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Statement of Basis Approval of No Further Action Volume 10 of 30 January 2000 ER Site 13 Operable Unit 1333 Round 8

Sandia National Laboratories/NM

Sandia National Laboratories

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ER Site 13
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(RCRA Permit No. NM5890110518)

NFA Originally Submitted August 14, 1997
RSI Originally Submitted September 1999

Environmental Restoration Project

United States Department of Energy
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ACRONYMS AND ABBREVIATIONS

CAB	cellulose acetate butyrate
CEARP	Comprehensive Environmental Assessment and Response Program
COC	constituents of concern
DOE	U.S. Department of Energy
DOU	Document of Understanding
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERCL	ER Chemistry Laboratory
ft	feet
HE	high explosive
HSWA	Hazardous and Solid Waste Amendments
IRP	Installation Restoration Program
KAFB	Kirtland Air Force Base
LOBP	Large Open Burn Pool
MDL	method detection limit
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
NFA	no further action
NMED	New Mexico Environmental Department
OB	Oversight Bureau
OU	operable unit
PQL	practical quantitation limit
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RPD	relative percent difference
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
UTL	upper tolerance limit
UXO	unexploded ordnance
VOC	volatile organics
µg/L	microgram(s) per liter

1.0 INTRODUCTION

1.1 Description of ER Site 13

Sandia National Laboratories/New Mexico (SNL/NM) Environmental Restoration (ER) Site 13, identified as the Oil Surface Impoundment (Lurance Canyon Burn Site) in the Hazardous and Solid Waste Amendment (HSWA) Module, comprises approximately 0.5 acre (SNL/NM April 1995) of United States Air Force land withdrawn from the U.S. Forest Service (USFS) and permitted to the Department of Energy (DOE) (SNL/NM July 1994a). It is an inactive site within the Lurance Canyon Burn Site (Burn Site), which is ER Site 94 and an active test area that encompasses several other ER sites, including ER Sites 65 and 12 (Figure 1-1, note that sites 94, 65, and 12 are divided into subunits). Portions of Site 94, Lurance Canyon Burn Site, are still active and are being used for testing fire survivability of transportation containers, weapons components, simulated weapons, and satellite components.

ER Site 13 was constructed in the canyon-floor alluvium in the upper reaches of the Lurance Canyon (Figure 1-1). The Lurance Canyon is surrounded by moderately steep sloping canyon walls, and the immediate topographic relief around the site is approximately 500 feet (ft). Canyon walls are composed of Precambrian metamorphic rock and capped by the Pennsylvanian-age Madera Formation (limestone). A 25- to 50-ft-wide road is cut on the hillslopes as a firebreak and encircles the Burn Site area. The canyon floor at the site is isolated by the canyon walls except for the western drainage into Arroyo del Coyote. Coyote Springs Road follows this arroyo and is the main access into Lurance Canyon (Figure 1-1). The mean elevation of the site is 6,350 ft above mean sea level (SNL/NM April 1995). For a detailed discussion regarding the local setting at ER Site 13, including the hydrology, geology, and meteorology, refer to the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for Operable Unit (OU) 1333, Canyons Test Area (SNL/NM September 1995). The current use of the area is industrial. The future projected use is recreational as per the recommendation of the Citizens' Advisory Board (CAB) (CAB June 1996). Figure 1-2 shows the location of ER Sites 13, 65A, and all other ER subsites in the Burn Site area.

1.2 No Further Action Basis

This proposal for a determination of no further action (NFA), based upon the results of risk-based confirmatory sampling and analyses, has been prepared using the criteria presented in Annex B (Criterion 5) of the Environmental Restoration Document of Understanding (DOU) (NMED April 1996), and is consistent with the HSWA Module. Review and analysis of all relevant data for ER Site 13 indicate that potential constituents of concern (COC) at this site were either less than site-specific background levels or not detected or less than applicable risk assessment action levels. Thus, ER Site 13 is being proposed for an NFA decision based on confirmatory sampling data demonstrating that COCs that might have been released from this solid waste management unit into the environment pose an acceptable level of risk under current and projected future land use (DOU NFA Criterion 5).

