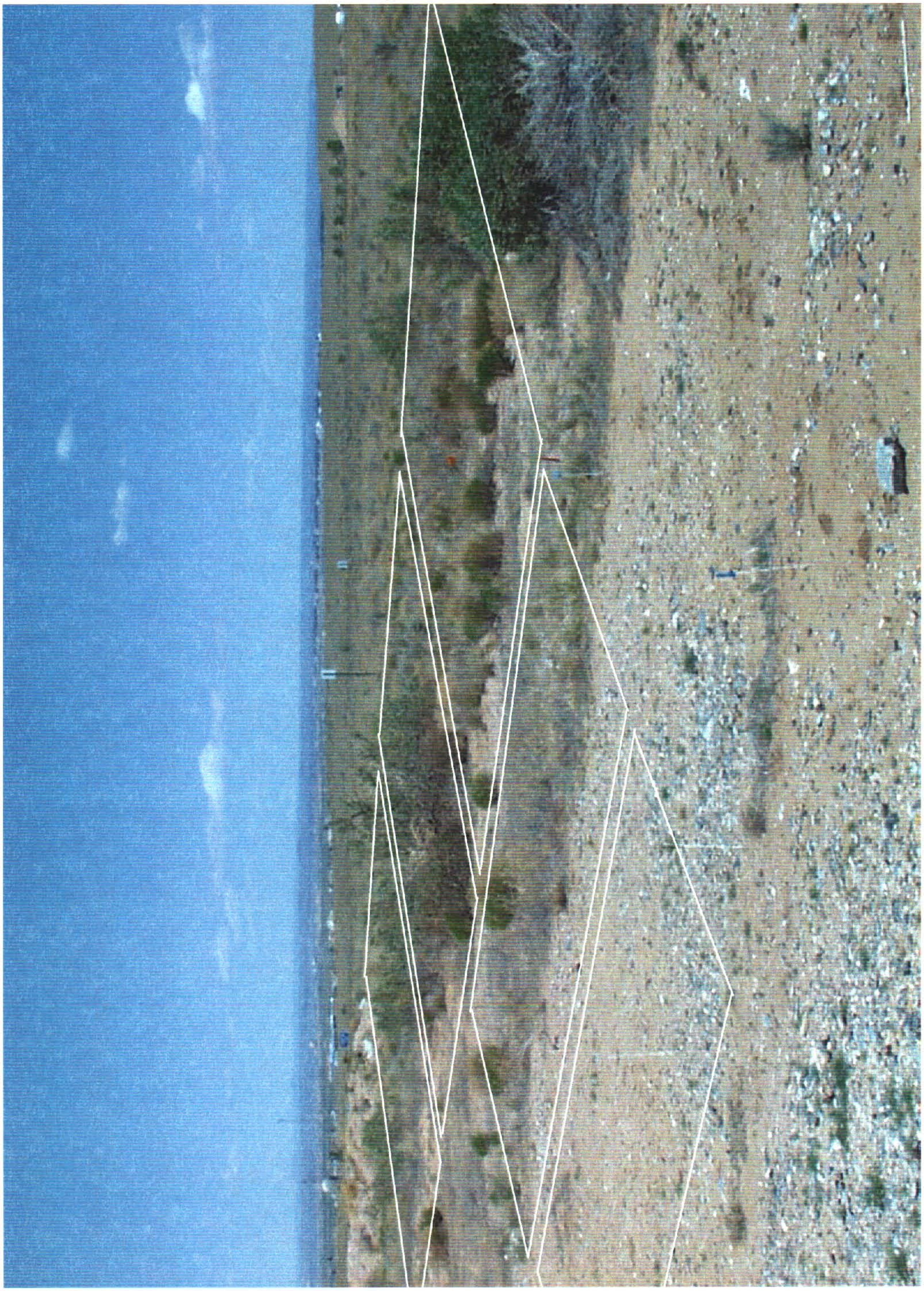


Figure 2-3 Photograph with markings delineating the approximate location of the covered sodium disposal trenches

sodium. On Saturday, December 17, 1988, a drum of sodium placed in an open trench exploded (Powers June 1988). A break in an underground water line near the Large Scale Melt Facility cooling tower resulted in water flowing into the trench containing the drum of sodium. The water reaction with the sodium in the drum produced hydrogen gas that either ignited or over-pressurized the drum and resulted in an explosion.

The explosion scene is described as follows:

"About 40 feet north of the site pad, there was a pit approximately 12 feet long, 6 feet wide and 3 feet deep. The pit was about 400 feet west of the 9939 control building and at least 150' north of the closest experimental facilities at the site. Within the pit was a broken metal barrel (a 55-gal drum) and evidence of sodium combustion. White deposits on the ground and on unused experimental hardware further attested to vigorous sodium combustion. Standing water covered the entire vicinity of the pit. A lump of sodium reaction products lay on the ground about 4 feet from the lip of the pit. A second lump of still-burning sodium lay about 39 feet west of the pit. A shard from the barrel was 26 feet west of the pit. Water was coming from a leak associated with city water connected to the site. All sodium combustion had ceased by the time the water lines were shut off." The amount of sodium involved in the incident was estimated to be between 20 and 40 pounds (Powers June 1988). The barrel remnants were not excessively corroded, but it is clear the barrel had not been leak-tight. Masses of sodium reaction products were collected and put into barrels provided by Division 3314. Site personnel conducted a follow up metal detector survey of the area after the incident. No indications of additional buried metal barrels were detected (Powers June 1988). The pit was refilled with dirt and marked off. The former location of the marked off (fenced-off) area is shown on Figure 2-1. The incident investigation report stated that the drum of elemental sodium was stored/disposed of in a manner that was inconsistent with accepted standard operating procedures (Powers June 1988).

2.1.2 Waste Characteristics

The primary waste material disposed of in the Site 117 trenches is reported to be reacted sodium. Records documenting the history of tests conducted at the Large Melt Facility (ER Site 103) indicate that 15 experiments, each involving use of 100 to 200 lbs of elemental sodium, were conducted between 1977 and 1981 (SNL/NM March 1996). During testing the sodium was heated to a molten state and then placed into a concrete crucible to evaluate interaction with concrete. After testing, the residual sodium was washed out of the crucible with a water spray into a trench excavated specifically for sodium disposal. Based on the available records concerning the quantity of sodium involved in each test, if all the sodium used in all 15 experiments that were conducted was disposed of in the trenches, approximately 1500 to 3000 lbs of sodium-rich soil may be present in the disposal pits. Because the sodium was washed out of the crucibles with water and allow to react, no reactive sodium will be present in the soil. The residual sodium salt present in the disposal pit soil is not a hazardous waste.

There is a possibility, albeit a low probability, for containers of sodium to have been placed into the sodium disposal trenches. Evidence from geophysical surveys conducted at the site, as presented in section 2.2.1.1, do not substantiate the presence of buried sodium containers. Debris such as scrap metal and equipment are reported to have possibly been placed in the trenches (SNL/NM March 1996). Partially buried solid waste is visible in the disposal area.

Various material interaction tests conducted at the Large Melt Facility involved use of a number of metals other than sodium. Disposal procedures for the waste products from these other experiments did not include placement of the test materials into trenches. Nevertheless, the possibility that the sodium trenches were used for unspecified purposes does exist and will be evaluated by the excavation, sampling, and analysis activities that are part of this VCA.

2.2 Investigation Approach

All solid waste will be removed from Site 117 as part of this corrective action by hand gathering all material lying on the surface and by excavating partially buried material using heavy equipment. Material lying on the surface or partially buried is evident in several areas of the site. The location of shallow buried materials has been delineated using geophysical techniques (Hyndman February 1998).

Direct observations on the surface, as well as geophysical survey results indicate that the majority of the solid waste materials present at Site 117 occur in a shallow (approximately 3 ft deep) segmented open trench located slightly northwest of the sodium disposal trench area (Figure 2-1). Exploratory trenching will be conducted in the areas where geophysical data indicate the presence of buried and partially buried materials. Samples will be collected from the soil directly underlying the debris removed from the site. Analytical results will be used to verify the presence or absence of subsurface soil contamination. Judgemental samples will also be collected from areas of stained soils if they are encountered in the exploratory trenches. Trenching in areas of geophysical anomalies will also verify the presence or absence of buried containers of sodium metal. If drums of elemental sodium are encountered during this VCA, additional consultation concerning safety protocols will be initiated with SNL/NM Industrial Hygiene, Safety Engineering and Waste Management personnel prior to performing any removal action.

Analytical results will provide the data needed to verify that a release from the solid waste items to the soil underlying the material has not occurred. Samples will also be collected from the soil that is removed from the exploratory trenches and temporarily staged onsite. The analytical data set will be used to perform a cumulative risk assessment, if constituents are detected above background levels. The results of this risk assessment will determine final disposition of the site and the excavated soil. This VCA is expected to achieve restoration of the site, rendering it suitable for future industrial land use.

This VCA Plan presents the technical basis for conducting excavation, sampling, and laboratory analysis. These activities are expected to provide the necessary information with which to propose the site for No Further Action (NFA) designation. Final disposition of the site will be dependent upon evaluation of the VCA results, which includes the results of a cumulative risk assessment, if needed. The risk assessment will use the verification sampling analytical data. This data set will contain representative concentrations of COCs in the soil below any debris items and stained soils encountered in the exploratory trenches, as well as the soil removed from the exploratory trenches that is staged in piles onsite.

2.2.1 Existing Data

The following section provides a summary of the site characterization investigations that have been conducted at Site 117. These include a UXO/HE survey, a cultural resource and sensitive species survey, a surface radiation survey and surface radiation VCM, and surface soil scoping sampling. A geophysical survey was also conducted to support the characterization of ER Site 117. A summary of the results of each investigation is presented below.

2.2.1.1 Non-sampling

Cultural-Resources Survey

A cultural resources survey was conducted as part of the significant preliminary investigations conducted both at ER Site 117 and 103. No cultural resources were identified at, or in the vicinity of ER Site 117 (Hoagland and Dello-Russo February 1995).

Sensitive-Species Survey

A sensitive-species survey was conducted as part of a biological assessment of Sites 117 and 103. No sensitive species were found (DOE March 1996)

UXO/HE Survey

In February 1994, Kirtland Air Force Base (KAFB) Explosive Ordnance Disposal (EOD) personnel conducted a visual survey for the presence of unexploded ordnance/high explosive

(UXO/HE) on the ground surface at ER Sites 117 and 103. No UXO/HE was found as a result of this survey (Young and Byrd September 1994).

Radiological Surveys and Surface Radiation VCM Activities

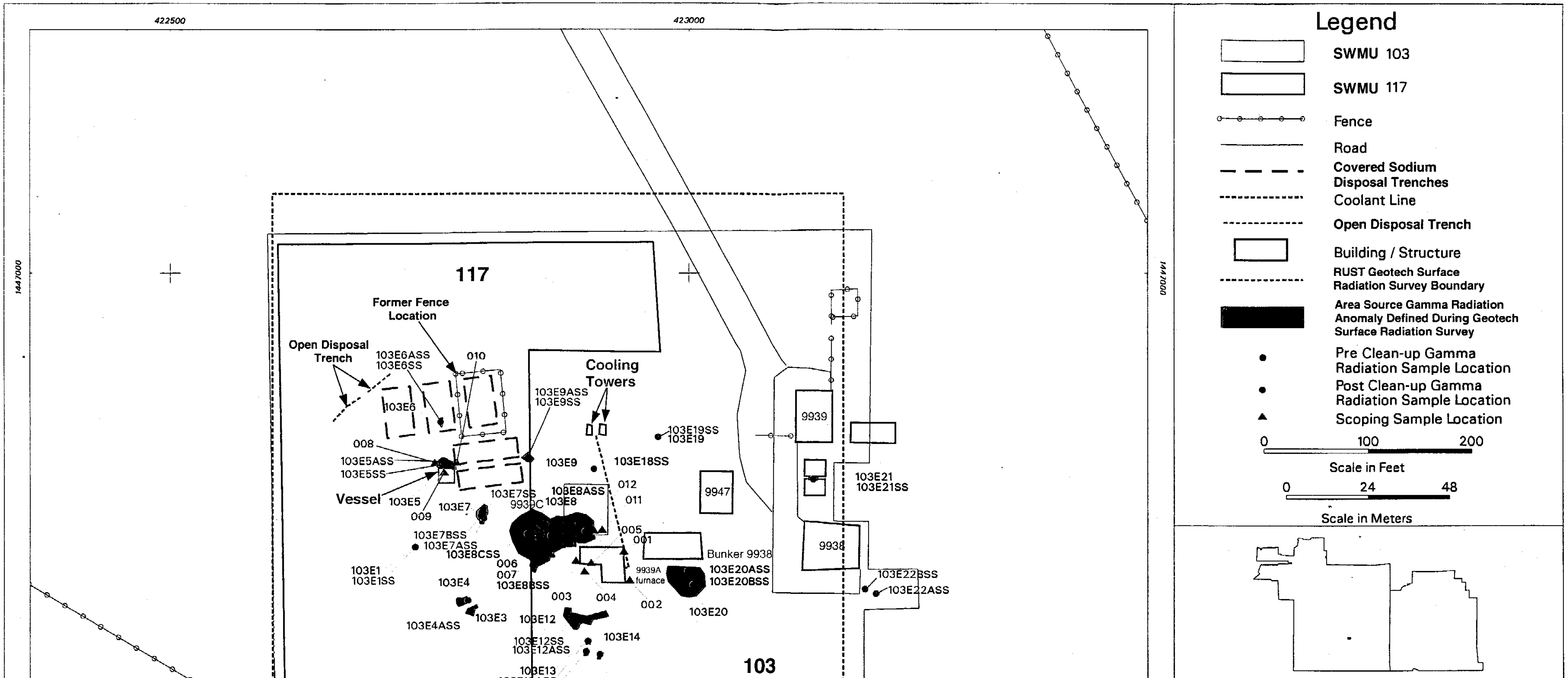
Because the Large Melt Facility was known to have used depleted uranium in its testing operations, RUST- Geotech conducted a surface radiation survey of Sites 103 and 117 using Na-I detectors for gamma radiation during March 1994. This walk-over survey covered 6.3 acres at 100% coverage (Figure 2-4). Twelve area source anomalies, two fragment source anomalies, and one fragment area source anomaly were located with gamma radiation activity ranging from 13 to 198 uR/Hr (SNL/NM September 1997). One of the area sources (103E6) identified in the survey occurred on the surface in the area of the Site 117 sodium trenches (Figure 2-4). In 1995, SNL/NM implemented a VCM for the removal of surface radiation anomalies at Sites 103 and 117. All fragments of depleted uranium and surface soil areas with gamma radiation activity 30 percent or greater than background were removed as part of the Rust Geotech Radiological VCM (SNL/NM September 1997). Gamma spectroscopy analytical results of soil samples collected following the removal of radioactive fragments and soil from Sites 103 and 117 are presented in Section 2.2.1.2. Based on post-cleanup radiological VCM sampling results, the Large Melt Facility (SWMU 103) has been proposed to be abolished from SNL/NM listing as radioactive material management area.

EM-61 and EM-31 Surface Geophysical Surveys

An initial geophysical survey covering Site 117 was performed in April 1997. An extension of the original survey was performed in January 1998. The geophysical investigation of Site 117 consisted of a high-precision metal detection survey utilizing a Geonics Ltd. EM-61 and a ground conductivity survey utilizing a Geonics Ltd. EM-31. The initial EM-61 survey covered an area of 280-ft by 200-ft. The initial EM-31 survey covered a larger area measuring 470-ft by 200-ft. Both EM-61 and EM-31 surveys were extended by 72 ft to the south. The surveyed region covers that entire area under consideration for this VCA.

Data from both instruments were collected along parallel north-south traverses separated by 5 ft. The data from the survey extensions were transferred to a personnel computer for reduction and merging with the original data. The data were reduced using the DAT61 and DAT31 program (Geonics Ltd.), and then imaged using the line Geosoft Mapping and Processing System (Geosoft Inc.). Final geophysical images were imported into the SNL/NM Environmental Restoration Geographic Information System for plotting onto site maps that includes building locations and other physical features. Results of the initial and extension geophysical surveys were presented in a summary report (Hyndman February 1998) and discussed below.

Results of the EM-31 ground conductivity survey are shown on Figure 2-5. EM-31 measurements are sensitive to depths of 15 to 20 ft bgs. A general background conductivity of approximately 25 milliseconds/meter (orange to red color, Figure 2-5) is present, which is typical of this area. The southeastern portion of the survey area is part of the Large Melt Facility's



Sandia National Laboratories, New Mexico
Environmental Operations Geographic Information System

Figure 2-4
Radiologic Anomalies & Previous Sampling Locations at SWMUs 117/103
OU1335, Southwest Test Area

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

1"=100'	1:1200	MAPID=990620
		SNL GIS ORG. 6804
Rachel Loehman	dh990292.aml	06/24/99

