Sandia National Laboratories/New Mexico

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

September 2000

Environmental
Restoration
Project

United States Department of Energy
Albuquerque Operations Office

EXECUTIVE SUMMARY

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

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

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

- SWMU 60 (Bunker Area in OU 1333) was a supply bunker and control bunker. The control bunker was destroyed during explosive testing in 1979. During the explosive test two mock weapons containing HE, depleted uranium, and beryllium were detonated, and the control bunker was destroyed. SWMU 60 was characterized through three investigations: 1) a CEARP in 1985, 2) an ER Preliminary Investigation from 1989 to 1994, and 3) a VCA conducted in 1999. The site investigations included a Phase I site investigation, a background review, a UXO/HE survey, a radiation survey, a cultural resource survey, and a sensitive species survey. The VCA was conducted in 1999 and included radiological surveys to characterize depleted uranium contamination present on remaining structures and debris, demolition and removal of this material, and confirmatory sampling. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

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

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

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

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

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

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

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

REFERENCES

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

1.0 INTRODUCTION

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

Operable Unit 1302

- SWMU 98, Building 863 TCA and Photochemical Release

Operable Unit 1332

- SWMU 82, Old Aerial Cable Site

Operable Unit 1333

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

Operable Unit 1334

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

Operable Unit 1335

- SWMU 117, Trenches (Building 9939)

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

REFERENCES

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

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3.0 SOLID WASTE MANAGEMENT UNIT 82, OLD AERIAL CABLE SITE

3.1 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) 82, Old Aerial Cable Site, Operable Unit (OU) 1332 on Kirtland Air Force Base (KAFB). Review and analysis of all relevant data for SWMU 82 indicate that concentrations of constituents of concern (COC) at this site are less than applicable risk assessment action levels. Thus, SWMU 82 is proposed for an NFA decision based upon confirmatory sampling data demonstrating that COCs that may have been released from this SWMU into the environment pose an acceptable level of risk under current and projected future land use as set forth by NFA Criterion 5. NFA Criterion 5 states that "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).

3.2 Description and Operational History

Section 3.2 describes the site and provides the operational history of SWMU 82.

3.2.1 Site Description

ER SWMU 82, the Old Aerial Cable (OAC) Site, is a 52-acre area on lands withdrawn from the U.S. Forest Service and permitted to Phillips Laboratories in a small canyon one and one-half miles east of the Phillips Laboratories Starfire Optical Range on Optical Range Road (Figure 3.2.1-1). The site is currently the home of the High Energy Research Test Facility (HERTF), which is operated by Phillips Laboratories. The HERTF includes a laboratory, a parking lot, and a test area/firing site behind the laboratory (Figure 3.2.1-2). When operated by SNL, the OAC Site was equipped with a concrete impact pad (Figure 3.2.1-3), an overhead cable spanning approximately 2600 feet between the northwest and southeast ridgelines, a 220-foot-long rocket sled track terminating in a 20- by 20-foot catch box filled with sand (Figure 3.2.1-4), numerous camera pads, a meteorological station, and a generator pad. The overhead cable has been dismantled; however, the rocket sled track and catch box, impact pad (now buried under an access road), generator pad, miscellaneous camera pads, and meteorological tower pad still remain (Figure 3.2.1-5). The current site boundaries shown in Figure 3.2.1-1 were determined from the distribution of debris on the site and from historical information on OAC test activities.

Principal vegetation in the vicinity of SWMU 82 consists of cacti, juniper, piñon, and other desert flora common to the area. The terrain in the vicinity varies from gently inclined on the canyon floor to steep-sided canyon walls (Figure 3.2.1-6). The SWMU is surrounded by a box canyon on the northwest, north, east, and southeast sides. The canyon walls are composed of Precambrian metarhyolite bedrock. Alluvial deposits thinly cover the canyon floor and consist of Salas Complex and Tesajo-Millet soil types.

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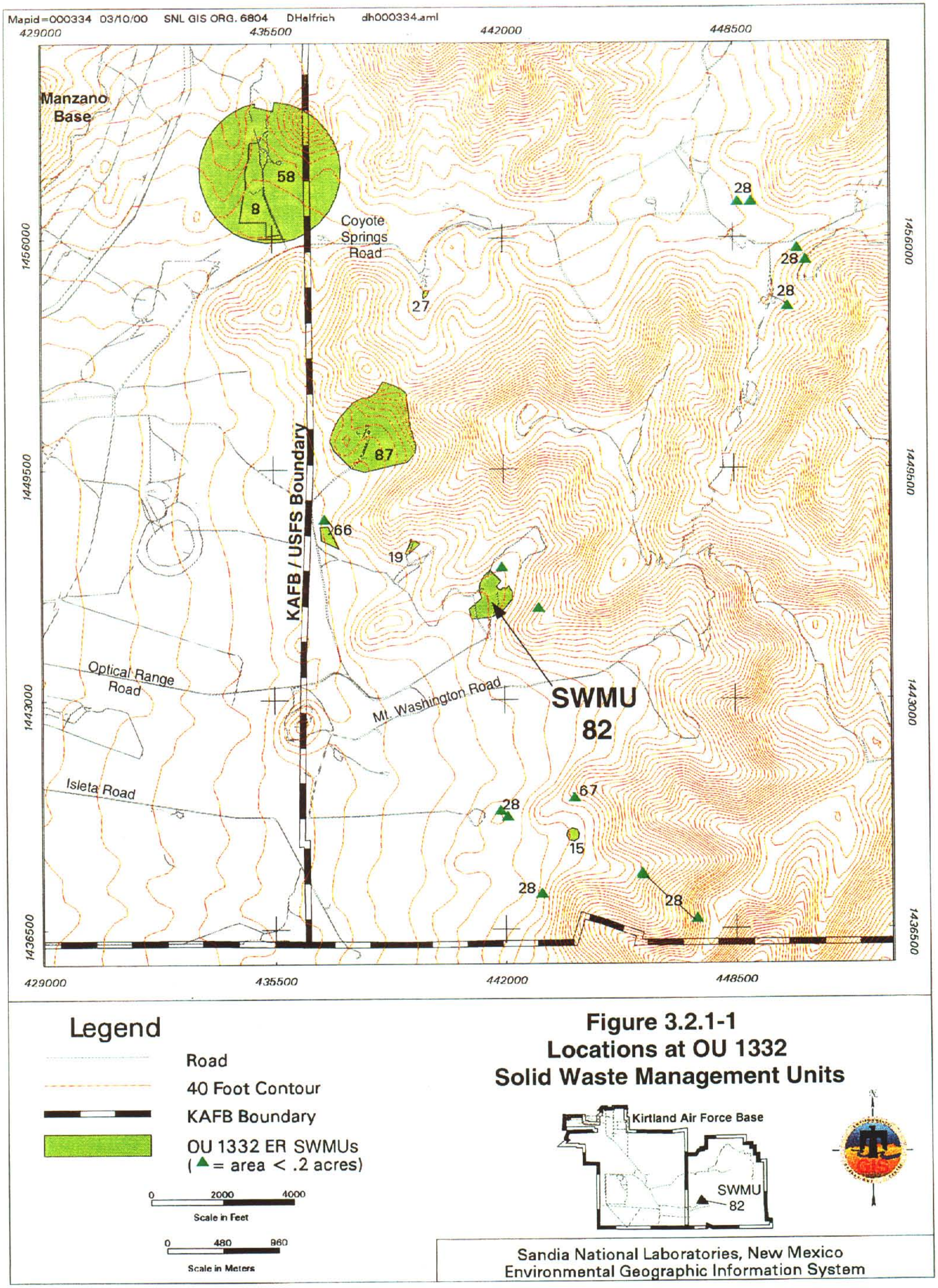


Figure 3.2.1-1
Locations at OU 1332
Solid Waste Management Units

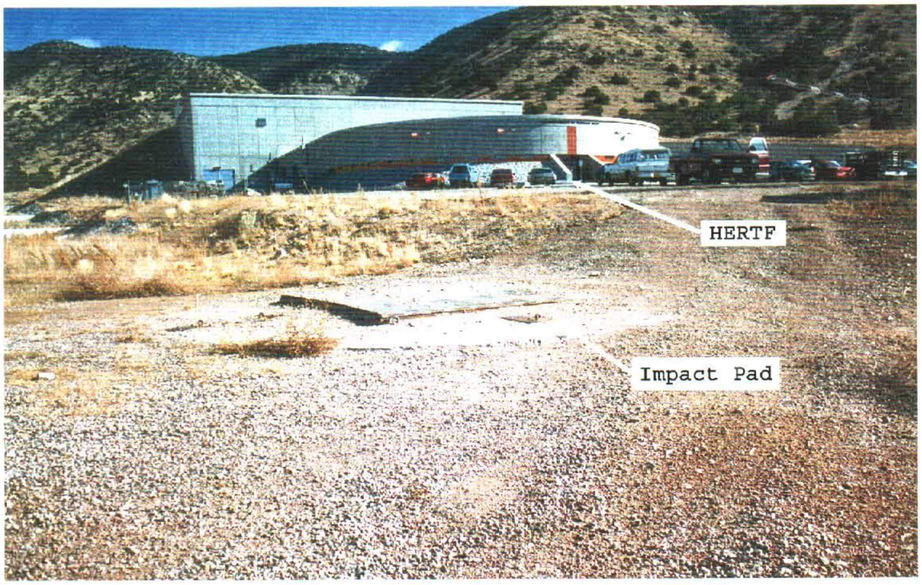
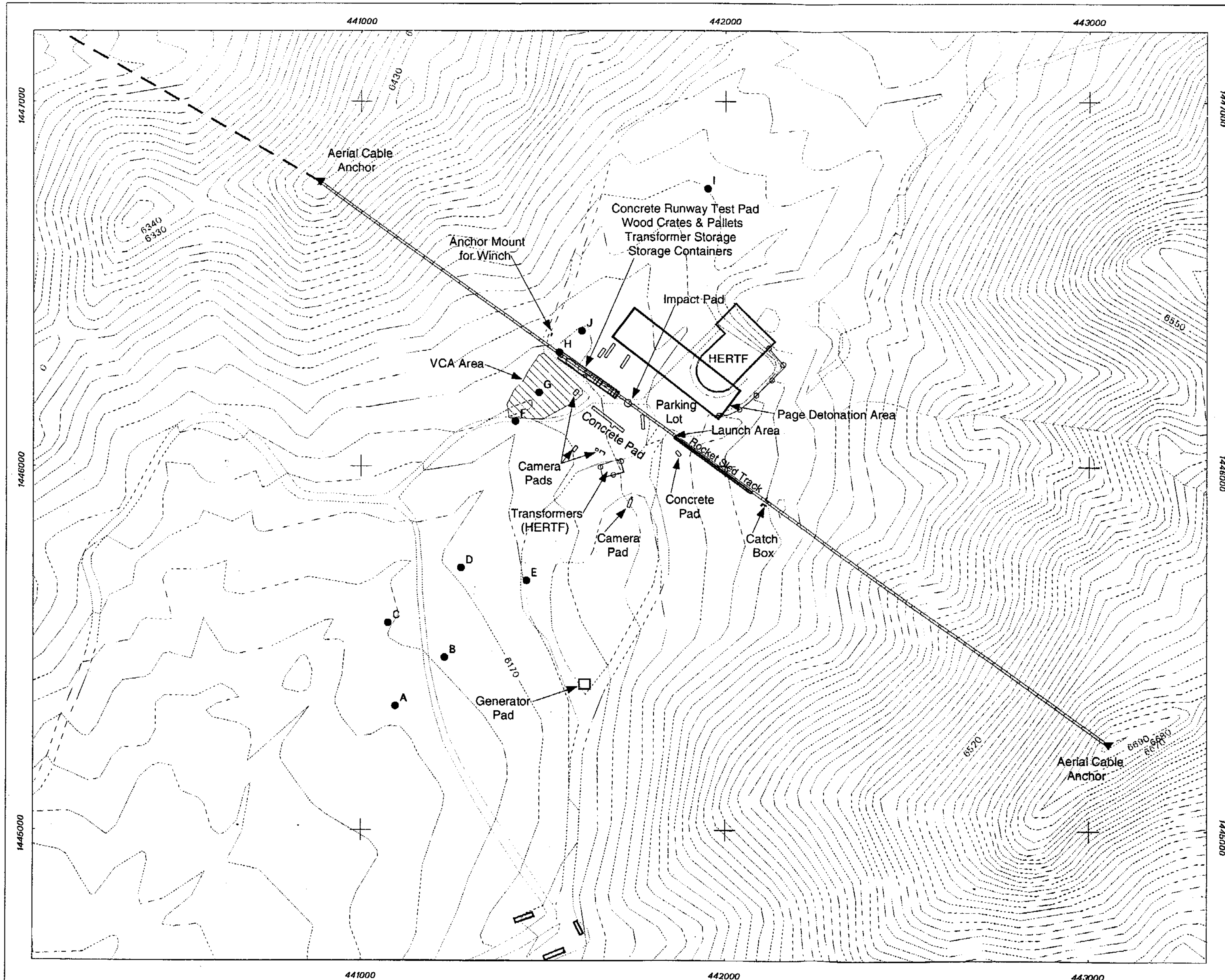


Figure 3.2.1-2 SWMU 82 - High Energy Research Test Facility with the Old Aerial Cable Impact Pad (before burial).

Figure 3.2.1-3 SWMU 82 - Old Aerial Cable Impact Pad (view to the northwest; before being buried by access road).

Figure 3.2.1-4
SWMU 82 - Sled Track (Launch Area, Track and Catch Box).



Legend

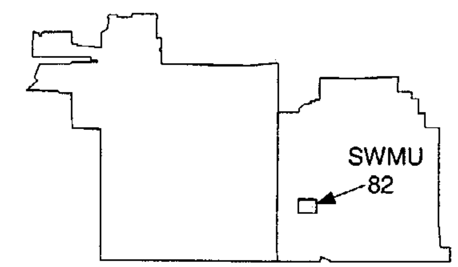
- Debris Pile
- Aerial Cable Anchor
- Road
- 10 Foot Contour
- Fence
- Misc. Structure
- Building / Structure
- Former Path of the Aerial Cable
- Anchor Cable
- Page Detonation Area
- VCA Area

Debris Piles Designation

A-Concrete Slab	F-Rubble
B-Concrete Slab	G-Foam Concrete, Rubble
C-Cable	H-Concrete Pad
D-Panel Boxes	I-Small Metal Cylinder
E-Met. Tower Base	J-Electrical Conduit Cable

0 300 600
Scale in Feet

0 72 144
Scale in Meters



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Figure 3.2.1-5
SWMU 82
Old Aerial Cable Site

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

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Unclassified		SNL GIS ORG. 6804
Rachel Loehman	rl000472.aml	05/19/00

Two engineered channels divert drainage around the HERTF complex. The drainage from the southeast side of the HERTF ends in a series of culverts at the west end of the parking lot. The drainage from the northwest side of the HERTF leaves an engineered channel and proceeds in sheet flow across the SWMU 82 impact pad area. The drainage enters the SWMU 82 Voluntary Corrective Action (VCA) area where fill and debris were removed from the arroyo (discussed in Section 3.4.5 of this proposal). The HERTF complex drainage joins the overall canyon drainage from the northeast and continues to the southwest out of the SWMU 82 area. The VCA installed erosion control in the area where the HERTF drainage joins the arroyo from the northeast. Surface water flows in the channels only during heavy rain storms, several times per year.

The unnamed arroyo dissipates as the topographic relief decreases to the west of SWMU 82. Typically, storm water in this area either evaporates or infiltrates into the soil without producing significant runoff. If the storm is of sufficient duration to produce runoff, the water is collected in a retention pond located in the southeast corner of Technical Area III. This water is retained until it either evaporates or infiltrates into the soils. Therefore, there is no hydrologic surface connection from the SWMU to Tijeras Arroyo or the Rio Grande. The average rainfall recorded at the Albuquerque International Sunport is 8.1 inches per year (NOAA 1990).

The nearest well to SWMU 82 is the HERTF production well, which is inside the SWMU 82 boundary. Water was found in fractured granite bedrock. The water table elevation at SWMU 82 based on this well is approximately 449 feet below ground surface (bgs). This well is registered in New Mexico State Engineer Office (Well Record for HERTF 1, N.M. Coordinate System Central Zone, X = 442065, Y = 1446165, drilled 7/5/90 to 7/13/90).

3.2.2 Operational History

The OAC Site was constructed by SNL/NM in 1968 to study problems in an experimental Fuel-Air Explosive (FAE) weapon called the Pave Pat. The Pave Pat weapon performed correctly in static tests on the ground, but failed to perform correctly when dropped from aircraft. A way was sought to perform precise drop tests into an instrumented arena to investigate the failure mechanism; the solution was to build the OAC Site. The site was selected to provide 200 feet of cable height above the arena, which would allow the free-falling, parachute-retarded Pave Pat to reach the desired 100 feet per second (fps) terminal velocity before entering the instrumented arena. The value of this arena design was immediately recognized, and other weapons testing commenced.

In a fuel-air weapon detonation, the nonhazardous outer case of the weapon is burst open, dispersing an explosive fuel into the air to form an explosive cloud, which is then detonated by another small high-explosive (HE) charge in the weapon. The HE and fuel are consumed in the detonation, producing carbon monoxide, carbon dioxide, water, nitrogen, and various nitrous oxides as the primary combustion by-products.

Another weapons program, the Garlic FAE, was tested from the aerial cable. The Garlic FAE, when deployed from aircraft, was not parachute retarded and had a terminal velocity of 800 fps. To achieve this velocity from a 200-foot-high cable facility, a rocket sled track was built on the valley floor to provide the accelerating force. Two towing lines ran from the rocket sled to turning devices on either side of the impact pad, then up to the Garlic FAE weapon, which was suspended from the aerial cable. The rockets were fired as the weapon was released from the cable by explosive cable cutters, resulting in the weapon being "pulled down" precisely to a point between the two cables. Figure 3.2.2-1 shows the general test configuration of a typical test. Figure 3.2.2-2 shows an actual weapons test in progress. The solid rocket propellant burned at the sled track produced primarily carbon dioxide, carbon monoxide, water, nitrogen, hydrogen, and less than 0.1 percent of other compounds (some possibly containing lead) as combustion by-products.

Impact tests were another type of weapons test conducted at the OAC. A weapon was dropped or pulled down into the impact pad to study the dynamics of the impact. It was used to study how a component of the weapon, such as its outer case, reacted under impact forces. In some studies, a weapon was dropped to confirm that it would not detonate unintentionally if accidentally dropped during handling. In one unusual case, a Mark 3 weapon (without the nuclear material), after being dropped from 90 feet without detonating, was later destroyed on the pad using high explosives due to concerns about the safety of moving the damaged weapon. However, the impact tests usually did not involve explosive detonations.

The OAC Site was equally applicable to SNL/NM's Nuclear Transportation Safety Programs. A hardened impact pad under the OAC was used to qualify nuclear material shipping containers in severe accident impact conditions in which containers were pulled down into the impact pad at high acceleration. The pad was periodically replaced due to damage by tests.

The OAC Site was used for other tests in which a reproducible aerial test environment was required. In 1970, SNL/NM was working on a radar system (called Murine) for Army helicopters to warn them of incoming missiles. A trolley carrying the warning radar system was attached to the cable system. Interceptor missiles were fired toward the trolley to evaluate the warning system while it transversed the OAC.

In 1974, the OAC Site was used to conduct an entirely different type of test. There was a concern over the health effects that would occur if, during an aircraft crash, the explosives around the plutonium in a nuclear weapon were to detonate and disperse the plutonium into the air. To study this hazard, the Plutonium Aerosol Generation Experiments (PAGE) were conducted at the OAC Site. Depleted uranium (DU) and cerium were used as proxies for plutonium in the tests. Air samplers were hung from the OAC. A test unit containing 0.89-1.45 kilograms of DU or 0.6 kilograms of cerium was detonated 30-60 meters upwind (to the northeast) of the sampling array. Eight tests were conducted using DU and one test used cerium.

The OAC Site was in operation intermittently until 1989, when the HERTF was constructed. Table 3.2.2-1 provides the relevant information on the OAC Site tests, which was used as a basis for field investigations during the SWMU characterization activities discussed in Section 3.4.4 of this NFA. Additional detail on these tests is provided in the Resource Conservation and Recovery Act (RCRA) Facility Investigation Work Plan for OU 1332, Foothills Test Area (SNL/NM June 1995).

3.3 Land Use

Section 3.3 discusses the current and future land use scenarios for SWMU 82.

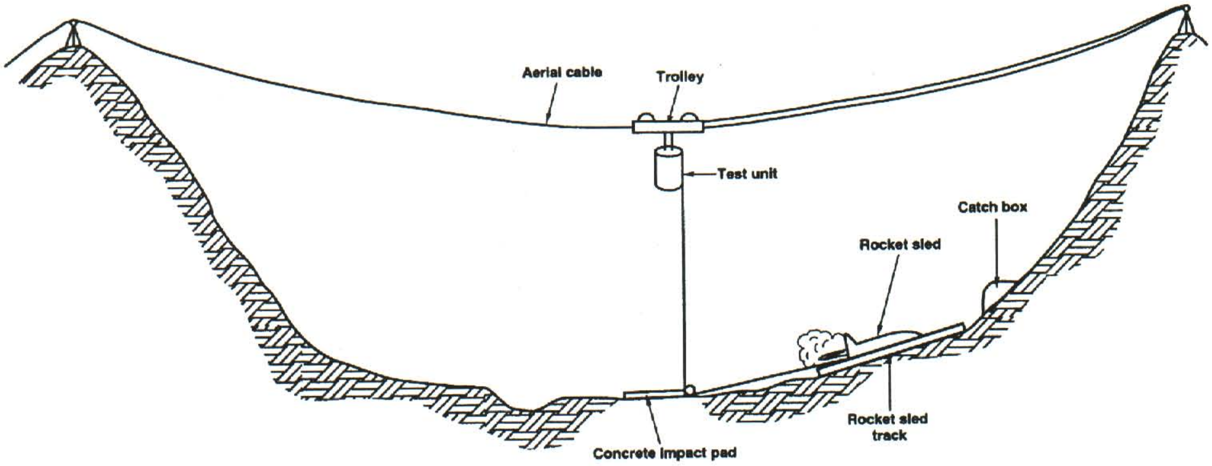

Figure 3.2.2-1 SWMU 82 - Conceptual Drawing of a Typical Test Configuration at the Old Aerial Cable Site.

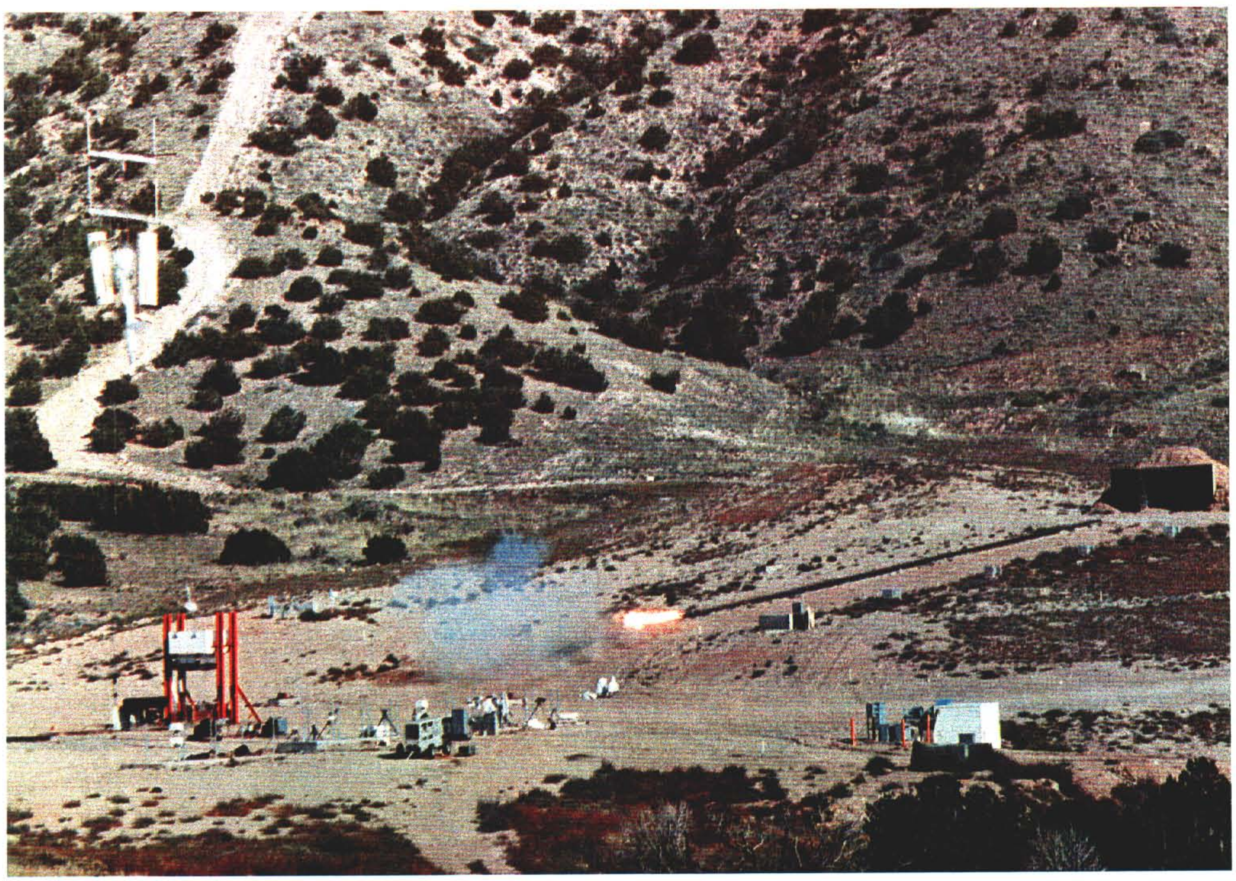

Figure 3.2.2-2 SWMU 82 - Actual Test Being Conducted at the Old Aerial Test Site.

Table 3.2.2-1
Summary of Activities and Contaminants of Concern at SWMU 82

Location	Activity	Date	Contaminants of Concern	Suspected Dispersion Areas
Impact pad	Fuel Air Explosion tests (Pave Pat and Garlic weapon systems were tested). The rocket sled track was used to accelerate/pull down some units into the impact pad.	1968- mid 1970s	None – MAPP Gas was consumed in the tests. The high explosive core used to detonate the MAPP gas was nitroguanidine or propylene oxide which was also consumed in the test.	All tests were detonated above ground level. The explosive core and MAPP Gas detonated and then burned. Combustion by-products dispersed in the air.
	Weapons impact tests on the following weapons: B28, B43, B54, B61, B77, and B83. Approximately 100 tests were conducted. The rocket sled track was used to accelerate/pull down some units into the impact pad.	1976-1981	None at the impact pad since the tests were nonexplosive impact tests.	None
	The Mark 3 weapons impact test was unusual in that, after the test the damaged weapon was destroyed in the impact area by explosives. Only one test was conducted.	Early 1970s	DU, beryllium, lithium hydride, and the combustion by-products from the detonation of 200 lbs C-4 explosives (primarily CO_2, CO, H_2O, N_2 and NO_x).	Immediate area of impact pad. The combustion by-products of C-4 explosives were all gases which dispersed in the air
	Material shipping container tests. The rocket sled track was used to accelerate/ pull down the units into the impact pad.	~ 1978	None – no hazardous or radioactive materials were used.	None.
	Murine missile tests shot Redeye missiles (without warheads) at a target on the OAC to test missile warning radar systems.	1968-1974	None – nonexplosive test. The solid rocket propellant in the Redeye missiles was consumed in flight. Remaining missile materials were nonhazardous.	None.
	Plutonium Aerosol Generation Experiments simulated the dispersion of plutonium by using DU and Cerium dispersed by explosive detonation.	1974	A total of 10.5 kilograms of DU and 0.6 kilograms of Cerium were released. Combustion by-products of the PBX-9404 explosive used in the tests were primarily CO_2, CO, H_2O, N_2 and NO_x).	Test detonations occurred 30-60 meters NE of impact pad and the resulting cloud of tracers dispersed to the SW an unknown distance.

Refer to footnotes at end of table.

Table 3.2.2-1 (Concluded)
Summary of Activities and Contaminants of Concern at SWMU 82

Location	Activity	Date	Contaminants of Concern	Suspected Dispersion Areas
Generator pad	Diesel fuel leak	1980s?	Diesel fuel (detected as THP, VOCs, and SVOCs)	Immediately around generator pad
Rocket sled track	The rocket sled track was used to accelerate/pull down some test units into the impact pad. Solid propellant rocket motors were used to accelerate the sled.	1970s-1980s	COCs from the rocket propellant and nongaseous combustion by-products include: HE and lead. The potential exists for pieces of rocket propellant to have been thrown unburned from damaged rocket motors.	All tests discussed above that used the rocket sled track dispersed COCs to the soils in immediate area of the catch box, sled track, and launch area.
Debris piles	Test debris, wire cable, electrical panels, and concrete pads	Unknown	Debris from the test discussed above (metals, and radionuclides)	Soils in immediate area of debris piles.

CO = Carbon monoxide.
CO_2 = Carbon dioxide.
COC = Contaminant of concern.
DU = Depleted uranium.
H_2O = Water.
HE = High explosive(s).
MAPP = Methyl-acetylene-propene-propadiene.
N_2 = Nitrogen.
NE = Northeast.
NO_x = Nitrogen oxides.
OAC = Old Aerial Cable.
PBX = Plastic-bonded explosive(s).
SVOC = Semivolatile organic compound.
SW = Southwest.
SWMU = Solid Waste Management Unit.
TPH = Total petroleum hydrocarbon.
VOC = Volatile organic compound.

3.3.1 Current Land Use

The current land use classification for SWMU 82 is recreational (DOE and USAF January 1996).

3.3.2 Future/Proposed Land Use

The projected land use for SWMU 82 is also recreational (DOE and USAF January 1996).

3.4 Investigatory Activities

SWMU 82 has been characterized and/or remediated in a series of investigations and VCA activities. This section discusses those activities.

3.4.1 Summary

SWMU 82 was initially investigated under the Department of Energy's (DOE's) Comprehensive Environmental Assessment and Response Program (CEARP) (DOE September 1987) and the RCRA Facility Assessment (EPA April 1987) identified ER Site 82 as a potential SWMU. The investigations included visual inspections of the site. The details are discussed in Section 3.4.2, Investigation #1—CEARP.

Preliminary investigations for SWMU 82 included personnel interviews, site inspections, site photographs, radiological surveys, pre-RCRA Facility Investigation (RFI) sampling conducted by the SNL/NM Radiation Protection Operations (RPO) personnel, surveys for unexploded ordnance (UXO)/HE, surveys for cultural resources, and surveys for sensitive species. The details are discussed in Section 3.4.3, Investigation #2—SNL/NM ER Project Preliminary Investigations.

The SWMU was characterized during a series of sampling events conducted between 1995 and 1999. The details of the sampling efforts and the analytical results are discussed in Section 3.4.4, Investigation #3—SNL/NM ER Project RFI Sampling Activities

A VCA was conducted in 1999 to remove debris and restore an arroyo channel that had been impacted by SWMU 82 operations. The details of the VCA are discussed in Section 3.4.5, Investigation #4—VCA Activities and Confirmatory Sampling.

3.4.2 Investigation #1—CEARP

3.4.2.1 Nonsampling Data Collection

The Old Aerial Cable Site (Site 82) was identified as a potential site during the investigation conducted under the CEARP. The CEARP Phase I report stated that:

"The Old Aerial Cable Site (Site 82) has been used for a variety of weapons-related explosives and impact tests. The facility is equipped with an overhead cable and a sled track. Rocket-powered sleds can be used to accelerate and draw down tests units from the overhead cable.

Plutonium aerosol dispersion was simulated in tests using uranium. Later, during the Vietnam War, some impact tests were conducted using burning uranium. The tests scattered some uranium and started fires in the surrounding area.

The PAGE study, conducted in 1974, involved the volatilization of aluminum, iron, depleted uranium, and cerium using PBX-9404. The study consisted of approximately 18 tests with kilogram quantities of metals used in each test. The materials were detonated at about 1 or 2 feet above ground, and air samples were collected by samplers suspended from the overhead cables. The metal particle clouds usually blew to the south/southwest.

Debris from testing operations at the old aerial cable site has been deposited in an arroyo on the east side of the aerial cable. There is also some evidence (scrap metal sticking out of the ground) of buried materials to the west, and a scrap yard lies north of the disposal site in the arroyo. Materials observed include sleds, cables, pieces of scrap metal and lumber, rocket motors, cans, bottles, and general trash.

The area surrounding the test facility may be contaminated with lead, depleted uranium, high explosives (including barium), and rocket propellant from test operations. Although large pieces of metal are generally picked up after a test, the finely divided material is left scattered in the test area. A determination needs to be made of whether this material has been abandoned under the RCRA." (DOE September 1987)

The CEARP report inaccurately describes the PAGE study details. CEARP appears to base its report on an interview during which the conceptual/planned test configuration for PAGE was discussed. The actual test documents show that only eight tests used a total of 10.5 kilograms of DU and one test used 0.6 kilograms of cerium during the PAGE study. The study originally called for more tests using cerium, but they were cancelled when it was decided that cerium did not work well as a plutonium proxy during the test (Luna July 1974)

3.4.2.2 Sampling Data Collection

No sampling activities were conducted at SWMU 82 as part of the CEARP.

3.4.2.3 Data Gaps

No samples were obtained during the CEARP to determine whether hazardous materials or wastes were stored or released to the surrounding environment.

3.4.2.4 Results and Conclusions

The finding under the CEARP was positive for RCRA-regulated hazardous waste and the Hazard Ranking System score for the SWMU was 5.8. The CEARP Phase I report recommended that additional information and sampling be collected to allow evaluation of conditions at the site (DOE September 1987).

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

3.4.3.1 Preliminary Data Collection

This section describes the preliminary data collection activities conducted at SWMU 82.

3.4.3.2 Preliminary Sampling by SNL/NM RPO

RPO personnel collected 16 site samples and 2 background samples from SWMU 82 on October 29, 1992, to determine if there were health and safety issues associated with the site, rather than to characterize the site under RCRA. A field survey was first conducted using a sodium-iodide detector. Surface soil samples were then collected from areas where the level of radioactivity appeared to be above background levels based on the survey (see Figure 3.4.3-1). Samples were analyzed for radionuclides using gamma spectroscopy. Table 3.4.3-1 shows the summary of results for this analysis. The complete analytical package is included in Annex 3-A.

The radionuclide levels were generally comparable to NMED-approved background activities and the activities in two site-specific background samples taken from a location approximately 4,000 feet to the southwest of the site (Dinwiddie September 1997). The samples did show slightly elevated thorium activities in 9 of 16 samples, but the levels were found to be associated with granitic rock outcrops rather than testing activities (Oldewage February 1993). The location of sample #16 was not recorded on the original study map, but it is not significant because the radionuclide levels at this location are at background levels, assuming naturally elevated thorium. The minimum detection activities for uranium-235 in three samples slightly exceeded the NMED-approved background activities.

3.4.3.3 Background Review

A background review was conducted by the ER Project in order to collect any relevant information regarding SWMU 82. Background information sources included interviews with SNL/NM staff and contractors who were familiar with site operational history and existing historical site records and reports. This background research was documented and has provided traceable references that sustain the integrity of the NFA proposal. Table 3.4.3-2 lists these information sources and references used to evaluated SWMU 82 are described below.

