

Sandia National Laboratories/New Mexico

**PROPOSALS FOR NO FURTHER ACTION
ENVIRONMENTAL RESTORATION PROJECT
SWMUs 98, 82, 60, 81A, 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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- 10-D Data Validation Results, 1999 Confirmatory Sampling
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10.0 SOLID WASTE MANAGEMENT UNIT 9, BURIAL SITE/OPEN DUMP

10.1 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) 9, Burial Site/Open Dump, Operable Unit (OU) 1334 on Kirtland Air Force Base (KAFB). SWMU 9 is an inactive site located within the former Area Z explosives testing area. Review and analysis of all relevant data for SWMU 9 indicate that concentrations of constituents of concern (COCs) at this site are less than applicable risk assessment action levels. Thus, SWMU 9 is proposed for an NFA decision based upon confirmatory sampling data demonstrating that COCs that may have been released into the environment pose an acceptable level of risk. The risk is based upon the current and projected land use, as set forth by Criterion 5. Criterion 5 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 future land use" (NMED March 1998).

10.2 Site Description and Operational History

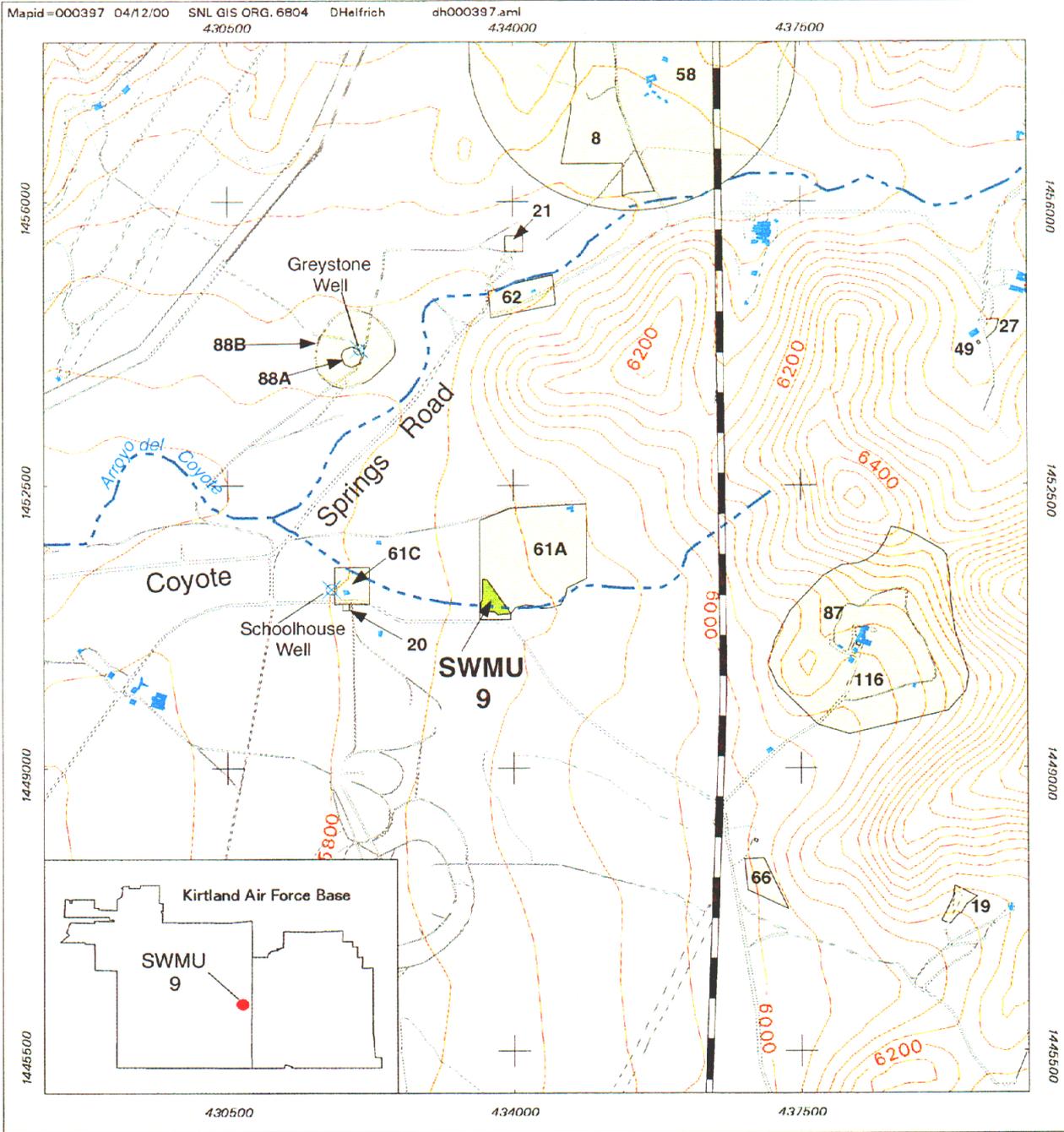
10.2.1 Site Description

SWMU 9 is located in OU 1334, which is known as the Central Coyote Test Area, and occupies 1.86 acres of land permitted to the U.S. Department of Energy (DOE) and SNL/NM and is controlled by the U.S. Air Force (USAF) (SNL/NM April 1994). SWMU 9 is an inactive site located on the north side of the KAFB Explosive Ordnance Disposal (EOD) Range approximately 1,800 feet east of the Schoolhouse Building, SWMU 61C (Figure 10.2.1-1), where an unnamed dirt road branches off to the north from Demolition Range Road and crosses an arroyo (Figure 10.2.1-2). SWMU 9 forms the southwest corner of adjacent SWMU 61A and encompasses features on the north and south arroyo banks as well as in the arroyo channel (Figure 10.2.1-3). The mean elevation of the site is 5,845 feet above mean sea level (amsl) (SNL/NM April 1994).

The original description of ER SWMU 9 included three "debris mounds" of which only the largest, Mound 1 (Figure 10.2.1-4a), was later determined to be a true soil-covered debris burial mound. Mound 1 was approximately 175 feet long and up to 8 feet high above the surrounding grade. The other two "mounds" were simply debris, dumped as either a discrete pile in the arroyo channel (Mound 2, Figure 10.2.1-4b) or as debris scattered along the south bank of the arroyo channel (Mound 3). Mound 2 debris consisted of a tangled mass of barbed wire, empty paint cans, ceramic electrical insulators, mortar shell storage cases, a military bomb rack, vehicle parts, a shrapnel-riddled iron plate, pieces of wood and metal, and building rubble (cinder blocks and glazed masonry tiles). Mound 3 debris consisted of wooden crate remnants, empty paint cans, expended smoke grenades, an empty 55-gallon (gal) drum containing a grate that appears to have been used as a grill, and other miscellaneous solid waste.

A burial pit containing radioactively contaminated materials was discovered during a voluntary corrective measure (VCM) conducted at the SWMU between 1996 and 1998. The burial pit was located about 30 feet northeast of the south end of Mound 1, was about 30 feet in diameter, and

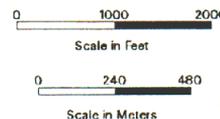
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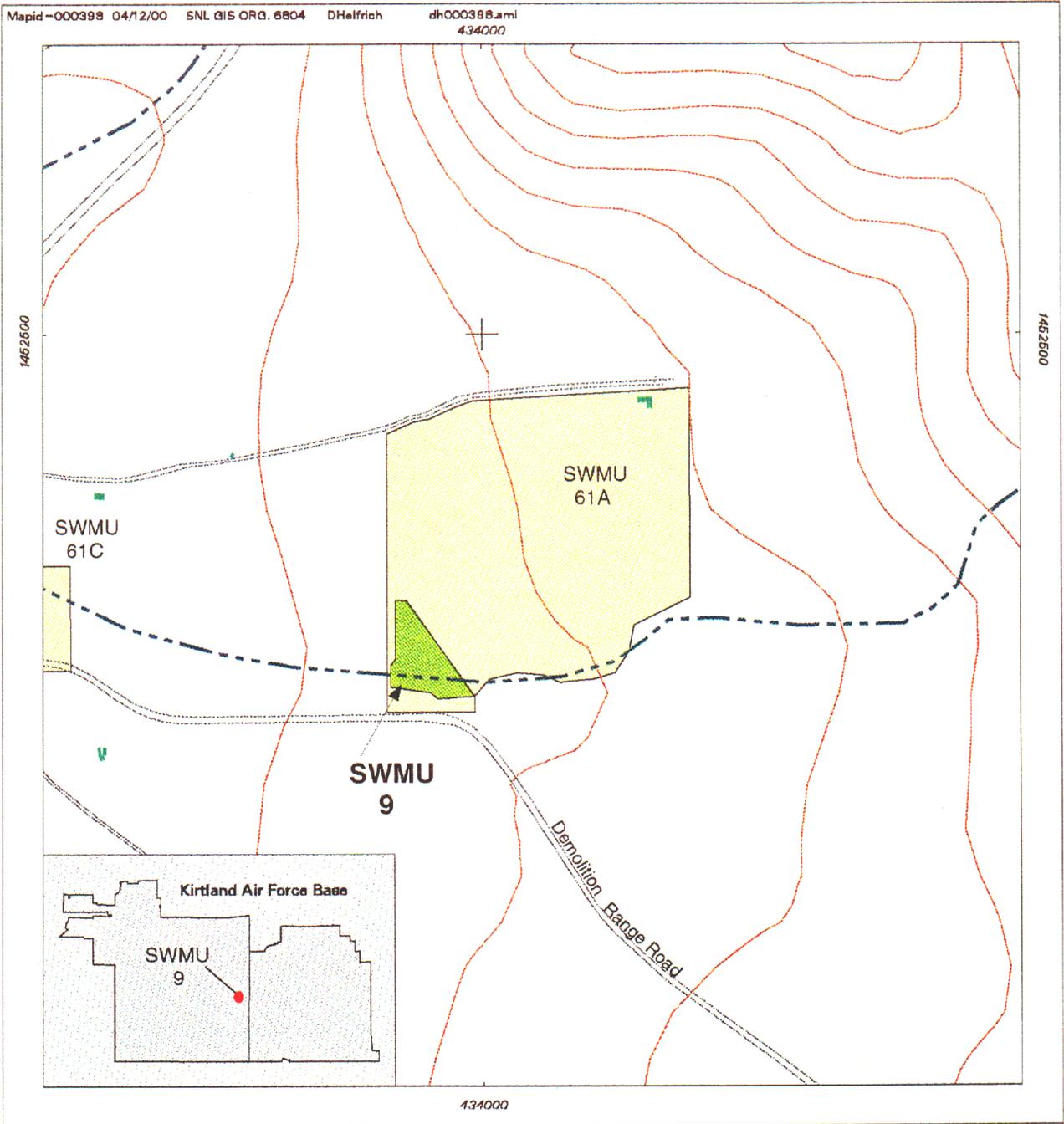
Legend

-  Monitoring Well
-  KAFB Boundary
-  Road
-  40 Foot Contour
-  Drainage
-  SWMU 9
-  Other SWMU Site
-  Building

Figure 10.2.1-1
Location of SWMU 9
Burial Site / Open Dump



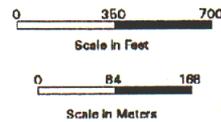
Sandia National Laboratories, New Mexico
 Environmental Geographic Information System



Legend

-  KAFB Boundary
-  Road
-  40 Foot Contour
-  Drainage
-  SWMU 9
-  Other SWMU Site
-  Building

Figure 10.2.1-2
Location of SWMU 9
Burial Site / Open Dump



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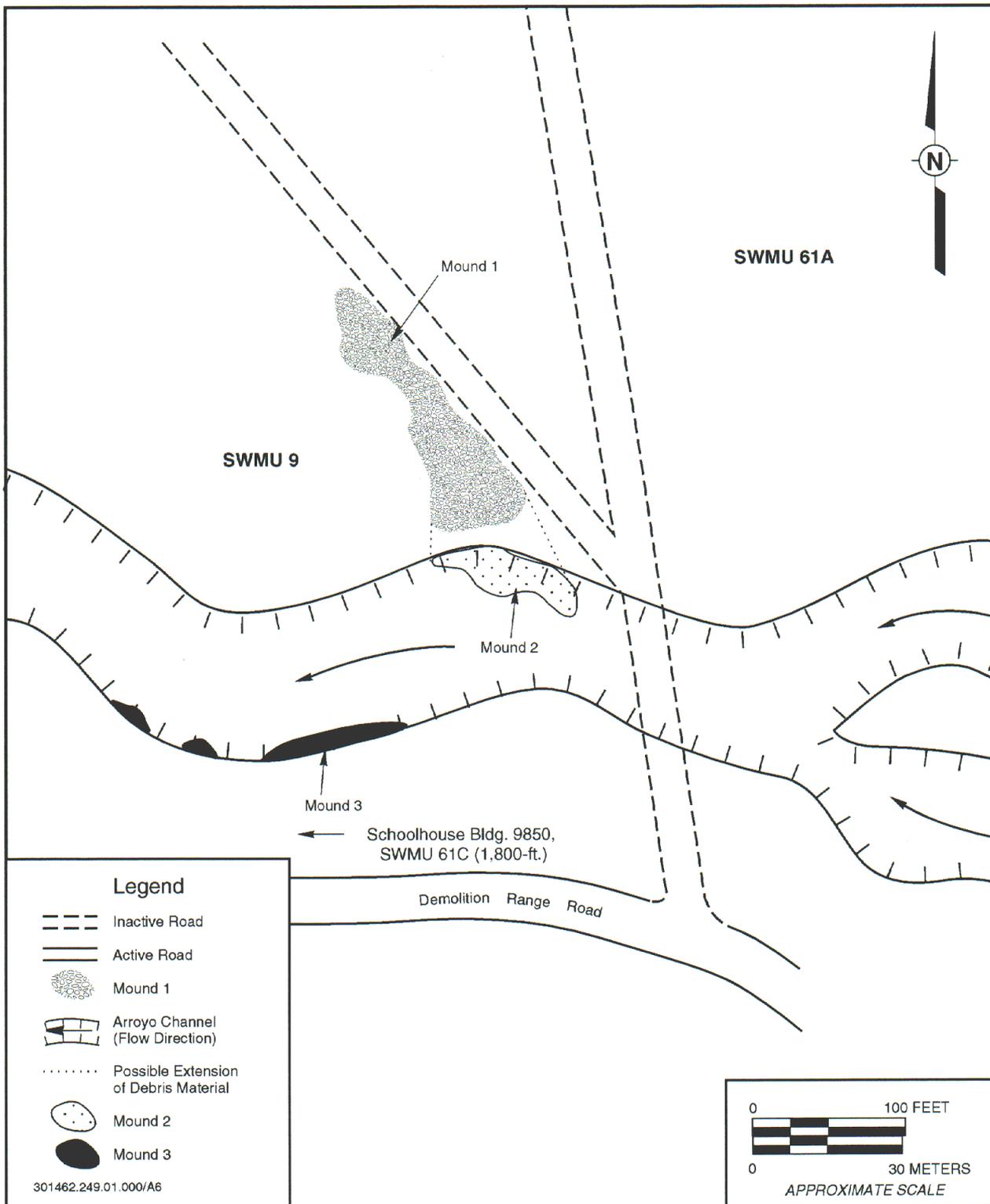


Figure 10.2.1-3
General Location Map Showing Mounds at SWMU Site 9, Burial Site/Open Dump

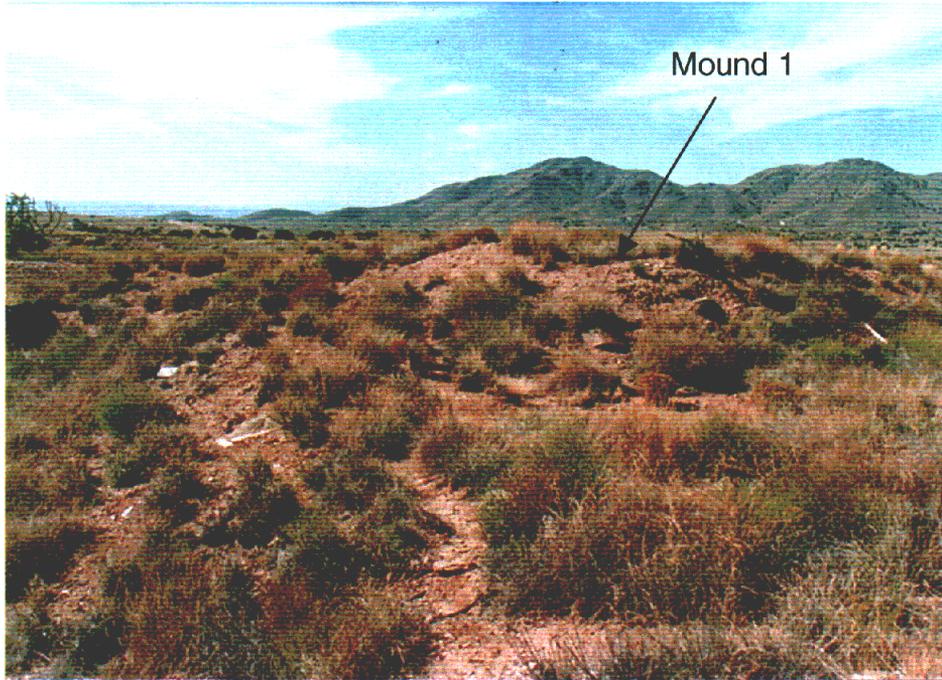


Figure 10.2.1-4a. SWMU 9 Burial Site / Open Dump. View to northwest of Mound 1 prior to excavation.

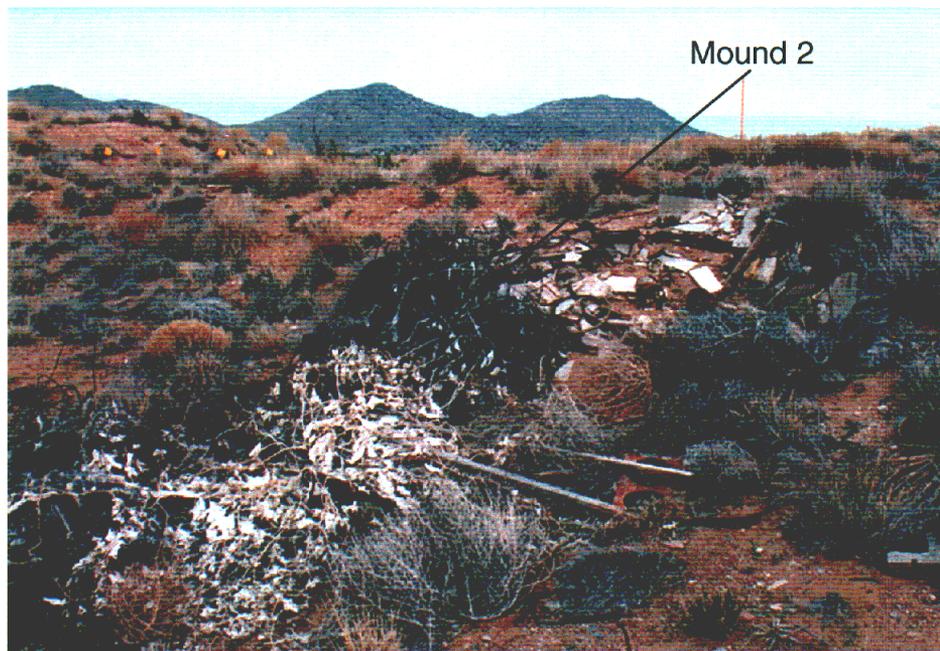


Figure 10.2.1-4b. View of debris pile originally described as Mound 2 in arroyo channel at south end of Mound 1. View to northeast.

had debris buried to a depth of about 4 feet. The VCM and burial pit are discussed in more detail in Section 10.4.5.2.

SWMU 9 is on the Arroyo del Coyote alluvial fan that is composed of Pleistocene-age, poorly to moderately sorted sediments ranging in size from clay to boulders (SNL/NM March 1995, IT May 1994). These deposits contain relatively impermeable carbonate-rich horizons and impermeable carbonate-cemented horizons that inhibit vertical groundwater flow (SNL/NM March 1995). Based upon the drilling record for the Schoolhouse Well, located approximately 2,000 feet west of SWMU 9 (Figure 10.2.1-1), the alluvial fan deposits are less than 100 feet thick and unconformably overlie the Madera Formation (SNL/NM March 1995). The Madera Formation consists of predominantly clastic limestone that contains fossiliferous, cherty limestone units with some interbedded shale, siltstone, sandstone, and pebble conglomerate (Myers and McKay 1970). To the west of SWMU 9 is the Coyote Fault, which forms the eastern margin of the Hubbell structural bench and exhibits down-to-the-west displacement. The fault is expressed geomorphically as linear range-front facets, and, as evidenced by the coincidence of Coyote Springs with the Coyote Fault (0.5 miles north of SWMU 9), probably influences groundwater pathways from the Manzanita Mountains to the alluvium (SNL/NM March 1995). The Schoolhouse Well is completed in the Madera Formation, and the depth to groundwater is approximately 95 feet below ground surface (bgs) (SNL/NM March 1997). The direction of groundwater flow in the vicinity of SWMU 9 is generally west-northwest (SNL/NM March 1997).

SWMU 9 lies along an unnamed arroyo that is a tributary to the Arroyo del Coyote (Figure 10.2.1-1). The unnamed arroyo drains a small watershed with headwaters in the western face of the Manzanita Mountains and joins Arroyo del Coyote approximately 2,800 feet northwest of the site. Arroyo del Coyote ultimately drains into Tijeras Arroyo, several miles northwest of the site.

10.2.2 Operational History

SWMU 9 is located in the former Area Z explosives testing area of the Coyote Test Field. Prior to its use by SNL/NM, this area was the setting for early homesteads, agriculture, ranching, and recreational activities. In 1957, in an agreement with the Atomic Energy Commission, the Armed Forces Special Weapons Project was granted the use of Areas X, Y, and Z (Figure 10.2.2-1). Area Z was designated as a test area for up to 250-pound high explosives (HE) tests. (SNL/NM September 1966).

The earliest air photos of the area in 1951 show the first evidence of manmade features at SWMU 9 (USGS 1951). In a 1967 photo (USGS 1967), activity has commenced at adjacent SWMU 61A and an access road between the two sites is present. A 1971 air photo (USGS 1971) shows a mound similar to the undisturbed Mound 1. No further activities are evident in subsequent 1975 and 1991 air photos (USGS 1975, 1991) indicating the sites were apparently abandoned between 1971 and 1975.

For a detailed discussion regarding the local setting at SWMU 9, refer to the "RCRA [Resource Conservation and Recovery Act] Facility Investigation [RFI] Work Plan for OU 1334, Central Coyote Test Area" (SNL/NM October 1994).

No documents or references related to operational activities at SWMU 9 were discovered during the initial phases of the site investigation. The debris, particularly that exposed in Mound 1, was

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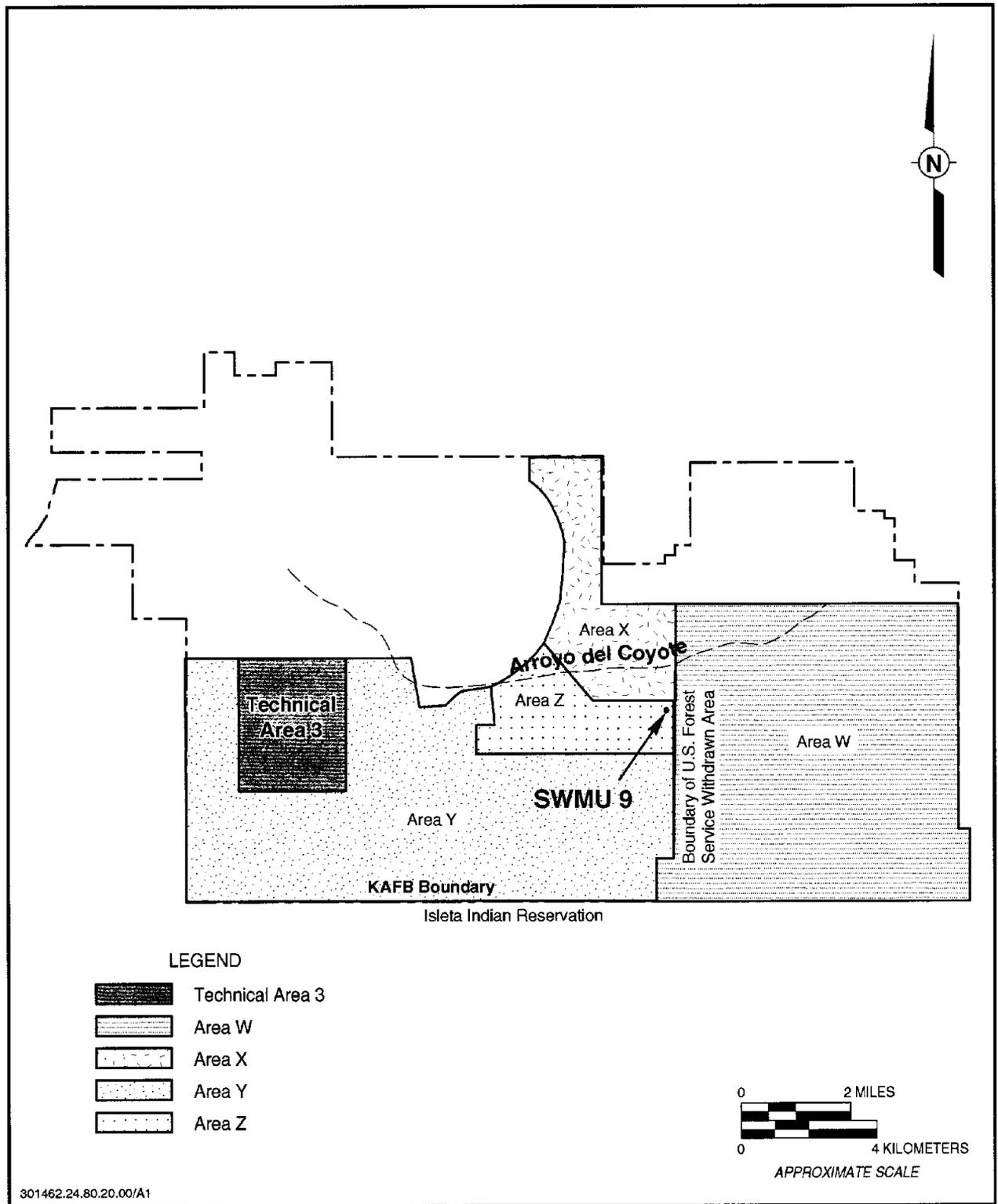


Figure 10.2-1
 Location of Former Coyote Test Field Areas and SWMU 9



thought to have come from testing activities at adjacent SWMU 61A, although that speculation could not be confirmed in interviews with SNL/NM and KAFB workers, as detailed in Section 10.4.3.1.1. In 1999, a retired worker confirmed that SWMU 9 was used as an unregulated open dump for test debris and trash generated in the local area (Pavletich March 1999).

10.3 Land Use

10.3.1 Current

SWMU 9 is located on land owned by the USAF and permitted to the DOE and SNL/NM. The current land use is industrial (Figure 10.3.1-1).

10.3.2 Future/Proposed

For future use planning, SWMU 9 has been recommended for industrial land use purposes (DOE and USAF March 1996).

10.4 Investigatory Activities

10.4.1 Summary

SWMU 9 was identified during investigations conducted under the DOE Comprehensive Environmental Assessment and Response Program (CEARP) and RCRA Facility Assessment (RFA) in the mid-1980s in conformance with the Comprehensive Environmental Response, Compensation, and Liability Act (Investigation #1). In 1992, preliminary investigations included background information reviews, personnel interviews, field surveys, and scoping sampling (Investigation #2). In 1996, preliminary RFI soil sampling included trenching and sampling the mounds (Investigation #3). A radiological VCM to excavate Mounds 1 and 2 was also started in 1996, and, after completion in 1999, was followed by confirmatory soil sampling (Investigation #4).

10.4.2 Investigation #1—CEARP

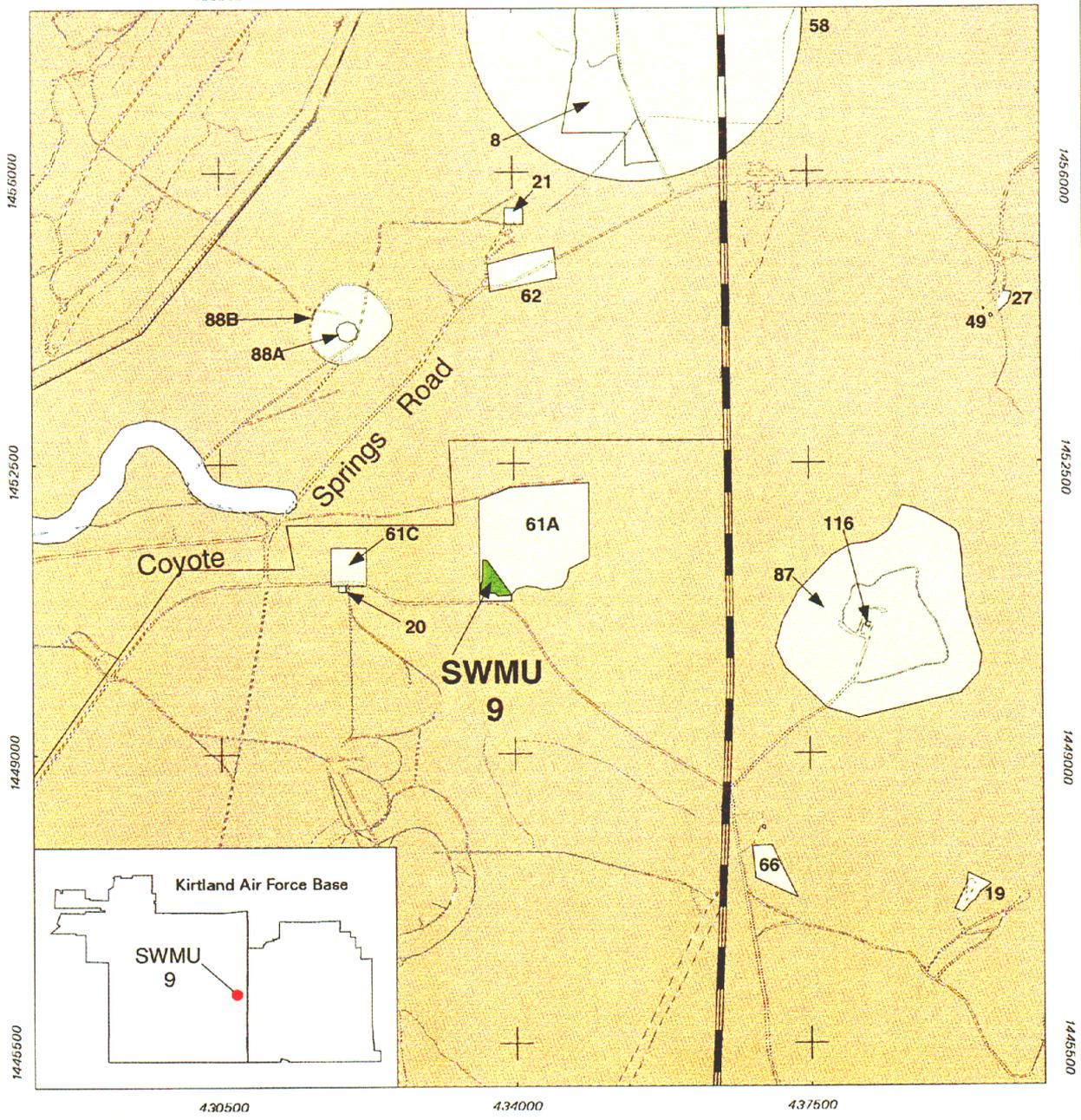
10.4.2.1 *CEARP Sampling Data Collection*

No sampling activities were performed at SWMU 9 as part of the CEARP.

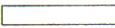
10.4.2.2 *CEARP Data Gaps*

A lack of information prevented calculating the Hazard Ranking System (HRS) and Modified HRS migration mode scores.

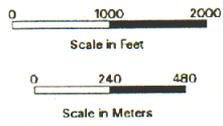
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Legend

-  KAFB Boundary
-  Road
-  SWMU 9
-  Other SWMUs
-  Recreational Land Use
-  Industrial Land Use

**Figure 10.3.1-1
SWMU 9: Burial Site/Open Dump
and Associated Land Uses
within KAFB Boundary and Vicinity**



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

10.4.2.3 *CEARP Results and Conclusions*

The CEARP finding was uncertain for Federal Facility Site Discovery and identification findings, preliminary assessment, and preliminary site inspection (DOE September 1987).

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

10.4.3.1 *Nonsampling Data Collection*

10.4.3.1.1 *Background Review*

A background review was conducted to collect available and relevant information regarding SWMU 9. Background information sources included interviews with current and former SNL/NM staff and contractors familiar with area operations, site operational history, and existing historical site records and reports. No specific information on-site activities at SWMU 9 or adjacent SWMU 61A was discovered until a retired worker confirmed that SWMU 9 was used as an open dump for test debris and trash generated in the local area (Pavletich March 1999). The study was completely documented and has provided traceable references that sustain the integrity of the NFA proposal. Table 10.4.3-1 lists the information sources that were used to assist in this background review.

10.4.3.1.2 *Unexploded Ordnance/High Explosives Survey*

In November 1993, KAFB EOD personnel conducted a visual survey for unexploded ordnance (UXO)/HE at Schoolhouse Mesa Test Sites that included SWMUs 20, 61C, 61A, and 9. UXO/HE materials identified and removed included one live ground burst simulator and one pound of HE fragments at SWMU 61A. Ordnance debris that was collected and removed from these four sites included six smoke grenades, two flare-illuminating cartridges, and three 40-millimeter white star parachute cartridges. These materials were associated with recent Department of Defense (DoD) war game exercises conducted throughout the Schoolhouse Mesa area. No live UXO/HE was found on the surface of the three mounds at SWMU 9.

10.4.3.1.3 *Radiological Surveys*

On January 6, 1993, SNL/NM Radiation Protection Office personnel conducted a beta/gamma radiation survey at the site with a Geiger-Muller detector and pancake probe. No activity above background was detected at the debris mounds or at a shallow surface depression located approximately 70 feet east-northeast of Mound 1 inside SWMU 61A.

A Phase I surface gamma radiation survey was conducted in conjunction with SWMUs 7, 61C, and 20 during February and April 1994. These surveys covered a total of 39.5 acres. For ease of reference and because SWMU 61A surrounds SWMU 9, all relevant radiological data were designated as SWMU 61A. A gamma scan survey was performed at 10-foot centers (70-percent coverage) over the surface of SWMU 61A and at 6-foot centers (100-percent coverage) over the surface of SWMU 9. Because no anomalies were detected within the

Table 10.4.3-1
Summary of Background Information Reviewed for SWMU 9

Information source	Reference
Technical test reports and project log books	None
Engineering drawings/maps	Basic Information, Reservation Boundary and Ownership (test Areas), October 7, 1954
Site Inspections (field notes, aerial photograph review, site photographs, radiological, UXO/HE, biological, and cultural resource surveys)	Fritz and Perkins March 1985 Martz May 1985 Bayliss July 1992 Byrd et al. July 1992 Gaither July 1992 Lojek November 1992 Lojek January 1993a Lojek January 1993b Lojek January 1993c Lojek February 1993 Sandhaus February 1994a Lojek March 1994 Young September 1994
Employee interviews, 22 interviews with 12 facility personnel (current and retired)	Gaither and Byrd June 1992 Bayliss July 1992 Byrd et al. July 1992 Gaither July 1992 Lojek December 1992 Lojek January 1993d Lojek January 1993e Lojek January 1993f Lojek January 1993g Cooper and Sandhaus December 1993 Cooper and Sandhaus February 1994 Sandhaus February 1994b Sandhaus February 1994c Lojek and Sandhaus March 1994 Peters and Sandhaus March 1994 Sandhaus March 1994 Sandhaus April 1994 Pavletich March 1999

HE = High explosives(s).
UXO = Unexploded ordnance.

eastern portion of the survey grid, the far eastern portion of SWMU 61A was not surveyed. During the survey, 63 point sources and 11 area sources of gamma activity at 30 percent or more above the natural background activity of 12 microrentgens (μR) per hour (hr) were identified at SWMUs 61A and 9. Three of the point sources were fragments of oxidized depleted uranium (schoepite [DU]) (RUST Geotech Inc. December 1994). One point-source anomaly was detected at 18 $\mu\text{R/hr}$ in the southeast corner of Mound 1. Figure 10.4.3-1 shows the survey boundaries and anomalies found during the Phase I survey. At that time, it was believed that the radioactive material was deposited by testing activities at SWMU 61A and that no radioactive material had been disposed of in the debris mounds. A detailed summary of the survey and anomalies found at these SWMUs is presented in Section 5.7.1 of the Surface Gamma Radiation Surveys Final Report (RUST Geotech Inc. December 1994).