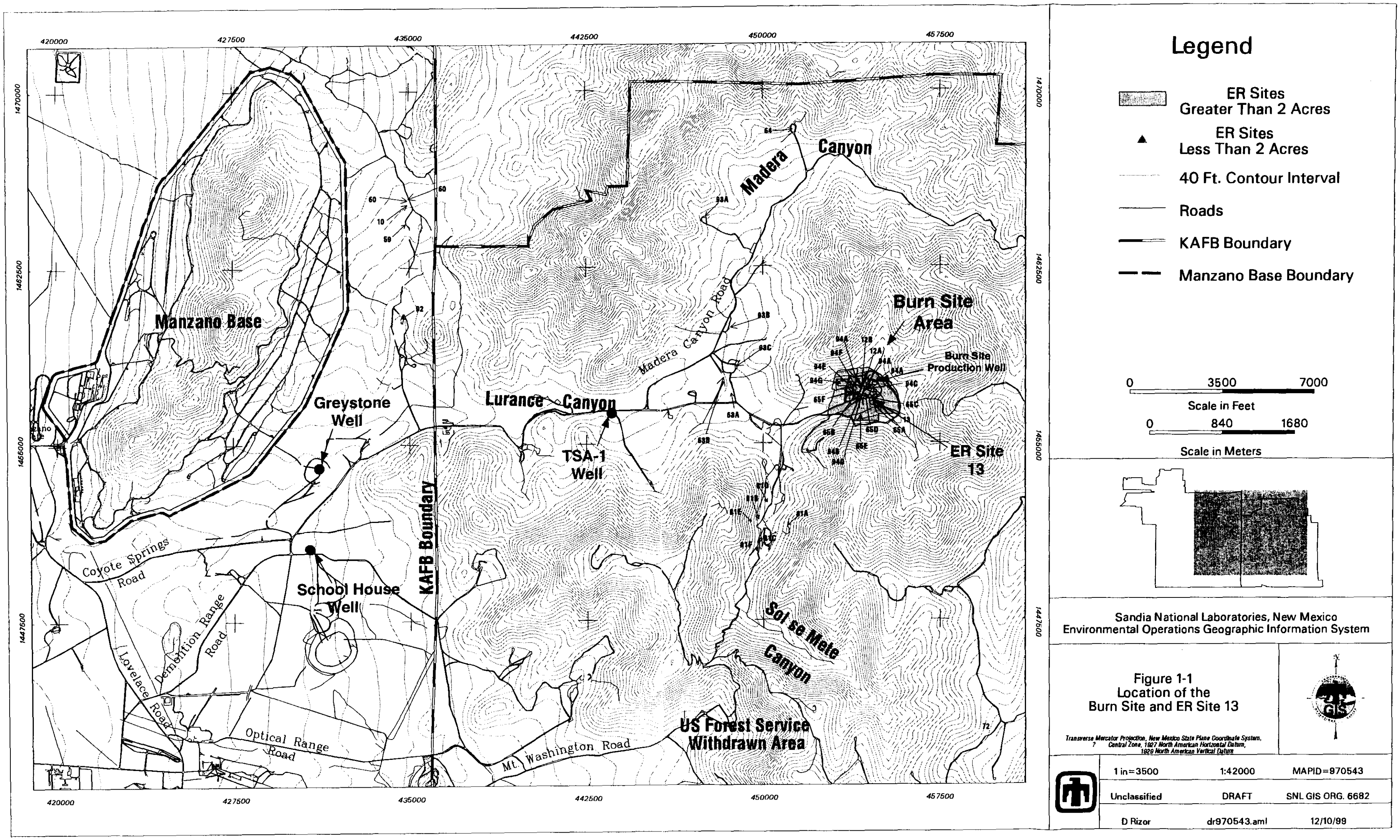

Figure 1-1
Location of the
Burn Site and ER Site 13

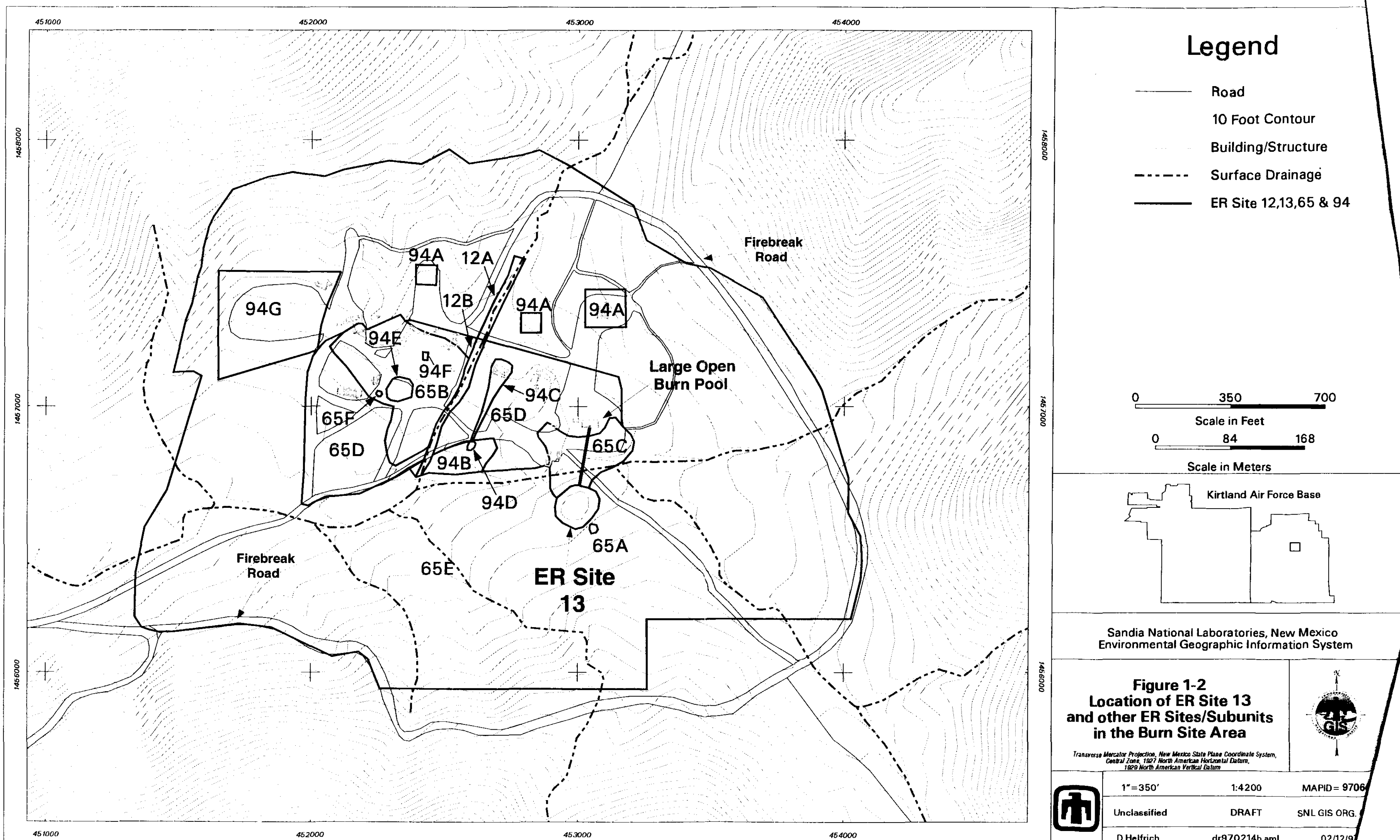

Figure 1-2
Location of ER Site 13 and other ER Sites/Subunits in the Burn Site Area

2.0 HISTORY OF ER SITE 13

2.1 Historical Operations

ER Site 13 was constructed in 1982 and was connected to the Large Open Burn Pool (LOBP) in 1983 (SNL/NM November 1994) to contain wastewater discharged from burn tests conducted at the LOBP (SNL/NM October 1994). ER Site 13 is a man-made, unlined surface impoundment or pit, which is located approximately 200 ft south of the LOBP (Figure 2-1). The impoundment is approximately 175 ft in diameter at the top rim and 25 ft deep (SNL/NM August 1994). A buried 24-inch-diameter corrugated discharge pipeline connects the LOBP and the impoundment. Wastewater from the LOBP was drained through the pipeline to a discharge manhole located on top of a concrete spillway at the north edge of the impoundment. The pipeline and discharge manhole were constructed so that wastewater flowed under a hydrostatic head from the LOBP to the manhole. The wastewater was discharged into the surface impoundment only after the manhole cover was opened. The flow rate into the impoundment was controlled by partially closing the manhole cover.

Nine burn tests were conducted in the LOBP between May 1984 and March 1987 that involved discharges to the Site 13 pit. The pit was deactivated in 1987 and has not been used since that time. In each of the burn tests, test objects were suspended above the LOBP, and the pool was filled with water to a depth of approximately 2.5 ft (about 34,000 gallons). A layer of JP-4 fuel (approximately 9,000 to 17,000 gallons) was placed on top of the water. The JP-4 fuel was ignited and allowed to burn until consumed. The remaining JP-4 fuel/water mixture, and possibly aluminum oxide and lead residue from the test units, was discharged from the LOBP through the corrugated discharge pipeline to ER Site 13. Wastewater discharged into the pit was left to evaporate and/or infiltrate into the impoundment, potentially resulting in the deposition of JP-4 fuel residue on the soil within the impoundment.

2.2 Previous Audits, Inspections, and Findings

ER Site 13 was identified during investigations conducted under the Comprehensive Environmental Assessment and Response Program (CEARP) (DOE September 1987) and the RCRA Facility Assessment (RFA) (EPA April 1987). The CEARP Phase I report (draft) indicates the surface impoundment was excavated within alluvial deposits south of the LOBP. The impoundment is unlined and received wastewater containing JP-4 fuel from burn tests conducted in the LOBP. An underground corrugated piping system conveyed the water from the LOBP to the impoundment. Water discharged to the impoundment was allowed to infiltrated into the soil or to evaporate. CEARP and RFA records indicate the site might have contained JP-4 fuel and associated petroleum hydrocarbon constituents.