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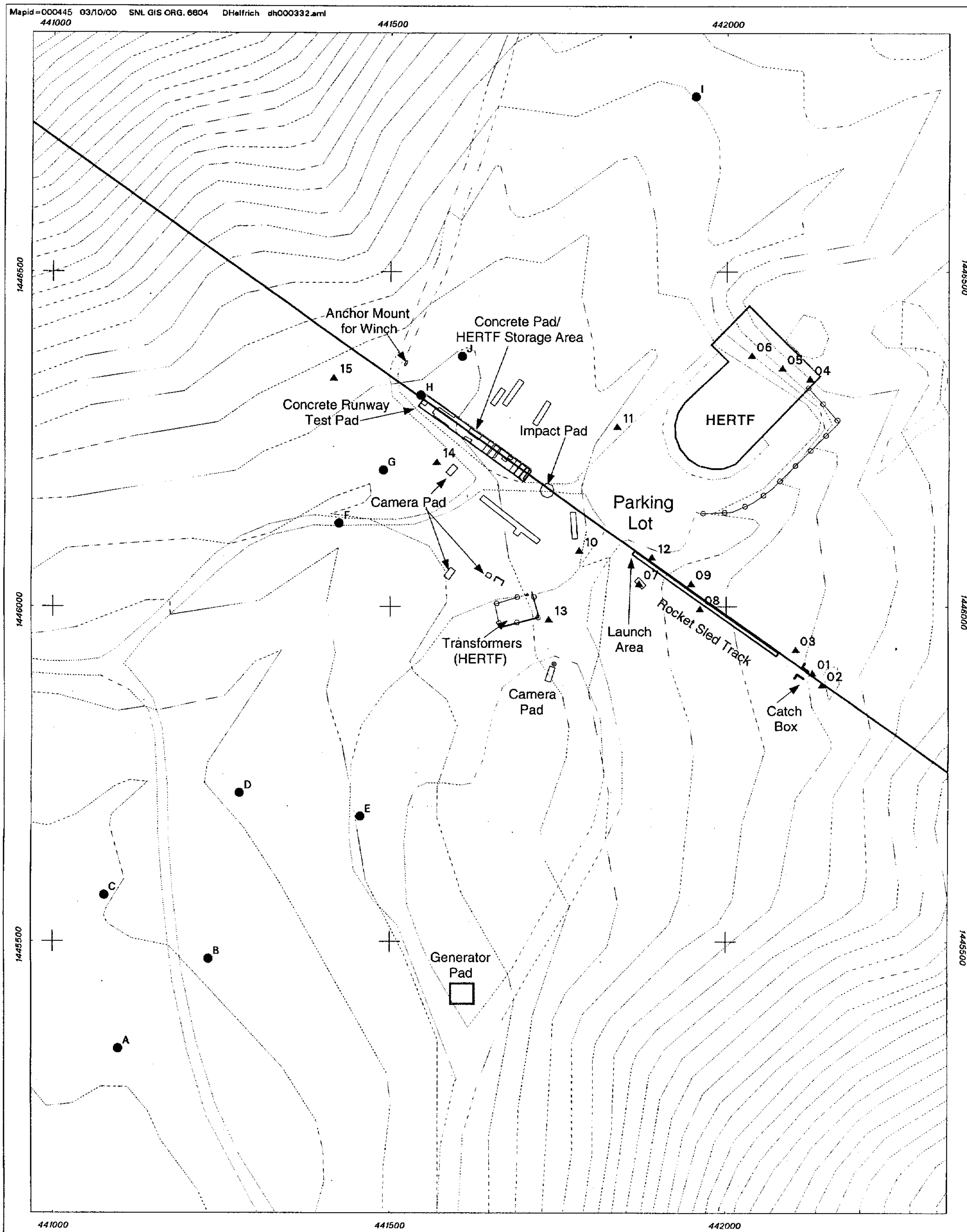

Legend

●	*Debris Piles*	*Debris Piles Designation*
▲	*Surface Soil Sampling Location*	A-Concrete Slab
	10 Foot Contour	B-Concrete Slab
	Road	C-Cable
	Building	D-Panel Boxes
	Misc. Structure	E-Met. Tower Base
	Fence	F-Rubble
	Former Path of the Aerial Cable	G-Foam, Concrete, Rubble
		H-Concrete Pad
		I-Small Metal Cylinder
		J-Electrical Conduit Cable

Figure 3.4.3-1
SWMU 82 - Radiation Protection Operations Sample Locations (Conducted in 1992)

0 160 320
Scale in Feet
0 38 76
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Table 3.4.3-1
Summary of SWMU 82 SNL/NM Radiation Protection Operations Surface Soil Sampling Gamma Spectroscopy Analytical Results October 1992 (On-Site Laboratory)

Sample Attributes			Activity[a] (pCi/g)							
ER Sample Location[b] (Figure 3.4.3-1)	Date Sampled	Sample Depth (ft)	Uranium-238	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Cesium-137	Error[c]
Site-Specific Background										
Old Cable Site Bkgd Soil **#1**	10/28/92	0.0–0.5	1.56E+00	1.79E-01	**1.08E+00**	5.05E-02	ND (5.09E-02)	--	5.90E-01	1.62E-02
Old Cable Site Bkgd Soil **#2**	10/28/92	0.0–0.5	1.56E+00	1.91E-01	9.39E-01	4.70E-02	ND (4.81E-02)	--	2.88E-01	1.14E-02
Site Samples										
Old Cable Site Soil Sample **#1**	10/28/92	0.0–0.5	1.57E+00	4.84E-01	**1.24E+00**	1.69E-01	ND (1.71E-01)	--	ND (2.93E-02)	--
Old Cable Site Soil Sample **#2**	10/28/92	0.0–0.5	ND (4.72E-01)	--	**1.20E+00**	1.44E-01	ND (1.55E-01)	--	ND (2.47E-02)	--
Old Cable Site Soil Sample **#3**	10/28/92	0.0–0.5	1.49E+00	4.06E-01	9.67E-01	1.48E-01	ND (1.39E-01)	--	ND (2.29E-02)	--
Old Cable Site Soil Sample **#4**	10/28/92	0.0–0.5	ND (4.00E-01)	--	7.31E-01	1.21E-01	ND (1.21E-01)	--	ND (2.05E-02)	--
Old Cable Site Soil Sample **#5**	10/28/92	0.0–0.5	1.59E+00	3.93E-01	9.96E-01	1.24E-01	ND (1.36E-01)	--	3.35E-02	1.88E-02
Old Cable Site Soil Sample **#6**	10/28/92	0.0–0.5	ND (4.36E-01)	--	8.93E-01	1.19E-01	ND (1.31E-01)	--	ND (2.32E-02)	--
Old Cable Site Soil Sample **#7**	10/28/92	0.0–0.5	1.88E+00	5.31E-01	**1.35E+00**	1.75E-01	ND (1.78E-01)	--	ND (3.90E-02)	--
Old Cable Site Soil Sample **#8**	10/28/92	0.0–0.5	1.32E+00	3.82E-01	**1.06E+00**	1.47E-01	ND (1.36E-01)	--	3.39E-02	1.90E-02
Old Cable Site Soil Sample **#9**	10/28/92	0.0–0.5	1.79E+00	5.62E-01	**1.35E+00**	1.60E-01	ND (1.66E-01)	--	5.96E-02	2.85E-02
Old Cable Site Soil Sample **#10**	10/28/92	0.0–0.5	ND (4.87E-01)	--	9.42E-01	1.34E-01	ND (1.36E-01)	--	ND (2.36E-02)	--
Old Cable Site Soil Sample **#11**	10/28/92	0.0–0.5	1.70E+00	5.49E-01	1.02E+00	1.43E-01	ND (1.38E-01)	--	ND (2.75E-02)	--
Old Cable Site Soil Sample **#12**	10/28/92	0.0–0.5	ND (4.23E-01)	--	8.05E-01	1.27E-01	ND (1.23E-01)	--	ND (2.13E-02)	--
Old Cable Site Soil Sample **#13**	10/28/92	0.0–0.5	ND (4.80E-01)	--	**1.11E+00**	1.51E-01	ND (1.42E-01)	--	ND (2.56E-02)	--
Old Cable Site Soil Sample **#14**	10/28/92	0.0–0.5	ND (4.84E-01)	--	**1.09E+00**	1.58E-01	ND (1.48E-01)	--	ND (2.76E-02)	--
Old Cable Site Soil Sample **#15**	10/28/92	0.0–0.5	ND (5.10E-01)	--	**1.29E+00**	1.41E-01	ND (1.44E-01)	--	1.14E-01	3.55E-02
Old Cable Site Soil Sample **#16**	10/28/92	0.0–0.5	1.74E+00	5.24E-01	**1.23E+00**	1.36E-01	ND (1.54E-01)	--	1.02E-01	3.03E-02
SNL/NM Foothills Background Range[d]			0.153–2.86	NA	0.113–1.18	NA	0.004–3.0	NA	0.007–0.876	NA
NMED-Approved Background Soil Activities–Lower Canyons Area[e]			2.31	NA	1.03	NA	0.16	NA	1.55	NA

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

[a]Uranium-238 and thorium-232 decay chain isotopes with short half lives are not presented in this table.

[b]Bold portion of location description shown on Figure 3.4.3-1.

[c]Two standard deviations about the mean detected activity.

[d]IT March 1996.

[e]Dinwiddie September 1997.

ER = Environmental restoration.
ft = Foot (feet).
pCi/g = Picocurie(s) per gram.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NMED = New Mexico Environment Department.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
-- = Error not calculated for nondetectable results.

Table 3.4.3-2
Summary of Background Information Reviewed for SWMU 82

Information Source	Reference
Visual walkover surveys and site inspections, site photographs, aerial photographs, UXO/HE survey, cultural resources survey, sensitive species survey, and radiological surveys	Hoagland and Dello-Russo February 1995 IT February 1995 RUST Geotech Inc. December 1994 SNL/NM September 1997 Oldewage February 1993 Aerial Photographs: USFS 1961 EJA-2-116 USGS 1967 VBUG-2-85 USFS 1971 EXG-1-116, EXG-2-275 USAF 1989 6-31-1 Young and Byrd September 1994
Reports, interviews, and/or site tours with SNL/NM facility personnel	Byrd, C. October 1993 Byrd, C. February 1994 Wrightson, W. May 1994 Wrightson, W. June 1994 Luna, R.E. July 1974 Gaither C. et al. May 1993 Bohannon, H.C. November 1985 Lane, T.B. et al. July 1985

HE = High Explosive(s).
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
USAF = U.S. Air Force.
USFS = U.S. Forest Service.
USGS = U.S. Geological Service.
UXO = Unexploded ordnance.

3.4.3.4 *UXO/HE Survey*

In January 1994, KAFB Explosives Ordnance Disposal conducted a surface visual UXO/HE survey of the OAC site (Young September 1994). Ordnance located and removed from this site included

- Three 5-inch projectiles
- Fifty-two expended Zuni rocket motors
- Four 2.75-inch expended rocket motors
- One grain (30 pounds) of uncased solid rocket propellant.

3.4.3.5 *Cultural Resources Survey*

A cultural resources survey was conducted at SWMU 82 in 1994; no cultural resources were identified at the site (Hoagland and Dello-Russo February 1995).

3.4.3.6 *Sensitive Species Survey*

A sensitive species survey and biological field investigation of SWMU 82 and surrounding support facilities was conducted in 1994. The resulting report summarizes sensitive, threatened, and endangered species found on the site and gives a comprehensive assessment of biological habitats (IT 1995). Only scattered individuals of the Visnagita Cactus were observed on the site. At that time, Visnagita Cactus was considered an endangered plant by the State of New Mexico. However, since that time, the species has been taken off the New Mexico endangered plant list and is no longer considered a sensitive plant species (NMEMNRD August 1995).

3.4.3.7 *Radiological Survey(s)*

In January 1994, RUST Geotech Inc. conducted a surface gamma radiation survey of SWMU 82 with 100-percent area coverage over 52 acres. Four slightly elevated areas were detected at levels ranging from 14 to 18 microroentgens (μR) per hour (hr) (background activities in the area were measured at approximately 12 μR/hr). Three anomalies were associated with granitic bedrock were considered to be naturally occurring. The fourth anomaly, located in an arroyo, was attributed to either finely dispersed radioactive contamination or to an elevated reading caused by the geometry of the arroyo (RUST Geotech December 1994).

In June 1996, pre-cleanup soil sampling for gamma spectroscopy analysis was conducted to assess the need for remediation of the areas found in 1994. A total of three samples were taken at SWMU 82. Two of the four areas were close enough to each other so that only one sample was taken to represent both areas. The results of the sampling showed that the elevated radiation is related to the underlying bedrock, which contains thorium series radionuclides with the ratio of its isotopes in natural background distributions. A detailed summary of the results of the verification sampling is also 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).

3.4.3.8 Sampling Data Collection

Twenty-one samples were collected for gamma spectroscopy analysis as discussed in Sections 3.4.3.2 and 3.4.3.7. The results of the analysis showed only naturally occurring radionuclides are present at SWMU 82.

3.4.3.9 Data Gaps

Information gathered from process knowledge, historical site files, surveys and inspections of the site, and personnel interviews were sufficient to identify the most likely COCs, the most likely locations of potential COC releases, and the types of analyses to be performed on soil samples.

3.4.3.10 Results and Conclusions

No cultural resources, sensitive species, or remaining UXO/HE hazards were identified at SWMU 82. No evidence of organic COCs such as stained soil or leaking containers was present. The radiological surveys and sampling conducted at the site found that radiation anomalies were associated with the bedrock.

3.4.4 Investigation #3—SNL/NM ER Project RFI Sampling Activities

Numerous sampling events were conducted between 1995 and 1999 to characterize SWMU 82. Several discrete areas or features were investigated. The discussion of sampling and results follows the OU 1332 Work Plan organization by the same feature subsets (i.e., site-specific background and downgradient locations, generator pad, debris piles/pads, rocket sled track area, and impact pad area). The data gaps and conclusions for all RFI sampling activities are discussed at the end of this section.

All samples were collected at 0-6 inch depth intervals in accordance with ER Field Operating Procedure (FOP) 94-52 (SNL/NM December 1994) using standard equipment (stainless steel bowl, hand trowel, etc.) and standard decontamination procedures in accordance with ER FOP 94-57 (SNL/NM May 1994). Samples were managed in accordance with ER FOP 94-34 (SNL/NM May 1995). SNL/NM chain-of-custody and sample documentation procedures were followed for all samples collected.

3.4.4.1 Nonsampling Data Collection

The RFI sampling was conducted after site visits to confirm the details of the feature being sampled. Samples were screened for radiation in the field using a beta/gamma meter with a sodium-iodide detector. No elevated radiation levels were found at sample locations or on sample containers during this phase of the investigation.

3.4.4.2 Site-Specific Background and Downgradient Sampling

The first RFI sampling task was to collect and analyze site-specific background and downgradient samples to determine if COCs from OAC activities might be leaving the site. This section discusses the sampling effort and results.

3.4.4.2.1 Sampling Activities

Three site-specific background sample locations were judgmentally selected in an area that was topographically up-gradient of all tests and at least 800 feet upwind of the PAGE test detonation points. The area was inspected when sampled and showed no evidence of any OAC activities. Three downgradient points were also selected judgmentally. The points were selected to be topographically downgradient of all tests and OAC debris and structures. The points selected are downwind of the PAGE test detonation points. Figure 3.4.4-1 shows both the site-specific background and downgradient sampling locations and their position in relation to the OAC test area. The ER Sample Identification on the chain-of-custody and in the analytical results tables for this section contains the following components: 82 = SWMU location, GR = grab sample, 001 = sample number, 0 = sample depth, SS = soil sample.

Samples were analyzed for target analyte list (TAL) metals (U.S. Environmental Protection Agency [EPA] Methods 6010, 7000, and 7470/7471A), volatile organic compounds (VOCs) (EPA Method 8240), semivolatile organic compounds (SVOCs) (EPA Method 8270), and total petroleum hydrocarbons (TPH) (EPA Method 8015M). All chemical analyses, except the HE screening, were conducted by Lockheed Analytical Services, Las Vegas, NV. HE screening was conducted by the SNL/NM on-site analytical laboratory using high-pressure liquid chromatography (HPLC).

All radiological analyses were performed by gamma spectroscopy (EPA Method 901.1; EPA November 1986) at the SNL/NM Radiation Protection Sample Diagnostics (RPSD) Laboratory.

3.4.4.2.2 Sampling Results

The results of the TAL metals analysis are shown in Table 3.4.4-1. The only metal level found above the NMED-approved background was arsenic at 13 milligrams per kilogram (mg/kg) in one site-specific background sample. The NMED-approved background levels for metals had not been established at the time of analysis, and the detection limits for silver, beryllium, cadmium, and mercury were slightly above the approved background levels. The detection limits had no real impact on-site characterization since, except for silver, higher values were found at other locations in the SWMU and were used in the risk assessment. Half the detection limit for silver was used in the risk assessment, according to EPA guidance.

The results of gamma spectroscopy for radionuclides are shown in Table 3.4.4-2. The site-specific background and downgradient samples were comparable and were below NMED-approved background activities. The uranium-238 and uranium-235 minimum detection activities were slightly above the NMED-approved background activities. The complete analytical package is included in Annex 3-A.

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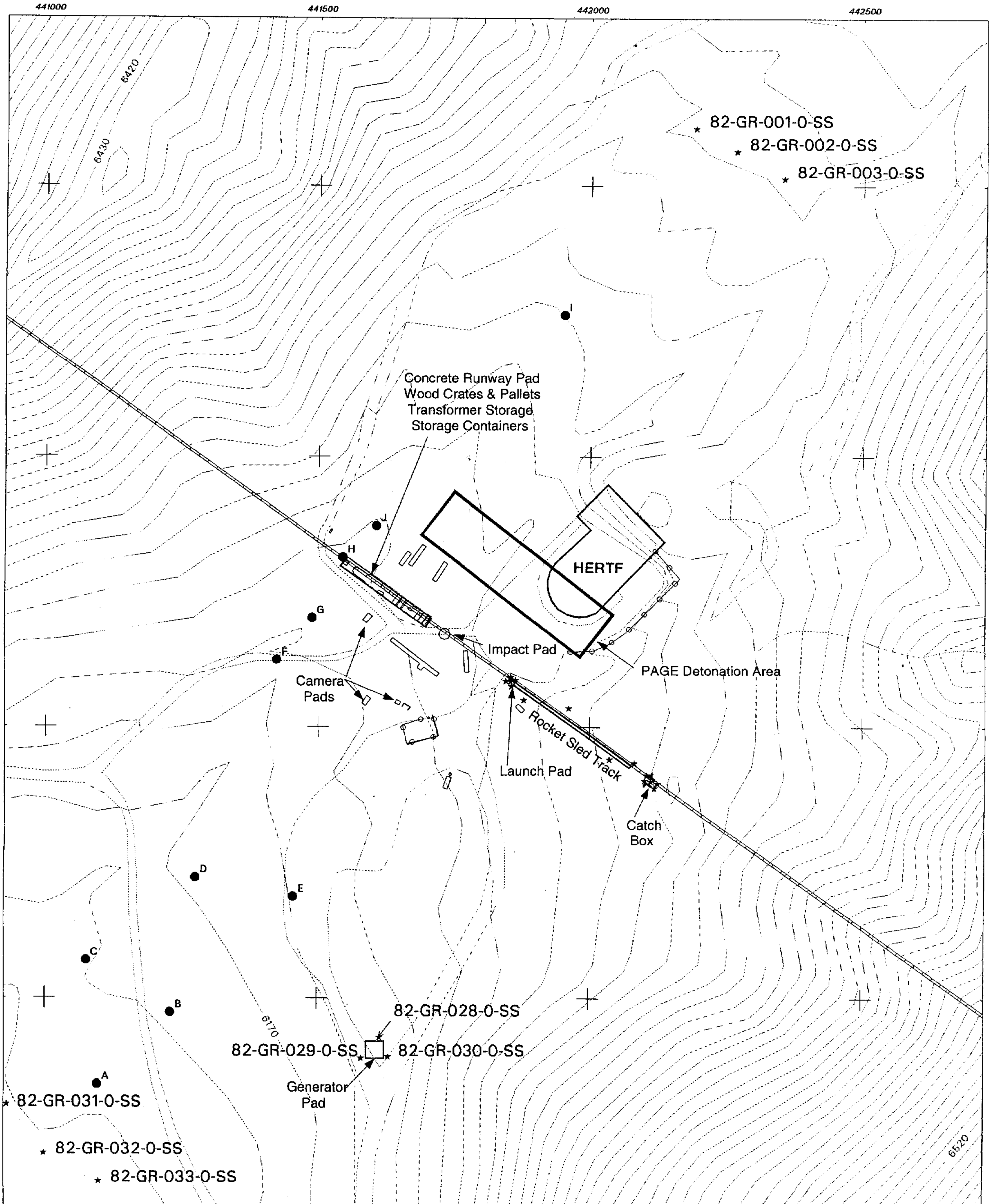


Legend

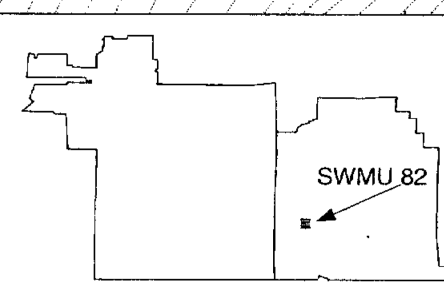
Symbol	Description
●	Debris Piles
★	Surface Soil Sampling Location
- - - -	10 Foot Contour
·······	Road
━━━	Building
───	Misc. Structure
o—o—o	Fence
━━━	PAGE Detonation Area
═══	Former Path of the Aerial Cable

Debris Piles Designation

- A-Concrete Slab
- B-Concrete Slab
- C-Cable
- D-Panel Boxes
- E-Met. Tower Base
- F-Rubble
- G-Foam, Concrete, Rubble
- H-Concrete Pad
- I-Small Metal Cylinder
- J-Electrical Conduit Cable

0 200 400
Scale in Feet

0 48 96
Scale in Meters



Sandia National Laboratories, New Mexico
Environmental Operations Geographic Information System

Figure 3.4.4-1
SWMU 82 - Site-Specific Background, Downgradient, & Generator Pad Sample Locations

Compiled by photogrammetric methods from aerial photography dated March 1989, March 1990, September 1991 and July 1992
Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone 1927 North American Horizontal Datum, 1929 North American Vertical Datum

1"=200'	1:2400	MAPID=000475
Unclassified		SNL GIS ORG. 6804
Rachel Loehman	rl000475.aml	05/21/00

Table 3.4.4-1
Summary of SWMU 82 Site-Specific Background and Downgradient RFI Surface Soil Sampling TAL Metals Analytical Results July 1995 (Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010, 7000, and 7470/7471A)[a] (mg/kg)										
Record Number[b]	ER Sample ID (Figure 3.4.3-1)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
Site-Specific Background														
03900	82-GR-001-0-SS	7/10/95	0.0–0.5	8.3	92	ND (1.0)	ND (1.0)	12	15	ND (0.10)	14	ND (1.0)	ND (2.0)	42
03900	82-GR-002-0-SS	7/10/95	0.0–0.5	13	100	ND (1.0)	ND (1.0)	8	11	ND (0.10)	12	ND (1.0)	ND (2.0)	45
03900	82-GR-003-0-SS	7/10/95	0.0–0.5	6.4	170	ND (1.0)	ND (1.0)	11	14	ND (0.10)	14	ND (1.0)	ND (2.0)	42
Downgradient														
03897	82-GR-031-0-SS	7/6/95	0.0–0.5	4.6	180	ND (1.0)	ND (1.0)	14	11	ND (0.10)	15	ND (1.0)	ND (2.0)	47
03897	82-GR-032-0-SS	7/6/95	0.0–0.5	7.7	96	ND (0.98)	ND (0.98)	10	8.5	ND (0.10)	11	ND (0.98)	ND (2.0)	49
03897	82-GR-033-0-SS	7/6/95	0.0–0.5	4.7	99	ND (1.0)	ND (1.0)	9.1	11	ND (0.10)	12	ND (0.98)	ND (2.0)	39
03897	82-GR-033-0-SS	7/6/95	0.0–0.5	6.5	86	ND (0.98)	ND (0.98)	9.2	7.8	ND (0.10)	11	ND (1.0)	ND (2.0)	40
Quality Assurance/Quality Control Samples (mg/L)														
03897	82-GR-010-0-SS	7/6/95	NA	ND (0.01)	ND (0.2)	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.003)	ND (0.0002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
03897	82-GR-010-0-SS	7/6/95	NA	ND (0.01)	ND (0.2)	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.003)	ND (0.0002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
03897	82-GR-020-0-SS	7/6/95	NA	ND (0.01)	ND (0.2)	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.003)	ND (0.0002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
03897	82-GR-020-0-SS	7/6/95	NA	ND (0.01)	ND (0.2)	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.003)	ND (0.0002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
03900	82-GR-033-0-SS	7/10/95	NA	ND (0.01)	ND (0.2)	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.003)	ND (0.0002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
03900	82-GR-033-0-SS	7/10/95	NA	ND (0.01)	ND (0.2)	ND (0.005)	ND (0,005)	ND (0.01)	ND (0.003)	ND (0.0002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
SNL/NM Foothills Background Range[c]				1.6–9.6	39–400	0.2–0.73	0.09–0.99	2.5–20	4.7–51	0.01–0.13	5.3–16	0.56–3.1	0.01–0.50	21–55
NMED-Approved Background Soil Concentrations—Lower Canyons Area[d]				9.8	246	0.75	0.64	18.8	18.9	0.055	16.6	2.7	<0.5	52.1

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

[a]EPA November 1986.

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

[c]IT March 1996.

[d]Garcia November 1998.

EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected at or above the method detection limit, shown in parentheses.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.

Table 3.4.4-2
Summary of SWMU 82 Site-Specific Background and
Downgradient RFI Surface Soil Sampling Gamma Spectroscopy Analytical Results
July 1995
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample ID (Figure 3.4.4-1)	Date Sampled	Sample Depth (ft)	Cesium-137	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Uranium-238	Error[c]
Site-Specific Background											
03899	82-GR-001-0-SS	7/10/95	0.0–0.5	9.55E-02	3.33E-02	4.96E-01	1.86E-01	ND (3.54E-01)	--	ND (4.96E+00)	--
03899	82-GR-002-0-SS	7/10/95	0.0–0.5	1.57E-01	4.32E-02	7.26E-01	2.24E-01	ND (3.70E-01)	--	ND (5.18E+00)	--
03899	82-GR-003-0-SS	7/10/95	0.0–0.5	6.47E-02	3.03E-02	6.67E-01	2.44E-01	ND (3.33E-01)	--	ND (4.64E+00)	--
Downgradient											
03867	82-GR-031-0-SS	7/6/95	0.0–0.5	6.71E-01	1.16E-01	8.76E-01	2.96E-01	ND (4.80E-01)	--	ND (6.71E+00)	--
03867	82-GR-032-0-SS	7/6/95	0.0–0.5	1.82E-01	3.61E-02	5.27E-01	2.16E-01	ND (3.75E-01)	--	ND (5.02E+00)	--
03867	82-GR-033-0-SS	7/6/95	0.0–0.5	2.21E-01	4.84E-02	4.60E-01	1.69E-01	ND (3.48E-01)	--	ND (4.99E+00)	--
03867	82-GR-033-0-SS	7/6/95	0.0–0.5	2.11E-01	4.81E-02	5.30E-01	1.81E-01	ND (3.42E-01)	--	ND (4.92E+00)	--
SNL/NM Foothills Background Range[d]				0.007–0.876	NA	0.113–1.18	NA	0.004–3.0	NA	0.153–2.86	NA
NMED-Approved Background Soil Activities—Lower Canyons Area[e]				1.55	NA	1.03	NA	0.16	NA	2.31	NA

[a]Uranium-238 and thorium-232 decay chain isotopes with short half lives are not presented in this table.
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations about the mean detected activity.
[d]IT March 1996.
[e]Dinwiddie September 1997.

ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
-- = Error not calculated for nondetectable results.

The results of VOC analyses are shown in Table 3.4.4-3. Very low levels of some VOCs were detected in the site-specific background samples. No VOCs were detected in the downgradient samples. Because only background sample analysis found VOCs, they are not considered to be evidence of site contamination. Table 3.4.4-4 shows the detection limits for the VOC analysis.

SVOCs were analyzed for, but not detected, in any background or downgradient sample. Table 3.4.4-5 presents the detection limits for SVOCs.

TPH was analyzed for, but not detected, in either the diesel range organics or the gasoline range organics. The detection limit for both ranges was 30 mg/kg.

The soil samples were screened for the presence of HE using HPLC. HE was not found in any background or downgradient sample.

3.4.4.2.3 Data Quality

Quality assurance (QA)/quality control (QC) field samples collected as part of the confirmatory soil sampling event included four duplicates, two soil trip blanks, two aqueous trip blanks, six aqueous field blanks, and six aqueous equipment blanks. Relative percent differences (RPD) were calculated for the TAL metals detected in the primary and duplicate samples, both of which were analyzed by Lockheed Analytical Services. The TAL metals analyses for the sample pairs for arsenic and lead yielded RPDs that slightly exceeded the acceptable RPD limit of less than 25 percent (Table 3.4.4-6). However, the metals concentrations in the downgradient samples collected from the site were less than the respective NMED-approved background levels for those metals. Although the RPDs presented in Table 3.4.4-6 exceed the RPD limit, they are typical of the heterogeneous uncontaminated soil and are, therefore, acceptable.

3.4.4.2.4 Data Validation

The off-site laboratory results from Lockheed Analytical Services were reviewed according to "Data Verification/Validation Level 2 – DV-2," in the SNL/NM Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994). The DV2 reports are presented in Annex 3-B. The gamma spectroscopy data from the RPSD Laboratory were reviewed according to "Laboratory Data Review Guidelines," Procedure No: RPSD-02-11, Issue No: 02. The RPSD verification/validation reports are presented along with the gamma-spectroscopy results in Annex 3-A. The verification/validation process confirms that the data are acceptable for use in this NFA proposal for SWMU 82. Blank contamination resulted in acetone and methylene chloride results being qualified as not detected according to the Blank Rule (EPA February 1994). No other analytical data from this sampling event required qualification during validation.

3.4.4.3 Generator Pad

Photographs taken during the CEARP site investigation show a generator on a pad and a small area of stained soil around the pad. The generator was removed before the RFI sampling. During the RFI sampling activities, visual inspection of the pad area did not show any stained soil around the pad. No documentation of a cleanup of the soil in this area could be found

Table 3.4.4-3
Summary of SWMU 82 Site-Specific Background and
Downgradient RFI Surface Soil Sampling VOC Analytical Results
July 1995
(Off-Site Laboratory)

Sample Attributes				Volatile Organic Compounds[a] (EPA Method 8240)[b] (µg/kg)				
Record Number[c]	ER Sample ID (Figure 3.4.4-1)	Date Sampled	Sample Depth (ft)	Benzene	2-Butanone	Chlorobenzene	Toluene	m,p-Xylene
Site-Specific Background								
03900	82-GR-001-0-SS	7/10/95	0.0–0.5	**1.4 J (5.0)**	**3.8 J (10)**	ND (5.0)	ND (5.0)	**1.8 J (5.0)**
03900	82-GR-002-0-SS	7/10/95	0.0–0.5	**1.6 J (4.9)**	ND (9.9)	**1.1 J (4.9)**	**1.1 J (4.9)**	ND (4.9)
03900	82-GR-003-0-SS	7/10/95	0.0–0.5	ND (4.9)	ND (9.9)	ND (4.9)	ND (4.9)	ND (4.9)
Downgradient								
03897	82-GR-031-0-SS	7/6/95	0.0–0.5	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)
03897	82-GR-032-0-SS	7/6/95	0.0–0.5	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)
03897	82-GR-033-0-SS	7/6/95	0.0–0.5	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)
03897	82-GR-033-0-SS	7/6/95	0.0–0.5	ND (4.9)	ND (9.9)	ND (4.9)	ND (4.9)	ND (4.9)
Quality Assurance/Quality Control Samples (all in µg/L, except where indicated otherwise)								
03900	82-GR-033-0-SS (FB)	7/10/95	NA	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)
03900	82-GR-033-0-SS (EB)	7/10/95	NA	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)
03900	82-GR-033-0-SS (TB)	7/10/95	NA	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)
03897	82-GR-033-0-SS (TB) (µg/kg)	7/7/95	NA	**1.2 J (5.3)**	ND (11)	ND (5.3)	ND (5.3)	ND (5.3)
03900	82-GR-033-0-SS (TB)	7/10/95	NA	ND (4.9)	ND (9.9)	ND (4.9)	ND (4.9)	ND (4.9)
03900	82-GR-033-0-SS (TB) (µg/kg)	7/10/95	NA	ND (4.9)	ND (9.9)	ND (4.9)	ND (4.9)	ND (4.9)

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

[a]Acetone and methylene chloride were qualified as nondetects based on the Blank Rule and Trip Blank contamination.

[b]EPA November 1986.

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

EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
FB = Field blank.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
J ( ) = The reported value is less than practical quantitation limit (shown in parentheses) but greater than or equal to the method detection limit.
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected at or above the method detection limit, shown in parentheses.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
TB = Trip Blank.
VOC = Volatile organic compound.

Table 3.4.4-4
VOC Analytical Method Detection Limits (EPA Method 8240 with Capillary)[a] Used for SWMU 82 Site-Specific Background and Downgradient RFI Surface Soil Sampling
July 1995
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
Acetone	9.7–10
Benzene	4.9–5.0
Bromodichloromethane	4.9–5.0
Bromoform	4.9–5.0
Bromomethane	4.9–5.0
2-Butanone	9.7–10
Carbon disulfide	4.9–5.0
Carbon tetrachloride	4.9–5.0
Chlorobenzene	4.9–5.0
Chloroethane	4.9–5.0
2-Chloroethyl vinyl ether	19–20
Chloroform	4.9–5.0
Chloromethane	4.9–5.0
1,2-Dichlorobenzene	4.9–5.0
1,3-Dichlorobenzene	4.9–5.0
1,4-Dichlorobenzene	4.9–5.0
cis-1,2-Dichloroethene	4.9–5.0
1,1-Dichloroethane	4.9–5.0
1,1-Dichloroethene	4.9–5.0
1,2-Dichloroethane	4.9–5.0
1,2-Dichloropropane	4.9–5.0
cis-1,3-Dichloropropene	4.9–5.0
Dibromochloromethane	4.9–5.0
trans-1,2-Dichloroethene	4.9–5.0
trans-1,3-Dichloropropene	4.9–5.0
Ethylbenzene	4.9–5.0
2-Hexanone	4.9–5.0
4-Methyl-2-pentanone	9.7–10
Methylene chloride	4.9–5.0
Styrene	4.9–5.0
Tetrachloroethane	4.9–5.0
Toluene	4.9–5.0
1,1,1-Trichloroethane	4.9–5.0
1,1,2,2-Tetrachloroethane	4.9–5.0
1,1,2-Trichloroethane	4.9–5.0
Trichloroethene	4.9–5.0
Trichlorofluoromethane	4.9–5.0
Vinyl acetate	9.7–10
Vinyl chloride	4.9–5.0
m,p-Xylene	4.9–5.0
o-xylene	4.9–5.0

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
MDL = Method Detection Limit.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SWMU = Solid Waste Management Unit.
VOC = Volatile Organic Compound.
µg/kg = Microgram(s) per kilogram.

Table 3.4.4-5
SVOC Analytical Method Detection Limits (EPA Method 8270)[a] Used for
SWMU 82 Site-Specific Background and Downgradient RFI Surface Soil Sampling
July 1995
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
Acenaphthene	650–660
Acenaphthylene	650–660
Anthracene	650–660
Benzo(a)anthracene	650–660
Benzo(b)fluoranthene	650–660
Benzo(k)fluoranthene	650–660
Benzo(g,h,i)perylene	650–660
Benzo(a)pyrene	650–660
Benzoic acid	3300
Benzyl alcohol	1300
4-Bromophenyl-phenylether	650–660
Butylbenzylphthalate	650–660
Di-n-butylphthalate	650–660
Carbazole	650–660
4-Chloro-3-methylphenol	1300
4-Chloroaniline	1300
bis(2-Chloroethoxy)methane	650–660
bis(2-Chloroethyl)ether	650–660
bis(2-Chloroisopropyl)ether	650–660
2-Chloronaphthalene	650–660
2-Chlorophenol	650–660
4-Chlorophenyl phenyl ether	650–660
Dibenz (a,h) anthracene	650–660
Dibenzofuran	650–660
1,2-Dichlorobenzene	650–660
1,3-Dichlorobenzene	650–660
1,4-Dichlorobenzene	650–660
2,4-Dichlorophenol	650–660
Diethylphthalate	650–660
2,4-Dimethylphenol	650–660
Dimethylphthalate	650–660
4,6-Dinitro-2-methylphenol	3300
2,4-Dintrophenol	3300
2,4-Dinitrotoluene	650–660
2,6-Dintrotoluene	650–660
3,3-Dichlorobenzidine	1300
bis(2-Ethylhexyl) phthalate	650–660
Fluoranthene	650–660
Fluorene	650–660

Refer to footnotes at end of table.

Table 3.4.4-5 (Concluded)
SVOC Analytical Method Detection Limits (EPA Method 8270)[a] Used for
SWMU 82 Site-Specific Background and Downgradient RFI Surface Soil Sampling
July 1995
(Off-Site Laboratory)

Analyte	Soil Sample MDL (μg/kg)
Hexachlorobenzene	650–660
Hexachlorobutadiene	650–660
Hexachlorocyclopentadiene	650–660
Hexachloroethane	650–660
Indeno(1,2,3-cd)pyrene	650–660
Isophorone	650–660
2-Methylnaphthalene	650–660
2-Methylphenol	650–660
4-Methylphenol	650–660
2-Nitroaniline	3300
3-Nitroaniline	3300
4-Nitroaniline	3300
N-Nitrosodiphenylamine	650–660
2-Nitrophenol	650–660
4-Nitrophenol	3300
Naphthalene	650–660
Nitrobenzene	650–660
N-Nitroso-di-n-propylamine	650–660
Di-n-octylphthalate	650–660
Pentachlorophenol	3300
Phenanthrene	650–660
Phenol	650–660
Pyrene	650–660
1,2,4-Trichlorobenzene	650–660
2,4,5-Trichlorophenol	650–660
2,4,6-Trichlorophenol	650–660

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
MDL = Method detection limit.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
μg/kg = Microgram(s) per kilogram.

Table 3.4.4-6
Summary of SWMU 82 TAL Metals Relative Percent Differences
July 1995
(Off-Site Laboratory)

Sample Attributes			Relative Percent Difference										
Record Number[a]	ER Sample ID (Figure 3.4.4-1)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Silver	Selenium	Zinc
03897 03897	82-GR-033-0-SS, 82-GR-033-0-SS (duplicate)	0.0–0.5 0.0–0.5	32.14	14.05	NC	NC	1.09	34.04	NC	8.70	NC	NC	2.53

[a]Analysis request/chain-of-custody record.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
NC = Not calculated for estimated values or nondetected results.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.

during the RFI. This section describes the sampling effort and analytical results to determine if the diesel fuel leak at the generator pad was adequately remediated.

3.4.4.3.1 Sampling Activities

Sampling locations were judgmentally selected in the soil at the edge of the generator pad. The three sample locations were selected to be topographically downgradient from the pad (see Figure 3.4.4-1). The ER Sample Identification on the chain-of-custody and in the analytical results tables for this section contains the following components: 82 = SWMU location; GR = grab sample; 001 = sample number; 0 = sample depth; SS = soil sample.

Samples were analyzed for VOCs (EPA Method 8240), SVOCs (EPA Method 8270), and TPH (EPA Method 8015M). All chemical analyses were conducted by Lockheed Analytical Services, Las Vegas, NV. All radiological analyses were performed by gamma spectroscopy (EPA Method 901.1) at the SNL/NM RSPD Laboratory.

3.4.4.3.2 Sampling Results

The results of gamma spectroscopy analysis for radionuclides are shown in Table 3.4.4-7. The radionuclide levels in the samples collected from the generator pad area were comparable and below NMED-approved background activities, with the exception of the thorium 232 in sample 82-GR-029-0-SS. The sample had a thorium 232 activity of 1.13E+00 picocuries per gram (pCi/g). The NMED approved background activity is 1.03E+00 pCi/g. The sample value is within the range of background samples and naturally elevated thorium in the rocks at SWMU 82 was previously discussed in Sections 3.4.3.2 and 3.4.3.7. The minimum detection activities for uranium-238 and uranium-235 were slightly above the approved background activities. The complete analytical package is included in Annex 3-A.

The results of analysis for VOCs are shown in Table 3.4.4-8. Ten VOCs were detected, seven of which were below the practical quantitation limits and are estimated values (see Table 3.4.4-8). The detection limits for VOCs are shown in Table 3.4.4-9.