VCM activities were conducted at SWMUs 61A and 9 during March 1995 and February, March, May, July, and October 1996. Point sources identified during the Phase I survey were removed in March 1995. In February 1996, SWMU 61A was resurveyed on 6-foot centers (100-percent coverage), and additional point and area sources that were discovered were remediated as the schedule permitted in February, March, May, and July 1996.

10.4.3.1.4 Cultural Resources Survey

A cultural resources survey was conducted as part of the SNL/NM sitewide environmental assessment. No cultural resources were identified at SWMU 9 (Hoagland and Dello-Russo February 1995).

10.4.3.1.5 Sensitive Species Survey

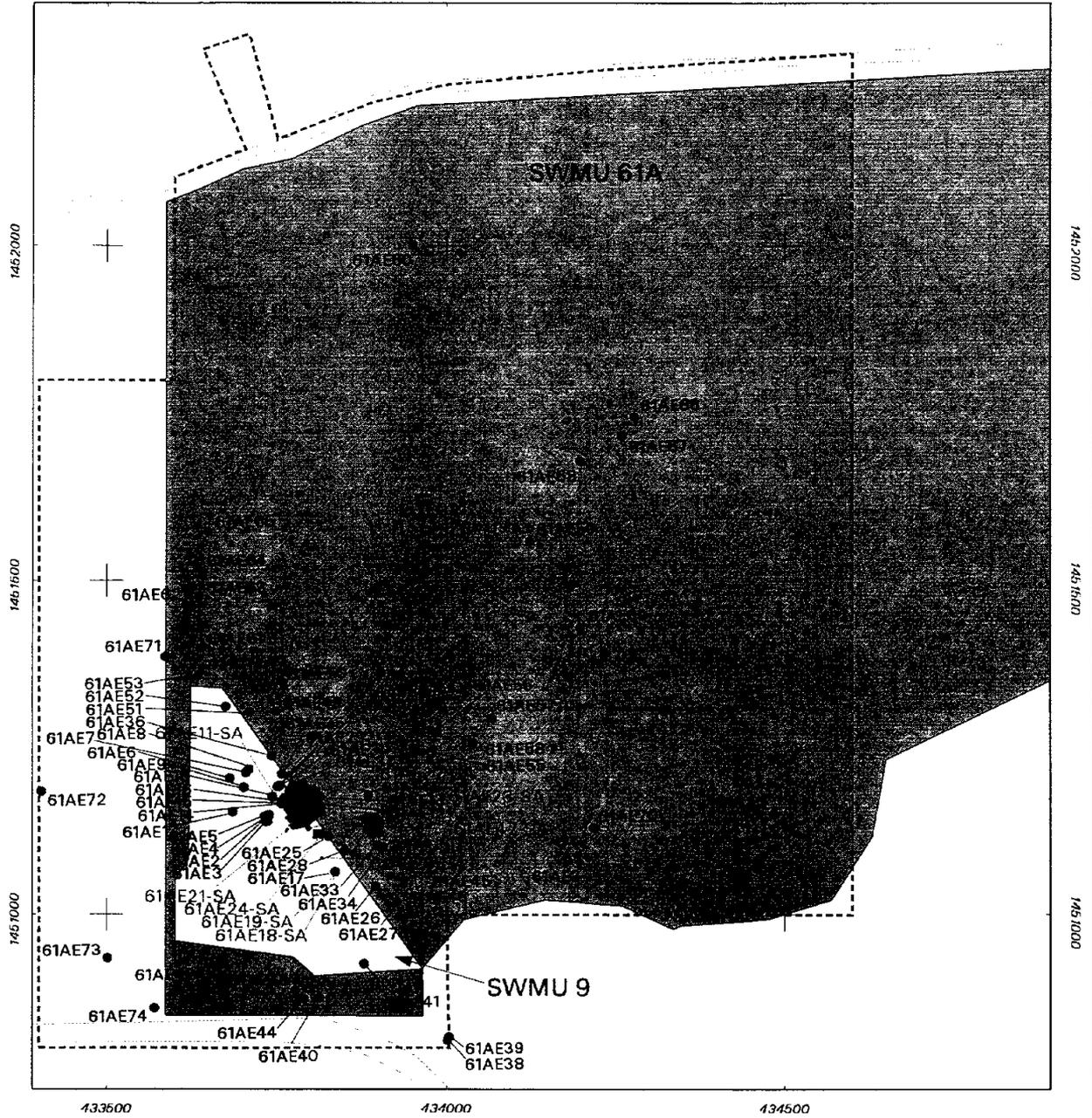
A sensitive species survey performed at SWMU 9 in 1994 did not indicate that any sensitive species were present on the site (IT February 1995).

10.4.3.2 Scoping Soil Sampling Data Collection

In June 1995, SWMU 9 was investigated as part of a sitewide scoping sampling program, which was established to obtain preliminary analytical data to support the ER Project site ranking and prioritization. A single soil sample was collected from the 0- to 0.5-foot depth interval from each of the three mounds. Another soil sample was collected south of Demolition Range Road for background metals and radionuclide comparison. The four samples were analyzed at the SNL/NM Environmental Restoration Chemistry Laboratory (ERCL) for RCRA metals plus beryllium, HE (by high pressure liquid chromatography [HPLC]), and total petroleum hydrocarbons (by immunoassay). The samples were also analyzed by gamma spectroscopy at the SNL/NM Radiation Protection Sample Diagnostics (RPSD) Laboratory. No quality assurance (QA)/quality control (QC) samples were collected.

This data is not included with this NFA proposal or used in any risk screening assessment. The high detection limits for metals and radionuclide analyses prevent a comparison with NMED-approved background values. No petroleum hydrocarbons were detected with the immunoassay analyses, and no HE compounds were detected by HPLC. No statement could

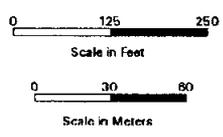
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Legend

- 61AE74 Point Source Gamma Radiation Anomaly (Elevated relative to site specific background)
- Road
- Rad Survey Boundary
- SWMU 61A - Schoolhouse Mesa Test Site: Blast Site
- SWMU 9 - Burial Site Open Dump
- 61AE18-SA Area Source Gamma Radiation Anomaly (Elevated relative to site specific background)

Figure 10.4.3-1
Phase I Survey Radiation Anomalies at
SWMU 61A: Schoolhouse Mesa
Test Site: Blast Site and
SWMU 9: Burial Site / Open Dump



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be made about possible radiological contamination because of the high minimum detectable activities (MDAs) for the gamma spectroscopy analyses.

10.4.3.3 Preliminary Investigations Data Gaps

Information gathered from site visits, radiological surveys, and personnel interviews aided in identifying the most likely COCs at SWMU 9 and selecting the types of analyses to be performed on soil samples. However, the scoping sample data was not adequate to support a risk screening assessment. The data was insufficient to determine if radiological materials were present in the mounds.

10.4.3.4 Preliminary Investigations Results and Conclusions

The analytical data from the scoping sampling was inadequate to define possible soil contamination at SWMU 9.

10.4.4 Investigation #3—SNL/NM ER Project 1996 RFI Sampling

10.4.4.1 1996 RFI Nonsampling Data Collection

No new site information was discovered prior to this phase of the investigation.

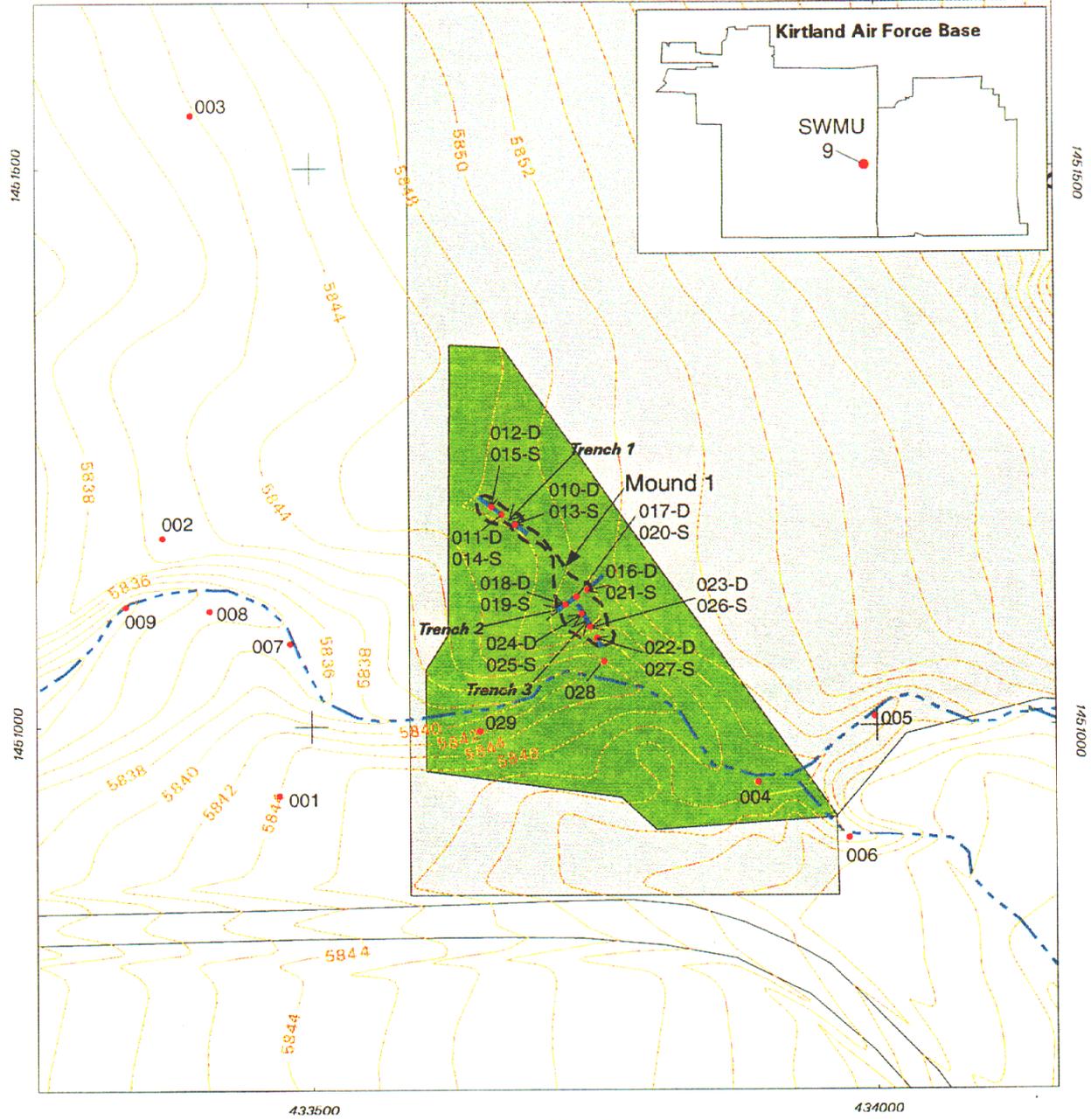
10.4.4.2 1996 RFI Sampling Data Collection

In June 1996, SWMU 9 was sampled according to the strategy, methodology, and procedures outlined in the OU 1334 RFI Work Plan (SNL/NM October 1994), as reviewed by the New Mexico Environment Department (NMED) and the U.S. Environmental Protection Agency (EPA). However, pursuant to draft EPA comments on the Work Plan (EPA November 1995), the sampling depth for subsurface samples was redefined as 0.5 to 1.0 feet bgs instead of the proposed 1.5 to 2.0 feet bgs.

The samples were identified by the following scheme: CCTA-09-GR-001-0-0.5-S, where CCTA-09-GR specifies that this is a grab sample (GR) taken from the Central Coyote Test Area at SWMU 9. "001" indicates the sample location at SWMU 9, as shown on Figures 10.4.4-1 and 10.4.4.-2. "0-0.5" is the sample interval (feet bgs). The final character (S, D, DU, EB, TB) identifies the type of sample (soil, debris, duplicate, equipment blank, or trip blank, respectively).

Site-specific background soil and arroyo channel sediment samples were collected to establish site-specific background concentrations and activities for metals and radionuclides. Background soil samples were collected from three locations in the western portion of the site (locations 001-003 on Figure 10.4.4-1) and background arroyo sediment samples were collected from three locations upstream of the Mound 1 area (locations 004-006 on Figure 10.4.4-1). Samples were collected from the surface (0 to 0.5 feet bgs) and subsurface (0.5 to 1.0 feet bgs) at these locations and were analyzed for gamma spectroscopy, RCRA metals plus beryllium, isotopic uranium, and isotopic thorium.

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Legend

- 001 Sampling Location & Identification
- SWMU 9
- SWMU 61A
- Trench
- - - Mound Outline
- - - Surface Drainage
- Road
- 2 Ft Contour

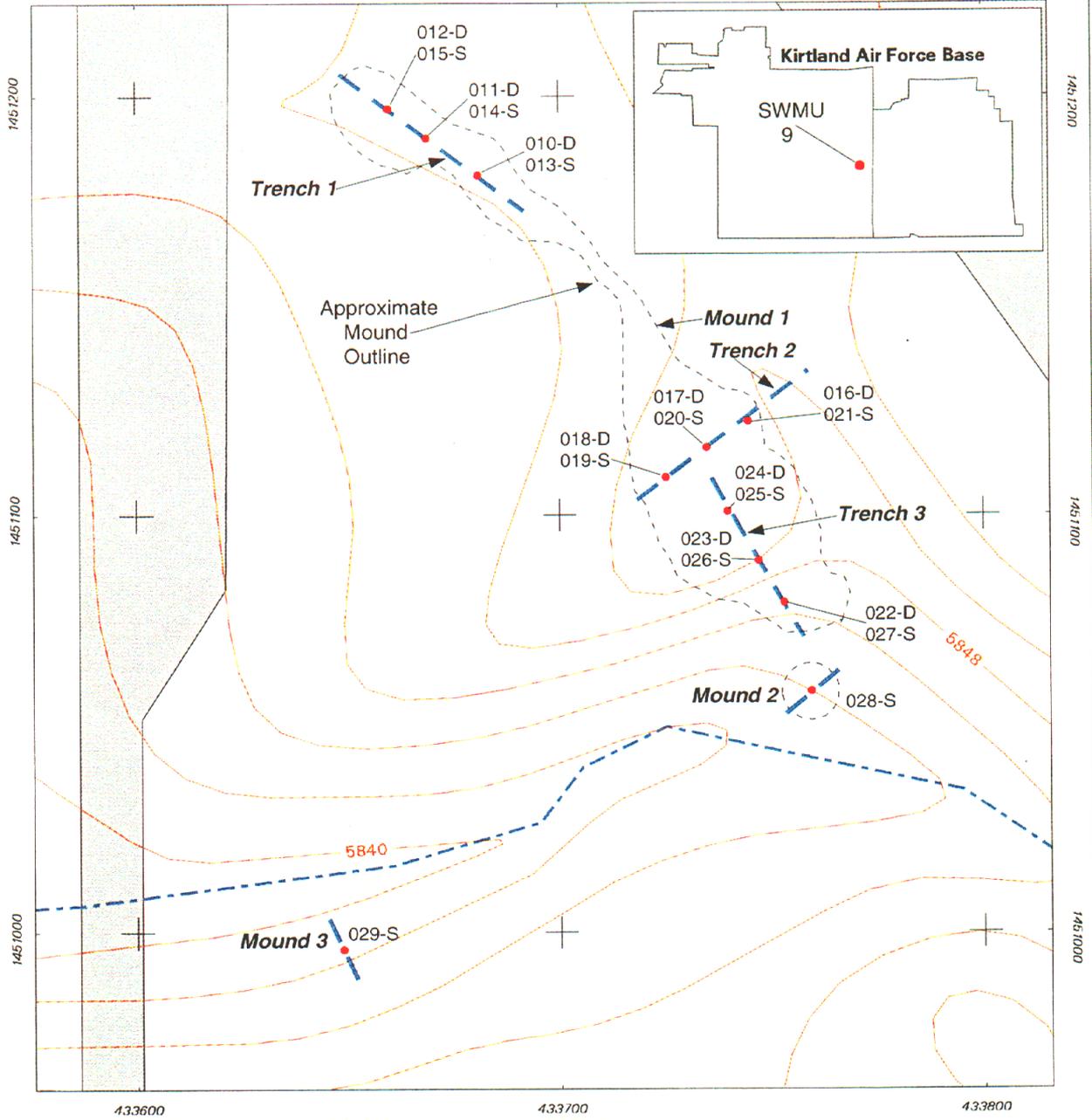
Figure 10.4.4-1
1996 & 1999 RFI Soil Sampling
Locations at SWMU 9,
Burial Site / Open Dump

0 75 150
Scale in Feet

0 18 36
Scale in Meters



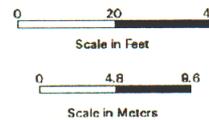
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Legend

- 028-S Sampling Location & Identification (-D=Debris, -S=Soil)
- Trench
- - - Mound
- 2 Ft Contour (Previous Topology)
- - - Surface Drainage
- SWMU 61A

Figure 10.4.4-2
1996 RFI Soil Sampling Locations
Mounds 1, 2, & 3 at SWMU 9,
Burial Site / Open Dump



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To check for possible contaminant migration downstream, arroyo channel sediment samples were collected downstream of Mound 3 (locations 007-009 on Figure 10.4.4-1) and analyzed for gamma spectroscopy, RCRA metals plus beryllium, HE, and semivolatile organic compounds (SVOCs).

Trenches were excavated across the three mounds to determine the extent and possible types of buried debris and to collect samples for characterization. One sample was collected from the trench excavated across Mound 2, and another sample was collected from the trench excavated across Mound 3 (locations 028 and 029, respectively, on Figure 10.4.4-2). Samples were analyzed for gamma spectroscopy, RCRA metals plus beryllium, HE, and SVOCs.

Three trenches were excavated across Mound 1, and samples were collected at three locations along each trench (Figure 10.4.4-2). At each of the nine locations, two samples were collected. The first sample was collected at the approximate center of the mound. The second sample was collected below the point of contact of the mound with native material at each location. All of these samples were analyzed for gamma spectroscopy, RCRA metals plus beryllium, HE, and SVOCs. The center of the mound samples were also analyzed for toxicity characteristic leaching procedure (TCLP) SVOCs and TCLP metals.

RCRA metals plus beryllium, HE, volatile organic compounds (VOCs), and gamma spectroscopy samples were analyzed at SNL/NM ERCL and RPSD on-site laboratories. Isotopic uranium, isotopic thorium, SVOCs, TCLP metals, TCLP SVOCs, and duplicates of some metals and HE samples were analyzed by Lockheed Analytical Services, Las Vegas, Nevada. Off-site samples were analyzed for RCRA metals plus beryllium and TCLP metals by EPA Method 6010/7000, for HE compounds using EPA Method 8330, for SVOCs and TCLP SVOCs using EPA Method 8270, for isotopic uranium and thorium by HASL-300, and for gamma spectroscopy by EPA Method 901.1.

10.4.4.3 1996 RFI Sampling Results and Conclusions

The analytical data indicated that Mound 1 contained radioactive materials (DU), VOCs, and HE residues. The isotopic analyses of the site-specific and arroyo sediment background samples (Table A-10, Annex A) indicated that slightly elevated thorium-232 activities might be naturally occurring at the SWMU.

The three trenches across Mound 1 (Figure 10.4.4-2) showed that only the southern end contained buried wastes, while the northern end was composed only of burlap bags filled with crushed granite. A shallow depression along the northwest side of Mound 1 indicated that it might have been used as protective berm during testing at SWMU 61A. The burned and buried debris exposed in Trenches 2 and 3 at the south end of Mound 1 consisted of shrapnel-riddled galvanized steel and metal-plate test stands, steel I-beams, wire and cable, metal tubing, plastic sheeting, concrete pieces, cans and bottles, burned wood and paper, and glazed tile fragments. The trench excavated across Mound 2 revealed that it was simply a pile of debris dumped in the arroyo and was not an extension of Mound 1 (location 028, Figure 10.4.4-2). The trench into Mound 3 showed that this feature was a natural terrace deposit with debris scattered on the surface rather than a burial mound (location 029, Figure 10.4.4-2). A VCM was planned to excavate, characterize, and dispose of the materials in the south end of Mound 1 and to characterize and dispose of the materials from Mounds 2 and 3.

Because of analytical problems such as method detection limits (MDLs) or MDAs above the NMED-approved background values, the on-site laboratory analytical data quality was considered unsuitable for site characterization or for use in risk assessments. To avoid confusion, the 1996 on-site laboratory data is not presented in this NFA proposal.

The limited amount of off-site laboratory analytical data was insufficient for complete site characterization. Only the seven HE soil samples from the north end of Mound 1 were included in the risk assessment evaluations since this portion of the mound will remain on site. The southern end of the mound was excavated and characterized separately for later disposal determination. On-site gamma spectroscopy results, off-site analytical data, and method detection limits are presented in Tables A-1 through A-10 in Annex A.

Following the VCM to excavate Mound 1 and to remove the debris from Mounds 2 and 3, the site was resampled, as described in Section 10.4.5.3.

10.4.4.4 1996 RFI Data Gaps

The available data was insufficient to adequately characterize the site or to perform risk assessments. However, the data indicated that the south end of Mound 1 contained radioactive material, mainly DU. The materials exposed during the Mound 1 trenching also indicated that the scope of work would be much larger than anticipated in the OU 1334 Work Plan. A VCM to excavate and manage potential mixed wastes was performed, as described in Section 10.4.5.

10.4.4.5 Data Quality

The SNL/NM ERCL Laboratory data was unsuitable for site characterization and for use in risk assessments, and there was insufficient off-site analytical data for complete site characterization and risk assessment purposes. However, a number of QA/QC samples were collected, and the results are included in the respective analytical results tables in Annex A. The equipment blanks associated with seven HE soil samples analyzed at the off-site laboratory are included in the risk assessment data set and did not contain any HE compounds.

10.4.4.6 Data Validation

All off-site laboratory results were reviewed and verified/validated according to "Data Verification/Validation Level 3—DV-3" in Attachment C of the Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994). In addition, SNL/NM Department 7713 (RPSD Laboratory) reviewed all gamma spectroscopy results according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 2 (SNL/NM July 1996). Annex A contains the off-site data validation reports for the HE data (the only data from the 1996 sampling included in the risk assessments).

10.4.5 Investigation #4-SNL/NM ER Project Voluntary Corrective Measure and 1999 RFI Confirmatory Sampling

The following sections discuss the radiological VCM, waste management activities, and 1999 RFI confirmatory sampling activities at SWMU 9.

10.4.5.1 *VCM and 1999 RFI Nonsampling Data Collection*

In a March 1999 interview, a former DoD employee confirmed that SWMU 9 was used as a general dump by area workers (Pavletich March 1999). This employee did not have any knowledge of radioactive material disposal in the mound or at the SWMU.

10.4.5.2 *VCM Activities*

Soil samples collected from the exploratory trenches across the southern end of Mound 1 during the June 1996 RFI sampling indicated radioactive (DU) contamination. A subsequent gamma radiation survey of Mound 1 in October 1996 also indicated contamination in the soil and on some of the excavated materials. Also in October of 1996, SNL/NM began to excavate Mound 1 as a VCM and to segregate radioactive materials for proper disposal.

A backhoe was used to excavate Mound 1 because it was evident that the lateral and vertical extent of contaminated materials would exceed the capabilities of manual excavation and clean-up procedures. Excavated materials (soil and small debris pieces) were spread out in a 6-inch thick layer and surveyed for elevated radiation readings (alpha and beta-gamma). Any materials with radiation readings above 1.3 times background were segregated for additional characterization and disposal. Radioactive soil and small contaminated debris pieces were placed into lined 55-gallon drums. Clean (i.e., non-radioactive) soil and small debris pieces were stockpiled on site in soil piles. Larger debris pieces were surveyed individually and segregated. The drums and soil piles were later sampled for waste characterization, as described below. Contamination on the larger debris pieces usually could be removed by scraping or wiping. The contaminated materials (soil, rust, DU) removed in this fashion were isolated and placed into the lined 55-gallon drums. Additional details of clean-up procedures are presented in the Final Report, Survey and Removal of Radioactive Surface Contamination at Environmental Restoration Sites, Sandia National Laboratories/New Mexico (SNL/NM September 1997).

The VCM was stopped after 10 days when UXO (a rocket warhead and a 5-inch diameter artillery shell) was encountered in the excavation. The open excavation was covered with soil and additional safety precautions and procedures were scheduled for implementation. However, due to budgetary restrictions, the VCM could not be resumed until June 1998. The Mound 1 excavation and surveying continued for one week in June and the first two weeks of August 1998, when it was finally completed.

A small burial pit containing DU-contaminated soil and debris was also discovered about 10 feet east of Mound 1. The pit was excavated during the June 1998 portion of the VCM.

The debris scattered in the arroyo (Mound 2) and on the arroyo terrace (Mound 3) was picked-up and surveyed for radiation in August 1998. Mound 2 debris consisted of a tangled mass of

barbed wire, empty paint cans, ceramic electrical insulators, mortar shell storage cases, a military bomb rack, vehicle parts, a shrapnel-riddled iron plate, pieces of wood and metal, and building rubble (cinder blocks and glazed masonry tiles). Mound 3 debris consisted of wooden crate remnants, empty paint cans, expended smoke grenades, an empty 55-gallon drum containing a grate that appears to have been used as a grill, and other miscellaneous solid waste. No radioactive contamination was found on the materials from Mounds 2 or 3.

Debris excavated from Mound 1 included shrapnel-riddled and blasted galvanized sheet metal forms and sheets, steel plates, iron beams, shipping containers, empty 55-gallon drums, weapon transport racks, construction rubble (cinder blocks, concrete blocks, glazed tiles, plumbing pipes, a small amount of Transite™ tiles), plastic wrappers for C-4 high explosive charges, burned wood and paper, wiring, unexploded ordnance (3- and 5-inch diameter artillery shells), spent fuze lines, paper, broken glass, and various beverage containers. Scattered pockets of radioactive materials (schoepite [DU] and DU-contaminated debris) were found in Mound 1. The wide variety of materials found agrees with the former employee's report that the site was used as a general dump for area activities (Pavletich March 1999).

When the VCM was completed in August 1998, approximately 520 cubic yards of soil had been excavated and screened from the southern portion of Mound 1. As mentioned earlier (Section 10.4.4.3), only the southern end of Mound 1 contained buried wastes. The northern end of the mound, consisting of burlap bags filled with crushed granite, was not excavated during the VCM.

The excavated soil is currently stored on site in 13 soil piles (each approximately 40 cubic yards) near the north end of Mound 1. With regulatory approval, the soil piles will be processed to remove as much debris as possible and then will be buried in the northern portion of the site. The scrap metal from Mounds 1, 2, and 3 is staged near the soil piles awaiting a waste disposal determination.

10.4.5.2.1 VCM Waste Management Activities

When the VCM was completed in August 1998, a total of 18 55-gallon drums of contaminated waste (soil and small debris pieces) and approximately 50 cubic yards of scrap metal had been excavated from Mound 1 and picked up from Mounds 2 and 3, and 520 cubic yards of soil had been excavated and surveyed from Mound 1 and the burial pit.

The 18 drums of contaminated soil and debris was sampled in September 1998 and were determined to be mixed waste. These waste drums were shipped to Envirocare of Utah for disposal by SNL/NM Waste Management.

Following the VCM stoppage in October 1996, approximately 30 cubic yards of scrap metal were disposed of as nonregulated waste by SNL/NM Waste Management. The remaining 20 cubic yards of scrap metal pieces (steel beams and sheets, empty drums, and weapon transport racks) are currently stored on site pending release and off-site disposal approval by SNL/NM Waste Management.

The 520 cubic yards of excavated soil and small debris pieces were stored in 13 soil piles on site and were sampled for waste characterization. When it became possible to consider the soil for redeposition on site, the piles were resampled for use in the SWMU 9 risk assessment

evaluation. These sampling results and ultimate disposition of the soil piles are discussed below in Section 10.4.5.2.2.

10.4.5.2.2 VCM Soil Pile Sampling

The 520 cubic yards of soil and small debris pieces in the 13 soil piles were extensively sampled for waste characterization in September, October, and November 1998. In February 1999, SNL/NM Waste Management determined that the soil and debris did not contain any RCRA-regulated waste. The piles were resampled in March and October 1999 and May 2000 to determine if COC concentrations would exceed acceptable risk assessment values and prohibit on-site redeposition.

Soil pile samples are identified by the following scheme: CCTA-09-VCM-Pile1-N, where VCM-Pile1 specifies that this was a VCM soil sample taken from Pile 1. The final character (N, S) identifies the sample location as being from the north or south side of the pile.

Twenty-six soil samples were collected from the 13 soil piles (one from the north and one from the south side of each pile). The samples were analyzed for: Target Analyte List (TAL) metals plus uranium, TCLP metals plus copper, zinc and mercury, VOCs, and TCLP VOCs, SVOCs, and TCLP SVOCs, HE, isotopic uranium, isotopic thorium, gamma spectroscopy, and tritium. The analytical results are in Tables B-1 through B-13 in Annex B and are summarized below. The results for all 26 soil samples were included in the risk assessment. The QA/QC is discussed in Section 10.4.5.4.1.

Soil pile sample analyses were performed off site at Core Laboratories Denver, Colorado, and the Casper, Wyoming, facilities. Samples were analyzed for TCLP and TAL metals plus total uranium by EPA Method 6010/7000, for HE compounds using EPA Method 8330, for SVOCs and TCLP SVOCs using EPA Method 8270, for VOCs and TCLP VOCs using EPA Method 8260A, for tritium by EPA Method 906.0, for isotopic uranium and thorium by HASL-300, and for gamma spectroscopy by EPA 901.1. Tritium, gamma spectroscopy, isotopic uranium, and isotopic thorium analyses were performed at the Casper, Wyoming, facility. Gamma spectroscopy analyses were also performed on site at the SNL/NM RPSD Laboratory.

Because of low soil moisture content, only 6 of the 26 soil pile samples could actually be analyzed for tritium. The low moisture content of these six samples also produced biased-high results, and two of the piles were resampled for confirmation. The second set of analyses were performed in October 1999 by General Engineering Laboratories of Charleston, South Carolina.

TAL Metals Plus Uranium and TCLP Metals Plus Mercury, Copper, and Zinc

Table B-1 (Annex B) presents the analytical results for the TAL metals and total uranium analyses. The NMED-approved background concentrations were exceeded for barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, uranium, vanadium, and zinc in several samples. These samples were also analyzed for TCLP metals, and the results are presented in Table B-2 (Annex B).

Barium concentrations ranged from 65.2 to 158 J milligrams (mg) per kilogram (kg) and exceeded the NMED-approved background concentration of 130 mg/kg in four samples.

Cadmium concentrations ranged from 0.458 to 2.78 mg/kg and exceeded the NMED-approved background concentration of 0.9 mg/kg in nine samples. Chromium concentrations ranged from 8.36 to 28.4 mg/kg and exceeded the NMED-approved background concentration limit of 17.3 mg/kg in three samples. Cobalt concentrations ranged from 3.76 to 8.61 mg/kg and exceeded the NMED-approved background concentration limit of 5.2 mg/kg in nine samples. Copper concentrations ranged from 10.1 to 194 mg/kg and exceeded the NMED-approved background concentration limit of 15.4 mg/kg in 16 samples. Lead concentrations ranged from 12.4 to 107 mg/kg and exceeded the NMED-approved background concentration limit of 21.4 mg/kg in thirteen samples. Mercury concentrations ranged from nondetect (ND) to 2.09 mg/kg. Only the Pile 7-N sample exceeded the NMED-approved background concentration of <0.1 mg/kg. Nickel concentrations ranged from 8.12 to 14.9 mg/kg and exceeded the NMED-approved background concentration limit of 11.5 mg/kg in five samples. Selenium concentrations ranged from 0.530 to 1.08 mg/kg; only the Pile 9-N sample exceeded the NMED-approved background concentration of <1 mg/kg. Uranium concentrations ranged from ND to 12.6 mg/kg; 20 of the 26 samples exceeded the NMED-approved background concentration of 3.42 mg/kg. Both samples from Pile 10 were below the background concentration. Vanadium concentrations ranged from 13.4 to 24.6 mg/kg and exceeded the NMED-approved background concentration of 20.4 mg/kg in seven samples. Zinc concentrations ranged from 38.3 to 354 J mg/kg; 22 of the 26 samples exceeded the NMED-approved background concentration of 62 mg/kg. Samples from Piles 8 and 13 were all below the background concentration.

TCLP analysis showed all metals analyzed for were below the maximum contaminant concentrations for the toxicity characteristic analysis (Table B-2, Annex B).

VOCs and TCLP VOCs

Methylene chloride, the only VOC detected, was found at concentrations of 2.4 J to 3.6 J $\mu\text{g}/\text{kg}$ in 3 of the 26 samples (Table B-3, Annex B). The MDLs for the VOC analyses are in Table B-4 (Annex B). No compounds were detected in the TCLP VOC analysis of the soil pile samples. The MDLs used for the TCLP VOC analysis are provided in Table B-5 (Annex B).

SVOCs and TCLP SVOCs

Anthracene, the only SVOC compound detected, was found in both samples from Pile 12 at concentrations of 140 J and 1,100 $\mu\text{g}/\text{kg}$ (Table B-6, Annex B). The MDLs for the SVOC analysis are in Table B-7 (Annex B). No compounds were detected in the TCLP SVOC analysis of the soil pile samples. The MDLs used for the TCLP SVOC analysis are provided in Table B-8 (Annex B).

HE

Due to analytical problems with the laboratory, the initial soil pile samples were rejected during data validation (Annex D). The piles were resampled in May 2000, and the 26 samples plus 3 duplicates were analyzed at General Engineering Laboratories in Charleston, South Carolina. The analytical results are presented in Table B-9 (Annex B) and are discussed below. The MDLs for the analysis are provided in Table B-10 (Annex B).

Six HE compounds were detected in the soil pile samples and duplicates. 1,3,5-Trinitrobenzene (ND [11.9] to 196 J $\mu\text{g}/\text{kg}$) was only detected in the sample and duplicate from the north side of Pile 12. 2,4,6-Trinitrotoluene (ND [14.1] to 4,800 $\mu\text{g}/\text{kg}$) was detected in 10 samples and 1 duplicate. 2-Amino-4,6-dinitrotoluene (ND [13.4] to 3,680 $\mu\text{g}/\text{kg}$) was detected in 11 samples and 2 duplicates. 4-Amino-2,6-dinitrotoluene (ND [10.1] to 2,290 $\mu\text{g}/\text{kg}$) was detected in 9 samples and 2 duplicates. 1,3,5,7-Tetranitro-1,3,5,7-tetrazacyclooctane (HMX) (ND [16.8] to 3,340 J $\mu\text{g}/\text{kg}$) and 1,3,5-trinitro-1,3,5-triazacyclohexane (RDX) (ND [12.5] to 23,200 $\mu\text{g}/\text{kg}$) were detected in every sample except those from the north side of Pile 1 and the sample and duplicate from the north side of Pile 8.

Radionuclides

Gamma spectroscopy analyses were performed on all 26 soil pile samples at an off-site laboratory, and 10 of the samples were also analyzed on site at SNL/NM RPSD Laboratory. The gamma spectroscopy results are presented in Table B-11 (Annex B). The NMED-approved background activity was exceeded in a number of the soil pile samples for uranium-235, uranium-238, and cesium-137, irrespective of the analytical laboratory.

Uranium-235 activities ($1\text{E}-01$ to $5\text{E}-01$ pCi/g) exceeded the NMED-approved background activity of $1.8\text{E}-01$ pCi/g in 19 of the 36 samples (from all piles except piles 8 and 11). Uranium-238 activities (ND [$8.25\text{E}-01$] to $2.42\text{E}+01$ pCi/g) exceeded the NMED-approved background activity of $1.4\text{E}+00$ pCi/g in 34 of the 36 samples (from all piles). Cesium-137 activities (ND [$1.61\text{E}-02$] to $8\text{E}-01$ pCi/g) exceeded the NMED-approved background activity of $7.9\text{E}-02$ pCi/g in 27 of the 36 samples (from all piles). Cobalt-60 (ND [$1\text{E}-01$ J] to $1.1\text{E}+00$ pCi/g) is an anthropogenic radionuclide that was also present in these samples. There is no background value for cobalt-60, so the maximum observed values were used for the risk assessment.

