Sandia National Laboratories/New Mexico

PROPOSAL FOR RISK-BASED NO FURTHER ACTION ENVIRONMENTAL RESTORATION SITE 154 BUILDING 9960 SEPTIC SYSTEMS OPERABLE UNIT 1295

August 1997

Environmental Restoration Project

United States Department of Energy
Albuquerque Operations Office

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BUILDING 9960 SEPTIC SYSTEMS
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Prepared by
Sandia National Laboratories/New Mexico
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Albuquerque, New Mexico

Prepared for
the U. S. Department of Energy

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
BA	butyl acetate
bgs	below ground surface
BTEX	benzene, toluene, ethylene, and xylene
COC	constituents of concern
DOE	U.S. Department of Energy
DOU	Document of Understanding
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
HE	high explosive
HI	hazard index
HMX	cyclotetramethylene tetranitramine
HSWA	Hazardous and Solid Waste Amendments
KAFB	Kirtland Air Force Base
NEPA	National Environmental Policy Act
NERI	Northeast Research Institute
NMED	New Mexico Environmental Department
OU	Operable Unit
PCB	polychlorinated biphenyls
PCE	perchloroethene
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-trazine
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TA-III	Technical Area III
TCE	trichloroethene
TNT	2,4,6-trinitrotoluene
USAF	U.S. Air Force
VOC	semivolatile organic compound

1.0 INTRODUCTION

1.1 Description of ER Site 154

Sandia National Laboratories/New Mexico (SNL/NM) occupies 2,829 acres of land owned by the Department of Energy (DOE), with an additional 14,920 acres of land provided by land-use permits with Kirtland Air Force Base (KAFB), the United States Forest Service, the State of New Mexico, and the Isleta Pueblo. SNL/NM has been involved in nuclear weapons research, component development, assembly, testing, and other research and development activities since 1945 (DOE September 1987).

Environmental Restoration (ER) Site 154, Building 9960 Septic Systems, is located in the Coyote Test Field area in the southern part of KAFB. It is approximately 1.3 miles east of SNL/NM Technical Area Three (TA-III), 0.4 mile west of Lovelace Road, and 1.3 miles north of the Solar Power Tower, a prominent landmark in the area. It is reached by traveling southeast on Lovelace Road, and then turning onto a dirt road that runs south for about 0.5 mile to Building 9960 (Figure 1-1).

ER Site 154 is composed of two adjacent but separate areas, shown on Figure 1-2. The "east system" consists of a septic system septic tank and seepage pit, and is shown in the upper photograph of Figure 1-3. The septic system lies north of Building 9960 and consists of a 9.5-foot by 4.5-foot, 900-gallon capacity septic tank connected to a 5-foot diameter seepage pit that bottoms at 10 feet below ground surface (bgs) according to a SNL/NM Facilities Engineering drawing (SNL/NM April 1965). The "west system" consists of a pair of high explosives (HE) seepage pits located southwest of Building 9960 (Figure 1-2), and is shown in the lower photograph of Figure 1-3. The pair of HE seepage pits are 5 feet in diameter and were installed to approximately 23 feet bgs according to the drawing referenced above. These HE pits will be designated as the "north HE pit" and the "south HE pit" in the remainder of this report. These two ER Site 154 areas encompass approximately 0.15 acre of essentially flat-lying land at an average mean elevation of 5,586 feet above mean sea level (amsl).

Vegetation consists predominantly of grasses including grama, muhly, dropseed, and galleta. Shrubs commonly associated with the grasslands include sand sage, winter fat, saltbrush, and rabbitbush. Cacti are common, and include cholla, pincushion, strawberry, and prickly pear (SNL/NM March 1993).

The surficial deposits at ER Site 154 consist of a thin veneer of recent (Holocene) alluvial fan and eolian deposits (Plate V, "Travertine Hills Area Surficial Geology Map", SNL/NM December 1995). Substantial difficulty was encountered when the first boreholes were drilled next to the HE pits with the Geoprobe™ in October 1994. An interval of tough clay-rich soil was encountered from about 5 feet to 23 feet bgs, and was underlain by an easier-drilling silty-sandy material from about 23 feet to an average subsurface refusal depth due to bedrock of approximately 26 feet bgs (SNL/NM October 1994). Plate XV ("SNL/KAFB & Vicinity Subsurface Bedrock Elevation Map", SNL/NM December 1995) also indicates that the surficial sediment package is only about 30 feet thick beneath the site, and Plate XII ("SNL/KAFB & Vicinity Surface and Subsurface Bedrock Geologic Map, Northern Half") shows that this veneer of alluvial and eolian material is underlain

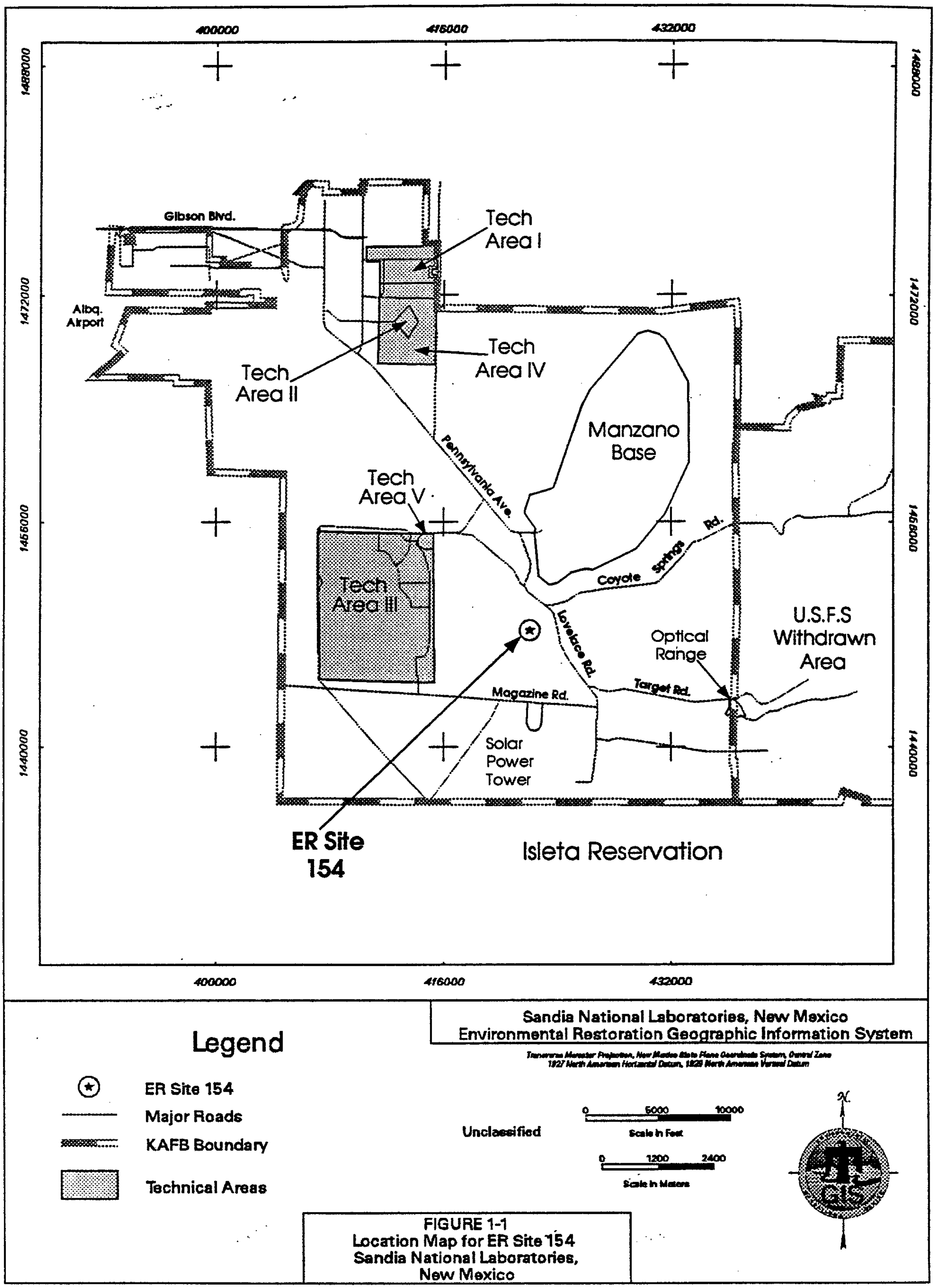
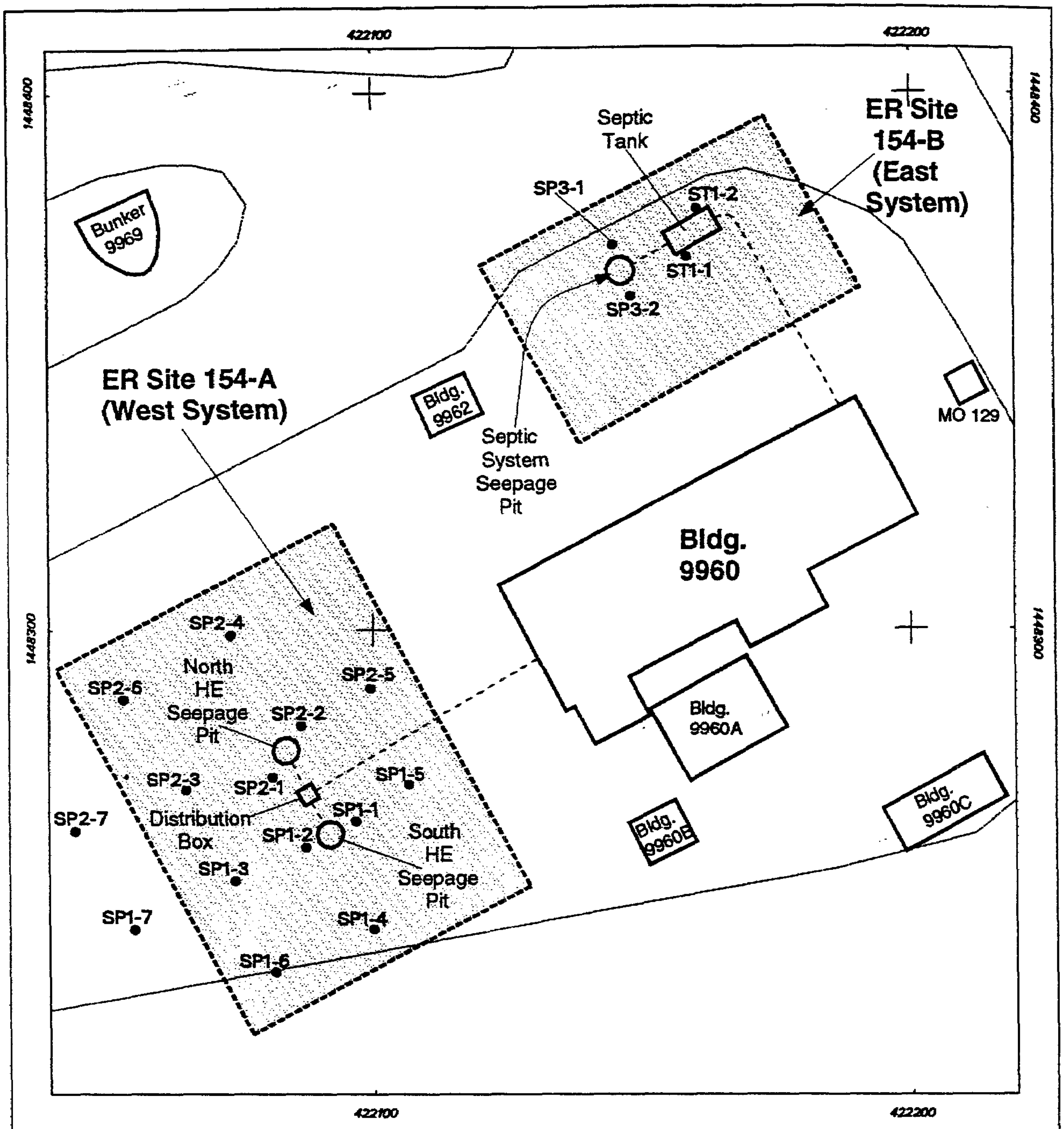


FIGURE 1-1
Location Map for ER Site 154
Sandia National Laboratories,
New Mexico



Legend

- Boring Location
- KAFB Road
- Building
- Sanitary Sewerline
- Septic Tank, Distribution Box, Seepage Pit
- ER Site 154

Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System

Unclassified

0 15 30 Scale in Feet

0 2.6 7.2 Scale in Meters

FIGURE 1-2
Site Map for ER Site 154
Sandia National Laboratories,
New Mexico

dahelfr SNL GIS ORG. 6682 06/18/97 MAPID=970553

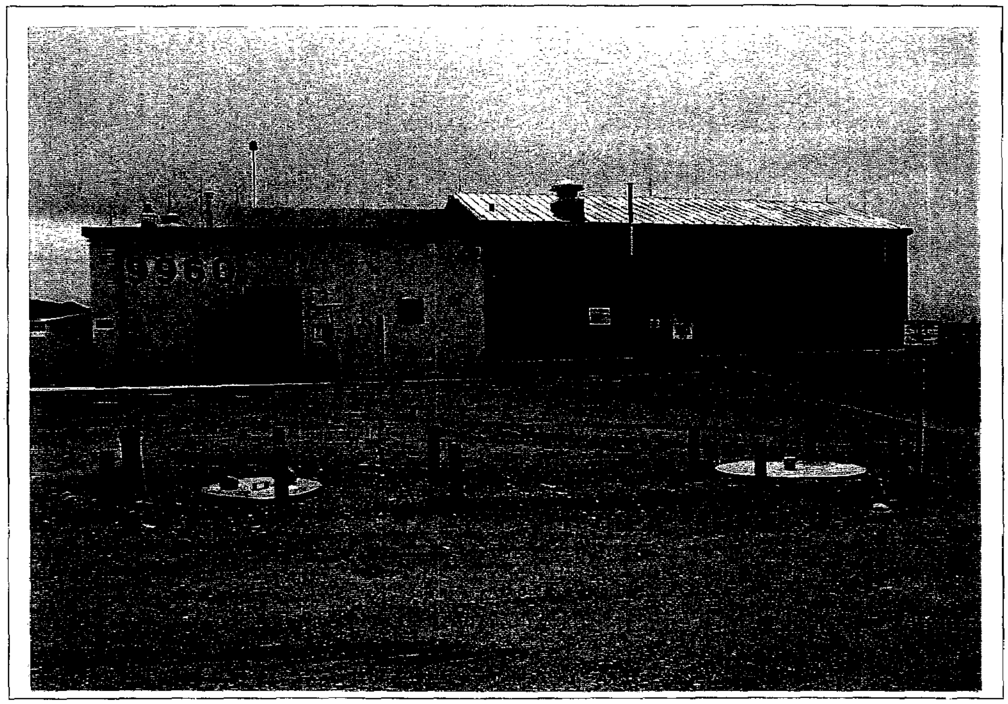
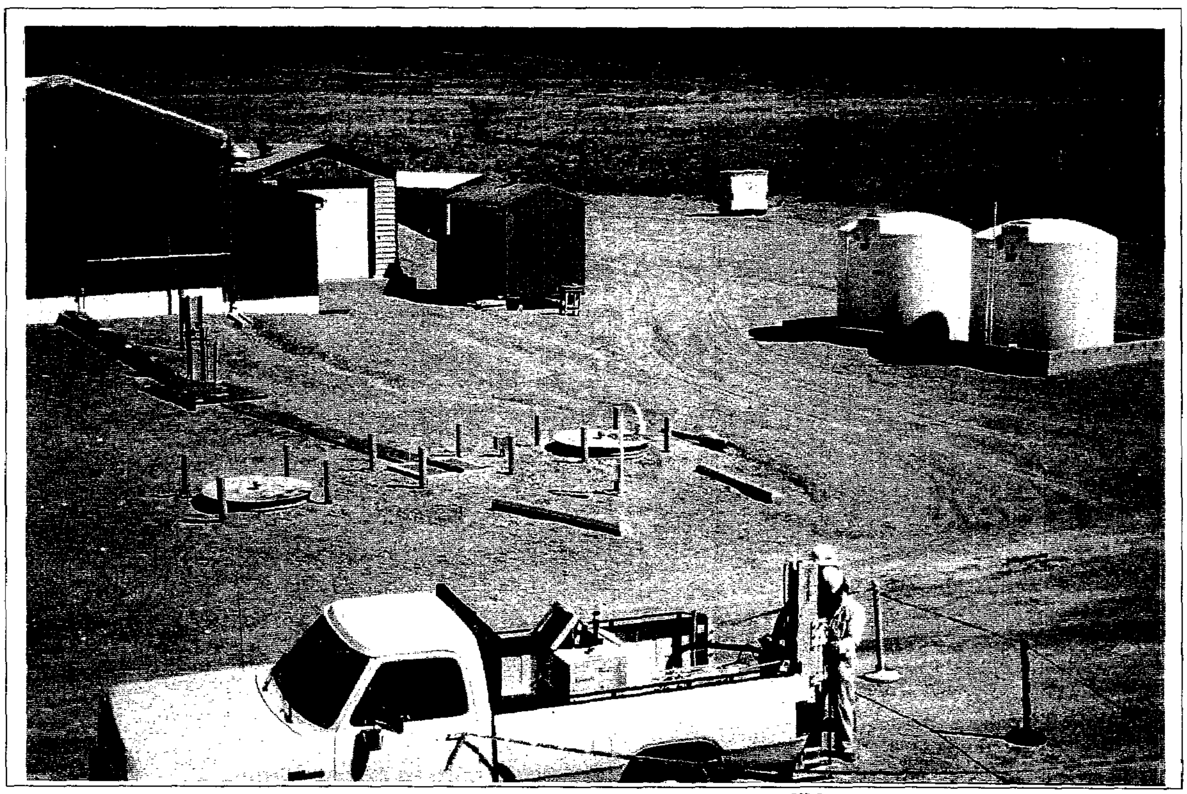


Photo showing the east system septic tank (left) and seepage pit (right) covers on the north side of Building 9960. October 26, 1994. View looking south.



Collecting fourth round soil samples with the Geoprobe™ sampling equipment from the north high explosives (HE) seepage pit boring location SP2-7 (Figure 1-2). HE wastewater storage tanks shown on the right side of the photo. March 11, 1997. View looking southeast.

Figure 1-3. ER Site 154 Photographs

by Permian Abo Formation sedimentary bedrock. Abo formation rocks in the KAFB area consist of shallow marine to nonmarine massive to thinly bedded sandstones, siltstones, and shales (SNL/NM March 1995a) that are distinctly red in color and are easily identified in drill cuttings. However, no red-colored rock fragments or material were recovered from any of the ER Site 154 boreholes. When the refusal surface was encountered, drilling progress stopped immediately, and only an occasional limestone fragment was recovered from the boreholes. It is therefore interpreted that the Abo Formation is overlain by a thin layer of calcrete or cemented gravel beneath ER Site 154.

This interpretation is supported by lithologic information obtained during drilling of the borehole for monitoring well LMF-1 that was installed in August 1995. This well is located approximately 1/4 mile east-southeast of ER Site 154. LMF-1 collared in a 10-foot thick layer interpreted to be caliche or calcium carbonate-cemented gravel. This layer was underlain by Abo Formation silty claystones and claystones from 10 feet bgs to 351 feet bgs. Pennsylvanian Madera Formation shales, siltstones, and sandstones were then encountered in LMF-1 starting at 351 feet bgs and persisted to the bottom of the well at 410 feet bgs. The water level in the well was determined to be 309 feet bgs, or 5,314 feet amsl shortly after it was installed (SNL/NM October 1995a).

On a larger scale, Plate XII of SNL/NM December 1995 report shows that the Tijeras Fault fracture zone is located about 300 feet northwest of ER Site 154. Regionally, the site is located in a structurally complex zone of faulted bedrock ramps that lie between the sediment-filled Albuquerque Basin to the west and the uplifted Manzanita Mountains to the east. The ramps are separated by generally west-dipping normal faults that trend northeast (and locally northwest) and exhibit down-to-the-west displacement (SNL/NM December 1995).

The water-table elevation was projected to be approximately 5,175 feet amsl beneath ER Site 154 in the fall of 1995, which would put the depth to groundwater beneath the site at approximately 411 feet. Local groundwater flow is believed to be in a generally westerly to southwesterly direction in the immediate vicinity of this site (SNL/NM March 1996a). The nearest production wells are northwest of ER Site 154 and include KAFB-1, 2, 4, 7, and 14, which range from approximately 4.6 to 6.8 miles away from the site (SNL/NM August 1996). The closest monitoring well to ER Site 154 is LMF-1. It was completed in the lower Abo formation with a screen zone extending from 310 to 350 feet bgs (SNL/NM October 1995a).

1.2 No Further Action Basis

Review and analysis of all relevant data for ER Site 154 indicate that except for the area immediately around the HE seepage pits, concentrations of constituents of concern (COC) at this site are less than (1) SNL/NM or other applicable background limits, or (2) proposed Subpart S or other action levels (EPA July 1990), or (3) applicable risk assessment actions levels. For updated soil action levels, some values (i.e., trivalent chromium) were taken from the "Report of Generic Action Level Assistance for the Sandia National Laboratories/New Mexico Environmental Restoration Program" (IT 1994). The generic values from this report were made current for guidance through June 1994 according to RCRA proposed Subpart S methods.

A maximum of 1,430 milligrams per kilogram (mg/kg) of 2,4,6-trinitrotoluene (TNT) was detected in a single composite sample collected from a depth of 23 to 25 feet immediately around the two HE pits. This concentration exceeds the applicable risk-based human health action level for this compound. Subsequent soil samples collected from the same, and from additional boring locations around the HE pits contained varying amounts of HE compounds, but at concentrations substantially below applicable TNT action levels. In addition, the HE contamination was detected in subsurface soils that are too deep (21.5 to 27 feet bgs) to realistically pose a risk from ingestion, inhalation, or biological uptake pathways. Thus, ER Site 154 is being proposed for an NFA decision based on confirmatory sampling data demonstrating that COCs that may have been released from this solid waste management unit (SWMU) into the environment pose an acceptable level of risk under current and projected future land use, per NFA Criterion 5 in Annex B of the ER Document of Understanding (DOU) (NMED April 1996).

2.0 HISTORY OF ER SITE 154

2.1 Historical Operations

The following historical information has been excerpted from several sources, including SNL/NM March 1993, IT March 1994, and SNL/NM November 1994a and March 1996c.

Building 9960 was constructed in 1965 for the purpose of machining and preparing explosive assemblies for tests at various locations in Coyote Test Field. Propellants were machined using a dry process, so no wastes were discharged to the floor drains. Wastewater from hosing explosive cuttings and powders such as TNT, cyclotetramethylene tetranitramine (HMX), hexahydro-1,3,5-trinitro-1,3,5-trazine (RDX), PBX-9404, Composition B, Octol, Amatol, PETN, and Baratol from machine floors was discharged directly to the HE wastewater system. The HE wastewater system consisted of an open concrete channel lined with rubber matting leading to a filter basket in a distribution/catch box on the southwest side of the building. The liquid from the distribution box discharged to the two HE seepage pits. The cotton bags that lined the filter basket prior to 1980 often failed, resulting in the discharge of explosives residue to the seepage pits. They were replaced with polyester bags, which were disposed of by the U.S. Air Force explosive ordinance disposal team every six months. Small quantities of alcohol cleaning solution may have been discharged to the drains. Up to 300 gallons per day of wastewater may have been generated from hosing down machines and the floor.

The seepage pits are no longer in use. Disposal of effluent to the pits was discontinued in 1991, and above-ground holding tanks for the HE wastewater were installed in 1992 (SNL/NM July 1997). Liquid effluent from machining operations is currently diverted at the end of the trench to the nearby tanks (shown in the lower photograph of Figure 1-3). The water in the tanks is analyzed periodically, then disposed to the sanitary sewer system.

Building 9960 contains one bathroom with shower, sink, toilet, and floor drain that discharged to the septic system northwest of the building. Estimated effluent volumes range from 40 to 400 gallons per day. The septic system is no longer in use. An internal memo dated July 26, 1993 (SNL/NM July 1993), lists numerous septic tanks, including the Building 9960 tank, that were removed from service with the construction of the TA-III sanitary sewer system.

2.2 Previous Audits, Inspections, and Findings

ER Site 154 was first listed as a potential release site in the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) report to the U.S. Environmental Protection Agency (EPA) in 1987 (EPA April 1987). This report contained a generic statement about this and many other SNL/NM septic systems where sanitary and industrial wastes may have been discharged during past operations. This SWMU was included in the RFA report as Site 79, along with other septic and drain systems at SNL/NM. All the septic system sites included in Site 79 are now designated by individual SWMU numbers.

3.0 EVALUATION OF RELEVANT EVIDENCE

3.1 Unit Characteristics and Operating Practices

ER Site 154 unit characteristics and operating procedures are discussed in Sections 1.1 and 2.1 of this report.

3.2 Results of SNL/NM ER Project Sampling/Surveys

3.2.1 Summary of Prior Investigations

The following sources of information, presented generally in chronological order, were used to evaluate ER Site 154:

- Interviews with employees familiar with the site operational history
- Results of samples collected from the septic tank in 1992 (SNL/NM June 1993) and 1994 (SNL/NM May 1994)
- Results of four surveys, including an archeological/cultural resources survey (Hoagland and Dello-Russo 1995), a sensitive or special-status species or environments survey (IT February 1995), a geophysical survey (Lamb 1994), and a passive soil gas survey (NERI June 1995)
- Approved RCRA Facility Investigation (RFI) Work Plan and addenda for Operable Unit (OU) 1295, Septic Tanks and Drainfields (SNL/NM March 1993, November 1994a, December 1994, January 1995a, March 1995b, and May 1995; and EPA September 1994, January 1995, and March 1995)
- Results of confirmatory subsurface soil sampling conducted in October 1994 (SNL/NM October 1994); October 1995 (SNL/NM October 1995b); June and July 1996 (SNL/NM June 1996), and March 1997 (SNL/NM March 1997a)
- SNL/NM Facilities Engineering building drawing (SNL/NM April 1965)
- Photographs and field notes collected at the site by SNL/NM ER staff
- SNL/NM Geographic Information System data.