The results of SVOC analysis are shown in Table 3.4.4-10. Chrysene, at 170 J micrograms (μg)/kg, was the only SVOC detected. The SVOC detection limits are presented in Table 3.4.4.5.

The results of TPH analysis are shown in Table 3.4.4-11. Sample 82-GR-029-0-SS contained diesel range organics at 380 mg/kg. Sample 82-GR-030-0-SS contained diesel range organics at 35 mg/kg. No gasoline range organics were detected at the detection limit of 30 mg/kg.

3.4.4.3.3 Data Quality

QA/QC field samples collected as part of the confirmatory soil sampling event included one soil trip blank, two aqueous trip blanks, three aqueous field blanks and three aqueous equipment blanks. Acetone, methylene chloride, and 4-methyl-2-pentanone were present in blanks, and the soil results qualified as not detected based on the Blank Rule (EPA February 1994). No other analytes were qualified based on QA/QC samples.

Table 3.4.4-7
Summary of SWMU 82 Generator Pad RFI
Surface Soil Sampling Gamma Spectroscopy Analytical Results
July 1995
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample ID (Figure 3.4.4-1)	Date Sampled	Sample Depth (ft)	Cesium-137	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Uranium-238	Error[c]
03899	82-GR-028-0-SS	7/10/95	0.0–0.5	4.38E-02	2.65E-02	**1.04E+00**	3.11E-01	ND (3.76E-01)	--	ND (5.39E+00)	--
03899	82-GR-029-0-SS	7/10/95	0.0–0.5	7.28E-02	3.87E-02	**1.13E+00**	3.36E-01	ND (4.62E-01)	--	ND (6.30E+00)	--
03899	82-GR-030-0-SS	7/10/95	0.0–0.5	8.65E-02	4.16E-02	8.49E-01	2.81E-01	ND (4.46E-01)	--	ND (6.55E+00)	--
SNL/NM Foothills Background Range[d]				0.007–0.876	NA	0.113–1.18	NA	0.004–3.0	NA	0.153–2.86	NA
NMED-Approved Background Soil Activities—Lower Canyons Area[e]				1.55	NA	1.03	NA	0.16	NA	2.31	NA

Note: Values in **bold** exceed background soil activities.
[a]Uranium-238 and thorium-232 decay chain isotopes with short half lives are not presented in this table.
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations about the mean detected activity.
[d]IT March 1996.
[e]Dinwiddie September 1997.

ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
pCi/g = Picocurie(s) per gram.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
-- = Error not calculated for nondetectable results.

Table 3.4.4-8
Summary of SWMU 82 Generator Pad RFI Surface Soil Sampling VOC Analytical Results
July 1995
(Off-Site Laboratory)

Sample Attributes				Volatile Organic Compounds (EPA Method 8240)[a,b] (µg/kg)									
Record Number[c]	ER Sample ID (Figure 3.4.4-1)	Date Sampled	Sample Depth (ft)	Benzene	Bromoform	2-Butanone	2-Chloroethyl vinyl ether	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	Tetrachloro-ethene	1,1,2,2-Tetrachloro-ethane	m,p-Xylene
03900	82-GR-028-0-SS	7/10/95	0.0–0.5	ND (5.0)	ND (5.0)	ND (10)	ND (20)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	**1.1 J (5.0)**
03900	82-GR-029-0-SS	7/10/95	0.0–0.5	**1.1 J (5.0)**	ND (5.0)	**16**	**2.3 J (20)**	ND (5.0)	ND (5.0)	ND (5.0)	**1.6 J (5.0)**	ND (5.0)	**1.5 J (5.0)**
03900	82-GR-030-0-SS	7/10/95	0.0–0.5	ND (5.0)	**2.4 J (5.0)**	**3.7 J (10)**	**2.1 J (20)**	**7**	**3.4 J (5.0)**	**3.8 J (5.0)**	ND (5.0)	**13**	**1 J (5.0)**
Quality Assurance/Quality Control Samples (all in µg/L, except where indicated otherwise)													
03900	82-GR-033-0-SS (FB)	7/10/95	NA	ND (5.0)	ND (5.0)	ND (10)	ND (20)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
03900	82-GR-033-0-SS (EB)	7/10/95	NA	ND (5.0)	ND (5.0)	ND (10)	ND (20)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
03900	82-GR-033-0-SS (TB)	7/10/95	NA	ND (5.0)	ND (5.0)	ND (10)	ND (20)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
03900	82-GR-033-0-SS (TB)	7/10/95	NA	ND (4.9)	ND (4.9)	ND (9.9)	ND (20)	ND (4.9)	ND (4.9)	ND (4.9)	ND (4.9)	ND (4.9)	ND (4.9)
03900	82-GR-033-0-SS (TB) (µg/kg)	7/10/95	NA	ND (4.9)	ND (4.9)	ND (9.9)	ND (20)	ND (4.9)	ND (4.9)	ND (4.9)	ND (4.9)	ND (4.9)	ND (4.9)

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

[a] EPA November 1986.

[b] Acetone, 4-methyl-2-pentanone, and methylene chloride were qualified as nondetects based on the Blank Rule and Trip Blank contamination.

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

EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
FB = Field Blank.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
J ( ) = The reported value is greater than or equal to the method detection limit but less than the practical quantitation limit, shown in parentheses.
µg/L = Microgram(s) per liter.
µg/kg = Microgram(s) per kilogram.
NA = Not applicable.
ND ( ) = Not detected at or above the method detection limit, shown in parentheses.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
TB = Trip Blank.
VOC = Volatile organic compound

Table 3.4.4-9
VOC Analytical Method Detection Limits (EPA Method 8240 With Capillary)[a] Used for SWMU 82 Generator Pad RFI Soil Sampling
July 1995
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
Acetone	9.9–10.0
Benzene	5.0
Bromodichloromethane	5.0
Bromoform	5.0
Bromomethane	5.0
2-Butanone	9.9–10.0
Carbon disulfide	5.0
Carbon tetrachloride	5.0
Chlorobenzene	5.0
Chloroethane	5.0
2-Chloroethyl vinyl ether	20.0
Chloroform	5.0
Chloromethane	5.0
Dibromochloromethane	5.0
1,2-Dichlorobenzene	5.0
1,3-Dichlorobenzene	5.0
1,4-Dichlorobenzene	5.0
1,1-Dichloroethane	5.0
1,2-Dichloroethane	5.0
1,1-Dichloroethene	5.0
cis-1,2-Dichloroethene	5.0
trans-1,2-Dichloroethene	5.0
1,2-Dichloropropane	5.0
cis-1,3-Dichloropropene	5.0
trans-1,3-Dichloropropene	5.0
Ethylbenzene	5.0
2-Hexanone	5.0
4-Methyl-2-pentanone	9.9–10.0
Methylene chloride	5.0
Styrene	5.0
Tetrachloroethane	5.0
Toluene	5.0
1,1,1-Trichloroethane	5.0
1,1,2,2-Tetrachloroethane	5.0
1,1,2-Trichloroethane	5.0
Trichloroethene	5.0
Trichlorofluoromethane	5.0
Vinyl acetate	9.9–10.0

Refer to footnotes at end of table.

Table 3.4.4-9 (Concluded)
VOC Analytical Method Detection Limits (EPA Method 8240 With Capillary)[a] Used for
SWMU 82 Generator Pad RFI Soil Sampling
July 1995
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
Vinyl chloride	5.0
m,p-Xylene	5.0
o-xylene	5.0

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
MDL = Method detection limit.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.
µg/kg = Microgram(s) per kilogram.

Table 3.4.4-10
Summary of SWMU 82 Generator Pad RFI
Surface Soil Sampling SVOC Analytical Results
July 1995
(Off-Site Laboratory)

Sample Attributes				SVOCs (EPA Method 8270)[a] (µg/kg)
Record Number[b]	ER Sample ID (Figure 3.4.4-1)	Date Sampled	Sample Depth (ft)	Chrysene
03900	82-GR-029-0-SS	7/10/95	0.0–0.5	**170 J (650)**
Quality Assurance/Quality Control Samples (µg/L)				
03900	82-GR-033-0-SS	7/10/95	NA	ND (10)
03900	82-GR-033-0-SS	7/10/95	NA	ND (10)

Note: Values in **bold** represent detected SVOCs.
[a]EPA November 1986.
[b]Analysis request/chain-of-custody record.
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 = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected at or above the method detection limit, shown in parentheses.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SS = Soil sample.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.

Table 3.4.4-11
Summary of SWMU 82 Generator Pad RFI
Surface Soil Sampling TPH Analytical Results
July 1995
(Off-Site Laboratory)

Sample Attributes				TPH (EPA Method 8015M)[a] (mg/kg)	
Record Number[b]	ER Sample ID (Figure 3.4.4-1)	Date Sampled	Sample Depth (ft)	Diesel Range Organics	Gasoline Range Organics
03900	82-GR-028-0-SS	7/10/95	0.0–0.5	ND (29)	ND (29)
03900	82-GR-029-0-SS	7/10/95	0.0–0.5	**380**	ND (30)
03900	82-GR-030-0-SS	7/10/95	0.0–0.5	**35**	ND (30)
Quality Assurance/Quality Control Samples (mg/L)					
03900	82-GR-033-0-SS	7/10/95	NA	ND (1.0)	ND (1.0)
03900	82-GR-033-0-SS	7/10/95	NA	ND (1.0)	ND (1.0)

Note: Values in **bold** represent detected TPHs.
[a]EPA November 1986.
[b]Analysis request/chain-of-custody record.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
M = Modified.
mg/L = Milligram(s) per liter.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
ND ( ) = Not detected at or above the method detection limit, shown in parentheses.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
TPH = Total petroleum hydrocarbon.

3.4.4.3.4 Data Validation

The off-site laboratory results from Lockheed Analytical Services were reviewed according to "Data Verification/Validation Level 2 – DV-2," in the SNL/NM Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994). The DV2 reports are presented in Annex 3-B. The gamma spectroscopy data from the RPSD Laboratory were reviewed according to "Laboratory Data Review Guidelines," Procedure No: RPSD-02-11, Issue No: 02. The RPSD verification/validation reports are presented along with the gamma-spectroscopy results in Annex 3-A. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 82. None of the soil sample analytical data required qualification during validation.

3.4.4.4 Debris Piles/Pads

The OU 1332 Work Plan identifies ten "debris piles" (A through J) as features to be evaluated. In actuality, the debris piles category is a catch-all for test debris and features and includes concrete pads, wire cable, electrical panel boxes, foam, concrete rubble, a small metal cylinder, and electrical conduit cable. Sampling was conducted to determine if OAC test activities left COCs on these features or in the surrounding soils.

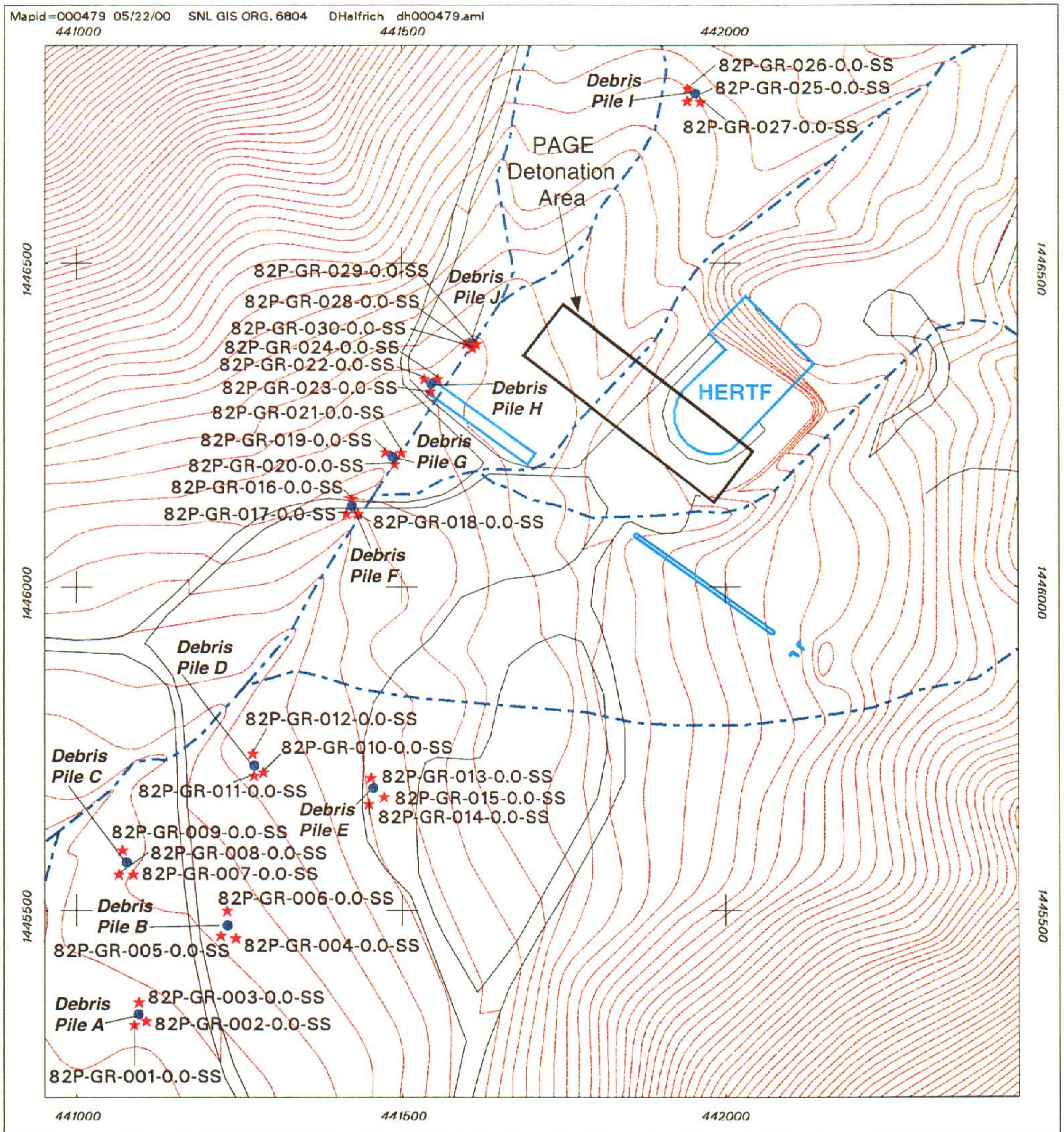
3.4.4.4.1 Sampling Activities

Three soil samples were judgmentally selected around the perimeter of each feature at the locations shown in Figure 3.4.4-2. The ER Sample Identification on the chain-of-custody and in the analytical results tables for this section contains the following components: 82P = SWMU 82 pile/pad location; GR = grab sample; 001 = sample number; 0 = sample depth; SS = soil sample.

Samples were analyzed for TAL metals (EPA Methods 6010A and 7471) by General Engineering Laboratories, Charleston, SC. All radiological analyses were performed by gamma spectroscopy (EPA Method 901.1; EPA November 1986) at the SNL/NM RSPD.

3.4.4.4.2 Sampling Results

The results of TAL metals analysis on the soils around each feature are shown in Table 3.4.4-12. One sample contained silver at 0.792 J mg/kg, which is above the NMED-approved background level of <0.5. One sample contained arsenic at 24 mg/kg, which is above the NMED-approved background level of 9.8 mg/kg. Samples contained mercury levels of 0.0795 mg/kg and 0.0665 mg/kg, which are above the NMED-approved background level of 0.055 mg/kg, but within the background sample range. One sample contained lead at 19.3 mg/kg, which is above the NMED-approved background level of 18.9 mg/kg, but within the background sample range. In each of these cases, the levels found probably represent a heterogeneous background instead of site contamination.



Legend

- Debris Pile
- Debris Pile Sample
- Road / Parking Area
- 5 Foot Contour
- Surface Drainage
- Building / Concrete Pad
- PAGE Detonation Area

Debris Piles Designation
A-Concrete Slab
B-Concrete Slab
C-Cable
D-Panel Boxes
E-Met. Tower Base
F-Rubble
G-Foam, Concrete, Rubble
H-Concrete Pad
I-Small Metal Cylinder
J-Electrical Conduit Cable

Figure 3.4.4-2
SWMU 82
Debris Piles/Pads
Sampling Locations

0 125 250
Scale in Feet

0 30 60
Scale in Meters

Sandia National Laboratories Environmental Geographic Information System

Table 3.4.4-12
Summary of SWMU 82 Debris Piles RFI
Surface Soil Sampling TAL Metals Analytical Results
November 1997
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010A and 7471)[a] (mg/kg)										
Record Number[b]	ER Sample ID (Figure 3.4.4-2)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
510073	82P-GR-001-0.0-SS	11/20/97	0.0–0.5	6.05	106	0.452 J (0.495)	ND (0.0104)	7.96	13.8	0.0359	8.47	0.224 J (0.495)	0.326 J (0.495)	34.6
510073	82P-GR-002-0.0-SS	11/20/97	0.0–0.5	3.68	98.4	0.474	ND (0.0104)	10.1	14.9	0.0195 J (0.0317)	8.72	ND (0.07)	0.364 J (0.467)	37.1
510073	82P-GR-003-0.0-SS	11/20/97	0.0–0.5	4.12	94.5	0.448 J (0.472)	ND (0.0104)	8.7	14.2	0.0315 J (0.0330)	8.09	ND (0.07)	0.32 J (0.472)	35.8
510073	82P-GR-004-0.0-SS	11/19/97	0.0–0.5	3.67	104	0.489 J (0.495)	ND (0.0104)	8.72	15.9	0.0255 J (0.0325)	9.17	ND (0.07)	0.32 J (0.495)	37.9
510073	82P-GR-005-0.0-SS	11/19/97	0.0–0.5	3.97	104	0.438 J (0.490)	0.0251J (0.490)	7.84	17.7	0.0259 J (0.0296)	8.47	ND (0.07)	0.394 J (0.490)	40.2
510073	82P-GR-006-0.0-SS	11/19/97	0.0–0.5	3.12	88.5	0.354 J (0.467)	ND (0.0104)	4.56	16.9	0.018 J (0.0295)	6.23	ND (0.07)	0.281 J (0.467)	28.4
510073	82P-GR-007-0.0-SS	11/20/97	0.0–0.5	4.01	105	0.482 J (0.490)	ND (0.0104)	9.64	12.7	0.0306 J (0.0332)	9.47	ND (0.07)	0.338 J (0.490)	37.2
510073	82P-GR-008-0.0-SS	11/20/97	0.0–0.5	8.91	166	0.604 J (1.18)	ND (0.0104)	11.7	10.2	0.0336	12	ND (0.07)	**0.792 J (1.18)**	38.6
510073	82P-GR-009-0.0-SS	11/20/97	0.0–0.5	6.13	154	0.584	ND (0.0104)	10.4	10.6	0.0234 J (0.0321)	10.9	ND (0.07)	0.35 J (0.485)	37
510073	82P-GR-010-0.0-SS	11/20/97	0.0–0.5	3.18	107	0.426 J (0.476)	0.131J (0.476)	6.45	12.8	0.023 J (0.0324)	8.68	ND (0.07)	0.323 J (0.476)	38.4
510073	82P-GR-011-0.0-SS	11/20/97	0.0–0.5	4.25	110	0.486	0.0855 J (0.467)	8.99	14.6	0.0249 J (0.0323)	9.46	ND (0.07)	0.426 J (0.467)	41.9
510073	82P-GR-012-0.0-SS	11/20/97	0.0–0.5	4.87	109	0.463 J (0.500)	0.0667 J (0.500)	9.26	14.9	0.0323	9.17	ND (0.07)	0.371 J (0.500)	40.5
510073	82P-GR-013-0.0-SS	11/20/97	0.0–0.5	4.71	100	0.372 J (0.476)	0.0787 J (0.476)	5.41	12	0.0248 J (0.0324)	7.91	ND (0.07)	0.356 J (0.476)	27.6
510073	82P-GR-014-0.0-SS	11/20/97	0.0–0.5	4.66	116	0.400 J (0.459)	0.0523 J (0.459)	6.24	10.2	0.029 J (0.0317)	8.59	0.208 J (0.459)	0.414 J (0.459)	29.5
510073	82P-GR-015-0.0-SS	11/20/97	0.0–0.5	3.99	104	0.445 J (0.490)	ND (0.0104)	6.71	9.4	**0.0795**	9.27	0.159 J (0.490)	0.396 J (0.490)	29.3
510073	82P-GR-016-0.0-SS	11/19/97	0.0–0.5	4.86	121	0.329 J (0.481)	ND (0.0104)	5.7	6.85	0.0209 J (0.0299)	6.56	ND (0.07)	0.461 J (0.481)	22.9
510073	82P-GR-017-0.0-SS	11/19.97	0.0–0.5	5.01	91.4	0.446 J (0.495)	ND (0.0104)	5.77	11.1	0.0225 J (0.0282)	7.7	0.266 J (0.495)	0.363 J (0.495)	36.6
510073	82P-GR-018-0.0-SS	11/19/97	0.0–0.5	4.87	162	0.515	ND (0.0104)	8.44	9.81	ND (0.0173)	10.2	ND (0.07)	0.458 J (0.500)	31.7

Refer to footnotes at end of table.

Table 3.4.4-12 (Continued)
Summary of SWMU 82 Debris Piles RFI
Surface Soil Sampling TAL Metals Analytical Results
November 1997
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010A and 7471)[a] (mg/kg)										
Record Number[b]	ER Sample Location (Figure 3.4.4-2)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
510073	82P-GR-019-0.0-SS	11/19/97	0.0–0.5	3.8	69.1	0.407 J (0.495)	ND (0.0104)	4.44	10.4	0.0244 J (0.0264)	6.19	ND (0.07)	0.424 J (0.495)	32.4
510073	82P-GR-020-0.0-SS	11/19/97	0.0–0.5	**24**	101	0.450 J (0.500)	ND (0.0104)	6.55	16.7	0.0232 J (0.0317)	9.22	0.387 J (0.500)	0.144 J (0.500)	41.3
510073	82P-GR-021-0.0-SS	11/19/97	0.0–0.5	6.2	101	0.322 J (0.495)	ND (0.0104)	5.29	7.53	0.0258 J (0.0316)	5.92	0.289 J (0.495)	ND (0.031)	25.7
510073	82P-GR-022-0.0-SS	11/19/97	0.0–0.5	5.86	82.2	0.455 J (0.476)	ND (0.0104)	7.12	12.6	0.0173 J (0.0333)	10.6	0.245 J (0.476)	0.0808 J (0.476)	36.3
510073	82P-GR-023-0.0-SS	11/19/97	0.0–0.5	4.38	70.9	0.245 J (0.495)	ND (0.0104)	4.67	10.8	ND (0.0173)	4.57	0.168 J (0.495)	0.121 J (0.495)	19.9
510073	82P-GR-024-0.0-SS	11/19/97	0.0–0.5	1.38	73.4	0.213 J (0.495)	ND (0.0104)	4.42	3.97	0.0179 J (0.0332)	5.19	0.184 J (0.495)	ND (0.031)	15
510073	82P-GR-025-0.0-SS	11/19/97	0.0–0.5	6.87	90.3	0.571	ND (0.0104)	9.74	16.9	0.021 J (0.0314)	10.6	0.241 J (0.495)	0.108 J (0.495)	49.7
510073	82P-GR-026-0.0-SS	11/19/97	0.0–0.5	5.35	139	0.432 J (0.485)	ND (0.0104)	8.46	9.75	0.0304	8.51	0.52	0.123 J (0.485)	28.3
510073	82P-GR-027-0.0-SS	11/19/97	0.0–0.5	4.57	148	0.393 J (0.467)	ND (0.0104)	7.17	9.09	0.04	8.29	0.245 J (0.467)	0.196 J (0.467)	23.7
510073	82P-GR-028-0.0-SS	11/19/97	0.0–0.5	7.89	89.8	0.323 J (0.495)	ND (0.0104)	5.06	7.71	0.0300 J (0.0333)	5.75	0.295 J (0.495)	0.156 J (0.495)	30.7
510073	82P-GR-029-0.0-SS	11/19/97	0.0–0.5	5.25	110	0.348 J (0.467)	ND (0.0104)	5.33	7.31	0.0355	6.17	0.373 J (0.467)	0.129 J (0.467)	35.5
510073	82P-GR-030-0.0-SS	11/19/97	0.0–0.5	5.3	87.9	0.397 J (0.495)	ND (0.0104)	5.7	7.69	0.0355	6.91	ND (0.07)	ND (0.031)	38.5
510073	82P-GR-031-0.0-SS	11/20/97	0.0–0.5	3.93	102	0.463 J (0.476)	ND (0.0104)	8.39	**19.3**	**0.0665**	8.64	ND (0.07)	0.163 J (0.476)	31.6
510073	82P-GR-032-0.0-SS	11/20/97	0.0–0.5	3.95	96.4	0.437 J (0.500)	ND (0.0104)	6.88	10.3	0.0245 J (0.0312)	8.8	0.180 J (0.500)	0.181 J (0.500)	28.4

Refer to footnotes at end of table.

Table 3.4.4-12 (Concluded)
Summary of SWMU 82 Debris Piles RFI
Surface Soil Sampling TAL Metals Analytical Results
November 1997
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010A and 7471)[a] (mg/kg)										
Record Number[b]	ER Sample Location (Figure 3.4.4-2)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
Quality Assurance Quality Control Samples (mg/L)														
510073	82P-GR-033-FB	11/20/97	NA	ND (0.00293)	ND (0.000332)	ND (0.000223)	0.000385 J (0.00500)	ND (0.000729)	ND (0.000678)	ND (0.000104)	ND (0.00227)	ND (0.0014)	0.00126 J (0.00500)	0.00121 J (0.00500)
510073	82P-GR-034-EB	11/20/97	NA	ND (0.00293)	ND (0.000332)	ND (0.000223)	ND (0.000208)	ND (0.000729)	ND (0.000678)	ND (0.000104)	ND (0.00227)	ND (0.0014)	ND (0.00062)	0.00115 J (0.00500)
SNL/NM Foothills Background Range[c]				1.6–9.6	39–400	0.2–0.73	0.09–0.99	2.5–20	4.7–51	0.01–0.13	5.3–16	0.56–3.1	0.01–0.50	21–55
NMED-Approved Background Soil Concentrations—Lower Canyons Area[d]				9.8	246	0.75	0.64	18.8	18.9	0.055	16.6	2.7	<0.5	52.1

Note: Values in **bold** exceed background soil concentrations.
[a]EPA November 1986.
[b]Analysis request/chain-of-custody record.
[c]IT March 1996
[d]Garcia November 1998

EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
FB = Field Blank.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J ( ) = Analyte concentration is less than the practical quantitation limit (shown in parentheses), but greater than or equal to method detection limit.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected at or above the method detection limit, shown in parentheses.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SS = Soil sample.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.

The results of radionuclide analysis by gamma spectroscopy for the soils around each feature are shown in Table 3.4.4-13. No elevated radionuclides were detected. The uranium-238 and uranium-235 minimum detection activities were slightly above the NMED-approved background activities. The complete analytical package is included in Annex 3-A.

In addition, a swipe sample was taken on the materials (e.g. concrete, metal) at each feature for HE analysis. The laboratory had problems with the swipe preparation and the resulting analyses did not produce usable data. NMED Hazardous and Radioactive Materials Bureau (HRMB) personnel were asked if they wanted the data replaced and they indicated that it was not necessary to replace the data because it was swipe data (Mignardot March 1999). The swipe samples were not necessary for site characterization because three soil samples were also taken around each debris pile location.

3.4.4.4.3 Data Quality

QA/QC field samples collected as part of the confirmatory soil sampling event included four duplicates, one field blank and one equipment blank.

RPDs were calculated for the TAL metals detected in the primary and duplicate samples, both of which were analyzed by General Engineering Laboratories. The TAL metals analyses for the sample pairs for silver, arsenic (1 of 2 pairs), mercury, and lead (1 of 2 pairs) yielded RPDs that exceeded the acceptable RPD limit of less than 25 percent (Table 3.4.4-14). Although the RPDs presented in Table 3.4.4-14 exceed the RPD limit, they are typical of the heterogeneous uncontaminated soil and are, therefore, acceptable.

RPDs were calculated for the radionuclides detected in the primary and duplicate samples, both of which were analyzed by RPSD. Of the four radionuclides examined, only thorium-232 and one of two sets of cesium duplicates had detectable levels. The RPDs were acceptable for thorium, but the cesium RPD exceeded the acceptable RPD limit of less than 25 percent (see Table 3.4.4-14). Although the RPDs presented in Table 3.4.4-14 exceed the RPD limit, they are typical of the heterogeneous uncontaminated soil and are, therefore, acceptable.

3.4.4.4.4 Data Validation

The off-site laboratory results from General Engineering Laboratories were reviewed according to "Data Verification/Validation Level 2 – DV-2," in the SNL/NM Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994). The DV2 reports are presented in Annex 3-B. The gamma spectroscopy data from the RPSD Laboratory were reviewed according to "Laboratory Data Review Guidelines," Procedure No: RPSD-02-11, Issue No: 02. The RPSD verification/ validation reports are presented, along with the gamma-spectroscopy results, in Annex 3-A. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 82. None of the soil sample analytical data required qualification during validation.

Table 3.4.4-13
Summary of SWMU 82 Debris Pile RFI
Soil Sampling Gamma Spectroscopy Analytical Results
November 1997
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample ID (Figure 3.4.4-2)	Date Sampled	Sample Depth (ft)	Cesium-137	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Uranium-238	Error[c]
510071	82P-GR-001-0.0-SS	11/20/97	0.0–0.5	2.42E-01	4.46E-01	8.56E-01	4.14E-01	ND (2.55E-01)	--	ND (3.41E+00)	--
510071	82P-GR-002-0.0-SS	11/20/97	0.0–0.5	6.76E-01	1.06E-01	8.65E-01	4.13E-01	ND (2.61E-01)	--	ND (3.57E+00)	--
510071	82P-GR-003-0.0-SS	11/20/97	0.0–0.5	5.06E-01	3.62E-01	7.98E-01	4.15E-01	ND (2.62E-01)	--	ND (3.60E+00)	--
510071	82P-GR-004-0.0-SS	11/19/97	0.0–0.5	6.78E-01	1.12E-01	8.24E-01	3.93E-01	ND (2.55E-01)	--	ND (3.44E+00)	--
510072	82P-GR-005-0.0-SS	11/19/97	0.0–0.5	1.21E+00	1.81E-01	9.01E-01	4.34E-01	ND (2.85E-01)	--	ND (3.87E+00)	--
510071	82P-GR-006-0.0-SS	11/19/97	0.0–0.5	4.96E-02	2.06E-02	8.82E-01	4.53E-01	ND (2.43E-01)	--	ND (3.34E+00)	--
510071	82P-GR-007-0.0-SS	11/20/97	0.0–0.5	4.49E-01	9.16E-02	8.00E-01	1.37E+00	ND (2.48E-01)	--	ND (3.52E+00)	--
510071	82P-GR-008-0.0-SS	11/20/97	0.0–0.5	5.16E-02	4.14E-02	7.14E-01	4.69E-01	ND (2.45E-01)	--	ND (3.29E+00)	--
510071	82P-GR-009-0.0-SS	11/20/97	0.0–0.5	9.64E-02	2.98E-02	8.24E-01	4.55E-01	ND (2.49E-01)	--	ND (3.41E+00)	--
510072	82P-GR-010-0.0-SS	11/20/97	0.0–0.5	1.58E-01	3.74E-02	7.33E-01	3.52E-01	ND (2.35E-01)	--	ND (3.24E+00)	--
510071	82P-GR-011-0.0-SS	11/20/97	0.0–0.5	2.64E-01	1.62E-01	7.24E-01	3.42E-01	ND (2.55E-01)	--	ND (3.50E+00)	--
510071	82P-GR-012-0.0-SS	11/20/97	0.0–0.5	2.76E-01	5.63E-02	8.11E-01	4.08E-01	ND (2.68E-01)	--	ND (3.66E+00)	--
510071	82P-GR-013-0.0-SS	11/20/97	0.0–0.5	3.05E-01	6.33E-02	8.24E-01	3.94E-01	ND (2.45E-01)	--	ND (3.44E+00)	--
510071	82P-GR-014-0.0-SS	11/20/97	0.0–0.5	4.06E-02	2.91E-02	8.78E-01	4.20E-01	ND (2.50E-01)	--	ND (3.57E+00)	--
510072	82P-GR-015-0.0-SS	11/20/97	0.0–0.5	ND (3.28E-02)	--	8.61E-01	4.11E-01	ND (2.42E-01)	--	ND (3.34E+00)	--
510071	82P-GR-016-0.0-SS	11/19/97	0.0–0.5	4.66E-02	2.91E-02	7.07E-01	5.86E-01	ND (2.28E-01)	--	ND (3.24E+00)	--
510071	82P-GR-017-0.0-SS	11/19/97	0.0–0.5	7.84E-02	3.72E-02	7.64E-01	3.76E-01	7.24E-02	8.79E-02	ND (3.36E+00)	--
510071	82P-GR-018-0.0-SS	11/19/97	0.0–0.5	1.93E-02	1.34E-02	7.80E-01	4.09E-01	ND (2.46E-01)	--	ND (3.32E+00)	--
510071	82P-GR-019-0.0-SS	11/19/97	0.0–0.5	1.10E-01	3.57E-02	6.06E-01	3.30E-01	ND (2.16E-01)	--	ND (3.07E+00)	--
510072	82P-GR-020-0.0-SS	11/19/97	0.0–0.5	8.71E-02	3.17E-02	8.58E-01	5.18E-01	ND (2.45E-01)	--	ND (3.50E+00)	--
510071	82P-GR-021-0.0-SS	11/19/97	0.0–0.5	1.18E-02	1.11E-02	7.94E-01	3.76E-01	ND (2.26E-01)	--	ND (3.06E+00)	--
510071	82P-GR-022-0.0-SS	11/19/97	0.0–0.5	ND (2.37E-02)	--	9.18E-01	4.51E-01	ND (2.47E-01)	--	ND (3.34E+00)	--
510071	82P-GR-023-0.0-SS	11/19/97	0.0–0.5	2.25E-02	3.07E-02	4.88E-01	2.54E-01	ND (2.11E-01)	--	ND (2.81E+00)	--
510071	82P-GR-024-0.0-SS	11/19/97	0.0–0.5	1.82E-02	1.24E-02	ND (1.21E-01)	--	ND (2.29E-01)	--	ND (3.00E+00)	--
510072	82P-GR-025-0.0-SS	11/19/97	0.0–0.5	8.94E-02	2.97E-02	4.59E-01	2.34E-01	ND (2.08E-01)	--	ND (2.82E+00)	--
510071	82P-GR-026-0.0-SS	11/19/97	0.0–0.5	4.20E-01	6.86E-02	6.45E-01	3.43E-01	ND (3.16E-01)	--	ND (4.27E+00)	--
510071	82P-GR-027-0.0-SS	11/19/97	0.0–0.5	4.55E-01	1.31E-01	6.14E-01	3.80E-01	ND (2.85E-01)	--	ND (4.04E+00)	--
510071	82P-GR-028-0.0-SS	11/19/97	0.0–0.5	ND (2.08E-02)	--	7.41E-01	3.86E-01	ND (2.50E-01)	--	ND (3.36E+00)	--
510071	82P-GR-029-0.0-SS	11/19/97	0.0–0.5	1.52E-01	4.23E-02	7.87E-01	4.02E-01	ND (2.74E-01)	--	ND (3.75E+00)	--
510072	82P-GR-030-0.0-SS	11/19/97	0.0–0.5	8.31E-02	2.83E-02	6.85E-01	3.36E-01	ND (2.59E-01)	--	ND (3.44E+00)	--
510071	82P-GR-031-0.0-SSD	11/20/97	0.0–0.5	4.00E-01	6.99E-02	7.37E-01	3.56E-01	ND (2.56E-01)	--	ND (3.66E+00)	--
510071	82P-GR-032-0.0-SSD	11/20/97	0.0–0.5	ND (3.77E-02)	--	7.81E-01	4.17E-01	ND (2.74E-01)	--	ND (3.84E+00)	--

Refer to footnotes at end of table.

Table 3.4.4-13 (Concluded)
Summary of SWMU 82 Debris Pile RFI
Soil Sampling Gamma Spectroscopy Analytical Results
November 1997
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample ID (Figure 3.4.4-2)	Date Sampled	Sample Depth (ft)	Cesium-137	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Uranium-238	Error[c]
SNL/NM Foothills Background Range[d]				0.007–0.876	NA	0.113–1.18	NA	0.004–3.0	NA	0.153–2.86	NA
NMED-Approved Background Soil Activities—Lower Canyons Area[e]				1.55	NA	1.03	NA	0.16	NA	2.31	NA

[a]Uranium-238 and thorium-232 decay chain isotopes with a short half lives are not presented in this table.
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations about the mean detected activity.
[d]IT March 1996.
[e]Dinwiddie September 1997.

ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NMED = New Mexico Environment Department.
P = Impact pad.
pCi/g = Picocurie(s) per gram.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.

Table 3.4.4-14
Summary of SWMU 82 TAL Metals and Gamma Spectroscopy Relative Percent Differences
November 1997
(Off-Site Laboratory)

Sample Attributes			Metals Relative Percent Difference										
Record Number[a]	ER Sample ID (Figure 3.4.4-2)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
510073 510073	82P-GR-001-0.0-SS, 82P-GR-031-0.0-SSD (duplicate)	0.00–0.5 0.00–0.5	42.48	3.85	2.40	NC	5.26	33.23	59.77	1.99	NC	66.67	9.06
510073 510073	82P-GR-015-0.0-SS, 82P-GR-032-0.0-SSD (duplicate)	0.00–0.5 0.00–0.5	1.01	7.58	1.81	NC	2.50	9.14	105.77	5.20	12.39	74.52	3.12

Sample Attributes			Radionuclides[b] Relative Percent Difference			
Record Number[a]	ER Sample ID (Figure 3.4.4-2)	Sample Depth (ft)	Uranium-238	Thorium-232	Uranium-235	Cesium -137
510073 510073	82P-GR-001-0.0-SS, 82P-GR-031-0.0-SSD (duplicate)	0.00–0.5 0.00–0.5	NC	14.94	NC	49.22
510073 510073	82P-GR-015-0.0-SS, 82P-GR-032-0.0-SSD (duplicate)	0.00–0.5 0.00–0.5	NC	9.74	NC	NC

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

[b]Uranium-238 and thorium-232 decay chain isotopes with a short half lives are not presented in this table.