Isotopic Uranium and Isotopic Thorium

Table B-12 (Annex B) presents the analytical results of the isotopic uranium and isotopic thorium analyses. Uranium-234 activities ($8.70\text{E}-01$ to $2.51\text{E}+00$ pCi/g) were detected above the NMED-approved background activity of $1.6\text{E}+00$ pCi/g in nine of the 26 samples. Uranium-235 activities ($2\text{E}-02$ to $3.6\text{E}-01$ J pCi/g) were detected above the NMED-approved background activity of $1.8\text{E}-01$ in two samples (piles 2-N and 8-S). Uranium-238 activities ($1.85\text{E}+00$ to $5.84\text{E}+00$ pCi/g) were detected above the NMED-approved background activity of $1.4\text{E}+00$ pCi/g in all 26 samples. Thorium-232 ($5.70\text{E}-01$ J to $1.95\text{E}+00$ pCi/g) was detected above the NMED-approved background activity of $1.01\text{E}+00$ in 11 of the 26 samples.

Because of the higher analytical precision in the isotopic analysis for uranium-238, uranium-235, uranium-234, and thorium-232 in the soil pile samples, the isotopic results for these four isotopes were used in the risk assessment rather than the gamma spectroscopy results.

Tritium

Low soil moisture content caused biased-high results with large uncertainties for tritium in six of the 26 soil samples collected in September 1998 (analyzed at Core Laboratories, Casper,

Wyoming). Two of the piles (2 and 9) with the highest apparent tritium concentrations were resampled for confirmation in October 1999. The second set of analyses were performed by GEL of Charleston, South Carolina. Considering the low moisture content of all the samples and the uncertainty for each analysis, tritium is not present in the soil piles at activities above the SNL/NM background value of 420 pCi/L. The analytical results are presented in Table B-13 (Annex B).

10.4.5.2.3 VCM Summary and Conclusions

In February 1999, SNL/NM Waste Management determined that the soil piles did not contain any RCRA-regulated wastes and that the unexcavated north end of Mound 1 did not contain any RCRA hazardous waste.

Based on the results of Human Health Screening and RESRAD risk assessments, DOE removed the site radiological restrictions in July 1999. SNL/NM delisted the site as a Radioactive Materials Management Area in January 2000.

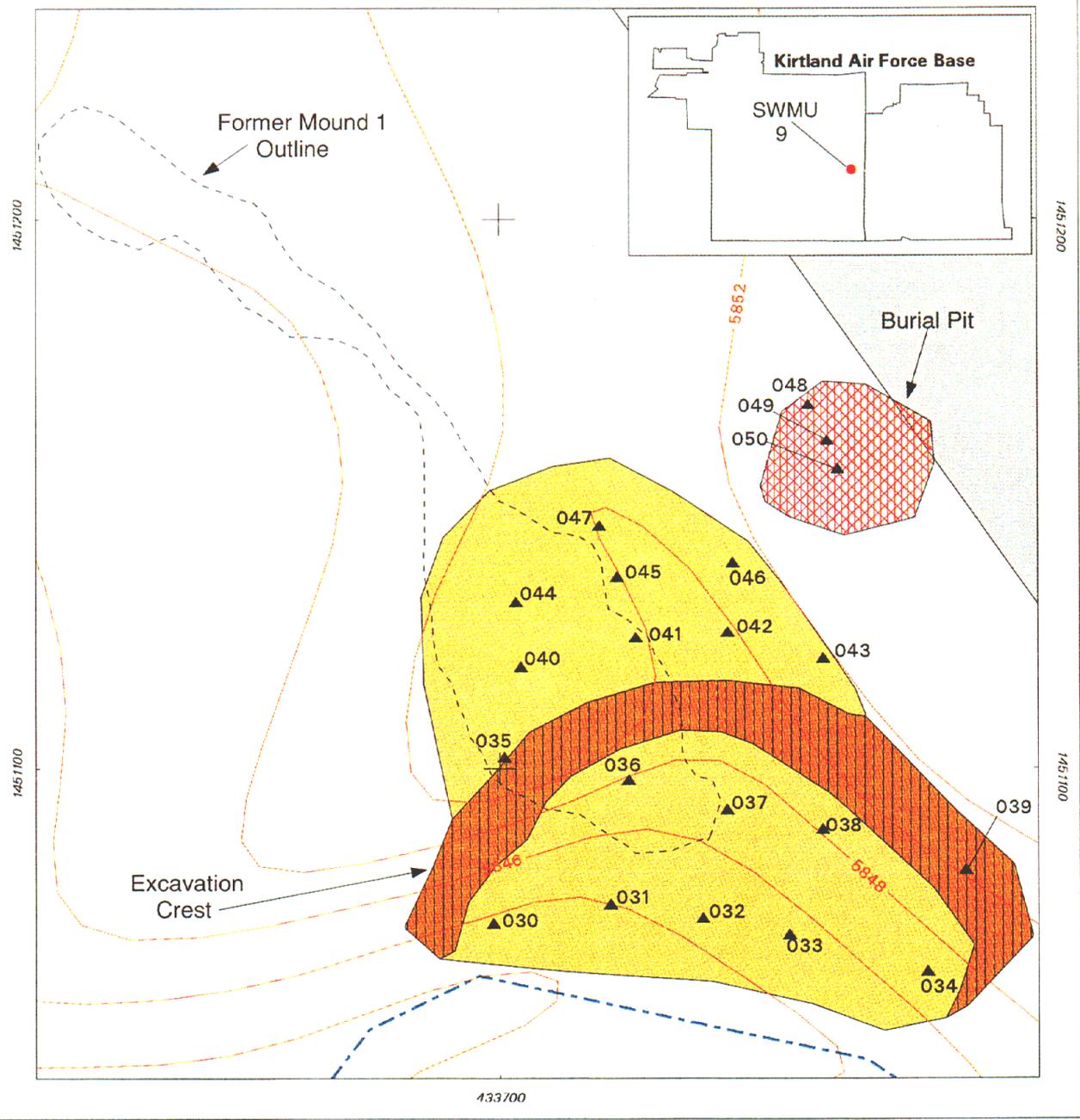
A risk assessment evaluation for the soil piles showed that the soil would also be acceptable for redeposition on site. Current plans are to sift the soil piles through a 2-inch opening screen (grizzly) to remove as much of the small debris pieces as possible and to deposit the soil on site in a shallow excavation with a 2- to 3-foot-thick native soil cover. The soil pile processing and redeposition is scheduled for September 2000. The unexcavated north end of Mound 1 will also be processed with the soil piles and will be redeposited on site.

Because the soil piles will be redeposited back onto the site, the data has been included in the overall SWMU Human Health Risk Assessment in Section 10.6.

10.4.5.3 1999 RFI Confirmatory Sampling

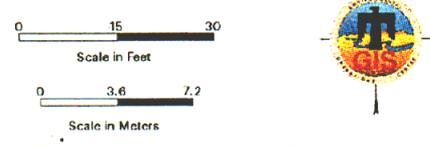
In July 1999, following the VCM, the excavated area under the south end of former Mound 1 was sampled. Because of the analytical problems with the 1996 RFI samples, as described in Sections 10.4.4.3 and 10.4.4.4, the SWMU was resampled following the general strategy, methodology and procedures outlined in the OU 1334 RFI Work Plan (SNL/NM October 1994), as reviewed by the NMED and the EPA. However, pursuant to draft EPA comments on the Work Plan (EPA November 1995), the sampling depth for near-surface samples was redefined as 0.5- to 1.0-foot bgs, instead of the proposed 1.5- to 2.0-foot bgs. The Mound 3 sample depth was kept at the originally specified 3- to 3.5-foot bgs. An NMED Request for Supplemental Information (RSI) (NMED August 1997) required gross alpha and gross beta analyses at all locations and additional samples under Mound 1 (Figure 10.4.5.3-1). A second NMED RSI (NMED March 1998) required gamma spectrum analyses for the arroyo channel sediment samples. The full analytical suite was also used when the shallow burial pit just east of Mound 1 was sampled.

The RFI confirmatory samples are identified by the following scheme: CCTA-09-GR-001-0-0.5-S, where CCTA-09-GR specifies that this is a grab sample taken from the Central Coyote Test Area at SWMU 9. "001" indicates the sample location at the SWMU, as shown on Figures 10.4.4-1 and 10.4.5.3-1. "0.0-0.5" is the sample interval (feet bgs). The final character



- Legend**
- ▲ Sample Location
 - - - Mound
 - 2 Ft Contour (Previous Topology)
 - - - Surface Drainage
 - SWMU 61A
 - ▨ Burial Pit
 - Excavation Floor
 - ▨ Excavation Crest

Figure 10.4.5.3-1
1999 Soil Sampling Locations &
VCM Excavation at SWMU 9,
Burial Site / Open Dump



Sandia National Laboratories, New Mexico
 Environmental Geographic Information System

(S, DU, EB, TB) identifies the type of sample (soil, duplicate, equipment blank, or trip blank, respectively).

RFI confirmatory samples were collected from 50 locations covering five areas at SWMU 9. These five areas or locations sampled were Site-Specific and Arroyo Channel Sediment Background, Arroyo Channel Sediment, Mound 3, VCM Excavation at Mound 1, and the Burial Pit.

No samples were collected at the former Mound 2 site (location 028 on Figure 10.4.4-2) because it was discovered to be a debris pile rather than a burial mound, and the debris had been removed during the VCM. RFI sampling in the VCM excavation at Mound 1 also covered the former Mound 2 area (Figure 10.4.5.3-1).

All but the gamma spectroscopy analyses were performed off site at General Engineering Laboratories of Charleston, South Carolina. Samples were analyzed for TAL metals plus uranium by EPA Method 6010/7000, for HE compounds using EPA Method 8330, for SVOCs using EPA Method 8270, for VOCs using EPA Method 8260A, and for gross alpha and gross beta using EPA Method 900.0. Gamma spectroscopy analyses were performed on site at the SNL/NM RPSD Laboratory. Copies of the on-site gamma spectroscopy results are in Annex C.

Site-Specific and Arroyo Sediment Background Samples

SNL/NM conducted background soil and arroyo sediment sampling at SWMU 9 to establish site-specific background concentrations for metals and activities for radionuclides. As specified in the OU 1334 Work Plan, background soil samples were collected at three locations west of the site boundary (locations 001–003 on Figure 10.4.4-1), and background arroyo sediment samples were collected at three locations upstream of the site (locations 004-006 on Figure 10.4.4-1). The samples were analyzed for TAL metals plus uranium and radionuclides. The analytical results are summarized below.

TAL Metals Plus Uranium

Table 10.4.5-1 presents the analytical results for the TAL metals plus uranium analyses. The NMED-approved background concentrations were exceeded for barium, cobalt, and nickel.

Barium (59.8 J to 158 J mg/kg) exceeded the 130 mg/kg NMED-approved background concentration in the site-specific background sample (003-0.5-1.0) and the arroyo sediment background sample (006-0.5-1.0). Cobalt (3.8 to 5.65 mg/kg) and nickel (7.63 to 16.2 mg/kg) were detected above the NMED-approved background concentrations of 5.2 and 11.5 mg/kg, respectively, only in one arroyo sediment sample (006-0-0.5).

All other metals were below their respective NMED-approved background concentrations for these background samples. However, the antimony results were rejected during data validation, as explained in Annex D.

Radionuclides

Table 10.4.5-2 presents the analytical results for the gamma spectroscopy analyses. Uranium-235 activities (1.36E-01 to 2.06E-01 pCi/g) exceeded the NMED-approved background

Table 10.4.5-1
 Summary of SWMU 9 Confirmatory Soil Sampling TAL Metals Plus Uranium Analytical Results
 July 1999
 (Off-Site Laboratory)

Record Number	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Date Sampled (Locations 001-003)	Sample Depth (ft)	Metals (EPA Method 60107000) ^a (mg/kg)									
				Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
Site-specific background samples (locations 001-003)													
602158	CCTA-09-GR-001-0-0.5-S	7-12-99	0.0-0.5	ND (0.191) R	2.65 J	86.1 J	0.374 J (0.500)	ND (0.019)	10.3 J	4.74	8.84	8.15	281
602158	CCTA-09-GR-001-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	2.86 J	87.6 J	0.399 J (0.500)	ND (0.019)	8.70 J	4.61	8.86	7.74	275
602158	CCTA-09-GR-002-0.0-0.5-S	7-12-99	0.0-0.5	ND (0.191) R	2.78 J	85.0 J	0.366 J (0.493)	ND (0.019)	8.29 J	4.49	9.09	7.95	282
602158	CCTA-09-GR-002-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	2.75 J	84.2 J	0.362 J (0.463)	ND (0.019)	7.85 J	4.49	9.83	8.90	285
602158	CCTA-09-GR-003-0-0.5-S	7-12-99	0.0-0.5	ND (0.191) R	3.33 J	130 J	0.411 J (0.500)	ND (0.019)	8.31 J	3.93	8.87	6.89	211
602158	CCTA-09-GR-003-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	3.48 J	139 J	0.428 J (0.500)	ND (0.019)	8.76 J	4.08	8.91	6.49	205
Arroyo sediment background samples (locations 004-006)													
602158	CCTA-09-GR-004-0-0.5-S	7-12-99	0.0-0.5	ND (0.191) R	2.17 J	63.8 J	0.241 J (0.481)	ND (0.019)	5.65 J	3.89	8.28	8.11	212
602158	CCTA-09-GR-004-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	3.13 J	94.0 J	0.338 J (0.490)	ND (0.019)	9.20 J	5.06	12.0	7.52	257
602158	CCTA-09-GR-004-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	3.19 J	77.1 J	0.288 J (0.485)	ND (0.019)	7.66 J	4.91	11.2	7.02	243
602158	CCTA-09-GR-004-0.5-1.0-S	7-12-99	0.0-0.5	ND (0.191) R	2.39 J	75.3 J	0.244 J (0.495)	ND (0.019)	8.11 J	5.06	10.6	6.79	246
602158	CCTA-09-GR-005-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	4.02 J	59.8 J	0.242 J (0.495)	ND (0.019)	7.81 J	4.27	9.83	5.70	218
602158	CCTA-09-GR-006-0-0.5-S	7-12-99	0.0-0.5	ND (0.191) R	3.16 J	158 J	0.419 J (0.500)	ND (0.019)	12.9 J	5.65	11.4	6.64	275
602158	CCTA-09-GR-006-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	2.83 J	94.3 J	0.335 J (0.485)	ND (0.019)	7.96 J	4.78	10.2	5.99	239
Arroyo channel sediment samples (locations 007-009)													
602158	CCTA-09-GR-007-0-0.5-S	7-12-99	0.0-0.5	ND (0.191) R	2.34 J	77.3 J	0.282 J (0.485)	ND (0.019)	9.24 J	4.31	10.7	7.11	204
602158	CCTA-09-GR-007-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	2.03 J	58.4 J	0.196 J (0.467)	ND (0.019)	5.22 J	3.25	8.15	5.45	161
602158	CCTA-09-GR-007-0.5-1.0-S	7-12-99	0.0-0.5	ND (0.191) R	2.61 J	76.5 J	0.273 J (0.459)	ND (0.019)	8.48 J	4.47	10.6	7.65	223
602158	CCTA-09-GR-008-0-0.5-S	7-12-99	0.0-0.5	ND (0.191) R	2.48 J	65.0 J	0.254 J (0.463)	ND (0.019)	7.18 J	4.18	12.6	6.81	214
602158	CCTA-09-GR-008-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	2.90 J	62.9 J	0.201 J (0.476)	ND (0.019)	5.60 J	3.54	7.24	5.57	187
602158	CCTA-09-GR-009-0-0.5-S	7-12-99	0.0-0.5	ND (0.191) R	2.25 J	73.5 J	0.269 J (0.490)	ND (0.019)	8.05 J	3.88	8.76	5.98	205
602158	CCTA-09-GR-009-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191) R	2.50 J	124	0.270 J (0.490)	ND (0.019)	7.70 J	3.92	9.05	12.2	196
Mound 3 soil sample (location 029)													
602159	CCTA-09-GR-029-3-0.3-5-S	7-12-99	3.0-3.5	ND (0.191)	2.70	103	0.421 J (0.463)	0.0657 J (0.463)	8.49	4.67	9.07	7.41	253
VCM excavation under Mound 1 samples (locations 030-047)													
602159	CCTA-09-GR-030-0-0.5-S	7-12-99	0.0-0.5	ND (0.191)	3.22	86.7	0.379 J (0.467)	0.172 J (0.467)	7.94	4.76	32.4	8.05	227
602159	CCTA-09-GR-030-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191)	1.90	50.4	0.224 J (0.459)	ND (0.019)	5.84	3.24	7.66	4.62	165
602159	CCTA-09-GR-031-0-0.5-S	7-12-99	0.0-0.5	ND (0.191)	2.66	78.0	0.330 J (0.455)	0.0550 J (0.455)	8.45	4.61	10.4	9.95	227
602159	CCTA-09-GR-031-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191)	2.16	63.4	0.260 J (0.455)	ND (0.019)	5.42	3.87	8.12	6.10	204
602159	CCTA-09-GR-032-0-0.5-S	7-12-99	0.0-0.5	ND (0.191)	3.17	109	0.482	0.0530 J (0.467)	9.36	4.59	11.4	10.5	229
602159	CCTA-09-GR-032-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191)	3.37	110	0.447 J (0.472)	0.0617 J (0.472)	9.55	4.57	11.0	11.7	212
602159	CCTA-09-GR-032-0.5-1.0-S	7-12-99	0.0-0.5	ND (0.191)	2.97	96.5	0.405 J (0.485)	0.108 J (0.485)	8.67	4.39	10.4	12.2	229
602159	CCTA-09-GR-033-0-0.5-S	7-12-99	0.0-0.5	ND (0.191)	3.68	131	0.471 J (0.481)	0.444 J (0.481)	16.5	4.67	30.5	26.5	257
602159	CCTA-09-GR-033-0.5-1.0-S	7-12-99	0.5-1.0	0.392 J (0.962)	3.76	125	0.448 J (0.481)	0.380 J (0.481)	11.7	4.29	33.7	23.3	247
602159	CCTA-09-GR-034-0-0.5-S	7-12-99	0.0-0.5	ND (0.191)	3.09	127	0.440 J (0.485)	0.406 J (0.485)	20.7	5.30	13.2	28.5	246
602159	CCTA-09-GR-034-0.5-1.0-S	7-12-99	0.5-1.0	ND (0.191)	4.89	61.8	0.305 J (0.485)	ND (0.019)	7.00	4.37	10.5	8.36	225

Refer to footnotes at end of table.

Table 10.4.5-1 (Continued)
 Summary of SWMU 9 Confirmatory Soil Sampling TAL Metals Plus Uranium Analytical Results
 July 1999
 (Off-Site Laboratory)

Record Number	Sample Attributes			Metals (EPA Method 6010/7000) ^a (mg/kg)												
	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Date Sampled	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese			
602162	CCTA-09-GR-035-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	2.91	109 J	0.513	0.135 J (0.500)	8.49	5.12	10.5 J	7.57	256 J			
602162	CCTA-09-GR-035-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	3.17	145 J	0.510	0.132 J (0.490)	8.06	4.76	10.9 J	7.20	244 J			
602162	CCTA-09-GR-036-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	2.55	121 J	0.434 J (0.485)	0.214 J (0.485)	11.3	4.68	12.3 J	12.4	252 J			
602162	CCTA-09-GR-036-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	2.88	103 J	0.416 J (0.485)	0.215 J (0.485)	10.1	5.40	536 J	20.3	313 J			
602162	CCTA-09-GR-036-0.5-1.0-DU	7-13-99	0.5-1.0	ND (0.191) R	2.15	103 J	0.346 J (0.500)	0.182 J (0.500)	8.06	3.87	14.2 J	11.3	217 J			
602162	CCTA-09-GR-037-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	2.40	116 J	0.385 J (0.485)	0.530	13.9	5.29	30.2 J	27.9	259 J			
602162	CCTA-09-GR-037-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	1.94	79.9 J	0.318 J (0.490)	0.237 J (0.490)	7.25	4.37	16.5 J	14.8	219 J			
602162	CCTA-09-GR-038-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	2.76	117 J	0.425 J (0.495)	0.513	9.60	4.55	27.7 J	28.1	245 J			
602162	CCTA-09-GR-038-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	1.86	55.6 J	0.263 J (0.490)	0.179 J (0.490)	12.4	4.29	10.4 J	7.63	229 J			
602162	CCTA-09-GR-039-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	3.32	110 J	0.455 J (0.490)	0.122 J (0.490)	8.94	4.49	10.0 J	17.1	223 J			
602162	CCTA-09-GR-039-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	2.48	95.1 J	0.367 J (0.485)	0.0767 J (0.485)	5.79	3.73	7.68 J	7.64	193 J			
602162	CCTA-09-GR-040-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	2.86	101 J	0.505	0.377 J (0.500)	8.78	5.00	53.0 J	14.1	255 J			
602162	CCTA-09-GR-040-0.5-1.0-S	7-13-99	0.5-1.0	0.566 J (0.962) R	3.67	137 J	0.505	1.90	11.5	5.4	94.5 J	31.7	275 J			
602162	CCTA-09-GR-041-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	3.54	151 J	0.489	0.639	8.88	4.52	30.1 J	19.0	228 J			
602162	CCTA-09-GR-041-0-0.5-DU	7-13-99	0-0.5	ND (0.191) R	3.59	140 J	0.469 J (0.485)	0.608	9.17	4.49	24.8 J	18.4	212 J			
602162	CCTA-09-GR-041-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	3.06	120 J	0.375 J (0.490)	0.204 J (0.490)	6.73	3.73	9.13 J	7.98	163 J			
602162	CCTA-09-GR-042-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	3.04	169 J	0.463 J (0.481)	0.807	11.6	4.79	68.0 J	36.0	233 J			
602162	CCTA-09-GR-042-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	3.06	209 J	0.463 J (0.490)	0.409 J (0.490)	8.04	4.48	30.0 J	126	236 J			
602162	CCTA-09-GR-043-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	2.70	91.3 J	0.421 J (0.500)	0.289 J (0.500)	8.97	4.36	13.0 J	15.7	235 J			
602162	CCTA-09-GR-043-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	1.87	61.7 J	0.327 J (0.500)	0.198 J (0.500)	6.10	3.22	8.41 J	9.18	165 J			
602163	CCTA-09-GR-044-0-0.5-S	7-13-99	0-0.5	1.06	3.86	157	0.546	0.836	16.7	5.35	102	96.5	275			
602163	CCTA-09-GR-044-0.5-1.0-S	7-13-99	0.5-1.0	1.34	4.46	147	0.539	0.948	15.4	5.27	51.4	36.9	269			
602163	CCTA-09-GR-045-0-0.5-S	7-13-99	0-0.5	1.83	3.91	156	0.538	0.861	17.9	5.35	52.2	33.3	274			
602163	CCTA-09-GR-045-0.5-1.0-S	7-13-99	0-0.5	1.75	3.79	169	0.554	1.04	21.8	5.70	47.8	36.3	284			
602163	CCTA-09-GR-045-0.5-1.0-DU	7-13-99	0.5-1.0	ND (0.191) R	3.66	152	0.537	0.746	20.5	5.49	32.6	39.7	292			
602163	CCTA-09-GR-046-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	3.08	116	0.546	0.277 J (0.476)	11.7	5.51	38.8	24.7	278			
602163	CCTA-09-GR-046-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	3.57	158	0.531	0.145 J (0.472)	11.5	5.67	15.0	24.2	285			
602163	CCTA-09-GR-047-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	3.66	187	0.572	0.257 J (0.495)	14.2	5.33	15.5	23.2	268			
602163	CCTA-09-GR-047-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	3.54	156	0.589	0.306 J (0.463)	13.3	5.49	16.4	24.8	285			
Burial Pit samples (locations 048-050)																
602163	CCTA-09-GR-048-0-0.5-S	7-13-99	0-0.5	0.386 J (0.960)	3.26	96.8	0.553	0.0647 J (0.490)	11.6	5.04	11.6	16.6	265			
602163	CCTA-09-GR-048-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	3.45	93.9	0.542	0.0889 J (0.495)	10.6	4.86	10.7	15.9	258			
602163	CCTA-09-GR-049-0-0.5-S	7-13-99	0-0.5	ND (0.191) R	3.31	106	0.591	0.175 J (0.472)	12.4	5.46	33.3	29.2	286			
602163	CCTA-09-GR-049-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191) R	3.11	116	0.853	0.215 J (0.472)	13.4	5.66	17.2	24.3	300			

Refer to footnotes at end of table.

Table 10.4.5-1 (Continued)
 Summary of SWMU 9 Confirmatory Soil Sampling TAL Metals Plus Uranium Analytical Results
 July 1999
 (Off-Site Laboratory)

Sample Attributes		Metals (EPA Method 6010/7000) ^a (mg/kg)											
Record Number	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Date Sampled	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
602163	CCTA-09-GR-050-0-0.5-S	7-13-99	0-0.5	ND (0.191)	3.10	78.9	0.452 J (0.485)	0.117 J (0.485)	12.2	4.88	12.3	16.1	241
602163	CCTA-09-GR-050-0.5-1.0-S	7-13-99	0.5-1.0	ND (0.191)	2.84	80.9	0.448 J (0.459)	0.0476 J (0.485)	10.2	4.83	12.5	14.4	257
Background Soil Concentrations—Coyote Test Field ^d				3.9	5.6	130	0.65	0.9	17.3	5.2	15.4	21.4	NE
Quality Assurance/Quality Control Samples (mg/L)													
602159	CCTA-09-GR-000-EB	7-12-99	NA	ND (0.00349)	ND (0.00451)	ND (0.00051)	ND (0.00026)	ND (0.00044)	ND (0.00056)	ND (0.00069)	ND (0.00104)	ND (0.00159)	ND (0.00448)
602163	CCTA-09-GR-000-EB	7-13-99	NA	ND (0.00349)	ND (0.00451)	ND (0.00051)	ND (0.00026)	ND (0.00044)	ND (0.00056)	ND (0.00069)	ND (0.00104)	ND (0.00159)	ND (0.00448)

Refer to footnotes at end of table.

Table 10.4.5-1 (Continued)
 Summary of SWMU 9 Confirmatory Soil Sampling TAL Metals Plus Uranium Analytical Results
 July 1999
 (Off-Site Laboratory)

Record Number	Sample Attributes			Metals (EPA Method 6010/7000) ^a (mg/kg)									
	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1) Sampled Date	Sample Depth (ft)	Mercury	Nickel	Selenium	Silver	Thallium	Uranium	Vanadium	Zinc			
Site-specific background samples (locations 001-003)													
602158	CCTA-09-GR-001-0-0.5-S	0-0.5	0.0222 J (0.0332)	9.55	ND (0.135)	0.345 J (0.500)	ND (0.221)	0.605 J	15.0	28.3			
602158	CCTA-09-GR-001-0.5-1.0-S	0.5-1.0	0.00909 J (0.0329)	8.90	ND (0.135)	0.339 J (0.500)	ND (0.221)	1.22 J	15.6	27.7			
602158	CCTA-09-GR-002-0-0.5-S	0-0.5	0.0181 J (0.0261)	8.48	ND (0.135)	0.355 J (0.493)	ND (0.221)	0.510 J	14.6	28.5			
602158	CCTA-09-GR-002-0.5-1.0-S	0.5-1.0	0.0170 J (0.0315)	8.36	ND (0.135)	0.364 J (0.463)	ND (0.221)	0.544 J	14.1	28.7			
602158	CCTA-09-GR-003-0-0.5-S	0-0.5	0.0105 J (0.0291)	8.75	ND (0.135)	0.435 J (0.500)	ND (0.221)	0.412 J	15.4	29.2			
602158	CCTA-09-GR-003-0.5-1.0-S	0.5-1.0	0.0118 J (0.0269)	9.44	ND (0.135)	0.400 J (0.500)	ND (0.221)	0.520 J	16.1	30.2			
Arroyo sediment background samples (locations 004-006)													
602158	CCTA-09-GR-004-0-0.5-S	0-0.5	ND (0.00225)	7.63	ND (0.135)	0.382 J (0.481)	ND (0.221)	0.550 J	11.9	30.2			
602158	CCTA-09-GR-004-0.5-1.0-S	0.5-1.0	0.00264 J (0.0304)	10.4	ND (0.135)	0.447 J (0.480)	ND (0.221)	0.666 J	15.7	34.5			
602158	CCTA-09-GR-004-0.5-1.0-S	0.5-1.0	ND (0.00225)	9.66	ND (0.135)	0.393 J (0.485)	ND (0.221)	0.589 J	14.8	32.7			
602158	CCTA-09-GR-005-0-0.5-S	0-0.5	ND (0.00225)	9.90	ND (0.135)	0.414 J (0.495)	ND (0.221)	0.414 J	14.6	33.0			
602158	CCTA-09-GR-005-0.5-1.0-S	0.5-1.0	ND (0.00225)	8.38	ND (0.135)	0.457 J (0.495)	ND (0.221)	0.477 J	13.5	25.4			
602158	CCTA-09-GR-006-0-0.5-S	0-0.5	0.00361 J (0.0313)	16.2	ND (0.135)	0.478 J (0.500)	ND (0.221)	0.458 J	16.6	34.6			
602158	CCTA-09-GR-006-0.5-1.0-S	0.5-1.0	ND (0.00225)	9.48	ND (0.135)	0.477 J (0.485)	ND (0.221)	0.463 J	15.2	31.3			
Arroyo channel sediment samples (locations 007-009)													
602158	CCTA-09-GR-007-0-0.5-S	0-0.5	ND (0.00225)	9.98	ND (0.135)	0.458 J (0.485)	ND (0.221)	0.694 J	13.4	30.4			
602158	CCTA-09-GR-007-0.5-1.0-S	0.5-1.0	ND (0.00225)	6.94	ND (0.135)	0.300 J (0.467)	ND (0.221)	0.545 J	10.0	22.8			
602158	CCTA-09-GR-007-0.5-1.0-S	0.5-1.0	ND (0.00225)	10.1	ND (0.135)	0.313 J (0.459)	ND (0.221)	0.535 J	13.7	32.3			
602158	CCTA-09-GR-008-0-0.5-S	0-0.5	ND (0.00225)	9.95	ND (0.135)	0.315 J (0.463)	ND (0.221)	1.02 J	12.4	30.5			
602158	CCTA-09-GR-008-0.5-1.0-S	0.5-1.0	ND (0.00225)	7.36	ND (0.135)	0.323 J (0.476)	ND (0.221)	4.03 J	11.0	25.3			
602158	CCTA-09-GR-009-0-0.5-S	0-0.5	ND (0.00225)	9.35	ND (0.135)	0.324 J (0.490)	ND (0.221)	0.473 J	12.1	28.3			
602158	CCTA-09-GR-009-0.5-1.0-S	0.5-1.0	ND (0.00225)	8.74	ND (0.135)	0.352 J (0.490)	ND (0.221)	0.503	12.8	28.2			
Mound 3 soil sample (location 029)													
602159	CCTA-09-GR-029-3.0-3.5-S	3.0-3.5	0.00613 J (0.0301)	8.71	ND (0.135)	0.287 J (0.463)	ND (0.221)	0.598	15.3	29.7			
VCM excavation under Mound 1 samples (locations 030-047)													
602159	CCTA-09-GR-030-0-0.5-S	0-0.5	ND (0.00225)	8.92	0.338 J (0.467)	0.278 J (0.467)	ND (0.221)	1.25	15.1	41.7			
602159	CCTA-09-GR-030-0.5-1.0-S	0.5-1.0	0.00262 J (0.0277)	6.28	ND (0.135)	0.246 J (0.459)	ND (0.221)	1.19	9.75	24.5			
602159	CCTA-09-GR-031-0-0.5-S	0-0.5	0.0128 J (0.0302)	9.00	0.402 J (0.455)	0.220 J (0.455)	ND (0.221)	2.04	14.2	42.2			
602159	CCTA-09-GR-031-0.5-1.0-S	0.5-1.0	ND (0.00225)	7.07	ND (0.135)	0.233 J (0.455)	ND (0.221)	2.24	10.9	28.7			
602159	CCTA-09-GR-032-0-0.5-S	0-0.5	0.00408 J (0.0333)	9.19	0.287 J (0.467)	0.266 J (0.467)	ND (0.221)	3.20	16.5	34.3			
602159	CCTA-09-GR-032-0.5-1.0-S	0.5-1.0	0.0133 J (0.0306)	9.42	ND (0.135)	0.223 J (0.472)	ND (0.221)	3.01	16.6	35.6			
602159	CCTA-09-GR-032-0.5-1.0-S	0.5-1.0	0.0129 J (0.0287)	8.66	0.324 J (0.485)	0.279 J (0.485)	ND (0.221)	3.52	15.3	35.7			
602159	CCTA-09-GR-033-0-0.5-S	0-0.5	0.0424	10.6	0.435 J (0.481)	0.351 J (0.481)	ND (0.221)	4.73	16.8	207			
602159	CCTA-09-GR-033-0.5-1.0-S	0.5-1.0	0.0436	9.18	0.415 J (0.481)	0.371 J (0.481)	ND (0.221)	3.67	16.0	243			
602159	CCTA-09-GR-034-0-0.5-S	0-0.5	0.00950 J (0.0272)	10.6	0.396 J (0.485)	0.431 J (0.485)	ND (0.221)	6.68	16.9	67.2			

Refer to footnotes at end of table.