3.2.2 Septic Tank Sampling

Two rounds of samples have been collected in 1992 and 1994 from the ER Site 154 septic tank for waste characterization purposes. The results of each of the two sampling events are discussed below, and summaries of the analytical results for the septage samples are summarized in Sections 6.1 (1992 samples) and 6.2 (1994 samples).

The first round of liquid and sludge septage samples were collected from the septic tank in June 1992 (SNL/NM June 1993). As shown in the Section 6.1 table, the liquid supernate samples were analyzed for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), explosives compounds, pesticides, polychlorinated biphenyls (PCB), total metals, selected radionuclides, and several other miscellaneous analytes. Trace levels of one VOC (trichloroethene, or TCE) and two SVOCs (bis [2-ethylhexyl] phthalate and phenol) were identified. Explosives compounds, pesticides, PCBs, nitrates/nitrites, and cyanide were not detected. Very low levels of a number of metals, phenolic compounds, formaldehyde, fluoride, oil and grease, and radium-226 and -228 activities (below state discharge limits) were also detected. The sludge samples (composed of 93.3 percent water) were analyzed for total metals, gross alpha and beta activity, tritium, and selected radionuclide constituents. A number of metals, low gross alpha and beta activity, tritium, and a few selected radionuclides were detected in the material.

A second round of liquid and sludge septage samples were collected from the septic tank in May 1994 (SNL/NM May 1994). As shown in the Section 6.2 table, the liquid supernate samples were analyzed for three isotopic uranium constituents, tritium, and also for additional radionuclides by the gamma spectroscopy technique. Trace activity levels of the three isotopic uranium radionuclides and tritium were detected, and additional radionuclides were not detected by the gamma spectroscopy method. The sludge samples were analyzed for VOCs, SVOCs, phenolic and explosives compounds, total RCRA metals, three isotopic uranium radionuclides, and also for additional radionuclides using the gamma spectroscopy technique. Trace levels of one VOC (methylene chloride), six SVOCs, phenolic compounds, isotopic uranium isotopes, and several other radionuclides by the gamma spectroscopy method were identified in the material. Explosives compounds were not detected in the material.

3.2.3 Geophysical Surveys

Several geophysical surveys using Geonics™ model EM-31 and EM-38 ground conductivity meters were performed in the ER Site 154 septic system and HE pit areas on March 3, 1994 (Lamb 1994). The purpose of the geophysical surveys was to attempt to locate any wetted areas around the seepage pit septic system or HE pits. The EM-31 instrument was used for deeper surveys (up to 18 feet bgs), and the EM-38 was employed for more shallow work (within 5 feet of the surface). Information generated at this site did not identify any areas of moist soil in the subsurface and was not useful in guiding the soil sampling effort.

3.2.4 Soil Gas Surveys

A passive soil-gas survey was conducted in the septic system and HE pits in May and June 1994 (SNL/NM May 1994). PETREX™ sampling tubes were used to help identify any releases of VOCs and SVOCs that may have occurred via the septic systems at this site. A PETREX™ soil-gas survey is a semiquantitative screening procedure that can be used to identify the presence of VOCs and SVOCs in soil gas. This technique may be used to guide VOC and SVOC site investigations. The advantages of this sampling methodology are that large areas can be surveyed at relatively low cost, the technique is highly sensitive to organic vapors, and the result produces a measure of soil vapor chemistry over a two- to three-week period rather than at one point in time. Each PETREX™ soil-gas sampler consists of two activated-charcoal coated wires housed in a reusable glass test tube container. At each sampling location, sample tubes are buried in an inverted position so that the mouth of the sampler is about 1 foot below grade. Samplers are left in place for a two- to three-week period, and are then removed from the ground and sent to the manufacturer, Northeast Research Institute (NERI), for analysis using thermal desorption-gas chromatography/mass spectrometry. The analytical laboratory reports all sample results in terms of "ion counts" instead of concentrations, and identifies those samples that contain compounds above the PETREX™ technique detection limits. In NERI's experience, levels below 100,000 ion counts for a single compound (such as perchloroethene [PCE] or TCE), and 200,000 ion counts for mixtures (such as benzene, toluene, ethylene, and xylene [BTEX] or aliphatic compounds [C4-C11 cycloalkanes]), under normal site conditions, would not represent detectable levels by standard quantitative methods for soils and/or groundwater (NERI June 1995).

A map showing the soil gas sampling locations and the analytical results of the ER Site 154 passive soil gas survey are presented in Section 6.3. Six PETREX™ tube samplers (numbers P-260 through P-265) were placed in a grid pattern that covered the area around and west of the septic system seepage pit. Six other PETREX™ samplers (numbers P-266 through P-271) were placed in a grid pattern around the north and south HE pits (SNL/NM May 1994).

All of the PETREX™ samplers placed at this site were analyzed for two individual constituents (PCE and TCE) and two groups of compounds (BTEX and aliphatic compounds). Significant levels of PCE and TCE were not detected in soil gas at any of the 12 PETREX™ sampling locations at this site. BTEX compounds were identified in soil gas at concentrations that could potentially be detected in soil samples at three out of the six sampling locations around the septic system, and at none of the six locations around the HE pits. Potentially detectable concentrations of aliphatic compounds in soil gas were identified at two of the six septic system locations, and at one of the six PETREX™ locations around the HE pits (NERI June 1995). However, except for trace levels of the common laboratory-introduced contaminants, VOCs were not detected in any of the confirmatory soil samples collected at this site. The potentially detectable BTEX and aliphatic compounds identified in soil gas may reflect near-surface emanations from fluid leakage from vehicles that occasionally park in the unpaved areas in which the two passive soil gas surveys were conducted.

3.2.5 Cultural-Resources Survey

An archeological/cultural resources survey was conducted at each of the 23 OU 1295 ER sites (including ER Site 154) in 1994, and no archeological or cultural resources of concern were identified at any of these heavily disturbed sites (Hoagland and Dello-Russo 1995).

3.2.6 Sensitive-Species Survey

A field survey was conducted in the KAFB area in 1994 to identify sensitive or special status species or environments at numerous ER sites. All 23 of the OU 1295 ER sites were examined during this field effort, and no sensitive species or environments were identified at any of the septic and drain system sites (IT February 1995).

3.2.7 Confirmatory Sampling

Confirmatory soil sampling was conducted to determine whether COCs above background or action levels were released via the septic and drain systems at this site. Four rounds of confirmatory soil sampling were performed at this site and are described in detail in the following paragraphs. The confirmatory soil sampling program was performed in accordance with the rationale and procedures described in the approved Septic Tank and Drainfields (ADS-1295) RFI Work Plan (SNL/NM March 1993) and ER Site 154-pertinent addenda to the Work Plan process (listed in the fourth bulleted item of Section 3.2.1 above), developed during the OU 1295 project approval. A summary of the types of samples, number of sample locations, sample depths and analytical requirements for confirmatory soil samples collected at this site is presented in Table 3-1.

Results of the organic, inorganic, and radionuclide analyses performed on the ER Site 154 confirmatory soil and associated quality assurance/quality control (QA/QC) samples are summarized in Tables 3-2, 3-3, and 3-4. The sample analyses were performed by both off-site commercial, and SNL/NM in-house laboratories. In addition, results of the SNL/NM in-house gamma spectroscopy screening for other radionuclides in the soil samples from this site are presented in Sections 6.4 through 6.7. Complete soil sample analytical data packages for confirmatory and QA/QC samples collected at the site from 1994 through 1997 are archived in the SNL/NM Environmental Safety and Health Records Center and are readily available for review and verification (SNL/NM March 1997b).

The following method was used to evaluate the potential for COCs around the septic system septic tank and seepage pit and the HE pits at this site. The Geoprobe™ sampling system was used to collect subsurface soil samples at this site. The Geoprobe™ sampling tool was fitted with a butyl acetate (BA) sampling sleeve and was then hydraulically driven to the top of the designated sampling depth. The sampling tool was opened and driven an additional 2 feet in order to fill the 2-foot long by approximately 1.25-inch diameter BA sleeve. The sampling tool and soil-filled sleeve were then retrieved from the borehole. In order to minimize the potential for loss of volatile compounds (if present), the soil to be analyzed for VOCs was not emptied from the BA sleeve into another sample container. The filled BA sleeve was removed from the sampling tool, and the top 7 inches were cut off. Both ends of the 7-inch section of filled sleeve were immediately capped with a Teflon membrane and rubber end cap, sealed with tape, and placed in an ice-filled cooler at the site. The soil in this section of sleeve was then submitted for a VOC analysis.

Soil from the remainder of the sleeve was then emptied into a decontaminated mixing bowl. Following this, additional 2-foot sampling runs were completed in order to recover enough soil to satisfy sample volume requirements for the interval. Soil recovered from these additional runs was also emptied into the mixing bowl and blended with soil from the first sampling run.

Table 3-1
ER Site 154: Confirmatory Sampling Summary Table

Sampling Area	Analytical Parameters	Number of Borehole Locations	Top of Sampling Interval(s) at Each Boring Location (in feet)	Total Number of Investigative Samples	Total Number of Duplicated Samples	Date(s) Samples Collected
East System:	VOCs	2	9.5	2		10/26/94
Septic Tank	SVOCs	2	9.5	2		10/26/94
	RCRA metals	2	9.5	2		10/26/94
	Hexavalent chromium	2	9.5	2		10/26/94
East System:	VOCs	2	10 and 20	2	1	10/25/94
Seepage Pit	SVOCs	2	10 and 20	2	1	10/25/94
	RCRA metals	2	10 and 20	2	1	10/25/94
	Hexavalent chromium	2	10 and 20	2	1	10/25/94
	Isotopic uranium	2	10 and 20	2		10/25/94
	Gamma spectroscopy radionuclides	2	10 and 20	2		10/25/94
West System:	VOCs	2	21.5-23	2		10/24/94
North HE	SVOCs	2	21.5-23	2		10/24/94
Seepage Pit	HE compounds	7	21.5-25.3	7	2	6/96 - 3/97
	Nitrate/nitrite	3	23-25	3		6/25,26/94
	RCRA metals	7	21.5-25.3	7	1	10/94 - 3/97
	Hexavalent chromium	2	21.5-23	2		10/24/94
	Tritium composite	2	22	1		6/24/96
	Gamma spectroscopy radionuclides	2	24	1		6/25/96
West System:	VOCs	2	23	2		10/19,24/94
South HE	SVOCs	2	23	2		10/19,24/94
Seepage Pit	HE compounds	7	23-25	7	1	6/96 - 3/97
	Nitrate/nitrite	3	23-24	3		6/24-26/94
	RCRA metals	7	23-25	7	1	10/94 - 3/97
	Hexavalent chromium	2	23	2		10/24/94
	Tritium composite	2	22	1		6/24/96
	Gamma spectroscopy radionuclides	2	22	1		6/24/96
West System:						
Composite Samples	HE compounds	2	23-25	1		10/25/95
From Around Both	Isotopic uranium	4	23-26	1		10/19-24/94
the North and South						
HE Seepage Pits						

HE = High explosives
RCRA = Resource Conservation and Recovery Act
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

Table 3-2: Summary of Organic Constituent Analytical Results for ER Site 154 Confirmatory Soil and QA/QC Samples