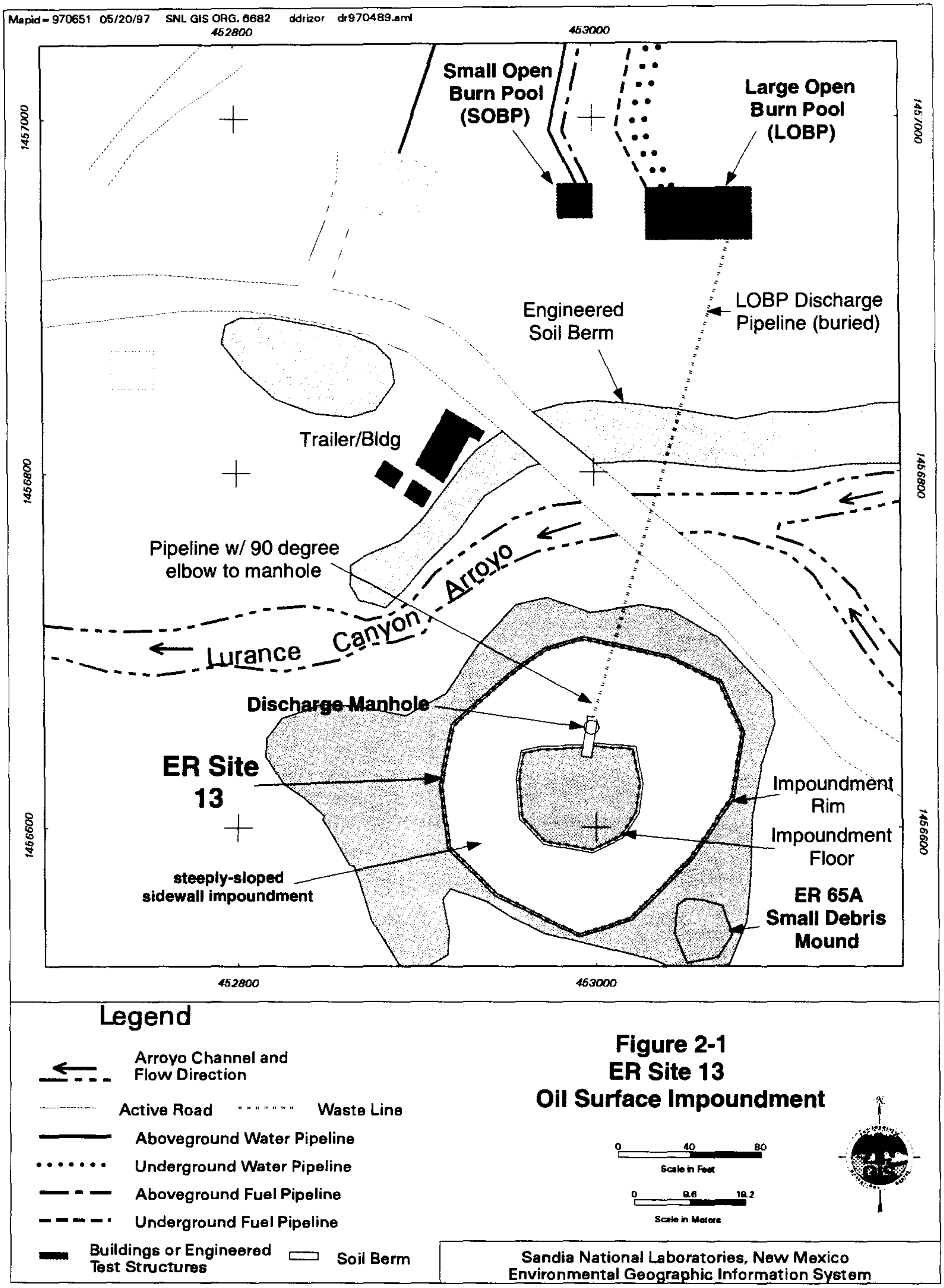

Figure 2-1
ER Site 13
Oil Surface Impoundment

3.0 EVALUATION OF RELEVANT EVIDENCE

3.1 Unit Characteristics and Operating Practices

Changes have not occurred to the site since it became inactive in 1987 (as described in Section 2.1), except that the end of the pipe leading from the LOBP to the pit has been capped to prevent water from accumulating in the pit. Water is currently present in the manhole (located at the concrete spillway within the pit) between the end cap and the manhole outlet. This water was sampled as part of the confirmatory sampling effort described in Section 3.2.8. The COCs at the site include JP-4 fuel and RCRA metals, primarily lead.

3.2 Results of Sampling/Surveys

This section describes the results of field work and analytical data that form the basis of this NFA proposal.

3.2.1 Summary of Prior Investigations

The following sources of information, presented in chronological order, were used to evaluate ER Site 13:

- Site background investigation documented in the OU 1333 Canyons Test Area RFI Work Plan (SNL/NM September 1995)
- Unexploded ordnance/high explosive (UXO/HE) surface survey
- Surface Radiological surveys
- Cultural and biological resource surveys
- Scoping sampling
- Burn Site-specific background sampling
- Confirmatory sampling.

3.2.2 UXO/HE Survey

In October 1993, Kirtland Air Force Base (KAFB) Explosive Ordnance Disposal personnel conducted a visual survey for the presence of UXO/HE on the ground surface of ER Sites 13, 12, 65, and 94. No UXO/HE or ordnance debris was found at ER Site 13 (SNL/NM September 1994).

3.2.3 Radiological Surveys

During November and December 1993 and January 1994, RUST Geotech Inc. conducted a surface gamma radiation survey of the Burn Site Area, including the area around the rim of the ER Site 13 pit. No anomalies were identified in the vicinity of ER Site 13. A detailed surface survey (100 percent surface area coverage) of the interior of the pit, the rim, and the pit perimeter 20 ft out from the rim was conducted by SNL/NM Radiation Protection personnel on April 22-23, 1997, in accordance with procedure RPOP-08-810 (SNL/NM December 1994). All readings were consistent with local background levels.

3.2.4 Cultural Resources Survey

A survey of cultural resources was conducted as part of the assessment of the Lurance Canyon Burn Site. No cultural resources were identified at or near ER Site 13. The survey results are documented in the Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico (SNL/NM March 1996).

3.2.5 Sensitive-Species Survey

A sensitive-species survey was conducted as part of a biological assessment of the Lurance Canyon Burn Site. No sensitive species were found during this survey. The survey results are documented in the Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico (SNL/NM March 1996).

3.2.6 Scoping Sampling

In August 1995, two samples were collected from one location in the base of the pit immediately down gradient from the concrete spillway using a power auger. Samples were collected from 0-0.5 ft and 3.5-4 ft below grade. Three auger holes were attempted, and all ended in refusal at 5 ft below grade. The two samples were analyzed at the SNL/NM ER Chemistry Laboratory (ERCL) for metals (by X-ray fluorescence and modified U.S. Environmental Protection Agency [EPA] Method 6010) and for total petroleum hydrocarbons (TPH) (by Immunoassay Test Kit). Analytical results do not indicate the presence of contamination; however, TPH was detected between 10 - 100 parts per million (ppm) in one subsurface sample (3.5 - 4 ft).

The purpose of the scoping sampling effort was to obtain preliminary analytical data to support ER Project site ranking and prioritization. No quality assurance (QA)/quality control (QC) samples were collected.

3.2.7 Site-Specific Background Sampling

An investigation of the background soils immediately surrounding the Burn Site (i.e., ER Sites 65 and 94) was conducted in May 1996. In consultation with the New Mexico Environment Department (NMED) and DOE-Oversight Bureau (OB) personnel, background sampling locations were chosen in the vicinity of the Burn Site, well outside the Site 65 boundary roughly defined by the firebreak road (Figure 3-1). A total of 11 sample locations were chosen: 6 within the arroyos that flow into the Burn Site area, hereinafter referred to as the "background arroyo" locations, and 5 samples located on hillslopes, defined as the "background soil" locations. Each location was sampled at two depth intervals: 0 to 6 inches, and 6 to 12 inches, and two duplicates were collected, for a total of 24 samples. Each sample was analyzed at an off-site laboratory for RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, silver, and selenium) plus beryllium, in accordance with EPA Methods 6010/7000, and for radionuclides by gamma spectroscopy. The calculated upper tolerance limits (UTL) or 95th percentile values for each metal are shown in Table 3-1. Note that for cadmium, mercury, and silver, values were all non-detect from the site-specific background soil samples, so background values for SNL-wide soil were selected from the Background Concentrations for Constituents of Concern to the SNL/NM ER Project and the KAFB Installation Restoration Program (IRP), Canyons Background Study, Appendix C, Table C-24, (Fan Group) (other Canyons Groups were also non-detect for the same metals). The UTLs/95th percentile values shown in Table 3-1 for the soil group are used to evaluate confirmatory analytical data against site-specific background values in this NFA proposal because ER Site 13 is not located in an arroyo channel.