Table 10.4.5-1 (Continued)
 Summary of SWMU 9 Confirmatory Soil Sampling TAL Metals Plus Uranium Analytical Results
 July 1999
 (Off-Site Laboratory)

Record Number	Sample Attributes				Metals (EPA Method 6010/7000) ^a (mg/kg)										
	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Date Sampled	Sample Depth (ft)		Mercury	Nickel	Selenium	Silver	Thallium	Uranium	Vanadium	Zinc			
602159	CCTA-09-GR-034-0.5-1.0-S	7-13-99	0.5-1.0	0.00300 J (0.0314)	8.43	0.351 J (0.485)	0.281 J (0.485)	ND (0.221)	2.62	13.4	31.8				
602162	CCTA-09-GR-035-0.0-5-S	7-13-99	0-0.5	0.0242 J (0.0333)	10.2 J	0.544	ND (0.031)	ND (0.221)	0.793 J	16.3	28.7 J				
602162	CCTA-09-GR-035-0.5-1.0-S	7-13-99	0.5-1.0	0.0197 J (0.0290)	9.60 J	0.536	ND (0.031)	ND (0.221)	0.613 J	16.1	28.4 J				
602162	CCTA-09-GR-036-0.0-5-S	7-13-99	0-0.5	0.0201 J (0.0288)	10.3 J	0.675	ND (0.031)	ND (0.221)	5.53 J	14.3	80.6 J				
602162	CCTA-09-GR-036-0.5-1.0-S	7-13-99	0.5-1.0	0.0227 J (0.0330)	11.5 J	0.672	ND (0.031)	ND (0.221)	5.49 J	14.9	288 J				
602162	CCTA-09-GR-036-0.5-1.0-DU	7-13-99	0.5-1.0	0.0239 J (0.0330)	8.01 J	0.562	ND (0.031)	ND (0.221)	3.95 J	12.3	60.4 J				
602162	CCTA-09-GR-037-0.0-5-S	7-13-99	0-0.5	0.0260 J (0.0305)	14.1 J	0.709	ND (0.031)	ND (0.221)	8.35 J	14.7	241 J				
602162	CCTA-09-GR-037-0.5-1.0-S	7-13-99	0.5-1.0	0.0212 J (0.0276)	8.76 J	0.514	ND (0.031)	ND (0.221)	7.04 J	12.6	176 J				
602162	CCTA-09-GR-038-0.0-5-S	7-13-99	0-0.5	0.0215 J (0.0243)	9.75 J	0.474 J (0.495)	ND (0.031)	ND (0.221)	8.28 J	14.3	70.1 J				
602162	CCTA-09-GR-038-0.5-1.0-S	7-13-99	0.5-1.0	0.0109 J (0.0288)	10.8 J	0.431 J (0.490)	ND (0.031)	ND (0.221)	1.94 J	11.7	33.7 J				
602162	CCTA-09-GR-039-0.0-5-S	7-13-99	0-0.5	0.00998 J (0.0274)	9.13 J	0.447 J (0.490)	ND (0.031)	ND (0.221)	2.71 J	15.0	29.3 J				
602162	CCTA-09-GR-039-0.5-1.0-S	7-13-99	0.5-1.0	0.0107 J (0.0302)	7.38 J	0.347 J (0.485)	ND (0.031)	ND (0.221)	2.03 J	12.8	24.5 J				
602162	CCTA-09-GR-040-0.0-5-S	7-13-99	0-0.5	0.0709 J	10.1 J	0.458 J (0.500)	ND (0.031)	ND (0.221)	4.31 J	15.9	59.3 J				
602162	CCTA-09-GR-040-0.5-1.0-S	7-13-99	0.5-1.0	0.0993 J	12.0 J	0.751	0.113 J (0.481)	ND (0.221)	7.93 J	16.5	134 J				
602162	CCTA-09-GR-041-0.0-5-S	7-13-99	0-0.5	0.0340 J	9.86 J	0.610	0.140 J (0.485)	ND (0.221)	8.97 J	16.5	87.8 J				
602162	CCTA-09-GR-041-0.0-5-DU	7-13-99	0-0.5	0.0237 J (0.0283)	9.63 J	0.576	0.0875 J (0.485)	ND (0.221)	9.67 J	16.3	83.9 J				
602162	CCTA-09-GR-041-0.5-1.0-S	7-13-99	0.5-1.0	0.0122 J (0.0323)	7.86 J	0.286 J (0.490)	ND (0.031)	ND (0.221)	19.5 J	14.5	34.9 J				
602162	CCTA-09-GR-042-0.0-5-S	7-13-99	0-0.5	0.0965 J	10.8 J	0.504	0.210 J (0.481)	ND (0.221)	17.7 J	15.6	148 J				
602162	CCTA-09-GR-042-0.5-1.0-S	7-13-99	0.5-1.0	0.0266 J (0.0281)	9.80 J	0.592	0.153 J (0.490)	ND (0.221)	6.21 J	16.0	184 J				
602162	CCTA-09-GR-043-0.0-5-S	7-13-99	0-0.5	0.0146 J (0.0288)	8.47 J	0.418 J (0.500)	ND (0.031)	ND (0.221)	7.91 J	14.1	40.2 J				
602162	CCTA-09-GR-043-0.5-1.0-S	7-13-99	0.5-1.0	0.0192 J (0.0323)	6.50 J	0.294 J (0.500)	ND (0.031)	ND (0.221)	2.73 J	11.5	26.9 J				
602163	CCTA-09-GR-044-0.0-5-S	7-13-99	0-0.5	0.0740	11.6	0.447 J (0.485)	0.0852 J (0.485)	ND (0.221)	8.99	22.0	141				
602163	CCTA-09-GR-044-0.5-1.0-S	7-13-99	0.5-1.0	0.0686	11.2	0.621	0.247 J (0.481)	ND (0.221)	9.33	22.0	136				
602163	CCTA-09-GR-045-0.0-5-S	7-13-99	0-0.5	0.0946	11.8	0.562	0.207 J (0.495)	ND (0.221)	11.5	22.4	151				
602163	CCTA-09-GR-045-0.5-1.0-DU	7-13-99	0-0.5	0.0679	12.7	0.536	0.107 J (0.481)	ND (0.221)	14.7	23.6	148				
602163	CCTA-09-GR-045-0.5-1.0-S	7-13-99	0.5-1.0	0.296	12.2	0.721	0.185 J (0.463)	ND (0.221)	12.1	21.7	133				
602163	CCTA-09-GR-046-0.0-5-S	7-13-99	0-0.5	0.0404	11.2	0.689	0.0844 J (0.476)	ND (0.221)	15.2	20.4	72.0				
602163	CCTA-09-GR-046-0.5-1.0-S	7-13-99	0.5-1.0	0.0163 J (0.0333)	11.3	0.660	0.0866 J (0.472)	ND (0.221)	13.5	22.9	40.8				
602163	CCTA-09-GR-047-0.0-5-S	7-13-99	0-0.5	0.108	11.7	0.719	ND (0.031)	ND (0.221)	10.5	22.4	54.3				
602163	CCTA-09-GR-047-0.5-1.0-S	7-13-99	0.5-1.0	0.105	11.2	0.533	ND (0.031)	ND (0.221)	10.0	22.5	71.8				
Burial Pit samples (locations 048-050)															
602163	CCTA-09-GR-048-0.0-5-S	7-13-99	0-0.5	0.00783 J (0.0317)	10.3	0.678	ND (0.031)	ND (0.221)	11.5	20.4	35.0				
602163	CCTA-09-GR-048-0.5-1.0-S	7-13-99	0.5-1.0	0.0125 J (0.0308)	9.88	0.556	ND (0.031)	ND (0.221)	12.7	19.3	33.5				
602163	CCTA-09-GR-049-0.0-5-S	7-13-99	0-0.5	0.0225 J (0.0316)	11.1	0.754	ND (0.031)	ND (0.221)	13.5	18.7	47.3				
602163	CCTA-09-GR-049-0.5-1.0-S	7-13-99	0.5-1.0	0.0227 J (0.0329)	11.9	0.798	ND (0.031)	ND (0.221)	14.1	19.7	54.6				
602163	CCTA-09-GR-050-0.0-5-S	7-13-99	0-0.5	0.0105 J (0.0251)	9.30	0.521	ND (0.031)	ND (0.221)	5.85	16.7	42.9				
602163	CCTA-09-GR-050-0.5-1.0-S	7-13-99	0.5-1.0	0.0222 J (0.0320)	9.49	0.591	ND (0.031)	ND (0.221)	4.61	17.2	37.8				

Refer to footnotes at end of table.

Table 10.4.5-1 (Concluded)
 Summary of SWMU 9 Confirmatory Soil Sampling TAL Metals Plus Uranium Analytical Results
 July 1999
 (Off-Site Laboratory)

Sample Attributes				Metals (EPA Method 60107000) ^a (mg/kg)							
Record Number ^b	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Date Sampled	Sample Depth (ft)	Mercury	Nickel	Selenium	Silver	Thallium	Uranium	Vanadium	Zinc
602159	CCTA-09-GR-000-EB	7-12-99	NA	ND (0.000035)	ND (0.00129)	ND (0.00271)	ND (0.00073)	ND (0.00308)	0.000131 J (0.000200)	ND (0.00059)	0.0154
602163	CCTA-09-GR-000-EB	7-13-99	NA	ND (0.000035)	ND (0.00129)	ND (0.00271)	ND (0.00073)	ND (0.00308)	ND (0.000251)	ND (0.00059)	0.00641
Background Soil Concentrations—Coyote Test Field ^d											
				<0.1	11.5	<1	<1	<1.1	3.42	20.4	62

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

^a EPA November 1986.

^b Analysis request/chain-of-custody record.

^c **Bold** portion of the Sample ID corresponds to the sample location in Figures 10.4.4-1 and 10.4.5.3-1.

^d From Dinwiddie September 1997. The minimum background concentration between surface and subsurface is reported.

- CCTA = Central Coyote Test Area.
- DU = Duplicate sample.
- EB = Equipment blank.
- EPA = U.S. Environmental Protection Agency.
- ER = Environmental Restoration.
- ft = Foot (feet).
- GR = Grab sample.
- ID = Identification.
- J () = Estimated value. See Data Validation report.
- mg/kg = The reported value is greater than or equal to the method detection limit but is less than the practical quantitation limit, shown in parentheses.
- mg/L = Milligram(s) per kilogram.
- NA = Not applicable.
- ND () = Not detected above the method detection limit, shown in parentheses.
- R = Rejected value. See Data Validation report.
- Rad = Radioactive.
- S = Soil sample.
- SWMU = Solid Waste Management Unit.
- TAL = Target analyte list.
- VCM = Voluntary Corrective Measure.

Table 10.4.5-2
 Summary of SWMU 9 Confirmatory Soil Sampling Gamma Spectroscopy Analytical Results
 July 1999
 (On-Site Laboratory)

Record Number ^a	Sample Attributes			Activity (pCi/g)											
	ER Sample ID ^b (Figures 10.4.4-1 and 10.4.5.3-1)	Date Sampled	Sample Depth (ft)	Uranium-235			Uranium-238			Thorium-232			Cesium-137		
				Result	Error ^c	Result	Error ^c	Result	Error ^c	Result	Error ^c	Result	Error ^c	Result	Error ^c
Site-specific background samples (locations 001-003)															
602160	CCTA-09-GR-001-0-0.5-S	7-12-99	0.0-0.5	2.06E-01	1.70E-01	ND (7.19E-01)	--	8.79E-01	4.42E-01	5.04E-02	--	5.04E-02	3.66E-02	5.04E-02	3.66E-02
602161	CCTA-09-GR-001-0.5-1.0-S	7-12-99	0.5-1.0	ND (1.99E-01)	--	ND (5.39E-01)	--	8.57E-01	4.61E-01	1.03E-01	--	1.03E-01	2.30E-02	1.03E-01	2.30E-02
602161	CCTA-09-GR-002-0-0.5-S	7-12-99	0.0-0.5	ND (2.01E-01)	--	ND (5.39E-01)	--	8.79E-01	4.68E-01	1.10E-01	--	1.10E-01	1.76E-01	1.10E-01	1.76E-01
602161	CCTA-09-GR-002-0.5-1.0-S	7-12-99	0.5-1.0	ND (2.07E-01)	--	ND (5.45E-01)	--	7.97E-01	4.11E-01	1.20E-01	--	1.20E-01	4.85E-02	1.20E-01	4.85E-02
602161	CCTA-09-GR-003-0-0.5-S	7-12-99	0.0-0.5	9.79E-02	1.76E-01	ND (5.26E-01)	--	7.78E-01	4.34E-01	1.98E-01	--	1.98E-01	5.23E-02	1.98E-01	5.23E-02
602161	CCTA-09-GR-003-0.5-1.0-S	7-12-99	0.5-1.0	ND (1.98E-01)	--	ND (5.18E-01)	--	6.73E-01	3.79E-01	ND (2.33E-02)	--	ND (2.33E-02)	--	ND (2.33E-02)	--
Arroyo sediment background samples (locations 004-006)															
602160	CCTA-09-GR-004-0-0.5-S	7-12-99	0.0-0.5	ND (1.95E-01)	--	ND (6.62E-01)	--	7.50E-01	4.01E-01	1.03E-01	--	1.03E-01	3.89E-02	1.03E-01	3.89E-02
602161	CCTA-09-GR-004-0-0.5-DU	7-12-99	0.0-0.5	ND (1.83E-01)	--	ND (4.89E-01)	--	7.09E-01	3.85E-01	1.37E-01	--	1.37E-01	4.73E-02	1.37E-01	4.73E-02
602161	CCTA-09-GR-004-0.5-1.0-S	7-12-99	0.5-1.0	1.42E-01	1.78E-01	ND (5.45E-01)	--	7.79E-01	4.62E-01	ND (2.56E-02)	--	ND (2.56E-02)	--	ND (2.56E-02)	--
602161	CCTA-09-GR-005-0-0.5-S	7-12-99	0.0-0.5	9.85E-02	1.56E-01	ND (4.65E-01)	--	7.23E-01	4.28E-01	1.13E-01	--	1.13E-01	4.62E-02	1.13E-01	4.62E-02
602161	CCTA-09-GR-005-0.5-1.0-S	7-12-99	0.5-1.0	ND (1.89E-01)	--	ND (4.80E-01)	--	7.34E-01	4.11E-01	ND (2.46E-02)	--	ND (2.46E-02)	--	ND (2.46E-02)	--
602161	CCTA-09-GR-006-0-0.5-S	7-12-99	0.0-0.5	1.36E-01	1.98E-01	ND (6.13E-01)	--	9.35E-01	4.75E-01	6.35E-02	--	6.35E-02	4.12E-02	6.35E-02	4.12E-02
602161	CCTA-09-GR-006-0.5-1.0-S	7-12-99	0.5-1.0	ND (1.95E-01)	--	ND (5.01E-01)	--	7.38E-01	4.21E-01	3.90E-02	--	3.90E-02	3.57E-02	3.90E-02	3.57E-02
Arroyo channel sediment samples (locations 007-009)															
602160	CCTA-09-GR-007-0-0.5-S	7-12-99	0.0-0.5	ND (1.81E-01)	--	ND (6.12E-01)	--	7.79E-01	4.03E-01	6.27E-02	--	6.27E-02	2.83E-02	6.27E-02	2.83E-02
602161	CCTA-09-GR-007-0-0.5-DU	7-12-99	0.0-0.5	ND (1.84E-01)	--	ND (4.95E-01)	--	7.80E-01	4.02E-01	6.95E-02	--	6.95E-02	3.23E-02	6.95E-02	3.23E-02
602161	CCTA-09-GR-007-0.5-1.0-S	7-12-99	0.5-1.0	1.01E-01	1.56E-01	ND (4.68E-01)	--	7.23E-01	3.85E-01	ND (2.41E-02)	--	ND (2.41E-02)	--	ND (2.41E-02)	--
602161	CCTA-09-GR-008-0-0.5-S	7-12-99	0.0-0.5	ND (1.75E-01)	--	ND (4.76E-01)	--	ND (1.29E-01)	--	6.08E-02	--	6.08E-02	3.55E-02	6.08E-02	3.55E-02
602161	CCTA-09-GR-008-0.5-1.0-S	7-12-99	0.5-1.0	ND (1.69E-01)	--	ND (4.48E-01)	--	5.59E-01	3.30E-01	ND (2.01E-02)	--	ND (2.01E-02)	--	ND (2.01E-02)	--
602160	CCTA-09-GR-009-0-0.5-S	7-12-99	0.0-0.5	1.99E-01	1.56E-01	ND (7.02E-01)	--	6.74E-01	3.64E-01	6.52E-02	--	6.52E-02	6.58E-02	6.52E-02	6.58E-02
602161	CCTA-09-GR-009-0.5-1.0-S	7-12-99	0.5-1.0	ND (1.71E-01)	--	ND (4.44E-01)	--	6.35E-01	4.92E-01	7.30E-02	--	7.30E-02	3.92E-02	7.30E-02	3.92E-02
Mound 3 soil sample (location 029)															
602161	CCTA-09-GR-029-3.0-3.5-S	7-12-99	3.0-3.5	8.88E-02	1.65E-01	3.77E-01	4.26E-01	7.92E-01	4.25E-01	3.22E-02	4.25E-01	3.22E-02	2.53E-02	3.22E-02	2.53E-02
VCM excavation under Mound 1 samples (locations 030-047)															
602160	CCTA-09-GR-030-0-0.5-S	7-12-99	0.0-0.5	1.28E-01	1.59E-01	ND (7.02E-01)	--	7.41E-01	3.83E-01	5.59E-02	--	5.59E-02	4.90E-02	5.59E-02	4.90E-02
602161	CCTA-09-GR-030-0.5-1.0-S	7-12-99	0.5-1.0	ND (1.79E-01)	--	4.59E-01	3.62E-01	5.80E-01	3.49E-01	2.75E-02	--	2.75E-02	1.79E-02	2.75E-02	1.79E-02
602161	CCTA-09-GR-031-0-0.5-S	7-12-99	0.0-0.5	ND (1.74E-01)	--	ND (4.89E-01)	--	ND (1.38E-01)	--	3.49E-02	--	3.49E-02	3.58E-02	3.49E-02	3.58E-02
602161	CCTA-09-GR-031-0.5-1.0-S	7-12-99	0.5-1.0	ND (1.94E-01)	--	ND (5.79E-01)	--	7.08E-01	3.99E-01	ND (3.80E-02)	--	ND (3.80E-02)	--	ND (3.80E-02)	--
602160	CCTA-09-GR-032-0-0.5-S	7-12-99	0.0-0.5	ND (1.90E-01)	--	1.16E+00	6.56E-01	8.03E-01	7.28E-01	7.78E-02	--	7.78E-02	3.85E-02	7.78E-02	3.85E-02
602161	CCTA-09-GR-032-0-0.5-DU	7-12-99	0.0-0.5	ND (1.90E-01)	--	ND (5.47E-01)	--	8.53E-01	4.63E-01	8.25E-02	--	8.25E-02	4.11E-02	8.25E-02	4.11E-02
602161	CCTA-09-GR-032-0.5-1.0-S	7-12-99	0.5-1.0	8.91E-02	1.66E-01	8.77E-01	6.11E-01	7.10E-01	4.16E-01	ND (2.44E-02)	--	ND (2.44E-02)	--	ND (2.44E-02)	--
602161	CCTA-09-GR-033-0-0.5-S	7-12-99	0.0-0.5	ND (2.24E-01)	--	1.48E+00	5.68E-01	9.23E-01	5.20E-01	1.55E-01	--	1.55E-01	4.96E-02	1.55E-01	4.96E-02
602161	CCTA-09-GR-033-0.5-1.0-S	7-12-99	0.5-1.0	1.18E-01	7.90E-02	2.02E+00	5.62E-01	8.27E-01	5.04E-01	1.57E-01	--	1.57E-01	5.63E-02	1.57E-01	5.63E-02
602160	CCTA-09-GR-034-0-0.5-S	7-12-99	0.0-0.5	ND (1.93E-01)	--	2.15E+00	1.93E+00	7.75E-01	4.16E-01	3.20E-01	--	3.20E-01	6.49E-02	3.20E-01	6.49E-02
602161	CCTA-09-GR-034-0.5-1.0-S	7-12-99	0.5-1.0	8.82E-02	1.57E-01	ND (4.62E-01)	--	6.99E-01	3.60E-01	4.51E-02	--	4.51E-02	3.40E-02	6.99E-01	3.40E-02
602165	CCTA-09-GR-035-0-0.5-S	7-13-99	0.0-0.5	ND (2.32E-01)	--	ND (8.21E-01)	--	ND (1.47E-01)	--	ND (3.18E-02)	--	ND (3.18E-02)	--	ND (3.18E-02)	--

Refer to footnotes at end of table.

Table 10.4.5-2 (Concluded)
 Summary of SWMU 9 Confirmatory Soil Sampling Gamma Spectroscopy Analytical Results
 July 1999
 (On-Site Laboratory)

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

- ^a Analysis request/chain-of-custody record
 - ^b **Bold** portion of the Sample ID corresponds to the sample location in Figures 10.4.4-1 and 10.4.5.3-1.
 - ^c Two standard deviations about the mean detected activity.
 - ^d From Dinwiddie September 1997.
 - ^e Southwest background activities are presented where Coyote Test Field Background activities are not available.
 - ^f The more conservative, lower subsurface background activity is used as a benchmark for consistency with current risk screening assessment methodology.
- CCTA = Central Coyote Test Area.
 - DU = Duplicate sample.
 - EB = Equipment blank.
 - ER = Environmental Restoration.
 - ft = Foot (feet).
 - GR = Grab sample.
 - ID = Identification.
 - NA = Not applicable.
 - ND () = Not detected at or above the reported value, shown in parentheses.
 - pCi/g = Picocurie(s) per gram.
 - pCi/mL = Picocurie(s) per milliliter.
 - Rad = Radioactive.
 - S = Surface soil sample.
 - SWMU = Solid Waste Management Unit.
 - VCM = Voluntary corrective measure.
 - .. = Error not provided for nondetectable results.

activity of 1.8E-01 pCi/g only in the 0.0- to 0.5-foot sample at location 001. Cesium-137 (ND [2.33E-02] to 1.98E-01 pCi/g) were detected above the NMED-approved background activity of 7.9E-02 pCi/g in seven of the 12 background samples.

Gross Alpha/Gross Beta

Gross alpha /gross beta analyses give a site-specific range of 7.53 to 32.5 pCi/g for gross alpha and 20.8 to 35.0 pCi/g for gross beta (Table 10.4.5-3).

Arroyo Channel Sediment Samples

Soil samples were collected at three downstream locations west of the soil mounds and the site boundary (locations 007–009 on Figure 10.4.4-1). The samples were analyzed for TAL metals plus uranium, VOCs, HE, and radionuclides. The results are summarized below.

TAL Metals Plus Uranium

Table 10.4.5-1 presents the analytical results for the TAL metals plus uranium analyses. The 0.5- to 1.0-foot sample at location 008 (Figure 10.4.4-1) contained uranium (4.03 J mg/kg) above the NMED-approved background concentration of 3.42 mg/kg. This was the only metal in these samples that exceeded the NMED-approved background values; however, the antimony results were rejected during data validation (Annex D) for all but the 0.5- to 1.0-foot sample at location 009.

VOCs

Table 10.4.5-4 presents the analytical results for the VOC analyses. The 0.0- to 0.5-foot sample from location 008 (Figure 10.4.4-1) contained ethylbenzene (0.51 J µg/kg) and xylene (6.1 µg/kg). These were the only VOC detections in these samples. The MDLs for the VOC analysis are provided in Table 10.4.5-5.

Radionuclides

Table 10.4.5-2 presents the analytical results for the gamma spectroscopy analyses. The 0.0- to 0.5-foot sample from location 009 (Figure 10.4.4-1) contained uranium-235 (1.99E-01 pCi/g) at an activity above the NMED-approved background of 1.8E-01 pCi/g. All other radionuclides in these samples were below background values.

Gross Alpha/Gross Beta

Table 10.4.5-3 presents the analytical results for the gross alpha/gross beta analyses. Gross alpha (6.50 to 24.7 pCi/g) was within the same order of magnitude as the site-specific range of

Table 10.4.5-3
 Summary of SWMU 9 Confirmatory Soil Sampling
 Gross Alpha and Gross Beta Analytical Results
 July 1999
 (Off-Site Laboratory)

Sample Attributes				Activity (pCi/g)			
Record Number ^a	ER Sample ID ^b (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	Gross Alpha		Gross Beta	
				Result	Error ^c	Result	Error ^c
Site-specific background samples (locations 001-003)							
602158	CCTA-09-GR-001-0-0.5-S	7-12-99	0.0-0.5	14.1 J	3.83	24.5	3.87
602158	CCTA-09-GR-001-0.5-1.0-S	7-12-99	0.5-1.0	12.4 J	3.76	27.6	3.7
602158	CCTA-09-GR-002-0-0.5-S	7-12-99	0.0-0.5	15.0 J	3.84	24.6	3.56
602158	CCTA-09-GR-002-0.5-1.0-S	7-12-99	0.5-1.0	12.4 J	3.51	26.6	3.71
602158	CCTA-09-GR-003-0-0.5-S	7-12-99	0.0-0.5	10.1 J	3.26	20.8	3.23
602158	CCTA-09-GR-003-0.5-1.0-S	7-12-99	0.5-1.0	8.48 J	3.09	22.4	3.47
Arroyo sediment background samples (locations 004-006)							
602158	CCTA-09-GR-004-0-0.5-S	7-12-99	0.0-0.5	7.85 J	3.02	35.0	4.24
602158	CCTA-09-GR-004-0-0.5-DU	7-12-99	0.0-0.5	8.49 J	3.21	30.8	3.98
602158	CCTA-09-GR-004-0.5-1.0-S	7-12-99	0.5-1.0	7.53	2.41	29.0	3.07
602158	CCTA-09-GR-005-0-0.5-S	7-12-99	0.0-0.5	9.16	3.06	28.6	3.66
602158	CCTA-09-GR-005-0.5-1.0-S	7-12-99	0.5-1.0	15.0	3.66	28.8	3.34
602158	CCTA-09-GR-006-0-0.5-S	7-12-99	0.0-0.5	12.7	3.63	27.0	3.49
602158	CCTA-09-GR-006-0.5-1.0-S	7-12-99	0.5-1.0	32.5	5.07	33.9	3.47
Arroyo channel sediment samples (locations 007-009)							
602158	CCTA-09-GR-007-0-0.5-S	7-12-99	0.0-0.5	7.27	2.85	25.5	3.47
602158	CCTA-09-GR-007-0-0.5-DU	7-12-99	0.0-0.5	10.1	3.2	27.4	3.75
602158	CCTA-09-GR-007-0.5-1.0-S	7-12-99	0.5-1.0	10.7	3.37	33.4	3.62
602158	CCTA-09-GR-008-0-0.5-S	7-12-99	0.0-0.5	12.9	3.67	34.3	3.68
602158	CCTA-09-GR-008-0.5-1.0-S	7-12-99	0.5-1.0	6.50	3.14	30.3	4.45
602158	CCTA-09-GR-009-0-0.5-S	7-12-99	0.0-0.5	10.9	3.35	26.9	3.58
602158	CCTA-09-GR-009-0.5-1.0-S	7-12-99	0.5-1.0	24.7	4.83	27.8	3.62
Mound 3 soil sample (location 029)							
602159	CCTA-09-GR-029-3-0-3.5-S	7-12-99	3-3.5	15.6	4.39	27.5	4.15
VCM excavation under Mound 1 samples (locations 030-047)							
602159	CCTA-09-GR-030-0-0.5-S	7-12-99	0.0-0.5	12.1	4.01	26.8	4.02
602159	CCTA-09-GR-030-0.5-1.0-S	7-12-99	0.5-1.0	9.01	3.5	29.6	3.98
602159	CCTA-09-GR-031-0-0.5-S	7-12-99	0.0-0.5	13.7	4.33	30.8	4.26
602159	CCTA-09-GR-031-0.5-1.0-S	7-12-99	0.5-1.0	12.5	3.89	25.2	3.98
602159	CCTA-09-GR-032-0-0.5-S	7-12-99	0.0-0.5	16.1	4	27.3	3.78
602159	CCTA-09-GR-032-0-0.5-DU	7-12-99	0.0-0.5	12.9	3.96	23.3	3.75
602159	CCTA-09-GR-032-0.5-1.0-S	7-12-99	0.5-1.0	19.4	5.13	22.8	3.98
602159	CCTA-09-GR-033-0-0.5-S	7-12-99	0.0-0.5	15.0	3.99	23.9	3.71
602159	CCTA-09-GR-033-0.5-1.0-S	7-12-99	0.5-1.0	13.8	3.77	22.1	3.61
602159	CCTA-09-GR-034-0-0.5-S	7-12-99	0.0-0.5	15.0	3.79	30.7	3.85
602159	CCTA-09-GR-034-0.5-1.0-S	7-12-99	0.5-1.0	11.7	3.54	30.8	3.8
602162	CCTA-09-GR-035-0-0.5-S	7-13-99	0.0-0.5	16.0	4.1	28.5	3.84
602162	CCTA-09-GR-035-0.5-1.0-S	7-13-99	0.5-1.0	16.5	4.1	29.7	3.9
602162	CCTA-09-GR-036-0-0.5-S	7-13-99	0.0-0.5	16.2	4.19	34.1	4.21
602162	CCTA-09-GR-036-0.5-1.0-S	7-13-99	0.5-1.0	19.2	4.49	33.7	4.09
602162	CCTA-09-GR-036-0.5-1.0-DU	7-13-99	0.5-1.0	18.0	4.28	31.8	4.03
602162	CCTA-09-GR-037-0-0.5-S	7-13-99	0.0-0.5	12.8	3.46	27.4	3.51
602162	CCTA-09-GR-037-0.5-1.0-S	7-13-99	0.5-1.0	14.1	3.78	27.9	3.98
602162	CCTA-09-GR-038-0-0.5-S	7-13-99	0.0-0.5	16.0	3.94	27.1	3.82
602162	CCTA-09-GR-038-0.5-1.0-S	7-13-99	0.5-1.0	9.07	3.24	31.2	3.89
602162	CCTA-09-GR-039-0-0.5-S	7-13-99	0.0-0.5	12.7	3.55	22.6	3.57
602162	CCTA-09-GR-039-0.5-1.0-S	7-13-99	0.5-1.0	12.3	3.62	24.5	3.75
602162	CCTA-09-GR-040-0-0.5-S	7-13-99	0.0-0.5	12.9	3.39	26.3	3.56

Refer to footnotes at end of table.

Table 10.4.5-3 (Concluded)
 Summary of SWMU 9 Confirmatory Soil Sampling
 Gross Alpha and Beta Analytical Results
 July 1999
 (Off-Site Laboratory)

Sample Attributes				Activity (pCi/g)			
Record Number ^a	ER Sample ID ^b (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	Gross Alpha		Gross Beta	
				Result	Error ^c	Result	Error ^c
602162	CCTA-09-GR- 040 -0.5-1.0-S	7-13-99	0.5-1.0	16.2	4.12	28.3	3.87
602162	CCTA-09-GR- 041 -0-0.5-S	7-13-99	0.0-0.5	15.1	4	25.1	3.89
602162	CCTA-09-GR- 041 -0-0.5-DU	7-13-99	0.0-0.5	16.7	4.11	21.9	3.65
602162	CCTA-09-GR- 041 -0.5-1.0-S	7-13-99	0.5-1.0	11.7	3.83	24.5	3.85
602162	CCTA-09-GR- 042 -0-0.5-S	7-13-99	0.0-0.5	22.9	5.02	29.0	3.94
602162	CCTA-09-GR- 042 -0.5-1.0-S	7-13-99	0.5-1.0	13.2	3.85	27.7	4.02
602162	CCTA-09-GR- 043 -0-0.5-S	7-13-99	0.0-0.5	18.3	4.76	28.8	4.32
602162	CCTA-09-GR- 043 -0.5-1.0-S	7-13-99	0.5-1.0	13.6	3.76	27.8	3.82
602163	CCTA-09-GR- 044 -0-0.5-S	7-13-99	0.0-0.5	18.3	4.25	37.1	4.2
602163	CCTA-09-GR- 044 -0.5-1.0-S	7-13-99	0.5-1.0	19.7	4.85	38.6	4.58
602163	CCTA-09-GR- 045 -0-0.5-S	7-13-99	0.0-0.5	18.0	4.45	41.1	4.48
602163	CCTA-09-GR- 045 -0-0.5-DU	7-13-99	0.0-0.5	26.4	5.33	49.4	4.94
602163	CCTA-09-GR- 045 -0.5-1.0-S	7-13-99	0.5-1.0	17.7	4.07	29.4	3.84
602163	CCTA-09-GR- 046 -0-0.5-S	7-13-99	0.0-0.5	12.4	3.57	27.9	3.73
602163	CCTA-09-GR- 046 -0.5-1.0-S	7-13-99	0.5-1.0	18.9	4.49	37.3	4.44
602163	CCTA-09-GR- 047 -0-0.5-S	7-13-99	0.0-0.5	12.3	3.58	30.1	3.86
602163	CCTA-09-GR- 047 -0.5-1.0-S	7-13-99	0.5-1.0	11.9	3.56	27.8	3.96
Burial Pit samples (locations 048-050)							
602163	CCTA-09-GR- 048 -0-0.5-S	7-13-99	0.0-0.5	19.2	4.05	31.9	3.7
602163	CCTA-09-GR- 048 -0.5-1.0-S	7-13-99	0.5-1.0	13.6	3.53	31	3.88
602163	CCTA-09-GR- 049 -0-0.5-S	7-13-99	0.0-0.5	23.8	4.71	42.4	4.22
602163	CCTA-09-GR- 049 -0.5-1.0-S	7-13-99	0.5-1.0	21.3	4.58	45	4.62
602163	CCTA-09-GR- 050 -0-0.5-S	7-13-99	0.0-0.5	14.1	3.78	32.3	4.24
602163	CCTA-09-GR- 050 -0.5-1.0-S	7-13-99	0.5-1.0	13	3.64	30.2	3.86
Quality Assurance/Quality Control Samples (pCi/L)							
602159	CCTA-09-GR-000-EB	7-12-99	NA	1.02	0.699	0.256	1.33
602163	CCTA-09-GR-000-EB	7-13-99	NA	0.956	0.488	1.85	0.869

^a Analysis request/chain-of-custody record.

^b **Bold** portion of the Sample ID corresponds to the sample location in Figures 10.4.4-1 and 10.4.5.3-1.

^c Two standard deviations about the mean detected activity.

- CCTA = Central Coyote Test Area.
- DU = Duplicate sample.
- EB = Equipment blank.
- ER = Environmental Restoration.
- ft = Foot (feet).
- GR = Grab sample.
- ID = Identification.
- J = Estimated value. See Data Validation report.
- NA = Not applicable.
- pCi/g = Picocurie(s) per gram.
- pCi/L = Picocurie(s) per liter.
- Rad = Radioactive.
- S = Soil sample.
- SWMU = Solid Waste Management Unit.
- VCM = Voluntary corrective measure.

Table 10.4.5-4
 Summary of SWMU 9 Confirmatory Soil Sampling VOC Analytical Results
 July 1999
 (Off-Site Laboratory)

Sample Attributes				VOCs (EPA Method 8260) ^a (µg/kg)						
Record Number ^b	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	Acetone	Chloroform	Ethylbenzene	Methylene chloride	Toluene	Trichloroethene	Xylene
Arroyo channel sediment samples (locations 007-009)										
602158	CCTA-09-GR-007-0-0.5-S	7-12-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)
602158	CCTA-09-GR-007-0-0.5-DU	7-12-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)
602158	CCTA-09-GR-007-0.5-1.0-S	7-12-99	0.5-1.0	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)
602158	CCTA-09-GR-008-0-0.5-S	7-12-99	0.0-0.5	ND (10.3)	ND (1.0 U)	0.51 J (1.00)	ND (1.4)	ND (0.9)	ND (0.3)	6.1
602158	CCTA-09-GR-008-0.5-1.0-S	7-12-99	0.5-1.0	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)
602158	CCTA-09-GR-009-0-0.5-S	7-12-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)
602158	CCTA-09-GR-009-0.5-1.0-S	7-12-99	0.5-1.0	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)
Mound 3 soil sample (location 029)										
602159	CCTA-09-GR-029-3.0-3.5-S	7-12-99	3.0-3.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	3.2 J
VCM excavation under Mound 1 samples (locations 030-047)										
602159	CCTA-09-GR-030-0-0.5-S	7-12-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7 J)
602159	CCTA-09-GR-030-0.5-1.0-S	7-12-99	0.5-1.0	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7 J)
602159	CCTA-09-GR-031-0-0.5-S	7-12-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7 J)
602159	CCTA-09-GR-031-0.5-1.0-S	7-12-99	0.5-1.0	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7 J)
602159	CCTA-09-GR-032-0-0.5-S	7-12-99	0.0-0.5	ND (10.3)	ND (1.1 U)	ND (0.3)	ND (9.5 U)	ND (0.9)	ND (0.3)	3.3 J
602159	CCTA-09-GR-032-0-0.5-DU	7-12-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7 J)
602159	CCTA-09-GR-032-0.5-1.0-S	7-12-99	0.5-1.0	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	3.9 J
602159	CCTA-09-GR-033-0-0.5-S	7-12-99	0.0-0.5	ND (10.3)	ND (1.5 U)	ND (0.3)	44	1.5	ND (0.3)	3.2 J
602159	CCTA-09-GR-033-0.5-1.0-S	7-12-99	0.5-1.0	ND (10.3)	ND (1.5 U)	ND (0.3)	26	1.7	ND (0.3)	4.1 J
602159	CCTA-09-GR-034-0-0.5-S	7-12-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7 J)
602159	CCTA-09-GR-034-0.5-1.0-S	7-12-99	0.5-1.0	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7 J)
602162	CCTA-09-GR-035-0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	18	ND (0.9)	ND (0.3)	ND (0.7)
602162	CCTA-09-GR-035-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)
602162	CCTA-09-GR-036-0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	ND (9.6 U)	ND (0.9)	ND (0.3)	ND (0.7)
602162	CCTA-09-GR-036-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)
602162	CCTA-09-GR-036-0.5-1.0-DU	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)
602162	CCTA-09-GR-037-0-0.5-S	7-13-99	0.0-0.5	13 J (25.0)	ND (0.1)	ND (0.3)	ND (8.4 U)	1.1	ND (0.3)	1.0 J (2.00)

Refer to footnotes at end of table.