D = Duplicate.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NC = Not calculated for estimated values or nondetected results.
SS = Soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.

3.4.4.5 *Rocket Sled Track Area*

The rocket sled track area included the sled track, launch area, and catcher box. The area was evaluated to determine if solid combustion by-products from the solid rocket propellant, or solid rocket propellant itself may be present on the site. The solid rocket propellant burned at the sled track produced primarily CO_2, CO, H_2O, N_2, H_2, and less than 0.1 percent other compounds (some possibly containing lead), as combustion by-products.

3.4.4.5.1 *Sampling Activities*

Five sample locations were judgmentally selected in the launch area, and an additional five locations were selected in the catcher box. Four samples were collected at randomly selected locations along the sled track. One soil sample was collected from the location where a 30-pound piece of rocket propellant had been found and removed during the UXO survey. Sampling locations are shown on Figure 3.4.4-3. The ER Sample Identification on the chain-of-custody and in the analytical results tables for this section contains the following components: 82S = SWMU 82 sled track locations; GR = grab sample; 001 = sample number; 0 = sample depth; SS = soil sample.

Samples were analyzed for TAL metals (EPA Methods 6010A and 7471) and high explosives (EPA Method 8330) by General Engineering Laboratories, Charleston, SC. All radiological analyses were performed by gamma spectroscopy (EPA Method 901.1; EPA November 1986) at the SNL/NM RPSD laboratory.

3.4.4.5.2 *Sampling Results*

The results of TAL metals analysis are shown in Table 3.4.4-15. Sample 82S-GR-013-0-SS contained arsenic at 10.2 mg/kg, which is above the 9.8 mg/kg NMED-approved background value. Samples 82S-GR-003-0-SS and 82S-GR-005-0-SS contained cadmium at 1.41 and 4.17 mg/kg, respectively, above the 0.64 mg/kg NMED-approved background value. Samples 82S-GR-001-0-SS and 82S-GR-015-0-SS contained mercury at 0.0654 and 0.061 mg/kg respectively, which were above the 0.055 mg/kg NMED-approved background value but within the background sample range. Sample 82S-GR-003-0-SS contained lead at 19 mg/kg, which was above the NMED-approved background value of 18.9 mg/kg but within the background sample range. The metals in all other samples were at or below the NMED-approved background values.

The results of gamma spectroscopy for radionuclides are shown in Table 3.4.4-16. The complete analytical package is included in Annex 3-A. The radionuclide levels in the samples from the sled track area were at or below NMED-approved background activities, with the exception of the thorium 232 value for sample 82S-GR-002-0-SS. The sample had a thorium 232 level of 1.05E+00 pCi/g, which was above the NMED-approved background activity is 1.03E+00 pCi/g. The sample value is within the range of background samples and the naturally elevated thorium in the rocks at SWMU 82 has been previously discussed in Sections 3.4.3.2 and 3.4.3.7. The minimum detection activities for uranium-238 and uranium-235 in some samples were slightly above NMED-approved background activities.

The analysis for high explosives did not detect HE presence in any sample. The detection limits for HE are shown in Table 3.4.4-17.

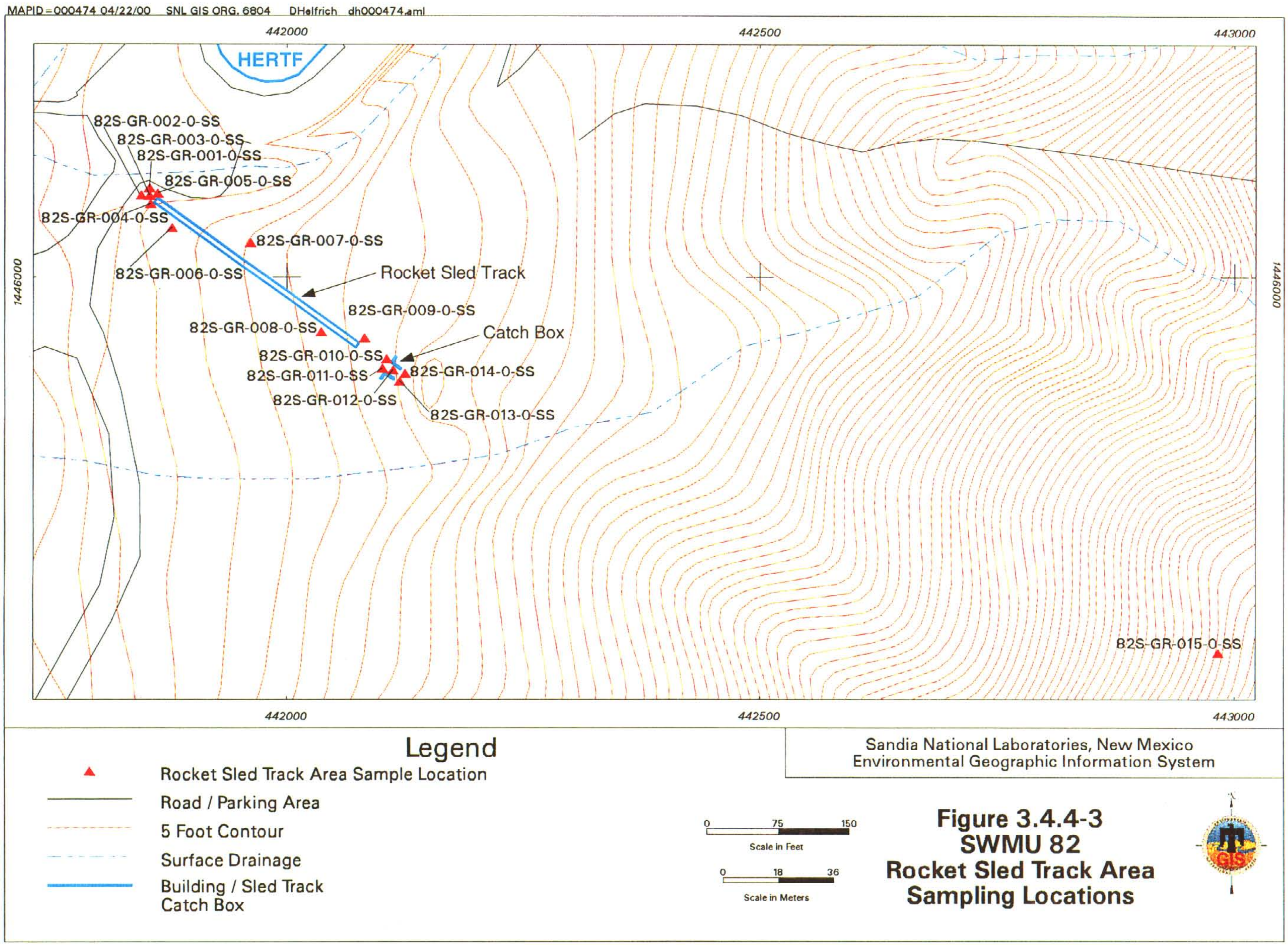


Figure 3.4.4-3
SWMU 82
Rocket Sled Track Area
Sampling Locations

Table 3.4.4-15
Summary of SWMU 82 Sled Track RFI Soil Sampling TAL Metals Analytical Results
November 1997
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010A and 7471)[a] (mg/kg)										
Record Number[b]	ER Sample ID (Figure 3.4.4-3)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
510062	82S-GR-001-0-SS	11/11/97	0.0–0.5	3.51	157	0.571	ND (0.0104)	11.1	10.2	**0.0654**	9.03	ND (0.07)	0.388 J (0.490)	34.6
510062	82S-GR-002-0-SS	11/11/97	0.0–0.5	4.43	207	0.687	ND (0.0104)	13.9	12.6	0.0503	10.8	ND (0.07)	0.386 J (05.00)	41.6
510062	82S-GR-003-0-SS	11/11/97	0.0–0.5	4.1	152	0.601	**1.41**	11.3	**19**	0.0376	9.76	ND (0.07)	0.438 J (0.500)	43.9
510062	82S-GR-004-0-SS	11/11/97	0.0–0.5	3.97	153	0.661	ND (0.0104)	12.4	12.2	0.0454	10.7	ND (0.07)	0.374 J (0.485)	40.4
510062	82S-GR-005-0-SS	11/11/97	0.0–0.5	6.41	160	0.649	**4.17**	12.1	14.5	0.0422	11.9	ND (0.07)	0.395 J (0.500)	43.9
510062	82S-GR-006-0-SS	11/11/97	0.0–0.5	3.31	86	0.353 J (0.0112)	ND (0.0104)	6.8	8.39	ND (0.0173)	6.13	0.175 J (0.485)	0.325 J (0.485)	27.5
510062	82S-GR-007-0-SS	11/11/97	0.0–0.5	5	211	0.480 J (0.490)	ND (0.0104)	9.83	10.1	0.0227 J (0.0332)	8.27	0.148 J (0.490)	0.323 J (0.490)	34.6
510062	82S-GR-008-0-SS	11/11/97	0.0–0.5	4.39	103	0.326 J (0.481)	ND (0.0104)	5.19	9.35	0.0170 J (0.0314)	5.83	0.220 J (0.481)	0.337 J (0.481)	27
510062	82S-GR-009-0-SS	11/11/97	0.0–0.5	5.25	151	0.498	ND (0.0104)	8.37	12.5	ND (0.0173)	9.53	0.166 J (0.495)	0.328 J (0.495)	36.2
510062	82S-GR-010-0-SS	11/11/97	0.0–0.5	4.19	102	0.253 J (0.476)	ND (0.0104)	5.14	8.3	0.0362	5.2	ND (0.07)	0.316 J (0.476)	25.1
510062	82S-GR-011-0-SS	11/11/97	0.0–0.5	3.66	199	0.422 J (0.495)	ND (0.0104)	8.99	9.15	0.0184 J (0.0295)	7.87	ND (0.07)	0.266 J (0.495)	32.5
510062	82S-GR-012-0-SS	11/11/97	0.0–0.5	3.87	175	0.415 J (0.476)	ND (0.0104)	9.04	7.24	ND (0.0173)	7.62	ND (0.07)	0.303 J (0.476)	29.4
510062	82S-GR-013-0-SS	11/11/97	0.0–0.5	**10.2**	105	0.440 J (0.476)	ND (0.0104)	11.2	8.77	0.0355	8.99	ND (0.07)	0.307 J (0.476)	43.2
510062	82S-GR-014-0-SS	11/11/97	0.0–0.5	3.28	112	0.358 J (0.495)	ND (0.0104)	6.45	7.58	ND (0.0173)	6.87	ND (0.07)	0.261 J (0.495)	29.5
510062	82S-GR-015-0-SS	11/11/97	0.0–0.5	5.56	130	0.454 J (0.485)	0.238 J (0.485)	7.87	14.8	**0.061**	12.6	0.399 J (0.485)	0.299 J (0.485)	33.3
510062	82S-GR-016-0-SSD	11/11/97	0.0–0.5	3.73	144	0.556	ND (0.0104)	10.1	10.7	0.0265 J (0.0315)	9.3	0.241 J (0.490)	0.300 J (0.490)	34.9
Quality Assurance/Quality Control Samples (mg/L)														
510062	82A-GR-017-FB	11/11/97	NA	ND (0.00293)	ND (0.000332)	ND (0.000223)	ND (0.000208)	ND (0.000729)	ND (0.000678)	ND (0.000104)	ND (0.00227)	ND (0.0014)	ND (0.00062)	ND (0.000966)
510062	82A-GR-018-EB	11/11/97	NA	ND (0.00293)	ND (0.000332)	ND (0.000223)	ND (0.000208)	ND (0.000729)	ND (0.000678)	ND (0.000104)	ND (0.00227)	ND (0.0014)	ND (0.00062)	0.00134 J (0.00500)

Refer to footnotes at end of table.

Table 3.4.4-15 (Concluded)
Summary of SWMU 82 Sled Track RFI Soil Sampling TAL Metals Analytical Results
November 1997
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010A and 7471)[a] (mg/kg)										
Record Number[b]	ER Sample ID (Figure 3.4.4-3)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SNL/NM Foothills Background Range[c]				1.6–9.6	39–400	0.2–0.73	0.09–0.99	2.5–20	4.7–51	0.01–0.13	5.3–16	0.56–3.1	0.01–0.50	21–55
NMED-Approved Background Soil Concentrations—Lower Canyons Area[d]				9.8	246	0.75	0.64	18.8	18.9	0.055	16.6	2.7	<0.5	52.1

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

[a]EPA November 1986.

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

[c]IT March 1996.

[d]Garcia November 1998.

EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
FB = Field blank.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J ( ) = Analyte concentration is less than the practical quantitation limit (shown in parentheses), but greater than or equal to the method detection limit.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected at or above the method detection limit, shown in parentheses.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SS = Soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.
SNL/NM = Sandia National Laboratories/New Mexico.

Table 3.4.4-16
Summary of SWMU 82 Sled Track RFI Soil Sampling Gamma Spectroscopy Analytical Results
November 1997
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample ID (Figure 3.4.4-3)	Date Sampled	Sample Depth (ft)	Cesium-137	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Uranium-238	Error[c]
510070	82S-GR-001-0-SS	11/11/97	0.0–0.5	1.78E-02	2.36E-02	8.29E-01	3.99E-01	ND (2.66E-01)	--	ND (3.74E+00)	--
510070	82S-GR-002-0-SS	11/11/97	0.0–0.5	ND (4.11E-02)	--	**1.05E+00**	5.06E-01	ND (2.81E-01)	--	ND (3.74E+00)	--
510070	82S-GR-003-0-SS	11/11/97	0.0–0.5	ND (4.26E-02)	--	1.03E+00	7.09E-01	ND (2.81E-01)	--	ND (3.71E+00)	--
510070	82S-GR-004-0-SS	11/11/97	0.0–0.5	1.93E-01	1.42E-02	9.27E-01	4.84E-01	ND (2.60E-01)	--	ND (3.54E+00)	--
510070	82S-GR-005-0-SS	11/11/97	0.0–0.5	ND (4.00E-02)	--	9.71E-01	1.40E+00	ND (2.73E-01)	--	ND (3.55E+00)	--
510070	82S-GR-006-0-SS	11/11/97	0.0–0.5	ND (3.59E-02)	--	8.38E-01	4.29E-01	ND (2.63E-01)	--	ND (3.54E+00)	--
510070	82S-GR-007-0-SS	11/11/97	0.0–0.5	5.53E-02	3.28E-02	9.08E-01	4.34E-01	ND (2.86E-01)	--	ND (3.98E+00)	--
510070	82S-GR-008-0-SS	11/11/97	0.0–0.5	ND (3.26E-02)	--	6.59E-01	3.28E-01	ND (2.37E-01)	--	ND (3.20E+00)	--
510070	82S-GR-009-0-SS	11/11/97	0.0–0.5	ND (3.95E-02)	--	7.11E-01	3.61E-01	ND (2.14E-01)	--	ND (1.58E+00)	--
510070	82S-GR-010-0-SS	11/11/97	0.0–0.5	ND (3.22E-02)	--	7.12E-01	3.78E-01	ND (1.82E-01)	--	ND (1.30E+00)	--
510070	82S-GR-011-0-SS	11/11/97	0.0–0.5	ND (4.40E-02)	--	7.40E-01	3.97E-01	ND (2.30E-01)	--	ND (1.68E+00)	--
510070	82S-GR-012-0-SS	11/11/97	0.0–0.5	ND (3.72E-02)	--	7.90E-01	3.89E-01	ND (2.09E-01)	--	ND (1.54E+00)	--
510070	82S-GR-013-0-SS	11/11/97	0.0–0.5	ND (3.29E-02)	--	5.94E-01	3.09E-01	ND (1.84E-01)	--	ND (1.32E+00)	--
510070	82S-GR-014-0-SS	11/11/97	0.0–0.5	2.68E-02	1.88E-02	7.49E-01	3.83E-01	ND (2.19E-01)	--	ND (1.59E+00)	--
510070	82S-GR-015-0-SS	11/11/97	0.0–0.5	8.36E-01	1.41E-01	6.09E-01	3.13E-01	ND (1.81E-01)	--	ND (3.98E+00)	--
510070	82S-GR-016-0-SSD	11/11/97	0.0–0.5	ND (4.54E-02)	--	1.03E+00	5.02E-01	ND (2.33E-01)	--	ND (1.79E+00)	--
SNL/NM Foothills Background Range[d]				0.007–0.876	NA	0.113–1.18	NA	0.004–3.0	NA	0.153–2.86	NA
NMED-Approved Background Soil Activities—Lower Canyons Area[e]				1.55	NA	1.03	NA	0.16	NA	2.31	NA

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

[a]Uranium-238 and thorium-232 decay chain isotopes with short half lives are not presented in this table.

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

[c]Two standard deviations about the mean detected activity.

[d]IT March 1996.

[e]Dinwiddie September 1997.

ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
pCi/g = Picocurie(s) per gram.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
-- = Error not calculated for nondetectable results.

Table 3.4.4-17
HE Analytical Method Detection Limits (EPA Method 8330)[a] Used for
SWMU 82 Sled Track RFI Soil Sampling
November 1997
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
2-Amino-4,6-dinitrotoluene	6.6
4-Amino-2,6-dinitrotoluene	5.45
m-Dinitrobenzene	4.05
2,4-Dinitrotoluene	6.18
2,6-Dinitrotoluene	6.48
HMX	5.27
Nitrobenzene	5.21
m-Nitrotoluene	11.1
o-Nitrotoluene	7.83
p-Nitrotoluene	10.6
RDX	9.71
Tetryl	7.55
2,4,6-Trinitrotoluene	5.67
sym-Trinitrobenzene	6.62

[a]EPA November 1986.

EPA = U.S. Environmental Protection Agency.
HE = High Explosive(s).
HMX = Cyclotetramethylene tetranitramine.
MDL = Method detection limit.
µg/kg = Microgram(s) per kilogram.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
RDX = Cyclo-1,3,5-trimethylene-2,4,6-trinitramine.
SWMU = Solid Waste Management Unit.
Tetryl = Trinitro-2,4,6-phenylmethylnitramine.

3.4.4.5.3 *Data Quality*

QA/QC field samples collected as part of the confirmatory soil sampling event included two duplicates, two field blanks and two equipment blanks.

RPDs were calculated for the TAL metals detected in the primary and duplicate samples, both of which were analyzed by General Engineering Laboratories. The TAL metals analyses for the sample pairs for silver and mercury yielded RPDs that exceeded the acceptable RPD limit of less than 25 percent (Table 3.4.4-18). Although the RPDs presented in Table 3.4.4-18 exceed the RPD limit, they are typical of the heterogeneous uncontaminated soil and are, therefore, acceptable.

RPDs were calculated for the radionuclides detected in the primary and duplicate samples, both of which were analyzed by RPSD. Of the four radionuclides examined only thorium-232 had detectable levels. The RPDs were acceptable for this parameter (see Table 3.4.4-18).

3.4.4.5.4 *Data Validation*

The off-site laboratory results from General Engineering Laboratories were reviewed according to "Data Verification/Validation Level 2 – DV-2," in the SNL/NM Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994). The DV2 reports are presented in Annex 3-B. The gamma spectroscopy data from the RPSD Laboratory were reviewed according to "Laboratory Data Review Guidelines," Procedure No: RPSD-02-11, Issue No: 02. The RPSD verification/ validation reports are presented, along with the gamma-spectroscopy results, in Annex 3-A. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 82. None of the soil sample analytical data required qualification during validation.

3.4.4.6 *Impact Pad*

The area of the impact pad and adjacent areas that are topographically downgradient from the impact tests and downwind of the PAGE dispersion test area were investigated. The sampling in this effort assessed the potential of impact pad activities and PAGE test activities to deposit COCs in the surface soils of the area.

3.4.4.6.1 *Sampling Activities*

Two distinct sampling efforts were conducted to assess this area. In 1995, the immediate area of the impact pad was assessed. In 1998-1999, the larger area that was topographically downgradient of the impact pad area and down wind of the PAGE test detonations points was assessed.

The soils in the immediate area around the impact pad were assessed in 1995. Impact tests and the destruction of the Mark 3 weapon in this area had the potential to deposit COCs to the soils. The sampling pattern consisted of points on eight equiangular radial lines beginning at the center point of the impact pad and extending 20 feet beyond the edge of the pad. Samples were taken every 10 feet along each radial line, beginning at the edge of the pad, for a total of

Table 3.4.4-18
Summary of SWMU 82 TAL Metals and Gamma Spectroscopy Relative Percent Differences
November 1997
(Off-Site Laboratory)

Sample Attributes			Metals Relative Percent Difference										
Record Number[a]	ER Sample ID (Figure 3.4.4-3)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
510062 510062	82S-GR-001-0-SS, 82S-GR-016-0-SSD (duplicate)	0.0–0.5 0.0–0.5	6.08	8.64	0.88	NC	9.43	4.78	84.66	2.95	NC	25.58	0.86

Sample Attributes			Radionuclides[b] Relative Percent Difference			
Record Number[a]	ER Sample ID (Figure 3.4.4-3)	Sample Depth (ft)	Cesium-137	Uranium-235	Uranium-238	Thorium-232
510062 510062	82S-GR-001-0-SS, 82S-GR-016-0-SSD (duplicate)	0.0–0.5 0.0–0.5	NC	NC	NC	21.62

[a]Analysis request/chain-of-custody record.
[b]Uranium-238 and thorium-232 decay chain isotopes with a short half lives are not presented in this table.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NC = Not calculated for estimated values or nondetected results.
SS = Soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.

24 sample locations (see Figure 3.4.4-4). The surface of this area was subsequently buried under a HERTF access road.

The second area was assessed in 1998-1999 for COCs that were dispersed during impact tests, the Mark 3 detonation, and PAGE tests. Samples locations were judgmentally selected to be topographically downgradient of the impact pad area and down-wind of the PAGE test detonation points (see Figure 3.4.4-4). To establish the site-specific background for radionuclides, ten background sampling locations were judgmentally selected topographically up-gradient of all tests and at least 800 feet up-wind of the PAGE detonation points (see Figure 3.4.4-5). The ER Sample Identification on the chain-of-custody and in the analytical results tables for this section contains the following components: 82IP = SWMU 82 impact pad location or 82BK = SWMU 82 background; GR = grab sample; 001 = sample number; 0 = sample depth; SS = soil sample.

3.4.4.6.2 Sampling Results

Sampling Activities in 1995

Samples were analyzed for TAL Metals (EPA Methods 6010, 7000, and 7470/7471A), Lockheed Analytical Services, Las Vegas, NV. High explosive screening was conducted by the on-site analytical laboratory using HPLC. All radiological analyses were conducted by gamma spectroscopy (EPA Method 901.1) at the SNL/NM RSPD.

The sampling results for radionuclides immediately around the impact pad area are shown in Table 3.4.4-19. The complete analytical package is included in Annex 3-A. No elevated radionuclides were found in any sample. The minimum detection activities for uranium-238 and uranium-235 slightly exceeded the NMED-approved background activity in some samples. The PAGE study did use 0.6 kilograms of cerium in a test; however, because of the short half-life of cerium, no detectable elevation in cerium from the study can remain and thus was not further evaluated.

The analytical results for TAL metals in the soils immediately around the impact pad area are shown in Table 3.4.4-20. Mercury was found in sample 82-GR-011-0-SS at 0.21 mg/kg, which is above the NMED-approved background value of 0.055 mg/kg. Nickel was found in Sample 82-GR-019-0-SS at 20 mg/kg, which is above the NMED-approved background value of 16.6 mg/kg. Lead was found in samples 82-GR-017-0-SS, 82-GR-019-0-SS, and 82-GR-026-0-SS at 20, 20, and 23 mg/kg respectively. The NMED-approved background value for lead is 18.9 mg/kg. Zinc was found in sample 82-GR-023-0-SS at 350 mg/kg, which is above the NMED-approved background value of 52.1 mg/kg.

Soil samples were screened for the presence of high explosives using HPLC. One of 24 samples did show pentaerythritol tetranitrate (PETN) at 1 mg/kg, and, although it is only screening-level data, it has been included in the risk assessment.

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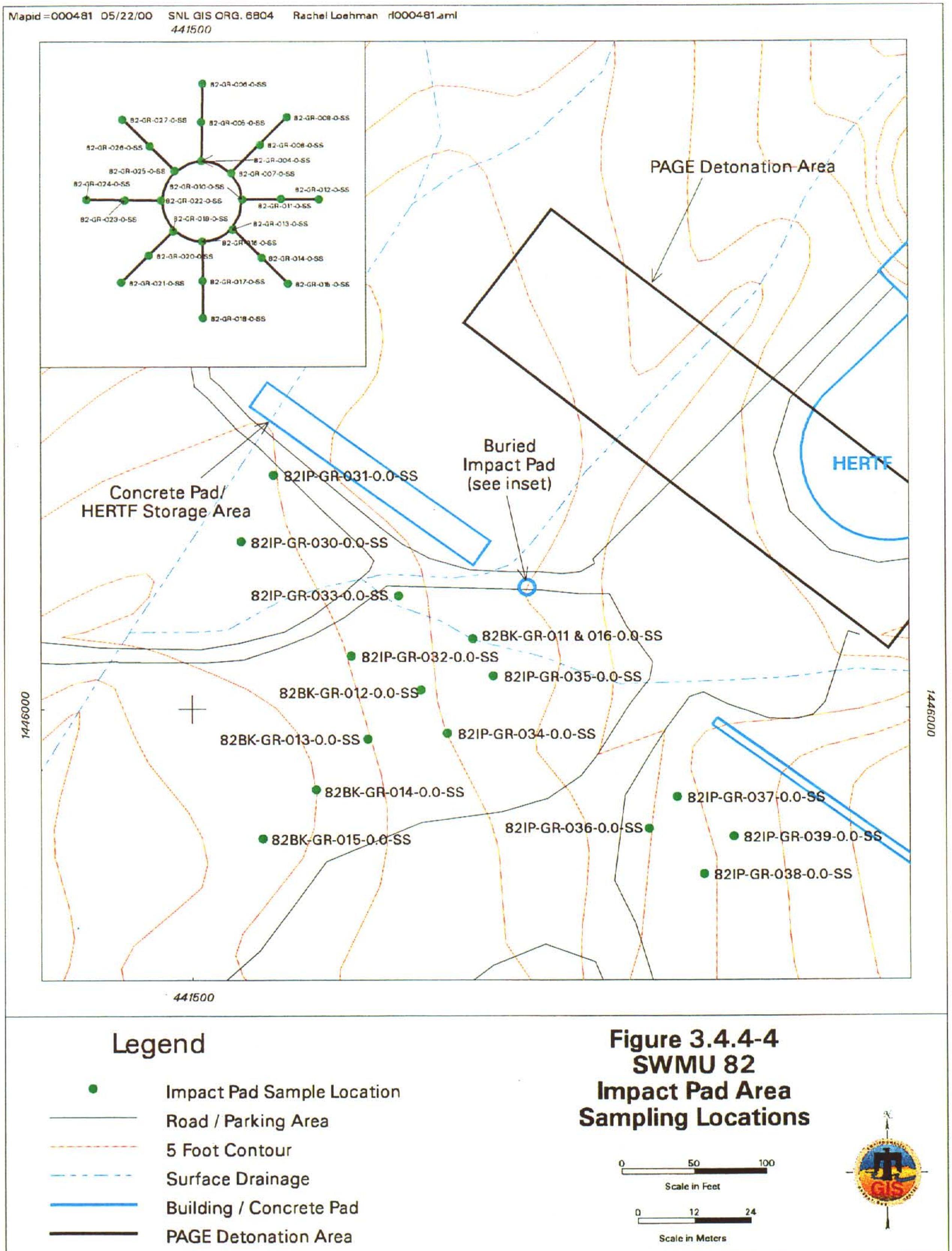

Figure 3.4.4-4
SWMU 82
Impact Pad Area
Sampling Locations

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

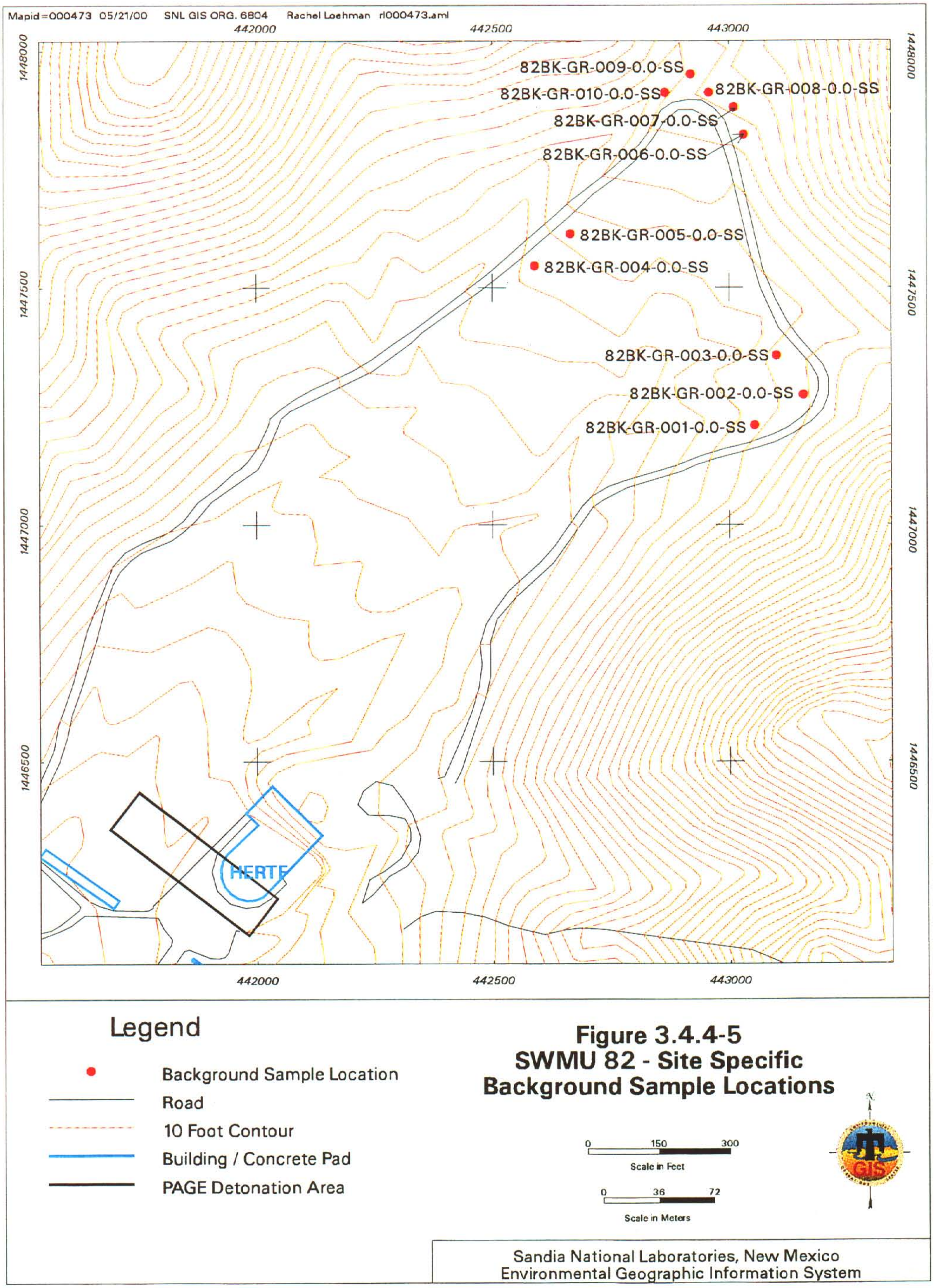

Figure 3.4.4-5
SWMU 82 - Site Specific Background Sample Locations

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Table 3.4.4-19
Summary of SWMU 82 Impact Pad RFI Surface Soil Sampling Gamma Spectroscopy Analytical Results
July 1995
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample ID	Date Sampled	Sample Depth (ft)	Cesium-137	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Uranium-238	Error[c]
03867	82-GR-004-0-SS	7/6/95	0.0–0.5	ND (5.19E-02)	--	5.54E-01	2.78E-01	ND (3.31E-01)	--	ND (1.85E+00)	--
03867	82-GR-005-0-SS	7/6/95	0.0–0.5	ND (6.51E-02)	--	7.12E-01	2.77E-01	ND (3.89E-01)	--	ND (5.93E+00)	--
03867	82-GR-006-0-SS	7/6/95	0.0–0.5	ND (5.81E-02)	--	7.34E-01	2.30E-01	ND (3.69E-01)	--	ND (2.03E+00)	--
03867	82-GR-007-0-SS	7/6/95	0.0–0.5	ND (5.03E-02)	--	5.80E-01	2.84E-01	ND (3.60E-01)	--	ND (4.78E+00)	--
03867	82-GR-008-0-SS	7/6/95	0.0–0.5	ND (6.59E-02)	--	7.93E-01	2.98E-01	ND (3.88E-01)	--	ND (2.07E+00)	--
03867	82-GR-009-0-SS	7/6/95	0.0–0.5	ND (5.51E-02)	--	6.11E-01	2.35E-01	ND (3.70E-01)	--	ND (5.22E+00)	--
03867	82-GR-010-0-SS	7/6/95	0.0–0.5	ND (5.67E-02)	--	6.19E-01	2.39E-01	ND (3.85E-01)	--	7.84E-01	1.08E+00
03867	82-GR-010-0-SS	7/6/95	0.0–0.5	ND (4.94E-02)	--	5.59E-01	9.44E-02	ND (3.18E-01)	--	7.96E-01	9.05E-01
03867	82-GR-011-0-SS	7/6/95	0.0–0.5	ND (5.21E-02)	--	5.39E-01	1.87E-01	ND (3.37E-01)	--	ND (1.84E+00)	--
03867	82-GR-012-0-SS	7/6/95	0.0–0.5	ND (5.30E-02)	--	6.07E-01	2.67E-01	ND (3.57E-01)	--	ND (1.90E+00)	--
03867	82-GR-013-0-SS	7/6/95	0.0–0.5	ND (4.91E-02)	--	5.83E-01	1.98E-01	ND (3.34E-01)	--	ND (1.80E+00)	--
03867	82-GR-014-0-SS	7/6/95	0.0–0.5	ND (4.86E-02)	--	5.88E-01	1.83E-01	ND (3.33E-01)	--	ND (1.84E+00)	--
03867	82-GR-015-0-SS	7/6/95	0.0–0.5	ND (5.55E-02)	--	6.53E-01	2.08E-01	ND (3.59E-01)	--	ND (1.95E+00)	--
03867	82-GR-016-0-SS	7/6/95	0.0–0.5	ND (6.21E-02)	--	5.64E-01	2.24E-01	ND (3.59E-01)	--	ND (2.08E+00)	--
03867	82-GR-017-0-SS	7/6/95	0.0–0.5	ND (5.36E-02)	--	6.26E-01	2.02E-01	ND (3.44E-01)	--	ND (1.85E+00)	--
03867	82-GR-018-0-SS	7/6/95	0.0–0.5	ND (8.93E-02)	--	8.36E-01	3.43E-01	ND (5.34E-01)	--	ND (2.91E+00)	--
03867	82-GR-019-0-SS	7/6/95	0.0–0.5	ND (5.21E-02)	--	7.28E-01	2.24E-01	ND (3.17E-01)	--	5.07E-01	6.42E-01
03867	82-GR-020-0-SS	7/6/95	0.0–0.5	ND (5.74E-02)	--	6.16E-01	2.16E-01	ND (3.57E-01)	--	ND (1.97E+00)	--
03867	82-GR-020-0-SS	7/6/95	0.0–0.5	ND (6.39E-02)	--	6.28E-01	2.37E-01	ND (4.08E-01)	--	ND (5.72E+00)	--
03867	82-GR-021-0-SS	7/6/95	0.0–0.5	ND (5.63E-02)	--	7.85E-01	2.97E-01	ND (4.01E-01)	--	ND (5.30E+00)	--
03867	82-GR-022-0-SS	7/6/95	0.0–0.5	ND (5.11E-02)	--	5.52E-01	2.35E-01	ND (3.46E-01)	--	ND (4.70E+00)	--
03867	82-GR-023-0-SS	7/6/95	0.0–0.5	ND (5.60E-02)	--	6.88E-01	2.46E-01	ND (3.98E-01)	--	ND (5.75E+00)	--
03867	82-GR-024-0-SS	7/6/95	0.0–0.5	ND (5.85E-02)	--	6.43E-01	1.56E-01	ND (3.75E-01)	--	ND (5.17E+00)	--
03867	82-GR-025-0-SS	7/6/95	0.0–0.5	ND (6.10E-02)	--	7.04E-01	2.96E-01	ND (3.83E-01)	--	ND (5.49E+00)	--
03867	82-GR-026-0-SS	7/6/95	0.0–0.5	ND (6.45E-02)	--	4.90E-01	2.81E-01	ND (4.07E-01)	--	ND (5.91E+00)	--
03867	82-GR-027-0-SS	7/6/95	0.0–0.5	ND (5.83E-02)	--	6.04E-01	2.08E-01	ND (3.66E-01)	--	ND (5.63E+00)	--
SNL/NM Foothills Background Range[d]				0.007–0.876	NA	0.113–1.18	NA	0.004–3.0	NA	0.153–2.86	NA
NMED-Approved Background Soil Activities—Lower Canyons Area[e]				1.55	NA	1.03	NA	0.16	NA	2.31	NA

Refer to footnotes at end of table.

Table 3.4.4-19 (Concluded)
Summary of SWMU 82 Impact Pad RFI Surface Soil Sampling Gamma Spectroscopy Analytical Results
July 1995
(On-Site Laboratory)

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

[a]Uranium-238 and thorium-232 decay chain isotopes with short half lives are not presented in this table.

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

[c]Two standard deviations about the mean detected activity.

[d]IT March 1996.

[e]Dinwiddie September 1997.

ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
GR = Grab sample.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
-- = Error not calculated for nondetectable results.