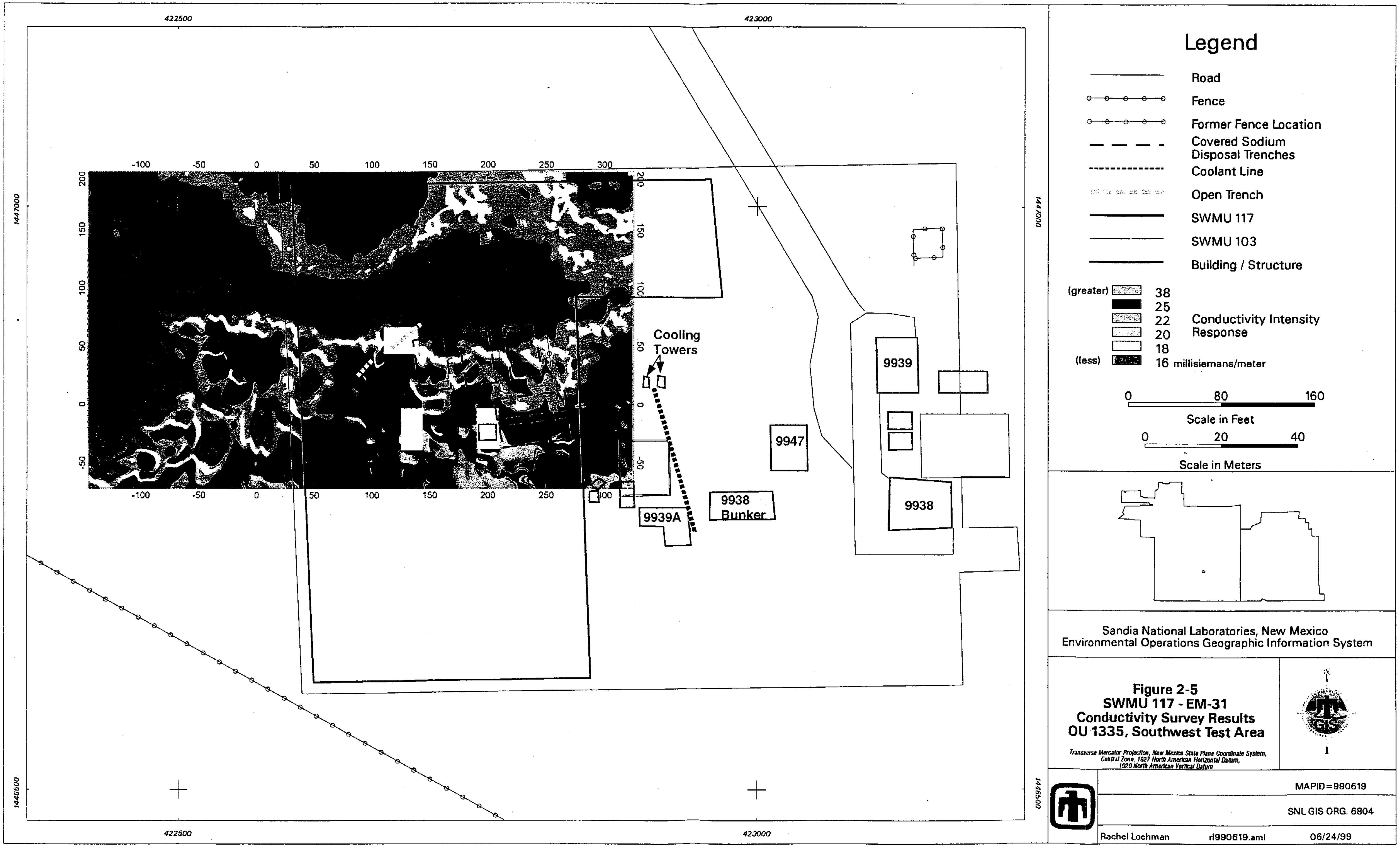
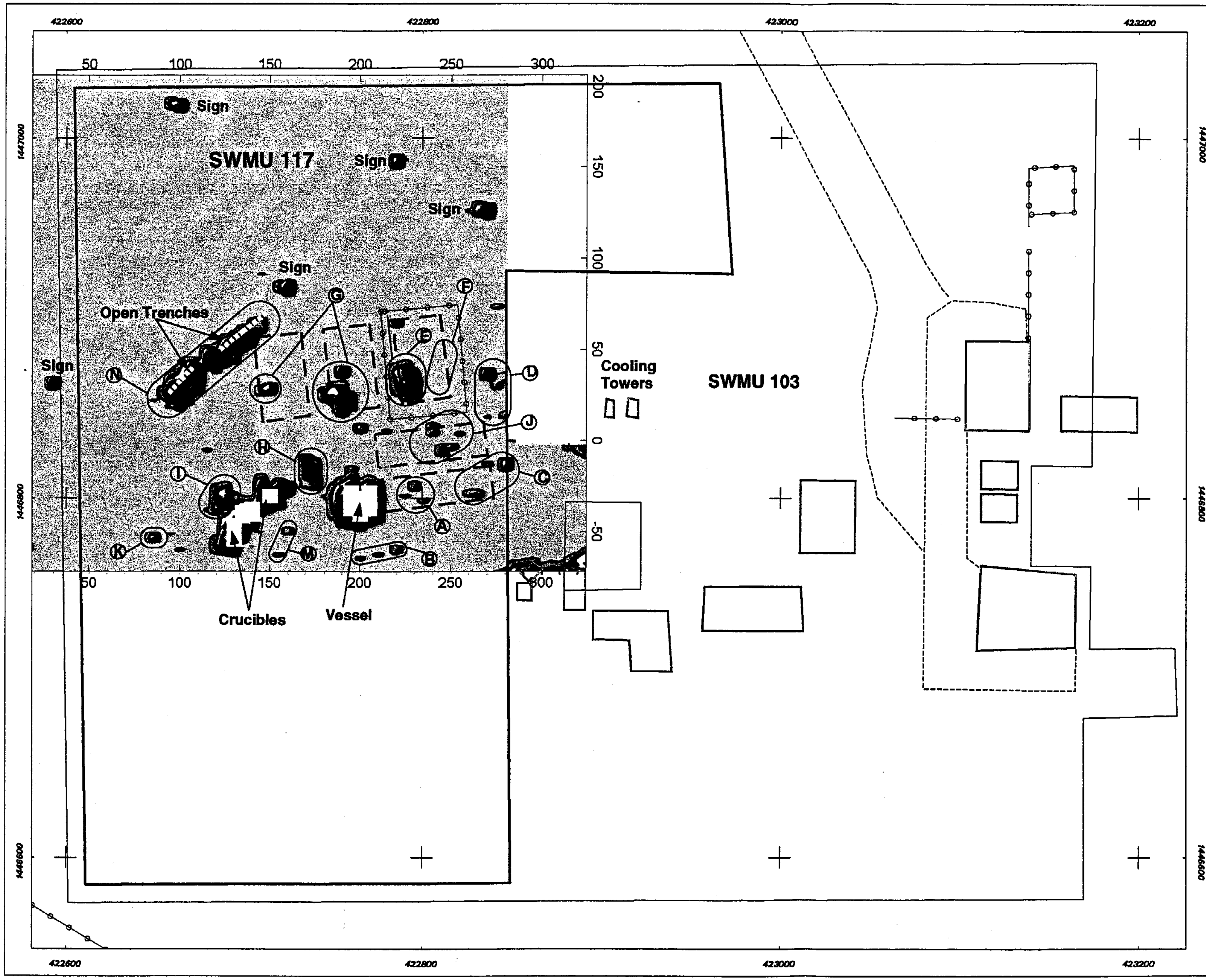


Figure 2-5
SWMU 117 - EM-31
Conductivity Survey Results
OU 1335, Southwest Test Area

operational yard and consists of hard compacted soil. This compacted soil or "hardstand" displays an elevated conductivity (red to pink color, Figure 2-5). Two large areas of anomalous low conductivity (blue color, Figure 2-5) are present. These occur in the western and east-central portions of the survey area. The low conductivity may be related to disruption of the soil, allowing rain and runoff to "wash" conductive elements from the soil. These large anomalies occupy broad areas and suggest a response to geologic and topographic conditions. They also are not coincident with any of the locations of the sodium disposal trench locations that have been indicated by previous site workers.

Results of the EM-61 metal detection survey are presented on Figure 2-6. EM-61 measurements can detect metallic materials to a depth of approximately 10 ft bgs. The shallow open trench located northwest of the sodium disposal trenches, appears on the surface to consist of two separate segments (Figure 2-7). The metal detection survey results indicate buried material below the section of ground between the segments. There are two other significant metal anomalies located directly south and west of where the sodium disposal trenches are suspected to be located. These two large metal anomalies that are partially masked by the blank, open, unsurveyed sections are located in the south-central portion of the EM-61 survey area. These metal anomalies represent objects that are being stored on the surface of the site. The open blank (white) display on the map occurs because the survey coverage had to be diverted around the surface features. The western-most anomaly/open blank area is a row of concrete crucibles with rebar reinforcement and a metal box-like structure (see Figure 2-2A photograph).



Sandia National Laboratories, New Mexico
Environmental Operations Geographic Information System

Figure 2-6
Investigation of EM-61 Metal Detection Results for SWMU 117 OU 1335 Test Area

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

MAPID=990622
SNL GIS ORG. 6804
Rachel Loehman r990622.aml 06/24/99

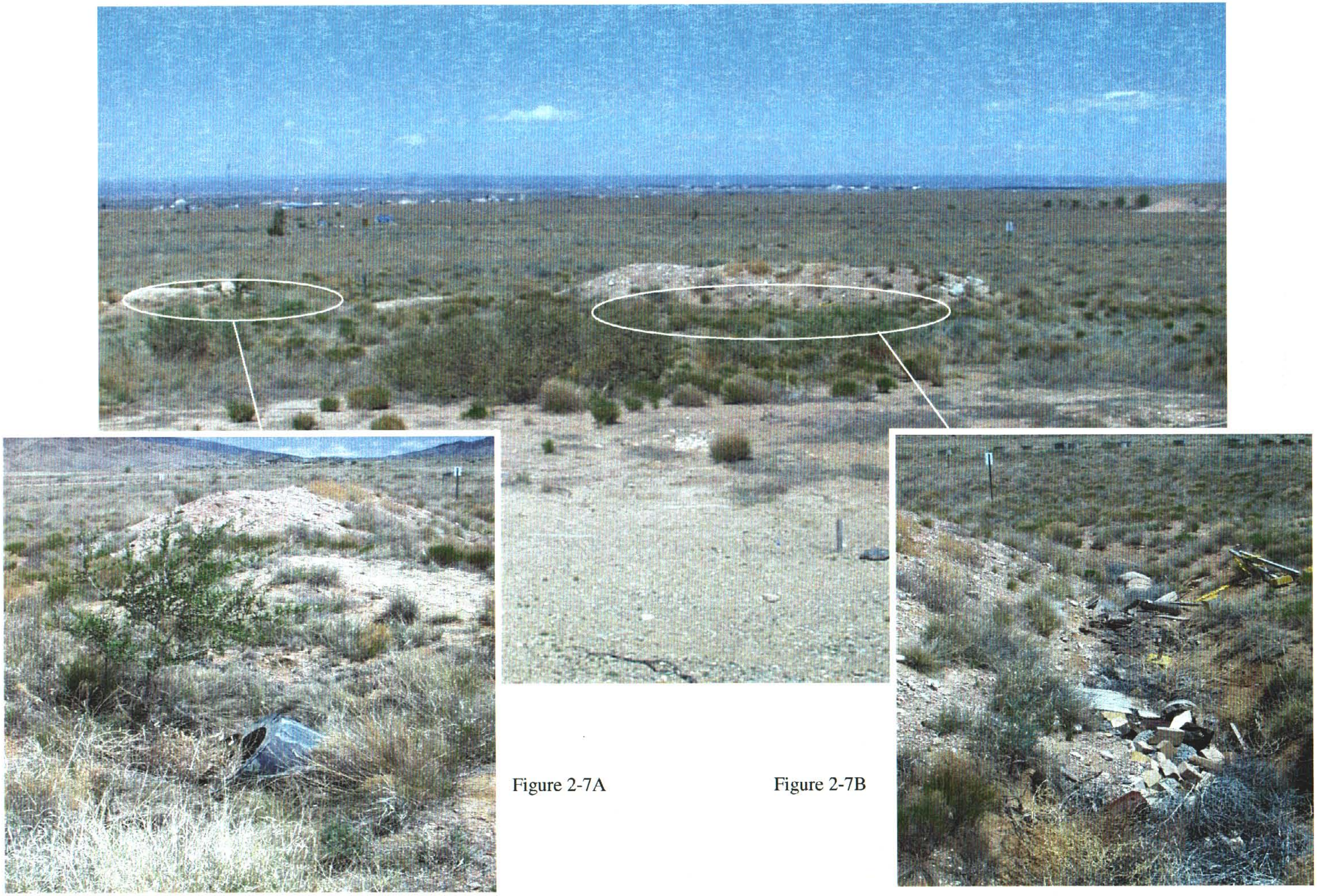


Figure 2-7A

Figure 2-7B

Figure 2-7 Photographs showing the two segments of the shallow open trench located directly northwest of the sodium disposal trenches. Figure 2-7A is a close-up of the materials exposed in the shorter westernmost segment of the trench. Figure 2-7B shows the items exposed in the longer easternmost section of the trench.

The object creating the partially masked anomaly directly to the east of the crucibles is a corrugated metal test vessel sitting on top of a concrete pad. A follow-up field investigation was conducted at ER Site 117 in December 1998 to try and determine the sources of the other anomalies identified by the EM–61 metal detection survey. A summary of this investigation is provided below.

The locations of all the metal anomalies were reconfirmed by surveying the anomaly areas using a hand-held metal detector, and digging up shallow anomalies to determine the sources. The instrument used to locate the anomalies was a Shonstedt metal detector (model number GA-72Cv). This device can locate only ferrous metals. The unit can be adjusted to variable sensitivities and can detect large buried objects, such as drums to depths of seven feet. During this follow-up survey, small metallic sources such as a nails or cans were identified and removed from the site. If the anomaly was large, such as a buried concrete slab containing rebar, it was left in place and the location was flagged for future removal. Each area was surveyed for radioactivity using a Geiger-Muller pancake probe. Information concerning the characteristics of each anomaly that was identified was recorded. Results of this follow-up investigation are presented on Figure 2-6 and Table 2-1. A detailed visual inspection of anomaly N, which consists of materials within an open trench, was performed on March 22, 1999. All of the metal anomalies indicated by the EM-61 geophysical survey were located and determined to be surface or shallow subsurface materials. The two partially buried items, G - (pipe stand and rubble pile) and E – (crushed and rusted drum), located in two of the sodium disposal trench locations, as well as items in the shallow open trench, will be excavated and examined further as part of this VCA.

Table 2-1 Results of the Follow-up Investigation of EM-61 Metal Detections

Location	Finding	Gamma Radiation Survey Results
A	Pin flag from previous survey, buried wire and nails	Radiation levels at background
B (two areas)	Buried wire and nails, miscellaneous bolts	Radiation levels at background
C	An area where iron-bearing gravel was found. The gravel appears to be concrete fragments originating from one of the crucibles.	Radiation levels at background
D	Rubble Pile, Partially buried concrete slab with Rebar	Radiation levels at background
E	Drum , Crushed and rusted in Na pit area	Radiation levels at background
F	East of partial burial anomaly. Low grade metallic anomaly. Contents unknown.	Radiation Levels at background
G	Rubble Pile near Pipe Stand- Nails, iron-bearing gravel (See Anomaly C) and bolts	Radiation levels at background
H	Iron bearing concrete fragments from crucible, Several anomalies.	Radiation Levels at background
I	Rubble pile- Several anomalies including scrap rusted five-gallon buckets.	Radiation Levels at background
J	Gravel and concrete from crucibles	Radiation Levels at background
K and L	Could not locate these anomalies	Could not locate
M	Gravel and concrete from crucibles	Radiation Levels at background
N	Small concrete crucible (~ 2 ft diameter), partially buried metal container (~ 2.5 ft diameter), 1 gallon cans, bricks, wood, concrete crucible rubble, metallic slag, concrete plugs with metal pipe at core.	Not measured (March 1999)

2.2.1.2 **Sampling**

Post Radiation VCM Verification Sampling

After removal of radiologically contaminated soil and DU fragments at Sites 103 and 117 as part of the RUST-Geotech Radiological VCM, 13 post clean-up (verification) soil samples were collected (SNL/NM September 1997). Surface soil samples were taken from locations where point and area source radiologic anomalies had been removed (see Figure 2-4). Table 2-2 summarizes the laboratory gamma spectroscopy analytical results from this sampling event. U-238 radionuclide activities measured in samples collected in the vicinity of Site 117 ranged from 0.764 pCi/g to 12.9 pCi/g. A radiological risk assessment has been performed using the analytical results for the surface soil samples collected from ER Sites 117 and 103. Results of the risk assessment indicate an acceptable risk based the measured radionuclide concentrations. Both sites are being proposed for removal from the SNL/NM's radioactive material and management area listing and pending approval from DOE and SNL/NM Radioactive Waste Management Department.

Surface Soil Scoping Sampling

SNL/NM conducted a scoping sampling investigation of ER Sites 117 and 103 in July 1995. This sampling program focused on collection of surface soil samples in areas that would have the greatest potential for a release to the environment as the result of testing operations at the Large Melt Facility. Soil samples were collected from a depth of 0-6 inches below ground surface

Table 2-2 Post Radiation Clean-up Gamma Spectroscopy Sampling Results for SWMUs 117 and 103

ER Site	Sample Number			Cs-137 Activity (pCi/g)	MDA (pCi/g)	Qualifier [1]	Th-232 Activity (pCi/g)	MDA (pCi/g)	U-235 Activity (pCi/g)	MDA (pCi/g)	Qualifier [1]	U-238 Activity (pCi/g)	MDA (pCi/g)	Qualifier [1]
117	103E	1	-SS	2.60E-02	2.60E-02	ND	3.87E-01	9.66E-02	8.56E-02	9.96E-02		3.52E+00	6.50E-01	
117	103E	4A	-SS	4.71E-02	2.78E-02		2.83E-01	2.71E-01	3.47E-01	3.47E-01	ND	4.51E+00	4.51E+00	ND
117	103E	5A	-SS	5.64E-02	5.64E-02	ND	3.77E-01	2.46E-01	4.36E-01	4.36E-01	ND	1.09E+01	5.19E+00	
117	103E	6A	-SS	2.24E-02	4.03E-02		0.00E+00	1.27E+00	7.41E-01	2.63E-01		7.64E-01	1.46E-01	
117	103E	7A	-SS	3.69E-02	3.82E-02		3.52E-01	3.89E-01	4.06E-01	4.06E-01	ND	6.73E+00	9.51E+00	
117	103E	7B	-SS	5.85E-02	5.85E-02	ND	2.65E-01	2.55E-01	3.37E-01	3.53E-01		1.29E+01	8.25E+00	
117	103E	9A	-SS	2.60E-01	5.09E-02		5.52E-01	3.34E-01	4.46E-01	4.46E-01	ND	4.50E+00	4.58E+00	
103	103E	12A	-SS	5.80E-02	5.80E-02	ND	4.30E-01	2.54E-01	4.32E-01	4.32E-01	ND	8.66E+00	6.55E+00	
103	103E	13A	-SS	2.37E-02	3.24E-02		5.07E-01	2.41E-01	3.68E-01	3.68E-01	ND	5.13E+00	5.13E+00	ND
103	103E	14A	-SS	3.71E-01	5.30E-02		3.71E-01	3.10E-01	3.65E-01	3.65E-01	ND	1.36E+00	1.73E+00	
103	103E	18	-SS	2.29E-01	2.99E-02		5.21E-01	2.21E-01	4.53E-01	4.53E-01	ND	7.12E+00	7.12E+00	ND
103	103E	22A	-SS	5.01E-02	5.01E-02	ND	4.23E-01	2.16E-01	3.62E-01	3.62E-01	ND	4.84E+00	4.84E+00	ND
103	103E	22B	-SS	6.74E-02	6.74E-02	ND	4.95E-01	4.09E-01	6.10E-01	6.10E-01	ND	1.82E+01	1.26E+01	

MDA = Minimum detection activity

pCi/g = Picocuries per gram of soil.

Cs = Cesium

Th = Thorium

U = Uranium

[1] ND = Activity less than MDA

(bgs) at twelve locations and analyzed for metals. Nine samples (001, 002, 003, 004, 005, 006, 007, 011, and 012) were collected around test structures or buildings associated with operations the Large Melt Facility (SWMU 103). Three samples (008, 009, and 010) were collected adjacent to a test structure that was being staged next to the sodium disposal trenches. No surface soil scoping samples were collected in the areas identified as the sodium disposal trenches. Sample locations are shown on Figure 2-4 and analytical results are presented on Table 2-3. No elevated metal concentrations were noted in the three samples (008, 009, and 010) that were collected adjacent to the structure located near the sodium disposal trenches. Elevated concentrations of chromium, iron and magnesium were identified in soil samples collected adjacent to the furnace facility on Site 103 (Figure 2-4, Table 2-3). Metal sampling results have been submitted with a No Further Action Proposal for Site 103 that is pending approval from NMED. Based on the analytical results from the surface soil scoping sampling, it is anticipated that no elevated RCRA metal concentrations will be found in the soil within the sodium disposal trenches. The Site 117 soil sampling laboratory analytical results will be used to verify the concentrations of RCRA metal, Na, Be, Ni, total U, and Zr in the subsurface soil.