Table 10.4.5-4 (Continued)
 Summary of SWMU 9 Confirmatory Soil Sampling VOC Analytical Results,
 July 1999
 (Off-Site Laboratory)

Record Number ^b	Sample Attributes			VOCs (EPA Method 8260) ^a (µg/kg)									
	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	Acetone	Chloroform	Ethylbenzene	Methylene chloride	Toluene	Trichloroethene	Xylene			
602162	CCTA-09-GR-037-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (7.0 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-038-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	15	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-038-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-039-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	ND (6.3 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-039-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	0.51 J (1.00)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-040-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	0.97 J (1.00)	0.52 J (1.00)	33	2.6	0.58 J (1.00)	1.2 J (2.00)			
602162	CCTA-09-GR-040-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (8.2 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-041-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	ND (6.3 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-041-0.0-0.5-DU	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	ND (6.5 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-041-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-042-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-042-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)			
602162	CCTA-09-GR-043-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	ND (7.1 U)	1.4	ND (0.3)	0.81 J (2.00)			
602162	CCTA-09-GR-043-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-044-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	33	1.6	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-044-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	18	ND (0.9)	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-045-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	25	1.6	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-045-0.0-0.5-DU	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	26	1.3	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-045-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	41	1.4	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-046-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (1.0 U)	0.47 J (1.00)	23	2.8	ND (0.3)	1.1 J (2.00)			
602163	CCTA-09-GR-046-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-047-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (1.1 U)	0.44 J (1.00)	14	2.4	ND (0.3)	0.81 J (2.00)			
602163	CCTA-09-GR-047-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (1.2 U)	ND (0.3)	26	1.6	ND (0.3)	ND (0.7)			
Burial Pit samples (locations 048-050)													
602163	CCTA-09-GR-048-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (1.0 U)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-048-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-049-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-049-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-050-0.0-0.5-S	7-13-99	0.0-0.5	ND (10.3)	ND (0.1)	ND (0.3)	ND (5.0 U)	ND (0.9)	ND (0.3)	ND (0.7)			
602163	CCTA-09-GR-050-0.5-1.0-S	7-13-99	0.5-1.0	ND (10.3)	ND (0.1)	ND (0.3)	ND (1.4)	ND (0.9)	ND (0.3)	ND (0.7)			

Refer to footnotes at end of table.

Table 10.4.5-4 (Concluded)
 Summary of SWMU 9 Confirmatory Soil Sampling VOC Analytical Results
 July 1999
 (Off-Site Laboratory)

Record Number ^b	Sample Attributes			VOCs (EPA Method 8260) ^a (µg/kg)						
	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	Acetone	Chloroform	Ethylbenzene	Methylene chloride	Toluene	Trichloroethene	Xylene
602159	CCTA-09-GR-000-EB	7-12-99	NA	3.7 J (5.00)	ND (0.7)	ND (0.3)	ND (1.2)	ND (0.5)	ND (0.6 J)	ND (1.1)
602159	CCTA-09-GR-000-TB	7-12-99	NA	ND (3.7)	ND (0.7)	ND (0.3)	1.5 J (5.00)	ND (0.5)	ND (0.6 J)	ND (1.1)
602163	CCTA-09-GR-000-EB	7-13-99	NA	ND (3.7)	ND (0.7)	ND (0.3)	1.3 J (5.00)	ND (0.5)	ND (0.6)	ND (1.1)
602163	CCTA-09-GR-000-TB	7-13-99	NA	ND (3.7)	ND (0.7)	ND (0.3)	ND (1.2)	ND (0.5)	ND (0.6)	ND (1.1)

Note: Values in **bold** represent detected VOCs.

^a EPA November 1986.

^b Analysis request/chain-of-custody record.

^c **bold** portion of the Sample ID corresponds to the sample location in Figures 10.4.4-1 and 10.4.5.3-1.

CCTA = Central Coyote Test Area.

DU = Duplicate sample.

EB = Equipment blank.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ft = Foot (feet).

GR = Grab sample.

ID = Identification.

J = Estimated value. See Data Validation report

J () = The reported value is greater than or equal to the method detection limit but is less than the practical quantitation limit, shown in parentheses.

µg/kg = Microgram(s) per kilogram.

µg/L = Microgram(s) per liter.

NA = Not applicable.

ND () = Not detected at or above the reported value, shown in parentheses.

Rad = Radioactive.

S = Soil sample.

SWMU = Solid Waste Management Unit.

TB = Trip blank.

U = Nondetected value. See Data Validation report.

VCM = Voluntary corrective measure.

VOC = Volatile organic compound.

Table 10.4.5-5
 VOC Analytical Method Detection Limits (EPA Method 8260)^a
 Used for SWMU 9 Confirmatory Soil Sampling
 July 1999
 (Off-Site Laboratory)

Analyte	Soil Sample MDL ($\mu\text{g}/\text{kg}$)	Aqueous Sample MDL ($\mu\text{g}/\text{L}$)
Acetone	10.3	3.7
Benzene	0.5	0.3
Bromoform	0.3	0.4
2-Butanone	3.2	5.9
Carbon disulfide	0.3	1.8
Carbon tetrachloride	0.5	0.2
Chlorobenzene	0.3	0.3
Chlorodibromomethane	0.2	0.3
Chloroethane	0.3	0.3
Chloroform	0.1	0.7
Dichlorobromomethane	0.1	0.4
1,1-Dichloroethane	0.1	0.4
1,2-Dichloroethane	0.2	0.2
1,1-Dichloroethylene	0.3	0.7
cis-1,2-Dichloroethylene	0.1	0.7
trans-1,2-Dichloroethylene	0.1	0.3
1,2-Dichloropropane	0.2	0.2
cis-1,3-Dichloropropylene	0.2	0.3
trans-1,3-Dichloropropylene	0.3	0.3
Ethylbenzene	0.3	0.3
2-Hexanone	2.8	3.2
Methyl bromide	0.3	0.4
Methyl chloride	0.2	0.2
Methylene chloride	1.4	0.2
4-Methyl-2-pentanone	3.1	1.6
Styrene	0.3	0.2
1,1,2,2-Tetrachloroethane	0.6	0.5
Tetrachloroethylene	0.4	0.7
Toluene	0.9	0.5
1,1,1-Trichloroethane	0.1	0.2
1,1,2-Trichloroethane	0.3	0.4
Trichloroethylene	0.3	0.6
Vinyl acetate	2.1	1.8
Vinyl chloride	0.4	0.4
Xylenes (total)	0.7	1.1

^aEPA November 1986.

EPA = U.S. Environmental Protection Agency.

MDL = Method detection limit.

$\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.

$\mu\text{g}/\text{L}$ = Microgram(s) per liter.

SWMU = Solid Waste Management Unit.

VOC = Volatile organic compound.

7.53 to 32.5 pCi/g. Gross beta (25.5 to 34.3 pCi/g) was within the same order of magnitude of the site-specific range of 20.8 to 35.0 pCi/g.

Mound 3 Samples

As previously mentioned in Section 10.4.4.3, when a trench was cut into this feature during the 1996 sampling event (location 029 on Figure 10.4.4-2), it was discovered to be a natural terrace deposit along the arroyo wall rather than an actual burial mound. Nevertheless, a sample was collected at the same level as the arroyo channel (i.e., 3.0- to 3.5-feet below the terrace top). The sample was analyzed for TAL metals plus uranium, VOCs, SVOCs, HE, and radionuclides. The results are summarized below.

TAL Metals plus Uranium

Table 10.4.5-1 presents the analytical results for the TAL metals plus uranium analyses. All metals were below their NMED-approved background concentrations.

VOCs

Table 10.4.5-4 presents the analytical results for the VOC analysis. Xylene (3.2 J $\mu\text{g}/\text{kg}$) was the only VOC compound detected in this sample. The MDLs for the VOC analysis are provided in Table 10.4.5-5.

SVOCs

Table 10.4.5-6 presents the analytical results for the SVOC analysis. No SVOC compounds were detected in this sample. The MDLs for the SVOC analysis are provided in Table 10.4.5-7.

HE

Table 10.4.5-8 presents the analytical results for the HE analysis. HMX (1,400 $\mu\text{g}/\text{kg}$) and RDX (3,200 $\mu\text{g}/\text{kg}$) were detected in this sample. This conflicts with the on-site analytical data from the 1996 sampling where no HE compounds were detected. The MDLs used for the HE analyses are provided in Table 10.4.5-9.

Radionuclides

Table 10.4.5-2 presents the analytical results for the gamma spectroscopy analyses. No isotopes were present above their respective NMED-approved background activities.

Table 10.4.5-6
 Summary of SWMU 9 Confirmatory Soil Sampling SVOC Analytical Results
 July 1999
 (Off-Site Laboratory)

Record Number ^b	Sample Attributes				SVOCs (EPA Method 8270) ^a (µg/kg)						
	ER Sample ID ^c (Figures 10.10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	2,4-Dinitrotoluene	Anthracene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Pentachlorophenol		
Mound 3 soil sample (location 029)											
602159	CCTA-09-GR-029-3.0-3.5-S	7-12-99	3.0-3.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
VCM excavation under Mound 1 samples (locations 030-047)											
602159	CCTA-09-GR-030-0-0.5-S	7-12-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-030-0.5-1.0-S	7-12-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-031-0-0.5-S	7-12-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-031-0.5-1.0-S	7-12-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-032-0-0.5-S	7-12-99	0-0.5	440	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-032-0-0.5-DU	7-12-99	0-0.5		ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-032-0.5-1.0-S	7-12-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-033-0-0.5-S	7-12-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-033-0.5-1.0-S	7-12-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602159	CCTA-09-GR-034-0-0.5-S	7-12-99	0-0.5	ND (117)	ND (88)	ND (72)	130 J (333)	ND (55)	ND (57)		
602159	CCTA-09-GR-034-0.5-1.0-S	7-12-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-035-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-035-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-036-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-036-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-036-0.5-1.0-DU	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-037-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-037-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-038-0-0.5-S	7-13-99	0-0.5	720	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-038-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-039-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-039-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-040-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-040-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-041-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-041-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-042-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-042-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-043-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		
602162	CCTA-09-GR-043-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)		

Refer to footnotes at end of table.

Table 10.4.5-6 (Concluded)
 Summary of SWMU 9 Confirmatory Soil Sampling SVOC Analytical Results
 July 1999
 (Off-Site Laboratory)

Sample Attributes			SVOCs (EPA Method 8270) ^a (µg/kg)							
Record Number ^b	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	2,4-dinitrotoluene	Anthracene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Pentachlorophenol	
602163	CCTA-09-GR-044-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	220 J (667)	
602163	CCTA-09-GR-044-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	230 J (667)	
602163	CCTA-09-GR-045-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	120 J (333)	110 J (333)	120 J (333)	280 J (667)	
602163	CCTA-09-GR-045-0-0.5-DU	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	71 J (333)	270 J (667)	
602163	CCTA-09-GR-045-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	230 J (667)	
602163	CCTA-09-GR-046-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
602163	CCTA-09-GR-046-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
602163	CCTA-09-GR-047-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
602163	CCTA-09-GR-047-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
Burial Pit samples (locations 04B-050)										
602163	CCTA-09-GR-048-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
602163	CCTA-09-GR-048-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
602163	CCTA-09-GR-049-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
602163	CCTA-09-GR-049-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
602163	CCTA-09-GR-050-0-0.5-S	7-13-99	0-0.5	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
602163	CCTA-09-GR-050-0.5-1.0-S	7-13-99	0.5-1.0	ND (117)	ND (88)	ND (72)	ND (81)	ND (55)	ND (57)	
Quality Assurance/Quality Control Samples (µg/L)										
602159	CCTA-09-GR-000-EB	7-12-99	NA	ND (1.4)	ND (2.3)	ND (2)	ND (2.5)	ND (2.2)	ND (2.8)	
602163	CCTA-09-GR-000-EB	7-13-99	NA	ND (1.4)	ND (2.3)	ND (2)	ND (2.5)	ND (2.2)	ND (2.8)	

Note: Values in bold represent detected SVOCs.

^a EPA November 1986.

^b Analysis request/chain-of-custody record.

^c Bold portion of the Sample ID corresponds to the sample location in Figures 10.4.4-1 and 10.4.5.3-1.

CCTA = Central Coyote Test Area.

DU = Duplicate sample.

EB = Equipment blank.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ft = Foot (feet).

GR = Grab sample.

ID = Identification.

J () = The reported value is greater than or equal to the method detection limit but is less than the practical quantitation limit, shown in parentheses.

µg/kg

µg/L

NA

ND ()

Rad

S

SVOC

SWMU

VCM

= Microgram(s) per kilogram.

= Microgram(s) per liter.

= Not applicable.

= Not detected at or above the reported value, shown in parentheses.

= Radioactive.

= Soil sample.

= Semivolatile organic compound.

= Solid Waste Management Unit.

= Voluntary corrective measure.

Table 10.4.5-7
 SVOC Analytical Method Detection Limits (EPA Method 8270)^a
 Used for SWMU 9 Confirmatory Soil Sampling
 July 1999
 (Off-Site Laboratory)

Analyte	Soil Sample MDL ($\mu\text{g}/\text{kg}$)	Aqueous Sample MDL ($\mu\text{g}/\text{L}$)
Acenaphthene	160	2.2
Acenaphthylene	147	1.3
Anthracene	88	2.3
Benzo(a)anthracene	68	2.8
Benzo(a)pyrene	72	2.0
Benzo(b)fluoranthene	142	4.7
Benzo(g,h,i)perylene	81	2.5
Benzo(k)fluoranthene	132	2.6
Benzoic acid	893	9.3
Benzyl alcohol	230	2.5
4-Bromophenyl phenyl ether	118	0.03
Butylbenzyl phthalate	90	3.7
4-Chloroaniline	155	1.5
Bis(2-chloroethoxy)methane	169	2.5
Bis(2-chloroethyl)ether	53	2.0
Bis(2-chloroisopropyl)ether	105	0.61
4-Chloro-3-methyl phenol	128	3.1
2-Chloronaphthalene	173	2.4
2-Chlorophenol	157	2.1
4-Chlorophenyl phenyl ether	146	2.8
Chrysene	55	2.2
m,p-Cresol	153	1.8
o-Cresol	63	2.1
Dibenzo(a,h)anthracene	83	2.2
Dibenzofuran	134	4.3
Di-n-butylphthalate	73	2.9
1,2-Dichlorobenzene	171	2.7
1,3-Dichlorobenzene	129	2.5
1,4-Dichlorobenzene	61	2.3
3,3'-Dichlorobenzidine	278	4.2
2,4-Dichlorophenol	176	1.4
Diethylphthalate	76	2.1
2,4-Dimethylphenol	109	6.1
Dimethylphthalate	109	2.1
2,4-Dinitrophenol	368	7.9
2,4-Dinitrotoluene	117	1.4
2,6-Dinitrotoluene	140	1.1
Di-n-octylphthalate	174	4.2
1,2-Diphenylhydrazine	57	2.3
Bis(2-ethylhexyl)phthalate	299	3.7
Fluoranthene	65	3.1
Fluorene	114	2.1

Refer to footnotes at end of table.

Table 10.4.5-7 (Concluded)
 Summary of SVOC Analytical Method Detection Limits (EPA Method 8270)
 Used for SWMU 9 Confirmatory Soil Sampling
 July 1999
 (Off-Site Laboratory)

Analyte	Soil Sample MDL ($\mu\text{g}/\text{kg}$)	Aqueous Sample MDL ($\mu\text{g}/\text{L}$)
Hexachlorobenzene	70	2.9
Hexachlorobutadiene	153	3.8
Hexachlorocyclopentadiene	193	4.4
Hexachloroethane	132	3.4
Ideno(1,2,3-cd)pyrene	80	3.4
Isophorone	146	2.6
2-Methyl-4,6-dinitrophenol	101	0.67
2-Methylnaphthalene	204	3.2
Naphthalene	157	2.0
m-Nitroaniline	83	1.8
o-Nitroaniline	67	2.8
p-Nitroaniline	103	1.0
Nitrobenzene	132	3.3
2-Nitrophenol	181	2.9
4-Nitrophenol	109	3.5
n-Nitrosodiphenylamine	21	5.0
n-Nitrosodipropylamine	129	5.0
Pentachlorophenol	57	2.8
Phenanthrene	60	1.8
Phenol	57	0.8
Pyrene	72	2.5
1,2,4-Trichlorobenzene	186	2.4
2,4,5-Trichlorophenol	154	2.5
2,4,6-Trichlorophenol	77	0.96

^aEPA November 1986.

EPA = U.S. Environmental Protection Agency.

MDL = Method detection limit.

$\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.

$\mu\text{g}/\text{L}$ = Microgram(s) per liter.

SVOC = Semivolatile organic compound.

SWMU = Solid Waste Management Unit.

Table 10.4.5-8
 Summary of SWMU 9 Confirmatory Soil Sampling HE Analytical Results
 July 1999
 (Off-Site Laboratory)

Record Number ^b	Sample Attributes			Analyte (EPA Method 8330) ^a (µg/kg)							RDX
	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	1,3,5-Trinitrobenzene	2,4,6-Trinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-dinitrotoluene	4-Amino-2,6-dinitrotoluene	HMX		
Mound 3 soil sample (location 029)											
602159	CCTA-09-GR-029-3.0-3.5-S	7-12-99	3.0-3.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	1,400	3,200	
VCM excavation under Mound 1 samples (locations 030-047)											
602159	CCTA-09-GR-030-0.0-0.5-S	7-12-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-030-0.5-1.0-S	7-12-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-031-0.0-0.5-S	7-12-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-031-0.5-1.0-S	7-12-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-032-0.0-0.5-S	7-12-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-032-0.5-1.0-S	7-12-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-033-0.0-0.5-S	7-12-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-033-0.5-1.0-S	7-12-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-034-0.0-0.5-S	7-12-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602159	CCTA-09-GR-034-0.5-1.0-S	7-12-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602162	CCTA-09-GR-035-0.0-0.5-S	7-12-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602162	CCTA-09-GR-035-0.5-1.0-S	7-12-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602162	CCTA-09-GR-036-0.0-0.5-S	7-12-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602162	CCTA-09-GR-036-0.5-1.0-S	7-12-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602162	CCTA-09-GR-037-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	1,400	160	480	500	890 J	1,000 J	
602162	CCTA-09-GR-037-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	2,000	440	440	460	1,800 J	2,400 J	
602162	CCTA-09-GR-038-0.0-0.5-S	7-13-99	0.0-0.5	670	18,000	840	840	1,000	730 J	18,000 J	
602162	CCTA-09-GR-038-0.5-1.0-S	7-13-99	0.5-1.0	510	15,000	590	590	760	180 J	800 J	
602162	CCTA-09-GR-039-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602162	CCTA-09-GR-039-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602162	CCTA-09-GR-040-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	130	170	170	140	480 J	2,400 J	
602162	CCTA-09-GR-040-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	170	170	170	140	940 J	26,000 J	
VCM excavation under Mound 1 samples (locations 030-047)											
602162	CCTA-09-GR-041-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	1,100 J	4,200 J	
602162	CCTA-09-GR-041-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	1,100	2,800	
602162	CCTA-09-GR-042-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	170	170	170	140 J	270 J	1,100 J	
602162	CCTA-09-GR-042-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	250 J	250 J	150 J	140 J	6,200 J	6,700 J	
602162	CCTA-09-GR-043-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	1,100 J	2,100 J	
602162	CCTA-09-GR-043-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	160 J	110 J	
602162	CCTA-09-GR-044-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3)	ND (9.7)	
602163	CCTA-09-GR-044-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	880	880	830	640	1,100 J	2,900	

Refer to footnotes at end of table.

Table 10.4.5-8 (Concluded)
 Summary of SWMU 9 Confirmatory Soil Sampling HE Analytical Results
 July 1999
 (Off-Site Laboratory)

Sample Attributes			HE (EPA Method 8330) ^a (µg/kg)									
Record Number ^b	ER Sample ID ^c (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Date	Sample Depth (ft)	1,3,5-trinitrobenzene	2,4,6-trinitrotoluene	2,6-dinitrotoluene	2-amino-4,6-dinitrotoluene	4-amino-2,6-dinitrotoluene	HMX	RDX		
602163	CCTA-09-GR-044-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	17,000	ND (6.5)	710	630	1,200 J	2,200		
602163	CCTA-09-GR-045-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	1,800	ND (6.5)	570	460	1,100 J	1,600		
602163	CCTA-09-GR-045-0.0-0.5-DU	7-13-99	0.0-0.5	ND (6.6)	1,200	ND (6.5)	740	630	2,700 J	1,300		
602163	CCTA-09-GR-045-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	990	ND (6.5)	160	130	1,100 J	2,400		
602163	CCTA-09-GR-046-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3 J)	92		
602163	CCTA-09-GR-046-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	150 J	660		
602163	CCTA-09-GR-047-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	1,500 J	ND (9.7)		
602163	CCTA-09-GR-047-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3 J)	ND (9.7)		
Burial Pit samples (locations 048-050)												
602163	CCTA-09-GR-048-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3 J)	ND (9.7)		
602163	CCTA-09-GR-048-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3 J)	ND (9.7)		
602163	CCTA-09-GR-049-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3 J)	ND (9.7)		
602163	CCTA-09-GR-049-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3 J)	ND (9.7)		
602163	CCTA-09-GR-050-0.0-0.5-S	7-13-99	0.0-0.5	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3 J)	ND (9.7)		
602163	CCTA-09-GR-050-0.5-1.0-S	7-13-99	0.5-1.0	ND (6.6)	ND (5.7)	ND (6.5)	ND (6.6)	ND (5.5)	ND (5.3 J)	ND (9.7)		
Quality Assurance/Quality Control Samples (µg/L)												
602159	CCTA-09-GR-000-EB	7-12-99	NA	ND (0.021)	ND (0.029)	ND (0.043)	ND (0.019)	ND (0.02)	ND (0.046)	ND (0.018)		
602163	CCTA-09-GR-000-EB	7-13-99	NA	ND (0.021)	ND (0.029)	ND (0.043)	ND (0.019)	0.22	ND (0.046)	ND (0.018)		

Note: Values in **bold** represent detected HE analytes.

^aEPA November 1986.

^bAnalysis request/chain-of-custody record.

^c**Bold** portion of the Sample ID corresponds to the sample location in Figures 10.4.4-1 and 10.4.5.3-1.

CCTA = Central Coyote Test Area.

DU = Duplicate sample.

EB = Equipment blank.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ft = Foot (feet).

GR = Grab sample.

HE = High explosive(s).

HMX = 1,3,5,7-Tetranitro-1,3,5,7-tetraazacyclooctane.

ID = Identification.

J = Estimated value. See Data Validation report.

µg/kg = Microgram(s) per kilogram.

µg/L = Microgram(s) per liter.

NA = Not applicable.

ND () = Not detected at or above the reported value, shown in parentheses.

RDX = 1,3,5-Trinitro-1,3,5-triazacyclohexane.

S = Soil sample.

SWMU = Solid Waste Management Unit.

VCM = Voluntary corrective measure.

Table 10.4.5-9
 HE Analytical Method Detection Limits (EPA Method 8330)^a
 Used for SWMU 9 Confirmatory Soil Sampling
 July 1999
 (Off-Site Laboratory)

Analyte	Soil Sample MDL ($\mu\text{g}/\text{kg}$)	Aqueous Sample MDL ($\mu\text{g}/\text{L}$)
1,3-Dinitrobenzene	4.1	0.02
2-Amino-4,6-dinitrotoluene	6.6	0.019
4-Amino-2,6-dinitrotoluene	5.5	0.02
2,4-Dinitrotoluene	6.2	0.014
2,6-Dinitrotoluene	6.5	0.043
HMX	5.3	0.046
Nitrobenzene	5.2	0.016
m-Nitrotoluene	11	0.031
o-Nitrotoluene	7.8	0.024
p-Nitrotoluene	11	0.034
RDX	9.7	0.018
Tetryl	7.5	0.022
1,3,5-Trinitrobenzene	6.6	0.021
2,4,6-Trinitrotoluene	5.7	0.029

^aEPA November 1986.

EPA = U.S. Environmental Protection Agency.

HE = High explosive(s).

HMX = 1,3,5,7-Tetranitro-1,3,5,7-tetrazacyclooctane.

MDL = Method detection limit.

$\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.

$\mu\text{g}/\text{L}$ = Microgram(s) per liter.

RDX = 1,3,5-Trinitro-1,3,5-triazacyclohexane.

SWMU = Solid Waste Management Unit.

Tetryl = 2,4,6-Trinitrophenylmethylnitramine.

Gross Alpha/Gross Beta

Table 10.4.5-3 presents the analytical results for the gross alpha/gross beta analyses. Gross alpha (15.6 pCi/g) was within the same order of magnitude as the site-specific range of 7.53 to 32.5 pCi/g. Gross beta (27.5 pCi/g) was within the same order of magnitude as the site-specific range of 20.8 to 35.0 pCi/g.

VCM Excavation at Mound 1 Samples

Forty soil samples, including four duplicates, were collected at 18 locations in the VCM excavation at the south end of Mound 1 (locations 030 to 047 on Figure 10.4.5.3-1). The samples were analyzed for TAL metals plus uranium, VOCs, SVOCs, HE, and radionuclides. The results are summarized below.

TAL Metals Plus Uranium

Table 10.4.5-1 presents the analytical results for the TAL metals plus uranium analyses. Eleven metals were detected at concentrations above the NMED-approved background limit. The results are summarized below.

Barium (50.4 to 209 J mg/kg) exceeded the NMED-approved background of 130 mg/kg in 15 samples from nine locations. Cadmium (ND [0.019] to 1.90 mg/kg) exceeded the NMED-approved background of 0.9 mg/kg in three samples from three locations. Chromium (5.42 to 21.8 mg/kg) exceeded the NMED-approved background of 17.3 mg/kg in one sample from location 034, and in both samples and one duplicate at location 045. Cobalt (3.22 to 5.70 mg/kg) exceeded the NMED-approved background of 5.2 mg/kg in thirteen samples from eight locations. Copper (7.66 to 536 J mg/kg) exceeded the NMED-approved background of 15.4 mg/kg in 21 samples from 12 locations. Lead (4.62 to 126 mg/kg) exceeded the NMED-approved background of 21.4 mg/kg in 17 samples from 10 locations. Mercury (ND [0.00225-0.0333] to 0.296 mg/kg) exceeded the NMED-approved background of <0.1 mg/kg in three samples from two locations. Nickel (6.28 to 14.1 J mg/kg) exceeded the NMED-approved background of 11.5 mg/kg in seven samples from five locations. Uranium (0.613 to 19.5 mg/kg) exceeded the NMED-approved background of 3.42 mg/kg in 27 samples from 14 of the 18 locations. Vanadium (9.75 to 23.6 mg/kg) exceeded the NMED-approved background concentration of 20.4 mg/kg in eight samples and one duplicate from four locations. Zinc (24.5 to 288 mg/kg) exceeded the NMED-approved background concentration of 62 mg/kg in twenty samples from twelve locations.

The antimony results were rejected during data validation for the 20 samples collected from locations 035–043. However, the number of nondetects and low concentrations that were detected in these samples probably indicate that this metal is not present in concentrations above the NMED-approved background concentration.

VOCs

Table 10.4.5-4 presents the analytical results for the VOC analyses. Acetone (13 J µg/kg) was detected in the 0.0- to 0.5-foot sample at location 037. Chloroform (0.51 J and 0.97 J µg/kg) was

detected in two samples (locations 039 and 040). Ethylbenzene (0.44 J to 0.52 J $\mu\text{g}/\text{kg}$) was detected in three samples (locations 040, 046, and 047). Methylene chloride (14 to 44 $\mu\text{g}/\text{kg}$) was detected in 13 samples from 8 locations (033, 035, 038, 040, 044, 045, 046, and 047). Toluene (1.1 to 2.8 $\mu\text{g}/\text{kg}$) was detected in 13 samples from 9 locations (032, 033, 037, 040, 043, 044, 045, 046, and 047). Trichloroethylene (0.58 J $\mu\text{g}/\text{kg}$) was only detected in the 0.0- to 0.5-foot sample from location 039. Xylene (0.81 J to 4.1 J $\mu\text{g}/\text{kg}$) was detected in nine samples from seven locations (032, 033, 037, 040, 043, 046, and 047). The MDLs used for the VOC analyses are provided in Table 10.4.5-5.

SVOCs

Table 10.4.5-6 presents the analytical results for the SVOC analyses. A total of six SVOC analytes were detected in these samples. 2,4-Dinitrotoluene (440 $\mu\text{g}/\text{kg}$) was detected in the 0.0- to 0.5-foot duplicate sample at location 032. Anthracene (720 $\mu\text{g}/\text{kg}$) and was detected in the 0.0- to 0.5-foot sample at location 038. Benzo(a)pyrene (120 J $\mu\text{g}/\text{kg}$) was detected in the 0.0- to 0.5-foot sample at location 045. Benzo(g,h,i)perylene (130 J and 110 J $\mu\text{g}/\text{kg}$) was detected in the 0.0- to 0.5-foot sample at location 034 and the 0.0- to 0.5-foot sample from location 045. Chrysene (120 J and 71 J $\mu\text{g}/\text{kg}$) was detected in the 0.0- to 0.5-foot sample and duplicate at location 045. Pentachlorophenol (220 J to 280 J $\mu\text{g}/\text{kg}$) was detected in the four sample and duplicate collected at locations 044 and 045. The MDLs used for the SVOC analyses are presented in Table 10.4.5-7.

HE

Table 10.4.5-8 presents the analytical results for the HE analyses. A total of seven HE compounds were detected in these samples. 1,3,5-Trinitrobenzene (670 and 510 $\mu\text{g}/\text{kg}$) was detected in both samples from location 038. 2,4,6-Trinitrotoluene (130 to 18,000 $\mu\text{g}/\text{kg}$) was detected in 12 samples and one duplicate from seven locations (037, 038, 040, 041, 042, 044, and 045). 2,6-Dinitrotoluene (160 $\mu\text{g}/\text{kg}$) was detected in the 0.0- to 0.5-foot sample from location 037. Both 2-amino-2,6-dinitrotoluene (150 J to 840 $\mu\text{g}/\text{kg}$) and 4-amino-2,6-dinitrotoluene (130 J to 1,000 $\mu\text{g}/\text{kg}$) were detected in 10 samples and one duplicate from six locations (037, 038, 040, 042, 044, and 045). HMX (100 J to 6,200 J $\mu\text{g}/\text{kg}$) was detected in 21 samples and three duplicates from 13 of the 18 locations under the former mound. RDX (92 to 26,000 J $\mu\text{g}/\text{kg}$) was detected in 22 samples and 3 three duplicates from 12 of the 18 locations under the former mound. The MDLs used for the HE analyses are provided in Table 10.4.5-9.

Radionuclides

Table 10.4.5-2 presents the analytical results for the gamma spectroscopy analyses. Uranium-235 (ND [9.12 E-02] to 3.15E-01 pCi/g) exceeded the 1.8E-01 pCi/g NMED-approved background activity in five samples from five locations (038, 039, 042, 044, and 047). Uranium-238 (ND [4.62E-01] to 4.56E+00 pCi/g) exceeded the NMED-approved background activity of 1.4E+00 pCi/g in 16 samples and 3 duplicates from 11 locations (033, 034, 036, 040, 041, 042, 043, 044, 045, 046, and 047). Thorium-232 (ND [1.13E-01 to 1.08E+00 pCi/g) only exceeded the NMED-approved background activity of 1.01E+00 in the 0.5- to 1.0-foot sample from location 047. Cesium-137 (ND [1.48E-02] to 3.20E-01 pCi/g) exceeded the

NMED-approved background activity of 7.9E-02 pCi/g in five samples and two duplicates from five locations (032, 033, 034, 045, and 047).

Gross Alpha/Gross Beta

Table 10.4.5-3 presents the analytical results for the gross alpha /gross beta analyses. Gross alpha (9.01 to 26.4 pCi/g) was within the same order of magnitude as the site-specific range of 7.53 to 32.5 pCi/g. Gross beta (21.9 to 49.4 pCi/g) was within the same order of magnitude as the site-specific range of 20.8 to 35.0 pCi/g.

Burial Pit Samples

This small burial pit was discovered 10 feet east of Mound 1 and was excavated during the June 1998 portion of the VCM. It contained DU-contaminated test debris from a depth of about 1 to 3 feet below grade. Six samples were collected at 3 locations in the burial pit northeast of the former Mound 1 excavation (locations 048–050 on Figure 10.4.5.3-1). The samples were analyzed for TAL metals plus uranium, VOCs, SVOCs, HE, and radionuclides. The results are summarized below.

TAL Metals Plus Uranium

Table 10.4.5-1 presents the analytical results for the TAL metals plus uranium analyses. Beryllium (0.452 J to 0.653 mg/kg) exceeded the NMED-approved background concentration of 0.65 mg/kg in the 0.5- to 1.0-foot sample from location 049. Nickel (9.30 to 11.9 mg/kg) also exceeded the NMED-approved background concentration of 11.5 mg/kg in this same sample. In the 0.0- to 0.5- and 0.5- to 1.0-foot samples at location 049, cobalt (4.68 to 5.66 mg/kg), copper (10.7 to 33.3 mg/kg), and lead (14.4 to 29.2 mg/kg) exceeded their NMED-approved background concentrations of 5.2, 15.4, and 21.4 mg/kg. Uranium (4.61 to 14.1 mg/kg) exceeded the NMED-approved background concentration of 3.42 mg/kg in all six samples from the three locations (048, 049, and 050).

VOCs

Table 10.4.5-4 presents the analytical results for the VOC analysis. No VOCs were detected in any of the burial pit samples. The MDLs for the VOC analysis are provided in Table 10.4.5-5.

SVOCs

Table 10.4.5-6 presents the analytical results for the SVOC analysis. No SVOC compounds were detected in any of the burial pit samples. The MDLs for the SVOC analysis are provided in Table 10.4.5-7.

HE

Table 10.4.5-8 presents the analytical results for the HE analysis. No HE compounds were detected in any of the burial pit samples. The MDLs used for the HE analyses are provided in Table 10.4.5-9.

Radionuclides

Table 10.4.5-2 presents the analytical results for the gamma spectroscopy analyses. Uranium-238 (ND [5.98E-01] to 4.92E+00 pCi/g) exceeded the NMED-approved background activity of 1.4E+00 pCi/g in three samples from two locations (048 and 049). Cesium-137 (2.85E-02 to 1.34E-01 pCi/g) exceeded the NMED-approved background activity of 7.9E-02 pCi/g in the 0.0- to 0.5 and 0.5- to 1.0-foot samples from location 049.

Gross Alpha/Gross Beta

Table 10.4.5-3 presents the analytical results for the gross alpha/gross beta analyses. Gross alpha (13 to 23.8 pCi/g) was within the same order of magnitude as the site-specific range of 7.53 to 32.5 pCi/g. Gross beta (30.2 to 45 pCi/g) was within the same order of magnitude as the site-specific range of 20.8 to 35.0 pCi/g.

10.4.5.4 Data Quality

10.4.5.4.1 Quality Assurance/Quality Control Results

All off-site samples were processed at state-certified laboratories using accepted contract laboratory program protocols and EPA methods for Level III data generation. The on-site SNL/NM RPSD Laboratory used acceptable EPA methods and sufficient QA/QC procedures to produce acceptable data for site characterization.

Soil Pile Samples

Tables B-1, B-3, B-6, B-9, B-11, and B-13 (Annex B) present the analytical results for the QA/QC samples collected during the soil pile sampling at SWMU 9.

Because the objective of the soil pile sampling was to collect data for waste characterization, QA/QC samples were limited to one equipment blank (EB) and two trip blanks (TBs). However, three duplicate samples were collected in the May 2000 resampling of the soil piles for HE. EB samples were analyzed off site for metals, VOCs, SVOCs, HE, gamma spectroscopy, and tritium. Two gamma spectroscopy EB samples were analyzed on site at the SNL/NM RPSD Laboratory for site characterization and sample release to off-site laboratories. Two TB samples were analyzed off site for VOCs.

Metal concentrations in the EB sample were either below detection limits or were low estimated (J) values (Table B-1, Annex B). No VOCs were detected in the EB sample or the two TB samples (Table B-3, Annex B). No SVOCs were detected in the EB sample (Table B-6,

Annex B). No HE compounds were detected in the EB sample (Table B-9, Annex B). No radionuclides were detected in either the gamma spectroscopy or tritium analyses (Tables B-11 and B-13, respectively, Annex B).

For the May 2000 HE sample analyses, matrix interferences related to the heterogeneity of the samples were the probable cause for low matrix spike and matrix spike duplicate recoveries and variability in the duplicate sample results. Laboratory control samples and duplicates also experienced low recoveries and, as a result, many tetryl results were qualified as "UJ" and some HMX results were qualified "J" during data validation.

Because of the higher analytical precision in the isotopic analysis for uranium-238, uranium-235, uranium-234, and thorium-232 in the soil pile samples, the isotopic results for these four isotopes were used in the risk assessment rather than the gamma spectroscopy results.

1999 RFI Confirmatory Samples

TAL Metals plus Uranium

Table 10.4.5-1 presents the analytical results for the metals QA/QC results collected during the 1999 RFI confirmatory sampling at SWMU 9. The analytical results include arroyo sediment background, arroyo sediment, samples from the VCM excavation (under former Mound 1), and equipment blanks. Six duplicate soil samples were collected. Two equipment blanks were collected, one per day of sampling. Analysis of the EBs yielded one uranium detection (0.000131 J mg/L) and two zinc detections (0.0154 and 0.00641 mg/L). The detections were not high enough to invalidate or qualify the soil data.