Sample Attributes					VOCs (EPA 8240) (ug/kg)					SVOCs (EPA 8270) (ug/kg)	High Explosives (EPA 8330) (ug/kg)						Nitrate/ Nitrite (EPA 300 modified) (ug/kg)
Sample Number	ER Sample ID (Figure 1-2)	Sample Date	Sample Depth (ft)	Lab	Acetone	2-Hexanone	MEK	Methylene Chloride	Toluene	2,4-Dinitrotoluene	2-Am-4,6-DNT	HMX	PETN	RDX	1,3,5-TNB	2,4,6-TNT	
Round 1: Samples From the East System Septic Tank and Seepage Pit Area:																	
018145-1,2	ST-1	10/26/94	9.5-13.5	QARV	ND	ND	ND	1.6 B,J	ND	ND	--	--	--	--	--	--	--
018146-1,2	ST-2	10/26/94	9.5-13.5	QARV	ND	ND	ND	1.6 B,J	ND	ND	--	--	--	--	--	--	--
018140-1,2	SP3-1	10/25/94	10-14	QARV	5.2 J	ND	ND	2.3 B,J	ND	ND	--	--	--	--	--	--	--
018141-1,2	SP3-1	10/25/94	20-22	QARV	7.3 J	ND	ND	2.5 B,J	1.3 J	ND	--	--	--	--	--	--	--
018142-1,2	SP3-2	10/25/94	10-14	QARV	ND	ND	ND	2.2 B,J	ND	ND	--	--	--	--	--	--	--
018143-1,2	SP3-2 (dupl.)	10/25/94	10-14	QARV	ND	ND	ND	2.2 B,J	ND	ND	--	--	--	--	--	--	--
018144-1,2	SP3-2	10/25/94	20-23	QARV	ND	ND	ND	2.1 B,J	ND	ND	--	--	--	--	--	--	--
Round 1: Samples From the HE Pits Area:																	
018136-1,2	SP1-1	10/19/94	23-26	QARV	ND	ND	ND	2.5 B,J	ND	430 J	--	--	--	--	--	--	--
018139-1,2	SP1-2	10/24/94	23-26	QARV	ND	ND	ND	3.8 B,J	ND	ND	--	--	--	--	--	--	--
018138-1,2	SP2-1	10/24/94	23-25	QARV	ND	ND	ND	1.9 B,J	ND	ND	--	--	--	--	--	--	--
018137-1,2	SP2-2	10/24/94	21.5-26	QARV	ND	ND	ND	2 B,J	ND	130 J	--	--	--	--	--	--	--
Round 2: Single Composite Sample from South HE Pit Borehole SP1-1 and North HE Pit Borehole SP2-2 (Figure 1-2):																	
025744-3	SP1/2-1,2	10/25/95	23-25	905	--	--	--	--	--	--	--	ND	--	ND	ND	1,430,000	--
Round 3: Samples From the HE Pits Area:																	
030301-1	SP1-1	6/24/96	24-26	905	--	--	--	--	--	--	--	45,000	ND	7,400	--	102,000	ND
030300-1	SP1-2	6/24/96	24-26	905	--	--	--	--	--	--	--	81,000	ND	6,000	--	23,000	ND
030307-1	SP1-3	7/1/96	25-26.5	905	--	--	--	--	--	--	--	400	ND	2,000	--	8,500	--
030306-1	SP1-4	7/1/96	23-25	905	--	--	--	--	--	--	--	ND	ND	ND	--	ND	--
030305-1	SP1-5	6/26/96	23-25	905	--	--	--	--	--	--	--	ND	ND	ND	--	ND	ND
030303-1	SP2-1	6/26/96	23-25	905	--	--	--	--	--	--	--	100	ND	3,000	--	4,500	ND
030302-1	SP2-2	6/25/96	23.5-25	905	--	--	--	--	--	--	--	10,000	ND	2,000	--	2,000	ND
030302-5	SP2-2 (dupl.)	6/25/96	23.5-25	LAS	--	--	--	--	--	--	ND	ND	--	2,300	230 J	690	--
030304-1	SP2-3	6/26/96	25-27	905	--	--	--	--	--	--	--	ND	ND	2,000	--	ND	ND
030304-5	SP2-3 (dupl.)	6/26/96	25-27	LAS	--	--	--	--	--	--	130 J	5,300	--	1,700	530	6,100	--
030308-1	SP2-4	7/2/96	23.5-25	905	--	--	--	--	--	--	--	ND	ND	ND	--	ND	--
030310-1	SP2-5	7/2/96	21.5-23	905	--	--	--	--	--	--	--	ND	ND	ND	--	ND	--
Round 4: Samples From the HE Pits Area:																	
31993-1	SP1-6	3/12/97	25.5-26	ERCL	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	--
31989-1	SP1-7	3/11/97	24.5-26	ERCL	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	--
31990-1	SP1-7 (dupl.)	3/11/97	24.5-26	LAS	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	--
31992-1	SP2-6	3/11/97	24.3-25	ERCL	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	--
31991-1	SP2-7	3/11/97	25.3-26	ERCL	--	--	--	--	--	--	ND	ND	--	ND	ND	ND	--
Detection Limit (ug/kg) (QARV)					10	10	10	5	5	1,300	--	--	--	--	--	--	--
Detection Limit (ug/kg) (LAS)					--	--	--	--	--	--	250	2,200	--	1,000	250	250	--
Detection Limit (ug/kg) (905)					--	--	--	--	--	--	--	100	150	150	--	76	25,000
Detection Limit (ug/kg) (ERCL)					--	--	--	--	--	--	1,300	3,300	--	3,000	1,400	2,000	--

Table 3-2 concluded: Summary of Organic Constituent Analytical Results for ER Site 154 Confirmatory Soil and QA/QC Samples

Sample Attributes					VOCs (EPA 8240) (ug/L for water, ug/kg for soil)					SVOCs (EPA 8270) (ug/L for water, ug/kg for soil)	High Explosives (EPA 8330) (ug/kg)						Nitrate/ Nitrite (EPA 300 modified) (ug/kg)
Sample Number	ER Sample ID (Figure 1-2)	Sample Date	Sample Depth (ft)	Lab	Acetone	2-Hexanone	MEK	Methylene Chloride	Toluene	2,4-Dinitrotoluene	2-Am-4,6-DNT	HMX	PETN	RDX	1,3,5-TNB	2,4,6-TNT	
Quality Assurance/Quality Control Samples (all in ug/L)																	
Round 1 QA/QC Samples:																	
018148-1,2	Site 154 (aqueous EB)	10/26/94	NA	QARV	ND	ND	ND	2.2 B,J	ND	ND	--	--	--	--	--	--	--
018147-1	Site 154 (soil TB)	10/26/94	NA	QARV	280	14 J	100	24 B	42	--	--	--	--	--	--	--	--
Detection Limit for water (ug/L) (QARV)					10	10	10	5	5	10	--	--	--	--	--	--	--
Detection Limit for soil (ug/kg) (QARV)					25	25	25	12	12	--	--	--	--	--	--	--	--
Proposed Subpart S Action Level For Soil (ug/kg)					8E+06	None	5E+07	9E+04	2E+07	1,000	None	None	None	None	4,000	40,000	None

Notes:

B - analyte was detected in the laboratory method blank
2-Am-4,6-DNT - 2-amino-4,6-dinitrotoluene
Dupl. - Duplicate soil sample
EB - Equipment blank
ERCL - SNL/NM Environmental Restoration Project Chemistry Laboratory
HE - High explosives
HMX - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
J - Concentration below the practical quantitation limit (PQL)
LAS - Lockheed Analytical Services laboratory
MEK - Methyl ethyl ketone
NA - Not applicable
ND - Not detected
PETN - Pentaerythrol tetranitrate
QA/QC - Quality assurance/quality control
QARV - Quanterra laboratory in Arvada, Colorado
RDX - hexahydro-1,3,5-trinitro-1,3,5-triazine
SVOCs - Semivolatile organic compounds
TB - Trip blank
1,3,5-TNB - 1,3,5-Trinitrobenzene
2,4,6-TNT - 2,4,6-Trinitrotoluene
ug/kg - Micrograms per kilogram
ug/L - Micrograms per liter
VOCs - Volatile organic compounds
905 - SNL/NM explosives analytical laboratory in Building 905
-- Indicates that no sample was collected, or a sample was collected but was not analyzed for the particular analyte

Table 3-3: Summary of RCRA Metals and Hexavalent Chromium Analytical Results for ER Site 154 Confirmatory Soil and QA/QC Samples

Sample Attributes					Metals (EPA 6010/7000) (mg/kg)								
Sample Number	ER Sample ID (Figure 1-2)	Sample Date	Sample Depth (ft)	Lab	Ag	As	Ba	Cd	Cr	Cr^{6+}	Hg	Pb	Se
Round 1: Samples From the East System Septic Tank and Seepage Pit Area:													
018145-2	ST-1	10/26/94	9.5-13.5	QARV	ND	4.8	241	ND	5.3	ND	ND	ND	0.46 J
018146-2	ST-2	10/26/94	9.5-13.5	QARV	ND	3.7	112	ND	7.0	ND	ND	ND	ND
018140-2	SP3-1	10/25/94	10.5-14	QARV	ND	4.6	104	ND	6.1	ND	ND	ND	ND
018141-2	SP3-1	10/25/94	20.5-22	QARV	ND	3.4	64.9	ND	15.2	ND	ND	ND	0.52
018142-2	SP3-2	10/25/94	10.5-14	QARV	ND	4.0	158	ND	6.1	ND	ND	ND	ND
018143-2	SP3-2 (dupl.)	10/25/94	10.5-14	QARV	ND	4.0	199	ND	7.2	ND	ND	ND	ND
018144-2	SP3-2	10/25/94	20.5-23	QARV	ND	3.0	58.3	ND	8.2	ND	ND	ND	ND
Round 1: Samples From the HE Pits Area:													
018136-1,2	SP1-1	10/19/94	23-26	QARV	ND	4.0	1,230	0.63 J	8.1	ND	ND	ND	ND
018139-1,2	SP1-2	10/24/94	23-26	QARV	ND	3.3	111	ND	7.5	ND	ND	ND	ND
018138-2	SP2-1	10/24/94	23-25	QARV	ND	4.0	104	ND	10.8	ND	ND	ND	ND
018137-2	SP2-2	10/24/94	21.5-26	QARV	ND	2.9	1,460	ND	7.2	ND	ND	ND	ND
Round 3: Samples From the HE Pits Area:													
030307-2	SP1-3	7/1/96	25-26.5	ERCL	5.4	ND	91	ND	9.1	--	ND	7.5 J	ND
030306-2	SP1-4	7/1/96	23-25	ERCL	4.7	ND	170	ND	8.2	--	ND	8.2 J	ND
030305-2	SP1-5	6/26/96	23-25	ERCL	ND	ND	200	ND	ND	--	ND	ND	ND
030304-2	SP2-3	6/26/96	25-27	ERCL	1.8 J	ND	38	ND	ND	--	ND	ND	ND
030304-6	SP2-3 (dupl.)	6/26/96	25-27	LAS	ND	2.6	24 J	ND	6.7	--	ND	4.2	ND
030308-2	SP2-4	7/2/96	23.5-25	ERCL	5.7	ND	150	ND	11	--	ND	11	ND
030310-2	SP2-5	7/2/96	21.5-23	ERCL	6.2	ND	100	ND	9.7	--	ND	11	ND
Round 4: Samples From the HE Pits Area:													
31993-1	SP1-6	3/12/97	25.5-26	ERCL	ND	1.3 J	23	0.13 J	6.8	--	ND	3.2	0.74 J
31989-1	SP1-7	3/11/97	24.5-26	ERCL	ND	3.8	210	0.36 B	6.7	--	ND	4.6	1.6
31990-1	SP1-7 (dupl.)	3/11/97	24.5-26	LAS	ND	3.3	120	0.53 J	8.2	--	ND	4.6	0.68 J
31992-1	SP2-6	3/11/97	24.3-25	ERCL	ND	5.0	45	0.19 B	6.6	--	ND	30	1.3
31991-1	SP2-7	3/11/97	25.3-26	ERCL	ND	2.8	22	0.16 J,B	7.3	--	--	5.6	0.55 J
Detection Limit (mg/kg) (QARV)					1.0-2.0	1.0-2.0	1.0-2.0	0.5-1.0	1.0-2.0	0.20	0.10	5.0-10.0	0.5-1.0
Detection Limit (mg/kg) (LAS)					2.0	2.0	40	1.0	2.0	NA	0.10	0.61	1.0
Detection Limit (mg/kg) (ERCL)					0.16-2.5	2.4-18	2.0-8.4	0.16-3.8	2.8-6.9	NA	0.16-0.23	1.2-9.2	1.2-38

Table 3-3 concluded: Summary of RCRA Metals and Hexavalent Chromium Analytical Results for ER Site 154 Confirmatory Soil and QA/QC Samples

Sample Attributes					Metals (EPA 6010/7000)								
Sample Number	ER Sample ID (Figure 1-2)	Sample Date	Sample Depth (ft)	Lab	Ag	As	Ba	Cd	Cr	Cr^{6+}	Hg	Pb	Se
Quality Assurance/Quality Control Samples (all in mg/L)													
Round 1 QA/QC Sample:													
018148-3	Site 154 (aqueous EB)	10/26/94	NA	QARV	ND	ND	ND	ND	ND	--	ND	0.0032	ND
Round 3 QA/QC Sample:													
030309-2	Site 154 (aqueous EB)	7/2/96	NA	ERCL	ND	ND	ND	ND	ND	--	ND	ND	ND
Detection Limit (mg/L) (QARV)					0.010	0.010	0.010	0.0050	0.010	NA	0.00020	0.0030	0.0050
Detection Limit (mg/L) (ERCL)					0.005	0.012	0.022	0.009	0.016	NA	0.0002	0.019	0.088
SNL/NM Site-Wide Background Range (mg/kg)					0.0016-8.7	2.1-7.9	0.5-495	0.0027-6.2	0.5-31.4	0.02-<2.5	0.0001-0.68	0.75-103	0.037-17.2
Site-Specific Background UTL or 95th percentile (mg/kg)					<1.0	7	214	0.9	12.8	1	<0.1	11.8	<1.0
Proposed Subpart S Action Level For Soil					400	0.50	6,000	80	80,000 *	400 *	20	400 **	400