2.2.2 Conceptual Model

ER Site 117 consists of two to five buried sodium disposal trenches. Historical records indicate that these trenches were used for containment of the spray water and associated reacted sodium salt washed out of concrete test crucibles. Non-sodium scrap metal, and less likely, containers of sodium, may also have been placed into one or more disposal trenches. Other tests performed at the Large Melt Facility, not associated with the sodium interaction tests, involved use of metals

Table 2-3 Surface Soil Scoping Sampling Analytical Results For Metals at SWMUs 117 and 103

Analytes				Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper
Site	Sample Number	LAB		All Concentrations in ppm									
	Characterization (Soil)	ERCL	MDL	20	10	50	10	3.4	10	20	10	10	20
103	103-GR-001-0-SS	ERCL		9500	ND	ND	190	ND	ND	51000	ND	ND	24
103	103-GR-002-0-SS	ERCL		5200	ND	ND	150	ND	ND	53000	ND	ND	24
103	103-GR-003-0-SS	ERCL		4700	ND	ND	170	ND	ND	58000	27	ND	ND
103	103-GR-004-0-SS	ERCL		3200	ND	ND	79	ND	ND	25000	220	27	ND
103	103-GR-005-0-SS	ERCL		3900	ND	ND	180	ND	ND	67000	ND	ND	ND
103	103-GR-006-0-SS	ERCL		5400	ND	ND	130	ND	ND	57000	ND	ND	ND
103	103-GR-007-0-SS	ERCL		4100	ND	ND	160	ND	ND	61000	ND	ND	ND
117	103-GR-008-0-SS	ERCL		5700	ND	ND	87	ND	ND	22000	ND	ND	ND
117	103-GR-009-0-SS	ERCL		4200	ND	ND	97	ND	ND	25000	ND	ND	ND
117	103-GR-010-0-SS	ERCL		4400	ND	ND	64	ND	ND	12000	ND	ND	ND
103	103-GR-011-0-SS	ERCL		3600	ND	ND	90	ND	ND	34000	ND	ND	ND
103	103-GR-012-0-SS	ERCL		3900	ND	ND	170	ND	ND	71000	ND	ND	ND
	QC Samples (Soil)												
117	103-GR-010-0-SSD	ERCL		4800	ND	ND	77	ND	ND	19000	ND	ND	ND
103	103-GR-012-0-SSD	ERCL		4200	ND	ND	140	ND	ND	59000	ND	ND	ND
		Lockheed	MDL	41	12		41	1	1	1000	2.1	10	5.2
103	103-GR-012-0-SS	Lockheed		8900	ND	ND	220	ND	ND	62000	34	ND	16
103	103-GR-012-0-SSD	Lockheed		5300	ND	ND	130	ND	ND	46000	6.9	ND	8.6

Note: ND = Not Detected
ERCL = Environmental Restoration Chemistry Laboratory
MDL = Method Detection Limit

Table 2-3 Surface Soil Scoping Sampling Analytical Results For Metals at SWMUs 103 and 117 (continued)

Analytes				Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Site	Sample Number	LAB		All Concentrations in ppm										
	Characterization (Soil)	ERCL	MDL	5	10	10	10	0.2	4	50	10	200	10	10
103	103-GR-001-0-SS	ERCL		12000	16	5600	240	ND	ND	ND	ND	ND	14	100
103	103-GR-002-0-SS	ERCL		91000	28	5100	200	ND	ND	ND	ND	ND	ND	91
103	103-GR-003-0-SS	ERCL		7200	25	5900	140	ND	ND	ND	ND	ND	11	84
103	103-GR-004-0-SS	ERCL		8600	52	26000	180	ND	ND	ND	ND	ND	ND	160
103	103-GR-005-0-SS	ERCL		5500	ND	9000	110	ND	ND	ND	ND	ND	16	59
103	103-GR-006-0-SS	ERCL		6300	ND	3600	110	ND	ND	ND	ND	ND	14	26
103	103-GR-007-0-SS	ERCL		5700	ND	4200	120	ND	ND	ND	ND	ND	14	43
117	103-GR-008-0-SS	ERCL		7000	ND	2600	120	ND	ND	ND	ND	ND	ND	17
117	103-GR-009-0-SS	ERCL		6300	10	2600	120	ND	ND	ND	ND	ND	ND	41
117	103-GR-010-0-SS	ERCL		6200	10	2000	130	ND	ND	ND	ND	ND	ND	15
103	103-GR-011-0-SS	ERCL		5300	10	2700	99	ND	ND	ND	ND	ND	ND	24
103	103-GR-012-0-SS	ERCL		5600	10	4100	110	ND	ND	ND	ND	ND	11	28
	QC Samples (Soil)													
117	103-GR-010-0-SSD	ERCL		6700	10	2300	140	10	10	10	10	10	10	15
103	103-GR-012-0-SSD	ERCL		7000	10	3600	180	10	10	10	10	10	10	30
		Lockheed	MDL	21		1000	3.1		8.3		2.1		22	4.1
103	103-GR-012-0-SS	Lockheed		14000	10	6700	170	10	8.2	10	10	10	27	120
103	103-GR-012-0-SSD	Lockheed		8300	10	3700	150	10	10	10	10	10	17	31

Note: ND = Not Detected
ERCL = Environmental Restoration Chemistry Laboratory
MDL = Method Detection Limit

or metal alloys such as zirconium oxide, stainless steel and depleted uranium (DU). Disposal procedures for these other metal test materials are not associated with the established disposal practice for the sodium spray pits. But, because of the history of operations at the Large Melt Facility that included use of various other metals, additional metals have been added to the COC list for this site. Besides sodium, all samples will be analyzed for RCRA metals, Be, Ni, Zr, total U and depleted uranium for this VCA. None of the test operations indicate use of volatile organic compounds (VOCs) or semivolatile organic compounds (SVOCs). The following section summarizes the nature and extent of contamination and the contamination fate and transport at SWMU 117.

2.2.2.1 Nature and Extent of Contamination

Debris lying on the surface or protruding from surface soil is visible in the vicinity of the sodium disposal trenches. Material visible on the surface of the site includes: a crushed metal drum, a metal pipe, wood, concrete, 1-gallon metal cans, and metal slag. The debris present on the surface appears to be non-hazardous solid waste. There is no evidence to suggest that unexploded ordinance (UXO), test equipment, or DU has been disposed of in the Site 117 sodium disposal trenches. Exploratory trenching in areas of metal geophysical anomalies will verify what materials, if any, are buried in the sodium disposal trench area. Constituents that have a potential for being present in the sodium disposal trenches include both known and possible metals used in testing at the Large Melt Facility. RCRA metals, Na, U, Be, Ni, Zr and DU are included in the list of COCs.

2.2.2.2 Fate and Transport

Figure 2-8 illustrates all the potential contaminant migration pathways available if COCs are present within the disposal trenches comprising ER Site 117. Air and soil are the only potential exposure pathways and only become applicable if the contents of the disposal trenches are exposed during intrusive activities (e.g., excavation).

2.2.2.3 Data Gaps

The extent and amount of debris buried in the area of the sodium disposal pits will need to be determined by excavation. The characteristics of any buried debris and the extent of soil contamination, if any occurs in the area of the sodium disposal trenches, must also be determined. Previous sampling and analysis investigations evaluated surface soils in the vicinity of Site 117. Exploratory trenching and subsurface verification soil sampling is needed to verify the amount of debris present in the subsurface and that no soil contamination occurs within the sodium disposal trenches.

2.2.3 Sampling Activities

The proposed focus for sampling activities at ER Site 117 includes: 1) collection of subsurface soil samples directly underlying any debris item or debris layer encountered during trenching, 2) collection of subsurface soil samples from areas of discolored or stained soil encountered in the exploratory trenches and, 3) collection of soil samples from each soil pile that is created by the

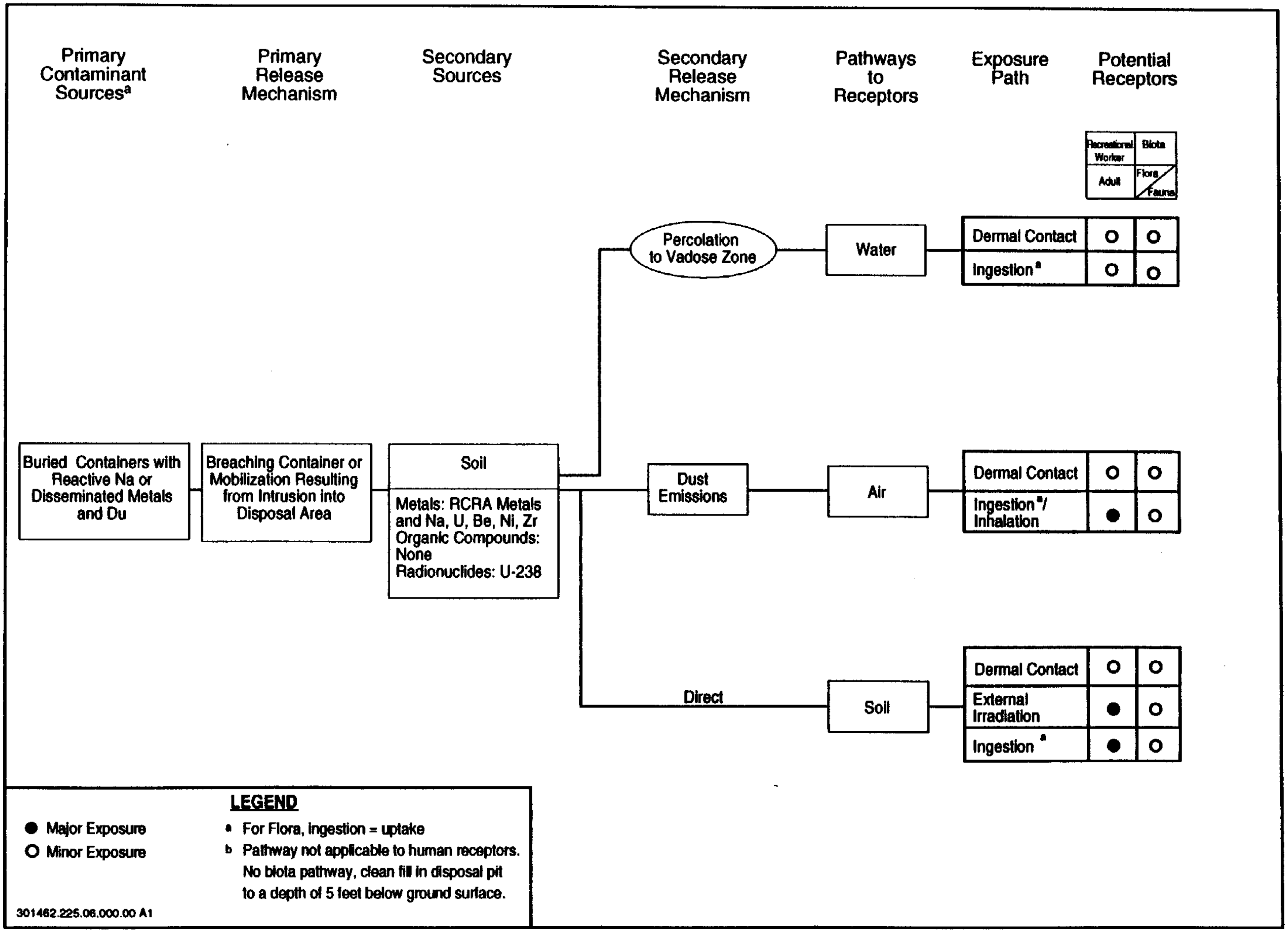


Figure 2-8

Conceptual Model Flow Diagram for SWMU 117, Trenches (Building 9939)

excavation of each exploratory trench. Swipe samples will be collected from the solid waste items removed during this VCA for analysis of radiological constituents (alpha/beta-emitters) by SNL/NM Radiation Protection. Radiological analyses will be reviewed and approval for free release will be obtained prior to removal of the solid waste materials from the site.

The sampling strategy for this VCA is designed to verify that no release of contaminants has occurred to the soil underlying the solid waste present in the sodium disposal area. It will also verify that any discolored soil encountered in the subsurface of the sodium disposal area is the result of the sodium crucible washing operations and no regulated contaminants are present. Samples collected from each soil pile generated from each exploratory trench will be used to verify that COC concentrations do not exceed background or risk-based levels of concern and that the soil piles can be placed back in the exploratory trench at the completion of the project.

The proposed sampling effort includes collection and analysis of a minimum of ten soil samples from the five exploratory trenches that will be dug in the area. Two samples will be collected from the soil directly below any debris layer or item uncovered during exploratory trenching. An additional five judgemental soil samples have been designated for collection in areas of stained or discolored soil, if it is encountered.

The locations of the five exploratory trenches that are planned, are based on the locations of the geophysical metal anomalies that indicate buried and partially buried materials in the sodium disposal trench area. The exploratory trenches will transect locations where metallic materials have been identified by the EM-61 Metal Detection Survey. These metal anomaly locations represent the only known locations where buried debris will occur. This sampling strategy complements the VCA objective of removal of all solid waste from the site. Other potential sodium disposal trench locations in this area will not be excavated because there is no indication, based on visual and/or geophysical evidence, that buried materials are present. The selected trenching and sampling locations will verify that subsurface soil in the sodium disposal area does not contain any regulated constituents at levels of concern. The proposed exploratory trenching locations are shown on Figure 2-9. In addition, two samples will be collected from each pile of soil generated from the excavation. One soil pile will be generated from each of the exploratory trenches.

Samples collected from the exploratory trenches will be taken from the excavator bucket as soil is removed from the trench. Soil samples taken from the excavator bucket and from the soil piles will be collected following SNL/NM standard operation procedure "Spade and Scoop Method for Collection of Soil Samples" (FOP 94-52).

2.2.3.1 Contaminant Source

Principle potential contaminant sources include debris and test materials that may have inadvertently been placed into the sodium disposal pits. Containers of elemental sodium, if present, may contain a reactive characteristic waste. During the excavation, visual observations will be augmented by field screening using radiation meters to assess any soil staining or other evidence of potential radiological contamination. Process knowledge indicates no volatile organic or semivolatile organic compounds were used in association with testing operations. An

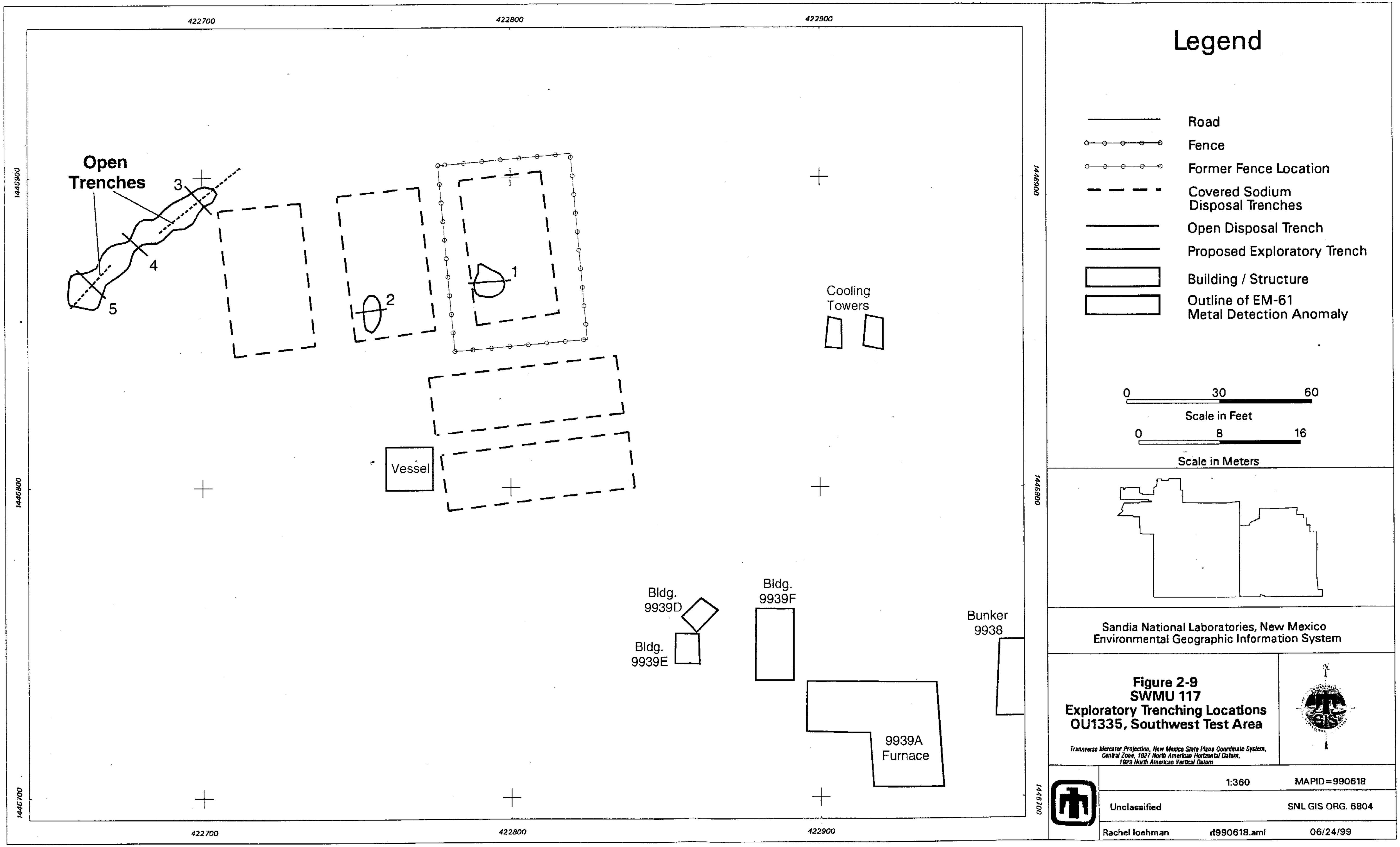


Figure 2-9
SWMU 117
Exploratory Trenching Locations
OU1335, Southwest Test Area

organic vapor analyzer (OVA) will be available on-site and utilized as needed to assess if any odors detected during the excavation are volatile organic compound vapors. Additional samples may be collected as the result of field observations or field screening measurements. The proposed scope of activities that will be completed in conjunction with this investigation is summarized in Table 2-4.

2.2.3.2 Media Characterization

Soil samples for metals analysis will be submitted to an SNL/NM-approved off-site analytical laboratory and analyzed for RCRA Metals, total U, Be, Ni, Na, and Zr by U.S. EPA SW–846 Methods 6010/6020/7471 (Table 2-5). The analysis of samples for additional chemical parameters will be expanded as needed based on field screening and observations of the subsurface conditions encountered during the excavation. An OVA will be available on-site to assess if any odors emanating from the excavation are the result of volatile organic vapors. Beta/gamma-emitting radionuclides will be screened for in the field using portable, real time instrumentation (such as the Geiger-Muller "pancake probe"). Soil samples will also be sent to an SNL/NM radiological laboratory for gamma-spectroscopy analysis for DU and other gamma-emitting radionuclides.