Table 10.4.5-10 presents the relative percent difference (RPD) results for the TAL metals plus uranium analyses performed for the six duplicate soil samples. RPDs were only calculated for detections and were not calculated for results that were qualified "J" during data validation. As a result, RPDs were not calculated for either silver or thallium. All other metals had at least one RPD value. The following list includes the RPDs for those metals for which only one value could be calculated: antimony (0.03), beryllium (0.016), and mercury (0.0269). Other RPDs ranged from 0.05 to 0.73 for arsenic, 1.0 to 13 for barium, 0.031 to 0.179 for cadmium, 0.19 to 2.04 for chromium, 0.02 to 1.53 for cobalt, 0.4 to 4.4 for copper, 0.59 to 9.0 for lead, 3 to 45 for manganese, 0.23 to 3.04 for nickel, 0.026 to 0.11 for selenium, 0.19 to 3.2 for uranium, 0.1 to 3.8 for vanadium, and 1.3 to 7.6 for zinc.

VOCs

Table 10.4.5-4 presents the analytical results for VOCs in the QA/QC samples that were collected during the RFI sampling of SWMU 9. Five duplicate soil samples, two EBs, and two TBs were collected and analyzed. Acetone was detected in one EB sample and methylene chloride was detected in one EB and one TB sample.

The 0.0- to 0.5-foot duplicate soil sample from location 032 did not contain the toluene (1.4 µg/kg) or xylene (3.3 J µg/kg) found in the "normal" sample. The 0.0- to 0.5-foot sample and duplicate from location 045 did contain comparable amounts of methylene chloride

Table 10.4.5-10
 Summary of SWMU 9 Field Duplicate Relative Percent Differences
 Confirmatory Soil Sampling
 July 1999
 (Off-Site Laboratory)

Record Number ^a	Sample Attributes		Relative Percent Difference										
	ER Sample ID ^b (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	
602158	CCTA-09-GR-004-0-0.5-S CCTA-09-GR-004-0-0.5-DU	0-0.5	NC	36.2	38.3	NC	NC	47.8	26.1	36.7	7.5	19.2	
602158	CCTA-09-GR-007-0-0.5-S CCTA-09-GR-007-0-0.5-DU	0-0.5	NC	25.0	26.8	NC	NC	47.6	31.6	26.1	33.6	32.3	
602159	CCTA-09-GR-032-0-0.5-S CCTA-09-GR-032-0-0.5-DU	0-0.5	NC	6.1	0.9	NC	NC	2.0	0.4	3.6	10.8	1.3	
602162	CCTA-09-GR-036-0.5-1.0-S CCTA-09-GR-036-0.5-1.0-DU	0.5-1.0	NC	29.0	0.0	NC	NC	22.5	33.0	189.7	57.0	36.2	
602162	CCTA-09-GR-041-0-0.5-S CCTA-09-GR-041-0-0.5-DU	0-0.5	NC	1.4	7.6	NC	5.0	3.2	0.7	19.3	3.2	6.4	
602163	CCTA-09-GR-045-0-0.5-S CCTA-09-GR-045-0-0.5-DU	0-0.5	4.5	3.1	8.0	2.9	18.8	19.6	6.3	8.8	8.6	3.6	

Record Number ^a	Sample Attributes		Relative Percent Difference										
	ER Sample ID ^b (Figures 10.4.4-1 and 10.4.5.3-1)	Sample Depth (ft)	Mercury	Nickel	Selenium	Silver	Thallium	Uranium	Vanadium	Zinc			
602158	CCTA-09-GR-004-0-0.5-S CCTA-09-GR-004-0-0.5-DU	0-0.5	NC	30.7	NC	NC	NC	19.1	27.5	13.3			
602158	CCTA-09-GR-007-0-0.5-S CCTA-09-GR-007-0-0.5-DU	0-0.5	NC	35.9	NC	NC	NC	48.5	29.1	28.6			
602159	CCTA-09-GR-032-0-0.5-S CCTA-09-GR-032-0-0.5-DU	0-0.5	NC	2.5	NC	NC	NC	6.1	0.6	3.7			
602162	CCTA-09-GR-036-0.5-1.0-S CCTA-09-GR-036-0.5-1.0-DU	0.5-1.0	NC	35.8	17.8	NC	NC	35.1	19.1	130.7			
602162	CCTA-09-GR-041-0-0.5-S CCTA-09-GR-041-0-0.5-DU	0-0.5	NC	2.4	5.7	NC	NC	7.5	1.2	4.5			
602163	CCTA-09-GR-045-0-0.5-S CCTA-09-GR-045-0-0.5-DU	0-0.5	125.4	4.0	29.4	NC	NC	19.4	8.4	10.7			

^a Analysis request/chain-of-custody record.

^b Bold portion of the Sample ID corresponds to the sample location in Figures 10.4.4-1 and 10.4.5.3-1.

CCTA = Central Coyote Test Area.

DU = Duplicate sample.

ER = Environmental Restoration.

ft = Foot (feet).

GR = Grab sample.

ID = Identification.

NC = Not calculated for nondetected results or laboratory estimated values.

S = Soil sample.

SWMU = Solid Waste Management Unit.

(25 versus 26 µg/kg) and toluene (1.6 versus 1.3 µg/kg). No VOCs were detected in the other duplicate sample pairs.

SVOCs

Table 10.4.5-6 presents the analytical results for SVOCs in the QA/QC samples that were collected during the RFI sampling of SWMU 9. Four duplicate soil samples and two EBs were collected and analyzed.

2,4-Dinitrotoluene (440 µg/kg) was detected only in the duplicate 0.0- to 0.5-foot sample from location 032, and not in the "normal" sample. The duplicate 0.0- to 0.5-foot sample from location 045 contained chrysene and pentachlorophenol, while the normal sample also contained benzo(a)pyrene and benzo(g,h,i)perylene. No SVOCs were detected in the other duplicate soil pairs or in the EBs.

HE

Table 10.4.5-8 presents the analytical results for HE in the QA/QC samples that were collected during the RFI sampling of SWMU 9. Four duplicate soil samples and two EBs were collected and analyzed.

Similar concentrations of HMX and RDX were detected in the sample and duplicate pairs from location 036 (0.5- to 1.0-foot depth) and location 041 (0.0- to 0.5-foot depth). Five SVOCs at similar concentrations were detected in the 0.0- to 0.5-foot duplicate pair from location 045. One HE compound (4-amino-2,6-dinitrotoluene; 0.22 µg/L) was detected in one EB.

Radionuclides

Table 10.4.5-2 presents the analytical results for gamma spectroscopy analyses in the QA/QC samples that were collected during the RFI sampling of SWMU 9. Six duplicate soil samples and two EBs were collected and analyzed at the SNL on-site laboratory.

No elevated activities were measured in the 0.0- to 0.5-foot duplicate pair from location 007. Cesium-137 was detected in the duplicate 0.0- to 0.5-foot sample from location 032 and 045. Uranium-238 was only detected in the duplicate 0.5- to 1.0-foot sample from location 036, 041, and 045. Similar concentrations of cesium-137 and/ or uranium-238 were detected in the three duplicate pairs. No elevated activities were measured in the EBs.

Gross Alpha/Gross Beta

Table 10.4.5-3 presents the analytical results for the gross alpha/gross beta analyses in the QA/QC samples that were collected during the RFI sampling of SWMU 9. Six duplicate soil samples and two EBs were collected and analyzed.

Results were similar for all the duplicate pairs. Low levels of activity were detected in both EBs.

10.4.5.5 *Data Validation*

All off-site laboratory results were reviewed and verified/validated according to "Data Verification/Validation Level 3—DV-3," in Attachment C of the Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994) or "Data Validation Procedure for Chemical and Radiochemical Data," in SNL/NM Environmental Restoration Project Administrative Operating Procedure (AOP) 00-03, Rev. 0 (SNL/NM December 1999). In addition, SNL/NM Department 7713 (RPSD Laboratory) reviewed all gamma spectroscopy results according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 2 (SNL/NM July 1996). Annex C contains the off-site data validation reports for SWMU 9 soil piles and Annex D contains the off-site data validation reports for SWMU 9 confirmatory sampling.

10.5 **Site Conceptual Model**

The site conceptual model for SWMU 9 is based upon the residual COCs identified in the soil samples for the surface, near-surface, and subsurface of the burial site/open dump. This section summarizes the nature and extent of contamination and the environmental fate of the COCs.

10.5.1 **Nature and Extent of Contamination**

The potential COCs at SWMU 9 are metals, VOCs, SVOCs, HE, and radionuclides resulting from waste disposal practices (burial) of debris at the site. Metal and radionuclide COCs were determined by comparing sample results to background concentrations and activities established for the Coyote Test Field Area (Dinwiddie September 1997). Any metal or radionuclide found to exceed background in any sample was considered to be a potential COC for the site. Metal COCs included 18 of the 20 TAL metals (Table 10.4.5-11). VOC COCs included acetone, chloroform, ethylbenzene, methylene chloride, toluene, trichloroethylene, and xylene. SVOC COCs included 2,5-dinitrotoluene, anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, and pentachlorophenol. HE COCs included 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, and RDX. Radionuclide COCs included cobalt-60, cesium-137, thorium-232, uranium-234, uranium-235, and uranium-238.

Table 10.4.5-11 summarizes the COCs and the locations where metals and radionuclides exceeded background and VOCs, SVOCs, and HE compounds were detected. Confirmatory samples were collected from areas within SWMU 9 where potential releases to the environment could have occurred, and from the soil piles which will be redeposited back on the site. Twenty-six samples were collected from the 13 soil piles. Seven samples, including one duplicate, were collected in the arroyo channel downstream from Mound 3. One sample was collected under Mound 3. Forty samples, including four duplicates, were collected in the VCM excavation at the south end of Mound 1. Six samples were collected in the burial pit.

Table 10.4.5-11
Summary of COCs for SWMU 9

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/Coyote Test Field ^b (mg/kg, except where noted)	Maximum Concentration (mg/kg, except where noted)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
Metals	38 environmental, 2 duplicates 82 environmental, 5 duplicates	Antimony	3.9	1.91 J	0.468	(All samples with detections below background value)
		Arsenic	5.6	4.89	3.19	(All samples below background value)
		Barium	130	209 J	111	19 samples above background value
		Beryllium	0.65	0.653	0.440	CCTA-09-GR-049-0.5-1.0-S
		Cadmium	0.9	2.78	0.52	12 samples above background value
		Chromium	17.3	28.4	11.4	CCTA-09-VCM-File9-N CCTA-09-VCM-File11-S CCTA-09-VCM-File12-N CCTA-09-GR-034-0-0.5-S CCTA-09-GR-045-0-0.5-S CCTA-09-GR-045-0-0.5-DU CCTA-09-GR-045-0.5-1.0-S
		Cobalt	5.2	8.61	4.8	24 samples above background value
		Copper	15.4	536 J	33.7	39 samples above background value
		Lead	21.4	126	22.6	32 samples above background value
		Manganese	NA	409	244.6	(All samples below background value)
Mercury	82 environmental, 5 duplicates		<0.1	2.09	0.0542	CCTA-09-VCM-File7-S CCTA-09-GR-045-0.5-1.0-S CCTA-09-GR-047-0-0.5-S CCTA-09-GR-047-0.5-1.0-S
		Nickel	11.5	14.9	10.1	13 samples above background value

Table 10.4.5-11 (Continued)
Summary of COCs for SWMU 9

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/Coyote Test Field ^b (mg/kg, except where noted)	Maximum Concentration (mg/kg, except where noted)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
Metals (cont.)	82 environmental, 5 duplicates	Selenium	<1	1.08	0.553	CCTA-09-VCM-File9-N
		Silver	<1	0.458 J	0.137	(All samples below background value)
	80 environmental, 5 duplicates	Thallium	<1.1	ND (0.221)	0.221	(All samples below background value)
		Uranium	3.42	19.5 J	6.17	54 samples above background value
	80 environmental, 5 duplicates	Vanadium	20.4	24.6	17.0	15 samples above background value
		Zinc	62	354	90	42 samples above background value
		Acetone	NA	13 J µg/kg	9.7 µg/kg	CCTA-09-GR-037-0-0.5-S
VOCs	80 environmental, 5 duplicates	Chloroform	NA	0.97 J µg/kg	0.43 µg/kg	CCTA-09-GR-039-0.5-1.0-S CCTA-09-GR-040-0-0.5-S
		Ethylbenzene	NA	0.52 J µg/kg	0.30 µg/kg	CCTA-09-GR-008-0-0.5-S CCTA-09-GR-040-0-0.5-S CCTA-09-GR-046-0-0.5-S CCTA-09-GR-047-0-0.5-S
	80 environmental, 4 duplicates	Methylene chloride	NA	44 µg/kg	6.8 µg/kg	Detected in 16 samples
		Toluene	NA	2.8 µg/kg	0.98 µg/kg	Detected in 13 samples
		Trichloroethene	NA	0.56 J µg/kg	0.30 µg/kg	CCTA-09-GR-040-0-0.5-S
		Xylene	NA	6.1 µg/kg	0.96 µg/kg	Detected in 11 samples
2,4-Dinitrotoluene	NA	440 µg/kg	143 µg/kg	CCTA-09-GR-032-0-0.5-DU		
Anthracene	NA	1100 µg/kg	112 µg/kg	CCTA-09-GR-038-0-0.5-S CCTA-09-VCM-File12-N CCTA-09-VCM-File12-S		

Refer to footnotes at end of table.

Table 10.4.5-11 (Continued)
Summary of COCs for SWMU 9

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/Coyote Test Field ^b (mg/kg, except where noted)	Maximum Concentration (mg/kg, except where noted)	Average Concentration ^c (mg/kg except, where noted)	Sampling Locations Where Background Concentration Exceeded ^d
SVOCs (contd.)	80 environmental, 4 duplicates	Benzo(a)pyrene	NA	120 J µg/kg	79 µg/kg	CCTA-09-GR-045-0-0.5-S
		Benzo(g,h,i)perylene	NA	130 J µg/kg	105 µg/kg	CCTA-09-GR-034-0-0.5-S CCTA-09-GR-045-0-0.5-S
		Chrysene	NA	120 J µg/kg	61 µg/kg	CCTA-09-GR-045-0-0.5-S CCTA-09-GR-045-0-0.5-DU
		Pentachlorophenol	NA	280 J µg/kg	95 µg/kg	CCTA-09-GR-044-0-0.5-S CCTA-09-GR-044-0.5-1.0-S CCTA-09-GR-045-0-0.5-S CCTA-09-GR-045-0-0.5-DU CCTA-09-GR-045-0.5-1.0-S
		1,3,5-Trinitrobenzene	NA	670 µg/kg	26 µg/kg	CCTA-09-GR-038-0-0.5-S CCTA-09-GR-038-0.5-1.0-S CCTA-09-VCM-Pile12-N CCTA-09-VCM-Pile12-DU
		2,4,6-Trinitrotoluene	NA	18,000 µg/kg	836 µg/kg	Detected in 24 samples
		2,6-Dinitrotoluene	NA	160 µg/kg	11.2 µg/kg	CCTA-09-GR-037-0-0.5-S
		2-Amino-4,6-dinitrotoluene	NA	3,680 µg/kg	199 µg/kg	Detected in 24 samples
		4-Amino-2,6-dinitrotoluene	NA	2,290 µg/kg	148 µg/kg	Detected in 22 samples
		HMX	NA	6,200 J µg/kg	851 µg/kg	Detected in 53 samples
Radionuclides	36 environmental, 9 splits	RDX	NA	26,000 J µg/kg	2,731 µg/kg	Detected in 52 samples
		Cobalt-60	NA	1.1 pCi/g	Not calculated ^e	NA
		Cesium-137	0.079 pCi/g ^f	0.8 pCi/g	Not calculated ^e	36 samples above background value
		Thorium-232 (Isotopic)	1.01 pCi/g ^f	1.95 pCi/g	Not calculated ^e	11 samples above background value

Refer to footnotes at end of table.

Table 10.4.5-11 (Continued)
Summary of COCs for SWMU 9

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/Coyote Test Field ^b (mg/kg, except where noted)	Maximum Concentration (mg/kg, except where noted)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d	
Radionuclides (contd.)	116 environmental, 5 duplicates, 9 splits	Uranium-234 (Isotopic)	1.6 pCi/g ^f	2.51 pCi/g	Not calculated ^e	CCTA-09-VCM-Pile1-N CCTA-09-VCM-Pile2-N CCTA-09-VCM-Pile2-S CCTA-09-VCM-Pile7-S CCTA-09-VCM-Pile8-S CCTA-09-VCM-Pile9-N CCTA-09-VCM-Pile9-S CCTA-09-VCM-Pile11-N CCTA-09-VCM-Pile13-S	
			0.18 pCi/g	0.360 pCi/g	Not calculated ^e	CCTA-09-VCM-Pile2-N CCTA-09-VCM-Pile8-S	
			1.4 pCi/g ^f	5.84 pCi/g	Not calculated ^e	26 samples above background value	
		8 environmental, 2 duplicates	Uranium-238 (Isotopic) Tritium	NA	721 pCi/L	Not calculated ^e	NA
				NA	26.4 pCi/g	Not calculated ^e	NA
		54 environmental, 5 duplicates	Gross Alpha Gross Beta	NA	49.4 pCi/g	Not calculated ^e	NA
				NA			

^aNumber of samples does not include background samples.

^bFrom Dinwiddie September 1997. The minimum background concentration/activity between surface and subsurface is reported.

^cAverage concentration includes all samples, excluding background. For nondetect results, the detection limit is used to calculate the average.

^dMetal and radionuclide samples include nondetect results where the DL or the MDA exceeds the approved background concentration. Organic samples include all detected results.

^eAn average MDA is not calculated because of the variability in instrument counting error and the number of reported nondetectable activities.

^fSouthwest background activities are presented when Coyote Test Field background activities are not available.

CCTA = Central Coyote Test Area.

COC = Constituent of concern.

DL = Detection limit.

DU = Duplicate sample.

GR = Grab sample.

HMX = 1,3,5,7-Tetranitro-1,3,5,7-tetrazacyclooctane.

J = Estimated value.

µg/kg = Microgram(s) per kilogram.

MDA = Minimum detectable activity.

mg/kg = Milligram(s) per kilogram.

NA = Not applicable.

ND () = Not detected above the detection limit, shown in parentheses.

pCi/g = Picocurie(s) per gram.

pCi/L = Picocurie(s) per liter.

Pile-N = North of pile.

Pile-S = South of pile.

RDX = 1,3,5-Trinitro-1,3,5-triazacyclohexane.

SWMU = Solid waste management unit.

S = Soil sample.

VCM = Voluntary corrective measure.

10.5.2 Environmental Fate

The primary source for COCs was the disposal of wastes and debris associated with unknown testing activities in the Schoolhouse Mesa Test Area. Available information indicates that SWMU 9 was used as an unregulated dump site. Mound 1 received the majority of the waste materials, while Mound 2 was an isolated pile of debris in the arroyo channel. Mound 3 was a natural terrace deposit on the south side of the arroyo channel with debris scattered on its surface. All debris associated with Mounds 2 and 3 was removed during the VCM at Mound 1.

Based upon the nature and extent of contamination at the site (Section 10.5.1), the VCM excavation at the south end of Mound 1 contains metals, HE, VOC, SVOC, and radionuclide COCs in the surface and near-surface soil. The burial pit contains metals and radionuclides. The soil piles contain metals, VOCs, SVOCs, HE, and radionuclides. One VOC analyte and HE compounds were detected in the Mound 3 sample. Two VOCs were detected in one arroyo sediment sample.

Because a VCM has removed the primary source materials (debris and radionuclides), only secondary sources of COCs remain at the site in the form of residual metals, VOCs, SVOCs, HE, and radionuclides in the surface and subsurface soils. The secondary release mechanisms at SWMU 9 are suspension and or dissolution of COCs in surface-water runoff and percolation through the soil, direct contact with soil (radionuclides only), VOC vapor emanations, dust emissions, and uptake of COCs in the soil by biota (Figure 10.5.2-1). The depth to groundwater at the site is approximately 95 feet bgs, and the vadose zone is comprised of relatively impermeable carbonate-rich soil horizons and impermeable carbonate-cemented horizons (SNL/NM March 1995). In addition, high-partitioning coefficients and low mobility in the transporting medium would enhance dilution of the COC concentrations. As a result, the nature and extent of COCs as defined in this NFA proposal does not render groundwater a viable contaminant pathway. The pathways to receptors are surface water, soil water, air, and soil. Biota also provides a pathway through food chain transfers. Annex E, Section V, provides additional discussion of the fate and transport of COCs at SWMU 9.

SWMU 9 is along the floor and banks of an unnamed arroyo that flows west and eventually joins Tijeras Arroyo. Only during intense local rainfall or heavy rainfall in the headwaters of the arroyo could runoff actively erode the site. Therefore, surface-water is considered a possible release mechanism.

The current land use for SWMU 9 is industrial. The future land use for SWMU 9 is also industrial (DOE and USAF March 1996); therefore, the potential human receptor at the site is an industrial worker. For all applicable pathways, the exposure route for the industrial worker is dermal contact, external irradiation, and ingestion/inhalation. Ingestion of soil, external irradiation from soil, and ingestion/inhalation of air are considered the major exposure routes for the industrial worker. Potential ecological receptors include plants and wildlife at the site. Uptake of COCs through direct contact with soil is considered to be the major exposure route for plants. Exposures in wildlife can result from the ingestion of COCs through food chain transfers and the incidental ingestion of soil from the site. Annex E, Section V, provides additional discussion of the exposure routes and receptors at SWMU 9.



10.6 Site Assessments

The site assessment process for SWMU 9 includes risk screening assessments followed by baseline risk assessments (as required) for both human health and ecological risk. This section briefly summarizes the site assessment results. Annex E describes the assessment in detail.

10.6.1 Summary

The site assessment concludes that SWMU 9 does not have the potential to affect human health under an industrial land-use scenario. After considering the uncertainties associated with the available data and modeling assumptions, ecological risks associated with SWMU 9 were found to be low. Section 10.6.2 describes the site screening assessments and Annex E provides details of the site assessment.

10.6.2 Screening Assessments

Risk screening assessments were performed for both human health risk and ecological risk for SWMU 9. This section summarizes the risk screening assessments.

10.6.2.1 Human Health

SWMU 9 has been recommended for industrial land-use (DOE and USAF March 1996). Because COCs are present in concentrations or activities greater than background levels, it was necessary to perform a human health risk analysis for the site. Besides COC metals, this assessment included any VOCs, SVOCs, or HE compounds detected above their reporting limits and any radionuclide compounds detected above background levels and/or MDAs. The risk assessment process evaluates quantitatively the potential adverse human health effects caused by COCs in the site's soil. The Risk Screening Assessment calculated the hazard index (HI) and excess cancer risk for an industrial land-use setting. The excess cancer risk from nonradiological COCs and radiological COCs is not additive (EPA 1989).

In summary, the HI calculated for SWMU 9 nonradiological COCs for an industrial land-use setting is 0.1, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). Incremental risk is determined by subtracting risk associated with background from potential nonradiological COC risk. The incremental HI is 0.1. The total excess cancer risk for SWMU 9 nonradiological COCs for an industrial land-use setting is $4\text{E-}06$, which is slightly above the acceptable risk value provided by the NMED (NMED March 1998). Guidance from the NMED indicates that excess lifetime risk of developing cancer by an individual must be less than the $1\text{E-}06$ for Class A and B carcinogens and less than $1\text{E-}05$ for Class C carcinogens. The incremental cancer risk for SWMU 9 is $3.83\text{E-}06$. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated through use of maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the upper 95-percent confidence limit of the mean concentration of the organic risk drivers is used in place of the maximum concentration, the total excess cancer risk is reduced to $9.67\text{E-}07$, and the incremental excess cancer risk is calculated to be $9.66\text{E-}07$, both within proposed guidelines.

The incremental total effective dose equivalent for radionuclides for an industrial land-use setting for SWMU 9 is 3.5 millirems (mrem)/year (yr), which is significantly less than the recommended dose limit of 15 mrem/yr found in EPA's OSWER Directive No. 9200.4-18 (EPA 1997a) and reflected in a document entitled "Sandia National Laboratories/New Mexico Environmental Restoration Project-RESRAD Input parameter Assumptions and Justification" (SNL/NM February 1998). The incremental excess cancer risk values calculated from naturally occurring radiation and from intakes considered background concentration values.

The residential land-use scenario for this site are provided only for comparison in the Risk Screening Assessment (Annex E). This report concludes that SWMU 9 does not have the potential to affect human health under an industrial land-use scenario.

10.6.2.2 *Ecological*

An ecological risk assessment that corresponds with the screening procedures in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997b) 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 and identifying potentially bioaccumulative constituents (see Annex E, Section VII). This methodology also requires developing a site conceptual model and a food web model as well as selecting ecological receptors. Each of these items is presented in the "Predictive Ecological Risk Assessment Methodology for SNL/NM ER Program, Sandia National Laboratories/New Mexico" (IT July 1998) and will not be duplicated here. The screen also includes estimations of exposure and ecological risk.

Tables 15, 16, 17, and 18 of Annex E present 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 1 were originally predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk attributable primarily to exposure concentration (maximum COC concentration was used in estimating risk), exposure setting (area use factors of one were assumed), background risk, and using detection limits as exposure concentrations. Based upon an evaluation of these uncertainties, ecological risks associated with this site are expected to be low.

10.6.3 Baseline Risk Assessments

10.6.3.1 *Human Health*

Based upon the fact that human health results of the screening assessment summarized in Section 10.6.2 indicate that SWMU 9 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 9.

10.6.3.2 *Ecological*

Based upon the fact that ecological results of the screening assessment summarized in Section 10.6.2 indicate that SWMU 9 has low ecological risk, a baseline ecological risk assessment is not required for SWMU 9.

10.6.4 Other Applicable Assessments

A Surface Water Assessment was conducted at SWMU 9 in September 1998. The surface water assessment guidance was developed jointly by Los Alamos National Laboratory and the NMED Surface Water Quality Bureau (LANL August 1998). The assessment evaluated the potential for erosion from SWMU 9. SWMU 9 received a score of 67.5 indicating that it has a high erosion potential, primarily due to its location on the banks and floor of the unnamed arroyo that crosses the site.

10.7 No Further Action Proposal

10.7.1 Rationale

Based upon field investigation data and the human health risk assessment analysis, an NFA is being recommended for SWMU 9 because no COCs were present at concentration levels considered hazardous to human health for an industrial land-use scenario.

10.7.2 Criterion

Based upon the evidence provided above, SWMU 9 is proposed for an NFA decision in conformance with Criterion 5, which states that "The SWMU/AOC has been characterized or remediated in accordance with current applicable state or federal regulations and that available data indicate that contaminants pose an acceptable level of risk under current and projected future land use" (NMED March 1998).

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ANNEX 10-E
Risk Screening Assessment



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SWMU 9: RISK SCREENING ASSESSMENT REPORT

I. Site Description and History

Solid Waste Management Unit (SWMU) 9, Burial Site/Open Dump at Sandia National Laboratories/New Mexico (SNL/NM), covers 1.86 acres of land that is owned by Kirtland Air Force Base (KAFB) and leased to the U.S. Department of Energy (DOE). The site is located about 1,800 feet east of the Schoolhouse Building (SWMU 61C), where an unnamed dirt road that branches off to the north from Demolition Range Road crosses an arroyo. SWMU 9 forms the southwestern corner of the adjacent SWMU 61A and encompasses features on the north and south arroyo banks. The elevation of the site is 5,845 feet above mean sea level.

Environmental concern about SWMU 9 is based upon the various debris types that were dumped, burned, and buried at the site between approximately 1967 and 1971. The debris is reported to have come from various undocumented activities in the local area. The initial Comprehensive Environmental Assessment and Response Program site survey in the mid-1980s, identified three mounds where debris was thought to have been buried. Subsequent investigation disclosed that debris was only actually buried in the largest mound (Mound 1.) Mound 2 was discovered to be an isolated pile of debris (i.e., no additional buried debris was found at the location), whereas Mound 3 consisted simply of debris scattered on a terrace deposit. Beginning in 1995 voluntary corrective measures (VCM) were conducted to survey and remove radioactive materials (depleted uranium [DU] fragments) from the surface of SWMU 9 and the adjacent SWMU 61A. Between 1996 and 1999 a second VCM was conducted to excavate, survey, and remove materials from the largest debris burial mound (Mound 1) at SWMU 9. Debris materials from Mounds 2 and 3 were also surveyed and removed during this VCM.

Debris excavated from Mound 1 included shrapnel-riddled and blasted galvanized sheet metal forms and sheets, steel plates, iron beams, shipping containers, empty 55-gallon drums, weapons transport racks, construction rubble (cinder blocks, concrete blocks, glazed tiles, plumbing pipes, approximately 0.5 gallon of Transite tile pieces), plastic wrappers for C-4 high explosive (HE) charges, burned wood and paper, wiring, unexploded ordnance (3- and 5-inch diameter artillery shells), spent fuze lines, paper, broken glass, and various beverage containers. Scattered pockets of radioactive materials (schoepite [DU], and DU-contaminated debris) were found in Mound 1 and in another shallow burial pit just east of Mound 1. Debris at Mound 2 consisted of a tangled mass of barbed wire, empty paint cans, ceramic electrical insulators, mortar shell storage cases, a military bomb rack, vehicle parts, a shrapnel-riddled iron plate, pieces of wood and metal, and building rubble (cinder blocks, glazed masonry tiles.) Debris at Mound 3 consisted of wooden crate remnants, empty paint cans, expended smoke grenades, an empty 55-gallon drum containing a grate that appeared to have been used as a grill, and other miscellaneous solid waste.

The annual precipitation for the area, as measured at the Albuquerque International Sunport, is 8.1 inches. The closest perennial water source, Coyote Springs, is located approximately 4,000 feet north of the site. Cattail and Homestead Springs, located about 2,000 feet north of the site are not perennial. During most rainfall events, rainfall quickly infiltrates the soil at SWMU 9. However, virtually all of the moisture subsequently undergoes evapotranspiration.

The estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall (NOAA 1990).

SWMU 9 is on an unnamed arroyo that is a tributary to Arroyo del Coyote. The unnamed arroyo drains a small watershed with headwaters in the western face of the Manzanita Mountains and joins Arroyo del Coyote about 3,800 feet west of the site. SWMU 9 lies on the Arroyo del Coyote alluvial fan that is composed of Pleistocene-age fine- to coarse-grained poorly to moderately sorted sediments ranging in size from small clay particles to boulders. These deposits contain relatively impermeable carbonate-rich soil horizons and impermeable carbonate-cemented horizons that inhibit vertical groundwater flow. Based upon the well record for the Schoolhouse Mesa Well, located approximately 1,800 feet west of SWMU 9, the alluvial fan deposits are less than 100 feet thick and unconformably overlie the Madera Formation. The Madera Formation consists of predominantly clastic limestone that contains fossiliferous, cherty limestone units with some interbedded shale, siltstone, sandstone, and pebble conglomerate. SWMU 9 is bounded on the west by the Coyote Fault that probably influences groundwater pathways from the Manzanita Mountains to the alluvium. The Schoolhouse Well is completed in the Madera Formation and the depth to groundwater is approximately 95 feet below ground surface (bgs). Groundwater recharge is likely from precipitation in the Manzanita Mountains infiltrating through fractured bedrock. There are no water supply wells in this area of KAFB.

Principal vegetation at SWMU 9 consists of desert grassland flora common to the area including grasses, juniper, yucca, and cacti. Soil at the site has been identified as Tesajo-Millet stony sandy loams. For purposes of defining the background levels of metals and radionuclides in soils, this soil has been included as part of the Coyote Test Field Supergroup. Slope angles vary from low (<10-percent) over most of the site to high (>30-percent) on the arroyo walls and as a result the runoff potential ranges from slow to rapid. A surface-water site assessment showed a high erosion potential in the area of Mound 1 excavation, as a result of the high slope angle. Following the completion of all investigation activities, the excavation area will be regraded and vegetated to minimize possible runoff and erosion impacts.

II. Data Quality Objectives

The original Data Quality Objectives (DQOs) presented in the Operable Unit (OU) 1334 Work Plan as modified by subsequent Notice of Deficiency and Request for Supplemental Information comments identify the site-specific confirmatory sampling locations, sample depths, sampling procedures, and analytical requirements. The DQOs outlined the quality assurance (QA)/quality control (QC) requirements necessary for producing definitive analytical data suitable for risk-assessment purposes. However, following the 1996 RFI sampling and the VCM at Mound 1, the confirmatory sampling conducted at SWMU 9 was modified to:

- Characterize site soils for background metal and radionuclide concentrations;
- Characterize the nature and extent of possible contaminants of concern (COCs) in the arroyo channel sediment;
- Determine the lateral and vertical extent of Mound 1 and characterize the nature and extent of possible COCs;

- Characterize the nature and extent of any residual COCs in the VCM excavations at Mound 1 and the newly discovered burial pit;
- Characterize the nature and extent of any residual COCs in the excavated soil (VCM soil piles) for later onsite redeposition;
- Characterize the nature and extent of possible COCs in soil underlying Mounds 2 and 3.
- Provide analytical data of sufficient quality to support risk screening assessments.

Table 1 summarizes the rationale for the sampling pattern design. The source for potential COCs at SWMU 9 was the debris buried in Mound 1, debris in the newly discovered burial pit, and materials dumped at Mound 2 in the arroyo channel. The VCM activities removed 14, 55-gallon drums of mixed waste, approximately 40 cubic yards of scrap metal, and 520 cubic yards of soil and debris.

Following the conclusion of the VCM excavation, a series of confirmatory soil samples were collected from under the southern end of Mound 1 (where the debris was buried), from the burial pit, from the soil mounds, from under Mound 3, and from the arroyo channel downstream of Mound 3 (Table 2.) The confirmatory soil samples were collected from 18 locations in the Mound 1 VCM excavation, from 3 locations in the burial pit, from 26 soil pile locations (2 per soil pile), from 1 location under Mound 3, and from 3 locations in the arroyo channel. The Mound 1 and burial pit samples were identified CCTA-09-GR-030 through CCTA-09-GR-050. The Mound 3 sample was identified CCTA-09-GR-029. The arroyo sediment samples were identified CCTA-09-GR-007 through CTA-09-GR-009. Except for the Mound 3 sample, all of the samples were from the surface (0- to 0.5-foot depth) and near-surface (0.5- to 1.0-foot depth) and were collected using a hand trowel. The Mound 3 sample was from the depth of 3.0 to 3.5 feet bgs at the base of the exploratory trench excavated in 1996. The soil piles were sampled by collecting one sample from the north and south sides of the pile using a hand trowel. These samples were identified CCTA-09-VCM-Pile 1-N through CCTA-09-VCM-Pile 13-S. The soil samples were collected using the sampling procedures detailed in SNL/NM field operating procedures.

Table 2 summarizes the analytical methods and data quality requirements necessary to (1) adequately characterize hazardous waste or hazardous constituents associated with the materials buried on site and (2) to support risk screening assessments.

The SWMU 9 confirmatory soil samples were analyzed for all COCs: for radionuclides (using gamma spectroscopy, isotopic uranium and thorium, gross alpha and gross beta, and tritium), for Target Analyte List (TAL) metals plus total uranium, for volatile organic compounds (VOCs), for semivolatile organic compounds (SVOCs), and for HE compounds. The samples were analyzed by three analytical laboratories: Core Laboratories Inc., General Engineering Laboratories, Inc. (GEL/EPI), and the on-site SNL/NM Radiation Protection Sample Diagnostic (RPSD) Laboratory. Gamma spectroscopy analyses were performed on a majority of the samples. Isotopic uranium and thorium and tritium analyses were only performed on the soil pile samples. Gross alpha and gross beta were not performed on the soil pile samples. Table 3 lists the analytical methods and some of the data quality requirements.