3.2.8 Confirmatory Trenching and Sampling

In May 1996 confirmatory sampling was conducted at ER Site 13. Subsurface sampling was conducted using a backhoe to excavate to the desired depth. During scoping sampling, the power auger experienced refusal at 5 ft below ground surface, indicating that bedrock could be present at this depth. Trenching with a backhoe was determined to be the best way to verify the presence or absence of bedrock and to ensure the collection of sufficient subsurface soil volumes for analytical testing. Based on discussions with the DOE-OB, the RFI Work Plan sampling strategy was modified from the proposed single boring in the pit bottom, to include four trenches in the bottom of the pit. This change tripled the amount of subsurface analytical samples.

One surface and two subsurface soil samples were collected from each trench location within the pit (for a total of 12 samples). Water still present in the discharge pipe was also sampled. In addition, an equipment rinsate blank (water), trip blank (water), and soil field blank were included in the samples shipped off site. Soil and water samples were analyzed for semivolatile organic compounds (SVOC) (EPA Method 8270) and TPH by diesel range organics (DRO) (EPA Method 8015 modified) at an off-site laboratory, and volatile organic compounds (VOC) (EPA Method 8240/8260) and RCRA metals (plus beryllium) at the on-site ERCL. The locations of the four surface samples (CY13-GR-002-0-S, CY13-GR-003-0-S, CY13-GR-004-0-S, CY13-GR-005-0-S) in the pit bottom are shown in Figure 3-2. After the collection of the

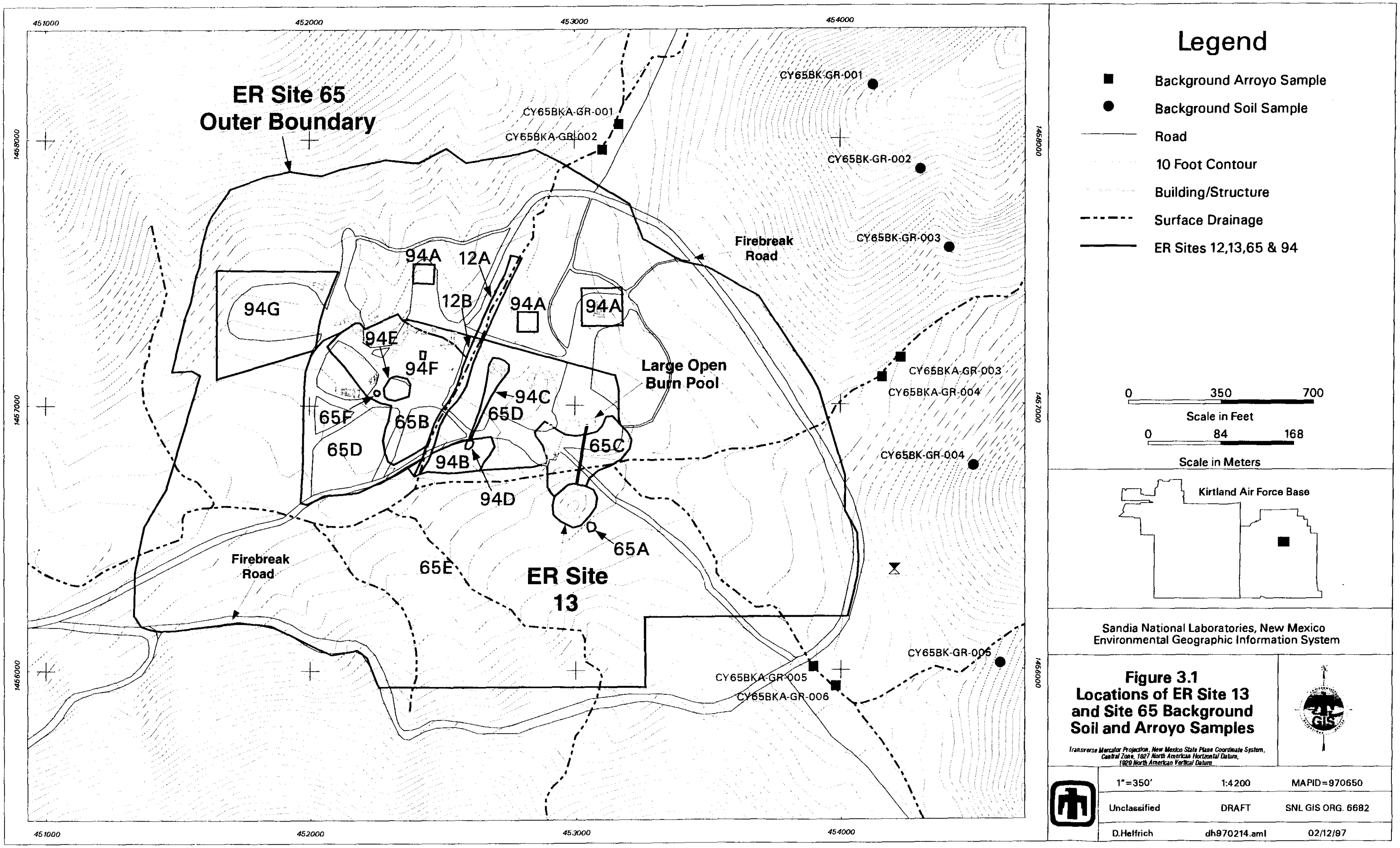

Figure 3.1
Locations of ER Site 13 and Site 65 Background Soil and Arroyo Samples

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

Table 3-1
Summary of Burn Site Background Concentrations for
Metals and Radionuclides

	Metal Constituents								
Analyte	As	Ba	Be	Cd	Cr	Pb	Hg	Se	Ag
Arroyo UTL (mg/kg)	4.95	271.5	0.6	0.74	18.1	14.9	NA	3.6	NA
Soil UTL (mg/kg)	7.4	270	0.77	1.6[1]	23.2	20.8 (0-6") 15.6 (6-12")	0.31[1]	3.5	2.0[1]

Notes: mg/kg - Milligrams per kilogram.
Metals: As - arsenic; Ba - barium; Be - beryllium; Cd - cadmium; Cr - chromium; Pb - lead; Hg - mercury; Se - selenium; Ag - silver.
UTL - Upper tolerance limit; NA - Not applicable (analyte not detected; therefore, no UTL was calculated).
[1] Values were all non-detect from the Burn Site samples, so values were selected from the "Background Concentrations for Constituents of Concern to the SNL/NM ER Project and the KAFB IRP, Canyons Background Study, Appendix C, Table C-24, "Fan Group".

surface samples, trenches were excavated to collect subsurface samples. The four trenches were excavated one at a time (i.e., one trench was excavated, sampled, then filled in before the next one was started) because of space limitations in the bottom of the pit. The trenches were excavated beneath each of the surface sample locations in a spoked pattern, oriented north (CY13-GR-002), west (CY13-GR-003), south (CY13-GR-004), and east (CY13-GR-005) (Figure 3-2). All trenches were excavated to approximately 5 to 6 ft below grade, except for the east trench, which was excavated to approximately 13 ft below grade to allow screening of subsurface soils to this depth within the pit. Trenches were approximately 2 ft wide and 6 to 8 ft long. Bedrock was not encountered in any of the trenches, although gravel layers were.