Table 3.4.4-20
Summary of SWMU 82 Impact Pad RFI Surface Soil Sampling TAL Metals Analytical Results
July 1995
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010, 7060, 7421, 7471, and 7740)[a] (mg/kg)										
Record Number[b]	ER Sample ID	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
03897	82-GR-004-0-SS	7/6/95	0.0–0.5	3.5	110	ND (1.0)	ND (1.0)	8.6	8.1	ND (0.095)	9.1	ND (0.99)	ND (2.0)	35
03897	82-GR-005-0-SS	7/6/95	0.0–0.5	3.8	140	ND (1.0)	ND (1.0)	8.8	10	ND (0.10)	9.6	ND (1.0)	ND (2.0)	33
03897	82-GR-006-0-SS	7/6/95	0.0–0.5	3.4	160	ND (1.0)	ND (1.0)	8.2	9.0	ND (0.095)	9.4	ND (0.99)	ND (2.0)	34
03897	82-GR-007-0-SS	7/6/95	0.0–0.5	3.7	120	ND (0.99)	ND (0.99)	7.3	7.5	ND (0.095)	ND (7.9)	ND (1.0)	ND (2.0)	31
03897	82-GR-008-0-SS	7/6/95	0.0–0.5	3.8	150	ND (1.0)	ND (1.0)	9.2	12	ND (0.095)	11	ND (1.0)	ND (2.0)	37
03897	82-GR-009-0-SS	7/6/95	0.0–0.5	4.7	140	ND (0.99)	ND (0.99)	7.9	8.7	ND (0.10)	8.7	ND (0.99)	ND (2.0)	30
03897	82-GR-010-0-SS	7/6/95	0.0–0.5	3.7	98	ND (1.0)	ND (1.0)	8.7	9.3	ND (0.091)	ND (8.0)	ND (0.99)	ND (2.0)	33
03897	82-GR-010-0-SS	7/6/95	0.0–0.5	4.0	99	ND (0.99)	ND (0.99)	7.2	9.7	ND (0.10)	9.2	ND (0.99)	ND (2.0)	31
03897	82-GR-011-0-SS	7/6/95	0.0–0.5	2.7	69	ND (1.0)	ND (1.0)	4.7	6.7	**0.21**	ND (8.0)	ND (1.0)	ND (2.0)	25
03897	82-GR-012-0-SS	7/6/95	0.0–0.5	5.7	170	ND (0.99)	ND (0.99)	9.3	11	ND (0.095)	11	ND (1.0)	ND (2.0)	41
03897	82-GR-013-0-SS	7/6/95	0.0–0.5	4.5	170	ND (0.99)	ND (0.99)	10	16	ND (0.10)	10	ND (0.99)	ND (2.0)	42
03897	82-GR-014-0-SS	7/6/95	0.0–0.5	4.1	120	ND (1.0)	ND (1.0)	8.2	7.7	ND (0.095)	11	ND (1.0)	ND (2.0)	34
03897	82-GR-015-0-SS	7/6/95	0.0–0.5	2.1	120	ND (0.99)	ND (0.99)	8.3	8.0	ND (0.10)	8.6	ND (1.0)	ND (2.0)	36
03897	82-GR-016-0-SS	7/6/95	0.0–0.5	3.2	78	ND (1.0)	ND (1.0)	7.3	10	ND (0.10)	ND (8.0)	ND (0.99)	ND (2.0)	32
03897	82-GR-017-0-SS	7/6/95	0.0–0.5	2.5	140	ND (0.99)	ND (0.99)	8.2	**20**	ND (0.087)	10	ND (1.0)	ND (2.0)	31
03897	82-GR-018-0-SS	7/6/95	0.0–0.5	6.0	190	ND (0.97)	ND (0.97)	10	15	ND (0.10)	14	ND (0.99)	ND (1.9)	48
03897	82-GR-019-0-SS	7/6/95	0.0–0.5	3.7	110	ND (0.99)	ND (0.99)	13	**20**	ND (0.10)	**20**	ND (1.0)	ND (2.0)	38
03897	82-GR-020-0-SS	7/6/95	0.0–0.5	3.3	110	ND (0.97)	ND (0.97)	8.2	11	ND (0.10)	9.3	ND (1.0)	ND (1.9)	40
03897	82-GR-020-0-SS	7/6/95	0.0–0.5	3.5	100	ND (0.97)	ND (0.97)	8.2	8.3	ND (0.10)	13	ND (1.0)	ND (1.9)	41
03897	82-GR-021-0-SS	7/6/95	0.0–0.5	4.1	100	ND (0.97)	ND (0.97)	6.4	8.1	ND (0.10)	8.3	ND (1.0)	ND (1.9)	43
03897	82-GR-022-0-SS	7/6/95	0.0–0.5	6.0	110	ND (1.0)	ND (1.0)	7.7	8.1	ND (0.10)	8.3	ND (1.0)	ND (2.0)	52
03897	82-GR-023-0-SS	7/6/95	0.0–0.5	4.9	120	ND (0.99)	ND (0.99)	9.0	12	ND (0.10)	14	ND (1.0)	ND (2.0)	**350**
03897	82-GR-024-0-SS	7/6/95	0.0–0.5	6.9	140	ND (1.0)	ND (1.0)	11	14	ND (0.10)	15	ND (1.0)	ND (2.0)	49
03897	82-GR-025-0-SS	7/6/95	0.0–0.5	3.3	110	ND (0.98)	ND (0.98)	6.8	7.0	ND (0.10)	9.9	ND (0.99)	ND (2.0)	47
03897	82-GR-026-0-SS	7/6/95	0.0–0.5	2.4	91	ND (0.98)	ND (0.98)	7.1	**23**	ND (0.10)	9.7	ND (0.97)	ND (2.0)	44
03897	82-GR-027-0-SS	7/6/95	0.0–0.5	5.0	110	ND (1.0)	ND (1.0)	11	9.4	ND (0.10)	12	ND (1.0)	ND (2.0)	39
Quality Assurance/Quality Control Samples (mg/L)														
03897	82-GR-010-0-SS	7/6/95	NA	ND (0.01)	ND (0.02)	ND (0.005)	ND (0.05)	ND (0.01)	ND (0.003)	ND (0.002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
03897	82-GR-010-0-SS	7/6/95	NA	ND (0.01)	ND (0.02)	ND (0.005)	ND (0.05)	ND (0.01)	ND (0.003)	ND (0.002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)

Refer to footnotes at end of table.

Table 3.4.4-20 (Concluded)
Summary of SWMU 82 Impact Pad RFI Surface Soil Sampling TAL Metal Analytical Results
July 1995
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010, 7060, 7421, 7471, and 7740)[a] (mg/kg)										
Record Number[b]	ER Sample Location	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
03897	82-GR-020-0-SS	7/6/95	NA	ND (0.01)	ND (0.2)	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.003)	ND (0.0002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
03897	82-GR-020-0-SS	7/6/95	NA	ND (0.01)	ND (0.2)	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.003)	ND (0.0002)	ND (0.04)	ND (0.005)	ND (0.01)	ND (0.02)
SNL/NM Foothills Background Range[c]				1.6–9.6	39–400	0.2–0.73	0.09–0.99	2.5–20	4.7–51	0.01–0.13	5.3–16	0.56–3.1	0.01–0.50	21–55
NMED-Approved Background Soil Concentrations—Lower Canyons Area[d]				9.8	246	0.75	0.64	18.8	18.9	0.055	16.6	2.7	<0.5	52.1

Note: Values in **bold** exceed background soil concentrations.
[a]EPA November 1986.
[b]Analysis request/chain-of-custody record.
[c]IT March 1996.
[d]Garcia November 1998.

EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J () = Value shown is less than the practical quantitation limit (shown in parentheses), but greater than or equal to method detection limit.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
ND () = Not detected at or above the method detection limit, shown in parentheses.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SS = Soil sample.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.

Sampling Activities During 1998-1999

The larger area around the immediate impact pad area was assessed in several sampling events from 1998-1999. The intent of this investigation was to determine if COCs were dispersed from the impact area during test activities. The PAGE tests focused the investigation on radionuclides, while the detonation and dispersion of the Mark 3 materials focused concern on metals, such as beryllium, and on explosives.

RCRA metals analyses (EPA Methods 6010 and 7471A) were conducted by General Engineering Laboratories, Charleston, SC. Gross alpha and gross beta analysis (EPA Method 900.0) was conducted at the Core Laboratories, Inc., Aurora, CO. All gamma spectroscopy (EPA Method 901.1) analysis was conducted at the SNL/NM RSPD.

The results of gross alpha and gross beta analysis for site-specific background and impact pad locations are presented in Table 3.4.4-21. The gross alpha and gross beta analytical results for samples from the impact area were compared against the site-specific background results. The results in Table 3.4.4-21 for the impact pad area are considered background being that an order-of-magnitude difference is used as the criteria to indicate potential contamination in gross alpha and gross beta analysis.

The results of gamma spectroscopy analysis are presented in Table 3.4.4-22. The complete analytical package is included in Annex 3-A. All uranium-238 and Cesium-137 results (excluding background samples) were below NMED-approved background activities. Sample 82IP-GR-014-0-SS contained thorium-232 at 1.09 pCi/g, verses an approved background activity of 1.03 pCi/g. Sample 82IP-GR-016-0-SSD contained a uranium-235 activity of 0.22 pCi/g, verses an approved background activity of 0.16 pCi/g. Both values are within the background sample range and are probably background. The minimum detection activity for uranium-235 slightly exceeded the NMED-approved background activity.

The results of RCRA metals analysis are presented in Table 3.4.4-23. All results were at background levels, except for silver. Six out of eleven samples had silver levels above the NMED-approved background value, but all were very close to the approved background value and are within the range of the background samples. In each of these cases, the levels found probably represent a heterogeneous background instead of site contamination.

The analysis for high explosives did not detect HE presence in any sample. The detection limits for HE are shown in Table 3.4.4-24.

3.4.4.6.3 Data Quality

Sampling Activities in 1995

QA/QC field samples collected as part of the 1995 confirmatory soil sampling event included four duplicates, two field blanks, and two equipment blanks.

RPDs were calculated for the TAL metals detected in the primary and duplicate samples, both of which were analyzed by Lockheed Analytical Services. The TAL metals analyses for one of

Table 3.4.4-21
Summary of SWMU 82 Impact Pad and Site-Specific Background RFI Surface Soil Sampling
Gross Alpha/Gross Beta Analytical Results
March 1998
(Off-Site Laboratory)

Sample Attributes				Activity (EPA Method 900.0)[a] (pCi/g)	
Record Number[b]	ER Sample ID (Figure 3.4.4-4 and 3.4.4-5)	Date Sampled	Sample Depth (ft)	Gross Alpha	Gross Beta
Site-Specific Background					
600035	82BK-GR-001-0.0-SS	3/12/98	0.0–0.5	3.12	21.6
600035	82BK-GR-002-0.0-SS	3/12/98	0.0–0.5	3.86	30.1
600035	82BK-GR-003-0.0-SS	3/12/98	0.0–0.5	3.05	23
600035	82BK-GR-004-0.0-SS	3/12/98	0.0–0.5	4.12	21.7
600035	82BK-GR-005-0.0-SS	3/12/98	0.0–0.5	5.57	20.6
600035	82BK-GR-006-0.0-SS	3/12/98	0.0–0.5	6.34	23.5
600035	82BK-GR-007-0.0-SS	3/12/98	0.0–0.5	4.87	24.6
600035	82BK-GR-008-0.0-SS	3/12/98	0.0–0.5	5.1	30.7
600035	82BK-GR-009-0.0-SS	3/12/98	0.0–0.5	3.43	15.5
600035	82BK-GR-010-0.0-SS	3/12/98	0.0–0.5	3.79	14.7
Impact Pad					
600035	82IP-GR-011-0.0-SS	3/12/98	0.0–0.5	2.77	32
600035	82IP-GR-012-0.0-SS	3/12/98	0.0–0.5	5.57	40.2
600035	82IP-GR-013-0.0-SS	3/12/98	0.0–0.5	5.39	26.8
600035	82IP-GR-014-0.0-SS	3/12/98	0.0–0.5	6.14	32.5
600035	82IP-GR-015-0.0-SS	3/12/98	0.0–0.5	3.61	33
600035	82IP-GR-016-0.0-SSD	3/12/98	0.0–0.5	7.68	32.6
Quality Assurance/Quality Control Sample (pCi/L)					
600035	82IP-GR-017-0-EB	3/12/98	NA	0.11	-1.9

[a]EPA November 1986.
[b]Analysis request/chain-of-custody record.

BK = Background sample.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
IP = Impact pad.
NA = Not applicable.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SS = Soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.

Table 3.4.4-22
Summary of SWMU 82 Impact Pad and Site-Specific Background RFI Surface Soil Sampling
Gamma Spectroscopy Analytical Results
March 1998 and March 1999
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample ID (Figures 3.4.4-4 and 3.4.4-5)	Date Sampled	Sample Depth (ft)	Cesium-137	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Uranium-238	Error[c]
Site-Specific Background											
510497	82BK-GR-001-0-SS	3/12/98	0.0–0.5	6.85E-02	3.27E-02	8.19E-01	4.45E-01	ND (2.18E-01)	--	1.13E+00	8.80E-01
510497	82BK-GR-002-0-SS	3/12/98	0.0–0.5	2.82E-01	7.35E-02	7.83E-01	4.07E-01	ND (2.40E-01)	--	ND (1.63E+00)	--
510497	82BK-GR-003-0-SS	3/12/98	0.0–0.5	3.40E-01	6.94E-02	6.19E-01	3.11E-01	ND (2.18E-01)	--	8.81E-01	7.40E-01
510497	82BK-GR-004-0-SS	3/12/98	0.0–0.5	5.56E-01	1.98E-01	8.71E-01	4.50E-01	ND (2.34E-01)	--	ND (1.51E+00)	--
510486	82BK-GR-005-0-SS	3/12/98	0.0–0.5	4.47E-01	2.20E-01	6.59E-01	3.32E-01	ND (2.03E-01)	--	ND (1.83E+00)	--
510497	82BK-GR-006-0-SS	3/12/98	0.0–0.5	5.76E-01	1.97E-01	8.63E-01	4.89E-01	ND (2.43E-01)	--	1.04E+00	8.09E-01
510497	82BK-GR-007-0-SS	3/12/98	0.0–0.5	4.27E-01	8.21E-02	7.62E-01	3.83E-01	ND (2.11E-01)	--	ND (1.39E+00)	--
510497	82BK-GR-008-0-SS	3/12/98	0.0–0.5	8.11E-01	1.77E-01	7.66E-01	4.03E-01	ND (1.38E-01)	--	1.84E+00	1.15E+00
510497	82BK-GR-009-0-SS	3/12/98	0.0–0.5	2.42E-01	1.94E-01	6.36E-01	3.37E-01	1.29E-01	1.79E-01	**2.55E+00**	1.11E+00
510486	82BK-GR-010-0-SS	3/12/98	0.0–0.5	1.98E-01	4.67E-02	5.31E-01	1.01E+00	ND (1.37E-01)	--	ND (1.83E+00)	--
Impact Pad											
510497	82IP-GR-011-0-SS	3/12/98	0.0–0.5	1.66E-02	1.12E-02	8.82E-01	4.42E-01	ND (2.01E-01)	--	ND (1.33E+00)	--
510497	82IP-GR-012-0-SS	3/12/98	0.0–0.5	ND (4.24E-02)	--	8.92E-01	4.69E-01	ND (2.12E-01)	--	9.08E-01	7.38E-01
510497	82IP-GR-013-0-SS	3/12/98	0.0–0.5	ND (4.35E-02)	--	7.79E-01	4.10E-01	ND (2.17E-01)	--	8.66E-01	7.90E-01
510497	82IP-GR-014-0-SS	3/12/98	0.0–0.5	7.81E-02	3.99E-02	**1.09E+00**	5.63E-01	ND (2.15E-01)	--	1.02E+00	6.97E-01
510486	82IP-GR-015-0-SS	3/12/98	0.0–0.5	ND (3.14E-02)	--	8.19E-01	3.98E-01	ND (1.94E-01)	--	ND (1.70E+00)	--
510497	82IP-GR-016-0-SSD	3/12/98	0.0–0.5	5.68E-01	1.13E-01	8.56E-01	4.34E-01	**2.20E-01**	1.83E-01	1.15E+00	8.02E-01
610680	82IP-GR-030-0.0-SS	3/23/99	0.0–0.5	3.21E-02	2.45E-02	6.62E-01	3.44E-01	ND (2.03E-01)	--	ND (7.14E-01)	--
610680	82IP-GR-031-0.0-SS	3/23/99	0.0–0.5	4.88E-02	3.59E-02	8.02E-01	4.17E-01	ND (2.04E-01)	--	ND (6.81E-01)	--
610687	82IP-GR-032-0.0-SS	3/23/99	0.0–0.5	1.74E-02	1.99E-02	7.10E-01	3.84E-01	1.44E-01	1.66E-01	ND (7.21E-01)	--
610680	82IP-GR-033-0.0-SS	3/23/99	0.0–0.5	ND (3.07E-02)	--	7.78E-01	3.95E-01	ND (2.06E-01)	--	ND (7.04E-01)	--
610680	82IP-GR-040-0.0-SS	3/23/99	0.0–0.5	ND (2.97E-02)	--	7.52E-01	4.18E-01	ND (2.10E-01)	--	ND (7.26E-01)	--
610680	82IP-GR-034-0.0-SS	3/23/99	0.0–0.5	ND (2.92E-02)	--	6.31E-01	3.77E-01	ND (2.01E-01)	--	ND (7.25E-01)	--
610687	82IP-GR-035-0.0-SS	3/23/99	0.0–0.5	2.76E-02	2.48E-02	6.60E-01	3.57E-01	ND (1.74E-01)	--	ND (6.20E-01)	--
610680	82IP-GR-036-0.0-SS	3/23/99	0.0–0.5	3.40E-02	3.59E-02	7.85E-01	4.33E-01	ND (2.19E-01)	--	ND (7.57E-01)	--
610680	82IP-GR-037-0.0-SS	3/23/99	0.0–0.5	3.81E-01	2.69E-01	7.96E-01	3.99E-01	ND (2.07E-01)	--	ND (7.31E-01)	--

Refer to footnotes at end of table.

Table 3.4.4-22 (Concluded)
Summary of SWMU 82 Impact Pad and Site-Specific Background RFI Surface Soil Sampling
Gamma Spectroscopy Analytical Results
March 1998 and March 1999
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample Location (Figure 3.4.4-5)	Date Sampled	Sample Depth (ft)	Cesium-137[c]	Error[d]	Thorium-232[c]	Error[d]	Uranium-235[c]	Error[d]	Uranium-238[c]	Error[d]
601687	82IP-GR-038-0.0-SS	3/23/99	0.0–0.5	2.60E-01	6.42E-02	7.25E-01	3.96E-01	1.50E-01	1.72E-01	ND (7.51E-01)	--
601680	82IP-GR-039-0.0-SS	3/23/99	0.0–0.5	7.53E-02	4.16E-02	7.70E-01	4.43E-01	ND (2.18E-01)	NA	1.87E+00	1.93E+00
SNL/NM Foothills Background Range[e]				0.007–0.876	NA	0.113–1.18	NA	0.004–3.0	NA	0.153–2.86	NA
NMED-Approved Background Soil Activities—Lower Canyons Area[f]				1.55	NA	1.03	NA	0.16	NA	2.31	NA

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

[a]Uranium-238 and thorium-232 decay chain isotopes with short half lives are not presented in this table.

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

[c]Two standard deviations about the mean detected activity.

[d]IT March 1996.

[e]Dinwiddie September 1997.

BK = Background.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
IP = Impact pad.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
RCRA = Resource Conservation and Recovery Act.
RFI = RCRA Facility Investigation.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.
-- = Error not calculated for nondetectable results.

Table 3.4.4-23
Summary of SWMU 82 Impact Pad RFI Soil Sampling RCRA Metals Plus Beryllium and Nickel Analytical Results March 1999 (Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010 and 7471A)[a] (mg/kg)									
Record Number[b]	ER Sample ID (Figure 3.4.4-4)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver
601681	82IP-GR-030-0.0-SS	3/23/99	0.0–0.5	3.61	89.7 J	0.422 J (0.490)	0.392 J (0.490)	6.65	9.93	0.00898 J (0.0299)	7.98	0.52	ND (0.031)
601681	82IP-GR-031-0.0-SS	3/23/99	0.0–0.5	4.76	71.7 J	0.331 J (0.472)	0.220 J (0.472)	4.61	9.59	ND (0.00225)	6.22	0.437 J (0.472)	ND (0.031)
601681	82IP-GR-032-0.0-SS	3/23/99	0.0–0.5	3.98	118 J	0.475 J (0.485)	0.406 J (0.485)	8.99	11.4	0.0174 J (0.0280)	9.63	0.464 J (0.485)	0.0676 J (0.485)
601681	82IP-GR-033-0.0-SS	3/23/99	0.0–0.5	7.72	84.4 J	0.371 J (0.485)	0.189 J (0.485)	4.12	9.06	ND (0.00225)	5.3	0.414 J (0.485)	0.0587 J (0.485)
601681	82IP-GR-040-0.0-SS	3/23/99	0.0–0.5	5.53	90.9 J	0.357J (0.476)	0.192 J (0.476)	4.71	9.79	ND (0.00225)	6.54	0.426 J (0.476)	0.0614 J (0.476)
601681	82IP-GR-034-0.0-SS	3/23/99	0.0–0.5	4.68	107 J	0.393 J (0.476)	0.254 J (0.476)	6.3	8.73	ND (0.00225)	7.18	0.416 J (0.476)	0.0830 J (0.476)
601681	82IP-GR-035-0.0-SS	3/23/99	0.0–0.5	5.71	147 J	0.5	0.257 J (0.490)	7.21	9.65	0.00219 J (0.284)	8.4	0.54	0.0631 J (0.490)
601681	82IP-GR-036-0.0-SS	3/23/99	0.0–0.5	3.43	102 J	0.429 J (0.490)	0.268 J (0.490)	6.05	9.53	ND (0.00225)	7.48	0.629	ND (0.031)
601681	82IP-GR-037-0.0-SS	3/23/99	0.0–0.5	2.92	76.5 J	0.329 J (0.500)	0.252 J (0.500)	4.2	10.2	ND (0.00225)	5.92	0.388 J (0.500)	ND (0.031)
601681	82IP-GR-038-0.0-SS	3/23/99	0.0–0.5	3.72	99.9 J	0.417 J (0.472)	0.360 J (0.472)	5.97	10.7	0.00287 J (0.0290)	8.61	0.423 J (0.472)	ND (0.031)
601681	82IP-GR-039-0.0-SS	3/23/99	0.0–0.5	3.39	114 J	0.418 J (0.481)	0.313 J (0.481)	6.04	12.5	ND (0.00225)	7.94	0.416 J (0.416)	0.0685 J (0.481)
Quality Assurance/Quality Control Sample (mg/L)													
601681	82IP-GR-041-0.0-EB	3/23/99	NA	ND (0.00451)	0.000998 J (0.00500)	ND (0.00026)	ND (0.00044)	ND (0.00056)	ND (0.00159)	ND (0.000035)	ND (0.00129)	ND (0.00271)	0.00139 J (0.00500)
SNL/NM Foothills Background Range[c]				1.6–9.6	39–400	0.2–0.73	0.09–0.99	2.5–20	4.7–51	0.01–0.13	5.3–16	0.56–3.1	0.01–0.50
NMED-Approved Background Soil Concentrations—Lower Canyons Area[d]				9.8	246	0.75	0.64	18.8	18.9	0.055	16.6	2.7	<0.5

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

[a]EPA November 1986.

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

[c]IT March 1996.

[d]Garcia November 1998.

Table 3.4.4-23 (Concluded)
Summary of SWMU 82 Impact Pad RFI Soil Sampling
RCRA Metals Plus Beryllium and Nickel Analytical Results
March 1999
(Off-Site Laboratory)

EB	= Equipment blank
EPA	= U.S. Environmental Protection Agency.
ER	= Environmental Restoration.
ft	= Foot (feet).
GR	= Grab sample.
ID	= Identification.
IP	= Impact pad.
J	= Qualified as estimated during data validation.
J ( )	= Value shown is less than the practical quantitation limit (shown in parentheses), but greater than or equal to method detection limit.
mg/kg	= Milligram(s) per kilogram.
mg/L	= Milligram(s) per liter.
NA	= Not applicable.
ND ( )	= Not detected at or above the method detection limit, shown in parentheses.
NMED	= New Mexico Environment Department.
RCRA	= Resource Conservation and Recovery Act.
RFI	= RCRA Facility Investigation.
SS	= Soil sample.
SNL/NM	= Sandia National Laboratories/New Mexico.
SWMU	= Solid Waste Management Unit.

Table 3.4.4-24
Summary of HE Analytical Method Detection Limits (EPA Method 8330)[a] Used for SWMU 82 Impact Pad RFI Soil Sampling
March 1999
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
m-Dinitrobenzene	4.1
2,4-Dinitrotoluene	6.2
2,6-Dinitrotoluene	6.5
2-Amino-4,6-dinitrotoluene	6.6
4-Amino-2,6-dinitrotoluene	5.5
HMX	5.3
Nitrobenzene	5.2
m-Nitrotoluene	11
o-Nitrotoluene	7.8
p-Nitrotoluene	11
RDX	9.7
Tetryl	7.5
sym-Trinitrobenzene	6.6
2,4,6-Trinitrotoluene	5.7

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
HE = High Explosive(s).
HMX = Cyclotetramethylene tetranitramine.
MDL = Method detection limit.
µg/kg = Microgram(s) per kilogram.
RCRA = Resource Conservation and Recovery Act.
RDX = Cyclo-1,3,5-trimethylene-2,4,6-trinitramine.
RFI = RCRA Facility Investigation.
SWMU = Solid Waste Management Unit.
Tetryl = Trinitro-2,4,6-phenylmethylnitramine.

two sample pairs for nickel and lead yielded RPDs that exceeded the acceptable RPD limit of less than 25 percent (Table 3.4.4-25). Although the RPDs presented in Table 3.4.4-25 exceed the RPD limit, they are typical of the heterogeneous uncontaminated soil and are, therefore, acceptable.

RPDs were calculated for the radionuclides detected in the primary and duplicate samples, both of which were analyzed by RPSD. All radionuclide RPDs were acceptable (see Table 3.4.4-25).

Sampling Activities 1998-1999

QA/QC field samples collected as part of the 1998-1999 confirmatory soil sampling events included three duplicates and one equipment blank.

RPDs were calculated for the RCRA metals detected in the primary and duplicate samples, both of which were analyzed by General Engineering Laboratories, Charleston, SC. The RCRA metals analyses for the sample pair for arsenic yielded RPDs that exceeded the acceptable RPD limit of less than 25 percent (Table 3.4.4-26). Although the RPDs presented in Table 3.4.4-26 exceed the RPD limit, they are typical of the heterogeneous uncontaminated soil and are, therefore, acceptable.

RPDs were calculated for the radionuclides detected in the primary and duplicate samples, both of which were analyzed by RPSD. Of the four radionuclides examined, only thorium 232 had detectable levels in both pairs. The RPDs were acceptable for this parameter (see Table 3.4.4-26). One of two pairs had detectable Cesium-137 levels. The RPDs for this set exceeded the acceptable RPD limit of less than 25 percent. Radionuclide levels in soil are highly variable, and the results probably represent a heterogeneous uncontaminated soil.

3.4.4.6.4 Data Validation

The off-site laboratory results from the 1995 sampling event from Lockheed Analytical Services were reviewed according to "Data Verification/Validation Level 2 – DV-2," in the SNL/NM Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994). The off-site laboratory results for the March 1999 sampling events from General Engineering Laboratories were reviewed according to "Data Verification/Validation Level 3 – DV-3," as defined in "Data Validation Procedure for Chemical and Radiochemical Data," SNL/NM Environmental Analytical Operating Procedure (AOP) 00-03, Rev. 0 (SNL/NM December 1999). The DV3 reports are presented in Annex 3-B. The gamma spectroscopy data from the RPSD Laboratory and the gross alpha/gross beta analysis by the Core Laboratory were also reviewed according to "Data Validation Procedure for Chemical and Radiochemical Data" SNL/NM ER Project AOP 00-03, Rev. 0 (SNL/NM December 1999). The RPSD verification/validation reports are presented along with the gamma-spectroscopy results in Annex 3-A. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 82. None of the soil sample analytical data required qualification during validation.

Table 3.4.4-25
Summary of SWMU 82 TAL Metals and Gamma Spectroscopy Relative Percent Differences
July 1995
(Off-Site Laboratory)

Sample Attributes			Metals Relative Percent Difference										
Record Number[a]	ER Sample ID	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver	Zinc
03897 03897	82-GR-010-0-SS, 82-GR-010-0-SS (duplicate)	0.0–0.5	7.79	1.02	NC	NC	18.87	4.21	NC	NC	NC	NC	6.25
03897 03897	82-GR-020-0-SS, 82-GR-020-0-SS (duplicate)	0.0–0.5	5.88	9.52	NC	NC	0.00	27.98	NC	33.18	NC	NC	2.47

Sample Attributes			Radionuclides Relative Percent Difference			
Record Number[b]	ER Sample ID	Sample Depth (ft)	Cesium-137	Thorium-232	Uranium-235	Uranium-238
03897 03897	82-GR-010-0-SS 82-GR-010-0-SS (duplicate)	0.0–0.5 0.0–0.5	NC	10.19	NC	1.52
03897 03897	82-GR-020-0-SS 82-GR-020-0-SS (duplicate)	0.0–0.5 0.0–0.5	NC	1.93	NC	NC

[a]Analysis request/chain-of-custody record.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NC = Not calculated for estimated values or nondetected results.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.

Table 3.4.4-26
Summary of SWMU 82 RCRA Metals and Gamma Spectroscopy Relative Percent Differences
March 1998 and March 1999
(Off-Site Laboratory)

Sample Attributes			Metals Relative Percent Difference									
Record Number[a]	ER Sample ID (Figure 3.4.4-4)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver
601681 601681	82IP-GR-033-0.0-SS, 82IP-GR-040-0.0-SS (duplicate)	0.0–0.5 0.0–0.5	33.06	7.42	3.85	1.57	13.36	7.75	NC	20.95	2.86	4.50

Sample Attributes			Radionuclides Relative Percent Difference			
Record Number[b]	ER Sample ID (Figure 3.4.4-4)	Sample Depth (ft)	Cesium-137	Thorium-232	Uranium-235	Uranium-238
600035 600035	82IP-GR-011-0-SS 82IP-GR-016-0-SSD (duplicate)	0.0–0.5 0.0–0.5	188.64	2.99	NC	NC
601681 601681	82IP-GR-033-0-SS 82IP-GR-040-0-SS (duplicate)	0.0–0.5 0.0–0.5	NC	3.40	NC	NC

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

ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
IP = Impact pad.
NC = Not calculated for estimated values or nondetected results.
RCRA = Resource Conservation and Recovery Act.
SS = Soil sample.
SSD = Soil sample duplicate.
SWMU = Solid Waste Management Unit.

3.4.4.7 *Data Gaps*

No data gaps remained after the RFI sampling discussed in this section, with the exception of the potential filled-in arroyo channel mentioned in the CEARP report (see Section 3.4.2.1 of this NFA). The investigation and VCA in the filled-in arroyo channel are addressed in Section 3.4.5 of this NFA.

3.4.4.8 *Results and Conclusions*

Slightly elevated levels of metals were found in samples from the various features at SWMU 82. The levels are generally within the range of samples collected in background locations. Levels in at least one sample exceed the NMED-approved background levels for silver, arsenic, beryllium, cadmium, mercury, nickel, lead, and zinc. None of the levels found were above action levels that would require cleanup (IT July 1998).

The radionuclide levels at the SWMU were essentially at background. Some minor elevation in radionuclide levels were found in a few samples above NMED-approved background activities but all were within the range of background sample results. SWMU 82 was designated a radioactive material management area (RMMA) based on the PAGE dispersion tests involving DU and cerium. After full characterization of the site, no elevated radionuclides above background ranges were found in the soils on the site. Based on the sampling data, the site was removed from the SNL/NM RMMA tracking program on July 26, 1999 (Annex 3-C).

One SVOC, chrysene, was found at low levels in one sample at the generator pad. This value did not exceed action levels that would require cleanup and was included in the risk assessment (IT July 1998).

Ten VOCs were found in at least one sample from the generator pad area. The levels for these VOCs did not exceed action levels that would require cleanup and were included in the risk assessment (IT July 1998).

TPH was found in two samples from the generator pad area. The levels were not considered significant because any spill from the small generator fuel tank would be small in quantity, which would bind to the soil and biodegrade over time. The diesel would have to pass through 444 feet of granite bedrock before it would have the possibility of reaching groundwater. Based on the depth to groundwater and the attenuation of the small quantity of diesel by the time it reaches that depth, the detected levels do not require further action.

One sample did show PETN at 1 mg/kg, and, although it is only screening-level data, it was included in the risk assessment. All other HE sampling did not detect any level of HE in soils.

In summary, based on characterization data, SWMU 82 was not significantly impacted from the OAC test activities. The levels of COCs that were found during analysis were included in the risk assessment calculation.

3.4.5 Investigation #4—VCA Activities and Confirmatory Sampling

A filled-in arroyo channel in the arroyo was identified during site inspections. A VCA was conducted to investigate this area and to remove buried debris that was found. This section discusses the VCA and its results.

3.4.5.1 Nonsampling Data Collection

The CEARP report identified an area of potential subsurface debris, based on a visual inspection of the site. The report states:

> "Debris from testing operations at the old aerial cable site has been deposited in an arroyo on the east side of the aerial cable. There is also some evidence (scrap metal sticking out of the ground) of buried materials to the west, and a scrap yard lies north of the disposal site in the arroyo. Materials observed include sleds, cables, pieces of scrap metal and lumber, rocket motors, cans, bottles, and general trash."

Visual surveys of the site by ER Project personnel identified several locations where surface debris and/or potential evidence of subsurface debris were presented. An area including Debris Piles F and G, shown in Figure 3.4.4-2 and previously discussed in Section 3.4.4.4 of this NFA, contained visual evidence of potential buried debris. In the area, an arroyo channel appeared to be filled in, based on the surrounding topography. Concrete, wire cable, polyurethane foam, wood, and electrical conduit were observed protruding from the soil in the area (see Figures 3.4.5-1 and 3.4.5-2).

Aerial photographs were examined to determine if they showed evidence of the arroyo being disturbed and/or filled in. The following aerial photographs were evaluated:

- USFS 1961 EJA-2-116
- USGS 1967 VBUG-2-85
- USFS 1971 EXG-1-116, EXG-2-275
- USAF 1989 6-31-1.

The U.S. Forest Service 1961 frame EJA-2-116 photograph does not show significant disturbance in the area. The U.S. Geologic Survey 1967 frame VBUG-2-85 photograph does show some activity in the area, but was taken before the OAC Site was developed. The U.S. Forest Service 1971 photograph frames EXG-1-116 and EXG-2-275 show the area after the OAC was developed. In these frames, the area of the filled-in arroyo appears to be cleared of vegetation, and roads that cross the arroyo in the area are present. The arroyo cannot be discerned in these photographs. The U.S. Air Force 1989, frame 6-31-1 photograph, shows vegetation growing in the area. No arroyo channel appears to be present at the filled in area, but it is discernable topographically above and below the area.

No nonsampling data collection activities were planned for the VCA. A radiation survey of the area was conducted during VCA activities and will be discussed in Section 3.4.5.2.

Figure 3.4.5-1 SWMU 82 - Debris at the End of the Filled-in Arroyo Area Before VCA.

Figure 3.4.5-2 SWMU 82 - Debris on Surface of Filled-in Area Before VCA.

3.4.5.2 VCA Activities

A VCA was conducted to address two issues. First, the potential for subsurface debris had to be characterized to determine what was buried there. Second, the surface and subsurface debris had to be removed from the arroyo and the arroyo channel restored to its approximate original topography to address surface water concerns.

A VCA Plan was developed and submitted to the NMED HRMB in August of 1999 (SNL/NM August 1999). Comments from the NMED HRMB personnel on the VCA Plan were received during a meeting on August 17, 1999, and the plan was modified to address those comments. The VCA Plan was presented to the Public during the September 15, 1999, DOE Public Meeting. It was conducted as described in the VCA Plan.

The area that was characterized and remediated is shown in Figure 3.4.5-3. Surface debris was present in the arroyo channel, in addition to the filled-in arroyo channel. The VCA started on September 20, 1999, with cleanup of the surface in or near the arroyo channel. All debris collected during the VCA was field screened for radioactivity using a hand-held beta/gamma meter. No debris found during the surface cleanup was radioactive. The debris collected from the surface included approximately 20 cubic yards of wire cable, and approximately 10 cubic yards of wood, electrical conduit, asphalt, electrical panel boxes, plastic, and metal waste. Debris Piles C, D, F, G, and J, previously discussed in Section 3.4.4.4, were completely removed during the VCA. The other debris piles, as previously discussed, were actually concrete pads and were not removed during the VCA.

The excavation of the filled-in arroyo channel was conducted after the completion of the surface debris cleanup activities. Excavation started at the south-southwest end of the area and proceeded to the north-northeast end of the filled-in arroyo channel (see Figure 3.4.5-3). The depth of excavation at the south-southwest end of the filled-in arroyo channel was approximately 6 feet deep where it joined the bottom of the existing arroyo channel. The depth was gradually decreased as the excavation proceeded to the north-northeast and ended at the base of the 3-foot-diameter culvert going under the road. The lateral and vertical extent of any debris area was determined by excavating until all debris was removed. Drainage channels were contoured during the debris removal process.

The three significant areas of buried debris were found as shown in Figure 3.4.5-4. Two burial areas containing wire cable were found (Figures 3.4.5-5 and 3.4.5-6). The cable were positively identified as being from the OAC operations by the dozen explosive actuated cable cutters found with the cable. All buried cable was removed, screened for radioactivity, and disposed of as nonregulated solid waste. No radioactive materials were found in either wire cable burial area.

One area contained concrete rubble that appeared to be broken-up concrete pads (Figure 3.4.5-7). Because the history of the OAC site indicates that the impact pad was periodically damaged by tests and replaced, it is possible that the concrete may have come from demolished impact pads. The concrete was field screened for radioactivity by ER personnel and surveyed by SNL/NM RPO personnel and found to be uncontaminated. This concrete was removed from the burial area and later resized and used to stabilize the drainage along the road at the north-northeast end of the filled-in arroyo channel.