Table 1
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 9 Sampling Areas	Potential COC Source	Number of Sampling Locations	Sample Density	Sampling Location Rationale
Site-specific and arroyo sediment background	Not applicable	6	Surface and near-surface samples collected from each judgmental soil and arroyo sediment sample location	Sample locations selected in western portion of site and upstream of mounds in arroyo channel where activities are not believed to have had an impact
Arroyo sediment	Materials dumped in arroyo and mounds	3	Surface and near-surface samples collected from 3 arroyo channel locations at approximately 100-foot depth intervals	Sample locations selected downstream of Mound 3 to determine nature and extent of potential COCs released to arroyo channel sediment
Mound 1	Buried debris materials	9	Three trenches were excavated and 9 locations were sampled to characterize the mound materials and underlying soil.	Sample locations to determine the nature and extent of potential COCs in mound materials and possible release to underlying soil
Mound 1 VCM excavation	Buried debris materials	18	Surface and near-surface samples collected from within the excavation	Sample locations to confirm that no significant levels of COCs remain where the southern end of the mound was excavated
Burial Pit	Buried debris materials	3	Surface and near-surface samples collected from 3 judgmental locations across the excavation	Sample locations to confirm that no significant levels of COCs remain in the excavation
Soil piles from VCM excavation	Buried debris materials	26	Two locations on each of the 13 mounds	Sample locations to confirm that no significant levels of COCs remain in the excavated soil
Mound 2	Buried debris materials	1	Soil sample collected from beneath mound contact with native soil	Sample locations to determine nature and extent of potential COCs in underlying soil
Mound 3	Buried debris materials	1	Soil sample collected from beneath mound contact with native soil	Sample locations to determine nature and extent of potential COCs in underlying soil

COC = Contaminant of concern.

SWMU = Solid Waste Management Unit.

VCM = Voluntary Corrective Measure.

**Table 2
Number of Confirmatory Soil Samples Collected During the SWMU 9 RFI, VCM, and Soil Pile Sampling**

Sample Type ^a	Number of Samples	Radionuclides						TAL Metals plus Uranium	VOCs	SVOCs	HE
		Gamma Spectroscopy	Gamma Spectroscopy	Isotopic Uranium/Thorium	Gross Alpha Gross Beta	Tritium					
Confirmatory	75	27	49	26	54	32	75	69	69	82	
Duplicates	7	-	5		5	2	5	5	4	7	
Equipment Blanks	3	1	2		2	1	3	3	3	3	
VOC Trip Blanks	4	-						4			
Total Samples	84	28	28	26	61	35	83	81	76	92	
Analytical Laboratory	-	Core	RPSD	Core	GEL/EPI	Core, GEL/EPI	Core, GEL/EPI	Core, GEL/EPI	Core, GEL/EPI	Core, GEL/EPI	

^aIncludes no site-specific background samples.

- Core = Core Laboratories.
- GEL/EPI = General Engineering Laboratories Inc.
- HE = High explosive(s).
- RFI = RCRA Facility Investigation.
- RPSD = Radiation Protection Sample Diagnostic Laboratory.
- SVOC = Semivolatile organic compound.
- SWMU = Solid Waste Management Unit.
- TAL = Target Analyte List.
- VCM = Voluntary Corrective Measure.
- VOC = Volatile organic compound.
- = Information not available.

Table 3
Summary of Data Quality Requirements

Analytical Requirement	Data Quality Level	Core Laboratories, Inc., and GEL/EPI	SNL/NM RPSD Laboratory
Gamma spectroscopy EPA Method 901.1 ^a	Definitive	27	Not analyzed
Gamma spectroscopy EPA Method 901.1 ^a	Definitive	Not applicable	49
Isotopic uranium and isotopic thorium HASL-300	Definitive	26	Not analyzed
Gross alpha/beta EPA Method 900.0 ^a	Definitive	54	Not analyzed
Tritium EPA Method 906.0 ^a	Definitive	32	Not analyzed
TAL metals plus uranium EPA Method 6010/7000 ^a	Definitive	75	Not analyzed
VOCs EPA Method 8260A ^a	Definitive	69	Not analyzed
SVOCs EPA Method 8270 ^a	Definitive	69	Not analyzed
HE Compounds EPA Method 8330 ^a	Definitive	75	Not analyzed

Note: The number of samples does not include QA/QC samples such as duplicates, trip blanks and equipment blanks.

^aEPA November 1986.

EPA = U.S. Environmental Protection Agency.

GEL/EPI = General Engineering Laboratories Inc.

HASL = Health and Safety Laboratory, NY.

HE = High explosive(s).

QA = Quality assurance.

QC = Quality control.

RPSD = Radiation Protection Sample Diagnostic Laboratory.

SNL/NM = Sandia National Laboratories/New Mexico.

SVOC = Semivolatile organic compound.

TAL = Target Analyte List.

VOC = Volatile organic compound.

Fourteen QA/QC sample were collected during the confirmatory sampling effort according to the Environmental Restoration (ER) Project QA Project Plan. The QA/QC samples consisted of seven duplicates, three equipment blanks, and four trip blanks. For sampling in the VCM and burial pit excavations, duplicate soil samples were collected at 10 percent of the sampling locations. Equipment wash (aqueous rinsate) blanks were prepared during the sampling day. Trip blanks accompanied the soil samples requiring VOC analyses. No significant QA/QC problems were identified in the QA/QC samples.

All of the sample results were verified/validated by SNL/NM. The off-site laboratory results from Core Laboratories and GEL/EPI were reviewed against "Data Validation Procedure for Chemical and Radiochemical Data" SNL/NM ER Project Administrative Operating Procedure 00-03, Rev. 0 (SNL/NM December 1999). The data validation reports are presented in Annex D. The gamma spectroscopy data from the SNL/NM RPSD laboratory were reviewed against "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 2. The RPSD verification/validation reports are presented along with the gamma spectroscopy results in Annex D. The reviews confirmed that the analytical data from the three analytical laboratories are acceptable for use in the NFA proposal. Therefore, the DQOs have been fulfilled.

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 9 was based upon an initial conceptual model validated with confirmatory sampling at the site. The initial conceptual model was developed from archival research, soil sampling, aerial photographs, radiological surveys and VCM excavation. The DQOs contained in the OU 1334 Work Plan and modified by subsequent regulatory comments, identified the sample locations, sample density, sample depth and analytical requirements. The sample data were subsequently used to develop the final conceptual model for SWMU 9 which is presented in Section 10.5 of 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 9 was evaluated using laboratory analyses of the soil samples (Section V). The analytical requirements included analyses for radionuclides; TAL metals plus uranium, VOC, SVOCs, and HE compounds. The analyses characterized any potential contaminants remaining after the VCM excavation. The analytes and methods listed in Tables 2 and 3 are appropriate to characterize the COCs and any potential degradation products at SWMU 9.

III.3 Rate of Contaminant Migration

SWMU 9 is an inactive site that has recently been remediated, 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 (radionuclides, metals, VOCs, SVOCs, and HE compounds). The rate of COC migration from surficial soils is therefore dependent predominantly on precipitation and occasional surface-water flow as described in Section V. Data available from 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 9.

III.4 Extent of Contamination

Surface and near-surface confirmatory soil samples were collected from the excavation areas at Mound 1 and the burial pit, the soil piles, arroyo channel, and Mound 3 to assess the effectiveness of the VCM remediation. The confirmatory soil samples were collected using the sampling strategy in Table 1 after all visible debris was excavated from the Mound 1 and burial pit locations and surface radiation readings were less than 1.3 times background.

The confirmatory soil samples were collected from the upper one-foot of the excavated areas. Sampling at a more extensive variety of depths was not a significant concern at SWMU 9 because the VCM goals were satisfied. Furthermore, the vertical rate of contamination migration was expected to be low for SWMU 9 because the low precipitation, high evapotranspiration, impermeable layers in vadose zone soils, and the relative low solubility of the majority of COCs. Therefore, the confirmatory soil samples are considered to be 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 9.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities were used to identify potential COCs. The SWMU 9 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 a detected concentration of an organic compound was too high (i.e., exceeded the detection level) it could possibly cause an adverse effect to human health or the environment, and therefore, the compound was retained. Nondetect organics not included in this assessment were determined 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 for metals and radionuclides (Dinwiddie September 1997) was selected to provide the background screening listed in Tables 4 and 5.

Table 4
 Nonradiological COCs for Human Health and Ecological Risk Assessment at SWMU 9 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)
Antimony	1.91 J	3.9	Yes	16,000 ^c	NA	Yes
Arsenic	4.89	5.6	Yes	44 ^d	NA	Yes
Barium	209 J	130	No	170 ^e	NA	Yes
Beryllium	0.653	0.65	No	19 ^d	NA	No
Cadmium	2.78	<1	No	64 ^d	NA	Yes
Chromium	28.4	12.8	No	16 ^d	NA	No
Cobalt	8.61	5.2	No	10,000 ^f	NA	Yes
Copper	536 J	15.4	No	6 ^d	NA	No
Lead	126	11.8	No	49 ^d	NA	Yes
Manganese	409	831	Yes	100,000 ^f	NA	Yes
Mercury	2.09	<0.1	No	5500 ^d	NA	Yes
Nickel	14.9	11.5	No	47 ^d	NA	Yes
Selenium	1.08	<1	No	800 ^c	NA	Yes
Silver	0.458 J	<1	Unknown	0.5 ^d	NA	No
Thallium	0.111 ^g	<1.1	Unknown	119 ^d	NA	Yes
Uranium	19.5 J	2.3	No	20 ^e	NA	No
Vanadium	24.6	20.4	No	3000 ^e	NA	Yes
Zinc	354	62	No	47 ^d	NA	Yes
Acetone	0.013 J	NA	NA	0.69 ^h	-0.24 ^h	No
2-amino-4,6-dinitrotoluene	3.68	NA	NA	3.76 ⁱ	1.94 ⁱ	No
4-amino-2,6-dinitrotoluene	2.29	NA	NA	3.76 ⁱ	1.94 ^l	No
Anthracene	1.1	NA	NA	917 ^d	4.45 ^d	Yes
Benzo(a)pyrene	0.12 J	NA	NA	3000 ^d	6.04 ^d	Yes
Benzo(ghi)perylene	0.13 J	NA	NA	58,884 ^k	6.58 ^k	Yes
Chloroform	0.00097 J	NA	NA	10.35 ^h	1.92 ^k	No

Refer to footnotes at end of table.

Table 4 (Continued)
 Nonradiological COCs for Human Health Risk Assessment at SWMU 9 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)
Chrysene	0.12 J	NA	NA	18,000 ^k	5.91 ^k	Yes
2,4-dinitrotoluene	0.44	NA	NA	204 ^k	1.98 ^k	Yes
2,6-dinitrotoluene	0.16	NA	NA	5,225 ^k	1.72 ^k	Yes
Ethylbenzene	0.00052 J	NA	NA	15.5 ^l	3.15 ^l	No
HMX	6.2 J	NA	NA	0.49 ^m	0.26 ⁿ	No
Methylene chloride	0.044	NA	NA	5 ^h	1.25 ^h	No
Pentachlorophenol	0.28 J	NA	NA	776 ^o	5.09 ^k	Yes
RDX	26 J	NA	NA	9 ^p	0.87 ^k	No
Toluene	0.0028	NA	NA	10.7 ^d	2.69 ^d	No
Trichloroethene	0.00058 J	NA	NA	10.6 ^d	2.29 ^d	No
1,3,5-trinitrobenzene	0.67	NA	NA	23 ^k	1.1 ^k	No
2,4,6-trinitrotoluene	18	NA	NA	453 ^q	1.6 ^k	Yes
Xylene	0.0061	NA	NA	23.4 ^h	1.5 ^k	No

Note: **Bold** indicates the COCs that failed the background screening procedure and/or are bioaccumulators.

^aFrom Dinwiddle (September 1997) CTF Soils.

^bNMED (March 1998).

^cCallahan et al. (1979).

^dYanicak (March 1997).

^eNeumann (1976).

^fVanderploeg et al. (1975).

^gParameter was nondetect. Concentration is 0.5 of detection limit.

^hHoward (1990).

ⁱTalmage (1996).

^jAssumed to be equivalent to the log K_{ow} for 2-amino-4,6-dinitrotoluene.

^kMicromedex, Inc (1998).

^lHoward (1989).

Table 4 (Concluded)
Nonradiological COCs for Human Health Risk Assessment at SWMU 9 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

^mFrom Rosenblatt et al. (1991).
ⁿMaxwell and Opresko (1996).
^oHoward (1991).
^pTalmage et al. (1996).
^qTalmage and Opresko (1995).
^rU.S. Geological Survey (USGS) 1984.
BCF = Bioconcentration factor.
COC = Constituent of concern.
CTF = Coyote Test Field.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
J = Estimated concentration.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NMED = New Mexico Environment Department.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Table 5
Radiological COCs for Human Health and Ecological Risk Assessment at SWMU 9 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)	Bioaccumulator? ^b (BCF >40)
H-3	721 (pCi/L)	None	No	NA	NA
Cs-137	0.8	0.079	No	3000 ^c	Yes
Co-60	1.1	None	No	1000 ^d	Yes
Th-232	1.95	1.01	No	3000 ^d	No ^e
U-234	2.51	1.6	No	900 ^d	Yes
U-235	0.36	0.18	No	900 ^d	Yes
U-238	5.84	1.4	No	900 ^d	Yes

Note: **Bold** indicates COCs that failed the background screening procedure and/or are bioaccumulators.

^aFrom Dinwiddie (September 1997), Canyons Background.

^bNMED (March 1998).

^cFrom Whicker and Schultz (1992).

^dFrom Baker and Soldat (1992).

^eYanicak (March 1997).

BCF = Bioconcentration factor.

COC = Constituent of concern.

NA = Not applicable.

NMED = New Mexico Environment Department.

pCi/g = Picocurie(s) per gram.

pCi/L = Picocurie(s) per liter.

SNL/NM = Sandia National Laboratories/New Mexico.

SWMU = Solid Waste Management Unit.

Human health nonradiological COCs were also compared to SNL/NM proposed Subpart S action levels, if applicable (IT July 1994).

Nonradiological inorganics that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium were not included in this risk assessment (EPA 1989). Both radiological and nonradiological COCs were evaluated. The nonradiological COCs evaluated included both inorganic and organic compounds.

Table 4 lists nonradiological COCs for the human health and ecological risk assessment at SWMU 9. Table 5 lists radiological COCs for the human health and ecological risk assessment. All tables show the associated SNL/NM maximum background concentration values (Dinwiddie September 1997). Sections VI.4, VII.2 and VII.3 discuss Tables 4 and 5.

V. Fate and Transport

The primary release of COCs at SWMU 9 was to the surface and subsurface soil as a result of past dumping and burial of waste materials along a natural arroyo channel. Subsequent VCMs have removed the primary source materials (debris) leaving residual COCs in soil as a secondary source. Under the 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 open grassland vegetation, wind erosion is a potentially significant transport mechanism from the site for COCs in surface soil; however, the effect of the wind may be moderated by the topographic relief of the arroyo channel.

Water at SWMU 9 is received as precipitation (approximately 8.1 inches of rain or snow annually), which will either evaporate at or near the point of contact, infiltrate into the soil, or form runoff. Runoff can 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. Surface flow in the arroyo from upstream precipitation runoff is a more significant potential transport mechanism at SWMU 9 than on-site precipitation runoff. The arroyo at this site is a tributary of Arroyo del Coyote, approximately 3,800 feet to the north of SWMU 9.

Infiltration of precipitation is rapid due to the coarse nature of the soil. Water that infiltrates into the soil/sediment at this site can leach COCs into the subsurface soil. However, the depth of percolation is limited by the carbonate-rich, lower soil horizons. Approximately 95 to 99 percent of the annual precipitation is lost to evapotranspiration in this area (NOAA 1990). Because groundwater at this site is approximately 95 feet bgs, the potential for COCs to reach groundwater through the unsaturated zone above the water table is very small.

Plant roots can take up COCs that are in the soil. These COCs can then be transported to the above-ground tissues with the xylem stream. Above-ground tissues can also take up constituents from direct contact with dust particles. Volatilized COCs can be taken up by plants directly from the air; however, volatile COCs within the plant tissues can also be lost to the air. Organic COCs in plant tissues can be metabolized or can undergo other types of biotransformations. Those that remain in the tissue can be consumed by herbivores or eventually be returned to the soil as litter. Above-ground litter can be transported by wind and water until it is decomposed. Constituents in plant tissues that are consumed by herbivores can be absorbed or be returned to the soil in feces (at the site or possibly transported from the site

in the herbivore). COCs that are absorbed can be held in tissues, biotransformed, or later excreted. The herbivore can be eaten by a primary carnivore or scavenger and the constituents still held in the tissues will repeat the potential fates of excretion, transformation, or eventual consumption by higher predators, scavengers, and decomposers. The potential for transport of the constituents within the food chain depends upon the mobility of the species that comprise the food chain and the potential for the constituent to be transferred across the links in the food chain.

Degradation of COCs at SWMU 9 can result from biotic or abiotic processes. COCs that are inorganic and elemental in form are not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Other transformations of inorganics may 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). Degradation processes for organic COCs can include photolysis, hydrolysis, and biotransformation. Photolysis requires light and, therefore, takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water, and can occur in the soil solution. Biotransformation (i.e., transformation due to plants, animals, and microorganisms) can occur; however, biological activity may be limited by the aridity of the environment at this site.

Table 6 summarizes the fate and transport processes that can occur at SWMU 9. COCs at this site include both inorganics (metals and radionuclides) and organics in soil. Because of the open vegetative cover at this site, the potential for transport of COCs by wind is moderate. Because the site is within an arroyo channel, the potential for transport by surface-water runoff is high. Significant leaching of COCs into the subsurface soil is unlikely and leaching to the groundwater at this site is highly unlikely. For inorganic COCs, the potential for degradation is low and the potential for uptake into the food chain is considered low because of the terrestrial nature of the habitat and the arid climate. Degradation and/or biotransformation of organics and their loss by volatilization may be significant. 2,4,6-trinitrotoluene (TNT) is degraded in the environment by photolysis and hydrolysis and is readily metabolized by animals and plants if absorbed (Talmage and Opresko 1995, Talmage et al. 1996). Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) can persist in soil and can leach into the subsurface soil with percolation (Maxwell and Opresko 1996; Talmage et al. 1996). RDX can be taken up by plant roots and sequestered in aboveground tissues (Talmage et al. 1996). Both HMX and RDX are readily metabolized and excreted by animals, making the potential for food chain uptake of these COCs low. The potential for degradation and/or biotransformation of the other organic COCs is low to moderate. Some organics may be lost through volatilization. The potential for uptake into the food chain by organic COCs at SWMU 9 is considered low to moderate because of the terrestrial nature of the habitat and the arid climate. Decay of radiological COCs is insignificant because of their long half lives.

Table 6
Summary of Fate and Transport at SWMU 9

Transport and Fate Mechanism	Existence at Site	Significance
Wind	Yes	Moderate
Surface runoff	Yes	High
Migration to groundwater	No	None
Food chain uptake	Yes	Low to moderate
Transformation/degradation	Yes	Low (inorganics and radionuclides) Low to moderate (organics)

SWMU = Solid Waste Management Unit.

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 of the above steps are discussed.

VI.2 Step 1. Site Data

Section I provides the description and history for SWMU 9. Section II presents DQOs. Section III discusses the determination of the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

SWMU 9 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 of the potential to inhale dust and volatiles. Soil ingestion is included for the radiological COCs as well. No water pathways to the groundwater are considered. Depth to groundwater at SWMU 9 is approximately 95 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 and volatiles)	Inhalation (dust and volatiles)
Plant uptake (residential only)	Plant uptake (residential only)
	Direct gamma

VI.4 Step 3. COC Screening Procedures

Step 3 is discussed in this section and includes two screening procedures. The first compares the maximum COC concentration to the background screening level. The second compares 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 10. Only the COCs that were detected above their respective SNL/NM

maximum background screening levels or did not have either a quantifiable or 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 5 present SWMU 9 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, 13 constituents were measured at concentrations greater than their respective background. Two constituents did not have quantified background screening levels; therefore, it is unknown if these compounds exceed background. Twenty COCs were organic compounds and do not have background screening levels.

The maximum concentration value for lead is 126 milligrams (mg) per kilogram (/kg). The EPA intentionally does not provide any human health toxicological data on lead; therefore, no risk parameter values could be calculated. However, EPA Region 6 guidance for the screening value for lead for the industrial land use scenario is 2,000 mg/kg (EPA 1996a); for the residential land use scenario, the EPA screening guidance value is 400 mg/kg (EPA July 1994). The maximum concentration value for lead at this site is less than both screening values; therefore, lead is eliminated from further consideration in the human health risk assessment.

For the radiological COCs, seven constituents had maximum activity concentrations greater than their respective background (U-238, U-235, U-234, Th-232, Co-60, H-3, and Cs-137). They were evaluated in the risk assessment for screening purposes.

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

Because the SWMU 9 sample set had more than ten COCs that continued beyond the first screening level (including COCs that did not have background screening values), the proposed Subpart S screening process was not performed. All nonradiological COCs that were not eliminated during the background screening process for SWMU 9 had a calculated hazard quotient (HQ) and excess cancer risk value.

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

VI.5 Step 4. Identification of Toxicological Parameters

Tables 7 (nonradiological) and 8 (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 7 were from the Integrated Risk Information System (IRIS) (EPA 2000), the Health Effects Assessment Summary Tables (HEAST) (EPA 1997a), and the Region 3 (EPA 1997c) and Region 9 (EPA 1996c) electronic databases. 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

Table 7
Toxicological Parameter Values for SWMU 9 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
Barium	7E-2 ^c	M	1.4E-4 ^d	-	-	-	-
Beryllium	2E-3 ^c	L to M	5.7E-6 ^c	M	-	8.4E+0 ^c	B1
Cadmium	5E-4 ^c	H	5.7E-5 ^d	-	-	6.3E+0 ^c	B1
Chromium III	1E+0 ^c	L	5.7E-7 ^e	-	-	-	-
Chromium VI	5E-3 ^c	L	-	-	-	4.2E+1 ^c	A
Cobalt	6E-2 ^d	-	2.9E-4 ^d	-	-	-	-
Copper	3.7E-2 ^d	-	-	-	-	-	D
Mercury	3E-4 ^f	-	8.6E-5 ^c	M	-	-	D
Nickel	2E-2 ^c	M	-	-	-	-	-
Selenium	5E-3 ^c	H	-	-	-	-	D
Silver	5E-3 ^c	L	-	-	-	-	D
Thallium ^g	8E-5 ^c	L	-	-	-	-	D
Uranium	3E-3 ^c	M	-	-	-	-	-
Vanadium	7E-3 ^f	-	-	-	-	-	-
Zinc	3E-1 ^c	M	-	-	-	-	D
Acetone	1E-1 ^c	L	1E-1 ^d	-	-	-	D
2-amino-4,6-dinitrotoluene ^h	-	-	-	-	6.8E-1 ^c	6.8E-1 ^d	B2
4-amino-2,6-dinitrotoluene ^h	-	-	-	-	6.8E-1 ^c	6.8E-1 ^d	B2
Anthracene	3E-1 ^c	L	3E-1 ^d	-	-	-	D
Benzo(a)pyrene	-	-	-	-	7.3E+0 ^c	7.3E+0 ^d	B2
Benzo(ghi)perylene ⁱ	-	-	-	-	7.3E+0 ^d	7.3E+0 ^d	B2
Chloroform	1E-2 ^c	M	1E-2 ^d	-	6.1E-3 ^c	8.1E-2 ^c	B2
Chrysene	-	-	-	-	7.3E-3 ^d	7.3E-3 ^d	B2
2,4-dinitrotoluene	2E-3 ^c	H	2E-3 ^d	-	6.8E-1 ^{c,h}	6.8E-1 ^{d,h}	B2
2,6-dinitrotoluene	1E-3 ^f	-	1E-3 ^d	-	6.8E-1 ^{c,h}	6.8E-1 ^{d,h}	B2
Ethylbenzene	1E-1 ^c	L	2.9E-1 ^c	L	-	-	D
HMX	5E-2 ^c	L	5E-2 ^d	-	-	-	D
Methylene chloride	6E-2 ^c	M	8.6E-1 ^f	-	7.5E-3 ^c	1.7E-3 ^c	B2
Pentachlorophenol	3E-2 ^c	M	3E-2 ^d	-	1.2E-1 ^c	1.2E-1 ^d	B2
RDX	3E-3 ^c	H	3E-3 ^d	-	1.1E-1 ^c	1.1E-1 ^d	C
Toluene	2E-1 ^c	M	1.1E-1 ^c	M	-	-	D
Trichloroethene	6E-3 ^d	-	6E-3 ^d	-	1.1E-2 ^d	6E-3 ^d	-
1,3,5-trinitrobenzene	3E-2 ^c	M	5E-5 ^d	-	-	-	-

Refer to footnotes at end of table.

Table 7 (Concluded)
Toxicological Parameter Values for SWMU 9 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
2,4,6-trinitrotoluene	5E-4 ^c	M	5E-4 ^d	–	3E-2 ^c	3E-2 ^d	C
Xylene ^j	2E+0 ^c	M	2E-1 ^d	–	–	–	D

^aConfidence associated with IRIS (EPA 2000) database values. Confidence: L = low, M = medium, H = high.

^bEPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 2000).

A = Human carcinogen.

B1 = Probable human carcinogen. Limited human data available.

B2 = Probable human carcinogen. Sufficient evidence in animals and inadequate or no evidence in humans.

C = Possible human carcinogen.

D = Not classifiable as to human carcinogenicity.

^cToxicological parameter values from IRIS electronic database (EPA 2000).

^dToxicological parameter values from EPA Region 9 electronic database (EPA 1996c).

^eToxicological parameter values from EPA Region 3 electronic database (EPA 1997c).

^fToxicological parameter values from HEAST database (EPA 1997a).

^gThallium does not have toxicological parameter values. Thallium sulfate was used as a surrogate.

^hToxicological parameter values are for dinitrotoluene, mixture.

ⁱBenzo(ghi) perylene does not have toxicological parameter values. Dibenz(a,h) anthracene was used as a surrogate.

^jToxicological parameter values are for xylene, mixture.

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

HEAST = Health Effects Assessment Summary Tables.

HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.

IRIS = Integrated Risk Information System.

mg/kg-d = Milligram(s) per kilogram day.

(mg/kg-day)⁻¹ = Per milligram per kilogram day.

RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

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 8
Radiological Toxicological Parameter Values for SWMU 9 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
H-3	7.20E-14	9.60E-14	0	A
Cs-137	3.20E-11	1.90E-11	2.10E-6	A
Co-60	1.90E-11	6.90E-11	9.80E-6	A
Th-232	3.80E-11	1.90E-08	3.30E-11	A
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

^aFrom Yu et al. (1993a).

^bEPA 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 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.

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 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 9 shows an HI of 0.1 for the SWMU 9 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 and volatile inhalation for nonradiological COCs. Table 10 shows an HI of 0.00 and an excess cancer risk of $3E-10$ assuming the maximum background concentrations of the SWMU 9 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, a TEDE was calculated for an industrial office worker who spends a majority of his time indoors and for an industrial worker who evenly splits his time indoors and outdoors at the site. After analyzing these two scenarios, the more conservative is the 50/50 time split. For the industrial land use scenario this resulted in an incremental TEDE of 3.5 millirem (mrem)/year (yr). 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 is used for the probable land use scenario (industrial in this case); the calculated dose value for SWMU 9 for the industrial land use is well below this guideline. The estimated excess cancer risk is $4.4E-5$.

For the residential land use scenario nonradioactive COCs, the HI is 158, and the excess cancer risk is $2E-2$ (Table 9). The numbers in the table included exposure from soil ingestion, dust and volatile inhalation, and plant uptake. Although the EPA (1991) generally recommends that inhalation not be included in a residential land use scenario, this pathway is 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 are not considered (see Appendix 1). Table 10 shows that for the SWMU 9 associated background constituents, the HI is 0.3 and the excess cancer risk is $5E-10$.

For the residential land use scenario radiological COCs, the incremental TEDE is 8.6 mrem/yr. The guideline being used is 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 9 for the residential land use scenario is well below this guideline. Consequently, SWMU 9 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 is $1.09E-4$. The excess cancer risk from the nonradiological COCs and the radiological COCs is not additive, as noted in the RAGS (EPA 1989).

Table 9
Risk Assessment Values for SWMU 9 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
Barium	209 J	0.00	–	0.03	–
Beryllium	0.653	0.00	3E-10	0.00	5E-10
Cadmium	2.78	0.01	9E-10	2.27	2E-9
Chromium, total ^b	28.4	0.01	6E-8	0.02	1E-7
Cobalt	8.61	0.00	–	0.00	–
Copper	536 J	0.01	–	2.6	–
Mercury	2.09	0.01	–	3.6	–
Nickel	14.9	0.00	–	0.02	–
Selenium	1.08	0.00	–	0.38	–
Silver	0.458 J	0.00	–	0.02	–
Thallium ^c	0.111 ^d	0.00	–	0.01	–
Uranium	19.5 J	0.01	–	0.05	–
Vanadium	24.6	0.00	–	0.02	–
Zinc	354	0.00	–	0.64	–
Acetone	0.013 J	0.00	–	0.00	–
2-amino-4,6-dinitrotoluene ^e	3.68	0.00	1E-6	0.00	5E-6
4-amino-2,6-dinitrotoluene ^e	2.29	0.00	8E-7	0.00	3E-6
Anthracene	1.1	0.00	–	0.00	–
Benzo(a) pyrene	0.12 J	0.00	3E-7	0.00	3E-6
Benzo(ghi) perylene ^f	0.13 J	0.00	3E-7	0.00	5E-6
Chloroform	0.00097 J	0.00	2E-9	0.00	6E-9
Chrysene	0.12 J	0.00	3E-10	0.00	4E-9
2,4-dinitrotoluene	0.44	0.00	1E-7	0.2	5E-7
2,6-dinitrotoluene	0.16	0.00	5E-8	0.00	2E-7
Ethylbenzene	0.00052 J	0.00	–	0.00	–
HMX	6.2 J	0.00	–	4.59	–
Methylene chloride	0.044	0.00	3E-9	0.00	3E-7
Pentachlorophenol	0.28 J	0.00	1E-8	0.00	3E-7
RDX	26 J	0.01	1E-6	142.8	2E-2
Toluene	0.0028	0.00	–	0.00	–
Trichloroethene	0.00058 J	0.00	7E-11	0.00	2E-9
1,3,5-trinitrobenzene	0.67	0.00	–	0.27	–
2,4,6-trinitrotoluene	18	0.04	2E-7	0.14	9E-7
Xylene ^g	0.0061	0.00	–	0.00	–
Total		0.1	4E-6	158	2E-2

Refer to footnotes at end of table.

Table 9 (Concluded)
Risk Assessment Values for SWMU 9 Nonradiological COCs

^aFrom EPA (1989).

^bChromium, total assumed to be chromium VI (most conservative).

^cToxicological parameter values are from thallium sulfate.

^dParameter was nondetect. Concentration assumed to be 0.5 of detection limit.

^eToxicological parameter values are for dinitrotoluene, mixture.

^fToxicological parameter values are from dibenz(a,h)anthracene.

^gToxicological parameter values are for xylene, mixture.

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.

J = Estimated concentration.

mg/kg = Milligram(s) per kilogram.

RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

SWMU = Solid Waste Management Unit.

– = Information not available.

Table 10
Risk Assessment Values for SWMU 9 Nonradiological Background Constituents

COC Name	Background Concentration ^a	Industrial Land Use		Residential Land Use	
		Hazard	Cancer	Hazard	Cancer
Barium	130	0.00	–	0.02	–
Beryllium	0.65	0.00	3E-10	0.00	5E-10
Cadmium	<1	–	–	–	–
Chromium, total ^c	12.8	0.00	–	0.00	–
Cobalt	5.2	0.00	–	0.00	–
Copper	15.4	0.00	–	0.07	–
Mercury	<0.1	–	–	–	–
Nickel	11.5	0.00	–	0.02	–
Selenium	<1	–	–	–	–
Silver	<1	–	–	–	–
Thallium ^d	<1.1	–	–	–	–
Uranium	2.3	0.00	–	0.01	–
Vanadium	20.4	0.00	–	0.02	–
Zinc	62	0.00	–	0.11	–
Total		0.00	3E-10	0.3	5E-10

^aFrom Dinwiddie (September 1997), CTF soils.

^bFrom EPA (1989).

^cChromium, total, assumed to be chromium VI (most conservative).

^dToxicological parameter values are from thallium sulfate.

COC = Constituent of concern.

CTF = Coyote Test Field.

EPA = U.S. Environmental Protection Agency.

mg/kg = Milligram(s) per kilogram.

SWMU = Solid Waste Management Unit.

– = Information not available.

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 is 0.1 (less than the numerical guideline of 1 suggested in the RAGS [EPA 1989]). Excess cancer risk is estimated at $4E-6$. Guidance from the New Mexico Environment Department (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 is driven by several explosives and semivolatile compounds. Most of the risk drivers are Class B2 carcinogens. Thus, the excess cancer risk for this site is 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 background nonradiological COCs the HI is 0.00 and the excess cancer risk is $3E-10$. Incremental risk is determined by subtracting risk associated with background from potential COC risk. These numbers are not rounded before the difference is determined and, therefore, may appear to be inconsistent with numbers presented in tables and within the text. For conservatism, the background constituents that do not have a quantified background concentrations are assumed to have an HQ of 0.00. Incremental HI is 0.1 and estimated incremental cancer risk is $3.83E-6$ for the industrial land use scenario. The incremental excess cancer risk to human health from the nonradiological COCs is above guidelines considering a industrial land use scenario.

For radiological COCs in the industrial land use scenario, incremental TEDE is 3.5 mrem/yr, which is significantly less than the EPA's numerical guideline of 15 mrem/yr. Incremental estimated excess cancer risk is $4.4E-5$.

The calculated HI for the residential land use scenario nonradiological COCs is 158, which is above the numerical guidance. Excess cancer risk is estimated at $2E-2$. The excess cancer risk is driven by semivolatile and HE compounds. Most of the compounds are Class B2 carcinogens. Therefore, the excess cancer risk for this site is above the suggested acceptable risk value ($1E-6$). The HI for associated background for the residential land use scenario is 0.3; the excess cancer risk is estimated at $5E-10$. The incremental HI is 157.41 and the estimated incremental cancer risk is $2E-2$ for the residential land use scenario. Both the incremental HI and estimated excess cancer risk indicates contribution to human health above proposed guidelines from the COCs considering the residential land use scenario.

The incremental TEDE for the residential land use scenario from the radiological components is 8.6 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 is $1.09E-4$.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at SWMU 9 was based upon an initial conceptual model that was validated with confirmatory sampling conducted around the

site. The confirmatory sampling was implemented as set forth by the OU 1334 RFI Work Plan (SNL/NM October 1994). The DQOs contained in the RFI Work Plan are appropriate for use in risk screening assessments. The data collected, based upon sample location, density, and depth are representative of the site. The analytical requirements and results satisfy the DQOs. The 1994 data quality was verified and the data quality was verified and validated against SNL/NM procedures (SNL/NM July 1994, July 1996, December 1999). Therefore, there is no uncertainty associated with the data quality used to perform the risk screening assessment at SWMU 9.

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 are conservative and that calculated intakes are probably overestimates. Maximum measured values of COC concentrations are 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 2000), the HEAST (EPA 1997a), EPA Region 3 (EPA 1997c) and EPA Region 9 (EPA 1996c) electronic databases. Where values are not provided, information is not available from the HEAST (EPA 1997a), IRIS (EPA 2000), or the EPA regions (EPA 1996c, 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.

Total and incremental HI values for the nonradiological COCs are below human health guidelines 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 through the use of maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the upper 95% confidence limit of the mean concentration (all in mg/kg) for 2-amino-4,6-dinitrotoluene (0.302), 4-amino-2,6-dinitrotoluene (0.217), benzo(a)pyrene (0.082), benzo(ghi) perylene (0.118), 2,4-dinitrotoluene (0.158), RDX (3.7), and 2,4,6-TNT (1.4) is used in place of the maximum concentration the total excess cancer risk is reduced to $9.67E-7$ and the incremental excess cancer risk is calculated to be $9.66E-7$, both of which are within proposed guidelines considering an industrial land use scenario.

For radiological COCs, the conclusion of the risk assessment is that potential effects on human health for both industrial and residential land use scenarios are within guidelines and are 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 9 has identified COCs consisting of some inorganic, organic, 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 and volatile inhalation for chemical constituents and soil ingestion, dust and volatile 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 (0.1) is significantly less than the accepted numerical guidance from the EPA. Excess cancer risk ($4E-6$) is above the acceptable risk value provided by the NMED for an industrial land use scenario (NMED March 1998). The incremental HI is 0.1, and the incremental cancer risk is $3.83E-6$ for the industrial land use scenario. If the upper 95% confidence limit of the mean concentration (all in mg/kg) for 2-amino-4,6-dinitrotoluene (0.302), 4-amino-2,6-dinitrotoluene (0.217), benzo(a)pyrene (0.082), benzo(ghi) perylene (0.118), 2,4-dinitrotoluene (0.158), RDX (3.7), and 2,4,6-TNT (1.4) is used in place of the maximum concentration the total excess cancer risk is reduced to $9.67E-7$ and the incremental excess cancer risk is calculated to be $9.66E-7$, both of which are within proposed guidelines considering an industrial land use scenario.