Surface soil samples were collected using the spade-and-scoop method (FOP 94-52) (SNL/NM January 1995). Subsurface samples were collected directly from the backhoe bucket, which scraped a layer of soil approximately 6 inches thick from the bottom of the excavation at the desired depths. Liquid in the discharge pipe was sampled directly from the manhole, which allowed easy access to stagnant effluent water trapped there.

Data Summary

The analytical results for organic analytes are shown in Table 3-2, and for inorganic analytes in Table 3-3. Surface and subsurface soil, water, and QA/QC results are shown in separate groups in these tables to facilitate discussion of the results. QA/QC sample results are discussed in Section 3.2.8.1.

The COCs at the site include JP-4 fuel and RCRA metals, primarily lead. VOC and SVOC analyses were conducted to look for organic fuel constituents, and TPH/DRO analyses were run to screen for hydrocarbons that would potentially be missed in VOC or SVOC analyses. The results for all samples (soil and water) indicate hydrocarbon contamination at the site is either not present or occurs at very low levels.

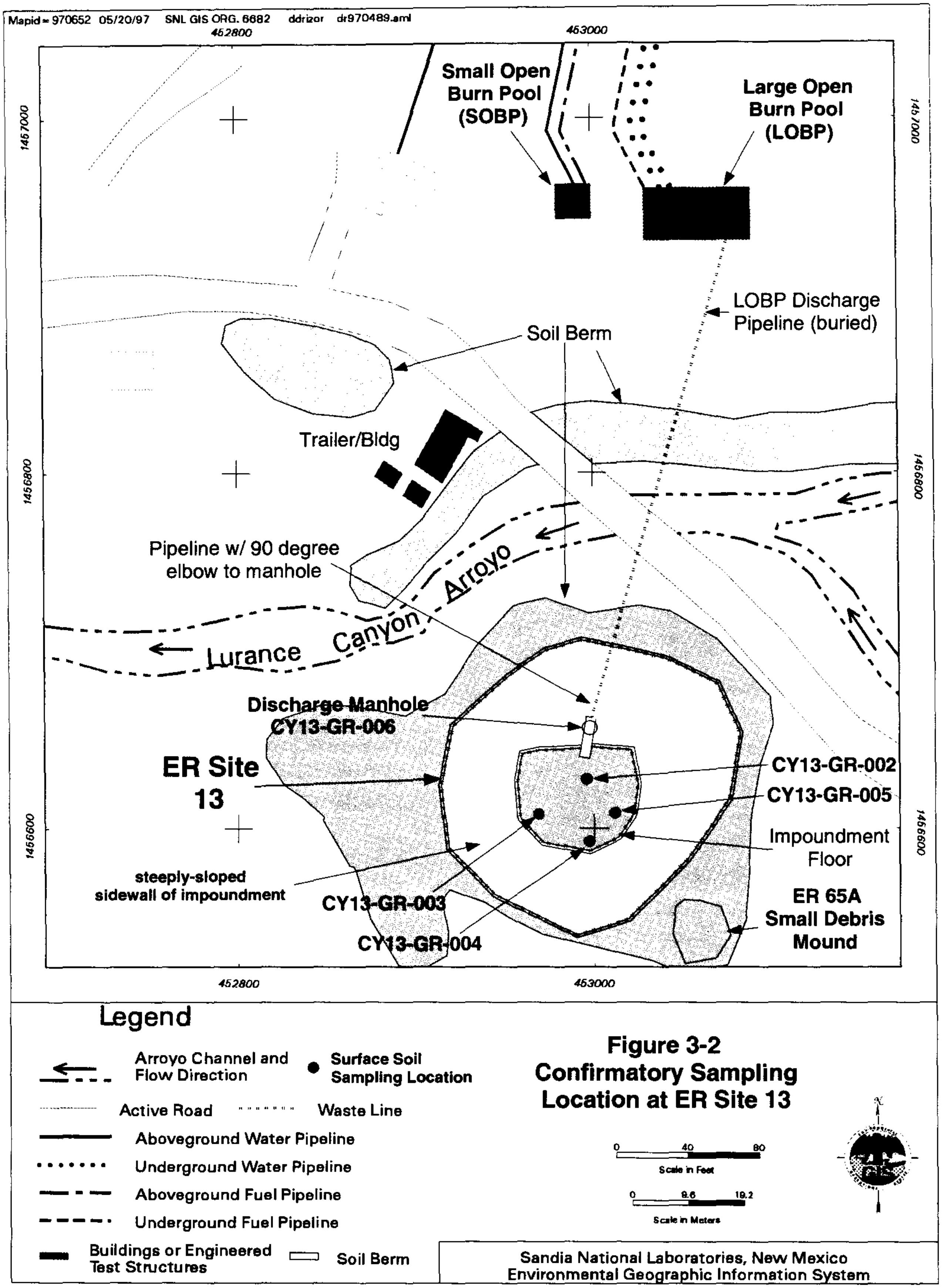

Figure 3-2
Confirmatory Sampling Location at ER Site 13

Table 3-2
Summary of Site 13 Confirmatory Soil Sample Organic Analytical Results, May 1996

Site Area Sampled	Sample Attributes			Volatile Organic Compounds (mg/kg)		SVOCs (mg/kg)	TPH (mg/kg)
	Sample Number	ER Sample ID	Depth (ft)	Acetone	2-Butanone		
Surface	029608	CY13-GR-002-0-SS	0-0.5	0.011J	ND	ND	ND
	029611	CY13-GR-003-0-SS	0-0.5	0.014J	ND	ND	ND
	029615	CY13-GR-004-0-SS	0-0.5	0.017J	ND	ND	ND
	029618	CY13-GR-005-0-SS	0-0.5	0.014J	ND	ND	2.2J
Subsurface North Trench	029609	CY13-GR-002-2.5-S	2.5	ND	ND	ND	2.9J
	029610	CY13-GR-002-5-S	5	ND	ND	ND	ND
Subsurface West Trench	029612	CY13-GR-003-2.5-S	2.5	ND	ND	ND	ND
	029613	CY13-GR-003-5.5-S	5.5	ND	ND	ND	ND
	029614	CY13-GR-003-5.5-SD	5.5	ND[1]	ND[1]	ND	ND
Subsurface South Trench	029616	CY13-GR-004-2.5-S	2.5	ND	ND	ND	ND
	029617	CY13-GR-004-5-S	5	ND	ND	ND	ND
Subsurface East Trench	029619	CY13-GR-005-4.5-S	4.5	0.013J	0.0058J	ND	ND
	029620	CY13-GR-005-12.5-S	12.5	ND	ND	ND	ND
Practical Quantitation Limit (mg/kg)				0.020	0.020	0.330-1.60	4.0
Water from Discharge Pipe (in µg/L)							
Collection Point	Sample Number	ER Sample ID	Depth (ft)	VOCs (µg/L) Sample was non-detect for all VOC analytes		SVOCs (µg/L) 2,6 - Dinitrotoluene	TPH (µg/L)
Discharge manhole	029621	CY13-GR-006	NA	ND	ND	17	1,600 ql[2]
Practical Quantitation Limit (µg/L)				5.0 - 10.0		9.5 - 48.0	95
Quality Assurance/Quality Control Samples (all in µg/L)							
Sample Type	Matrix	ER Sample ID	Depth (ft)	VOCs µg/L Sample was non-detect for all VOC analytes		SVOCs µg/L	TPH µg/L
Equipment Blank	Water	CY13-GR-007-EB	NA	ND	ND	ND	ND
Trip Blank	Water	CY13-GR-008-TB	NA	ND	ND	NA	NA
Practical Quantitation Limit (µg/L)				5.0 - 10.0		9.5 - 48.0	95