Notes:

B - Analyte was detected in the laboratory method blank.
EB - Equipment blank
ERCL-SNL/NM Environmental Restoration Chemistry Laboratory
LAS - Lockheed Analytical Services
Metals: Ag - silver; **As** - arsenic; **Ba** - barium; **Be** - beryllium; **Cd** - cadmium; **Cr** - chromium; **Cr^{6+}** - hexavalent chromium; **Hg** - mercury, **Pb** - lead; **Se** - Selenium
mg/kg - Milligrams per kilogram
mg/L - milligrams per liter
J - Concentration below the practical quantitation limit (PQL)
NA - **Not applicable.**
ND - Not detected at the method detection limit (MDL)
UTL - upper tolerance limit
QARV - Quanterra Arvada, CO. Laboratory
QA/QC - Quality assurance/quality control
* 80,000 mg/kg is for Cr^{3+} only (IT 1994). For Cr^{6+}, proposed Subpart S action level is 400 mg/kg.
** No proposed Subpart S action level for lead in soil; 400 ppm is EPA proposed action level (EPA July 1994)
-- Indicates that no sample was collected, or a sample was collected but was not analyzed for the particular analyte

Table 3-4: Summary of Isotopic Uranium and Tritium Analytical Results for ER Site 154 Confirmatory Soil Samples

Sample Attributes					Isotopic Uranium (EPI A-011B) (pCi/g)						Tritium (EPA-600 906.0) (pCi/L)	
Sample Number	ER Sample ID (Figure 1-2)	Sample Date	Sample Depth (ft)	Lab	U-233/ U-234 Result	U-233/ U-234 Error *	U-235 Result	U-235 Error *	U-238 Result	U-238 Error *	Result	Error*
Round 1: Samples From the East System Septic Tank and Seepage Pit Area:												
023877-1	SP3-1/2	10/25/94	10.5-14	GEL	0.695	0.109	0.045 J	0.024	0.714	0.111	--	--
023878-1	SP3-1/2	10/25/94	20.5-22	GEL	0.801	0.123	0.024 J	0.017	0.795	0.122	--	--
Round 1: Single Composite Sample from South HE Pit Boreholes SP1-1 and SP1-2, and North HE Pit Boreholes SP2-1 and SP2-2, (Figure 1-2):												
023876-1	SP1/2-1/2	10/19-24/94	23-26	GEL	0.982	0.138	0.032 J	0.02	0.746	0.114	--	--
Round 3: Composite Samples from Around the South and North HE Pits:												
030300-3	SP1-1/2	6/24/96	22-26	LAS	--	--	--	--	--	--	ND	68
030302-3	SP2-1/2	6/25/96	22-25	LAS	--	--	--	--	--	--	ND	68
Minimum Detectable Activity (pCi/g) (GEL)					0.09	--	0.09	--	0.09	--	--	--
Minimum Detectable Activity (pCi/L) (LAS)					--	--	--	--	--	--	120	--
SNL Site-Wide Background Range (pCi/g) **					0.44-<5.02	--	0.004-3	--	0.153-2.3	--	U	--
Site-Specific Background 95th percentile (mg/kg) **					1.6	--	0.16	--	1.4	--	U	--
Nationwide Tritium Range in Precipation and Drinking Water (pCi/L)***						--	--	--	--	--	100-400	--

Notes:

GEL - GEL analytical laboratory
HE - High explosive
J - Result is detected below the reporting limit or is an estimated concentration.
LAS - Lockheed Analytical Services
M.D.A. - Minimum detectable activity
pCi/L - Picocuries per liter
pCi/g - Picocuries per gram
U - Undefined for SNL/NM soils
U-233 - Uranium 233
U-234 - Uranium 234.
U-235 - Uranium 235.
U-238 - Uranium 238.
* Error - +- 2 sigma uncertainty
** IT March 1996
*** EPA October 1993
-- Indicates that no sample was collected, or a sample was collected but was not analyzed for the particular analyte

The blended soil was then transferred from the bowl into sample containers using a decontaminated plastic spatula.

The first round of soil samples was collected in October 1994 from one boring on either side of both the east system septic tank and seepage pit, and also from one boring on either side of each of the two HE pits (SNL/NM October 1994). As shown in Figure 1-2, boreholes were located no further than approximately 3 feet out from the edge of the respective units. Septic tank soil samples were collected from one interval in each of the two boreholes starting at the outside bottom of the tank, which was measured to be 9.5 feet bgs. Soil samples were also collected from two intervals in each of the two east system seepage pit boreholes. The top of the shallow intervals started at the bottom of the unit, which was estimated to be 10 feet bgs based on an SNL/NM facilities engineering drawing (SNL/NM April 1965) and field measurements to the top of the gravel inside the unit. The lower (deep) intervals started at 10 feet below the top of the upper intervals, or 20 feet bgs.

A similar procedure was used to characterize soil around each of the two west system HE pits. Samples were collected from a pair of boreholes 180 degrees apart on either side of each of the two units. The first-round north HE pit borehole locations are designated SP2-1 and SP2-2 on Figure 1-2, and the south HE pit boreholes are designated SP1-1 and SP1-2 on the figure. The original intent was to collect samples from two vertical intervals in each borehole starting at the base of each HE pit, which was estimated to be approximately 23 feet bgs based on an SNL/NM Facilities Engineering drawing (SNL/NM April 1965). However, subsurface refusal due to shallow bedrock was encountered at 25 to 26 feet bgs around these two units. As a result, soil from only one interval starting at the base of the HE pits and ending immediately above the subsurface bedrock was able to be collected in each of the four HE pit boreholes (SNL/NM October 1994).

The first-round septic system and HE pit soil samples were analyzed for VOCs, SVOCs, RCRA metals, and hexavalent chromium by a commercial laboratory. Also, to determine if radionuclides were released to the environment from past activities at this site, two composite samples from both the septic system seepage pit boreholes and a single composite sample from the four HE pit boreholes were analyzed for three isotopic uranium radionuclides by a commercial laboratory. Composite samples from both the shallow and deep septic system seepage pit sampling intervals were also analyzed for additional radionuclides using SNL/NM in-house gamma spectroscopy.

As shown in the Table 3-2, only low to trace concentrations of three VOC compounds that are common laboratory contaminants were detected in first-round soil samples collected from this site. Below-reporting-limit concentrations one SVOC (2,4-dinitrotoluene) were detected in two of the samples from the HE pit boreholes, and no SVOCs were identified in samples from around the east system septic tank and seepage pit. As shown in Table 3-3, elevated barium concentrations of 1,460 and 1,230 mg/kg were detected in the north HE pit borehole SP2-2 and the south HE pit borehole SP1-1, respectively (Figure 1-2). The barium concentration of 241 mg/kg in the septic tank soil boring ST-1 also is slightly above the SNL/NM background 95th percentile concentration of 214 mg/kg for barium. Also, 15.2 mg/kg of chromium was detected in the deep soil sample from the east system seepage pit borehole SP3-1. This quantity is slightly above the 95th percentile concentration of 12.8 for chromium. It was also determined that first-round samples inadvertently had not been collected or analyzed for explosives compounds, which have been used since the facility became operational in 1965. It was therefore concluded that a second round of sampling was required to adequately define the potential extent of contamination at the site.

A second round of sampling was conducted at the site in October 1995. The original plan was to collect samples from the four previous borehole locations next to the HE pits and from six new step-out borings to determine the extent of the elevated barium concentrations and to analyze for explosives compounds. However, sample collection and volume limitations due to drilling difficulties and associated equipment problems precluded completing the second-round sampling task as planned. As a result, only one composite sample consisting of equal fractions of soil from the north HE pit boring location SP2-2 and the south HE pit SP1-1 (Figure 1-2) was successfully collected at this time. The soil was retrieved from depths of 23 to 25 feet in each of the two borings. Analysis by an SNL/NM laboratory for explosives compounds detected 1,430 mg/kg of 2,4,6-trinitrotoluene in the material. As a result of this analysis and the previously identified elevated barium concentrations, it was concluded that a third round of sampling was required to determine the nature and extent of contamination of the metals (barium) and explosives contamination in subsurface soils around the HE pits.

The third round of soil sampling was completed at the site in June and July 1996 (SNL/NM June 1996). Samples were collected from two previous boring locations around the north HE pit (SP2-1 and SP2-2) and from three new step-out locations around this unit (SP2-3, SP2-4, and SP2-5). Samples were also collected from two previous boring locations around the south HE pit (SP1-1 and SP1-2) and from three new step-out locations around this unit (SP1-3, SP1-4, and SP1-5). The samples from the four previous boring locations next to the HE pits were analyzed only for explosives compounds, which had not been done previously. Samples from the six step-out borings were analyzed for explosives compounds, RCRA metals, and samples from six of the ten third-round sampling locations were also analyzed for nitrate and nitrite. The sample collection rationale for this sampling round was to retrieve enough soil to satisfy analytical volume requirements from intervals immediately above bedrock at all of the third-round locations, since the material at the soil-bedrock interface was considered to have the highest probability of containing contamination. Soil was collected from 23 to 27 feet bgs in north HE pit borings, and 21.5 to 26.5 feet bgs in south HE pit borings. Sample collection depths varied in each borehole because of a slightly undulating bedrock surface and variations in the amount of soil recovered from each boring, which in turn dictated the length of each sampling interval.

Explosives compounds were detected in all four of the third-round samples collected next to the HE pits. Explosives compounds were also detected in two of the six step-out locations (SP1-3 and SP2-3) located on the west side of the units but, for the most part, were at lower concentrations than those detected in samples from immediately adjacent to the HE pits. Samples from the other four step-out borings SP1-4, SP1-5, SP2-4, and SP2-5, and on the south, east, and north sides of the HE pits did not contain detectable levels of HE compounds. Nitrate and nitrite were not identified in the six samples that were analyzed for these compounds. The RCRA metals analytical results of samples from the six step-out borings indicated that of the eight RCRA metals, only silver was elevated relative to the SNL/NM 95th percentile background concentration <1 mg/kg for silver (IT March 1996). Slightly elevated silver concentrations were identified in samples from five of the six step-out boring locations. As a result of the explosives compounds and slightly elevated silver concentrations, it was concluded that a fourth round of limited soil sampling was required at locations south and west of the two HE pits to fully define the nature and extent of the release of HE residue to subsurface soils at the site.

The fourth and final round of soil sampling was completed at the site in March 1997 (SNL/NM March 1997a). Samples were collected from two more step-out boring locations west and northwest of the north HE pit (SP2-6 and SP2-7 on Figure 1-2) and from two additional step-out locations (SP1-6 and SP1-7) west and southwest of the south HE pit. Sampling depths ranged from 24.3 to 26 feet bgs in these boreholes. As before, the sample collection rationale was to retrieve soil from immediately above the bedrock surface since this material was considered to have the highest probability of containing explosives residue. The samples were analyzed for RCRA metals and explosives compounds. Explosives constituents were not detected in any of these boreholes, and with the exception of a lead concentration of 30 mg/kg in one borehole (SP2-6), elevated metals concentrations were not identified in any of the four fourth-round samples. It was concluded at this point that the nature and extent of contamination at the site was fully defined and that additional sampling was not required.

3.2.7.1 *Quality Assurance/Quality Control Results*

QA/QC samples collected during the first round of sampling at this site consisted of a duplicate soil sample, an aqueous equipment rinsate blank sample, and a soil trip blank submitted with the shipment of VOC soil samples to the off-site commercial laboratory. The duplicate soil sample consisted of material from the shallow sampling interval in the septic system seepage pit borehole SP3-2 (Figure 1-2). It was analyzed for the same constituents (VOCs, SVOCs, RCRA metals, and hexavalent chromium) as the equivalent sample from the same interval. Concentrations of the organic and metals constituents detected in the duplicate soil sample were in close agreement with those detected in the equivalent field sample from the same sampling interval, with one exception. The barium concentrations from the pair of samples from boring location SP1-7 differed by a factor of about two. The equipment rinsate sample was also analyzed for VOCs, SVOCs, RCRA metals, and hexavalent chromium. Only a trace concentration of lead slightly above the method reporting limit was detected in this rinsate sample. A soil trip blank was also placed in the cooler used to store the VOC soil samples in the field, and accompanied the VOC soil sample shipment to the off-site commercial laboratory. Low levels of methylene chloride were detected in multiple associated laboratory soil method blanks, and five common VOC laboratory contaminants were also detected in the trip blank. These common laboratory contaminants were either not detected or were found in substantially lower concentrations in the confirmatory soil samples compared to the trip blank.

Soil used for the trip blank was initially collected from an SNL/NM location considered to be free of VOCs. It was then prepared by heating the material in a drying oven, and then transferring it immediately to the sample container. This heating process drove off any residual organic compounds (if present) and soil moisture that may have been contained in the material. It is thought that when the soil trip blank container was opened at the laboratory, it immediately adsorbed both moisture and VOCs present in the laboratory atmosphere to a significantly greater degree than the associated site samples.