Incremental TEDE and corresponding estimated cancer risk from radiological COCs are much less than EPA guidance values; the estimated TEDE is 3.5 mrem/yr for the industrial land use scenario. This value is much less than the numerical guidance of 15 mrem/yr in EPA guidance (EPA 1997b). The corresponding incremental estimated cancer risk value is $4.4E-5$ 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 is only 8.6 mrem/yr with an associated risk of $1.09E-4$. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore, SWMU 9 is eligible for unrestricted radiological release.

Uncertainties associated with the calculations are considered 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 9. A component of the NMED Risk-Based Decision Tree (March 1998) is to conduct an ecological screening assessment that corresponds with that presented in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997d). The current methodology is tiered and contains an initial scoping assessment followed by a more detailed screening assessment. Initial components of 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 conservatism in the estimation of ecological risks, ecological relevance and professional judgment are also used as recommended by the EPA (1998) 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 of exposure of biota at or adjacent to the site to 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 4 and 5), inorganic constituents in soil within the 0- to 5-foot depth interval that exceeded background concentrations were as follows:

- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Uranium
- Vanadium
- Zinc
- H-3
- Co-60
- Cs-137
- Th-232
- U-234
- U-235
- U-238.

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

- Silver
- Thallium.

Organic analytes detected in soil were as follows:

- Acetone
- 2-amino-4,6-dinitrotoluene
- 4-amino-2,6-dinitrotoluene
- Anthracene
- Benzo(a)pyrene
- Benzo(g,h,i)perylene
- Chloroform
- Chrysene
- 2,4-dinitrotoluene
- 2,6-dinitrotoluene
- Ethylbenzene
- HMX
- Methylene chloride
- Pentachlorophenol
- RDX
- Toluene
- Trichloroethene
- 1,3,5-trinitrobenzene
- 2,4,6-TNT
- Xylenes.

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 4 and 5):

- Barium
- Cadmium
- Cobalt
- Lead
- Mercury
- Nickel
- Selenium
- Thallium
- Vanadium
- Zinc

- Co-60
- Cs-137
- U-234
- U-235
- U-238
- Anthracene
- Benzo(a)pyrene
- Benzo(g,h,i)perylene
- Chrysene
- 2,4-dinitrotoluene
- 2,6-dinitrotoluene
- Pentachlorophenol
- 2,4,6-TNT.

It should be noted, however, that as directed by the NMED (March 1998), bioaccumulation for inorganics is 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 6 (Section V), wind is expected to be of moderate significance as a transport mechanism for COPECs at this site, and surface-water runoff is of potentially high significance. Migration to groundwater is not anticipated. Food chain uptake is expected to be of low to moderate significance. Degradation (decay) and transformation for the inorganic COPECs and radionuclides is expected to be of low significance but may be of moderate significance for the organic COPECs. Volatilization may be a mechanism of loss for some organic COPECs (e.g., VOCs).

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 involves a quantitative estimate of current ecological risks using exposure models in association with exposure

parameters and toxicity information obtained from the literature. The estimation of potential ecological risks is conservative to ensure that ecological risks are not underpredicted.

Components within the screening assessment include 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 for SNL/NM ER Program" (IT July 1998) and are not duplicated here.

VII.3.1.1 *Ecological Pathways and Setting*

SWMU 9 is approximately 1.86 acres in size. The site is located in an area dominated by grassland habitat, but the habitat of the site is dominated by an arroyo with riparian scrubland vegetation. The habitat at this site has been moderately disturbed by past use. The site is open to use by wildlife. Larger animals such as coyotes and deer may use the arroyo as a travel corridor. A sensitive species survey of the site was conducted on June 16, 1994 (IT February 1995). No threatened, endangered, or other sensitive species were found within this SWMU.

is the major route of exposure for plants and that exposure of plants to wind-blown soil is minor. Exposure modeling for the wildlife receptors was limited to the food and soil ingestion pathways and external radiation. Because of the lack of surface water at this site, exposure to COPECs through the ingestion of surface water was considered insignificant. Inhalation and dermal contact were also considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Groundwater is not expected to be affected by COCs at this site.

VII.3.1.2 COPECs

Waste materials dumped in the arroyo channel at SWMU 9 were the source of the COPECs associated with the soils at this site. Inorganic and organic COPECs identified for SWMU 9 are listed in Section VII.2.1. The inorganic COPECs include both radiological and nonradiological analytes. The inorganic analytes were screened against background concentrations and those that exceeded the approved SNL/NM background screening levels (Dinwiddie September 1997) for the area were considered to be COPECs. Nonradiological inorganics that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium were not included in this risk assessment as set forth by the EPA (1989). All organic analytes detected were considered to be COPECs for the site. In order to provide conservatism, this ecological risk assessment was based upon the maximum soil concentrations of the COPECs measured in the surface soil at this site. Tables 4 and 5 present maximum concentrations for the COPECs.

VII.3.1.3 Ecological Receptors

As described in detail in an IT Corporation report (July 1998), a nonspecific perennial plant was selected as the receptor to represent plant species at the site. Vascular plants are the principal primary producers at the site and are key to the diversity and productivity of the wildlife community associated with the site. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. The burrowing owl was selected to represent a top predator at this site. The burrowing owl is present at SNL/NM and is designated a species of management concern by the U.S. Fish and Wildlife Service in Region 2, which includes the state of New Mexico (USFWS September 1995).

VII.3.2 Exposure Estimation

For nonradiological COPECs, direct uptake from the soil was considered the only significant route of exposure for terrestrial plants. Exposure modeling for the wildlife receptors was limited to food and soil ingestion pathways and external radiation. Inhalation and dermal contact were considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Drinking water was also considered an insignificant pathway because of the lack of surface water at this site. The deer mouse was modeled under three dietary regimes: as an herbivore (100 percent of its diet as plant material), as an omnivore (50 percent of its diet as plants and 50 percent as soil invertebrates), and as an insectivore (100 percent of its diet as soil invertebrates). The burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Because the exposure in the burrowing owl from a diet consisting of equal parts of

herbivorous, omnivorous, and insectivorous mice would be equivalent to the exposure consisting of only omnivorous mice, the diet of the burrowing owl was modeled with intake of omnivorous mice only. Both species were modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 11 presents the species-specific factors used in modeling exposures in the wildlife receptors. Justification for use of the factors presented in this table is described in the ecological risk assessment methodology document (IT July 1998).

Although home range is also included in this table, exposures for this risk assessment were modeled using an area use factor of 1, implying that all food items and soil ingested are from the site being investigated. The maximum measured COPEC concentrations from surface soil samples were used to conservatively estimate potential exposures and risks to plants and wildlife at this site.

For the radiological dose rate calculations, the deer mouse was modeled as an herbivore (100 percent of its diet as plants), and the burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Both were modeled with soil ingestion comprising 2 percent of the total dietary intake. Receptors are exposed to radiation both internally and externally from tritium (H-3), Cs-137, Co-60, Th-232, U-234, U-235, and U-238. Internal and external dose rates to the deer mouse and the burrowing owl are approximated using modified dose rate models from DOE (1995) as presented in the ecological risk assessment methodology document for the SNL/NM ER Project (IT July 1998). Radionuclide-dependent data for the dose rate calculations were obtained from Baker and Soldat (1992). The external dose rate model examines the total-body dose rate to a receptor residing in soil exposed to radionuclides. The soil surrounding the receptor is assumed to be an infinite medium uniformly contaminated with gamma-emitting radionuclides. The external dose rate model is the same for both the deer mouse and the burrowing owl. The internal total-body dose rate model assumes that a fraction of the radionuclide concentration ingested by a receptor is absorbed by the body and concentrated at the center of a spherical body shape. This provides for a conservative estimate for absorbed 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 tritium, Cs-137, Co-60, Th-232, U-234, U-235, and U-238 in soil.

Table 12 presents the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 13 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 14 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

**Table 11
Exposure Factors for Ecological Receptors at SWMU 9**

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

^aBody weights are in kg wet weight.

^bFood intake rates are estimated from the allometric equations presented in Nagy (1987). Units are kg dry weight per day.

^cDietary compositions are generalized for modeling purposes. Default soil intake value of 2% of food intake.

^dFrom Silva and Downing (1995).

^eEPA (1993), based upon the average home range measured in semiarid shrubland in Idaho.

^fFrom Dunning (1993).

^gFrom Haug et al. (1993).

EPA = U.S. Environmental Protection Agency.

kg = Kilogram(s).

kg/day = Kilogram(s) per day.

SWMU = Solid Waste Management Unit.

Table 12
Transfer Factors Used in Exposure Models for
Constituents of Potential Ecological Concern at SWMU 9

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Inorganic			
Barium	1.5E-1 ^a	1.0E+0 ^b	2.0E-4 ^c
Beryllium	1.0E-2 ^a	1.0E+0 ^b	1.0E-3 ^a
Cadmium	5.5E-1 ^a	6.0E-1 ^d	5.5E-4 ^a
Chromium (total)	4.0E-2 ^c	1.3E-1 ^e	3.0E-2 ^c
Cobalt	4.0E-1 ^c	1.0E+0 ^b	3.0E-2 ^c
Copper	8.0E-1 ^f	2.5E-1 ^d	1.0E-2 ^a
Lead	9.0E-2 ^c	4.0E-2 ^d	8.0E-4 ^c
Mercury (organic)	1.0E+0 ^c	1.0E+0 ^b	2.5E-1 ^a
Mercury (inorganic)	1.0E+0 ^c	1.0E+0 ^b	2.5E-1 ^a
Nickel	2.0E-1 ^c	3.8E-1 ^e	6.0E-3 ^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
Thallium	4.0E-3 ^a	1.0E+0 ^b	4.0E-2 ^a
Uranium	2.3E-2 ^f	1.0E+0 ^b	1.0E-2 ^c
Vanadium	5.5E-3 ^a	1.0E+0 ^b	2.5E-3 ^a
Zinc	1.5E+0 ^a	3.0E-1 ^c	1.0E-1 ^a
Organic ^g			
Acetone	5.3E+1	1.3E+1	1.0E-8
2-amino-4,6-dinitrotoluene	2.9E+0	1.6E+1	1.9E-6
4-amino-2,6-dinitrotoluene	2.9E+0	1.6E+1	1.9E-6
Anthracene	1.0E-1	2.2E+1	7.3E-4
Benzo(a)pyrene	1.1E-2	2.7E+1	3.8E-2
Benzo(g,h,i)perylene	6.1E-3	2.8E+1	1.2E-1
Chloroform	3.0E+0	1.6E+1	1.8E-6
Chrysene	1.5E-2	2.6E+1	2.3E-2
2,4-dinitrotoluene	2.8E+0	1.7E+1	2.0E-6
2,6-dinitrotoluene	3.9E+0	1.6E+1	1.1E-6
Ethylbenzene	5.9E-1	1.9E+1	3.3E-5
HMX	2.7E+1	1.4E+1	3.4E-8
Methylene chloride	7.3E+0	1.5E+1	3.6E-7
Pentachlorophenol	4.4E-2	2.4E+1	3.3E-3
RDX	1.2E+1	1.5E+1	1.5E-7
Toluene	10.0E-1	1.8E+1	1.3E-5
Trichloroethene	1.1E+0	1.8E+1	1.2E-5
1,3,5-Trinitrobenzene	9.0E+0	1.5E+1	2.5E-7
2,4,6-Trinitrotoluene	4.6E+0	1.6E+1	8.3E-7
Xylenes	5.5E-1	1.9E+1	3.7E-5

Refer to footnotes at end of table.

Table 12 (Concluded)
Transfer Factors Used in Exposure Models for
Constituents of Potential Ecological Concern at SWMU 9

^aFrom Baes et al. (1984).

^bDefault value.

^cFrom NCRP (January 1989).

^dFrom Stafford et al. (1991).

^eFrom Ma (1982).

^fFrom IAEA (1994).

^gSoil-to-plant and food-to-muscle transfer factors from equations developed in Travis and Arms (1988).

Soil-to-invertebrate transfer factors from equations developed in Connell and Markwell (1990). All three equations based upon relationship of the transfer factor to the log K_{ow} value of compound.

HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.

IAEA = International Atomic Energy Agency.

K_{ow} = Octanol-water partition coefficient.

Log = Logarithm (base 10).

NCRP = National Council on Radiation Protection and Measurements.

RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

SWMU = Solid Waste Management Unit.

Table 13
Media Concentrations^a for Constituents of
Potential Ecological Concern at SWMU 9

Constituent of Potential Ecological Concern	Soil (maximum) ^a	Plant Foliage ^b	Soil Invertebrate ^b	Deer Mouse Tissues ^c
Inorganic				
Barium	2.1E+2 ^d	3.1E+1	2.1E+2	7.8E-2
Beryllium	6.5E-1	6.5E-3	6.5E-1	1.1E-3
Cadmium	2.8E+0	1.5E+0	1.7E+0	2.8E-3
Chromium (total)	2.8E+1	1.1E+0	3.7E+0	2.8E-1
Cobalt	8.6E+0	3.4E+0	8.6E+0	5.8E-1
Copper	5.4E+2 ^d	4.3E+2	1.3E+2	9.1E+0
Lead	1.3E+2	1.1E+1	5.0E+0	2.7E-2
Mercury (organic)	2.1E+0	2.1E+0	2.1E+0	1.7E+0
Mercury (inorganic)	2.1E+0	2.1E+0	2.1E+0	1.7E+0
Nickel	1.5E+1	3.0E+0	5.7E+0	8.7E-2
Selenium	1.1E+0	5.4E-1	1.1E+0	2.6E-1
Silver	4.6E-1 ^d	4.6E-1	1.2E-1	4.6E-3
Thallium	1.1E-1	4.4E-4	1.1E-1	7.2E-3
Uranium	2.0E+1 ^d	4.5E-1	2.0E+1	3.2E-1
Vanadium	2.5E+1	1.4E-1	2.5E+1	1.0E-1
Zinc	3.5E+2	5.3E+2	1.1E+2	1.0E+2
Organic				
Acetone	1.3E-2 ^d	6.9E-1	1.7E-1	1.4E-8
2-amino-4,6-dinitrotoluene	3.7E+0	1.1E+1	6.1E+1	2.1E-4
4-amino-2,6-dinitrotoluene	2.3E+0	6.7E+0	3.8E+1	1.3E-4
Anthracene	1.1E+0	1.1E-1	2.4E+1	2.8E-2
Benzo(a)pyrene	1.2E-1 ^d	1.4E-3	3.2E+0	1.9E-1
Benzo(g,h,i)perylene	1.3E-1 ^d	7.9E-4	3.7E+0	6.6E-1
Chloroform	9.7E-4 ^d	2.9E-3	1.6E-2	5.2E-8
Chrysene	1.2E-1 ^d	1.8E-3	3.1E+0	1.1E-1
2,4-dinitrotoluene	4.4E-1	1.2E+0	7.3E+0	2.7E-5
2,6-dinitrotoluene	1.6E-1	6.3E-1	2.6E+0	5.5E-6
Ethylbenzene	5.2E-4 ^d	3.0E-4	9.8E-3	5.2E-7
HMX	6.2E+0 ^d	1.7E+2	8.4E+1	1.4E-5
Methylene chloride	4.4E-2	3.2E-1	6.7E-1	5.6E-7
Pentachlorophenol	2.8E-1 ^d	1.2E-2	6.6E+0	3.5E-2
RDX	2.6E+1 ^d	3.2E+2	3.8E+2	1.6E-4
Toluene	2.8E-3	2.8E-3	5.1E-2	1.1E-6
Trichloroethene	5.8E-4 ^d	6.1E-4	1.0E-2	2.0E-7
1,3,5-trinitrobenzene	6.7E-1	6.0E+0	1.0E+1	6.3E-6
2,4,6-trinitrotoluene	1.8E+1	8.3E+1	2.9E+2	4.8E-4
Xylenes	6.1E-3	3.3E-3	1.2E-1	7.0E-6

Refer to footnotes at end of table.

Table 13 (Concluded)
Media Concentrations^a for Constituents of
Potential Ecological Concern at SWMU 9

^aIn 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.

^bProduct of the soil concentration and the corresponding transfer factor.

^cBased 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).

^dBased upon an estimated concentration.

EPA = U.S. Environmental Protection Agency.

HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.

RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

SWMU = Solid Waste Management Unit.

Table 14
Toxicity Benchmarks for Ecological Receptors at SWMU 9

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}
Inorganic							
Barium	500	Rat ⁿ	5.1	10.5	Chicken	20.8	20.8
Beryllium	10	Rat	0.66	1.29	-	-	-
Cadmium	3	Rat ⁱ	1.0	1.9	Mallard	1.45	1.45
Chromium (total)	1	Rat	2,737	5,354	Black duck	1.0	1.0
Cobalt	20	-	-	-	-	-	-
Copper	100	Mink	11.7	29.8	Chicken	47	47
Lead	50	Rat	8.0	15.7	American kestrel	3.85	3.85
Mercury (organic)	0.3	Rat	0.032	0.063	Mallard	0.0064	0.0064
Mercury (inorganic)	0.3	Mouse	13.2	14.0	Japanese quail	0.45	0.45
Nickel	30	Rat	40	78	Mallard	77.4	77.4
Selenium	1	Rat	0.20	0.39	Screech owl	0.44	0.44
Silver	2	Rat	17.8 ^j	34.8	-	-	-
Thallium	1	Rat ^k	0.0074	0.015	-	-	-
Uranium	5	Mouse	3.07	3.19	Black duck	16	16
Vanadium	2	Rat	0.21	0.38	Mallard	11.4	11.4
Zinc	50	Rat	160	313	Chicken	14.5	14.5
Organic ^l							
Acetone	-	Rat	10	20	-	-	-
2-amino-4,6-dinitrotoluene	80 ^l	Rat	2.81 ^m	5.5	-	-	-
4-amino-2,6-dinitrotoluene	-	Rat	1.93 ⁿ	3.78	-	-	-
Anthracene	18 ^o	Mouse	100 ^p	106	-	-	-
Benzo(a)pyrene	18 ^o	Mouse	1.0	1.1	-	-	-
Benzo(g,h,i)perylene	18 ^o	Mouse	1.0 ^q	1.1	-	-	-

Refer to footnotes at end of table.

Table 14 (Continued)
Toxicity Benchmarks for Ecological Receptors at SWMU 9

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}	
Chloroform	-	Rat	15	29	-	-	-	
Chrysene	18 ^o	Mouse	1.0 ^o	1.1	-	-	-	
2,4-dinitrotoluene	-	Rat	3.8 ⁱ	7.4	-	-	-	
2,6-dinitrotoluene	-	Rat	7.2 ^s	14.1	-	-	-	
Ethylbenzene	-	Rat	291 ^t	569	-	-	-	
HMX	-	Mouse ^u	3.0 ⁱ	3.0	-	-	-	
Methylene chloride	-	Rat	5.85	11.4	-	-	-	
Pentachlorophenol	-	Rat	0.24	0.47	-	-	-	
RDX	100	Mouse ^v	7.0 ⁱ	7.8	-	-	-	
Toluene	200	Mouse	26	28	-	-	-	
Trichloroethene	-	Mouse	0.70	0.74	-	-	-	
1,3,5-Trinitrobenzene	-	White-footed mouse ^w	6.74 ⁱ	6.32	-	-	-	
2,4,6-Trinitrotoluene	30	Rat ^x	1.6 ^y	3.1	-	-	-	
Xylenes	-	Mouse	2.1	2.2	-	-	-	

^aIn milligram(s) per kilogram soil dry weight.

^bFrom Efraymson et al. (1997).

^cBody weights (in kilogram[s]) for the NOAEL conversion are as follows: lab mouse, 0.030; lab rat, 0.350; mink, 1.0 (except where noted).

^dFrom Sample et al. (1996), except where noted.

^eIn milligram(s) per kilogram body weight per day.

^fBased 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.

^gBased 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.

^hBody weight: 0.435 kilogram.

ⁱBody weight: 0.303 kilogram.

^jBased upon a rat LOAEL of 89 mg/kg/d (EPA 2000) and an uncertainty factor of 0.2.

^kBody weight: 0.365 kilogram.

**Table 14 (Concluded)
Toxicity Benchmarks for Ecological Receptors at SWMU 9**

From Talmage et al. (1999).	
^m Based upon the rat NOAEL for 2,4,6-trinitrotoluene and the ratio of LD ₅₀ values for 2-amino-4,6-dinitrotoluene and 2,4,6-trinitrotoluene (Micromedex 1998).	
ⁿ Based upon the rat NOAEL for 2,4,6-trinitrotoluene and the ratio of LD ₅₀ values for 2-amino-4,6-dinitrotoluene and 2,4,6-trinitrotoluene (Micromedex 1998).	
^o From Sims and Overcash (1983).	
^p Based upon a subchronic NOAEL of 1000 mg/kg/d (EPA 2000) and an uncertainty factor of 0.1.	
^q No data available. Toxicity value based upon NOAEL for benzo(a)pyrene.	
^r Based upon a rat NOAEL for 2,4,6-trinitrotoluene and the ratio of LD ₅₀ values for 2,4-dinitrotoluene and 2,4,6-trinitrotoluene (Micromedex 1998).	
^s Based upon a rat NOAEL for 2,4,6-trinitrotoluene and the ratio of LD ₅₀ values for 2,6-dinitrotoluene and 2,4,6-trinitrotoluene (Micromedex 1998).	
^t From EPA (2000).	
^u Body weight: 0.023 kilogram.	
^v Body weight: 0.036 kilogram.	
^w White-footed mouse body weight: 0.0185 kilogram.	
^x Rat body weight: 0.318 kilogram.	
^y Based upon data summarized in Talmage et al. (1999).	
EPA = U.S. Environmental Protection Agency.	
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.	
LD ₅₀ = Acute lethal dose to 50 percent of the test population.	
LOAEL = Lowest-observed-adverse-effect level.	
mg/kg/d = Milligrams per kilogram per day.	
NOAEL = No-observed-adverse-effect level.	
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.	
SWMU = Solid waste management unit.	
- = insufficient toxicity data.	

(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.

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 9.

VII.3.4 Risk Characterization

Maximum concentrations in soil and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. Table 15 presents results of these comparisons. HQs are used to quantify the comparison with benchmarks for plants and wildlife exposure.

HQs for plants exceeded unity for total chromium, copper, lead, mercury, selenium, uranium, vanadium, and zinc. Because of a lack of sufficient toxicity information, HQs could not be determined for 12 of the organic COPECs. HQs exceeded unity for all three dietary regimes in the deer mouse for HMX; RDX; 2,4,6-TNT; and mercury when the mercury was assumed to be entirely in organic form. HQs for the herbivorous and omnivorous deer mice exceeded unity for copper, and HQs for the omnivorous and insectivorous deer mice exceeded unity for barium, vanadium, and pentachlorophenol. The insectivorous deer mouse also showed an HQ greater than unity from exposure to thallium, 2-amino-4,6-dinitrotoluene, and 4-amino-2,6-dinitrotoluene. HQs for the deer mouse could not be determined for cobalt because of a lack of sufficient toxicity information. For the burrowing owl, the only HQ that exceeded unity was that from exposures to mercury when the mercury was assumed to be entirely in organic form. HQs for beryllium, silver, thallium, and all organic COPECs could not be determined for the burrowing owl because of a lack of sufficient toxicity information. 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 had total HIs greater than unity, with a maximum HI of 78 for plants.

Tables 16 and 17 summarize the internal and external dose rate model results for tritium, Cs-137, Co-60, Th-232, U-234, U-235, and U-238. The total radiation dose rate to both the deer mouse and the burrowing owl was predicted to be 1.6E-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.

VII.3.5 Uncertainty Assessment

Many uncertainties are associated with the characterization of ecological risks at SWMU 9. 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 be more protective of 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

Table 15
HQs for Ecological Receptors at SWMU 9

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Inorganic					
Barium	4.2E-1	5.3E-1	1.8E+0	3.2E+0	2.3E-2
Beryllium	6.5E-2	2.4E-3	4.1E-2	8.0E-2	-
Cadmium	9.3E-1	1.3E-1	1.4E-1	1.4E-1	4.5E-3
Chromium (total)	2.8E+1	5.0E-5	8.7E-5	1.2E-4	9.5E-2
Cobalt	4.3E-1	-	-	-	-
Copper	5.4E+0	2.3E+0	1.5E+0	7.6E-1	4.7E-2
Lead	2.5E+0	1.4E-1	1.1E-1	7.5E-2	7.4E-2
Mercury (organic)	7.0E+0	5.3E+0	5.3E+0	5.3E+0	3.0E+1
Mercury (inorganic)	7.0E+0	2.4E-2	2.4E-2	2.4E-2	4.2E-1
Nickel	5.0E-1	6.5E-3	9.2E-3	1.2E-2	5.5E-4
Selenium	1.1E+0	2.2E-1	3.3E-1	4.4E-1	7.1E-2
Silver	2.3E-1	2.1E-3	1.3E-3	5.5E-4	-
Thallium	1.1E-1	2.8E-2	6.2E-1	1.2E+0	-
Uranium	3.9E+0	4.1E-2	5.1E-1	9.7E-1	5.0E-3
Vanadium	1.2E+1	2.6E-1	5.3E+0	1.0E+1	5.8E-3
Zinc	7.1E+0	2.7E-1	1.6E-1	5.6E-2	8.4E-1
Organic					
Acetone	-	5.5E-3	3.4E-3	1.3E-3	-
2-amino-4,6-dinitrotoluene	4.6E-2	3.1E-1	1.0E+0	1.7E+0	-
4-amino-2,6-dinitrotoluene	-	2.8E-1	9.2E-1	1.6E+0	-
Anthracene	6.1E-2	2.0E-4	1.8E-2	3.6E-2	-
Benzo(a)pyrene	6.7E-3	5.5E-4	2.4E-1	4.7E-1	-
Benzo(g,h,i)perylene	7.2E-3	5.0E-4	2.7E-1	5.4E-1	-
Chloroform	-	1.6E-5	5.0E-5	8.5E-5	-
Chrysene	6.7E-3	6.2E-4	2.3E-1	4.6E-1	-

Refer to footnotes at end of table.

Table 15 (Concluded)
Hazard Quotients for Ecological Receptors at SWMU 9

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
2,4-dinitrotoluene	-	2.6E-2	8.9E-2	1.5E-1	-
2,6-dinitrotoluene	-	7.0E-3	1.8E-2	2.8E-2	-
Ethylbenzene	-	8.6E-8	1.4E-6	2.7E-6	-
HMX	-	8.9E+0	6.7E+0	4.4E+0	-
Methylene chloride	-	4.4E-3	6.8E-3	9.1E-3	-
Pentachlorophenol	-	6.0E-3	1.1E+0	2.2E+0	-
RDX	2.6E-1	6.4E+0	7.0E+0	7.6E+0	-
Toluene	1.4E-5	1.6E-5	1.5E-4	2.9E-4	-
Trichloroethene	-	1.3E-4	1.2E-3	2.2E-3	-
1,3,5-trinitrobenzene	-	1.5E-1	2.0E-1	2.5E-1	-
2,4,6-trinitrotoluene	6.0E-1	4.2E+0	9.4E+0	1.5E+1	-
Xylenes	-	2.4E-4	4.2E-3	8.1E-3	-
HI ^a	7.8E+1	2.9E+1	4.2E+1	5.4E+1	3.1E+1

Note: **Bold** text indicates HQ or HI exceeds unity.

^aThe HI is the sum of individual HQs using the value for organic mercury as a conservative estimate of the HI.

HI = Hazard index.

HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.

HQ = Hazard quotient.

RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.

SWMU = Solid Waste Management Unit.

- = Insufficient toxicity data available for risk estimation purposes.

Table 16
Internal and External Dose Rates for
Deer Mice Exposed to Radionuclides at SWMU 9

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
H-3	3.6E-2	1.2E-7	–	1.2E-7
Cs-137	8.0E-1	2.5E-5	3.7E-5	6.1E-5
Co-60	1.1E+0	3.6E-6	2.1E-4	2.1E-4
Th-232	2.0E+0	7.8E-7	3.7E-4	3.7E-4
U-234	2.5E+0	2.9E-5	2.8E-7	2.9E-5
U-235	3.6E-1	3.9E-6	5.9E-6	9.8E-6
U-238	5.8E+0	5.9E-5	8.9E-4	9.5E-4
Total		1.2E-4	1.5E-3	1.6E-3

pCi/g = Picocurie(s) per gram.

SWMU = Solid Waste Management Unit.

– = Insufficient toxicity data available for risk estimation purposes.

Table 17
Internal and External Dose Rates for
Burrowing Owls Exposed to Radionuclides at SWMU 9

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
H-3	3.6E-2	4.7E-8	–	4.7E-8
Cs-137	8.0E-1	1.6E-5	3.7E-5	5.3E-5
Co-60	1.1E+0	9.2E-7	2.1E-4	2.1E-4
Th-232	2.0E+0	1.1E-6	3.7E-4	3.7E-4
U-234	2.5E+0	1.2E-5	2.8E-7	1.2E-5
U-235	3.6E-1	1.6E-6	5.9E-6	7.4E-6
U-238	5.8E+0	2.4E-5	8.9E-4	9.1E-4
Total		5.6E-5	1.5E-3	1.6E-3

pCi/g = Picocurie(s) per gram.

SWMU = Solid Waste Management Unit.

– = Insufficient toxicity data available for risk estimation purposes.

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 tritium, Cs-137, Co-60, Th-232, U-234, U-235, and U-238 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.

The assumption of an area use factor of 1.0 is a source of uncertainty for the burrowing owl. Because SWMU 9 is approximately 1.86 acres in size, an area use factor of approximately 0.054 would be justified for this receptor. This is sufficient to reduce the HQs for organic mercury from 30 to 1.6. It is unlikely that a significant proportion of the mercury at this site is in organic form because of the arid nature of the site; therefore, the assumption that all of the mercury is in organic form is highly conservative. The risk to the burrowing owl from exposure to mercury at this site is probably insignificant.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. Conservatism in the modeling of exposure and risk can result in the prediction of risk to ecological receptors when exposed at background concentrations. As shown in Table 18, HQs associated with exposures to background are greater than 1.0 for barium, chromium, thallium, vanadium, and zinc. In the case of vanadium, background may account for approximately 83 percent of the HQ values. For barium, background may account for 62 percent of the HQs for barium). It is, therefore, likely that the actual risks from vanadium and barium at SWMU 9 are overestimated by the HQs calculated in this screening assessment because of conservatism incorporated into the exposure assessment and in the toxicity benchmarks for these COPECs (e.g., the use of NOAELs for wildlife receptors).

The background value for thallium can only be specified as being less than 1.1 mg/kg. As shown in Table 18, one-half of this value (0.55 mg/kg), used as an approximation of the background concentration for thallium, results in HQs greater than unity for the omnivorous and insectivorous deer mice. Thallium was not detected in soil samples from SWMU 9 at a detection limit of 0.22 mg/kg. Because one-half of this detection limit (0.11 mg/kg) also shows potential risk to the insectivorous deer mouse (HQ = 1.2), thallium was retained as a COPEC. Based upon this low HQ and uncertainty associated with the estimation of thallium exposure point concentrations, potential risks from exposures to thallium are probably insignificant at this site.

A significant source of uncertainty associated with the prediction of ecological risks at this site is the use of the maximum measured concentrations to evaluate risk. This results in a conservative exposure scenario that does not necessarily reflect actual site conditions. In order to determine whether the predicted risks can be accounted for by the magnitude of the extreme

Table 18
HQs for Ecological Receptors Exposed to Background Concentrations at SWMU 9

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Inorganic					
Barium	2.6E-1	3.3E-1	1.1E+0	2.0E+0	1.4E-2
Beryllium	6.5E-2	2.4E-3	4.1E-2	8.0E-2	-
Cadmium	1.7E-1	2.4E-2	2.5E-2	2.6E-2	8.1E-4
Chromium (total)	1.3E+1	2.2E-5	3.9E-5	5.6E-5	4.3E-2
Cobalt	2.6E-1	-	-	-	-
Copper	1.5E-1	6.6E-2	4.4E-2	2.2E-2	1.4E-3
Lead	2.4E-1	1.3E-2	10.0E-3	7.0E-3	6.9E-3
Mercury (organic)	1.7E-1	1.3E-1	1.3E-1	1.3E-1	7.1E-1
Mercury (inorganic)	1.7E-1	5.7E-4	5.7E-4	5.7E-4	1.0E-2
Nickel	3.8E-1	5.0E-3	7.1E-3	9.2E-3	4.3E-4
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	-
Thallium	5.5E-1	1.4E-1	3.1E+0	6.0E+0	-
Uranium	4.6E-1	4.8E-3	6.0E-2	1.1E-1	5.9E-4
Vanadium	1.0E+1	2.1E-1	4.4E+0	8.5E+0	4.8E-3
Zinc	1.2E+0	4.7E-2	2.8E-2	9.9E-3	1.5E-1
HI ^a	2.8E+1	1.1E+0	9.0E+0	1.7E+1	9.7E-1

Note: **Bold** text indicates HQ or HI exceeds unity.

^aThe 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.

measurement, potential risks based upon average soil concentrations were evaluated for the COPECs with HQs greater than unity. The mean concentrations of barium, chromium, and vanadium are 111, 11.4, and 17.0 mg/kg, respectively. These means are all less than the corresponding background screening values for these COPECs, and therefore, the actual site risks are likely to be within background levels. For copper, lead, mercury, selenium, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, pentachlorophenol, RDX, and 2,4,6-TNT, the means are 33.7, 22.6, 0.0542, 0.553, 0.199, 0.148, 0.095, 2.73, and 0.836, respectively. In all of these cases, the mean soil concentration is sufficiently less than the maximum to reduce all HQs to values less than unity.

For uranium and zinc, the mean soil concentrations (6.17 and 90.0 mg/kg, respectively) have residual HQs of 1.2 and 1.8, respectively. In both of these cases, HQs greater than unity are limited to exposures to plant receptors. Because the plant toxicity benchmarks for metals are typically based upon laboratory/greenhouse studies in which the metal being tested is applied freshly to the soil in a form that is highly available to the plant (e.g., a soluble salt), the bioavailability associated with these benchmarks can significantly overestimate the bioavailability of the metals in field situations where the COPECs are typically in less soluble forms and have been allowed to "age" in the soil, reducing their availability to plants. For this reason, the risk to plants indicated by the low residual HQs for uranium and zinc are probably insignificant.

The mean soil concentration for HMX resulted in a residual HQ of 1.2 for the herbivorous deer mouse (HQs for all other receptors being less than 1). As with uranium and zinc, this low HQ is probably insignificant due to the conservative estimation of the toxicity benchmark. For the deer mice, the benchmark for HMX was based upon a chronic NOAEL of 3.0 milligrams per kilogram per day (mg/kg/d). The chronic LOAEL for HMX in the deer mouse is 7.5 mg/kg/d (based upon information in Talmage et al., 1999), indicating a possible range of HQs between 0.5 and 1.2 representing the range between the NOAEL and LOAEL-based benchmarks. It is, therefore, likely that potential exposures in this receptor to HMX are less than the threshold of toxicity.

Based upon this uncertainty analysis, ecological risks at SWMU 9 are expected to be low. HQs greater than unity were initially predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to exposure concentration and the contribution of background risk.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 9 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. The average concentrations of barium, chromium, and vanadium at the site were within the range of background concentrations. Predicted risks from exposures to copper, lead, mercury, selenium, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, pentachlorophenol, RDX, and 2,4,6-TNT were attributed to using maximum detected values. Risks to ecological receptors from exposures to uranium, zinc, and HMX were attributed to conservative assumptions of COPEC bioavailability and toxicity in

addition to the use of maximum measured concentration values. Based upon this final analysis, ecological risks associated with SWMU 9 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.

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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)	25,550 ^a	25,550 ^a	25,550 ^a
for noncarcinogenic compounds (= ED x 365 day/yr)	9,125	10,950	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

^aRisk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).

^bExposure Factors Handbook (EPA 1989b).

^cEPA Region VI guidance.

^dFor 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.

^eDermal 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.

References

ANL, see Argonne National Laboratory.

Argonne National Laboratory (ANL), 1993. *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD*, Version 5.0, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, IL.

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

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ADDITIONAL /SUPPORTING DATA

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