Notes: mg/kg - Milligrams per kilogram; µg/L - Micrograms per liter; ft - feet.
SVOC - Semivolatile organic compound; TPH - Total petroleum hydrocarbon; VOC - volatile organic compound.
J - Concentration below the practical quantitation limit (PQL) and above the method detection limit (MDL);
B - Analyte was detected in the laboratory method blank.
ND - Not detected at the MDL; NA - Not applicable/analyzed.
[1] This duplicate soil sample was analyzed for VOCs at the off-site laboratory only. Detections of acetone, 2-butanone, and methylene chloride were qualified as "non-detects" during the DV2 validation process because of higher detections of the same compounds in the soil field blank. See Section 3.2.8.1 for explanation.
[2] q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.
l = Sample analytical results resembles a hydrocarbon product occurring within the n-alkane range of C10-C28. Sample was re-analyzed after re-extraction outside of hold time because initial run had duplicate control sample QC precision outside acceptable limits. Highest result of the two analyses is shown in table; it is from the re-analysis.

Table 3-3
Summary of Site 13 Confirmatory Soil Sample Inorganic Analytical Results, May 1996

Site Area Sampled	Sample Attributes			Metals (EPA 6010/7000) (mg/kg)								
	Sample Number	ER Sample ID	Depth (ft)	Ag	As	Ba	Be	Cd	Cr	Hg	Pb	Se
Surface	029608	CY13-GR-002-0-SS	0-0.5	ND	ND	220	ND	ND	7.7J	ND	4.6J	ND
	029611	CY13-GR-003-0-SS	0-0.5	ND	ND	240	ND	ND	11J	ND	ND	ND
	029615	CY13-GR-004-0-SS	0-0.5	ND	ND	200	ND	ND	7.8J	ND	ND	ND
	029618	CY13-GR-005-0-SS	0-0.5	ND	ND	210	ND	ND	8.2J	ND	ND	ND
Subsurface	029609	CY13-GR-002-2.5-S	2.5	ND	ND	200	ND	ND	9J	ND	5.8J	ND
North Trench	029610	CY13-GR-002-5-S	5	ND	ND	170	ND	ND	8.1J	ND	ND	ND
Subsurface	029612	CY13-GR-003-2.5-S	2.5	ND	ND	170	ND	ND	7.1J	ND	ND	ND
West Trench	029613	CY13-GR-003-5.5-S	5.5	ND	ND	170	ND	ND	9.8J	ND	ND	ND
Subsurface	029616	CY13-GR-004-2.5-S	2.5	ND	ND	160	ND	ND	8.4J	ND	3.6J	ND
South Trench	029617	CY13-GR-004-5-S	5	ND	ND	160	ND	ND	7.9J	ND	ND	ND
Subsurface	029619	CY13-GR-005-4.5-S	4.5	ND	ND	160	ND	ND	5.9J	ND	ND	ND
East Trench	029620	CY13-GR-005-12.5-S	12.5	ND	ND	150	ND	ND	8.1J	ND	ND	ND
Practical Quantitation Limit (mg/kg)				6.4	98	38	0.44	8	19	0.24	13	191
Canyons Site-Specific (Burn Site) Background UTLs/95^{th} Percentile Concentrations (mg/kg)				2.0[1]	7.4	270	0.77	1.6[1]	23.2	0.31[1]	20.8[2] 15.6[3]	3.5
Water from Discharge Pipe	029619	CY13-GR-006	NA	ND	ND	0.57	ND	ND	ND	ND	0.0063	ND
Practical Quantitation Limit (mg/L)				0.010	0.010	0.010	0.002	0.005	0.010	0.0002	0.003	0.005
Quality Assurance/Quality Control Samples - Water (all in mg/L)												
Equipment Blank	029622	CY13-GR-007-EB	NA	ND	ND	ND	ND	ND	ND	ND	0.0026J	ND
Practical Quantitation Limit (mg/L)				0.010	0.010	0.010	0.002	0.005	0.010	0.0002	0.003	0.005

Notes: mg/kg - Milligrams per kilogram; µg/L - Micrograms per liter.
Metals: Ag - silver; As - arsenic; Ba - barium; Be - beryllium; Cd - cadmium; Cr - chromium; Hg - mercury; Pb - lead; Se - selenium.
J - Concentration below the practical quantitation limit (PQL) and above the method detection limit (MDL); B - Analyte was detected in the laboratory method blank.
ND - Not detected at the MDL; UTL - Upper tolerance limit; NA - Not applicable.
[1] Concentrations from Canyons background study, see Section 3.2.7 for explanation.
[2] Concentration for depth 0 - 6 inches below grade.
[3] Concentration for depth 6 - 12 inches below grade.

Metals analyses that were conducted on site had high detection limits relative to Burn Site-Specific UTL/95th percentile values for arsenic, cadmium, selenium, and silver. These metals are not known to be specific COCs for ER Site 13 and are therefore not expected to be present as site contaminants. To evaluate the potential risk associated with those metals that were not detected at the site, the detection limit practical quantitation limits (PQL) were used as the maximum values in the site risk assessment (see Section 3.4).

Surface Soil Results

All four surface soil samples had very low levels of acetone (maximum value 0.017J milligrams per kilogram [mg/kg]) detected. All results are qualified with a "J" to indicate the detected concentration is between the method detection limit (MDL) and the PQL. The only other detection was TPH at 2.2J mg/kg, which was below the PQL of 4.0 mg/kg. All other VOC and SVOC analytes were below the MDL.

All metal analytes were either below the MDL and/or the Burn Site-Specific UTL/95th percentile value. Only barium, chromium, and lead were detected. All chromium and lead values are qualified with a "J", indicating results were below the PQL but above the MDL.

Subsurface Soil Results

Acetone and 2-butanone were detected at very low levels in one sample between the MDL and PQL. The only other organic detection was TPH at 2.9J mg/kg in one sample, again below the PQL of 4.0 mg/kg. All other VOC and SVOC analytes were below the analyte MDL.

All metal analytes were either below the MDL or the Burn Site-Specific UTL/95th percentile value. Only barium, chromium, and lead were detected. All chromium and lead values are qualified as "J", indicating results were below the PQL but above the MDL.

Discharge Pipe Water Results

The only organic detection in the manhole wastewater sample were 2,6-dinitrotoluene at 17 micrograms per liter (µg/L) and TPH/DRO at 0.0016 µg/L (see Table 3-2 for qualifiers on the TPH detection). No VOCs and no other SVOCs were detected in the sample. This water is contained in the piping system and is isolated from the environment.

All metal analytes were below detection limits except barium (0.57 milligram per liter [mg/L]) and lead (0.0063 mg/L).