An aqueous equipment rinsate blank was collected at the conclusion of the third round of sampling in June and July 1996. It was analyzed for RCRA metals by an SNL/NM laboratory, and no metals were detected in the blank.

3.2.8 ER Site 154 Septic Tank Decontamination and Decommissioning

The ER Site 154 septic tank contents were removed and the tank was thoroughly cleaned and decontaminated in January 1996 (SNL/NM January 1996a). The empty and decontaminated tank was then inspected by a representative of the New Mexico Environment Department (NMED) to verify that the tank contents had been removed and the tank closed in accordance with applicable State of New Mexico regulations (SNL/NM January 1996b). As a final measure, a sample of the cleaned and decontaminated concrete from immediately beneath the septic tank inlet pipe was collected for waste characterization purposes and to verify that significant levels of radionuclides were not entrained in the material. A background tank concrete sample was also collected from the outer part of the tank cover that had never come into contact with septage, for comparison to the lower sample (SNL/NM January 1996c). Both of the concrete samples were analyzed for three isotopic uranium radionuclides by a commercial laboratory. The sample from below the inlet pipe was also screened for additional radionuclides using SNL/NM in-house gamma spectroscopy. Significant levels of radionuclides were not detected in either of these concrete samples (SNL/NM January 1996d).

3.3 Gaps in Information

The most recent material present in the septic system septic tank sampled in 1992 and 1994 was not necessarily representative of all discharges to the unit that occurred since it was put into service starting in 1965. The analytical results of the various rounds of septic tank sampling were used, along with process knowledge and other available information, to help identify the most likely COCs that might be found in soils next to and beneath the septic system units and HE pits. While the history of past releases at the site is incomplete, analytical data from the multiple confirmatory soil sampling events described in Section 3.2.7 above are sufficient to determine whether significant releases of COCs occurred at the site.

3.4 Risk Evaluation

3.4.1 Human Health Risk

ER Site 154 was recommended for industrial land-use (DOE and U.S. Air Force [USAF] March 1996). A complete discussion of the risk assessment process, results, and uncertainties is provided in Section 6.8. Due to the presence of several metals and HE compounds in concentrations greater than background levels, it was necessary to perform a human health risk assessment analysis for the site. Besides metals, any VOCs or SVOCs detected above their reporting limits and any radionuclide compounds either detected above background levels and/or minimum detectable activities were included in the initial screening stage of 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 Assessment Report calculated the hazard index (HI) and excess cancer risk for both an industrial land-use and residential land-use settings.

In summary, ER Site 154 has some explosives residue in soils more than 23 feet below grade. Because of the location of the site on KAFB, the site is designated for the industrial land-use scenario (DOE and USAF 1996). The risk assessment for the residential scenario is provided for perspective only.

Using conservative assumptions and employing a reasonable-maximum-exposure approach to the risk assessment, the calculations for the nonradiological COCs show that for the industrial land-use scenario the HI (HI = 3) is above the accepted numerical guidance from the EPA. The estimated excess cancer risk (CR = 2 x 10^{-5}) is in the middle of the suggested acceptable risk range. The incremental HI is 2.8, and the incremental cancer risk is 1.9 x 10^{-5} for the industrial land-use scenario. The main contributor for risk was the maximum value (1,430 milligrams per kilogram) for TNT. When the next highest TNT value (102 milligrams per kilogram) or the average value is used, the HI becomes 0.2 and the total HI becomes less than one. The total cancer risk becomes less than 5 x 10^{-6}. The incremental HI and cancer risk for industrial land-use becomes less than 0.3 and 1 x 10^{-6}, respectively. The human health risk associated with these results are within the acceptable range (HI less than one and cancer risk at 10^{-4} to 10^{-6}.

The uncertainties associated with the calculations are considered small relative to the conservativeness of the risk assessment analysis. It is therefore concluded that this site does not have significant potential to affect human health under an industrial land-use scenario.

3.4.2 Ecological Risk Assessment

An ecological risk assessment for ER Site 154 is also provided as part of the Risk Assessment Report in Section 6.8. COCs that have been detected at this site occur in the environment at depths substantially greater than 5 feet, which is normally the maximum depth at which COCs would be accessible to ecological receptors. Thus, no ecological risks are expected to be associated with COCs at the site. Much of the relevant ecological information for the site can be found in the National Environmental Policy Act (NEPA) compliance document (SNL/NM 1992), and the Environmental Assessment for the SNL/NM ER project (SNL/NM March 1996).

4.0 RATIONALE FOR NO FURTHER ACTION DECISION

Based on field investigation data and the human health risk assessment analysis, an NFA is being recommended for ER Site 154 for the following reasons:

- Significant levels of PCE and TCE were not detected in soil gas at any of the twelve PETREXTM sampling locations at this site. Potentially detectable levels of BTEX and/or aliphatic compounds were identified in soil gas at three out of the six sampling locations around the septic system, and at one of the six locations around the HE pits (NERI June 1995). However, only low to trace concentrations of three VOC compounds which are common laboratory contaminants were detected in first-round soil samples collected from this site. The potentially detectable BTEX and aliphatic compounds identified in soil gas most likely reflect fluid leakage from vehicles that on occasion park in the unpaved areas in which the two passive soil gas surveys were conducted.

- Below-reporting-limit concentrations of a single SVOC (2,4-dinitrotoluene) were detected in two of the samples from the HE pit boreholes, and no SVOCs were identified in samples from around the east system septic tank and seepage pit.

- Nitrate and nitrite were not detected in the six samples collected from around the HE pits that were analyzed for these two compounds.

- Activity levels of isotopic uranium and other radionuclides detected by the gamma spectroscopy method were within background levels. Tritium was not detected in the two composite samples from around the east system seepage pit.

- The elevated barium concentrations were detected only in two samples collected next to the HE pits, and decrease rapidly to background levels in samples collected away from the pits. Also, the highest barium concentration of 1,460 mg/kg detected at the site has been demonstrated to pose an insignificant risk to human health.

- The extent of HE contamination has been fully defined by the multiple rounds of sampling completed at the site, and has been shown to be present in only a very limited area around the HE pits. The 1,430 mg/kg of TNT that was identified in a single composite sample from around the HE pits exceeds applicable risk-based human health action levels. However, subsequent samples collected from the same boring locations as the composite sample, and from the HE pit step-out borings either contained HE concentrations well below applicable risk levels, or did not contain detectable contaminants. The HE contamination is also located sufficiently deep such that humans or wildlife would not come into contact with the material unless exceptionally deep excavating was completed at the site. This type of activity is not expected to occur at this location.

- ER Site 154 is underlain by a thin layer of cemented gravel starting at about 27 feet bgs. This cemented gravel layer in turn rests on top of relatively impermeable Abo Formation sandstones, siltstones, and shales. It has been demonstrated that the COCs that were released from the HE pits have migrated on top of the bedrock subsurface only a few tens of feet away from the release points. Depth to ground-water is approximately 411 feet bgs at this site. It is highly unlikely that COCs that were released into the environment have migrated to or impacted groundwater, given the relatively impermeable nature of the subsurface rocks, and the depth to groundwater beneath the site.

- Finally, the ER Site 154 septic tank contents were removed and the tank was thoroughly cleaned and decontaminated in January 1996. Analytical results of concrete samples collected from the inside of the decontaminated tank confirmed that no residual COCs were entrained in the material and the tank was backfilled with clean soil.

Sample analytical results generated from this confirmatory sampling investigation have shown that detectable or significant concentrations of COCs are present in soils only immediately adjacent to the HE seepage pits. The nature and extent of this contamination has been fully defined, and additional investigations are unnecessary. Based on archival information and chemical and radiological analytical results of soil samples collected at this site, SNL/NM has demonstrated that hazardous waste or COCs that have been released from this SWMU into the environment pose an acceptable level of risk under current and projected future land use (DOU Criterion 5 in Section 1.2 above), and the site does not pose a threat to human health or the environment. ER Site 154 is therefore recommended for an NFA determination.

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6.0 ANNEXES

6.1 ER Site 154: Summary of Constituents in the 1992 Septic Tank Septage Samples

6.2 ER Site 154: Summary of Constituents in the 1994 Septic Tank Septage Samples

6.3 ER Site 154: Summary of 1994 PETREX™ Passive Soil-Gas Survey Results

6.4 ER Site 154: Gamma Spectroscopy Screening Results for the Composite Soil Sample from the Septic System Seepage Pit Shallow Sampling Intervals

6.5 ER Site 154: Gamma Spectroscopy Screening Results for the Composite Soil Sample from the Septic System Seepage Pit Deep Sampling Intervals

6.6 ER Site 154: Gamma Spectroscopy Screening Results for the Composite Soil Sample for the Two Sampling Intervals Around the North HE Pit

6.7 ER Site 154: Gamma Spectroscopy Screening Results for the Composite Soil Sample from the Two Sampling Intervals Around the South HE Pit

6.8 ER Site 154: Risk Assessment Report

Section 6.8
ER Site 154: Risk Assessment Report

ER SITE 154: RISK ASSESSMENT ANALYSIS

I. Site Description and History

ER Site 154 includes the septic system and high explosives (HE) seepage pits that formerly served Bldg. 9960. Bldg. 9960, the Explosives Preparation Facility (Explosives Machining Facility), is located in the Coyote Test Field to the west of Lovelace Road, north of the intersection of the Coyote Springs Road, about 2.1 km (1.3 mi) east of Technical Area III. It was constructed in 1965 for the purpose of preparing explosive assemblies for tests at various locations in Coyote Test Field. Propellants were machined using a dry process, so no wastes were discharged to the floor drains. Wastewater from hosing explosive cuttings from machines and the floor, was discharged directly to the HE wastewater system. The HE wastewater system consisted of an open concrete channel lined with rubber matting leading to a filter basket in the distribution/catch box on the southwest side of the building. The liquid from the distribution box discharged to two 5-ft diameter by 23-ft deep seepage pits. The cotton bags that lined the filter basket prior to 1980 often failed, resulting in the discharge of explosives residue to the seepage pits. They were replaced with polyester bags, which were disposed of by an Air Force explosive ordinance disposal team every six months. Small quantities of an alcohol cleaning solution may have been discharged to the drains. Up to 300 gal per day of contaminated water may have been generated from hosing down machines and the floor. The seepage pits were removed from service in 1991. Liquid effluent from machining operations is currently diverted at the end of the trench to above ground polyethylene tanks located nearby. The water in the tanks is analyzed periodically then disposed to the sanitary sewer system.

Bldg. 9960 contains one bathroom with shower, sink, toilet, and floor drain. These discharged to a septic system consisting of a 900 gal tank and one 5-ft diameter by 10-ft deep seepage pit located about 50 feet north of the building. The septic system is no longer in use. Estimated effluent volumes range from 40 gal/day to 400 gal/day.

The potential contaminants at the site include various explosive compounds (TNT, PBX-9404, RDX, Composition B, Octol, Amatol, Baratol, HMX, and PETN). Aqueous samples obtained from the septic tank in 1991 detected phenol, chromium, copper, lead, manganese, and mercury. No releases of radiological contaminants are known to have occurred.

II. Human Health Risk Assessment Analysis

Risk assessment of this site includes a number of steps which 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:

Step 1.	Site data are described which provide information on the potential constituents of concern (COCs), as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways by which a representative population might be exposed to the COCs are identified.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The tiered approach includes screening steps, followed by potential intake calculations and a discussion or evaluation of the uncertainty in those calculations. Potential intake calculations are also applied to background screening data.
Step 4.	Data are described on the potential toxicity and cancer effects from exposure to the COCs and associated background constituents and subsequent intake.
Step 5.	Potential toxicity effects (specified as a Hazard Index) and cancer risks are calculated for nonradiological COCs and background
Step 6.	These values are compared with standards established by the United States (U.S.) Environmental Protection Agency (USEPA) and U.S. Department of Energy (USDOE) to determine if further evaluation, and potential site clean-up, is required. Nonradiological COC risk values are also compared to background risk so that an incremental risk may be calculated.
Step 7.	Discussion of uncertainties in the previous steps.

II.1 Step 1. Site Data

Site history and characterization activities are used to identify potential COCs. The identification of COCs and the sampling to determine the concentration levels of those COCs across the site are described in the ER Site 154 No Further Action Proposal. In order to provide conservatism in this risk assessment, the calculation uses only the maximum concentration value of each COC determined for the entire site. Both radiological and nonradiological COCs are evaluated. The nonradiological COCs evaluated are metals, inorganics and explosives.

II.2 Step 2. Pathway Identification

ER Site 154 has been designated with a future land-use scenario of industrial (USDOE and USAF 1996)(see Appendix 1 for default exposure pathways and parameters). Because of the location and the characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for chemical COCs and direct gamma exposure for radiological. The inhalation pathway for both chemicals and radionuclides is included because of the potential to inhale dust and volatiles. Relatively impermeable Permian Abo Formation bedrock is present at 26 feet deep at this site, and therefore no water pathways to the groundwater are considered. Depth to groundwater at Site 154 is approximately 411 feet below ground surface. Because of the lack of surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered to not be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate for the industrial land-use scenario. However, plant uptake is considered for the residential land-use scenario.