One (1) sampling equipment rinsate blank will be taken per 10 samples collected. The sampling scoop will be decontaminated following collection of each sample. Sampling equipment field rinsate blanks will be collected immediately after the equipment has been decontaminated. The rinsate blank will be analyzed for the same set of constituents requested for analysis in the environmental samples.

Table 2-4 Proposed Investigation Activities at SWMU 117

Data Needs	Investigative Technique	Location	Number of Samples	Analytes[a]	Selected Analytical Option[b]
Remove solid waste and sample below the items removed to verify that no soil contamination is present. Verification sampling is needed to confirm the absence of metals and radiological contamination.	Trenches will be dug as part of the removal of surface-exposed solid waste and to verify that debris or containers of sodium do not occur at depth in the sodium disposal pit area. Samples will be collected below any debris encountered during trenching.	Two samples will be collected in the soil immediately below any debris layer or item encountered during trenching. A minimum of 10 grab samples is planned based upon placement of 5 trenches through metal geophysical anomalies identified at the site. Samples of the soil below debris will be collected from the excavator bucket after soil is removed from the trench. Additional judgemental samples will be collected in areas of soil staining Grab samples will also be collected from the soil piles generated from the excavation. Samples will be collected using a stainless steel spade.	A minimum of 10 soil samples taken from exploratory trenches. Additional samples collected at a rate of 2 samples per debris layer or item encountered in each trench. A minimum of two soil samples per soil pile generated during the excavation.	RCRA metals, Na, U, Be, Ni, Zr; DU and other gamma-emitting radionuclides	Level III for metals analyses; Level II for gamma spectroscopy analyses.

[a] RCRA Metals, total U, Be, Ni Na,and Zr - Analyzed using EPA SW-846 Method 6010/6020/7471
Radionuclides - Analyzed using Gamma Spectroscopy – EPA Method 901.1

[b] Refers to the type of data provided by the analytical laboratory. Level III data is equivalent to an EPA CLP report. Level II data packages do not contain a full laboratory quality assurance report.

Table 2-5 Proposed Sampling and Analysis Requirements For SWMU 117

					Analyses		
					Field Screening	On-Site Laboratory	Off-Site Laboratory
Sample Location	Sample Media	Sample Type	Minimum No. of Samples	Sample Depth*	Gross beta/gamma	Gamma Spectrometry	EPA SW846 Metals (Methods 6010/6020/7174)
Exploratory Trench #1	soil	Grab	2	0-6"	X	2	2
Excavation Soil Pile #1	soil	Grab	2	0-6"	X	2	2
Exploratory Trench #2	soil	Grab	2	0-6"	X	2	2
Excavation Soil Pile #2	soil	Grab	2	0-6"	X	2	2
Exploratory Trench #3	soil	Grab	2	0-6"	X	2	2
Excavation Soil Pile #3	soil	Grab	2	0-6"	X	2	2
Exploratory Trench #4	soil	Grab	2	0-6"	X	2	2
Excavation Soil Pile #4	soil	Grab	2	0-6"	X	2	2
Exploratory Trench #5	soil	Grab	2	0-6"	X	2	2
Excavation Soil Pile #5	soil	Grab	2	0-6"	X	2	2
Judgemental Trench Samples	soil	Grab	1 to 5	0-6"	X	1 to 5	1 to 5
QA Samples	soil	duplicate	2	0-6"	X	2	2
	water	equipment rinsate	2	NA	X	2	2
	soil	MS/MSD	1	NA	X	0	1
TOTAL			25 to 30			24 to 29	25 to 30

* See Section 2.2.3.1 for more detail.

Five percent of all soil samples will be field duplicates. Samples and their respective duplicates will be analyzed for the same analytical parameters. Duplicate samples will be given unique sample numbers. In addition to field duplicate and equipment rinsate samples, five percent of the field samples will be designated for matrix spike/matrix spike duplicate (MS/MSD) laboratory analyses.

3 Data Collection Design and Procedures

This section presents the data collection and field operating procedures that will be used for this project. Quality Assurance (QA) management will be used to ensure that all information, data, and decisions resulting from this project are technically sound and properly documented. Quality Control (QC) is the functional mechanism through which QA achieves its goals. QC programs define the frequency and methods of checks, audits, and reviews necessary to identify problems, and dictate corrective action to resolved these problems, thus, ensuring data of high quality. The QA/QC program pertains to all data collection, evaluation, and review activities that are part of the project. Work under this project will be conducted in accordance with the QA/QC requirements presented in the SNL/ER Draft Quality Assurance Project Plan (QAPjP) (SNL/NM 1999).

3.1 Data Quality Objectives

The primary objective of this VCA is to remove all surface and subsurface solid waste from SWMU 117. The primary project-specific data need for SWMU 117 is collection of analytical data that can be used to verify that hazardous waste or hazardous constituents do not occur in the subsurface soil in the sodium disposal trench area. The data collected from this effort will meet the requirements to conduct human health/ecological risk assessments (EPA 1998) if concentrations of COCs are above background or human health risk based (HHRB) action levels. Laboratory chemical analytical results used for ecological or human health risk analysis will be

Level III analytical data. Radiological analyses will be Level II data. All chemical verification sampling analytical results will be validated and deemed useable for use in ecological or human health risk analysis. Laboratory method detection and practical quantitation limits, in comparison to NMED approved SNL/NM background concentrations, are provided on Table 3-1.

No additional data needs for physical or environmental media characterization (e.g. permeability, geology, etc) are required at this site. Cultural-resources and sensitive-species surveys have been conducted at the site to comply with the NEPA requirements (see Sections 3.7 and 3.8 of the OU 1335 Work Plan) (SNL/NM March 1996) and to support an ecological risk assessment.

3.2 Quality Assurance/Quality Control

Metals analytical data produced for this project will be Level III analyses and will be generated by an off-site laboratory. Only SNL/NM-approved analytical laboratories will be used to generate data used to make regulatory decisions. Off-site laboratories have their own quality assurance programs that include a Quality Assurance Project Plan (QAPjP) which governs laboratory activities. Metal analyses shall be performed using EPA procedures contained in the most recent edition of the EPA "Test Methods for Evaluating Solid Waste" (SW-846) (EPA1986a, EPA 1986b, EPA1987) or equivalent nationally recognized, validated analytical methods. Radiological analyses shall be performed by an SNL/NM on-site laboratory in accordance with procedures contained in the most recent edition "Environmental Measurements Laboratory Procedures Manual" (HASL-300) (DOE 1990) or EPA equivalent.

Table 3-1 Comparison of Background Soil Concentrations to Laboratory and Method Detection Limits

Analyte or Radionuclide	Method Detection Limit [ppm]	Laboratory Practical Quantitation Limits [ppm]	HRMB Maximum Background Concentrations For Subsurface Soil (NMED, 1997) [mg/kg, ppm or pCi/g]
Arsenic (As)	0.228	0.250	4.4
Barium (Ba)	0.027	0.250	214
Cadmium (Cd)	0.019	0.250	0.9
Chromium (Cr)-total	0.038	0.250	15.9
Lead (Pb)	0.079	0.250	11.8
Mercury (Hg)	0.00225	0.033	<0.1
Selenium (Se)	0.135	0.250	<1
Silver (Ag)	0.031	0.250	<1
Beryllium (Be)	0.012	0.250	0.65
Total Uranium (U)	0.0011	0.010	2.3
Nickel (Ni)	0.032	0.250	11.5
Zirconium (Zr)	TBD	0.100	9.2
Sodium (Na)	3.2	5.0	NA
Cesium 137 (Cs-137)	NA	0.084 pCi/g	0.079 pCi/g
Radium 226 (Rd-225)	NA	2.3 pCi/g	2.3 pCi/g
Thorium 232 (Th-232)	NA	1.01 pCi/g	1.01 pCi/g
Uranium 235 (U-235)	NA	0.16 pCi/g	0.16 pCi/g
Uranium 238 (U-238)	NA	1.4 pCi/g	1.4 pCi/g

NA = Not applicable
TBD = To Be Determined

Laboratory data will be evaluated using EPA SW-846 criteria and SNL/NM Technical Operating Procedure "Verification and Validation of Chemical and Radiochemical Data" (SNL/NM TOP 94-03). This SNL/NM procedure was developed in accordance with the EPA "Laboratory Data Validation Functional Guidelines For Evaluating Inorganic Analyses" (EPA 1988) and "National Functional Guidelines For Organic Data Review" (EPA 1991). TOP 94-03 is in the process of being revised. The draft and final versions of the new SNL/NM guidelines for validation of chemical and radiological data will be followed as they become available. Only data that is determined by the validation review process to be of sufficient quality will be used for the project-specific data uses described in section 3.1.

3.3 Field Activities

Field operations to be implemented under this VCA consist of: site preparation; excavation with heavy equipment; radiological and OVA field screening; soil and debris segregation; verification sampling and analysis; decontamination of personnel and equipment; and management and characterization of waste materials generated during these activities. Each of these activities will be performed in accordance with this VCA Plan and the OU 1335 Health and Safety Plan (HASP) to ensure the safety of field personnel. In addition, all monitoring, sampling, and decontamination procedures will adhere to pertinent SNL/NM standard operating procedures. Field Operating Procedures (FOPs) include: FOP 94-39 for excavation methods, FOP 94-26 for general decontamination; FOP 94-57 for heavy equipment decontamination, and FOP 94-34 for sample management and custody. As it applies to the procedures to be followed for addressing the hazards posed by the potential excavation of containers with reactive elemental sodium, SNL/NM Environmental Safety and Health (ES&H) Standard Operation Procedure (SOP) SP473056 (Control of Unexploded Ordnance at Sandia/NM Environmental Restoration Sites) will be followed. All significant field activities and measurements will be documented in the field log book or on appropriate field forms as stipulated in SNL/NM ER Field Operating Procedure (FOP) 94-25. Field screening analyses for the ER Site 117 VCA will be limited to beta/gamma radiation surveys and OVA measurements of the excavated materials. These measurements will be used to segregate excavated materials with anomalous radioactivity or volatile organic compounds and to ensure the safety of on-site personnel.

This VCA involves removal of all surface solid waste and trenching at locations of metal anomalies identified in the area of the ER Site 117 sodium disposal trenches. Excavated materials will be: visually examined and field-screened for radiological contamination using a Geiger-Muller 'pancake probe' or equivalent instrument; segregated based on field-screening results and material type (debris vs. soil), and; further characterized using appropriate analytical methods.

Trenching will proceed along a 10-ft long line transecting the identified metal anomaly. Soil will be removed in six-inch layers. Each six-inch layer of material removed by the excavator defines a "lift". Successive lifts will be removed from along the length of each exploratory trench until no evidence of debris is observed and a total depth of approximately 12 ft has been reached. This excavation process will be performed for each of the five exploratory trenches that have been designated.

Excavation will be limited to the dimensions of the exploratory trench (approximately 3 ft wide by 10 ft long by 12 ft in depth). If any debris is observed in the walls of the trench, the excavation will be lengthened and/or widened to uncover the item(s). Two verification soil samples will be collected directly below the debris item or debris layer after it has been removed from the trench. Samples will also be collected in areas of discolored or stained soil. Trench and sample location coordinates will be recorded using a Global Positioning System.

The areas of metal geophysical anomalies at ER Site 117 and the designated exploratory trenches are shown in Figure 2-9. Excavation will continue within each designated trench to a total depth of 12 ft bgs or until native soil is encountered underlying the bottom of the disposal trench. Soil and any metallic items and other debris encountered within the designated trench dimensions will be removed. If radiological or volatile organic compound contamination is detected through field screening, the excavation area will be expanded as needed based on the screening data.

Based on the general trench dimension of 12 ft deep by 3 ft wide by 10 ft long, each trench contains an *in-situ* soil volume of approximately 13 cubic yards. Total volume of *in-situ* soil within the five trenches is 67 cubic yards. With a general soil expansion rate of thirty percent, which is generally applied to the excavation of *in-situ* soil, the total volume of soil estimated to be staged onsite from the exploratory trenches is approximately 87 cubic yards. The site layout will accommodate an adequately sized area for the staging of soil piles.

Excavating will be performed using a backhoe or trackhoe, depending on availability of equipment. Excavated soil containing debris will be placed in an adjacent staging area where segregation of the debris from the soil will take place. The trenches will be excavated with vertical walls. No sloping of the trench walls will be required since workers will not enter the excavation. The excavation operation will include the use of a backhoe spotter, who will be used as needed to assist the equipment operator inspect the contents of each trench as the excavation proceeds. The spotter will assist the backhoe operator look for debris as well as potentially hazardous buried materials such as UXO or containers of sodium.

As the general procedure, any soil mixed with debris that is removed with the bucket of the excavator, will be segregated by spreading the material out on the ground prior to placement of soil onto the soil pile. If trenching exposes intervals laden with debris, each bucket of excavated material will be passed through a screen mechanism to facilitate sifting of the soil and segregation of the debris.

Segregation will occur next to the soil pile staging area, which will be located adjacent to the excavation. Excavated soil that has been passed through the screen mechanism will be scanned with a Sodium Iodide (NaI) or appropriate beta/gamma instrument. If radiation levels above background are detected, the soil will be segregated in order to reduce mixing radiologically contaminated and clean soil. Any scrap metal or other debris recovered from the trenches will be screened with a beta/gamma radiation meter and further segregated as needed.

Excavation activities could result in airborne fugitive dust. If needed to suppress wind blown excavated soil, site personnel will spray water on the soil piles as material is being accumulated.

A water trailer will be used on-site during excavation activities for dust control. A City of Albuquerque Topsoil Disturbance Permit will not be obtained because less than 0.75 acres will be disturbed by the VCA activities.

4 Project Management

This section provides information concerning the project management milestones and deadlines, the site-specific health and safety plan, community relations plan, and requirements for investigation-derived waste.

4.1 Project Scheduling and Reporting Requirements

The proposed schedule for implementation of the ER Site 117 VCA is presented below.

Start Date	Activity	Completion Date
August 2, 1999	Trenching and Solid Waste Removal at Site 117	August, 1999
August 2, 1999	Verification Sampling	August 6, 1999
January 13, 2000	Prepare VCA/NFA Report	April 12, 2000

4.2 Health and Safety Plan

This VCA will be covered under the OU 1335 RFI Health and Safety Plan, which includes recent addenda addressing excavation work and the specific hazards associated with this project. Specific attention has been given to addressing the potential hazards associated with personnel working near open trenches and the possibility of encountering a container(s) with elemental sodium. The HASP including the addenda have been reviewed and approved by SNL/NM safety personnel.

4.3 Investigation-derived Waste Plan

A site-specific Waste Management Plan has been developed for this VCA which conforms to the requirements specified by the SNL/ER Waste Management and Radioactive and Mixed Waste Management Departments. Non-regulated waste will be managed according to the SNL/ER Project Waste Management requirements. The Site 117 VCA Waste Management Plan has been prepared as a separate document. A synopsis of the plan's specifications is provided below.

All soil piles will be established and maintained in such a manner as to prevent new releases of potentially hazardous constituents to the environment. Soil staging areas will be on level ground. A berm will be constructed in such a manner as to divert surface water runoff around the staging area. Soil cement will be used to control soil from blowing from staged soil piles in the event of high winds. A graded approach to protective measures shall be implemented consistent with the hazards associated with the constituents present and site-specific conditions.

Soil piles shall be marked "Soil Pile" and shall be uniquely numbered and the number of each pile shall be recorded on the Waste Generation Log; this Log will be used for waste characterization and redeposition tracking purposes.

Debris that is segregated from excavated soil will be screened with appropriate radiological instrumentation, swipe sampled for radiological analysis as required by the SNL/NM Radiation and Mixed Waste Department and placed in a suitable container. Disposal requirements for any debris removed from the site will be determined by the SNL/NM Waste Management Department.

When trenching is completed the soil piles generated during the excavation will be sampled and sent to chemical and radiological laboratories for analysis. Laboratory analytical results will be reviewed to determine the acceptability of re-depositing each soil pile back into the trench from which the soil was excavated. Redeposition of the soil shall be acceptable if it is demonstrated that constituents that were analyzed are at or below background levels or human health and ecological risk assessment calculations indicate acceptable exposure values.

If consistent with cleanup levels and /or future land use of this SWMU, contaminated or potentially contaminated soils may be returned to the excavation or re-deposited and graded on the surface of the SWMU.

4.4 Community Relations Plan

Public involvement will be accomplished through the Community Relations Program Plan as outlined in the SNL/NM Program Implementation Plan for Albuquerque Potential Release Sites (SNL/NM February 1995).

5 References

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ANNEX 11-E
Risk Screening Assessment

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SWMU 117: RISK SCREENING ASSESSMENT REPORT

I. Site Description and History

Solid Waste Management Unit (SWMU) 117 was designated the Trenches (Building 9939) in the Hazardous and Solid Waste Amendments Module of Sandia National Laboratories/New Mexico's (SNL/NM) Resource Conservation and Recovery Act (RCRA) Permit. The Environmental Restoration (ER) site boundary established around the trenches encompasses approximately 2.5 acres (SNL/NM April 1995) of federally owned land controlled by Kirtland Air Force Base and permitted to the U.S. Department of Energy (DOE). SWMU 117 is located approximately 0.3 mile southwest of the intersection of Lovelace Road and Coyote Springs Road, and 1 mile north of the solar tower. The terrain in the vicinity of the site is generally flat to gently sloping to the west. The ground elevation at the site is approximately 5,610 feet.

The trenches at Building 9939 are associated with the adjacent Large Melt Facility (SWMU 103), an inactive site that was once used to test simulated nuclear reactor meltdown scenarios. Some of the scenario tests monitored concrete interactions with various metal melts. A number of the tests involved pouring molten sodium metal into concrete crucibles. A spray mist of water was used to react and remove any remaining solidified sodium metal in the concrete crucible following testing. Disposal trenches were dug at SWMU 117 to receive the reacted sodium and water mixture that was washed out of the concrete crucibles.

Historical records and technical memoranda provide a significant level of process knowledge concerning the operations conducted at the Large Melt Facility. The Large Melt Facility was built in 1971 and was originally designed as an explosives fabrication site but was never used for that purpose. In early 1977 the facility was adapted to conduct molten core concrete interaction studies sponsored by the Nuclear Regulatory Commission (NRC). SNL/NM used the facility to conduct experiments supporting reactor safety programs for customers such as the NRC, the DOE and Westinghouse Savannah River Laboratories.

The site history for the Large Melt Facility (SWMU 103) is discussed in detail in Section 5.5 of the RCRA facility investigation (RFI) Work Plan (SNL/NM March 1996). A risk-based no further action (NFA) proposal has been approved for SWMU 103 by the New Mexico Environmental Department (NMED). The Large Melt Facility performed reactor safety studies funded by the NRC. SNL/NM provided facilities for sodium containment and structural integrity tests for the proposed Clinch River Fast Breeder Reactor at Oak Ridge, Tennessee.