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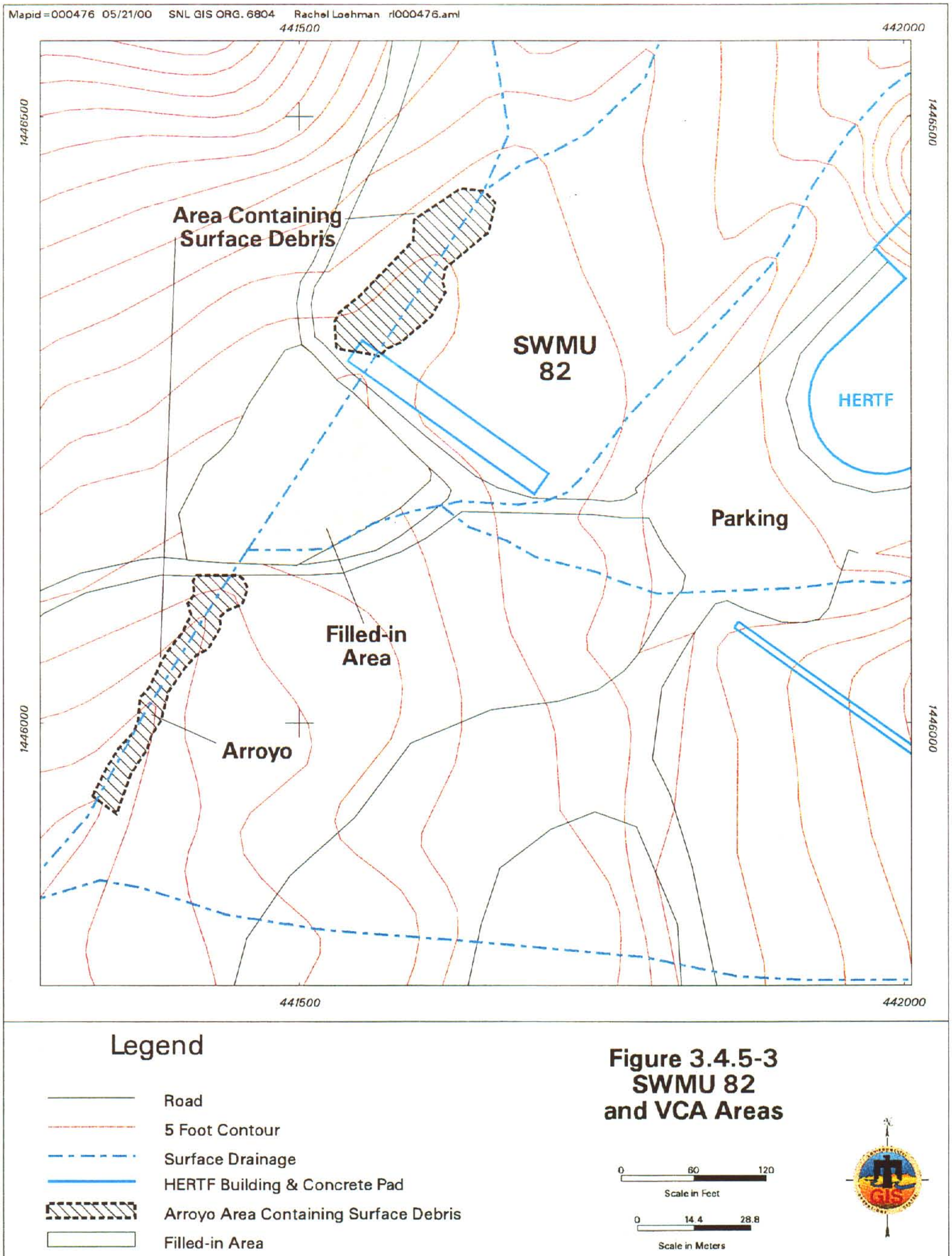

Figure 3.4.5-3
SWMU 82
and VCA Areas

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

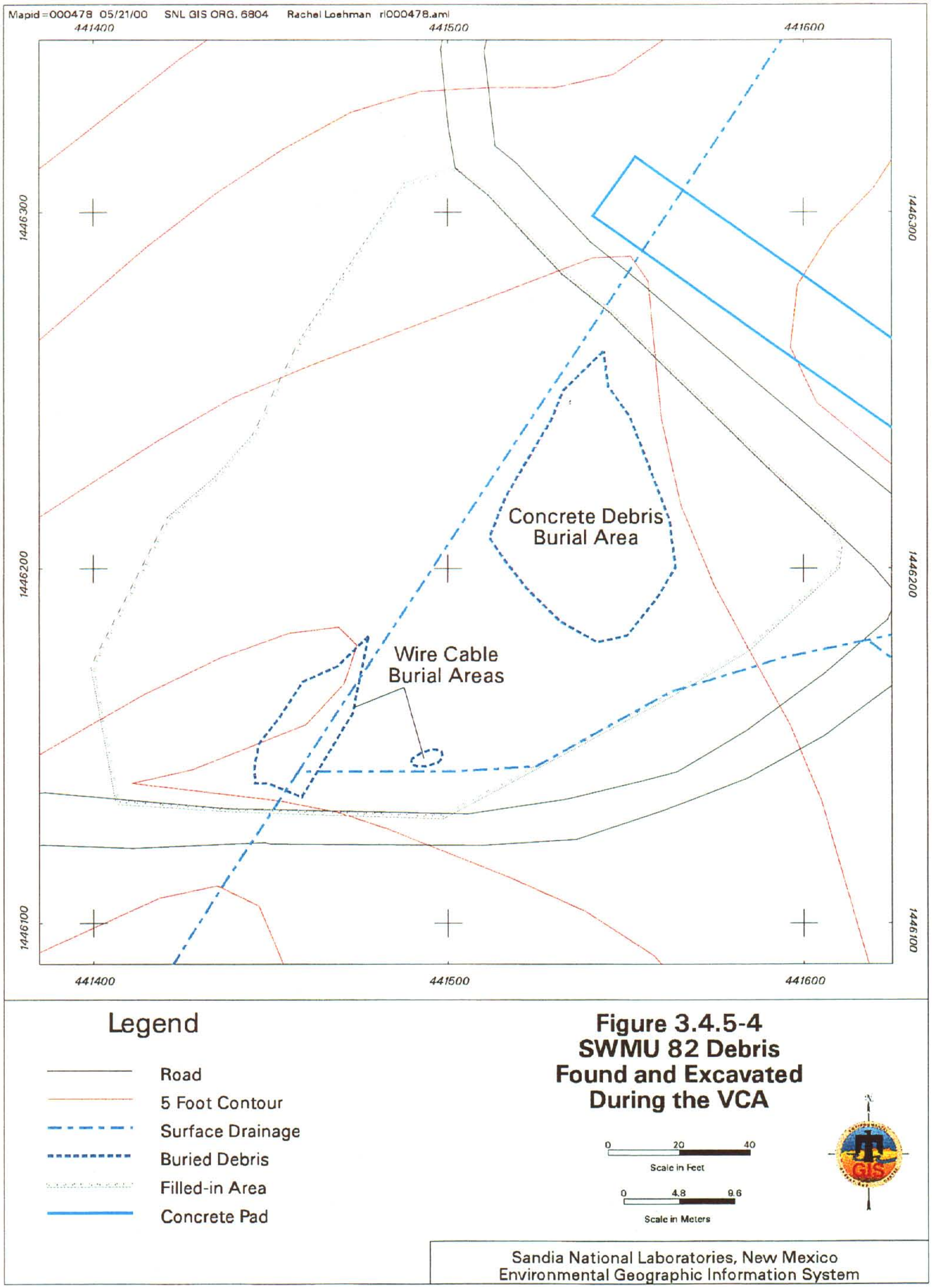

Figure 3.4.5-4
SWMU 82 Debris Found and Excavated During the VCA

Figure 3.4.5-5 SWMU 82 - Excavation of Wire Cable Burial Area.

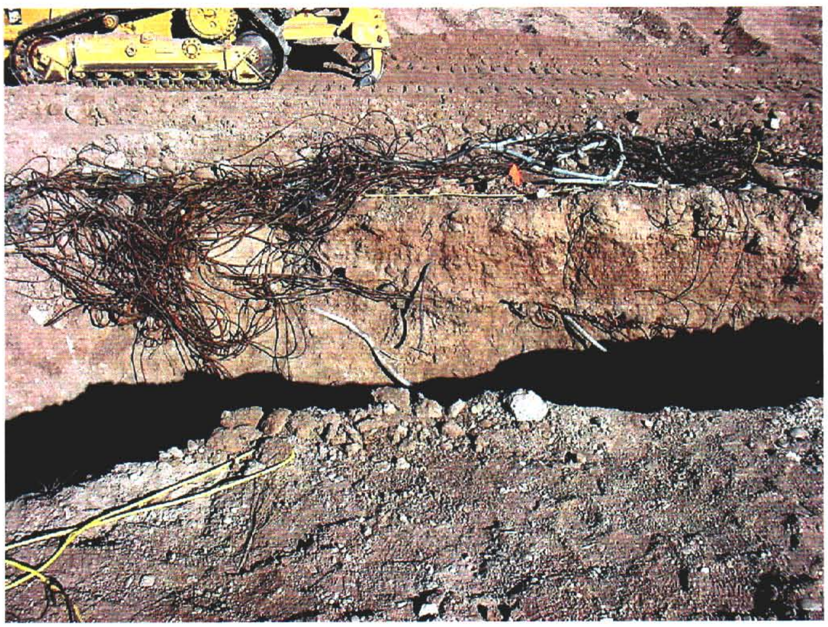

Figure 3.4.5-6 SWMU 82 - Wire Cable Burial Area.

Figure 3.4.5-7
SWMU 82 - Concrete Burial Area.

Four pieces of metal contaminated with DU on one side were found during the VCA (Figure 3.4.5-8). The largest piece of metal was about ¼-inch thick and one-foot square, was rusted, and had sharp edges consistent with metal fragments from a detonation. It may have been debris from the PAGE experiments and did not appear to be associated directly with any debris burial area. Excavation work was suspended until the entire VCA area was surveyed by SNL/NM RPO personnel later that day when one additional piece of radioactive debris was found.

One potential radioactive area source was found in the trench along the north-northeast edge of the filled-in area during the survey. It was unclear whether the slightly elevated radiation levels were from the geometry of the soil surrounding the area or from radioactive materials in the soil. To determine if elevated radionuclides were present in the soils, two soil samples from the area were taken for gamma spectroscopy analysis. The results of analysis for both samples show no elevated radionuclide levels. Based on the results and subsequent RPO surveys, the elevated readings were determined to be caused by the geometry of the trench.

The VCA was expanded to excavate the road area between the original VCA area and the concrete pad used by HERTF for storage (see Figure 3.4.5-9). Radioactive metal fragments were being found at the north-northeast edge of the original VCA excavation, and some wire and cable were found at the edge of the excavation and proceeding under the road. Personnel decided to remove the debris from under the road to the end of buried debris. The goal was to make sure that the northern edge of the filled-in area was defined and to determine that no additional radioactive fragments were in this area. An area approximately 15 feet by 60 feet long was excavated to native soil and/or the end of debris (see Figure 3.4.5-9). Soil was excavated to about 4 feet, which was at least a foot below the last observed debris depth, to ensure that all debris had been removed. Minor amounts of debris were found in this area. No radioactive debris was found during the excavation; however, one small radioactive metal fragment was found just southwest of the area on October 25, 1999, after the drainage along the road had been contoured in preparation for installation of erosion controls.

In addition to the filled, in arroyo area shown on Figure 3.4.5-3 and the road area on the north end, three other areas were excavated during the VCA. The area around Debris Pile J was planned for a surface cleanup. During the actual cleanup, the electrical conduit associated with Debris Pile J was found to continue into the soil of a shallow mound. The mound was completed removed by excavation. Only a small amount of electrical conduit was found in the mound. Two other features west of the original VCA area were investigated by digging a trench through the center of each feature. The first feature was a small mound at the west border of the VCA area that might have been manmade (marked as Trench A on Figure 3.4.5-9). The second feature was a depression further to the west of the VCA area (marked as Trench B on Figure 3.4.5-9). This feature was trenched to determine if it was a borrow area or was a burial area that had subsided. A 4-foot-deep trench was excavated through each feature. Undisturbed soil and no debris were found at both features.

The arroyo channel and two smaller drainage channels in the VCA were contoured according to Storm Water /Surface Water Pollution Prevention Best Management Practices (BMP) Guidance Document (LANL August 1998) before verification sampling was conducted. SNL/NM RPO personnel conducted a final radiation survey of the VCA area on October 28, 1999. No elevated radiation, not associated with bedrock outcrops, was found during this survey (SNL/NM October 1999). This survey also confirmed that rock outcrops in the area contained elevated levels of naturally occurring radionuclides.'

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Figure 3.4.5-8
SWMU 82 - DU Contaminated Metal Fragments Removed During VCA.

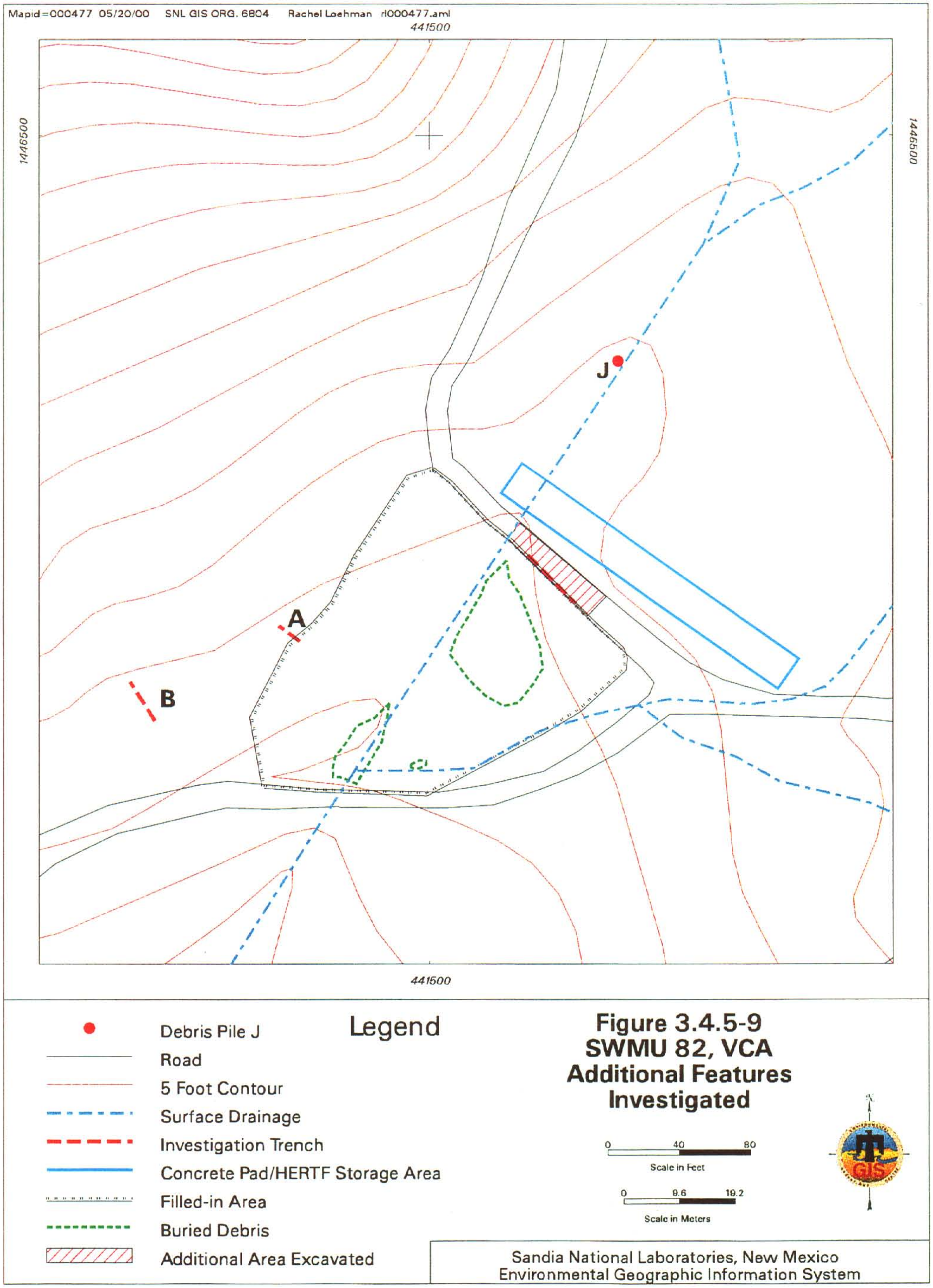

Figure 3.4.5-9
SWMU 82, VCA
Additional Features Investigated

After all debris was removed and verification sampling (discussed below) was completed, erosion controls were installed in the arroyo and drainage channels were installed in the VCA area per BMP Guidance (LANL August 1998). The drainage channels were covered with filter fabric, then covered by a 1-foot-thick layer of 6-inch-diameter broken rock. Areas on the edge of drainage channels that had been disturbed by the VCA were covered by vegetative mat. Figures 3.4.5-10 and 3.4.5-11 show the final condition of the site after installation of erosion controls.

3.4.5.3 *Verification Sampling Activities*

Two verification samples were taken in the northern surface debris cleanup area, with one of the samples taken where the former Debris Pile J was located. Six verification sample locations were judgmentally selected from the filled-in area to be representative of the debris areas found during the VCA (see Figure 3.4.5-12). Two samples were selected to be topographically downgradient of the VCA area. All samples were collected at 0-6 inch depth intervals in accordance with ER FOP 94-52 (SNL/NM December 1994) using standard equipment (stainless steel bowl, hand trowel, etc.) and standard decontamination procedures in accordance with ER FOP 94-57 (SNL/NM May 1994). Sample were managed in accordance with ER FOP 94-34 (SNL/NM May 1995). SNL/NM chain-of-custody and sample documentation procedures were followed for all samples collected. The ER Sample Identification on the chain-of-custody and in the analytical results tables for this section contains the following components: Ary = arroyo location; 082 = SWMU 82; 001 = sample number; SS = soil sample.

Samples were analyzed for RCRA metals plus beryllium and nickel (EPA Methods 6010A, 6010B, and 7471), VOCs (EPA Method 8240), SVOCs (EPA Method 8270), and HE (EPA Methods 8330) by General Engineering Laboratories, Charleston, SC. All radiological analyses were performed by gamma spectroscopy (EPA Method 901.1; EPA November 1986) at the SNL/NM RSPD Laboratory.

3.4.5.4 *Sampling Results*

The results of gamma spectroscopy analysis are presented in Table 3.4.5-1. The complete analytical package is included in Annex 3-A. All uranium-238, uranium-235, and cesium-137 results were below NMED-approved background activities. Sample Ary-082-005-SS contained thorium-232 at 1.12 pCi/g, verses an NMED-approved background activity of 1.03 pCi/g. The value is within the background range, and naturally elevated thorium has been found in the site bedrock, as previously discussed. Based on this information, the result is considered background. The minimum detection activity for uranium-235 slightly exceeded the NMED-approved background activity.

The results of RCRA metals plus beryllium and nickel analysis are presented in Table 3.4.5-2. All results were below NMED-approved background values except for arsenic and beryllium. Sample Ary-082-008-SS contained beryllium at 1.04 mg/kg, which is above the NMED-approved background value of 0.75 mg/kg. Samples Ary-082-002-SS, Ary-082-005-SS, Ary-082-007-SS, and Ary-082-008-SS contained arsenic levels of 11.3, 14.1, 26.5, and 11.9 mg/kg, respectively. The NMED-approved background value for arsenic is 9.8 mg/kg. The elevated levels for arsenic are probably from samples taken close to bedrock formations high in

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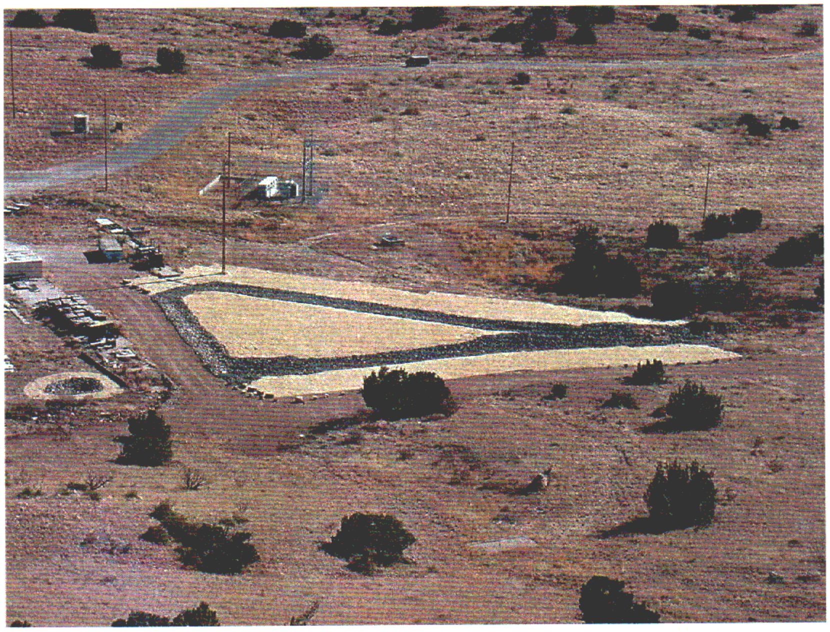
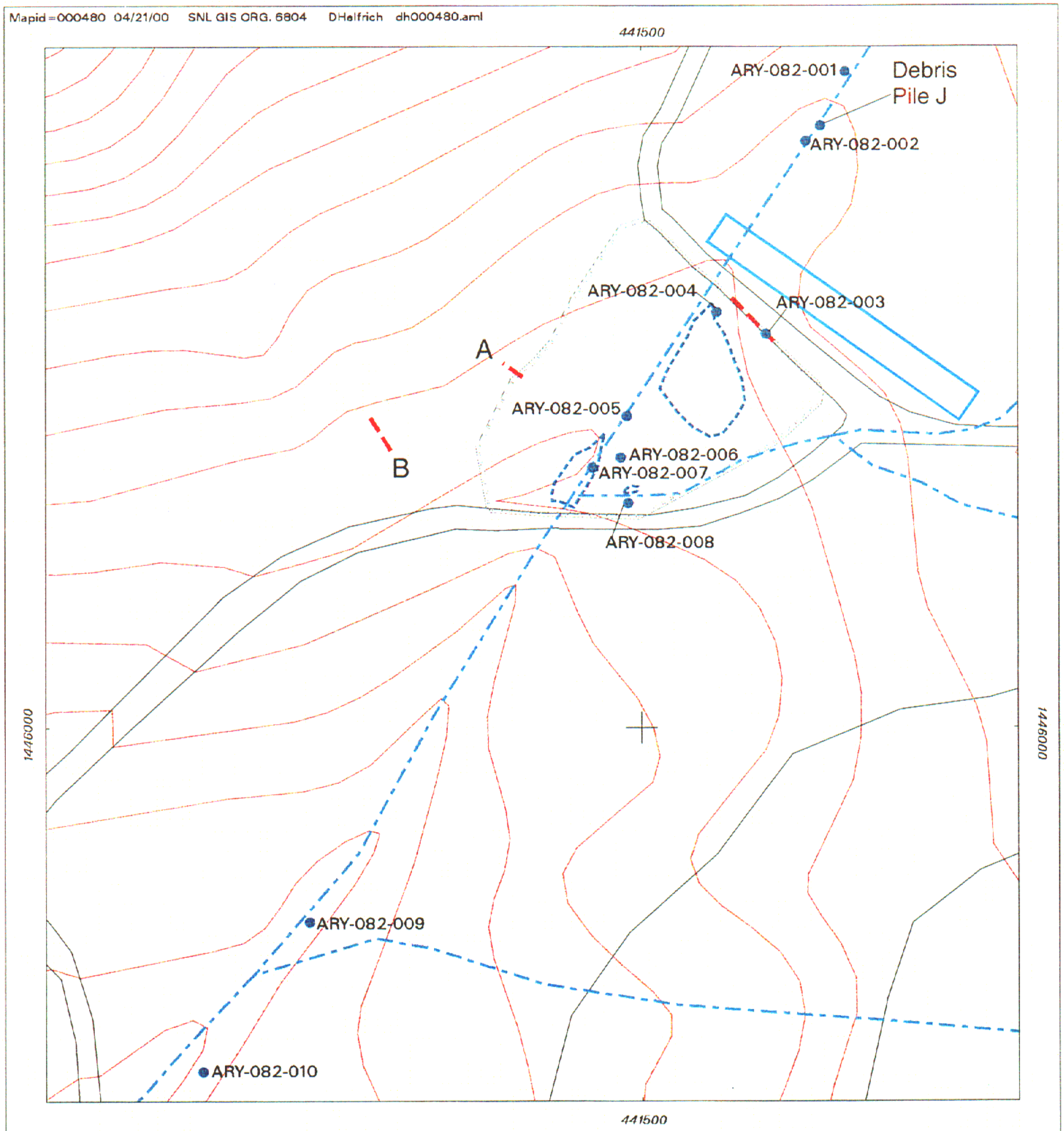


Figure 3.4.5-10 SWMU 82 - Post VCA and Erosion Control Installation.

Figure 3.4.5-11 SWMU 82 - Erosion Control Installed in Main Arroyo Channel.



Legend

- Arroyo Sample Location
- Road
- 5 Foot Contour
- Surface Drainage
- Investigation Trench
- Buried Debris
- Filled in Area
- Concrete Pad

Figure 3.4.5-12
SWMU 82, VCA
Sample Locations

0 50 100
Scale in Feet

0 12 24
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Table 3.4.5-1
Summary of SWMU 82 VCA Soil Sampling Gamma Spectroscopy Analytical Results
October 1999
(On-Site Laboratory)

Sample Attributes				Activity[a] (pCi/g)							
Record Number[b]	ER Sample ID (Figure 3.4.5-12)	Date Sampled	Sample Depth (ft)	Cesium-137	Error[c]	Thorium-232	Error[c]	Uranium-235	Error[c]	Uranium-238	Error[c]
602891	Ary-082-001-SS	10/26/99	0.0–1.0	9.19E-02	2.02E-02	6.09E-01	3.39E-01	1.19E-01	1.42E-01	ND (6.18E-01)	NA
602891	Ary-082-002-SS	10/26/99	0.0–1.0	6.04E-02	2.99E-02	6.61E-01	3.73E-01	7.47E-02	1.42E-01	ND (6.28E-01)	NA
602891	Ary-082-003-SS	10/26/99	0.0–1.0	2.96E-02	3.17E-02	6.71E-01	3.85E-01	ND (1.97E-01)	NA	ND (7.00E-01)	NA
602891	Ary-082-004-SS	10/26/99	0.0–1.0	4.54E-02	2.69E-02	7.40E-01	3.99E-01	ND (1.94E-01)	NA	ND (6.74E-01)	NA
602891	Ary-082-005-SS	10/26/99	0.0–1.0	2.57E-02	3.80E-02	**1.12E+00**	5.55E-01	ND (2.36E-01)	NA	ND (8.46E-01)	NA
602891	Ary-082-006-SS	10/26/99	0.0–1.0	5.39E-02	3.70E-02	8.62E-01	7.16E-01	9.15E-02	1.51E-01	ND (6.62E-01)	NA
602891	Ary-082-007-SS	10/26/99	0.0–1.0	9.11E-02	4.84E-02	ND (1.21E-01)	NA	4.07E-02	2.50E-02	ND (6.76E-01)	NA
602891	Ary-082-008-SS	10/26/99	0.0–1.0	9.00E-02	4.14E-02	ND (1.17E-01)	NA	ND (1.87E-01)	NA	ND (6.52E-01)	NA
602891	Ary-082-009-SS	10/26/99	0.0–1.0	4.84E-02	2.87E-02	6.87E-01	8.98E-01	ND (1.96E-01)	NA	ND (6.68E-01)	NA
602891	Ary-082-010-SS	10/26/99	0.0–1.0	1.84E-01	5.76E-02	ND (1.42E-01)	NA	ND (2.26E-01)	NA	ND (7.93E-01)	NA
SNL/NM Foothills Background Range[d]				0.007–0.876	NA	0.113–1.18	NA	0.004–3.0	NA	0.153–2.86	NA
NMED-Approved Background Soil Activities—Lower Canyons Area[e]				1.55	NA	1.03	NA	0.16	NA	2.31	NA

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

[a]Uranium-238 and thorium-232 decay chain isotopes with short half lives are not presented in this table.

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

[c]Two standard deviations about the mean detected activity.

[d]Background range from SNL/NM sitewide background data (SNL/NM 1996).

[e]Dinwiddie September 1997.

Ary = Arroyo.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SS = Soil sample.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.

Table 3.4.5-2
Summary of SWMU 82 VCA Soil Confirmatory Sampling RCRA Metals Analytical Results
October 1999
(Off-Site Laboratory)

Sample Attributes				RCRA Metals plus Beryllium and Nickel (EPA Methods 6010B and 7471A)[a] (mg/kg)									
Record Number[b]	ER Sample ID (Figure 3.4.5-12)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Selenium	Silver
602890	Ary-082-001-SS	10/26/99	0.0–0.5	7.81	84.8	0.443 J (0.455)	ND (0.0345)	6.99	9.51	ND (0.00205)	7.86	0.369 J (0.455)	ND (0.0545)
602890	Ary-082-002-SS	10/26/99	0.0–0.5	**11.3**	97.1	0.488 J (0.495)	ND (0.0376)	7.65	12.7	ND (0.00192)	8.43	0.562	ND (0.0594)
602892	Ary-082-003-SS	10/26/99	0.0–0.5	7.07	87.8	0.505	ND (0.0352)	5.32	10.8	0.0173 J (0.0329)	6.99	0.391 J (0.463)	0.0637 J (0.463)
602890	Ary-082-004-SS	10/26/99	0.0–0.5	9.16	138	0.572	ND (0.0365)	8.45	13.0	ND (0.00215)	11.4	0.417 J (0.481)	0.0628 J (0.481)
602890	Ary-082-005-SS	10/26/99	0.0–0.5	**14.1**	128	0.506	ND (0.0380)	7.96	14.1	ND (0.00219)	10.9	0.459 J (0.500)	ND (0.0600)
602890	Ary-082-006-SS	10/26/99	0.0–0.5	9.45	106	0.550	ND (0.0369)	7.40	10.9	0.00671 J (0.0268)	8.37	0.376 J (0.485)	ND (0.0583)
602890	Ary-082-007-SS	10/26/99	0.0–0.5	**26.5**	118	0.633	ND (0.0365)	7.66	15.8	0.00252 J (0.0332)	9.44	0.418 J (0.481)	ND (0.0577)
602890	Ary-082-008-SS	10/26/99	0.0–0.5	**11.9**	121	**1.04**	ND (0.0380)	8.47	14.0	ND (0.00210)	10.2	0.687	ND (0.0600)
602890	Ary-082-009-SS	10/26/99	0.0–0.5	6.76	84.0	0.469 J (0.481)	ND (0.0365)	7.59	9.69	0.00437 J (0.0299)	8.37	0.479 J (0.481)	ND (0.0577)
602890	Ary-082-010-SS	10/26/99	0.0–0.5	4.44	120	0.504	ND (0.0373)	7.11	18.2	0.0127 J (0.0285)	8.45	0.456 J (0.490)	ND (0.0588)
Quality Assurance Quality Control Sample (mg/L)													
602890	Ary-082-EB	10/26/99	NA	ND (0.00451)	ND (0.000510)	ND (0.000260)	ND (0.000440)	0.00113 J (0.00500)	ND (0.00159)	ND (0.0000350)	ND (0.00129)	ND (0.00271)	0.00100 J (0.000200)
SNL/NM Foothills Background Range[c]				1.6–9.6	39–400	0.2–0.73	0.09–0.99	2.5–20	4.7–51	0.01–0.13	5.3–16	0.56–3.1	0.01–0.50
NMED-Approved Background Soil Concentrations—Lower Canyons Area[d]				9.8	246	0.75	0.64	18.8	18.9	0.055	16.6	2.7	<0.5

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

[a]EPA November 1986.

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

[c]IT March 1996.

[d]Garcia November 1998.

Ary = Arroyo.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification
J ( ) = Value provided is less than the practical quantitation limit (shown in parentheses), but greater than or equal to method detection limit.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected at the method detection limit, shown in parentheses.
NMED = New Mexico Environment Department.
RCRA = Resource Conservation and Recovery Act.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Soil sample.
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.

that element. Arsenic is not considered a COC at the SWMU because no tests were conducted at the OAC site that could have deposited arsenic in the soil. The mean value of arsenic in all samples taken at the SWMU is 5.4 mg/kg, which is below the NMED-approved background value.

The analysis for high explosives did not detect HE in any sample. The detection limits for HE are shown in Table 3.4.5-3

Carbon disulfide, found in sample Ary-082-010-SS at 0.59 μg/kg, was the only VOC detected in any sample. This value was included in the risk assessment calculation. The detection limits for VOCs are shown in Table 3.4.5-4

The analysis for SVOCs did not detect SVOCs in any sample. The SVOC detection limits are presented in Table 3.4.5-5.

3.4.5.5 QA/QC Results

QA/QC field samples collected as part of the VCA verification soil sampling included one trip blank, two field blanks, and four equipment blanks.

3.4.5.6 Data Validation

The off-site laboratory results from General Engineering Laboratories were reviewed according to "Data Verification/Validation Level 3 – DV-3," as defined in "Data Validation Procedure for Chemical and Radiochemical Data," SNL/NM ER Project AOP 00-03, Rev. 0 (SNL/NM December 1999). The DV-3 reports are presented in Annex 3-B. The gamma spectroscopy data from the RPSD Laboratory were also reviewed according to "Data Validation Procedure for Chemical and Radiochemical Data" SNL/NM ER Project AOP-00-03, Rev. 0 (SNL/NM December 1999). The RPSD verification/validation reports are presented along with the gamma-spectroscopy results in Annex 3-A. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 82. None of the soil sample analytical data required qualification during validation.

3.4.5.7 Data Gaps

No gaps remained in the characterization of the SWMU upon the completion of the VCA.

3.4.5.8 Results and Conclusions

The VCA characterized and removed the debris on the surface and in the filled-in arroyo channel in the arroyo at SWMU 82. The debris removed from the VCA area was consistent with the site history for the OAC and was, with the exception of the four pieces of radioactive metal, nonregulated. Verification sampling demonstrated that, with a few exceptions, no elevated COCs remained after the VCA completion. Elevated levels of beryllium, arsenic, thorium and carbon disulfide were detected in at least one sample. The beryllium, arsenic, and thorium are

Table 3.4.5-3
HE Analytical Method Detection Limits (EPA Method 8330)[a] Used for
SWMU 82 VCA Soil Sampling
October 1999
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
m-Dinitrobenzene	4.1
2-Amino-4,6-dinitrotoluene	6.6
4-Amino-2,6-dinitrotoluene	5.5
2,4-Dinitrotoluene	6.2
2,6-Dinitrotoluene	6.5
HMX	5.3
Nitrobenzene	5.2
m-Nitrotoluene	11
o-Nitrotoluene	7.8
p-Nitrotoluene	11
RDX	9.7
Tetryl	7.5
sym-Trinitrobenzene	6.6
2,4,6-Trinitrotoluene	5.7

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
HE = High explosive(s).
HMX = Cyclotetramethylene tetranitramine.
MDL = Method detection limit.
µg/kg = Microgram(s) per kilogram.
RDX = Cyclo-1,3,5-trimethylene-2,4,6-trinitramine.
SWMU = Solid Waste Management Unit.
Tetryl = Trinitro-2,4,6-phenylmethylnitramine.
VCA = Voluntary Corrective Action.

Table 3.4.5-4
VOC Method Detection Limits (EPA Method 8260)[a] Used for
SWMU 82 VCA Soil Sampling
October 1999
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
Acetone	10.3
Benzene	0.5
Bromoform	0.3
2-Butanone	3.2
Carbon disulfide	0.3
Carbon tetrachloride	0.5
Chlorobenzene	0.3
Chlorodibromomethane	0.2
Chloroethane	0.3
Chloroform	0.1
Dichlorobromomethane	0.1
1,1-Dichloroethane	0.1
1,2-Dichloroethane	0.2
1,1-Dichloroethylene	0.3
cis-1,2-Dichloroethylene	0.1
1,2-trans-Dichloroethylene	0.1
1,2-Dichloropropane	0.2
cis-1,3-Dichloropropylene	0.2
trans-1,3-Dichloropropylene	0.3
Ethylbenzene	0.3
2-Hexanone	2.8
Methyl bromide	0.3
Methyl chloride	0.2
4-Methyl-2-pentanone	3.1
Methylene chloride	5
Styrene	0.3
Tetrachloroethylene	0.4
1,1,1-Trichloroethane	0.1
1,1,2-Trichloroethane	0.3
1,1,2,2-Tetrachloroethane	0.6
Toluene	0.9
Trichloroethylene	0.3
Vinyl acetate	2.1
Vinyl chloride	0.4
Xylenes (Total)	0.7

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
MDL = Method detection limit.
µg/kg = Microgram(s) per kilogram.
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.
VOC = Volatile organic compound.

Table 3.4.5-5
SVOC Analytical Method Detection Limits (EPA Method 8270)[a] Used for
SWMU 82 VCA Soil Sampling
October 1999
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
Acenaphthene	160
Acenaphthylene	147
Anthracene	86.7
Benzo(a)anthracene	66.7
Benzo(a)pyrene	73.3
Benzo(b)fluoranthene	143
Benzo(g,h,i)perylene	80.0
Benzo(k)fluoranthene	133
4-Bromophenyl phenyl ether	117
Butyl benzyl phthalate	90.0
Carbazole	153
4-Chloro-3-methyl phenol	127
4-Chloroaniline	153
2-Chloronaphthalene	173
2-Chlorophenol	157
4-Chlorophenyl phenyl ether	147
bis(2-Chloroethoxy)methane	170
bis(2-Chloroethyl)ether	53.3
bis(2-Chloroisopropyl)ether	103
Chrysene	53.3
m,p-Cresol	153
o-Cresol	63.3
Dibenzo(a,h)anthracene	83.3
Dibenzofuran	133
1,2-Dichlorobenzene	170
1,3-Dichlorobenzene	130
1,4-Dichlorobenzene	61.0
3,3-Dichlorobenzidine	277
2,4-Dichlorophenol	177
Diethyl phthalate	76.7
Dimethyl phthalate	110
2,4-Dimethylphenol	110
2-Methyl-4,6-dinitrophenol	100
2,4-Dinitrophenol	367
2,4-Dinitrotoluene	117
2,6-Dinitrotoluene	140
1,2-Diphenylhydrazine	56.7
bis(2-Ethylhexyl) phthalate	300
Fluoranthene	66.7
Fluorene	113

Refer to footnotes at end of table.