3.2.8.1 QA/QC Results

As part of the ER Site 13 sampling effort, several QA/QC samples were collected and analyzed at the off-site laboratory. No field QA/QC samples (duplicates, blanks, etc.) were analyzed at the ERCL. All off-site data were reviewed and verified/validated according to "Data Verification/Validation Level 2-DV2" in Technical Operating Procedure 94-03 Rev. 0 (SNL/NM July 1994b). The equipment rinsate blank, which checks the sampling equipment decontamination procedures, was analyzed for VOCs, SVOCs, TPH, and RCRA metals plus beryllium. Results were all non-detect, indicating decontamination was conducted appropriately. No VOCs were detected in the trip blank, which indicates no cross-contamination of VOCs occurred in the shipping cooler.

Sample CY13-GR-003-5.5-SD was analyzed for VOCs, SVOCs, TPH, and RCRA metals plus beryllium as a duplicate sample and as a matrix spike/matrix spike duplicate sample. This was the only soil sample that was analyzed for VOCs and RCRA metals plus beryllium at the off-site laboratory. All matrix spike recovery data were reported and met QC limits for this sample. All TPH/DRO results were reported as non-detects at the reporting limit of 4.0 mg/kg. Samples were qualified with assigned flags "UJ" indicating an estimated limit of detection because analytical precision reported for the matrix spike duplicate sample was 40 relative percent difference (RPD), exceeding the laboratory acceptance limit of 32 RPD. The impacts on the data set are insignificant since there were only two soil detections of TPH/DRO, the highest of which was 2.9 mg/kg.

A soil field blank was shipped with the samples to the off-site laboratory to provide information regarding possible VOC cross-contamination during shipping and in the laboratory (sample only analyzed for VOCs). Detections (in mg/kg) in this sample (CY13-GR-009-SB) included: acetone (0.130), 2-butanone (0.037), ethylbenzene (0.0025J), 2-hexanone (0.0042J), methylene chloride (0.0058), tetrachloroethene (0.0017J), toluene (0.0038J), and total xylenes (0.0095). Only one other soil sample, CY13-GR-003-5.5-SD, was analyzed for VOCs at the off-site laboratory. The following VOCs were detected (in mg/kg): acetone (0.012), 2-butanone (0.021), and methylene chloride (0.0019J). Because of the soil blank results, the VOC detections in sample CY13-GR-003-5.5-SD were qualified as "non-detects" as part of the DV-2 validation process. No other VOC results were impacted.

3.3 Gaps in Information

Historical information is very complete for ER Site 13 and contains the time of operation, number of discharges of wastewater to the pit, and the volumes of water and fuel used in each test that was discharged to the pit (see Section 2.1). The main data gap for ER Site 13 prior to this investigation had been surface and shallow subsurface soil analytical results to determine whether or not a significant release had occurred. This information was collected as part of the confirmatory sampling effort. No other decision-impacting data gaps remain.

3.4 Risk Evaluation

Risk-based clean-up criteria for ER Site 13 are based on a proposed "recreational" future land use as well as its current use for industrial/research and development purposes (DOE/USAF March 1996). A complete discussion of the risk assessment process, results, and uncertainties is provided in Section 6.1. Because detection limits for several metals analyzed on site exceeded background levels, it was necessary to perform a human health risk assessment for the site. The presence of low level detections of three VOCs was included in this assessment in addition to the metals. Because the wastewater sampled at the site is contained in the discharge pipe manhole between the manhole cover and a cap installed in the end of the pipe, the water results were not included in the risk assessment. Radionuclides were not Site 13 COCs, so a risk assessment for radioactive COCs was not conducted.

The risk assessment process provides a quantitative evaluation of the potential adverse human health effects caused by constituents in the site soil. The Risk Assessment Report calculated the hazard index (a unitless measure) and excess cancer risk for industrial, recreational, and residential land-use settings. For the ER Site 13 risk assessment, a conservative approach was used taking the maximum value of analytes from the combined surface and subsurface data sets. In summary, the hazard index calculated for ER Site 13 COCs is 0.4. The incremental hazard index is 0.36 for an industrial land-use setting, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). Incremental risk is determined by subtracting risk associated with background from potential COC risk. The excess cancer risk for Site 13 COCs is 6×10^{-5}. The incremental cancer risk is 5.4×10^{-5} in an industrial land-use setting, which is in the middle of the suggested range of acceptable risk of 10^{-6} and 10^{-4} (EPA 1989).

For the recreational land-use setting, the hazard index calculated for ER Site 13 COCs is 0.1, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). The excess cancer risk for ER Site 13 COCs is 2×10^{-5}. The incremental cancer risk is 1.8×10^{-5} in a recreational land-use setting, which is in the middle of the suggested range of acceptable risk of 10^{-6} and 10^{-4} (EPA 1989).

The residential land-use scenarios for this site are provided only for comparison in the Risk Assessment Report (Section 6.1). It is important to note that the constituent with the greatest impact on the risk assessment results for both industrial and recreational land-use scenarios is arsenic, which was not detected (the detection limit was used in the risk assessment) and is not a site COC. The report concludes that the Site 13 does not have significant potential to affect human health under a recreational or industrial land-use scenario.

3.5 Ecological Risk Assessment

Potential risks were indicated for all three ecological receptors at ER Site 13. However, the use of the maximum measured soil concentration or maximum detection limit to evaluate risk provided the "worst case" scenario for the risk assessment and may not reflect actual site conditions. Detection limits were used to evaluate risk for arsenic, cadmium, selenium, and silver. All of these exceeded their respective plant benchmark values. In addition, arsenic, cadmium, and selenium show potential risk to deer mice. Maximum measured soil concentrations for chromium (total) exceeded the plant benchmark value but did not result in

HQs greater than 1.0 for the wildlife receptors. The detection limit for selenium resulted in a potential risk to all ecological receptors and was the only COPEC concentration that resulted in an HQ greater than 1.0 for the burrowing owl. Insufficient toxicity information was found to estimate the potential ecological risk for acetone and 2-butanone in plants and the burrowing owl. This is also true for birds exposed to silver. Based upon these results, no analytes/compounds can be justified for elimination as a COPEC at Site 13; however, it is very likely that the modeled risk results are driven by conservatisms in data analysis. HQs based upon 95-percent upper confidence limits of the mean will likely be lower and still be a conservative estimate of site conditions.

4.0 RATIONALE FOR NO FURTHER ACTION DECISION

Based upon process knowledge, field investigation data, and the human health risk assessment analysis, an NFA is being recommended for Site 13 for the following reasons:

- Operational history of the site is well documented and involved limited use.
- VOC, SVOC, and TPH results indicate the surface and subsurface soils at the site were not impacted adversely by site operations involving residual JP-4 fuel in discharged wastewater.
- Metals results do not indicate the presence of RCRA-regulated metals in the surface or subsurface soils at concentrations that would adversely impact human health or the environment.
- Metals analyses that had elevated detection limits (for arsenic, cadmium, selenium, and silver) are not site-specific COCs.
- Arsenic had the greatest impact on the risk assessment, a result of using the elevated detection limit in the risk assessment (as opposed to a measured value). Even with arsenic included in the risk assessment, the hazard index is below 1.0 for both industrial and recreational land-use scenarios, and the excess cancer risk for chemical compounds/metals is within the suggested range of acceptable risk of 10^{-6} and 10^{-4} (EPA 1989).

Based on the evidence provided above, Site 13 is proposed for an NFA based on Criterion 5 of the DOU, which states "the [potential release site] has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected land use."