Fifteen large-scale tests with sodium metal were conducted at the Large Melt Facility. Each test used from 100 to 200 pounds of sodium. Following the tests, crucibles containing residual sodium were moved to the "Crucible Spray Pit." The residual sodium in the crucibles was rinsed with a spray mist of water. The reacted sodium was washed out of the crucibles and into the spray pits. The elemental sodium metal used for the tests was stored in drums or smaller containers. Historical records indicated that there was a potential for discarded test items (debris) and (a) storage container(s) with elemental sodium to be buried in the disposal pits area. Some tests performed at the Large Melt Facility used depleted uranium (DU), but disposal practices associated with these tests were not know to involve use of the sodium disposal pits.

In July 1999 a Voluntary Corrective Action (VCA) was conducted at SWMU 117 in the sodium disposal trench area. The VCA resulted in the removal of all buried debris within the site and confirmatory samples were collected to verify that no constituents of concern (COC) occurred in the surrounding soil. The buried debris items that were removed consisted mainly of concrete crucible fragments, bricks, scrap metal, electrical wiring, wood and plastic materials.

SWMU 117, located along the western margin of the Manzanita Mountains, is situated on a partially dissected coalescent alluvial fan complex that flanks the mountain front to the west. Late Pleistocene pediment and alluvial fan deposits have been mapped in the area of the site. Depth to bedrock is interpreted to be shallow in this area. Surface exposures of Precambrian bedrock are present in arroyo bottoms and in intervening ridges along the northern edge of Operable Unit (OU) 1335. A complex structural geologic setting occurs in the vicinity of the site. SWMU 117 is located slightly east of a series of north- and northeast-trending faults that occur along the front of the Four Hills and Manzanita Mountains.

These faults are part of the major rift-bounding fault complex present along the eastern margin of the Albuquerque Basin.

Vegetation is primarily desert grasses and tumbleweeds. The soil type identified in the area of SWMU 117 is a very fine sandy loam (SNL/NM March 1996). Surface-water runoff in the vicinity of the site is minor, because the surface slope is flat to gently inclined. Average annual rainfall on OU 1335 is about 8 to 10 inches. Based upon soil samples collected near the adjacent SWMU 74 (the Chemical Waste Landfill), soil moisture content in this area probably ranges from between 1 and 10 percent, with 5 or 6 percent being a reasonable average.

Depth to ground water measured in the closest monitoring well (LMF-1), which is located approximately 1,400 feet north of the site, is 350 feet below ground surface (bgs). Groundwater in well LMF-1 occurs in the bedrock Abo Sandstone Formation (SNL/NM March 1996). Additional detailed information concerning the geologic and hydrologic characteristics in the area of SWMU 117 are presented in the OU 1335 RFI Work Plan (SNL/NM March 1996) and Site Wide Hydrogeologic Characterization Report, Calendar Year 1994, Annual Report (SNL/NM March 1995).

II. Data Quality Objectives

The VCA for SWMU 117 was conducted in accordance with the data quality objectives (DQOs) development process specified in the RFI Work Plan for OU 1335 (SNL/NM March 1996). The primary objectives of the remedial action included the following:

- Removing and disposing of solid waste
- Sampling and analyzing soil directly underlying solid waste to verify the presence or absence of chemical and/or radiological contamination
- Sampling and analyzing stained soils encountered in exploratory trenches
- Verifying the absence of buried containers with elemental sodium

- Conducting the necessary site cleanup and collecting samples for analysis that would support the preparation of a risk screening assessment and NFA Proposal.

A thorough evaluation of the SWMU 117 operational history and an evaluation of the results of prior sampling as well as an analysis of the soil in the vicinity of the site was conducted to develop the objectives for the VCA. Exploratory trenches were dug based upon the locations of the geophysical metal anomalies that indicated that buried or partially buried materials occurred in the sodium disposal area. The exploratory trenches transected or paralleled the locations where metallic materials had been identified by the EM-61 Metal Detection Survey. The metal anomaly locations coincided with the only known locations based upon historical accounts where sodium disposal or buried debris would have occurred. Completed trenches were approximately 3 – 3.5 feet wide and ranged in length from approximately 26 to 80 feet. Exploratory trenching resulted in the excavation of approximately 12 cubic yards of nonregulated solid waste. Approximately 2 cubic yards of hazardous waste in the form of chromium-contaminated concrete, 3 cubic yards of radioactive-contaminated wood, electrical wiring, cable, bricks, and concrete and 0.5 cubic yard of mixed waste (DU- and chromium-contaminated) concrete were also excavated and removed from the site as part of the VCA.

Sampling activities at SWMU 117 included 1) collecting subsurface soil samples directly underlying isolated individual debris items or more extensive debris layers encountered during trenching, 2) collecting a subsurface soil sample from an area of discolored soil encountered in the exploratory trenches, and 3) collecting soil samples from each soil pile created by the excavation of each exploratory trench. Table 1 summarizes the sampling performed to meet the DQOs. In addition, swipe samples were collected from the solid waste items that had been removed during the VCA for analysis of radiological constituents (alpha/beta emitters) by SNL/NM Radiation Protection. Radiological analyses were reviewed prior to removing the solid waste materials from the site.

Table 1
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 117 Sampling Areas	Potential COC Source	Number of Sampling Locations	Sample Density	Sampling Location Rational
Exploratory trenches	Buried test materials and/or debris from sodium tests or other Large Melt Facility testing.	7	Two samples underlying debris item or debris layer. One sample from each area of stained soil.	Confirm the presence or absence of chemical or radiological contamination.
Soil piles generated from exploratory trenches	Residue or releases from buried test materials.	8	Two samples per soil pile.	Confirm the presence or absence of chemical or radiological contamination.

COC = Constituent of concern.
SWMU = Solid Waste Management Unit.

The sampling strategy for the VCA was designed to verify that no release of contaminants had occurred to the soil underlying the solid waste present in the sodium disposal area. Samples from each soil pile that was generated from each exploratory trench were used to verify that COC concentrations did not exceed background or risk-based levels of concern and that the soil piles could be placed back in the exploratory trench at the completion of the project.

Concurrent with excavation operations confirmatory samples were collected from within the trenches and from the soil piles that were generated from each completed trench (Table 2). Confirmatory samples were collected from seven locations within four trenches. Three of the trenches yielded buried debris. No debris occurred within the fourth exploratory trench, and only one sample was collected from the base of the excavation. Eight soil samples were collected from the four main soil piles associated with the three trenches that contained debris items. Samples from the trenches were taken at depths ranging from 1 to 11.5 feet bgs. The two samples from Trench #3, the longest trench with the most extensive debris, were taken from below the bottom of the debris zone and approximately 25 feet apart.

The exploratory trenches were sampled from soil removed from the trenches after it was dumped from the excavator buckets. The two samples from each soil pile were collected on opposite sides of the pile from a depth of 0 to 0.5 foot bgs. Soil samples were taken from the excavator bucket and from the soil piles as set forth by SNL/NM standard operation procedure "Spade and Scoop Method for Collection of Soil Samples" (FOP 94-52) (SNL/NM December 1994).

The SWMU 117 confirmatory samples were analyzed for all potential COCs, which included RCRA metals plus beryllium, nickel, sodium, uranium and zirconium, and DU-related radionuclides (U-234, U-235, U-238). Analysis for semivolatile organic compounds (SVOC) was also included for one sample from the stained area. The samples were analyzed by two analytical laboratories. Metals analyses were performed by General Engineering Laboratories, Inc. (GEL). Radionuclide analyses were performed on site at the SNL/NM Radiation Protection Sample Diagnostics (RPSD) laboratory. Table 3 summarizes the analytical methods and data quality for the analytical data that was collected.

Six field Quality Assurance (QA)/Quality Control (QC) samples were collected as part of the confirmatory-sampling effort in accordance with the ER Project QA Project Plan. The QA/QC samples consisted of three duplicate soil samples and three sampling equipment rinsate blanks. No significant QA/QC problems were identified in the field QA/QC sampling results. All the confirmatory soil sample results were verified/validated by SNL/NM. The off-site laboratory results from GEL were reviewed against "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM, January 2000). The data validation assessment reports for the off-site laboratory analyses are presented in the associated SWMU 117 NFA proposal. The gamma spectroscopy data from the RPSD Laboratory were reviewed against "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 02 (SNL/NM July 1996). The RPSD verification/validation reports are presented along with the gamma-spectroscopy results in the NFA proposal. The data quality assessment reports confirmed that the analytical data from the laboratories were acceptable for use in the NFA proposal. Therefore, the DQOs for this site have been fulfilled.

Table 2
Number of Confirmatory Soil Samples Collected During the SWMU 117 VCA

Sample Type	Number of Samples	Radionuclides	RCRA Metals +Be, Ni, Na, U, Zr	SVOCs
Confirmatory Trench	7	7	7	1
Confirmatory Soil Pile	8	8	8	–
Duplicates	3	3	3	–
Equipment Blanks	3	–	3	–
Total Samples	21	18	21	1
Analytical Laboratory	–	RPSD	GEL	GEL

Sampling dates: 08/09/99–08/13/99, 11/30/99.
Chain of Custody forms: 602214, 602215, 602217, 602982, 602983.
GEL = General Engineering Laboratories, Inc.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostics.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.

Table 3
Summary of Data Quality Requirements

Analytical Requirement	Data Quality	GEL	RPSD Laboratory
RCRA metals + Be, Ni, Na, U, Zr EPA Methods 6010/6020/7471[a]	Definitive	15	Not applicable
Gamma Spectroscopy EPA Method 901.1[a]	Definitive	Not analyzed	15
SVOCs EPA Method 8270[a]	Definitive	1	Not applicable

Note: The number of samples does not include QA/QC samples such as duplicates and equipment blanks.
[a]EPA November 1986.
EPA = Environmental Protection Agency.
GEL = General Engineering Laboratories, Inc.
QA/QC = quality assurance/quality control.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostics.
SVOC = Semivolatile organic compound.

III. Determination of Nature, Rate, and Extent of Contamination

III.1 Introduction

The determination of the nature, migration rate, and extent of contamination at SWMU 117 was based upon an initial conceptual model validated by exploratory trenching and confirmatory sampling at the site. The initial conceptual model was developed from archival research, soil sampling, geophysical surveys, and radiological surveys. The DQOs contained in the SWMU 117 VCA Plan (SNL/NM July 1999) identified the sampling strategy and analytical requirements. The analytical results of the samples were subsequently used to develop the final conceptual model for SWMU 117, which is presented in the associated NFA proposal. The quality of the data specifically used to determine the nature, migration rate, and extent of contamination are described below.

III.2 Nature of Contamination

Both the nature of contamination and the potential for the degradation of COCs at SWMU 117 was evaluated using laboratory analyses of the soil samples (Section V). The analytical requirements included analyses for DU-related radionuclides and RCRA metals plus Be, Ni, Na, U, and Zr. SVOC analyses were conducted on one material encountered during the excavation. The analyses characterized any potential contaminants underlying debris removed from the trenches and also the soil piles generated as the result of the excavation. The analytes and methods listed in Tables 2 and 3 are appropriate to characterize the COCs and any potential degradation products at SWMU 117.

III.3 Rate of Contaminant Migration

SWMU 117 is an inactive site from which all potential primary contaminant sources were removed, and therefore, all primary sources of COCs have been eliminated. As a result, only secondary sources of COCs potentially remain in the soil in the form of adsorbed COCs (DU and/or RCRA and associated metals). The rate of COC migration in subsurface soil is, therefore, dependent predominantly upon precipitation and vadose zone infiltration as described in Section V. Data available from the Site-Wide Hydrogeologic Characterization Project; numerous SNL/NM monitoring programs for air, water, and radionuclides; various biological surveys; and meteorological monitoring are adequate to characterize the rate of COC migration at SWMU 117.

III.4 Extent of Contamination

Subsurface confirmatory soil samples were collected from all excavated areas where subsurface debris were encountered and also from the soil piles generated as the result of the excavation. Soil samples from below isolated buried debris items or debris layers yielded no contaminants in underlying soils. Soil samples from the soil piles created as the result of trenching confirmed that no contaminants occurred in the excavated soil and that the soil was suitable for redeposition. The confirmatory soil samples were collected using the sampling strategy defined in Table 1.

The confirmatory soil samples from within the trenches were taken at depths ranging from approximately 1 to 11.5 feet bgs. The vertical rate of contaminant migration is expected to be extremely low for SWMU 117 because of the low precipitation, high evapotranspiration, and low permeability of vadose zone soils. Therefore, the confirmatory soil samples are considered to be both representative of the soil potentially contaminated with the COCs and sufficient to determine the vertical extent, if any, of COCs.

In summary, the design of the confirmatory sampling was appropriate and adequate to determine the nature, migration rate, and extent of residual COCs in surface and subsurface soils at SWMU 117.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities are used to identify potential COCs. The SWMU 117 NFA proposal describes the identification of COCs and the sampling that was conducted in order to determine the concentration levels of those COCs across the site. Generally, COCs evaluated in this risk assessment include all detected organics and all radiological and inorganic COCs for which samples were analyzed. If the detection limit of an organic compound was too high (i.e., could possibly cause an adverse effect to human health or the environment), the compound was retained. Nondetect organics not included in this assessment were found to have sufficiently low detection limits to ensure protection of human health and the environment. In order to provide conservatism in this risk assessment, the calculation used only the maximum concentration value of each COC found for the entire site. The SNL/NM maximum background concentration (Dinwiddie September 1997) was selected to provide the background screening listed in Tables 4, 5, 6, and 7. Human health nonradiological COCs were also compared to SNL/NM proposed Subpart S action levels (Table 4) (IT July 1994).

Nonradiological inorganics that are essential nutrients such as iron, magnesium, calcium and potassium were not included in this risk assessment (EPA 1989). Typically, sodium is eliminated as an essential nutrient also. However, because this site had elemental sodium as a potential contaminant, sodium was considered in the risk screening process. It should be noted that all metallic sodium was removed from the site and all that is remaining is sodium salts. Both radiological and nonradiological COCs were evaluated. The nonradiological COCs were limited to inorganic compounds as all organic compounds were nondetect.

Table 4 lists nonradiological COCs for the human health risk assessment at SWMU 117. Table 6 lists radiological COCs for the human health risk assessment. Tables 5 and 7 list the nonradiological COCs and the radiological COCs for the ecological risk assessment, respectively. All tables show the associated SNL/NM maximum background concentration values (Dinwiddie September 1997). Tables 4 and 6 are discussed in Sections VI.4, while Tables 5 and 7 are discussed in Sections VII.2 and VII.3.

V. Fate and Transport

The primary releases of COCs at SWMU 117 were to the subsurface soil and resulted from the burial of waste materials. Subsequent excavation and stockpiling of this soil as part of the VCA performed at this site in 1999 has resulting in the exposure, movement, and mixing of these subsurface soils. Under these current conditions, wind, water, and biota are potential natural mechanisms of COC transport from the site. Because the site is located in an area of little topographic relief and open grassland vegetation, wind erosion from the stockpiles could be a significant transport mechanism.

Table 4
Nonradiological COCs for Human Health Risk Assessment at SWMU 117 with Comparison to the Associated SNL/NM Background Screening Value, BCF, Log K_{ow}, and Subpart S Screening Value

COC Name	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K_{ow} (for organic COCs)	Bioaccumulator?[b] (BCF>40, log K_{ow}>4)	Subpart S Screening Value[c]	Is Individual COC less than 1/10 of the Action Level?
Arsenic	7	4.4	**No**	44[d]	NA	**Yes**	0.5	**No**
Barium	236 J	130	**No**	170[e]	NA	**Yes**	6000	Yes
Beryllium	0.422 J	0.65	Yes	19[d]	NA	No	0.2	**No**
Cadmium	0.221 J	<1	**Unknown**	64[d]	NA	**Yes**	80	Yes
Chromium, total[f]	15.3	15.9	Yes	16[d]	NA	No	400	Yes
Lead	11 J	11.8	Yes	49[d]	NA	**Yes**	–	–
Mercury	0.0118 J	<0.1	**Unknown**	5500[d]	NA	**Yes**	20	Yes
Nickel	10.3	11.5	Yes	47[d]	NA	**Yes**	2000	Yes
Selenium	0.5 J	<1	**Unknown**	800[g]	NA	**Yes**	400	Yes
Silver	0.06[h]	<1	**Unknown**	0.5[d]	NA	No	400	Yes
Sodium	2090 J	17,000[i]	Yes	20[j]	NA	No	NC	NA
Uranium	3.4 J	2.3	**No**	20[e]	NA	No	NC	NA
Zirconium	8.28 J	9.2[k]	Yes	300[j]	NA	**Yes**	NC	NA

Note: **Bold** indicates the COCs that failed the background and/or Subpart S screening procedures and/or are bioaccumulators.
[a]From Dinwiddie (September 1997) Southwest Area Soils.
[b]NMED (March 1998).
[c]IT Corporation (July 1994).
[d]Yanicak (March 1997).
[e]Neumann (1976).
[f]Assumed to be chromium VI for Subpart S screening procedure.
[g]Callahan et al. (1979).
[h]Parameter was nondetect. Concentration is approximately 0.5 detection limit.
[i]Background value taken from the USGS NURE (1994).
[j]IAEA (1994).
[k]Zirconium background was not calculated for the Southwest Test Area. The offsite background concentration was used as a surrogate background screening value.

BCF = Bioconcentration factor.
COC = Constituent of concern.
IAEA = International Atomic Energy Agency.
J = Estimated value.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NC = Not calculated.
NMED = New Mexico Environment Department.
NURE = National Uranium Resource Evaluation Program.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
USGS = U.S. Geological Survey.
– = Information not available.

Table 5
Nonradiological COCs for Ecological Risk Assessment at SWMU 117 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC Name	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K_{ow} (for organic COCs)	Bioaccumulator?[b] (BCF>40, log K_{ow}>4)
Arsenic	7	4.4	**No**	44[c]	NA	**Yes**
Barium	236 J	130	**No**	170[d]	NA	**Yes**
Beryllium	0.422 J	0.65	Yes	19[c]	NA	No
Cadmium	0.221 J	<1	**Unknown**	64[c]	NA	**Yes**
Chromium, total	15.3	15.9	Yes	16[c]	NA	No
Lead	11 J	11.8	Yes	49[c]	NA	**Yes**
Mercury	0.0118 J	<0.1	**Unknown**	5500[c]	NA	**Yes**
Nickel	10.3	11.5	Yes	47[c]	NA	**Yes**
Selenium	0.5 J	<1	**Unknown**	800[e]	NA	**Yes**
Silver	0.06[f]	<1	**Unknown**	0.5[c]	NA	No
Sodium	1820	17,000[g]	Yes	20[i]	NA	No
Uranium	3.4 J	2.3	**No**	20[d]	NA	No
Zirconium	8.28 J	9.2[h]	Yes	300[h]	NA	**Yes**

Note: **Bold** indicates the COCs that failed the background screening procedure and/or are bioaccumulators.
[a]From Dinwiddie (September 1997) Southwest Area Soils.
[b]NMED (March 1998).
[c]Yanicak (March 1997).
[d]Neumann (1976).
[e]Callahan et al. (1979).
[f]Parameter was nondetect. Concentration is approximately 0.5 detection limit.
[g]Background value taken from the USGS NURE (1994).
[h]Zirconium background was not calculated for the Southwest Test Area. The offsite background concentration was used as a surrogate background screening value.
[i]IAEA (1994).