PATHWAY IDENTIFICATION

Chemical Constituents	Radionuclide Constituents
Soil Ingestion	Soil Ingestion
Inhalation (Dust and volatiles)	Inhalation (Dust and Volatiles)
Plant uptake (Residential only)	Plant uptake (Residential only)
	Direct Gamma

II.3 Steps 3-5. Calculation of Hazard Indices and Cancer Risks

Steps 3 through 5 are discussed in this section. These steps include the discussion of the tiered approach in eliminating potential COCs from further consideration in the risk assessment process and the calculation of intakes from all identified exposure pathways, the discussion of the toxicity information, and the calculation of the hazard indices and cancer risks.

The risks from the COCs at ER Site 154 were evaluated using a tiered approach. First, the maximum concentrations of COCs were compared to the SNL/NM background screening level for this area (IT 1996). If a SNL/NM-specific screening level was not available for a constituent, then a background value was obtained, when possible, from the U.S. Geological Survey (USGS) National Uranium Resource Evaluation (NURE) program (USGS 1994).

The maximum concentration of each COC was used in order to provide a conservative estimate of the associated risk. If any nonradiological COCs were above either the SNL/NM background screening levels or the USGS background value, all nonradiological COCs 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 USDOE orders.

Second, if any nonradiological COC failed the initial screening step, the maximum concentration for each nonradiological COC was compared with action levels calculated using methods and equations promulgated in the proposed Resource Conservation and Recovery Act (RCRA) Subpart S (40 CFR Part 264 1990) and Risk Assessment Guidance for Superfund (RAGS) (USEPA 1989) documentation. If there are 10 or fewer COCs and each has a maximum concentration less than one-tenth of the action level, then the site would be judged to pose no significant health hazard to humans. If there are more than 10 COCs, the Subpart S screening procedure was skipped.

Third, hazard indices and risk due to carcinogenic effects were calculated using Reasonable Maximum Exposure (RME) methods and equations promulgated in RAGS (USEPA 1989). The combined effects of all nonradiological COCs in the soils were calculated. The combined effects of the nonradiological COCs at their respective background concentrations in the soils were also calculated. For toxic compounds, the combined effects were calculated by summing the individual hazard quotients for each compound into a total Hazard Index. This Hazard Index is compared to the recommended standard of 1. For potentially carcinogenic compounds, the individual risks were summed. The total risk was compared to the recommended acceptable risk range of 10^{-4} to 10^{-6}.

II.3.1 Comparison to Background and Action Levels

Nonradiological ER Site 154 COCs are listed in Table 1, radiological COCs are listed in Table 2. Both tables show the associated 95th percentile or UTL background levels (IT 1996).

The SNL/NM background levels have not yet been approved by the USEPA or the NMED. Background values presented herein are based on a comprehensive study of joint SNL/NM and U.S. Air Force data from the Kirtland Air Force Base (KAFB). The report (IT 1996) was submitted for regulatory review in early 1996, and NMED comments were received in mid-1997. The values shown in Table 1 supersede the background values described in an interim background study report (IT 1994), and reflect both values presented in IT 1996, and values based on negotiations between SNL/NM and NMED. Neither of the background data sets have been formally approved by regulatory authorities at the time of writing of this report.

Table 1. Nonradiological COCs at ER Site 154 and Comparison to the Background Screening Values.

COC name	Maximum concentration (mg/kg)	SNL/NM 95th % or UTL Level (mg/kg)	Is maximum COC concentration less than or equal to the applicable SNL/NM background screening value?
Arsenic	5	7	Yes
Barium	1,460	214	No
Cadmium	0.63 J	0.9	Yes
Chromium, total*	15.2	12.8	No
Chromium VI	0.2 ND	1	Yes
Lead	30	11.8	No
Mercury	0.1 ND	<0.1^	No
Selenium	1.6	<1	No
Silver	6.2	<1	No

ND - not detected
J - concentration is estimated
*total chromium assumed to be chromium III because chromium VI was calculated separately
^ uncertainty due to detection limits

Table 2. Radiological COCs at ER Site 154 and Comparison to the Background Screening Values.

COC name	Maximum concentration (pCi/g)	SNL/NM 95th % or UTL Level (pCi/g)	Is maximum COC concentration less than or equal to the applicable SNL/NM background screening value?
U-238	0.795	1.4	Yes
U-235	0.045 J	0.16	Yes
U233/234	0.982	1.6	Yes

J- estimated activity

Several compounds have maximum measured values greater than background screening levels. Therefore all nonradiological COCs were retained for further analysis with the exception of lead. The maximum concentration value for lead is 30 mg/kg. The USEPA intentionally does not provide any toxicological data on lead and therefore no risk parameter values can be calculated. However, USEPA guidance for the screening value for lead for an industrial land-use scenario is 2000 mg/kg (USEPA 1996a); for a residential land-use scenario, the USEPA screening guidance value is 400 mg/kg (USEPA 1994a). The maximum concentration value for lead at this site is less than both of those screening values and therefore lead is eliminated from further consideration in this risk assessment.

Because several COCs had concentrations greater than their respective SNL/NM background 95th percentile or UTL, the site fails the background screening criteria and all COCs proceed to the proposed Subpart S action level screening procedure. Since the ER Site 154 sample set had more than 10 COCs (including metals, inorganics and explosives) that continued past the first screening level, the proposed Subpart S screening process was skipped. All remaining COCs must have a Hazard Index value and an excess cancer risk value calculated. Since no radiological COCs exceeded background levels a radiological risk assessment was not necessary for Site 154.

II.3.2 Identification of Toxicological Parameters

Table 3 shows the COCs that have been retained in the risk assessment and the values for the toxicological information available for those COCs.

II.3.3 Exposure Assessment and Risk Characterization

Section II.3.3.1 describes the exposure assessment for this risk assessment. Section II.3.3.2 provides the risk characterization including the Hazard Index value and the excess cancer risk for both the potential nonradiological COCs and associated background; industrial and residential land-uses.

II.3.3.1 Exposure Assessment

Appendix 1 shows the equations and parameter values used in the calculation of intake values and the subsequent Hazard Index and excess cancer risk values for the individual exposure pathways. The appendix shows the parameters for both industrial and residential land-use scenarios. The equations are based on RAGS (USEPA 1989). The parameters are based on information from RAGS (USEPA 1989) as well as other USEPA guidance documents and reflect the RME approach advocated by RAGS (USEPA 1989).

Table 3. Nonradiological Toxicological Parameter Values for ER Site 154 COCs

COC name	RfD_o (mg/kg/d)	RfD_{inh} (mg/kg/d)	Confidence	Sf_o (kg-d/mg)	Sf_{inh} (kg-d/mg)	Cancer Class ^
Arsenic	0.0003	--	M	1.5	15.1	A
Barium	0.07	0.000143	M	--	--	D
Cadmium	0.0005	0.0000571	H	--	6.3	B1
Chromium, total*	1	0.000000571	L	--	--	D
Chromium VI	0.005	--	L	--	42	A
Mercury	0.0003	0.0000857	M	--	--	D
Selenium	0.005	--	H	--	--	D
Silver	0.005	--	L	--	--	D
2,4-Dinitrotoluene	0.002	--	H	--	--	B2
2-Am-4,6-DNT**	--	--	--	0.68	--	--
HMX	0.05	--	--	--	--	--
RDX	0.003	--	--	0.11	--	--
1,3,5-TNB	0.00005	--	L	--	--	D
2,4,6-TNT	0.0005	--	M	0.03	--	C
Nitrate/Nitrite^	0.1	--	--	--	--	D

* total chromium assumed to be chromium III because chromium VI is calculated separately
** used values for dinitrotoluene (mixture)
^ used values for nitrite (most conservative)
RfD_o - oral chronic reference dose in mg/kg-day
RfD_{inh} - inhalation chronic reference dose in mg/kg-day
Confidence - L = low, M = medium, H = high
SF_o - oral slope factor in $(mg/kg\text{-}day)^{-1}$
SF_{inh} - inhalation slope factor in $(mg/kg\text{-}day)^{-1}$
^ USEPA weight-of-evidence classification system for carcinogenicity:

- A - human carcinogen
- B1 - probable human carcinogen. Limited human data are available
- B2 - probable human carcinogen. Indicates sufficient evidence in animals and inadequate or no evidence in humans.
- C - possible human carcinogen
- D - not classifiable as to human carcinogenicity
- E - evidence of noncarcinogenicity for humans

-- information not available

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

II.3.3.2 Risk Characterization

Table 4 shows that for the ER Site 154 nonradiological COCs (using the maximum values), the Hazard Index value is 3 and the excess cancer risk is 2×10^{-5} for the designated industrial land-use scenario. The numbers presented included exposure from soil ingestion and dust inhalation for the nonradiological COCs. Table 5 shows that for the ER Site 154 associated nonradiological background constituents, the Hazard Index is 0.02 and the excess cancer risk is 4×10^{-6} for the designated industrial land-use scenario.

For the residential land-use scenario, the Hazard Index value increases to 13 and the excess cancer risk is 1×10^{-4}. The numbers presented included exposure from soil ingestion, dust and volatile inhalation, and plant uptake. Although USEPA (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, NM, to be eroded and, subsequently, for dust to be present even in predominantly residential areas. Because of the nature of the local soil, other exposure pathways are not considered (see Appendix 1). Table 5 shows that for the ER Site 154 associated nonradiological background constituents, the Hazard Index increases to 1 and the excess cancer risk is 8×10^{-5}.

II.4 <u>Step 6. Comparison of Risk Values to Numerical Standards.</u>

The risk assessment analyses considered the evaluation of the potential for adverse health effects for both an industrial land-use scenario, which is the designated land-use scenario for this site, and also a residential land-use scenario.

Table 4. Nonradiological Risk Assessment Values for ER Site 154 COCs.

COC Name	Maximum concentration (mg/kg)	Industrial Land-Use Scenario		Residential Land-Use Scenario	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	5.0	0.02	3E-6	0.27	5E-5
Barium	1,460	0.02	--	0.22	--
Cadmium	0.63 J	0.00	3E-10	0.51	4E-10
Chromium, total*	15.2	0.00	--	0.01	--
Chromium VI	0.2 ND	0.00	5E-10	0.00	7E-10
Mercury	0.1 ND	0.00	--	0.17	--
Selenium	1.6	0.00	--	0.56	--
Silver	6.2	0.00	--	0.26	--
2,4-Dinitrotoluene	0.43 J	0.00	--	0.20	--
2-Am-4,6-DNT**	0.13	0.00	4E-8	0.00	1E-7
HMX	81	0.00	--	0.01	--
RDX	7.4	0.00	3E-7	0.01	1E-6
1,3,5-TNB	0.53	0.01	--	0.04	--
2,4,6-TNT	1,430	2.8	2E-5	10.41	7E-5
Nitrate/Nitrite^	25 ND	0.00	--	0.00	--
TOTAL		**3**	**2E-5**	**13**	**1E-4**

* total chromium assumed to be chromium III because chromium VI is calculated separately
J - estimated concentration
ND - non-detect
** used values for dinitrotoluene (mixture)
^ used values for nitrate (most conservative)
-- information not available

Table 5. Nonradiological Risk Assessment Values for ER Site 154 Background Constituents.

Constituent Name	Background concentration (mg/kg)	Industrial Land- Use Scenario		Residential Land- Use Scenario	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	7	0.02	4E-6	0.40	8E-5
Barium	214	0.00	--	0.03	--
Cadmium	0.9	0.00	4E-10	0.74	5E-10
Chromium, total*	12.8	0.00	--	0.00	--
Chromium VI	1	--	--	--	--
Mercury	<0.1	--	--	--	--
Selenium	<1	--	--	--	--
Silver	<1	--	--	--	--
TOTAL		0.02	4E-6	1	8E-5

-- information not available
* total chromium assumed to be chromium III (consistent with Table 4)
NC - not calculated

For the industrial land-use scenario, the Hazard Index calculated for the nonradiological COCs is 3; this value is above the numerical standard of 1 suggested in RAGS (USEPA 1989). The excess cancer risk is estimated at 2×10^{-5}. In RAGS, the USEPA suggests that a range of values (10^{-6} to 10^{-4}) be used as the numerical standard; the value calculated for this site is in the middle of the suggested acceptable risk range. Therefore, for an industrial land-use scenario, the Hazard Index risk assessment value is above the established numerical standard and the excess cancer risk is in the middle of the suggested acceptable risk range. This risk assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the industrial and residential land-use scenarios. For the industrial land-use scenario, the Hazard Index is 0.02. The excess cancer risk is estimated at 4×10^{-6}. Incremental risk is determined by subtracting risk associated with background from potential nonradiological 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 discussed within the text. The incremental Hazard Index is 2.8 and the incremental cancer risk is 1.9×10^{-5} for the industrial land-use scenario.