Table 3.4.5-5 (Concluded)
SVOC Analytical Method Detection Limits (EPA Method 8270)[a] Used for
SWMU 82 VCA Soil Sampling
October 1999
(Off-Site Laboratory)

Analyte	Soil Sample MDL (µg/kg)
Hexachlorobenzene	70.0
Hexachlorobutadiene	153
Hexachlorocyclopentadiene	193
Hexachloroethane	133
Indeno(1,2,3-cd)pyrene	80.0
Isophorone	147
2-Methylnaphthalene	203
Naphthalene	157
m-Nitroaniline	83.3
o-Nitroaniline	66.7
p-Nitroaniline	103
Nitrobenzene	133
2-Nitrophenol	180
4-Nitrophenol	110
N-Nitrosodiphenylamine	20.7
N-Nitrosodipropylamine	130
Pentachlorophenol	56.7
Phenanthrene	60.0
Phenol	56.7
Di-n-butyl phthalate	73.3
Di-n-octyl phthalate	173
Pyrene	73.3
1,2,4-Trichlorobenzene	187
2,4,5-Trichlorophenol	153
2,4,6-Trichlorophenol	76.7

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
MDL = Method detection limit.
µg/kg = Microgram(s) per kilogram.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.

probably background, as previously discussed. All four COCs were included in the risk assessment. The VCA adequately characterized the area and addressed surface water regulation requirements by restoring the arroyo channel to its original drainage pattern and installing erosion controls.

3.5 Site Conceptual Model

The site conceptual model for SWMU 82 is based upon the residual COCs identified in soil samples following a VCA. This section summarizes the nature and extent of contamination and the environmental fate of COCs.

3.5.1 Nature and Extent of Contamination

The COCs at SWMU 82 are primarily metals, HE, and radionuclides associated with the testing activities at the OAC and a diesel spill at one edge of a small generator pad. Low levels of VOCs, TPH, and one SVOC were found in soils at the generator pad. One sample from the impact pad area detected the explosive PETN. Metal and radionuclide COCs were determined by comparing sample results to background concentrations and activities that had been established for the surface soils in the Canyons Supergroup areas (Garcia November 1998, and Dinwiddie September 1997). Potential metal COCs include barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and zinc. Radionuclides are generally at background levels, with high thorium-bearing bedrock in the area. Table 3.5.1-1 includes summaries of analytical results for the COCs for SWMU 82. In most cases, the COCs are only slightly elevated above background concentrations or activity limits specified for SWMU 82.

3.5.2 Environmental Fate

The primary source of COCs for SWMU 82 was the deposition of test debris, surface/ subsurface disposal of debris from testing activities, and a small spill of diesel fuel. The primary COC release mechanism to the surface (and subsurface) soils is from degradation of debris that could have occurred before its removal during the VCA activities, COCs dispersed during test activities, and loss of containment of a small quantity of diesel fuel to the soil.

After the removal of debris and DU-contaminated metal, possible secondary release mechanisms include suspension and/or dissolution of trace levels of residual COCs in surface-water runoff and percolation to the vadose zone, direct contact with soil (radionuclides only), dust emissions, and uptake of COCs in the soil by biota (Figure 3.5.2-1). The depth to groundwater at the site (at approximately 449 feet bgs) precludes migration of residual COCs to the aquifer. The pathways to receptors are soil ingestion, inhalation, and direct exposure (radionuclides). Plant uptake was also considered as a pathway for the residential scenario only. Annex 3-D provides additional discussion of the fate and transport of COCs at SWMU 82.

Table 3.5.1-1 summarizes materials considered as potential COCs for SWMU 82. All actual COCs were retained in the conceptual model and were evaluated in the human health and ecological risk assessments.

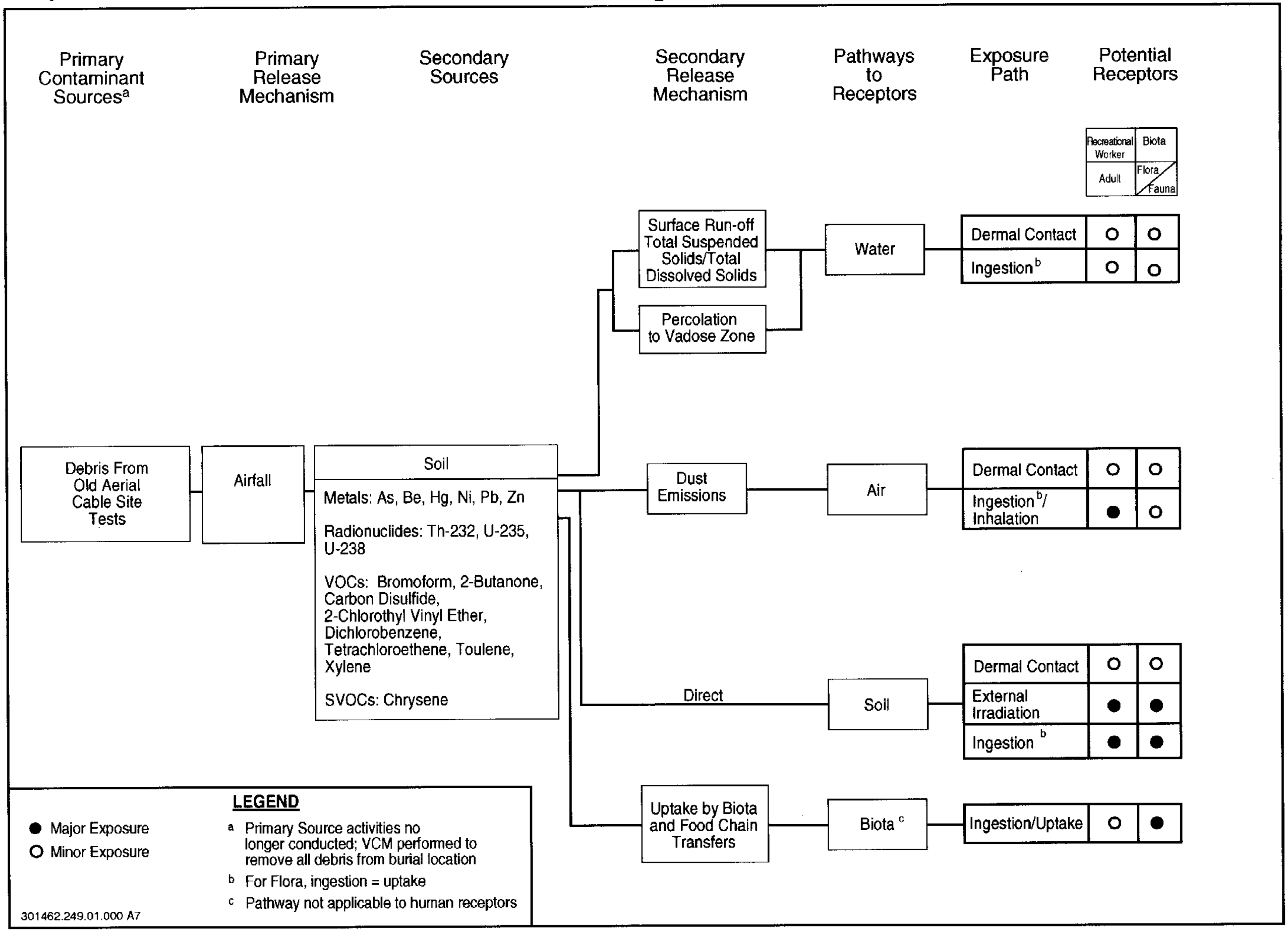


Figure 3.5.2-1

Conceptual Model Flow Diagram for SWMU 82, Old Aerial Cable Site

Table 3.5.1-1
Summary of Results for COCs at SWMU 82

COC Type	Number of Samples	COCs Greater Than Background	Maximum Background Limit/Canyons Supergroup[a] (mg/kg except where noted)	Maximum Concentration or Activity (mg/kg except where noted)	Average Concentration or Activity[b] (mg/kg except where noted)	Sampling Locations Where Background Concentration or Activity Exceeded[c]
Metals	99 environmental, 7 duplicates	Arsenic[d]	9.8	26.5	5.39	Ary-082-002-SS Ary-082-005-SS Ary-082-007-SS Ary-082-008-SS 82P-GR-020-0.0-SS 82S-GR-013-0-SS
		Barium	246	211	116.87	None
		Beryllium	0.75	1.04	0.62	Ary-082-008-SS
		Cadmium	0.64	4.17	0.40	82S-GR-003-0-SS 82S-GR-005-0-SS
		Chromium	18.8	14	7.92	None
		Lead	18.9	23	11.23	82-GR-017-0-SS 82-GR-019-0-SS 82-GR-026-0-SS 82P-GR-031-0.0-SS 82S-GR-003-0-SS
		Mercury	0.055	0.21	0.047	82-GR-011-0-SS 82P-GR-015-0.0-SS 82P-GR-031-0.0-SS 82S-GR-001-0-SS 82S-GR-015-0-SS
		Nickel	16.6	20	9.08	82-GR-019-0-SS
		Selenium	2.7	0.687	0.47	None
		Silver	<0.5	ND (2.0)	0.78	82P-GR-008-0.0-SS
		Zinc	52.1	350	39.63	82-GR-023-0-SS
VOCs	20 environmental	Benzene	NA	1.1 J μg/kg	NA	82-GR-029-0-SS
		Bromoform	NA	2.4 J μg/kg	NA	82-GR-030-0-SS
		2-Butanone	NA	16 μg/kg	NA	82-GR-029-0-SS 82-GR-030-0-SS

Refer to footnotes at end of table.

Table 3.5.1-1 (Continued)
Summary of Results for COCs at SWMU 82

COC Type	Number of Samples	COCs Greater Than Background	Maximum Background Limit/Canyons Supergroup[a] (mg/kg except where noted)	Maximum Concentration or Activity (mg/kg except where noted)	Average Concentration or Activity[b] (mg/kg except where noted)	Sampling Locations Where Background Concentration or Activity Exceeded[c]
VOCs (contd.)		Carbon Disulfide	NA	0.59 J µg/kg	NA	Ary-082-010-SS
		2-Chloroethyl vinyl ether	NA	2.3 J µg/kg	NA	82-GR-029-0-SS 82-GR-030-0-SS
		1,2-Dichlorobenzene	NA	7 µg/kg	NA	82-GR-030-0-SS
		1,3-Dichlorobenzene	NA	3.4 J µg/kg	NA	82-GR-030-0-SS
		1,4-Dichlorobenzene	NA	3.8 J µg/kg	NA	82-GR-030-0-SS
		Tetrachloroethene	NA	1.6 J µg/kg	NA	82-GR-029-0-SS
		1,1,2,2-Tetrachloroethane	NA	13 µg/kg	NA	82-GR-030-0-SS
		m, p-Xylene	NA	1.5 J µg/kg	NA	82-GR-028-0-SS 82-GR-029-0-SS 82-GR-030-0-SS
SVOCs	20 environmental	Chrysene	NA	170 J µg/kg	NA	82-GR-029-0-SS
HE	20 environmental	PETN	NA	1	NA	Impact Pad
Radionuclides	129 environmental, 7 duplicates	Cesium-137	1.55 pCi/g	1.21 pCi/g	Not Calculated[e]	None
		Thorium-232	1.03 pCi/g	1.35 pCi/g	Not Calculated[e]	Ary-082-005-SS 82-GR-028-0-SS 82-GR-029-0-SS 82IP-GR-014-0-SS 82S-GR-002-0-SS
		Uranium-235	0.16 pCi/g	ND (5.34E-01) pCi/g	Not Calculated[e]	82IP-GR-016-0-SSD, plus an additional 97 nondetect samples with MDAs above background

Refer to footnotes at end of table.

Table 3.5.1-1 (Concluded)
Summary of Results for COCs at SWMU 82

COC Type	Number of Samples	COCs Greater Than Background	Maximum Background Limit/Canyons Supergroup[a] (mg/kg except where noted)	Maximum Concentration or Activity (mg/kg except where noted)	Average Concentration or Activity[b] (mg/kg except where noted)	Sampling Locations Where Background Concentration or Activity Exceeded[c]
Radionuclides (contd.)		Uranium-238	2.31 pCi/g	ND (6.71E+00) pCi/g	Not Calculated[e]	None, plus an additional 60 nondetect samples with MDAs above background

Note that Canyons Supergroup LC subset is used for CS-137, while uranium-235, uranium-238 and thorium-232 had no subset within the Canyons Supergroup.

[a]Dinwiddie September 1997 (for radionuclides) or Garcia November 1998 (for metals).

[b]Average concentration includes all samples and duplicates. For nondetectable results for nonradiological COCs, the method detection limit is used in the average calculation.

[c]Includes samples with nondetect results where the method detection limit or minimum detectable activity exceeds the NMED-approved background limit.

[d]Arsenic is included because elevated concentrations were found in some samples, although it is not a COC at the site based on historical information.

[e]An average minimum detectable activity is not calculated because of the variability in instrument counting error and the number of reported nondetectable activities.

Ary = Arroyo.
COC = Constituent of concern.
GR = Grab sample.
HE = High explosive(s).
IP = Impact pad.
J = The reported value is an estimated concentration between the method detection limit and the practical quantitation limit, or is an estimated value.
MDA = Minimum detectable activity.
µg/kg = Microgram(s) per kilogram.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
ND ( ) = Not detected at or above the method detection limit or minimum detectable activity, shown in parentheses.
P = Debris pile.
pCi/g = Picocurie(s) per gram.
PETN = pentaerythritol tetranitrate.
S = Soil sample.
SS = Soil sample.
SSD = Soil sample duplicate.
SVOC = Semivolatile organic compound(s).
SWMU = Solid Waste Management Unit.
VCA = Voluntary corrective action.
VOC = Volatile organic compound(s).

The current and future land use for SWMU 82 is recreational (DOE and USAF January 1996). Therefore, the potential human receptor is considered a recreational user of the site. For all applicable pathways, the exposure route for the recreational user is dermal contact and ingestion/inhalation. Major exposure routes modeled in the human health risk assessment include soil ingestion for nonradiological COCs and direct gamma exposure for the radiological COCs. The inhalation pathway for both nonradiological and radiological COCs is also included because of the potential to inhale dust and volatiles (volatile inhalation for nonradiologicals only). Soil ingestion is included for the radiological COCs as well. Only soil ingestion is considered a primary contributor to exposure for the recreational user.

Potential biota receptors include flora and fauna at the site. Direct soil ingestion is considered a major exposure route for biota, in addition to ingesting COCs through food-chain transfers, the direct contact with COCs in soil, and direct gamma exposure from radiological COCs.

Section V, Annex 3-D, provides additional discussion of the exposure routes and receptors at SWMU 82.

3.6 Site Assessments

Site assessment at SWMU 82 includes risk screening assessments followed by risk baseline assessments (as required) for both human health and ecological risk. This section briefly summarizes the site-assessment results. Annex 3-D provides details of the site assessment.

3.6.1 Summary

The site assessment concludes that SWMU 82 has no significant potential to affect human health under a recreational land use scenario. After considering the uncertainties associated with the available data and modeling assumptions, ecological risks associated with SWMU 82 were found to be very low. Section 3.6.2 briefly describes, and Annex 3-D provides details of, the site assessments.

3.6.2 Screening Assessments

Risk screening assessments were performed for both human health risk and ecological risk for SWMU 82. This section briefly summarizes the risk screening assessment results.

3.6.2.1 Human Health

SWMU 82 has been recommended for recreational land use (DOE et al. October 1995). A complete discussion of the risk assessment process, results, and uncertainties is provided in Annex 3-D. Because of the presence of COCs in concentrations or activities greater than background levels, it was necessary to perform a health risk analysis for the site. Besides COC metals, any VOCs, SVOCs, and HE detected above their reporting limits and any radionuclide COCs detected above either background levels and/or minimum detectable activities were included in this assessment. The risk-assessment process provides a quantitative evaluation of the potential adverse human health effects caused by constituents in the site's soil. The Risk Screening Assessment Report calculated the hazard index (HI) and excess cancer risk for both a recreational and a residential land use setting. The excess cancer risk from nonradiological COCs and the radiological COCs is not additive (EPA 1989).

In summary, the HI calculated for SWMU 82 nonradiological COCs is 0.01 for a recreational land use setting, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). Incremental risk is determined by subtracting the risk associated with background levels from potential nonradiological COC risk. The incremental HI is also 0.01.

The total excess cancer risk for SWMU 82 nonradiological COCs is 2E-06 for a recreational land use setting. Guidance from the NMED indicates that excess lifetime risk of developing cancer by an individual must be less than 1E-06 for Class A and B carcinogens and less than 1E-05 for Class C carcinogens (NMED March 1998). Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated by using maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the upper 95-percent confidence limit of the mean for arsenic (5.98) is used in place of the maximum concentration, arsenic is below background and therefore is not considered further. With the removal of arsenic, the total excess cancer risk is reduced to 1E-09 and the incremental excess cancer risk is calculated to be 1.23E-09, both of which are within the proposed guidelines considering a recreational land use scenario.

The incremental total effective dose equivalent for radionuclides for a recreational land use setting for SWMU 82 is 0.13 millirem (mrem) per year (yr), which is well below EPA's numerical guideline of 15 mrem/yr found in EPA's OSWER Directive No. 9200.4-18 and reflected in a document entitled, "Sandia National Laboratories/New Mexico Environmental Restoration Project—RESRAD Input Parameter Assumptions and Justification" (SNL/NM February 1998). For a recreational land use scenario, the incremental excess cancer risk for radionuclides is 1.6E-06 which is much less than risk values calculated from naturally occurring radiation and from intakes considered background activity levels.

The residential land use scenario for this site is provided only for comparison in the Risk Screening Assessment Report (Annex 3-D).

3.6.2.2 Ecological

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

Annex 3-D presents the results of the ecological risk assessment screen. Site-specific information was incorporated into the screening assessment when such data were available. Hazard quotients of less than one were predicted for all COCs except arsenic, cadmium, mercury, and zinc. A closer examination of the exposure assumptions revealed an overestimation of risk primarily attributable to the exposure concentration used for the arsenic, cadmium, mercury, and zinc. The exposure concentration was calculated using the maximum concentration detected in the soil samples from SWMU 82 which overestimates the actual risk at this site. If the average concentration is used instead of the maximum concentration, the HQs are all less than the respective background screening values. Other uncertainties that contribute to the overestimation of risk include exposure setting (area-use factors of one were assumed). Based upon an evaluation of these uncertainties, ecological risks associated with this site are expected to be very low.

3.6.3 Baseline Risk Assessments

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

3.6.3.1 Human Health

Human health results of the screening assessment summarized in Section 3.6.2.1 indicate that SWMU 82 does not have the potential to affect human health under a recreational land use setting. Therefore, a baseline human-health risk assessment is not required for SWMU 82.

3.6.3.2 Ecological

Ecological results of the screening assessment summarized in Section 3.6.2.2 indicate that SWMU 82 has very low ecological risk. Therefore, a baseline ecological risk assessment is not required for SWMU 82.

3.6.4 Other Applicable Assessments

Surface Water Assessments were performed before and after the VCA. The VCA addressed surface water issues as reported in the Surface Water Assessment Reports (Annex 3-E).

3.6.4.1 Groundwater

No water pathways to the groundwater were considered in the SWMU 82 Risk Screening Assessment. Depth to groundwater beneath the site is approximately 449 feet bgs.

3.7 No Further Action Proposal

SWMU 82 is proposed for an NFA decision based upon all the supporting information contained in this chapter. This section provides the rationale and criterion for the NFA proposal.

3.7.1 Rationale

Based upon field investigation data and the human health-risk assessment analysis, no COCs (metals, radionuclides, high explosives, SVOCs, or VOCs) are present or remain at the site in concentrations or activity levels considered hazardous to human health for a recreational land use scenario. Therefore, an NFA is recommended for SWMU 82.

3.7.2 Criterion

Based upon the evidence provided above, SWMU 82 is proposed for an NFA decision in conformance with Criterion 5 (NMED March 1998), which states that "the SWMU/AOC 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."

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ANNEX 3-D
Risk Screening Assessment

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SWMU 82: RISK SCREENING ASSESSMENT REPORT

I. Site Description and History

Solid Waste Management Unit (SWMU) 82, the Old Aerial Cable (OAC) Site, a 52-acre area located in the U.S. Forest Service Withdrawn Lands, is in a small canyon 1.5 miles east of the Optical Range on Optical Range Road. Access is uncontrolled. The site is currently the home of the High Energy Research Test Facility (HERTF), which is operated by Philips Laboratories. The facility includes a laboratory, a parking lot, and a firing area behind the laboratory. While operated by Sandia National Laboratories/New Mexico (SNL/NM), the OAC was equipped with a concrete impact pad, an overhead cable, a rocket sled track, a catch box, various concrete pads for cameras, a meteorological station, and a generator pad. The rocket sled track, the catch box, the impact pad, the generator pad, and various concrete pads remain on site. The current site boundaries were determined both from the distribution of debris on the site and from historical information.

Principal vegetation in the vicinity of SWMU 82 consists of cacti, juniper, piñon, and other desert flora common to the area. The terrain in the vicinity varies from gently inclined on the canyon floor to steep-sided canyon walls. The SWMU is surrounded by a box canyon on the northwest, north, east, and southeast sides. The canyon walls are composed of Precambrian Metarhyolite bedrock. Alluvial deposits thinly cover the canyon floor and consist of Salas Complex and Tesajo-Millet soil types.

Two engineered channels divert drainage around the HERTF complex. The drainage from the east side of the HERTF ends in a series of culverts at the west end of the parking lot. The drainage from the west side of the HERTF leaves an engineered channel and proceeds in sheet flow across the SWMU 82 impact area. The drainage enters the SWMU 82 voluntary corrective action (VCA) area where fill and debris were removed from the arroyo. The HERTF complex drainage joins another arroyo from the northeast and continues southwest out of the SWMU 82 area in an unnamed arroyo. The VCA installed erosion control in the area where the HERTF drainage joins the arroyo from the northeast. Surface-water flow in the channels occurs only several times per year.

The unnamed arroyo dissipates as the topographic relief decreases to the west. Typically, storm water in this area either evaporates or infiltrates into the soil well before reaching Technical Area III. If the storm is of sufficient duration to produce runoff, the water is collected in a retention pond located in the southeastern corner of Technical Area III. This water is retained until it either evaporates or infiltrates into the soils. Therefore, there is no hydrologic surface connection from the SWMU to the Tijeras Arroyo or to the Rio Grande. The average rainfall at the Albuquerque International Sunport is 8.1 inches per year.

The nearest well to SWMU 82 is the HERTF production well, which is inside the SWMU 82 boundary. The water table elevation as determined through measurements at this well is approximately 5,835 feet above mean sea level beneath SWMU 82, which equates to a groundwater depth of approximately 405 feet below ground surface (bgs).

I.1 Operational History

The OAC Site has been used for weapons-related explosives, impact, and dispersion tests. The site was constructed in 1968 for the purpose of conducting fuel-air explosion tests. The facility was originally designed for dropping the test units, but later tests required the use of rocket-powered sleds to accelerate and draw the test units down from an overhead cable spanning the canyon. The rocket sled traveled on a 220-foot-long rail system that terminated in a 20- by 20-foot catch box filled with sand. The test unit then struck the concrete pad under the cable. One series of tests involved drawing objects down into empty nuclear fuel shipping containers (without the fuel). In another type of test, a trolley system that was suspended from the cable carried targets used for testing interceptor missiles launched from the ground. Dispersion tests involving depleted uranium (DU) and cerium were also conducted at the cable area. The clouds of metal particles from the tests blew to the south/southeast. The OAC was in operation intermittently until 1989, when the HERTF was constructed.

SWMU 82 was designated a radioactive material management area (RMMA) based upon the dispersion test involving DU and cerium. After full characterization of the site, no elevated radionuclides were found in the soils. Based upon the sampling data, the site was removed from the SNL/NM RMMA tracking program on July 26, 1999.

II. Data Quality Objectives

The data quality objectives (DQO) presented in the Operable Unit (OU) 1332 Work Plan, and the SWMU 82 VCA plan identified the site-specific confirmatory sampling locations, sampling depths, sampling procedures and analytical requirements. The DQOs outlined the quality assurance (QA)/quality control (QC) requirements necessary for producing the definitive analytical data suitable for risk-assessment proposes. The confirmatory sampling conducted at SWMU 82 was designed to:

- Confirm that a thorough remediation was conducted during the VCA
- Characterize the nature and extent of any residual contaminants of concern (COC)
- Provide sufficient quality of analytical data to support risk screening assessments.

Table 1 summarizes the rationale for the sampling locations. The source of potential COCs at SWMU 82 was the tests conducted at the OAC. Table 2 summarizes sampling data used to characterize the SWMU. Soil samples were taken at 111 locations within SWMU 82. All samples were collected from 0.5 foot bgs with a hand trowel and using the sampling procedures detailed in the OU 1332 Work Plan and in the SWMU 82 VCA plan.

Samples from the sampling areas discussed in Table 1 were analyzed for COCs from the area as discussed below. Samples from the background, and downstream areas were analyzed for DU-related radionuclides (U-238, Th-232, and U-235) and Cs-137; Target Analyte List (TAL) metals; volatile organic compounds (VOC); semivolatile organic compounds (SVOC); total petroleum hydrocarbons (TPH); and high explosives (HE). The concrete pad area was analyzed for DU-related radionuclides and Cs-137; radionuclides by Gross Alpha and

Table 1
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 82 Sampling Area	Potential COC Source	Number of Sampling Locations	Sampling Density or Pattern	Sampling Location Rationale
Background	Established background conditions for metals, radionuclides, HE, VOCs, and SVOCs. While there is no background for HE, VOCs, and SVOCs, the selected locations would show if HERTF activities that are ongoing were affecting SWMU 82.	3	Samples locations were selected judgmentally.	Confirm that the site is not introducing COCs that are migrating off site. Background sites were selected to be topographically upgradient of the test area (and up wind of dispersion tests). While there is no background for HE, VOCs, and SVOCs, the selected locations would show if HERTF activities that are ongoing were affecting SWMU 82.
Impact Pad Area	HE, DU, metals, and cerium from tests and test debris remaining at the site or dispersed from tests at this point	50	Several sampling events occurred. Site-specific background samples were taken from areas that were upwind of the dispersion tests. Judgmental samples were taken downwind and topographically downgradient from the pad. Additional samples were taken outward from the impact pad along radial lines.	Confirm that no significant levels of COCs are present in the soils that may have been affected by impact pad operations.
Rocket Sled Track, Launch Area, Catch Box	Solid rocket propellant and its combustion byproducts (including HE and some metals).	15 soil sampling locations	Locations of samples were selected judgmentally around the rocket sled launch point and the catch box. Samples were also taken at evenly spaced intervals from along the sled track.	Confirm that no significant levels of COCs remain in the soils that may have been impacted by sled track operations.

Refer to footnotes at end of table.

Table 1 (Concluded)
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 82 Sampling Area	Potential COC Source	Number of Sampling Locations	Sampling Density or Pattern	Sampling Location Rationale
Concrete Pads, Debris Piles	Construction debris (including scrap metal and concrete); and test materials that were dispersed or left on site.	30 soil locations and 10 swipe locations	Three soil samples were collected at evenly spaced intervals from around the perimeter of each pads/debris pile. Swipe samples were taken from the concrete and debris and were analyzed for metals and radionuclides.	Confirm that no significant levels of COCs are present on concrete pads/debris piles or in the soil surrounding them.
Downstream	Characterize downstream for soil and sediment (metals, radionuclides, HE, SVOCs, and VOCs).	3	Three soil samples were collected from judgmentally selected locations.	Downgradient samples were taken from locations selected in the path of COCs leaving the site in surface water or from areas that were in the path of dispersion tests but beyond expected impact areas.
VCA Area	Cable, metal debris, concrete and DU were removed from a buried arroyo channel.	10	Two samples were collected from topographically upgradient of the buried arroyo, six samples were taken from judgmentally selected locations based upon debris removed during the VCA, and two judgmental samples were selected in the arroyo topographically downgradient from the VCA.	Confirm that no significant levels of COCs are present in the soils at the VCA area after remediation.

COC = Contaminant of concern.
DU = Depleted uranium.
HE = High explosives.
HERTF = High Energy Research Test Facility.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VCA = Voluntary corrective action.
VOC = Volatile organic compound.

Table 2
Number of Soil Samples Collected During the Site Characterization and VCA at SWMU 82 and Used in the Risk Assessment

Sample Type	Number of Samples	SVOCs	VOCs	HE	RCRA or TAL Metals	Radionuclides
Confirmatory	304	20	20	36	99	129
VOC Trip Blanks	3		3			
Equipment Blank	14	3	3	3	8	
Field Blank	11	3	3	1	4	
Total Samples	335	26	29	40	111	129
Analytical Laboratory		Lockheed, GEL	Lockheed, GEL	Lockheed, GEL	Lockheed, GEL	RPSD

Sample dates: 10/26/99, 3/23/99, 3/12/98, 3/19-20/97, 11/11/97, 11/20/97, 11/19/97, 7/10/95, 7/6/95
Chain-of-Custody forms: 602890, 601687, 601680, 601681, 510486, 510497, 510073, 510062, 510070, 510071, 510072, 602892, 03899, 03867, 03897, 03900.
GEL = General Engineering Laboratories.
HE = High Explosives.
Lockheed = Lockheed Analytical Services.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostic.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.
VCA = Voluntary corrective action.
VOC = Volatile organic compound.

Gross Beta; Resource Conservation and Recovery Act (RCRA) metals or TAL metals; and HE. The rocket sled track, launch area and catch box were analyzed for: DU-related radionuclides and Cs-137; RCRA metals; and HE. The soils around the concrete pads and debris piles were analyzed for: DU-related radionuclides and Cs-137; and TAL metals. The generator pad was analyzed for: VOCs; SVOCs; TPH; and DU-related radionuclides and Cs-137. The VCA confirmatory samples were analyzed for: DU-related radionuclides and Cs-137; RCRA metals plus Be and Ni; VOCs; SVOCs; and HE.

The samples used for risk assessment were analyzed by three laboratories: General Engineering Laboratories Inc. (GEL), Lockheed Analytical Services, and the on-site SNL/NM Radiation Protection Sample Diagnostic (RPSD) Laboratory. Table 3 summarizes the analytical methods, data quality level, and the number of samples analyzed for each parameter.

Forty-six QA/QC samples were collected during the sampling effort, consistent with the Environmental Restoration (ER) Project Quality Assurance Project Plan. The QA/QC samples consisted of 18 duplicates, 3 trip blanks, 14 equipment blanks, and 11 field blanks. Duplicate soil samples were collected for approximately 10 percent of the chemical analysis, excluding radionuclides by gamma spectroscopy. Equipment blanks were collected at the end of each sampling day. Trip blanks accompanied the soil samples requiring VOC analysis. No problems were identified in the QA/QC samples that would exclude the data from use in the risk assessment with the exception of some VOCs that were validated as nondetects based upon blank contamination and the Blank Rule.

Table 3
Summary of Data Quality Requirements for Samples Used in the Risk Assessment

Analytical Requirement	Data Quality Level	GEL and Lockheed Laboratories	RPSD Laboratory
Gamma Spectroscopy EPA Method 901.1[a]	Definitive	Not analyzed	129 samples
RCRA metals EPA Method 6010/7000[a]	Definitive	99 samples	Not analyzed
VOCs EPA Method 8260A[a]	Definitive	20 samples	Not analyzed
SVOCs EPA Method 8270[a]	Definitive	20 samples	Not analyzed
HE Compounds EPA Method 8330[a]	Definitive	36 samples	Not analyzed

The number of samples does not include QA/QC samples such as duplicates, trip blanks, and equipment blanks.
[a]EPA (November 1986).
EPA = U.S. Environmental Protection Agency.
GEL = General Engineering Laboratories.
HE = High Explosives.
Lockheed = Lockheed Analytical Services.
QA/QC = Quality assurance/quality control.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostic Laboratory.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

All of the soil sample analytical results used in the risk assessment were verified/validated by SNL/NM. Analytical results from the off-site laboratory, GEL, were reviewed according to "Data Verification/Validation Level 3—DV-3" in the Technical Operating Procedure 94-03 (SNL/NM December 1999). The Lockheed Analytical Services data was reviewed according to "Data Verification/Validation Level 2—DV-2" (SNL/NM December 1999). The DV3 and DV2 reports are presented in the associated SWMU 82 no-further-action (NFA) Proposal. The gamma spectroscopy data from the RPSD Laboratory were reviewed according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 02. The RPSD verification/validation reports are presented in the NFA proposal as are the gamma-spectroscopy results. The reviews confirmed that the analytical data from the three analytical laboratories are acceptable for use in the NFA proposal and 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 82 was based upon an initial conceptual model validated with confirmatory sampling at the site. The initial conceptual model was developed from archival research, aerial photographs, visual observations of site conditions, and radiological surveys and sampling. The DQOs contained in the OU 1332 Work Plan and the SWMU 82 VCA plan identified the sample locations, sample density, sample depth, and analytical requirements. The sampling data were subsequently used to develop the final conceptual model for SWMU 82, which is presented in Section 3.5 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 degradation of COCs at SWMU 82 were evaluated using laboratory analysis of the soil samples (Section V). The analytical requirements included analysis for radionuclides, RCRA and TAL metals, VOCs, SVOCs, and HE compounds. The confirmatory analyses characterized any potential contaminants remaining after the VCA. The analytes and methods listed in Tables 2 and 3 were appropriate to characterize the COCs and any potential degradation products at SWMU 82.

III.3 Rate of Contaminant Migration

SWMU 82 is an inactive site that has been recently remediated; and therefore, all primary sources of COCs have been eliminated. As a result, only secondary sources of COCs potentially remain in soil in the form of adsorbed COCs (metals, VOCs, and SVOCs). The rate of COC migration from surficial soil is dependent predominantly upon precipitation and occasional surface-water flow as described in Section V. Data available from the 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 82.

III.4 Extent of Contamination

Surface soil samples were collected from all the OAC site features where COCs might be present, including the VCA area. The soil samples were collected using the sampling density shown in Table 1. All soil samples were collected from a depth of 0 to 0.5 foot. No significant levels of COCs were found in these samples to require additional characterization at depth. Furthermore, the vertical rate of contamination is expected to be extremely low for SWMU 82 because of the low precipitation, high evapotranspiration, and the relatively low solubility of the COCs. Therefore, the 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 sampling program was appropriate and adequate to determine the nature, migration rate and extent of residual COCs in the surface and subsurface soils at SWMU 82.

IV. Comparison of COCs to Background Screening Levels

SWMU history and characterization activities are used to identify potential COCs. The SWMU 82 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 inorganic and radiological COCs for which samples were analyzed. If the detection limit of an organic compound was too high (i.e., could possibly cause an adverse effect to human health or the environment), the compound was retained. Nondetect organics not included in this assessment were 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 (Dinwiddie September 1997, Garcia November 1998) was selected to provide the background screening listed in Tables 4 and 5. 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 that were evaluated included both inorganic and organic compounds.

Table 4 lists nonradiological COCs for the human health and ecological risk assessment at SWMU 82. 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, Garcia November 1998). Sections VI.4, VII.2 and VII.3 discuss Tables 4 and 5.

V. Fate and Transport

The primary releases of COCs at SWMU 82 were to the surface soil. Wind, water, and biota are natural mechanisms of COC transport from the primary release point. Winds at this site, however, are moderated by the canyon topography and by the woodland vegetation. Therefore, wind erosion is probably not significant as a transport mechanism at this site.

Water at SWMU 82 is received as precipitation (rain or occasionally snow). Precipitation will either evaporate at or near the point of contact, infiltrate into the soil, or form runoff. Infiltration at the site is enhanced by the coarse nature of the soil (the soil in the area of the site is primarily Salas Complex very gravelly to stony loam and Tesajo-Millett stony sandy loam [USDA 1977]); however, surface runoff may be produced during intense rainfall events and during extended rainfall periods. Surface-water runoff from SWMU 82 will flow into the unnamed arroyo channel (described in Section I.1) that flows westward to a retention pond in the southeastern corner of Technical Area III. Runoff may carry surface soil particles with adsorbed COCs. The distance of transport will depend upon the size of the particle and the velocity of the water.

Water that infiltrates into the soil will continue to percolate through the soil until field capacity is reached. COCs desorbed from the soil particles into the soil solution may be leached into the subsurface soil with this percolation. The effective rooting depths of the soil at SWMU 82 is about 60 inches [USDA 1977]. This indicates the depth of the system's transient water cycling zone (the dynamic balance between percolation/infiltration and evapotranspiration). Because groundwater at this site is approximately 405 feet bgs, the potential for COCs to reach groundwater through the unsaturated zone above the water table is very small. As water from the surface evaporates, the direction of COC movement may be reversed with capillary rise of the soil water.