BCF = Bioconcentration factor.
COC = Constituent of concern.
IAEA = International Atomic Energy Agency.
J = Estimated value.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NMED = New Mexico Environment Department.
NURE = National Uranium Resource Evaluation Program.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
USGS = U.S. Geological Survey.

Table 6
Radiological COCs for Human Health Risk Assessment at SWMU 117 with Comparison to the Associated SNL/NM Background Screening Value and BCF

COC Name	Maximum Concentration (pCi/g)	SNL/NM Background Concentration (pCi/g)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Is COC a Bioaccumulator?[c] (BCF>40)
Th-232	0.721	1.01	Yes	3000[c]	No[d]
U-238	31.4	1.4	**No**	900[c]	**Yes**
U-235	0.88	0.16	**No**	900[c]	**Yes**
U-234	3.93[e]	1.6	**No**	900[c]	**Yes**
Cs-137	0.26	0.664	Yes	3000[f]	**Yes**

Note: **Bold** indicates COCs that exceed background screening values and/or are bioaccumulators.
[a]From Dinwiddie (September 1997), Southwest Area Soils.
[c]Baker and Soldat (1992).
[b]NMED (March 1998).
[d]Yanicak (March 1997).
[e]U-234 values were calculated using the U-238 concentration and assuming that the U-238 to U-234 ratio was equal to that detected during waste characterization of DU-contaminated soils generated during the radiological voluntary corrective measures project, where U-234=U-238/8 (Miller June 1998).
[f]BCF from Whicker and Schultz (1982).

BCF = Bioconcentration factor.
COC = Constituent of concern.
DU = Depleted uranium.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Table 7
Radiological COCs for Ecological Risk Assessment at SWMU 117 with Comparison to the Associated SNL/NM Background Screening Value and BCF

COC Name	Maximum Concentration (pCi/g)	SNL/NM Background Concentration (pCi/g)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Is COC a Bioaccumulator?[b] (BCF>40)
Th-232	0.721	1.01	Yes	3000[c]	No[d]
U-238	31.4	1.4	**No**	900[c]	**Yes**
U-235	0.88	0.16	**No**	900[c]	**Yes**
U-234	3.93[e]	1.6	**No**	900[c]	**Yes**
Cs-137	0.26	0.664	Yes	3000[f]	**Yes**

Note: **Bold** indicates COCs that exceed background screening values and/or are bioaccumulators.
[a]From Dinwiddie (September 1997), Canyons Area Soils.
[d]Yanicak (March 1997).
[b]NMED (March 1998).
[c]Baker and Soldat (1992).
[e]U-234 values were calculated using the U-238 concentration and assuming that the U-238 to U-234 ratio was equal to that detected during waste characterization of DU-contaminated soils generated during the radiological voluntary corrective measures project, where U-234=U-238/8 (Miller June 1998).
[f]BCF from Whicker and Schultz (1982).

BCF = Bioconcentration factor.
COC = Constituent of concern.
DU = Depleted uranium.
ND = Not detected.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Water at SWMU 117 is received as precipitation (rain and occasional snow). Approximately 8 to 10 inches of precipitation is received annually. Precipitation will evaporate either at or near the point of contact, infiltrate into the soil, or form runoff. Infiltration at the site is enhanced by the sandy nature of the soil (the soil in the area of the site is primarily Wink fine sandy [USDA June 1977]). Runoff may carry surface soil particles with adsorbed COCs. The distance of transport will depend upon the size of the particle and the velocity of the water. The sloping sides of the stockpiles may result in runoff during intense rainfall events; however, the generally flat terrain of the site will limit the extent of lateral transport away from the soil piles by surface runoff. The trenches will capture and hold precipitation, preventing transport of COCs by surface water runoff.

Water that infiltrates into the soil will continue to percolate through the soil until field capacity is reached. COCs desorbed from the soil particles into the soil solution may be leached into the subsurface soil with this percolation. The effective rooting depths of the soil at SWMU 117 is about 60 inches (USDA June 1977). This indicates the depth of the system's transient water cycling zone (the dynamic balance between percolation/infiltration and evapotranspiration). Because groundwater at this site is approximately 350 feet bgs, the potential for COCs to reach groundwater through the unsaturated zone above the water table is very small. As water from the surface evaporates, the direction of COC movement could be reversed with capillary rise of the soil water.

Plant roots can take up COCs that are in the soil solution. COCs taken up by the roots can be transported to the above-ground tissues with the xylem stream. COCs can also be taken up by above-ground tissues both through direct contact with dust particles and directly from the air (volatilized COCs). COCs in these tissues can be consumed by herbivores or eventually returned to the soil as litter. Above-ground litter could be transported by wind until consumed by decomposer organisms in the soil. COCs in plant tissues that are consumed by herbivores can pass through the gut and be returned to the soil in feces (either at the site or away from the site as the herbivore moves), or they could be absorbed and held in tissues or later excreted. The herbivore could be eaten by a primary carnivore or scavenger, and the COCs still held in the consumed tissues would repeat the sequence of absorption, excretion, and consumption by higher predators, scavengers, and decomposers. The potential for transport of the COCs within the food chain is dependent upon the mobility of the species that comprise the food chain and the potential for the COCs to be transferred across the links in the food chain.

Because the COCs at SWMU 117 are all inorganic and elemental in form, they are not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Other transformations of inorganics could include changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). However, because of the long half-lives of the radionuclides and the aridity of the environment at this site, none of these mechanisms are expected to result in significant loses or transformations of these COCs.

Table 8 summarizes the fate and transport processes that can occur at SWMU 117. COCs at this site include both inorganics (metals) and radionuclides. Because of the local topography and open vegetation, the potential for transport of COCs by wind is moderate, but the potential for transport by surface-water runoff is low for COCs currently at or near the soil surface (i.e., stockpiled soil from the VCA). Significant leaching into the subsurface soil is unlikely for most inorganics, and leaching to the groundwater at this site is highly unlikely. The potential for uptake into the food chain is also considered to be low because of the terrestrial nature of the habitat and the arid climate. The potential for transformation is low and loss through decay of radiological COCs is insignificant because of their long half-lives.

VI. Human Health Risk Screening Assessment

VI.1 Introduction

Human health risk screening assessment of this site includes a number of steps that culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at the site. The steps to be discussed include the following:

Step 1.	Site data are described that provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways are identified by which a representative population might be exposed to the COCs.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The first component of the tiered approach includes two screening procedures. One screening procedure compares the maximum concentration of the COC to an SNL/NM maximum background screening value. COCs that are not eliminated during the first screening procedure are subjected to a second screening procedure that compares the maximum concentration of the COC to the SNL/NM proposed Subpart S action level.
Step 4.	Toxicological parameters are identified and referenced for COCs that were not eliminated during the screening steps.
Step 5.	Potential toxicity effects (specified as a hazard index [HI]) and estimated excess cancer risks are calculated for nonradiological COCs and background. For radiological COCs, the incremental total effective dose equivalent (TEDE) and incremental estimated cancer risk are calculated by subtracting applicable background concentrations directly from maximum on-site contaminant values. This background subtraction only occurs when a radiological COC occurs as contamination and exists as a natural background radionuclide.
Step 6.	These values are compared with guidelines established by the U.S. Environmental Protection Agency (EPA) and the DOE to determine whether further evaluation, and potential site cleanup, is required. Nonradiological COC risk values are also compared to background risk so that an incremental risk can be calculated.
Step 7.	Uncertainties regarding the contents of the previous steps are addressed.

Table 8
Summary of Fate and Transport at SWMU 117

Transport and Fate Mechanism	Existence at Site	Significance
Wind	Yes	Moderate
Surface runoff	Yes	Low
Migration to groundwater	No	None
Food chain uptake	Yes	Low
Transformation/degradation	Yes	Low

SWMU = Solid Waste Management Unit.

VI.2 Step 1. Site Data

Section I provides the description and history for SWMU 117. Section II presents the argument that DQOs were satisfied. Section III describes the determination of the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

SWMU 117 has been designated a future land use scenario of industrial (DOE and USAF March 1996) (see Appendix 1 for default exposure pathways and parameters). Because of the location and the characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for the nonradiological COCs and direct gamma exposure for the radiological COCs. The inhalation pathway for both nonradiological and radiological COCs is included because the potential exists to inhale dust. Soil ingestion is included for the radiological COCs as well. No water pathways to the groundwater are considered. Depth to groundwater at SWMU 117 is approximately 350 feet bgs. Because of the lack of surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered not to be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate for the industrial land use scenario. However, plant uptake is considered for the residential land use scenario.

Pathway Identification

Nonradiological Constituents	Radiological Constituents
Soil ingestion	Soil ingestion
Inhalation (dust)	Inhalation (dust)
Plant uptake (residential only)	Plant uptake (residential only)
	Direct gamma

VI.4 Step 3. COC Screening Procedures

This section discussed Step 3, which includes the two screening procedures. The first screening procedure compared the maximum COC concentration to the background screening level. The second screening procedure compared maximum COC concentrations to SNL/NM proposed Subpart S action levels. This second procedure was applied only to COCs that were not eliminated during the first screening procedure.

VI.4.1 Background Screening Procedure

VI.4.1.1 Methodology

Maximum concentrations of nonradiological COCs were compared to the approved SNL/NM maximum screening level for this area. The SNL/NM maximum background concentration was selected to provide the background screen in Table 4 and was used to calculate risk attributable to background in Table 12. Only the COCs that were detected above their respective SNL/NM maximum background screening levels or did not have either a quantifiable or a calculated background screening level were considered in further risk assessment analyses.

For radiological COCs that exceeded the SNL/NM background screening levels, background values were subtracted from the individual maximum radionuclide concentrations. Those that did not exceed these background levels were not carried any further in the risk assessment. This approach is consistent with DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1993). Radiological COCs that did not have a background value and were detected above the analytical minimum detectable activity were carried through the risk assessment at their maximum levels. The resultant radiological COCs remaining after this step are referred to as background-adjusted radiological COCs.

VI.4.1.2 Results

Tables 4 and 6 present SWMU 117 maximum COC concentrations that were compared to the SNL/NM maximum background values (Dinwiddie September 1997) for the human health risk assessment. For the nonradiological COCs, three constituents were measured at concentrations greater than their respective background. Four nonradiological COCs had no quantifiable background concentration, so it is not known whether those COCs exceeded background.

For the radiological COCs, three constituents had maximum activity concentrations slightly greater than their respective backgrounds (Cs-137, U-235, and U-238).

VI.4.2 Subpart S Screening Procedure

VI.4.2.1 Methodology

The maximum concentrations of nonradiological COCs not eliminated during the background screening process were compared with action levels (IT July 1994) calculated using methods and equations promulgated in the proposed RCRA Subpart S (EPA 1990) and Risk Assessment Guidance for Superfund (RAGS) (EPA 1989) documentation. Accordingly, all calculations were based upon the assumption that receptor doses from both toxic and potentially carcinogenic compounds result most significantly from ingestion of contaminated soil. Because the samples were all taken from the surface and near surface, this assumption is considered valid. If there were ten or fewer COCs and each had a maximum concentration of less than 1/10 the action level, then the site was judged to pose no significant health hazard to humans. If there were more than ten COCs, then the Subpart S screening procedure was not performed.

VI.4.2.2 Results

Table 4 shows the COCs and the associated proposed Subpart S action level. The table compares the maximum concentration values to 1/10 the proposed Subpart S action level. This methodology was guidance given to SNL/NM from the EPA (EPA 1996a). One COC (arsenic) that failed the background screening was above 1/10 the Subpart S action level. Therefore, all constituents with maximum concentrations above background were carried forward in the risk assessment process, and an individual COC hazard quotient (HQ), cumulative HI, and an excess cancer risk value were calculated.

Radiological COCs have no predetermined action levels analogous to proposed Subpart S levels; therefore, this step in the screening process was not performed for radiological COCs.

VI.5 Step 4. Identification of Toxicological Parameters

Tables 9 (nonradiological) and 10 (radiological) list the COCs retained in the risk assessment and the values for the available toxicological information. The toxicological values used for nonradiological COCs in Table 9 were from the Integrated Risk Information System (IRIS) (EPA 1998a), the Health Effects Assessment Summary Tables (HEAST) (EPA 1997a), and the Region 9 (EPA 1996b) electronic database. Dose conversion factors (DCF) used in determining the excess TEDE values for radiological COCs for the individual pathways were the default values provided in the RESRAD computer code (Yu et al. 1993a) as developed in the following documents:

- DCFs for ingestion and inhalation are taken from “Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion” (EPA 1988).
- DCFs for surface contamination (contamination on the surface of the site) were taken from DOE/EH-0070, “External Dose-Rate Conversion Factors for Calculation of Dose to the Public” (DOE 1988).
- DCFs for volume contamination (exposure to contamination deeper than the immediate surface of the site) were calculated using the methods discussed in “Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil” (Kocher 1983) and in ANL/EAIS-8, *Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil* (Yu et al. 1993b).

VI.6 Step 5. Exposure Assessment and Risk Characterization

Section VI.6.1 describes the exposure assessment for this risk assessment. Section VI.6.2 provides the risk characterization, including the HI and the excess cancer risk for both the potential nonradiological COCs and associated background for industrial and residential land uses. The incremental TEDE and incremental estimated cancer risk are provided for the background-adjusted radiological COCs for both industrial and residential land uses.

VI.6.1 Exposure Assessment

Appendix 1 shows the equations and parameter input values used in calculating intake values and subsequent HI and excess cancer risk values for the individual exposure pathways. The

Table 9
Toxicological Parameter Values for SWMU 117 Nonradiological COCs

COC Name	RfD_o (mg/kg-d)	Confidence[a]	RfD_{inh} (mg/kg-d)	Confidence[a]	SF_o (mg/kg-day)$^{-1}$	SF_{inh} (mg/kg-day)$^{-1}$	Cancer Class[b]
Arsenic	3E-4[c]	M	–	–	1.5E+0[c]	1.5E+1[c]	A
Barium	7E-2[c]	M	1.4E-4[d]	–	–	–	–
Cadmium	5E-4[c]	H	5.7E-5[d]	–	–	6.3E+0[c]	B1
Mercury	3E-4[e]	–	8.6E-5[c]	M	–	–	D
Selenium	5E-3[c]	H	–	–	–	–	D
Silver	5E-3[c]	L	–	–	–	–	D
Uranium	3E-3[c]	M	–	–	–	–	–

[a]Confidence associated with IRIS (EPA 1998a) database values. Confidence: L = low, M = medium.

[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 1998a) with the exception of 1,2-dibromo-3-chloropropane which was taken from HEAST (EPA 1997a):

A = Human carcinogen.
B1 = Probable human carcinogen. Limited human data available.
D = Not classifiable as to human carcinogenicity.

[c]Toxicological parameter values from IRIS electronic database (EPA 1998a).

[d]Toxicological parameter values from EPA Region 9 electronic database (EPA 1996b).

[e]Toxicological parameter values from HEAST database (EPA 1997a).

COC = Constituent(s) of concern.
EPA = U.S. Environmental Protection Agency.
HEAST = Health Effects Assessment Summary Tables.
IRIS = Integrated Risk Information System.
mg/kg-d = Milligram(s) per kilogram day.
(mg/kg-day)$^{-1}$ = Per milligram per kilogram day.
RfD_{inh} = Inhalation chronic reference dose.
RfD_o = Oral chronic reference dose.
SF_{inh} = Inhalation slope factor.
SF_o = Oral slope factor.
SWMU = Solid Waste Management Unit.
– = Information not available.

Table 10
Radiological Toxicological Parameter Values for SWMU 117 COCs Obtained from RESRAD Risk Coefficients[a]

COC Name	SF_o (1/pCi)	Sf_{inh} (1/pCi)	SF_{ev} (g/pCi-yr)	Cancer Class[b]
U-234	4.40E-11	1.40E-08	2.10E-11	A
U-235	4.70E-11	1.30E-08	2.70E-07	A
U-238	6.20E-11	1.20E-08	6.60E-08	A

[a]From Yu et al. (1993a).
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989): A = Human carcinogen for high dose and high dose rate (i.e., greater than 50 rem per year). For low-level environmental exposures, the carcinogenic effect has not been observed and documented.
1/pCi = One per picocurie.
COC = Constituent(s) of concern.
EPA = U.S. Environmental Protection Agency.
g/pCi-yr = Gram(s) per picocurie-year.
SF_{ev} = External volume exposure slope factor.
SF_{inh} = Inhalation slope factor.
SF_o = Oral (ingestion) slope factor.
SWMU = Solid Waste Management Unit.

appendix shows parameters for both industrial and residential land use scenarios. The equations for nonradiological COCs are based upon the RAGS (EPA 1989). Parameters are based upon information from the RAGS (EPA 1989) and other EPA guidance documents and reflect the reasonable maximum exposure (RME) approach advocated by the RAGS (EPA 1989). For radiological COCs, the coded equations provided in RESRAD computer code are used to estimate the incremental TEDE and cancer risk for individual exposure pathways. Further discussion of this process is provided in the *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD* (Yu et al. 1993a).

Although the designated land use scenario is industrial for this site, risk and TEDE values for a residential land use scenario are also presented. These residential risk and TEDE values are presented only to provide perspective of potential risk to human health under the more restrictive land use scenario.

VI.6.2 Risk Characterization

Table 11 shows an HI of 0.02 for the SWMU 117 nonradiological COCs and an estimated excess cancer risk of 4E-6 for the designated industrial land use scenario. The numbers presented included exposure from soil ingestion and dust inhalation for nonradiological COCs. Table 12 shows an HI of 0.01 and an excess cancer risk of 2E-6 assuming the maximum background concentrations of the SWMU 117 associated background constituents for the designated industrial land use scenario.

For the radiological COCs, contribution from the direct gamma exposure pathway is included. For the industrial land use scenario, an incremental TEDE of 9.1E-1 millirem (mrem) per year

Table 11
Risk Assessment Values for SWMU 117 Nonradiological COCs

COC Name	Maximum Concentration (mg/kg)	Industrial Land Use Scenario[a]		Residential Land Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	7	0.02	4E-6	0.40	8E-5
Barium	236 J	0.00	–	0.04	–
Cadmium	0.221 J	0.00	7E-11	0.18	1E-10
Mercury	0.0118 J	0.00	–	0.02	–
Selenium	0.5 J	0.00	–	0.18	–
Silver	0.06[b]	0.00	–	0.00	–
Uranium	3.4 J	0.00	–	0.01	–
Total		**0.02**	**4E-6**	**0.8**	**8E-5**

[a]From EPA (1989).
[b]Parameter was nondetect. Concentration assumed to be approximately 0.5 of detection limit.
COCs = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
– = Information not available.
J = Estimated value.

Table 12
Risk Assessment Values for SWMU 117 Nonradiological Background Constituents

COC Name	Background Concentration[a] (mg/kg)	Industrial Land Use Scenario[b]		Residential Land Use Scenario[b]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	4.4	0.01	2E-6	0.25	5E-5
Barium	130	0.00	–	0.02	–
Cadmium	<1	–	–	–	–
Mercury	<0.1	–	–	–	–
Selenium	<1	–	–	–	–
Silver	<1	–	–	–	–
Uranium	2.3	0.00	–	0.01	–
Total		**0.01**	**2E-6**	**0.3**	**5E-5**

[a]From Dinwiddie (September 1997), Southwest Area Soils.
[b]From EPA (1989).
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
– = Information not available.