For the residential land-use scenario, the calculated Hazard Index for the nonradiological COCs is 13, which is greater than the numerical guidance. The excess cancer risk is estimated at 1×10^{-4}; this value is at the upper limit of the suggested acceptable risk range. The Hazard Index for associated background for the residential land-use scenario is 1. The excess cancer risk is estimated at

8×10^{-5}. For the residential land-use scenario, the incremental Hazard Index is 11.5 and the incremental cancer risk is 4×10^{-5}.

II.5 Step 7 Uncertainty Discussion

The data used to characterize ER Site 154, Building 9960 Septic Systems, consisted of analytical results of subsurface soil samples retrieved from a total of four boring locations around the septic system tank and seepage pit, and from 14 boring locations surrounding the two high explosives (HE) pits at the site (Figure 1-2 of the NFA report). Material was collected from sampling intervals ranging from 9.5 feet to about 27 feet below ground surface (bgs) at this site. Four rounds of sample collection were required to fully characterize the nature and extent of explosives residue around the HE pits. Sampling was performed at this site in accordance with procedures specified in an RFI work plan approved by both the USEPA and NMED.

The main suspected COCs at the site included some RCRA metals and HE residues. Samples initially collected around the septic system units and HE pits were analyzed by an offsite commercial laboratory for VOCs by USEPA Method 8240, SVOCs by USEPA Method 8270, RCRA metals by USEPA Method 6010, mercury by USEPA Method 7471, hexavalent chromium by USEPA Method 7196, and three isotopic uranium radionuclides by Method EPI A-001B. No evidence of VOC, SVOC, or uranium contamination was indicated in the first round of sampling. Analyses of subsequent samples were therefore limited to RCRA metals, HE compounds by USEPA Method 8330, nitrates/nitrites by USEPA Method 300 modified, tritium by USEPA Method 600 906.0, and for additional radionuclides utilizing in-house SNL/NM gamma spectroscopy. The final (fourth) round of samples from around the HE pits were analyzed for RCRA metals and HE compounds only. Samples collected during rounds two, three, and four were analyzed both by offsite commercial laboratories and by onsite SNL/NM laboratories.

The conclusion from the risk assessment using maximum values is that the potential effects caused by potential nonradiological COCs on human health are above the suggested acceptable hazard index range compared to the established numerical standard for the industrial land-use scenario. Calculated incremental risk between potential nonradiological COCs and associated background indicate significant contribution of risk from nonradiological COCs when considering the industrial land-use scenario.

The effects on human health, for the nonradiological COCs, are greater when considering the residential land-use scenario. Incremental risk between potential nonradiological COCs and associated background also indicates a increased contribution of risk from the nonradiological COCs. The increased effects on human health are primarily the result of including the plant uptake exposure pathway. Constituents that posed little to no risk considering an industrial land-use scenario (some of which are below background screening levels), contribute a significant portion of the risk associated with the residential land-use scenario. Because the COCs were found in soils of 10 feet or greater below ground, the exposure pathways of soil inhalation and plant intake are highly unlikely. Brief periods of soil inhalation could theoretically occur if excavation were to take place at the site. However, to encounter significant COC concentrations, excavating would have to be in excess of 20 feet deep, which is highly unlikely.

An RME approach was used to calculate the risk assessment values, which means that the parameter values used in the calculations were conservative and that the calculated intakes are likely overestimates. Maximum measured values of the concentrations of the COCs and minimum value of the 95th UTL or percentile background concentration value, as applicable, of background concentrations associated with the COCs were used to provide conservative results.

Table 3 shows the uncertainties (confidence) in the nonradiological toxicological parameter values. There is a mixture of estimated values and values from the Health Effects Assessment Summary Tables (HEAST) (USEPA 1996b) and Integrated Risk Information System (IRIS) (USEPA 1988 1994b) data bases. Where values are not provided, information is not available from HEAST, IRIS, or USEPA regions. Because of the conservative nature of the RME approach, the uncertainties in the toxicological values are not expected to be of high enough concern to change the conclusion from the risk assessment analysis.

The nonradiological hazard index risk assessment using maximum values is outside the acceptable range for the industrial land-use scenario compared to the established numerical standard. Though the residential land-use Hazard Index is also above the numerical standard, it has been determined that future land-use at this locality will not be residential (USDOE and USAF 1996).

The main contributor (HI of 2.8 out of 3) to the nonradiological industrial land-use scenario risk assessment values was 2,4,6-trinitrotoluene (TNT). The maximum TNT value (1,430 mg/kg) detected was in a single composite sample collected from one borehole next the to north HE pit, and from a second borehole next to the South HE pit. TNT was detected no further than 20 feet out from the center of the south HE pit at concentrations of 102, 23, 8.5 mg/kg, and no further than 20 feet out from the center of the North HE pit at concentrations of 6.1, 4.5, 2, and 0,69 mg/kg. Nine additional samples collected from around the two units did not contain detectable TNT. The 2nd highest TNT value detected at the site (102 mg/kg) produced a hazard index of 0.2 and 0.74 for industrial and residential land use scenario, respectively. The average 2,4,6-trinitrotoluene in soil around the HE pits is estimated to be much less than 102 mg/kg because more than half of the sample population were nondetects for TNT and other HE compounds.

II.6 Summary

ER Site 154 has some explosives residue in soils more than 23 feet below grade. Because of the location of the site on KAFB, the site is designated for industrial land-use scenario (USDOE and USAF 1996). The risk assessment for the residential scenario is provided for perspective only.

Using conservative assumptions and employing a RME approach to the risk assessment, the calculations for the nonradiological COCs show that for the industrial land-use scenario the Hazard Index (HI = 3) is above the accepted numerical guidance from the USEPA. The estimated excess cancer risk ($CR = 2 \times 10^{-5}$) is in the middle of the suggested acceptable risk range. The incremental Hazard Index is 2.8 and the incremental cancer risk is 1.9×10^{-5} for the industrial land-use scenario. The main contributor for risk was the maximum value (1,430 mg/kg) for TNT. When the next highest TNT value (102 mg/kg) or the average value is used, the HI becomes 0.2 and the total HI becomes less than one. The total CR becomes less than 5×10^{-6}. The incremental HI and CR for industrial land-use becomes less than 0.3 and 1×10^{-6}, respectively. The human health risk associated with these results are within the acceptable range (HI less than one and CR at 10^{-4} to 10^{-6}.

The uncertainties associated with the calculations are considered small relative to the conservativeness of the risk assessment analysis. It is therefore concluded that this site does not have significant potential to affect human health under an industrial land-use scenario.

III. Ecological Risk Assessment

III.1 Introduction

This section addresses the ecological risks associated with COCs at SNL/NM ER Site 154. The ecological risk assessment process performed for this site is a screening level assessment which follows the methodology presented in IT (1997) and SNL/NM (1997). The methodology was based on screening level guidance presented by USEPA (USEPA 1992; 1996c; 1996d) and by Wentsel, et al. (1996) and is consistent with a phased approach. As recommended by USEPA (1996d), this assessment utilizes professional judgment in the evaluation of COC distribution for their relevance to potential ecological receptors through complete exposure pathways.

III.2 Ecological Pathways at the Site

ER Site 154 consists of a highly disturbed soil surface surrounded by desert grassland vegetation. The topography is flat and there are no major drainages or surface water features in the area. Building 9960 lies in an internal drainage basin; therefore, off-site surface water drainage is not connected to the Rio Grande. No threatened, endangered, or other special status species are known to occur at the site. Scattered individuals of the grama grass cactus (Pediocactus papyracanthus) occur in the grassland habitats of the Coyote Test Field (IT 1995). This species had once been listed as endangered by the New Mexico Forestry and Resource Conservation Division (NMFRCD) and as a C2 candidate for federal listing by the U.S. Fish and Wildlife Service, but has since been removed from both special status categories by the respective agencies.

Because of the depths of the seepage pits (10 to 23 feet bgs) at ER Site 154, COCs are not expected to occur in soils that are accessible to ecological receptors, and therefore, complete ecological pathways do not exist at this site. As stated in the protocol for performing ecological risk assessments for the SNL/NM ER program (IT 1997), COCs in soil are considered to be bioavailable to a depth of 5 feet. This judgment is based on low rainfall of this habitat. Based on information on root depths and burrowing depths of species common to the grassland habitat at SNL/NM (e.g., Davis 1966; Reynolds and Wakkinen 1987; Reynolds and Fraley 1989), rooting and burrowing in this habitat is expected to be concentrated in the first few feet of the soil profile. If the receptors cannot be exposed to a contaminant, the exposure pathway for that contaminant can be characterized as incomplete (USEPA 1996d).

III.3 Constituents of Potential Ecological Concern

Because no complete ecological pathways exist at this site, none of the COCs are considered constituents of potential ecological concern.

III.4 Risk Characterization

Due to the depth of the COCs in the subsurface soils, no complete ecological pathways exist at this site. The consequent lack of a cause and effect relationship leads to the conclusion no ecological risks are associated with the COCs at this site (Wentsel et al. 1996).

III.5 Uncertainties

The identification of 5 feet as the probable limit of rooting and burrowing depth at SNL/NM is founded on professional judgment based on the observed habitat conditions and information on rooting and burrowing depths from similar habitats and species. Although the possibility of contact with COCs at this depth cannot be completely ruled out, the rarity of such an event, coupled with the small size and disturbed nature of the site, will make it inconsequential to the health and integrity of the ecosystem at large.

III.6 Summary

No risks to ecological receptors are predicted for ER Site 154 due to the depth of COCs in the subsoils. Because these COCs are considered to be not bioavailable, complete ecological pathways do not exist at this site.

IV. References

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APPENDIX 1.

Sandia National Laboratories Environmental Restoration Program

EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

BACKGROUND

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 ER sites 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 USEPA Region VI and NMED, SNL/NM proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all Environmental Restoration sites exist within the boundaries of the Kirtland AFB. 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 ER sites. At this time, all SNL/NM ER sites have been tentatively designated for either industrial or recreational future land use. The NMED has also requested that risk calculations be performed based on 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, risk and dose values. 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), and;
- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

Based on the location of the SNL/NM ER sites 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 ER sites, there does not presently 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 ER site:

- Ingestion of contaminated fish and shell fish;
- Ingestion of contaminated fruits and vegetables;
- Ingestion of contaminated meat, eggs, and dairy products; and
- 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 on 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 and 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 Reasonable Maximum Exposure (RME) risk assessment calculations for industrial, recreational, and residential scenarios, based on 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 Quotient/Index, 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)

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

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 hazard index) 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 COCs 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 10^{-4} to 10^{-6}. The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the Hazard Index) 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 Hazard Index 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 ER sites, based on 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

Table 2. Default Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency (d/y)	***	***	***
Exposure duration (y)	30[a,b]	30[a,b]	30[a,b]
Body weight (kg)	70[a,b]	56[a,b]	70 adult[a,b] 15 child
Averaging Time (days) for carcinogenic compounds (=70 y x 365 d/y) for noncarcinogenic compounds (=ED x 365 d/y)	25550[a] 10950	25550[a] 10950	25550[a] 10950
Soil Ingestion Pathway			
Ingestion rate	100 mg/d[c]	6.24 g/y[d]	114 mg-y/kg-d[a]
Inhalation Pathway			
Inhalation rate (m^3/yr)	5000[a,b]	146[d]	5475[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 (L/d)	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

*** The exposure frequencies for the land use scenarios are often integrated into the overall contact rate for specific exposure pathways. When not included, the exposure frequency for the industrial land use scenario is 8 h/d for 250 d/y; for the recreational land use, a value of 2 hr/wk for 52 wk/y is used (EPA, 1989b); for a residential land use, all contact rates are given per day for 350 d/y.

[a] RAGS, Vol 1, Part B (EPA, 1991).

[b] Exposure Factors Handbook (EPA, 1989b)

[c] EPA Region VI guidance.

[d] For radionuclides, RESRAD (ANL, 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.

[e] Dermal Exposure Assessment (EPA 1992).

suggested for use for the various exposure pathways based on the assumption that a particular site has no unusual characteristics that contradict the default assumptions. For sites for which the assumptions are not valid, the parameter values will be modified and documented.

Summary

SNL/NM proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial, recreational or residential future land-use scenario. There are no current residential land-use designations at SNL/NM ER sites, but this scenario has been requested to be considered by the NMED. For sites designated as industrial or recreational land-use, SNL/NM will provide risk parameter values based on 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 Sandia ER sites. The parameter values are based on 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.

References

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EPA, 1989b, Exposure Factors Handbook, EPA/600/8-89/043, US Environmental Protection Agency, Office of Health and Environmental Assessment, Washington, D.C.

EPA, 1991, Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B), EPA/540/R-92/003, US Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

EPA, 1992, Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, Office of Research and Development, Washington, D.C.

October 13, 2003

ADDITIONAL /SUPPORTING DATA

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