Table 4
Nonradiological COCs for Human Health and Ecological Risk Assessment at SWMU 82 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC Name	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K_{ow} (for organic COCs)	Bioaccumulator?[b] (BCF >40, log K_{ow} 4)
Arsenic	26.5	9.8	**No**	44[c]	NA	**Yes**
Barium	211	246	Yes	170[d]	NA	**Yes**
Beryllium	1.04	0.75	**No**	19[c]	NA	No
Cadmium	4.17	0.64	**No**	64[c]	NA	**Yes**
Chromium, total	14	18.8	Yes	16[c]	NA	No
Lead	23	18.9	**No**	49[c]	NA	**Yes**
Mercury	0.21	0.055	**No**	5500[c]	NA	**Yes**
Nickel	20	16.6	**No**	47[c]	NA	**Yes**
Selenium	0.687	2.7	Yes	800[e]	NA	**Yes**
Silver	1[f]	<0.5	**No**	0.5[c]	NA	No
Zinc	350	52.1	**No**	47[c]	NA	**Yes**
Benzene	0.0011 J	NA	**NA**	5.2[c]	2.13[c]	No
Chrysene	0.17 J	NA	**NA**	18,000[g]	5.91[g]	**Yes**
Carbon Disulfide	0.00059 J	NA	**NA**	7.9[h]	2.93[h]	No
Bromoform	0.0024 J	NA	**NA**	37.4[g]	2.38[g]	No
2-Butanone	0.016	NA	**NA**	1[h]	0.29[h]	No
2-Chloroethyl vinyl ether	0.0023 J	NA	**NA**	5[i]	0.99[i]	No
m,p-Xylene	0.0015 J	NA	**NA**	23.4[h]	1.5[g]	No
Tetrachloroethene	0.0016 J	NA	**NA**	49[h]	2.67[g]	**Yes**
1,1,2,2-Tetrachloroethane	0.013	NA	**NA**	10[h]	2.39[h]	No
1,2-Dichlorobenzene	0.007	NA	**NA**	560[j]	3.38[j]	**Yes**
1,3-Dichlorobenzene	0.0034 J	NA	**NA**	740[j]	3.53[g]	**Yes**
1,4-Dichlorobenzene	0.0038 J	NA	**NA**	55.6[c]	3.52[c]	**Yes**
Pentaerythritol tetranitrate	1.0	NA	**NA**	281[k]	3.71[k]	**Yes**

Note: **Bold** indicates the COCs that failed the background screening procedure and/or are bioaccumulators.
[a]From Garcia (November 1998) Canyon Area Soils.
[b]NMED (March 1998).
[c]Yanicak (March 1997).
[d]Neumann (1976).
[e]Callahan et al. (1979).
[f]Parameter was nondetect. Concentration is 0.5 of detection limit.
[g]Micromedex, Inc (1998).
[h]Howard (1990).
[i]Howard (1993)
[j]Howard (1989).
[k]Rosenblatt et. al (1991).

BCF = Bioconcentration factor.
COC = Constituent of concern.
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.
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 82 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)
Cs-137	1.21	1.55	Yes	3000[c]	**Yes**
Th-232	**1.35**	1.03	**No**	3000[d]	No[e]
U-235[f]	**0.53 (ND)**	0.16	**No**	900[d]	**Yes**
U-238	**6.71 (ND)**	2.31	**No**	900[d]	**Yes**

Note: **Bold** indicates COCs that failed the background screening procedure and/or are bioaccumulators.
[a]From Dinwiddie (September 1997), Canyons Background.
[b]NMED (March 1998).
[c]From Whicker and Schultz (1982).
[d]From Baker and Soldat (1992).
[e]Yanicak (March 1997).
[f]Concentration for ND result where MDA is greater than background levels and any measured concentrations.
BCF = Bioconcentration factor.
COC = Constituent of concern.
MDA = Minimum detectable activity (concentration)
ND = Not detected.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Plant roots can take up COCs that are in the soil. These COCs may 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 biotransformations. Those that remain in the tissue can be consumed by herbivores or eventually 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 82 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 can 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 caused by 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 82. COCs at this site include both inorganics (metals and radionuclides) and organics in surface soil. Because of the local topography and woodland vegetation, the potential for transport of COCs by wind is low. The potential for transport by surface-water runoff is moderate for COCs currently at or near the soil surface. 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 moderate to low because of the terrestrial nature of the habitat and the arid climate. Degradation and/or biotransformation of organics and their loss by volatilization can be significant. The potential for uptake into the food chain by organic COCs at SWMU 82 is considered moderate to low because of the terrestrial nature of the habitat and the arid climate. Decay of radiological COCs is insignificant because of their long half lives.

VI. Human Health Risk Screening Assessment

VI.1 Introduction

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

Table 6
Summary of Fate and Transport at SWMU 82

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

SWMU = Solid Waste Management Unit.

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 U.S. Department of Energy (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 in the above steps are discussed.

VI.2 Step 1. Site Data

Section I provides the description and history for SWMU 82. Section II presents DQOs. Section III discusses the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

SWMU 82 has been designated a future land use scenario of recreational (DOE et al. October 1995) (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 82 is approximately 405 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 recreational 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)
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 screening procedure compares the maximum COC concentration to the background screening level. The second screening procedure compares maximum COC concentrations to SNL/NM proposed Subpart S action levels. This second procedure is applied only to COCs that are 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 background values 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 82 maximum COC concentrations that were compared to the SNL/NM maximum background values (Dinwiddie September 1997, Garcia 1998) for the human health risk assessment. For the nonradiological COCs, eight constituents were measured at concentrations greater than their respective background. Thirteen COCs were organic compounds and did not have background screening levels.

The maximum concentration value for lead is 23 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, three constituents had minimum detectable activities or detected concentrations greater than its respective background (U-238, U-235, and Th-232). All three were evaluated in the risk assessment for conservative 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 82 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 82 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 1998a), the Health Effects Assessment Summary Tables (HEAST) (EPA 1997a), and the Region 3 (EPA 1997b) and Region 9 (EPA 1996b) 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 potential nonradiological COCs and associated background for recreational and residential land uses. The incremental TEDE and incremental estimated cancer risk are provided for the background-adjusted radiological COCs for both recreational 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 recreational 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.

Table 7
Toxicological Parameter Values for SWMU 82 Nonradiological COCs

COC Name	RfD_o (mg/kg-d)	Confidence[a]	RfD_{inh} (mg/kg-d)	Confidence[a]	SF_o $(mg/kg\text{-}day)^{-1}$	SF_{inh} $(mg/kg\text{-}day)^{-1}$	Cancer Class[b]
Arsenic	3E-4[c]	M	–	–	1.5E+0[c]	1.5E+1[c]	A
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
Mercury	3E-4[e]	–	8.6E-5[c]	M	–	–	D
Nickel	2E-2[c]	M	–	–	–	–	–
Silver	5E-3[c]	L	–	–	–	–	D
Zinc	3E-1[c]	M	–	–	–	–	D
Benzene	1.7E-3[d]	–	1.7E-3[d]	–	2.9E-2[c]	2.9E-2[c]	A
Bromoform	2E-2[c]	M	2E-2[d]	–	7.9E-3[c]	3.9E-3[c]	B2
2-butanone	6E-1[c]	L	2.9E-1[c]	L	–	–	D
Carbon disulfide	1E-1[c]	M	2E-1[c]	M	–	–	–
2-chloroethyl vinyl ether	2.5E-2[f]	–	–	–	–	–	–
Chrysene	–	–	–	–	7.3E-3[d]	7.3E-3[d]	B2
1,2-dichloro-benzene	9E-2[c]	L	5.7E-2[d]	–	–	–	D
1,3-dichloro-benzene	3E-2[d]	–	3E-2[d]	–	–	–	D
1,4-dichloro-benzene	2.3E-1[d]	–	2.3E-1[c]	M	2.4E-2[e]	2.4E-2[d]	C
Pentaerythritol tetranitrate[g]	3.2E-3	–	3.2E-3	–	4.8E-3	4.8E-3	–
Tetrachloroethene	1E-2[c]	M	1E-2[d]	–	5.2E-2[d]	2E-3[d]	–
1,1,2,2-tetra-chloroethane	–	–	–	–	2E-1[c]	2E-1[c]	C
m,p-xylene[h]	2E+0[c]	M	2E-1[d]	–	–	–	D

[a]Confidence associated with IRIS (EPA 1998a) database values. Confidence: L = low, M = medium, H = high.
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 1998a) except for 1,4 Dichlorobenzene which is taken from HEAST (EPA 1997a)

- 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.

[c]Toxicological parameter values from IRIS electronic database (EPA 1998a).
[d]Toxicological parameter values from EPA Region 9 electronic database (EPA 1996b)
[e]Toxicological parameter values from HEAST database (EPA 1997a)
[f]Toxicological parameter values from EPA Region 3 electronic database (EPA 1997b)
[g]Toxicological parameter values for pentaerythritol tetranitrate based on ratio to TNT based on LD_{50}.
[h]Toxicological parameter values are for xylene, mixture.

COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
HEAST = Health Effects Assessment Summary Tables.
IRIS = Integrated Risk Information System.
mg/kg-d = Milligram(s) per kilogram day.
$(mg/kg\text{-}day)^{-1}$ = Per milligram per kilogram day.
RfD_{inh} = Inhalation chronic reference dose.

Table 7 (Concluded)
Toxicological Parameter Values for SWMU 82 Nonradiological COCs

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 82 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]
Th-232	3.30E-11	1.90E-08	2.00E-11	A
U-235	4.70E-11	1.30E-08	2.70E-07	A
U-238	6.2E-11	1.20E-08	6.60E-08	A

[a]From Yu et al. (1993a).
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989): A = Human carcinogen for high dose and high dose rate (i.e., greater than 50 rem per year). For low-level environmental exposures, the carcinogenic effect has not been observed and documented.
1/pCi = One per picocurie
COC = Constituent 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.

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 recreational 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 a HI of 0.01 for the SWMU 82 nonradiological COCs and an estimated excess cancer risk of 2E-6 for the designated recreational land use scenario. The numbers presented included exposure from soil ingestion and dust and volatile inhalation for nonradiological COCs. Table 10 shows a HI of 0.00 and an excess cancer risk of 6E-7 assuming the maximum

Table 9
Risk Assessment Values for SWMU 82 Nonradiological COCs

COC Name	Maximum Concentration (mg/kg)	Recreational Land Use Scenario[a]		Residential Land Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	26.5	0.01	2E-6	1.51	3E-4
Beryllium	1.04	0.00	3E-11	0.00	8E-10
Cadmium	4.17	0.00	9E-11	3.41	2E-9
Mercury	0.21	0.00	–	0.36	–
Nickel	20	0.00	–	0.03	–
Silver	1[b]	0.00	–	0.04	–
Zinc	350	0.00	–	0.63	–
Benzene	0.0011 J	0.00	5E-11	0.00	1E-8
Bromoform	0.0024 J	0.00	2E-12	0.00	5E-9
2-butanone	0.016	0.00	–	0.00	–
2-chloroethyl vinyl ether	0.0023 J	0.00	–	0.00	–
m,p-xylene	0.0015 J	0.00	–	0.00	–
Tetrachloroethene	0.0016 J	0.00	8E-12	0.00	2E-8
1,1,2,2-tetrachloroethane	0.013	0.00	8E-10	0.00	6E-7
1,2-dichlorobenzene	0.007	0.00	–	0.00	–
1,3-dichlorobenzene	0.0034 J	0.00	–	0.00	–
1,4-dichlorobenzene	0.0038 J	0.00	3E-11	0.00	5E-9
Pentaerythritol tetranitrate	1.0	0.00	2E-10	0.00	8E-9
Chrysene	0.17 J	0.00	5E-11	0.00	6E-9
Carbon Disulfide	0.00059 J	0.00	–	0.00	–
Total		**0.01**	**2E-6**	**6**	**3E-4**

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

Table 10
Risk Assessment Values for SWMU 82 Nonradiological Background Constituents

COC Name	Background Concentration[a] (mg/kg)	Recreational Land Use Scenario[b]		Residential Land Use Scenario[b]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	9.8	0.00	6E-7	0.56	1E-4
Beryllium	0.75	0.00	2E-11	0.00	6E-10
Cadmium	0.64	0.00	1E-11	0.52	4E-10
Mercury	0.055	0.00	–	0.09	–
Nickel	16.6	0.00	–	0.02	–
Silver	<0.5	–	–	–	–
Zinc	52.1	0.00	–	0.09	–
Total		**0.00**	**6E-7**	**1**	**1E-4**

[a]From Garcia (1998), Canyons Area.
[b]From EPA (1989).
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
– = Information not available.

background concentrations of the SWMU 82 associated background constituents for the designated recreational land use scenario.

For the radiological COCs, contribution from the direct gamma exposure pathway is included. For the recreational land use scenario, a TEDE was calculated for an individual who spends 4 hours per week on the site. This resulted in an incremental TEDE of 1.3E-1 millirem/year (mrem/yr). In accordance with EPA guidance found in Office of Solid Waste and Emergency Response Directive No. 9200.4-18 (EPA 1997c), an incremental TEDE of 15 mrem/yr is used for the probable land use scenario (recreational in this case); the calculated dose value for SWMU 82 for the recreational land use is well below this guideline. The estimated excess cancer risk is 1.6E-6.

For the residential land use scenario nonradioactive COCs, the HI is 6, and the excess cancer risk is 3E-4 (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 82 associated background constituents, the HI is 1 and the excess cancer risk is 1E-4.

For the radiological COCs, the incremental TEDE for the residential land use scenario is 1.8 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 82 for the residential land use scenario is well below this guideline. Consequently, SWMU 82 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 2.5E-5. The excess cancer risk from the nonradiological COCs and the radiological COCs is not additive, as noted in the RAGS (EPA 1989).

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

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

For the recreational land use scenario nonradiological COCs, the HI is 0.01 (less than the numerical guideline of 1 suggested in the RAGS [EPA 1989]). Excess cancer risk is estimated at 2E-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 arsenic. Arsenic is a Class A carcinogen. 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 recreational and the residential land use scenarios. Assuming the recreational land use scenario, for nonradiological COCs the HI is 0.00 and the excess cancer risk is 6E-7. 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 constituent that does not have a quantified background concentration (silver) is assumed to have an HQ of 0.00. Incremental HI is 0.01 and estimated incremental cancer risk is 1.40E-6 for the recreational land use scenario. The incremental excess cancer risk to human health from the nonradiological COCs is above guidelines considering a recreational land use scenario.

For radiological COCs in the recreational land use scenario, incremental TEDE is 1.3-E1 mrem/yr, which is significantly less than the EPA's numerical guideline of 15 mrem/yr. Incremental estimated excess cancer risk is 1.6E-6.

The calculated HI for the residential land use scenario nonradiological COCs is 6, which is above the numerical guidance. Excess cancer risk is estimated at 3E-4. The excess cancer risk is driven by arsenic. Arsenic is a Class A carcinogen. 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 1; the excess cancer risk is estimated at 1.3E-4. The incremental HI is 4.7 and the estimated incremental cancer risk is 2.01E-4 for the residential land use scenario. 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 1.8 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 2.4E-5.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at SWMU 82 was based upon an initial conceptual model that was validated with soil sampling conducted across the site. The sampling was implemented in accordance with the OU 1332 Work Plan and the SWMU 82 VCA plan. The DQOs contained in the Work Plan and SWMU 82 VCA 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. Data quality was verified/validated in accordance with SNL/NM procedures (SNL/NM July 1994, SNL/NM July 1996). Therefore, there is no uncertainty associated with the data quality used to perform the risk screening assessment at SWMU 82.

Because of the location, history of the site, and future land use (DOE et al. October 1995), 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 1998a), the HEAST (EPA 1997a), EPA Region 3 (EPA 1997b) and EPA Region 9 (EPA 1996b) electronic databases. Where values are not provided, information is not available from the HEAST (EPA 1997a), the IRIS (EPA 1998a), or the EPA regions (EPA 1996b, 1997b). 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 recreational land use scenario compared to established numerical guidance. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated by using maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the 95th-percentile upper confidence limit of the mean for arsenic (5.98) is used in place of the maximum concentration, arsenic is below background and, therefore, is not considered further. With the removal of arsenic, the total excess cancer risk is reduced to 1E-9 and the incremental excess cancer risk is calculated to be 1.23E-9, both of which are within proposed guidelines considering a recreational land use scenario.

For radiological COCs, the conclusion of the risk assessment is that potential effects on human health for both recreational 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

Identified COCs at SWMU 82 consist of some inorganic, organic, and radiological compounds. Because of the location of the site, the designated recreational 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 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 recreational land use scenario the HI (0.01) is significantly less than the accepted numerical guidance from the EPA. Excess cancer risk (2E-6) is above the acceptable risk value provided by the NMED for a recreational land use scenario (NMED March 1998). The incremental HI is 0.01, and the incremental cancer risk is 1.40E-6 for the recreational land use scenario. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated by using maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the 95th-percentile upper confidence limit of the mean for arsenic (5.98) is used in place of the maximum concentration, arsenic is below background and, therefore, is not considered further. With the removal of arsenic, the total excess cancer risk is reduced to 1E-9 and the incremental excess cancer risk is calculated to be 1.23E-9, both of which are within proposed guidelines considering a recreational land use scenario.

Incremental TEDE and corresponding estimated cancer risk from radiological COCs are much less than EPA guidance values; the estimated TEDE is 1.3E-1 mrem/yr for the recreational land use scenario. This value is much less than the numerical guidance of 15 mrem/yr in EPA guidance (EPA 1997c). The corresponding incremental estimated cancer risk value is 1.6E-6 for the recreational land use scenario. Furthermore, the incremental TEDE for the residential land use scenario that results from a complete loss of institutional control is only 1.8 mrem/yr with an associated risk of 2.4E-5. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore, SWMU 82 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 recreational 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 82. A component of the NMED Risk-Based Decision Tree (March 1998) is to conduct an ecological screening assessment that corresponds with that presented in 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 the NMED's decision tree (a discussion of DQOs, a data assessment, and evaluations of bioaccumulation and fate-and-transport potential) are addressed in previous sections of this report. Following the completion of the scoping assessment, a determination is made as to whether a more detailed examination of potential ecological risk is necessary. If deemed necessary, the scoping assessment proceeds to a screening assessment whereby a more quantitative estimate of ecological risk is conducted. Although this assessment incorporates conservatisms in the estimation of ecological risks, ecological relevance and professional judgment are also used as recommended by the EPA (1998b) to ensure that predicted exposures of selected ecological receptors reflect those reasonably expected to occur at the site.

VII.2 Scoping Assessment

The scoping assessment focuses primarily on the likelihood 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:

- Arsenic
- Beryllium
- Cadmium
- Lead
- Mercury
- Nickel
- Silver
- Zinc
- Th-232
- U-235
- U-238.

Organic analytes detected in soil were as follows:

- Benzene
- Bromoform
- 2-butanone
- Carbon disulfide
- 2-chloroethyl vinyl ether
- Chrysene
- 1,2-dichlorobenzene
- 1,3-dichlorobenzene
- 1,4-dichlorobenzene
- Pentaerythritol tetranitrate
- 1,1,2,2-tetrachloroethane
- Tetrachloroethene
- m,p-xylene.

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):

- Arsenic
- Cadmium
- Lead
- Mercury
- Nickel
- Zinc
- U-235
- U-238
- Chrysene
- 1,2-dichlorobenzene
- 1,3-dichlorobenzene
- 1,4-dichlorobenzene
- Tetrachloroethene
- Pentaerythritol tetranitrate.

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 low significance as a transport mechanism for COPECs at this site, but surface-water runoff may be of moderate significance. Migration to groundwater is not anticipated. Food chain uptake is expected to be of moderate to low significance. Degradation/transformation for inorganic COPECs and radionuclides is expected to be of low significance. For the organic COPECs, the potential for biotransformation/degradation is moderate to high, and loss by volatilization is also expected to occur.

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 82 is approximately 20 acres in size. The site is located in a small canyon at the base of the Manzanita Mountains and is dominated by an open piñon-juniper savanna woodland with a grassland understory. The site is open for use by wildlife. A sensitive species survey of the site was conducted on August 26, 1994 (IT February 1995). The area was also included in a basewide threatened and endangered species survey conducted by the New Mexico Natural Heritage Program (NMNHP) for the U.S. Air Force (NMNHP 1995). Although the former survey recorded some scattered individuals of the visnagita cactus (*Neolloydia intertexta*) on the site, which was then listed as an endangered plant by the State of New Mexico, this species has since been removed from the endangered plant list and is no longer considered a sensitive species. The NMNHP survey recorded gray vireos (*Vireo vicinior*), a New Mexico threatened species, in the foothills of the Manzanita Mountains, including the hill slopes adjacent to SWMU 82; however, the species is not known to occur within SWMU 82.

Complete ecological pathways may exist at this site through the exposure of plants and wildlife to COPECs in surface and subsurface soil. It was assumed that direct uptake of COPECs from soil 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

Inorganic and organic COPECs for SWMU 82 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 by IT Corporation (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. Although burrowing owls may not occur in the area of SWMU 82 because of the coarse nature of the soils, it is used to provide conservative representation of exposure and risk to other small predatory birds such as the western screech owl (*Otus kennicottii*) that may inhabit 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. 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 provide a conservative estimate of 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 Th-232, 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

Table 11
Exposure Factors for Ecological Receptors at SWMU 82

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

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

EPA = U.S. Environmental Protection Agency.
kg = Kilogram(s).
kg/day = Kilogram(s) per day.
SWMU = Solid Waste Management Unit.

the 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 Th-232, 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 (LOAEL). For wildlife, the toxicity benchmarks are based upon the no-observed-adverse-effect level (NOAEL) for chronic oral exposure in a taxonomically similar test species. Insufficient toxicity information was found to estimate the LOAELs or NOAELs for some COPECs for terrestrial plant life and for the burrowing owl, respectively.

The benchmark used for exposure of terrestrial receptors to radiation was 0.1 rad/day. This value has been recommended by the International Atomic Energy Agency (IAEA 1992) for the protection of terrestrial populations. Because plants and insects are less sensitive to radiation than vertebrates (Whicker and Schultz 1982), the dose of 0.1 rad/day should also offer sufficient protection to other components within the terrestrial habitat of SWMU 82.

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.

Analytes with HQs exceeding unity for plants were arsenic, cadmium, and zinc. HQs for plants could not be determined for any of the organic COPECs at this site except chrysene. Arsenic had HQs greater than unity for the deer mouse (all three dietary regimes). Mercury, when assumed to be entirely in organic form, resulted in HQs greater than 1.0 for the burrowing owl.

Table 12
Transfer Factors Used in Exposure Models for Constituents of Potential Ecological Concern at SWMU 82

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Inorganic			
Arsenic	4.0E-2[a]	1.0E+0[b]	2.0E-3[a]
Beryllium	1.0E-2[a]	1.0E+0[b]	1.0E-3[a]
Cadmium	5.5E-1[a]	6.0E-1[c]	5.5E-4[a]
Lead	9.0E-2[d]	4.0E-2[c]	8.0E-4[d]
Mercury	1.0E+0[d]	1.0E+0[b]	2.5E-1[a]
Nickel	2.0E-1[d]	3.8E-1[e]	6.0E-3[a]
Silver	1.0E+0[d]	2.5E-1[c]	5.0E-3[d]
Zinc	1.5E+0[a]	3.0E-1[c]	1.0E-1[a]
Organic[f]			
1,1,2,2-tetrachloroethane	1.6E+0	1.7E+1	5.4E-6
1,2-dichlorobenzene	4.3E-1	1.9E+1	5.7E-5
1,3-dichlorobenzene	3.5E-1	2.0E+1	8.2E-5
1,4-dichlorobenzene	4.0E-1	2.0E+1	6.6E-5
2-butanone	2.6E+1	1.4E+1	3.7E-8
2-chloroethyl vinyl ether	1.0E+1	1.5E+1	1.9E-7
Benzene	2.3E+0	1.7E+1	2.9E-6
Bromoform	1.6E+0	1.7E+1	5.3E-6
Carbon disulfide	7.8E-1	1.8E+1	2.0E-5
Chrysene	1.5E-2	2.6E+1	2.3E-2
Pentaerythritol tetranitrate	2.8E-1	2.0E+1	1.3E-4
Tetrachloroethene	1.1E+0	1.8E+1	1.1E-5
m,p-xylene	5.5E-1	1.9E+1	3.7E-5

[a]From Baes et al. (1984).
[b]Default value.
[c]From Stafford et al. (1991).
[d]From NCRP (January 1989).
[e]From Ma (1982).
[f]Soil-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.

K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
NCRP = National Council on Radiation Protection and Measurements.
SWMU = Solid Waste Management Unit.

Table 13
Media Concentrations[a] for Constituents of Potential Ecological Concern at SWMU 82

Constituent of Potential Ecological Concern	Soil (maximum)[a]	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Inorganic				
Arsenic	2.7E+1	1.1E+0	2.7E+1	8.9E-2
Beryllium	1.0E+0	1.0E-2	1.0E+0	1.7E-3
Cadmium	4.2E+0	2.3E+0	2.5E+0	4.3E-3
Lead	2.3E+1	2.1E+0	9.2E-1	4.9E-3
Mercury	2.1E-1	2.1E-1	2.1E-1	1.7E-1
Nickel	2.0E+1	4.0E+0	7.6E+0	1.2E-1
Silver	1.0E+0[d]	1.0E+0	2.5E-1	1.0E-2
Zinc	3.5E+2	5.3E+2	1.1E+2	1.0E+2
Organic				
1,1,2,2-tetrachloroethane	1.3E-2	2.1E-2	2.3E-1	2.1E-6
1,2-dichlorobenzene	7.0E-3	3.0E-3	1.4E-1	1.2E-5
1,3-dichlorobenzene	3.4E-3[e]	1.2E-3	6.7E-2	8.7E-6
1,4-dichlorobenzene	3.8E-3[e]	1.5E-3	7.4E-2	7.8E-6
2-butanone	1.6E-2	4.2E-1	2.2E-1	3.7E-8
2-chloroethyl vinyl ether	2.3E-3[e]	2.4E-2	3.4E-2	1.8E-8
Benzene	1.1E-3[e]	2.5E-3	1.9E-2	9.6E-8
Bromoform	2.4E-3[e]	3.9E-3	4.2E-2	3.8E-7
Carbon disulfide	5.9E-4[e]	4.6E-4	1.1E-2	3.5E-7
Chrysene	1.7E-1[e]	2.5E-3	4.4E+0	1.6E-1
Pentaerythritol tetranitrate	1.0E+0	2.8E-1	2.0E+1	4.0E-3
Tetrachloroethene	1.6E-3[e]	1.8E-3	2.9E-2	5.0E-7
m,p-xylene	1.5E-3[e]	8.2E-4	2.9E-2	1.7E-6

[a]In milligram(s) per kilogram. All biotic media are based upon dry weight of the media. Soil concentration measurements are assumed to have been based upon dry weight. Values have been rounded to two significant digits after calculation.
[b]Product of the soil concentration and the corresponding transfer factor.
[c]Based upon the deer mouse with an omnivorous diet. Product of the average concentration ingested in food and soil times the food-to-muscle transfer factor times a wet weight-dry weight conversion factor of 3.125 (EPA 1993).
[d]Analyte was not detected. Soil concentration value is 0.5 of the detection limit.
[e]Based upon an estimated concentration.
EPA = U.S. Environmental Protection Agency.
SWMU = Solid Waste Management Unit.

Table 14
Toxicity Benchmarks for Ecological Receptors at SWMU 82

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							
Arsenic	10	Mouse	0.126	0.133	Mallard	5.14	5.14
Beryllium	10	Rat	0.66	1.29	–	–	–
Cadmium	3	Rat[h]	1.0	1.9	Mallard	1.45	1.45
Lead	50	Rat	8.0	15.7	American kestrel	3.85	3.85
Mercury (inorganic)	0.3	Mouse	13.2	14.0	Japanese quail	0.45	0.45
Mercury (organic)	0.3	Rat	0.032	0.063	Mallard	0.0064	0.0064
Nickel	30	Rat	40	78.2	Mallard	77.4	77.4
Silver	2	Rat	17.8[i]	34.8	–	–	–
Zinc	50	Rat	160	313	Chicken	14.5	14.5
Organic							
1,1,2,2-tetrachloroethane	–	Rat	14.1[j]	27.6	–	–	–
1,2-dichlorobenzene	–	Rat	134[k]	262	–	–	–
1,3-dichlorobenzene	–	Rat	116[l]	227	–	–	–
1,4-dichlorobenzene	–	Rat	134[m]	262	–	–	–
2-butanone	–	Rat	1,771	3,464	–	–	–
2-chloroethyl vinyl ether	–	Rat	8.6[n]	16.8	–	–	–
Benzene	–	Mouse	26.4	27.9	–	–	–
Bromoform	–	Rat	14.3[o]	28.0	–	–	–
Carbon disulfide	–	Rabbit	1.1[o]	3.9	–	–	–
Chrysene	18[p]	Mouse	1.0[q]	1.1	–	–	–
Pentaerythritol tetranitrate	–	Mouse	5,868[r]	6,211	–	–	–
Tetrachloroethene	–	Mouse	1.4	1.5	–	–	–
m,p-xylene	–	Mouse	2.1	2.2	–	–	–

Refer to footnotes at end of table.

Table 14 (Concluded)
Toxicity Benchmarks for Ecological Receptors at SWMU 82

[a]In milligram(s) per kilogram soil dry weight.
[b]From Efroymson et al. (1997).
[c]Body weights (in kilogram[s]) for the NOAEL conversion are as follows: lab mouse, 0.030; lab rat, 0.350 (except where noted).
[d]From Sample et al. (1996), except where noted.
[e]In milligram(s) per kilogram body weight per day.
[f]Based upon NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.0239 kilogram and a mammalian scaling factor of 0.25.
[g]Based upon NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.
[h]Body weight: 0.303 kilogram.
[i]Based upon a rat LOAEL of 89 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.2.
[j]Based on mouse NOAEL for 1,1,1-trichloroethane from Sample et al. (1996) and scaled to a rat and ratio of LD_{50} values for 1,1,2,2-tetrachloroethane and 1,1,1-trichloroethane (Micromedex 1998).
[k]From EPA (1998a), based upon chronic NOAEL of 188 mg/kg per 5 out of 7 days multiplied by 0.71 to convert to mg/kg/d.
[l]Based on NOAEL for 1,2-dichlorobenzene (EPA 1998a) and the ratio of LD_{50} values for 1,2-dichlorobenzene and 1,3-dichlorobenzene (Micromedex 1998).
[m]Based on NOAEL for 1,2-dichlorobenzene (EPA 1998a) and the ratio of LD_{50} values for 1,2-dichlorobenzene and 1,4-dichlorobenzene (the ratio is equal to 1) (Micromedex 1998).
[n]Based on rat subchronic NOAEL for ethyl ether (EPA 1998a) and ratio of LD_{50} values for ethyl ether and 2-chloroethyl vinyl ether (Micromedex 1998).
[o]From EPA (1998a).
[p]From Sims and Overcash (1983).
[q]Based on the NOAEL for benzo(a)pyrene from Sample et al. (1996).
[r]Based on a NOAEL for nitroglycerin (Smith 1986) and ratio of LD_{50} values for nitroglycerin and pentaerythritol tetranitrate (Micromedex 1998).
EPA = U.S. Environmental Protection Agency.
LD_{50} = Acute lethal dose to 50 percent of the test population.
LOAEL = Lowest-observed-adverse-effect level.
mg/kg = Milligram(s) per kilogram.
mg/kg/d= Milligram(s) per kilogram per day.
NOAEL = No-observed-adverse-effect level.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data.

Table 15
HQs for Ecological Receptors at SWMU 82

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Inorganic					
Arsenic	**2.7E+0**	**1.9E+0**	**1.7E+1**	**3.2E+1**	1.3E-2
Beryllium	1.0E-1	3.8E-3	6.6E-2	1.3E-1	–
Cadmium	**1.4E+0**	2.0E-1	2.1E-1	2.1E-1	6.7E-3
Lead	4.6E-1	2.5E-2	1.9E-2	1.4E-2	1.4E-2
Mercury (inorganic)	7.0E-1	2.4E-3	2.4E-3	2.4E-3	4.3E-2
Mercury (organic)	7.0E-1	5.3E-1	5.3E-1	5.3E-1	**3.0E+0**
Nickel	6.7E-1	8.8E-3	1.2E-2	1.6E-2	7.4E-4
Silver	5.0E-1	4.6E-3	2.9E-3	1.2E-3	–
Zinc	**7.0E+0**	2.7E-1	1.6E-1	5.6E-2	8.3E-1
Organic					
1,1,2,2-tetrachloroethane	–	1.2E-4	7.0E-4	1.3E-3	–
1,2-dichlorobenzene	–	1.9E-6	4.1E-5	8.1E-5	–
1,3-dichlorobenzene	–	8.7E-7	2.4E-5	4.6E-5	–
1,4-dichlorobenzene	–	9.4E-7	2.3E-5	4.4E-5	–
2-butanone	–	1.9E-5	1.4E-5	9.8E-6	–
2-chloroethyl vinyl ether	–	2.2E-4	2.7E-4	3.1E-4	–
Benzene	–	1.4E-5	5.9E-5	1.0E-4	–
Bromoform	–	2.2E-5	1.3E-4	2.3E-4	–
Carbon disulfide	–	1.9E-5	2.3E-4	4.3E-4	–
Chrysene	9.4E-3	8.7E-4	3.3E-1	6.5E-1	–
Pentaerythritol tetranitrate	–	7.5E-6	2.6E-4	5.1E-4	–
Tetrachloroethene	–	1.9E-4	1.6E-3	3.0E-3	–
m,p-xylene	–	6.0E-5	1.0E-3	2.0E-3	–
HI[a]	**1.4E+1**	**2.9E+0**	**1.8E+1**	**3.4E+1**	**3.9E+0**

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

HQs for the burrowing owl could not be determined for beryllium, silver, and all organic COPECs. 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 34 for the insectivorous deer mouse. This HI was almost entirely accounted for by the HQ for arsenic.

Tables 16 and 17 summarize the internal and external dose rate model results for Th-232, U-235, and U-238. The total radiation dose rate to the deer mouse was predicted to be 1.4E-3 rad/day and that to the burrowing owl was predicted to be 1.3E-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 82. 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 toxicity benchmarks based upon NOAEL values, the incorporation of strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse, and the use of 1.0 as the area use factor for wildlife receptors regardless of seasonal use or home range size. Each of these uncertainties, which are consistent among each of the SWMU-specific ecological risk assessments, is discussed in greater detail in the uncertainty section of the ecological risk assessment methodology document for the SNL/NM ER Project (IT July 1998).

Uncertainties associated with the estimation of risk to ecological receptors following exposure to U-235, U-238, and Th-232 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 82 is approximately 20 acres in size, an area use factor of approximately 0.58 would be justified for this receptor. This is sufficient to reduce the HQ for organic mercury 1.7.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. For several inorganic COPECs, conservatisms in the modeling of exposure and risk 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 arsenic. Background may account for as much as 37 percent of the HQs for arsenic at this site. It is, therefore, likely that actual risk from arsenic at SWMU 82 is overestimated by the HQs calculated in this screening assessment because of conservatisms incorporated into the exposure assessment and in the toxicity benchmarks for these COPECs (e.g., the use of NOAELs for wildlife receptors).

Table 16
Internal and External Dose Rates for
Deer Mice Exposed to Radionuclides at SWMU 82

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Th-232	1.35	5.4E-7	2.6E-4	2.6E-4
U-235[a]	0.53	5.8E-6	8.6E-6	1.4E-5
U-238	6.71	6.8E-5	1.0E-3	1.1E-3
Total		7.4E-5	1.3E-3	1.4E-3

[a]Gamma spectrometry result for this radionuclide was ND (not detected above MDA), but the MDA was higher than background and other reported concentrations. Therefore, the maximum MDA was used in the risk assessment calculations.
MDA = Minimum detectable activities.
ND = Nondetect.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

Table 17
Internal and External Dose Rates for
Burrowing Owls Exposed to Radionuclides at SWMU 82

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Th-232	1.35	7.9E-7	2.6E-4	2.6E-4
U-235[a]	0.53	2.3E-6	8.6E-6	1.1E-5
U-238	6.71	2.7E-5	1.0E-3	1.1E-3
Total		3.1E-5	1.3E-3	1.3E-3

[a]Gamma spectrometry result for this radionuclide was ND (not detected above MDA), but the MDA was higher than background and other reported concentrations. Therefore, the maximum MDA was used in the risk assessment calculations.
MDA = Minimum detectable activities.
ND = Nondetect.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

Table 18
HQs for Ecological Receptors Exposed to Background Concentrations at SWMU 82

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Inorganic					
Arsenic	9.8E-1	6.9E-1	**6.2E+0**	**1.2E+1**	5.0E-3
Beryllium	7.5E-2	2.7E-3	4.8E-2	9.2E-2	–
Cadmium	2.1E-1	3.0E-2	3.1E-2	3.3E-2	1.0E-3
Lead	3.8E-1	2.1E-2	1.6E-2	1.1E-2	1.1E-2
Mercury (inorganic)	1.8E-1	6.3E-4	6.3E-4	6.3E-4	1.1E-2
Mercury (organic)	1.8E-1	1.4E-1	1.4E-1	1.4E-1	7.8E-1
Nickel	5.5E-1	7.3E-3	1.0E-2	1.3E-2	6.2E-4
Silver	1.3E-1	1.1E-3	7.2E-4	3.0E-4	–
Zinc	1.0E+0	3.9E-2	2.4E-2	8.3E-3	1.2E-1
HI[a]	**3.7E+0**	9.3E-1	**6.5E+0**	**1.2E+1**	9.3E-1

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

A significant source of uncertainty associated with the prediction of ecological risks at this site is the use of the maximum measured concentrations or detection limits to evaluate risk. This results in a conservative exposure scenario that does not necessarily reflect actual site conditions. To assess the potential degree of overestimation caused by using the maximum measured soil concentrations in the exposure assessment, average soil concentrations were calculated for the COPECs with HQs greater than unity to determine whether these HQs can be accounted for by the magnitude of the extreme measurement. The mean concentrations of arsenic, cadmium, mercury, and zinc were determined to be 5.4, 0.40, 0.047, and 40 mg/kg, respectively. These means are all less than their respective background values; therefore, their HQ values will be within the range of background risks as shown in Table 18.

Based upon this uncertainty analysis, ecological risks at SWMU 82 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, background risk, and using conservatively estimated wildlife use factors in the exposure model.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 82 were estimated through a screening assessment that incorporated site-specific information when available. Overall, risks to ecological receptors are expected to be low because predicted risks associated with exposure to COPECs are based upon calculations using maximum detected values. Predicted risks from exposure to arsenic, cadmium, mercury, and zinc were attributed to using maximum detected values. The average soil concentrations for these COPECs at the site were within the range of background concentrations. In addition, risk to the burrowing owl from exposure to mercury was only predicted when it was assumed to be 100 percent in organic form. This is an unlikely and highly conservative assumption. Based upon this final analysis, ecological risks associated with SWMU 82 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.

<u>Summary</u>

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

Table 2
Default Parameter Values for Various Land Use Scenarios

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

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

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October 13, 2003

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