(/yr) was calculated. In accordance with EPA guidance found in Office of Solid Waste and Emergency Response Directive No. 9200.4-18 (EPA 1997b), an incremental TEDE of 15 mrem/yr was used for the probable land use scenario (industrial in this case); the calculated dose value for SWMU 117 for the industrial land use was well below this guideline. The estimated excess cancer risk was 1.0E-5.

For the residential land use scenario nonradioactive COCs, the HI was 0.8 and the excess cancer risk was 8E-5 (Table 11). The numbers in the table included exposure from soil ingestion, dust inhalation, and plant uptake. Although the EPA (1991) generally recommends that inhalation not be included in a residential land use scenario, this pathway was included because of the potential for soil in Albuquerque, New Mexico, to be eroded and, subsequently, for dust to be present in predominantly residential areas. Because of the nature of the local soil, other exposure pathways were not considered (see Appendix 1). Table 12 shows that for the SWMU 117 associated background constituents, the HI is 0.3 and the excess cancer risk is 5E-5.

For the radiological COCs, the incremental TEDE for the residential land use scenario was 2.3 mrem/yr. The guideline being used was an excess TEDE of 75 mrem/yr (SNL/NM February 1998) for a complete loss of institutional controls (residential land use in this case); the calculated dose value for SWMU 117 for the residential land use scenario was well below this guideline. Consequently, SWMU 117 is eligible for unrestricted radiological release because the residential land use scenario resulted in an incremental TEDE of less than 75 mrem/yr to the on-site receptor. The estimated excess cancer risk was 1.5E-5. The excess cancer risk from the nonradiological COCs and the radiological COCs is not additive, as noted in the RAGS (EPA 1989).

VI.7 Step 6. Comparison of Risk Values to Numerical Guidelines.

The human health risk assessment analysis evaluated the potential for adverse health effects for both the industrial land use scenario (the designated land use scenario for this site) and the residential land use scenario.

For the industrial land use scenario nonradiological COCs, the HI was 0.02 (less than the numerical guideline of 1 suggested in the RAGS [EPA 1989]). Excess cancer risk was estimated at 4E-6. Guidance from the NMED indicates that excess lifetime risk of developing cancer by an individual must be less than 1E-6 for Class A and B carcinogens and less than 1E-5 for Class C carcinogens (NMED March 1998). The excess cancer risk was driven by arsenic. Arsenic is a Class A carcinogen. Thus, the excess cancer risk for this site was above the suggested acceptable risk value (1E-6). This assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the industrial and residential land use scenarios. Assuming the industrial land use scenario, for nonradiological COCs the HI was 0.01 and the excess cancer risk was 2E-6. Incremental risk is determined by subtracting risk associated with background from potential COC risk. These numbers were not rounded before the difference was determined and, therefore, may appear to be inconsistent with numbers presented in tables and within the text. For conservatism, the background constituent that does not have a quantified background concentration (silver) is assumed to have an HQ of 0.00. Incremental HI was 0.01 and estimated incremental cancer risk was 2.00E-6 for the industrial land use scenario. The incremental excess cancer risk to human health from nonradiological COCs was above proposed guidelines considering an industrial land use scenario.

For radiological COCs of the industrial land use scenario, incremental TEDE was 9.1E-1 mrem/yr, which is significantly less than EPA's numerical guideline of 15 mrem/yr. Incremental estimated excess cancer risk was 1.0E-5.

The calculated HI for the residential land use scenario nonradiological COCs was 0.8, which is below the numerical guidance. Excess cancer risk was estimated at 8E-5. The excess cancer risk was driven by arsenic. Arsenic is a Class A carcinogen. Therefore, the excess cancer risk for this site was above the suggested acceptable risk value (1E-6). The HI for associated background for the residential land use scenario was 0.3; the excess cancer risk was estimated at 5E-5. The incremental HI was 0.55 and the estimated incremental cancer risk was 3.00E-5 for the residential land use scenario. The incremental excess cancer risk to human health from the nonradiological COCs considering the residential land use scenario was above NMED guidance.

The incremental TEDE for a residential land use scenario from the radiological components was 2.3E-1 mrem/yr, which is significantly less than the numerical guideline of 75 mrem/yr suggested in the SNL/NM RESRAD Input Parameter Assumptions and Justification (SNL/NM February 1998). The estimated excess cancer risk was 1.5E-5.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at SWMU 117 was based upon an initial conceptual model that was validated with confirmatory sampling. The confirmatory sampling was implemented in accordance with the SWMU 117 VCA Plan (SNL/NM July 1999). The DQOs contained in the VCA Plan were appropriate for use in risk-screening assessments. The data collected, based upon sample location and depth, were representative of the site. The analytical requirements and results satisfied the DQOs. Data quality was verified/validated in accordance with SNL/NM procedures (SNL/NM January 2000). Therefore, there is no uncertainty associated with the data quality used to perform the risk screening assessment at SWMU 117.

Because of the location, history of the site, and future land use (DOE and USAF March 1996), there is low uncertainty in the land use scenario and the potentially affected populations that were considered in performing the risk assessment analysis. Because the COCs are found in surface and near-surface soils and because of the location and physical characteristics of the site, there is little uncertainty in the exposure pathways relevant to the analysis.

An RME approach was used to calculate the risk assessment values. This means that the parameter values in the calculations were conservative and that calculated intakes were probably overestimates. Maximum measured values of COC concentrations were used to provide conservative results.

Table 7 shows the uncertainties (confidence) in nonradiological toxicological parameter values. There is a mixture of estimated values and values from the IRIS (EPA 1998a), the HEAST (EPA 1997a), and the EPA Region 9 (EPA 1996b) electronic database. Where values are not provided, information is not available from the HEAST (EPA 1997a), IRIS (EPA 1998a), or the EPA regions (EPA 1996b, 1997c). Because of the conservative nature of the RME approach, uncertainties in toxicological values are not expected to change the conclusion from the risk assessment analysis.

The HI for nonradiological COCs was within the human health acceptable range for the industrial land use scenario compared to established numerical guidance. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated by using maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the 95th upper confidence limit of the mean for arsenic (4.69) is used in place of the maximum concentration, the incremental excess cancer risk is calculated to be 2E-7, which is within proposed guidelines considering an industrial land use scenario.

For radiological COCs, the conclusion of the risk assessment was that potential effects on human health for both industrial and residential land use scenarios were within guidelines and were a small fraction of the estimated 360 mrem/yr received by the average U.S. population (NCRP 1987).

The overall uncertainty in all of the steps in the risk assessment process is considered not significant with respect to the conclusion reached.

VI.9 Summary

SWMU 117 identified COCs consisting of some inorganic and radiological compounds. Because of the location of the site, the designated industrial land use scenario, and the nature of contamination, potential exposure pathways identified for this site included soil ingestion and dust inhalation for chemical constituents and soil ingestion, dust inhalation, and direct gamma exposure for radionuclides. Plant uptake was included as an exposure pathway for the residential land use scenario.

Using conservative assumptions and an RME approach to risk assessment, calculations for nonradiological COCs show that for the industrial land use scenario the HI (0.02) was significantly less than the accepted numerical guidance from the EPA. Excess cancer risk (4E-6) was above the acceptable risk value provided by the NMED for an industrial land use scenario (NMED March 1998). The incremental HI was 0.01, and the incremental cancer risk was 2.00E-6 for the industrial land use scenario. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated by using maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the 95th upper confidence limit of the mean for arsenic (4.69) is used in place of the maximum concentration, the incremental excess cancer risk is calculated to be 2E-7, which is within proposed guidelines considering an industrial land use scenario.

Incremental TEDE and corresponding estimated cancer risk from radiological COCs were much less than EPA guidance values; the estimated TEDE was 9.1E-1 mrem/yr for the industrial land use scenario. This value was much less than the numerical guidance of 15 mrem/yr in EPA guidance (EPA 1997b). The corresponding incremental estimated cancer risk value was

1.0E-5 for the industrial land use scenario. Furthermore, the incremental TEDE for the residential land use scenario that results from a complete loss of institutional control was only 2.3 mrem/yr with an associated risk of 1.5E-5. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore, SWMU 117 is eligible for unrestricted radiological release.

Uncertainties associated with the calculations are considered to be small relative to the conservativeness of risk assessment analysis. It is, therefore, concluded that this site poses insignificant risk to human health under the industrial land use scenario.

VII. Ecological Risk Screening Assessment

VII.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPEC) in soils at SWMU 117. A component of the NMED Risk-Based Decision Tree (NMED March 1998) is to conduct an ecological screening assessment that corresponds with that presented in EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997c). The current methodology is tiered and contains an initial scoping assessment followed by a more detailed screening assessment. Initial components of the NMED's decision tree (a discussion of DQOs, a data assessment, and evaluations of bioaccumulation and fate and transport potential) are addressed in previous sections of this report. Following the completion of the scoping assessment, a determination is made as to whether a more detailed examination of potential ecological risk is necessary. If deemed necessary, the scoping assessment proceeds to a screening assessment whereby a more quantitative estimate of ecological risk is conducted. Although this assessment incorporates conservatisms in the estimation of ecological risks, ecological relevance and professional judgment are also used as recommended by the EPA (1998b) to ensure that predicted exposures of selected ecological receptors reflect those reasonably expected to occur at the site.

VII.2 Scoping Assessment

The scoping assessment focuses primarily on the likelihood that biota at or adjacent to the site will be exposed to constituents associated with site activities. Included in this section are an evaluation of existing data and a comparison of maximum detected concentrations to background concentrations, examination of bioaccumulation potential, and fate and transport potential. A scoping risk management decision (Section VII.2.4) involves summarizing the scoping results and determining whether further examination of potential ecological impacts is necessary.

VII.2.1 Data Assessment

As indicated in Section IV (Tables 5 and 7), inorganic constituents in soil within the 0- to 5-foot depth interval that exceeded background concentrations were as follows:

- Arsenic
- Barium
- Uranium
- U-235
- U-238.

Four constituents do not have quantified background screening concentrations. Thus it is unknown if these constituents exceed background. These constituents are:

- Cadmium
- Mercury
- Selenium
- Silver.

No organic analytes were detected in the soil samples collected from this site.

VII.2.2 Bioaccumulation

Among the COPECs listed in Section VII.2.1, the following were considered to have bioaccumulation potential in aquatic environments (Section IV, Tables 5 and 7):

- Arsenic
- Barium
- Cadmium
- Mercury
- Selenium
- U-235
- U-238.

It should be noted, however, that as directed by the NMED (NMED March 1998), bioaccumulation for inorganics was assessed exclusively based upon maximum reported bioconcentration factors (BCF) for aquatic species. Because only aquatic BCFs are used to evaluate the bioaccumulation potential for metals, bioaccumulation in terrestrial species is likely to be overpredicted.

VII.2.3 Fate and Transport Potential

The potential for the COPECs to move from the source of contamination to other media or biota is discussed in Section V. As noted in Table 8 (Section V), wind is expected to be of moderate significance as a transport mechanism for COPECs at this site, but surface-water runoff is probably of low significance. Migration to groundwater is not anticipated. Food chain uptake is expected to be of low significance. Degradation (decay) and transformation for the COPECs and radionuclides is expected to be of low significance.

VII.2.4 Scoping Risk-Management Decision

Based upon information gathered through the scoping assessment, it was concluded that complete ecological pathways may be associated with this SWMU and that COPECs also exist at the site. As a consequence, a screening assessment was deemed necessary to predict the potential level of ecological risk associated with the site.

VII.3 Screening Assessment

As concluded in Section VII.2.4, complete ecological pathways and COPECs are associated with this SWMU. The screening assessment performed for the site involved a quantitative estimate of current ecological risks using exposure models associated with exposure parameters and toxicity information obtained from the literature. The estimation of potential ecological risks was conservative to ensure that ecological risks were not underpredicted.

Components within the screening assessment included the following:

- Problem Formulation—sets the stage for the evaluation of potential exposure and risk.
- Exposure Estimation—provides a quantitative estimate of potential exposure.
- Ecological Effects Evaluation—presents benchmarks used to gauge the toxicity of COPECs to specific receptors.
- Risk Characterization—characterizes the ecological risk associated with exposure of the receptors to environmental media at the site.
- Uncertainty Assessment—discusses uncertainties associated with the estimation of exposure and risk.
- Risk Interpretation—evaluates ecological risk in terms of HQs and ecological significance.
- Screening Assessment Scientific/Management Decision Point—presents the decision to risk managers based upon the results of the screening assessment.

VII.3.1 Problem Formulation

Problem formulation is the initial stage of the screening assessment that provides the introduction to the risk evaluation process. Components that are addressed in this section include a discussion of ecological pathways and the ecological setting, identification of COPECs, and selection of ecological receptors. The conceptual model, ecological food webs, and ecological endpoints (other components commonly addressed in a screening assessment) are presented in the "Predictive Ecological Risk Assessment Methodology" (IT July 1998) and are not duplicated here.

Table 13
Exposure Factors for Ecological Receptors at SWMU 117

Receptor Species	Class/Order	Trophic Level	Body Weight (kg)[a]	Food Intake Rate (kg/day)[b]	Dietary Composition[c]	Home Range (acres)
Deer mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Herbivore	2.39E-2[d]	3.72E-3	Plants: 100% (+ soil at 2% of intake)	2.7E-1[e]
Deer mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Omnivore	2.39E-2[d]	3.72E-3	Plants: 50% Invertebrates: 50% (+ soil at 2% of intake)	2.7E-1[e]
Deer mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Insectivore	2.39E-2[d]	3.72E-3	Invertebrates: 100% (+ soil at 2% of intake)	2.7E-1[e]
Burrowing owl (*Speotyto cunicularia*)	Aves/ Strigiformes	Carnivore	1.55E-1[f]	1.73E-2	Rodents: 100% (+ soil at 2% of intake)	3.5E+1[g]

[a]Body weights are in kg wet weight.
[b]Food intake rates are estimated from the allometric equations presented in Nagy (1987). Units are kg dry weight per day.
[c]Dietary compositions are generalized for modeling purposes. Default soil intake value of 2% of food intake.
[d]From Silva and Downing (1995).
[e]EPA (1993), based upon the average home range measured in semiarid shrubland in Idaho.
[f]From Dunning (1993).
[g]From Haug et al. (1993).
EPA = U.S. Environmental Protection Agency.
kg = Kilogram(s).
kg/day = Kilogram(s) per day.
SWMU = Solid Waste Management Unit.

dose. This concentrated radiation source at the center of the body of the receptor is assumed to be a "point" source. Radiation emitted from this point source is absorbed by the body tissues to contribute to the absorbed dose. Alpha and beta emitters are assumed to transfer 100 percent of their energy to the receptor as they pass through tissues. Gamma-emitting radionuclides only transfer a fraction of their energy to the tissues because gamma rays interact less with matter than do beta or alpha emitters. The external and internal dose rate results are summed to calculate a total dose rate from exposure to U-234, U-235, and U-238 in soil.

Table 14 presents the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 15 presents maximum concentrations in soil and derived concentrations in tissues of the various food chain elements that are used to model dietary exposures for each of the wildlife receptors.

VII.3.3 Ecological Effects Evaluation

Table 16 shows benchmark toxicity values for the plant and wildlife receptors. For plants, the benchmark soil concentrations are based upon the lowest-observed-adverse-effect level (LOAEL). For wildlife, the toxicity benchmarks are based upon the no-observed-adverse-effect level (NOAEL) for chronic oral exposure in a taxonomically similar test species. Insufficient toxicity information was found to estimate the LOAELs or NOAELs for some COPECs for terrestrial plant life and for the burrowing owl, respectively.

The benchmark used for exposure of terrestrial receptors to radiation was 0.1 rad/day. This value has been recommended by the International Atomic Energy Agency (IAEA 1992) for the protection of terrestrial populations. Because plants and insects are less sensitive to radiation than vertebrates (Whicker and Schultz 1982), the dose of 0.1 rad/day should also offer sufficient protection to other components within the terrestrial habitat of SWMU 117.

VII.3.4 Risk Characterization

Maximum concentrations in soil and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. Table 17 presents results of these comparisons. HQs are used to quantify the comparison with benchmarks for plants and wildlife exposure.

None of the analytes had HQs exceeding unity for plants and the burrowing owl. A HQ for silver for the burrowing owl could not be determined because of a lack of sufficient toxicity information. For the deer mouse, only arsenic and barium had HQs greater than unity. In both cases, these HQs were limited to the omnivorous and insectivorous dietary regimes. As directed by the NMED, HIs were calculated for each of the receptors (the HI is the sum of chemical-specific HQs for all pathways for a given receptor). All receptors except the burrowing owl had total HIs greater than unity, with a maximum HI of 12 for the insectivorous deer mouse.

Tables 18 and 19 summarize the internal and external dose rate model results for U-234, U-235, and U-238. The total radiation dose rate to the deer mouse was predicted to be 5.2E-3 rad/day. Total dose rate to the burrowing owl was predicted to be 4.9E-3 rad/day. The dose rates for the deer mouse and the burrowing owl are considerably less than the benchmark of 0.1 rad/day.

Table 14
Transfer Factors Used in Exposure Models for Constituents of Potential Ecological Concern at SWMU 117

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Arsenic	4.0E-2[a]	1.0E+0[b]	2.0E-3[a]
Barium	1.5E-1[a]	1.0E+0[b]	2.0E-4[c]
Cadmium	5.5E-1[a]	6.0E-1[d]	5.5E-4[a]
Mercury	1.0E+0[c]	1.0E+0[b]	2.5E-1[a]
Selenium	5.0E-1[c]	1.0E+0[b]	1.0E-1[c]
Silver	1.0E+0[c]	2.5E-1[d]	5.0E-3[c]
Uranium	2.3E-2[e]	1.0E+0[b]	1.0E-2[c]

[a]From Baes et al. (1984).
[b]Default value.
[c]From NCRP (January 1989).
[d]From Stafford et al. (1991).
[e]From IAEA (1994).
IAEA = International Atomic Energy Agency.
NCRP = National Council on Radiation Protection and Measurements.
SWMU = Solid Waste Management Unit.

Table 15
Media Concentrations[a] for Constituents of Potential Ecological Concern at SWMU 117

Constituent of Potential Ecological Concern	Soil (maximum)[a]	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Arsenic	7.0E+0	2.8E-1	7.0E+0	2.4E-2
Barium	2.4E+2	3.5E+1	2.4E+2	8.8E-2
Cadmium	2.2E-1	1.2E-1	1.3E-1	2.3E-4
Mercury	1.2E-2	1.2E-2	1.2E-2	9.4E-3
Selenium	5.0E-1	2.5E-1	5.0E-1	1.2E-1
Silver	6.0E-2[d]	6.0E-2	1.5E-2	6.1E-4
Uranium	3.4E+0	7.8E-2	3.4E+0	5.7E-2

[a]In milligram(s) per kilogram. All biotic media are based upon dry weight of the media. Soil concentration measurements are assumed to have been based upon dry weight. Values have been rounded to two significant digits after calculation.
[b]Product of the soil concentration and the corresponding transfer factor.
[c]Based upon the deer mouse with an omnivorous diet. Product of the average concentration ingested in food and soil times the food-to-muscle transfer factor times a wet weight-dry weight conversion factor of 3.125 (EPA 1993).
[d]Analyte was nondetect. Concentration is one-half the detection limit.
EPA = U.S. Environmental Protection Agency.
SWMU = Solid Waste Management Unit.

Table 16
Toxicity Benchmarks for Ecological Receptors at SWMU 117

Constituent of Potential Ecological Concern	Plant Benchmark[a,b]	Mammalian NOAELs			Avian NOAELs		
		Mammalian Test Species[c,d]	Test Species NOAEL[d,e]	Deer Mouse NOAEL[e,f]	Avian Test Species[d]	Test Species NOAEL[d,e]	Burrowing Owl NOAEL[e,g]
Arsenic	10	Mouse	0.126	0.13	Mallard	5.14	5.14
Barium	500	Rat[h]	10.5	5.1	Chicken	20.8	20.8
Cadmium	3	Rat[i]	1.0	1.9	Mallard	1.45	1.45
Mercury (inorganic)	0.3	Mouse	13.2	14.0	Japanese quail	0.45	0.45
Mercury (organic)	0.3	Rat	0.032	0.063	Mallard	0.0064	0.0064
Selenium	1	Rat	0.20	0.391	Screech owl	0.44	0.44
Silver	2	Rat	17.8[j]	34.8	–	–	–
Uranium	5	Mouse[k]	3.07	3.19	Black duck	16.0	16.0

[a]In milligram(s) per kilogram soil dry weight.
[b]From Efroymson et al. (1997).
[c]Body weights (in kilogram[s]) for the NOAEL conversion are as follows: lab mouse, 0.030; lab rat, 0.350 (except where noted).
[d]From Sample et al. (1996), except where noted.
[e]In milligram(s) per kilogram body weight per day.
[f]Based upon NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.0239 kilogram and a mammalian scaling factor of 0.25.
[g]Based upon NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.
[h]Body weight: 0.435 kilogram.
[i]Body weight: 0.303 kilogram.
[j]Based upon a rat lowest-observed-adverse-effect level of 89 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.2.
[k]Body weight: 0.028 kilogram.
EPA = U.S. Environmental Protection Agency.
NOAEL = No-observed-adverse-effect level.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data.

Table 17
Hazard Quotients for Ecological Receptors at SWMU 117

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Arsenic	7.0E-1	4.9E-1	**4.4E+0**	**8.3E+0**	3.4E-3
Barium	4.7E-1	5.9E-1	**2.1E+0**	**3.6E+0**	2.6E-2
Cadmium	7.4E-2	1.0E-2	1.1E-2	1.1E-2	3.6E-4
Mercury (inorganic)	3.9E-1	1.3E-4	1.3E-4	1.3E-4	2.4E-3
Mercury (organic)	3.9E-1	3.0E-2	3.0E-2	3.0E-2	1.7E-1
Selenium	5.0E-1	1.0E-1	1.5E-1	2.0E-1	3.3E-2
Silver	3.0E-2	2.7E-4	1.7E-4	7.2E-5	–
Uranium	6.8E-1	7.1E-3	8.8E-2	1.7E-1	8.7E-4
HI[a]	**2.5E+0**	**1.2E+0**	**6.8E+0**	**1.2E+1**	2.3E-1

Note: **Bold** text indicates HQ or HI exceeds unity.
[a]The HI is the sum of individual HQs using the value for organic mercury as a conservative estimate of the HI.
HI = Hazard index.
HQ = Hazard quotient.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data available for risk estimation purposes.

Table 18
Internal and External Dose Rates for
Deer Mice Exposed to Radionuclides at SWMU 117

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
U-234[a]	3.93	4.54E-05	4.43E-07	4.59E-05
U-235+D	0.88	9.56E-06	1.43E-05	2.39E-05
U-238+D	31.4	3.19E-04	4.77E-03	5.09E-03
Total		3.74E-04	4.78E-03	5.16E-03

[a]U-234 was estimated by 1/8 of the U-238 concentration.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

Table 19
Internal and External Dose Rates for
Burrowing Owls Exposed to Radionuclides at SWMU 117

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
U-234[a]	3.93	1.83E-05	4.43E-07	1.88E-05
U-235+D	0.88	3.86E-04	1.43E-05	1.82E-05
U-238+D	31.4	1.29E-04	4.77E-03	4.90E-03
Total		1.51E-04	4.78E-03	4.93E-03

[a]U-234 was estimated by 1/8 of the U-238 concentration.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

VII.3.5 Uncertainty Assessment

Many uncertainties are associated with the characterization of ecological risks at SWMU 117. These uncertainties result from assumptions used in calculating risk that could overestimate or underestimate true risk presented at a site. For this risk assessment, assumptions are made that are more likely to overestimate exposures and risk rather than to underestimate them. These conservative assumptions are used to provide more protection to the ecological resources potentially affected by the site. Conservatisms incorporated into this risk assessment include the use of maximum measured analyte concentrations in soil to evaluate risk, the use of wildlife toxicity benchmarks based upon NOAEL values, the incorporation of strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse, and the use of 1.0 as the area use factor for wildlife receptors regardless of seasonal use or home range size. Each of these uncertainties, which are consistent among each of the SWMU-specific ecological risk assessments, is discussed in greater detail in the uncertainty section of the ecological risk assessment methodology document for the SNL/NM ER Project (IT July 1998).

Uncertainties associated with the estimation of risk to ecological receptors following exposure to U-235 and Cs-137 are primarily related to those inherent in the radionuclide-specific data. Radionuclide-dependent data are measured values that have their associated errors. The dose rate models used for these calculations are based upon conservative estimates on receptor shape, radiation absorption by body tissues, and intake parameters. The goal is to provide a realistic but conservative estimate of a receptor's internal and external exposure to radionuclides in soil.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. Conservatisms in the modeling of exposure and risk can resulted in the prediction of risk to ecological receptors when exposed at background concentrations. As shown in Table 20, HQs associated with exposures to background are greater than 1.0 for arsenic and barium. Background may account for more than one-half the HQs for these two elements (63 percent for arsenic and 55 percent for barium). It is, therefore, likely that the actual risk from arsenic and barium at SWMU 117 is overestimated by the HQs calculated in this screening assessment because of conservatisms incorporated into the exposure assessment and in the toxicity benchmarks for these COPECs (e.g., the use of NOAELs for wildlife receptors).

A significant source of uncertainty associated with the prediction of ecological risks at this site is the use of the maximum measured concentrations or detection limits to evaluate risk. This results in a conservative exposure scenario that does not necessarily reflect actual site conditions. To assess the potential degree of overestimation caused by using the maximum measured soil concentrations in the exposure assessment, average soil concentrations were calculated for the COPECs with HQs greater than unity to determine whether these HQs can be accounted for by the magnitude of the extreme measurement. The average concentrations of arsenic and barium were determined to be 4.12 and 156 milligrams per kilogram, respectively. The average for arsenic is less than its background screening value; therefore, the HQ based upon the average concentration will be less than those shown in Table 20 for arsenic. Although the average concentration of barium is greater than its background screening value by approximately 20 percent, the HQs for the omnivorous and insectivorous deer mice are 1.4 and

Table 20
HQs for Ecological Receptors Exposed to Background Concentrations at SWMU 117

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Arsenic	4.4E-1	3.1E-1	**2.8E+0**	**5.2E+0**	2.2E-3
Barium	2.6E-1	3.3E-1	**1.1E+0**	**2.0E+0**	1.4E-2
Cadmium	1.7E-1	2.4E-2	2.5E-2	2.6E-2	8.1E-4
Mercury (inorganic)	1.7E-1	5.7E-4	5.7E-4	5.7E-4	1.0E-2
Mercury (organic)	1.7E-1	1.3E-1	1.3E-1	1.3E-1	7.1E-1
Selenium	5.0E-1	1.0E-1	1.5E-1	2.0E-1	3.3E-2
Silver	2.5E-1	2.3E-3	1.4E-3	6.0E-4	–
Uranium	4.6E-1	4.8E-3	6.0E-2	1.1E-1	5.9E-4
HI	**2.4E+0**	9.0E-1	**4.3E+0**	**7.7E+0**	7.7E-1

Note: **Bold** text indicates HQ or HI exceeds unity.
[a]The HI is the sum of individual HQs using the value for organic mercury as a conservative estimate of the HI.
HI = Hazard index.
HQ = Hazard quotient.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data available for risk estimation purposes.

2.4, respectively, when based upon the average concentration. Because the NOAEL for barium for the deer mice is based upon the highest dose administered to rats in a study by Perry et al. (1983, as cited in Sample et al. 1996), which produced no significant adverse effect, it is unlikely that HQs of this low magnitude reflect potential risk to these receptors.

Based upon this uncertainty analysis, ecological risks at SWMU 117 are expected to be very low. HQs greater than unity were initially predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to conservatively estimated exposure concentrations and toxicity benchmarks, and the contribution of background risk.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 117 were estimated through a screening assessment that incorporated site-specific information when available. Overall, risks to ecological receptors are expected to be low because predicted risks associated with exposure to COPECs are based upon calculations using maximum detected values. Predicted risks from exposure to arsenic and barium were attributed to using maximum detected values and conservatively estimated toxicity benchmarks. The average arsenic concentration at the site was within the range of background. Based upon the average soil concentrations, the HQs for barium that exceed unity are mostly attributable to the potential contribution of background and to the use of a conservatively estimated NOAEL as the toxicity benchmark. Based upon this final analysis, ecological risks associated with SWMU 117 are expected to be low.

VII.3.7 Screening Assessment Scientific/Management Decision Point

After potential ecological risks associated with the site have been assessed, a decision is made regarding whether the site should be recommended for NFA or whether additional data should be collected to assess actual ecological risk at the site more thoroughly. With respect to this site, ecological risks are predicted to be low. The scientific/management decision is to recommend this site for NFA.

VIII. References

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APPENDIX 1
EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

Introduction

Sandia National Laboratories/New Mexico (SNL/NM) proposes that a default set of exposure routes and associated default parameter values be developed for each future land use designation being considered for SNL/NM Environmental Restoration (ER) project sites. This default set of exposure scenarios and parameter values would be invoked for risk assessments unless site-specific information suggested other parameter values. Because many SNL/NM solid waste management units (SWMU) have similar types of contamination and physical settings, SNL/NM believes that the risk assessment analyses at these sites can be similar. A default set of exposure scenarios and parameter values will facilitate the risk assessments and subsequent review.

The default exposure routes and parameter values suggested are those that SNL/NM views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the U.S. Environmental Protection Agency (EPA) Region VI and New Mexico Environment Department (NMED), SNL/NM proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all SWMUs exist within the boundaries of the Kirtland Air Force Base (KAFB). Approximately 157 potential waste and release sites have been identified where hazardous, radiological, or mixed materials may have been released to the environment. Evaluation and characterization activities have occurred at all of these sites to varying degrees. Among other documents, the SNL/NM ER draft Environmental Assessment (DOE 1996) presents a summary of the hydrogeology of the sites, the biological resources present and proposed land use scenarios for the SNL/NM SWMUs. At this time, all SNL/NM SWMUs have been tentatively designated for either industrial or recreational future land use. The NMED has also requested that risk calculations be performed based upon a residential land use scenario. All three land use scenarios will be addressed in this document.

The SNL/NM ER project has screened the potential exposure routes and identified default parameter values to be used for calculating potential intake and subsequent Hazard index (HI), excess cancer risk and dose values. The EPA (EPA 1989a) provides a summary of exposure routes that could potentially be of significance at a specific waste site. These potential exposure routes consist of:

- Ingestion of contaminated drinking water
- Ingestion of contaminated soil
- Ingestion of contaminated fish and shell fish
- Ingestion of contaminated fruits and vegetables

- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming
- Dermal contact with chemicals in water
- Dermal contact with chemicals in soil
- Inhalation of airborne compounds (vapor phase or particulate)
- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

Based upon the location of the SNL/NM SWMUs and the characteristics of the surface and subsurface at the sites, we have evaluated these potential exposure routes for different land use scenarios to determine which should be considered in risk assessment analyses (the last exposure route is pertinent to radionuclides only). At SNL/NM SWMUs, there does not currently occur any consumption of fish, shell fish, fruits, vegetables, meat, eggs, or dairy products that originate on site. Additionally, no potential for swimming in surface water is present due to the high-desert environmental conditions. As documented in the RESRAD computer code manual (ANL 1993), risks resulting from immersion in contaminated air or water are not significant compared to risks from other radiation exposure routes.

For the industrial and recreational land use scenarios, SNL/NM ER has, therefore, excluded the following four potential exposure routes from further risk assessment evaluations at any SNL/NM SWMU:

- Ingestion of contaminated fish and shell fish
- Ingestion of contaminated fruits and vegetables
- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming.

That part of the exposure pathway for radionuclides related to immersion in contaminated air or water is also eliminated.

For the residential land use scenario, we will include ingestion of contaminated fruits and vegetables because of the potential for residential gardening.

Based upon this evaluation, for future risk assessments, the exposure routes that will be considered are shown in Table 1. Dermal contact is included as a potential exposure pathway in all land use scenarios. However, the potential for dermal exposure to inorganics is not considered significant and will not be included. In general, the dermal exposure pathway is generally considered to not be significant relative to water ingestion and soil ingestion pathways but will be considered for organic components. Because of the lack of toxicological parameter values for this pathway, the inclusion of this exposure pathway into risk assessment calculations may not be possible and may be part of the uncertainty analysis for a site where dermal contact is potentially applicable.

Table 1
Exposure Pathways Considered for Various Land Use Scenarios

Industrial	Recreational	Residential
Ingestion of contaminated drinking water	Ingestion of contaminated drinking water	Ingestion of contaminated drinking water
Ingestion of contaminated soil	Ingestion of contaminated soil	Ingestion of contaminated soil
Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)
Dermal contact	Dermal contact	Dermal contact
External exposure to penetrating radiation from ground surfaces	External exposure to penetrating radiation from ground surfaces	Ingestion of fruits and vegetables
		External exposure to penetrating radiation from ground surfaces

Equations and Default Parameter Values for Identified Exposure Routes

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation may also be significant for radionuclides. All of the above routes will, however, be considered for their appropriate land use scenarios. The general equations for calculating potential intakes via these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund (RAGS): Volume 1 (EPA 1989a, 1991). These general equations also apply to calculating potential intakes for radionuclides. A more in-depth discussion of the equations used in performing radiological pathway analyses with the RESRAD code may be found in the RESRAD Manual (ANL 1993). Also shown are the default values SNL/NM ER suggests for use in RME risk assessment calculations for industrial, recreational, and residential scenarios, based upon EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants. RESRAD input parameters that are left as the default values provided with the code are not discussed. Further information relating to these parameters may be found in the RESRAD Manual (ANL 1993).

Generic Equation for Calculation of Risk Parameter Values

The equation used to calculate the risk parameter values (i.e., hazard quotients/hazard index [HI], excess cancer risk, or radiation total effective dose equivalent [dose]) is similar for all exposure pathways and is given by:

Risk (or Dose) = Intake x Toxicity Effect (either carcinogenic, noncarcinogenic, or radiological)

$$= C \times (CR \times EFD/BW/AT) \times \text{Toxicity Effect} \quad (1)$$

where

C = contaminant concentration (site specific)
CR = contact rate for the exposure pathway
EFD = exposure frequency and duration
BW = body weight of average exposure individual
AT = time over which exposure is averaged.

The total risk/dose (either cancer risk or HI) is the sum of the risks/doses for all of the site-specific exposure pathways and contaminants.

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the constituents of concern (COC) present at the site. This estimate is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk range of 1E-6 for Class A and B carcinogens and 1E-5 for Class C carcinogens. The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the HI) for the toxicity resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of this quantitative estimate with the EPA standard HI of unity (1). The evaluation of the health hazard due to radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site.

The specific equations used for the individual exposure pathways can be found in RAGS (EPA 1989a) and the RESRAD Manual (ANL 1993). Table 2 shows the default parameter values suggested for used by SNL/NM at SWMUs, based upon the selected land use scenario. References are given at the end of the table indicating the source for the chosen parameter values. The intention of SNL/NM is to use default values that are consistent with regulatory guidance and consistent with the RME approach. Therefore, the values chosen will, in general, provide a conservative estimate of the actual risk parameter. These parameter values are suggested for use for the various exposure pathways based upon the assumption that a particular site has no unusual characteristics that contradict the default assumptions. For sites for which the assumptions are not valid, the parameter values will be modified and documented.

Summary

SNL/NM proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial, recreational or residential future land use scenario. There are no current residential land use designations at SNL/NM ER sites, but this scenario has been requested to be considered by the NMED. For sites designated as industrial or recreational land use, SNL/NM will provide risk parameter values based upon a residential land use scenario to indicate the effects of data uncertainty on risk value calculations or in order to potentially mitigate the need for institutional controls or restrictions on SNL/NM ER sites. The parameter values are based upon EPA guidance and supplemented by information from other government sources. The values are generally consistent with those proposed by Los Alamos National Laboratory, with a few minor variations. If these exposure routes and parameters are acceptable, SNL/NM will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

Table 2
Default Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency	8 hr/day for 250 day	4 hr/wk for 52 wk/yr	350 day/yr
Exposure duration (yr)	25[a,b]	30[a,b]	30[a,b]
Body weight (kg)	70[a,b]	70 adult[a,b] 15 child	70 adult[a,b] 15 child
Averaging Time (days) for carcinogenic compounds (= 70 y x 365 day/yr) for noncarcinogenic compounds (= ED x 365 day/yr)	25,550[a] 9,125	25,550[a] 10,950	25,550[a] 10,950
Soil Ingestion Pathway			
Ingestion rate	100 mg/day[c]	200 mg/day child 100 mg/day adult	200 mg/day child 100 mg/day adult
Inhalation Pathway			
Inhalation rate (m^3/yr)	5,000[a,b]	260[d]	7,000[a,b,d]
Volatilization factor (m^3/kg)	chemical specific	chemical specific	chemical specific
Particulate emission factor (m^3/kg)	1.32E9[a]	1.32E9[a]	1.32E9[a]
Water Ingestion Pathway			
Ingestion rate (liter/day)	2[a,b]	2[a,b]	2[a,b]
Food Ingestion Pathway			
Ingestion rate (kg/yr)	NA	NA	138[b,d]
Fraction ingested	NA	NA	0.25[b,d]
Dermal Pathway			
Surface area in water (m^2)	2[b,e]	2[b,e]	2[b,e]
Surface area in soil (m^2)	0.53[b,e]	0.53[b,e]	0.53[b,e]
Permeability coefficient	chemical specific	chemical specific	chemical specific

[a]Risk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).
[b]Exposure Factors Handbook (EPA 1989b).
[c]EPA Region VI guidance.
[d]For radionuclides, RESRAD (Argonne National Laboratory, 1993. *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD*, Version 5.0, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, IL. 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.
[e]Dermal Exposure Assessment (EPA 1992).
ED = Exposure duration.
EPA = U.S. Environmental Protection Agency.
hr = Hour.
kg = Kilogram(s).
m = Meter(s).
mg = Milligram(s).
NA = Not available.
wk = Week.
yr = Year.

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