5.0 REFERENCES

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6.0 ANNEXES

6.1 Risk Assessment Report

ER SITE 13: RISK ASSESSMENT ANALYSIS

I. Site Description and History

ER Site 13, identified as Oil Surface Impoundment (within the Lurance Canyon Burn Site complex) in the HSWA Module, comprises approximately 0.5 acres of U.S. Air Force (USAF) land withdrawn from the Bureau of Land Management (BLM) and permitted to the U.S. Department of Energy (DOE). This inactive site was constructed in the canyon-floor alluvium in the upper reaches of the Lurance Canyon drainage. The current use of the area is industrial. The future projected use is recreational as per the recommendation of the Citizen's Advisory Board (CAB) (CAB 1996, DOE and USAF 1996).

ER Site 13 was constructed in 1982 and was connected to the Large Open Burn Pan LOBP. ER Site 13 is a manmade, unlined surface impoundment, which is located approximately 200 ft south of the LOBP. The impoundment is approximately 175 ft id diameter at the top rim and 25 feet deep. A buried 24-in.-diameter corrugated culvert discharge pipeline connects the LOBP and the impoundment. Wastewater from the LOBP was drained through a pipeline to a discharge manhole located on top of a concrete spillway at the north edge of the impoundment. The pipeline and discharge manhole were constructed so that wastewater flows under a hydrostatic head form the LOBP to the manhole. The wastewater was discharged into the surface impoundment only when the manhole cover was opened. The flow rate into the impoundment was controlled by closing the manhole cover.

Nine burn tests were conducted in the LOBP between May 1984 and March 1987 that involved discharges to the Site 13 pit. The discharge line was capped and the Site 13 pit deactivated in 1987. In each of the burn tests, test objects were suspended above the LOBP, and water was filled in the pool to a depth of approximately 2.5 ft (about 34,000 gal). A layer of JP-4 fuel (approximately 9,000 to 17,000 gal) was placed on top of the water. The JP-4 fuel/water mixture, and possibly lead and aluminum oxide residue from the test units, was discharged from the LOBP through the corrugated culvert discharge pipeline to ER Site 13. Wastewater discharge into the Oil Surface Impoundment was left to evaporate and infiltrate in the impoundment, potentially resulting in the deposition of JP-4 fuel residue on the soil and within the impoundment.

Suspected constituents of concern (COC) include JP-4 residues (VOC and SVOCs) and RCRA-regulated metals, primarily lead.

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 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 the COCs and background.
Step 6.	These values are compared with standards established by the United States (U.S.) Environmental Protection Agency (EPA) to determine if further evaluation, and potential site clean-up, is required. The 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 13 No Further Action Proposal (NFA). 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. Chemicals that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium were not included in this risk assessment (EPA 1989a). The only COCs were nonradiological. The nonradioactive COCs evaluated include both metals and organics.

II.2 Step 2. Pathway Identification

ER Site 13 has been designated with a future land-use scenario of recreational, however the current land-use scenario is industrial and will remain industrial for the foreseeable future (CAB, 1996 and DOE 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. The inhalation pathway for chemicals is included because of the potential to inhale dust and volatiles. No contamination at depth was determined and therefore no water pathways to the groundwater are considered. Depth to groundwater at Site 13 is approximately 230 feet. 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
Soil Ingestion
Inhalation (Dust and volatiles)
Plant uptake (Residential only)

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 13 were evaluated using a tiered approach. First, the maximum concentrations of COCs were compared to the Canyons site-specific background screening level (SNL/NM, 1997). If a site-specific screening level was not available for a constituent, then a background value was obtained, when possible, from the SNL/NM Site-Wide Background Report, Cnayons Supergroup (IT 1996).

The maximum concentration of the each COC was used in order to provide a conservative estimate of the associated risk. If any COCs were above the site-specific background screening level or the site-wide background value, all COCs were considered in further risk assessment analyses.

Second, if any COC failed the initial screening step, the maximum concentration for each COC was compared with the relevant action level 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) (EPA, 1989a) 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 (EPA, 1989a). The combined effects of all COCs in the soils were calculated. The combined effects of the 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 metal 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

ER Site 13 COCs are listed in Table 1. The table shows the associated site-specific 95th percentile or UTL background levels (SNL/NM, 1997). The Canyons site-specific background levels have not yet been approved by the EPA or the New Mexico Environment Department (NMED), but are the result of statistical analyses of samples collected from background areas within the canyons area. EPA guidance (EPA, 1989b; 1992a; and 1992b) were followed to arrive at the background levels. The SNL/NM site-wide background levels have not yet been approved by the EPA or the NMED but are the result of a comprehensive study of joint SNL/NM and U.S. Air Force data from the Kirtland Air Force Base (KAFB). The report was submitted for regulatory review in early 1996. The values in Table 1 supersede the background values described in an interim background study report (IT 1994). Although no compounds/analytes had measured maximum values exceeding background screening levels, several compounds had detection limits that were above the background screening levels. Therefore, the maximum measured values used were actually the detection limits.

Therefore all COCs were retained for further analysis with the exception of lead. The maximum concentration value for lead is 5.8J mg/kg. The EPA intentionally does not provide any toxicological data on lead and therefore no risk parameter values can be calculated. However, EPA guidance for the screening value for lead for an industrial land-use scenario is 2000 mg/kg (EPA, 1996a); for a residential land-use scenario, the EPA screening guidance value is 400 mg/kg (EPA, 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 organic compounds do not have calculated background values, this screening step was skipped, and all detected organics are carried into the risk assessment analyses but are not shown on Table 1.

Because several COCs had detection limits greater than their respective site-specific background 95th percentile or UTL, the site fails the background screening criteria even though the COCs were not detected and all COCs proceed to the proposed Subpart S action level screening procedure. Because the ER Site 13 sample set had more than 10 COCs 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 cancer risk value calculated.

II.3.2 Identification of Toxicological Parameters

Table 2 shows the COCs that have been retained in the risk assessment and the values for the toxicological information available for those COCs.

Table 1. COCs at ER Site 13 and Comparison to the Background Screening Values.

COC name	Maximum concentration (mg/kg)	Canyons 95th % or UTL Level (mg/kg)	Is maximum COC concentration less than or equal to the applicable Canyons background screening value?
Arsenic	<98	7.4	**No**
Barium	240	270	Yes
Beryllium	<0.44	0.77	Yes
Cadmium	<8	1.6**	**No**
Chromium, total*	11	NC	**No**
Lead	5.8J	20.8	**No**
Mercury	<0.24	0.31**	Yes
Selenium	<191	3.5	**No**
Silver	<6.4	2.0**	**No**

* total chromium assumed to be chromium VI (most conservative)
J - estimated concentration
** UTL/95th percentile taken from Sitewide Background Report, Canyons Supergroup, Fan Group, Table C-25

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 potential 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 (EPA, 1989a). The parameter values are based on information from RAGS (EPA, 1989a) as well as other EPA guidance documents and reflect the RME approach advocated by RAGS (EPA, 1989a).

Although the current land-use scenario is industrial and projected future land-use is recreational 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.

Table 2. Toxicological Parameter Values for ER Site 13 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
Beryllium	0.005	--	L	4.3	8.4	B2
Cadmium	0.0005	0.0000571	H	--	6.3	B1
Chromium, total*	0.005	--	L	--	42	A
Mercury	0.0003	0.0000137	--	--	--	D
Selenium	0.005	--	H	--	--	D
Silver	0.005	--	--	--	--	D
Acetone	0.1	--	L	--	--	D
2-Butanone	0.6	0.286	--	--	--	D
Methylene Chloride	0.06	0.857	--	0.0075	0.00164	B2
TPH	--	--	--	--	--	--

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, Est. - estimated
Heast - Heast table from EPA 1996b
SF_o - oral slope factor in $(mg/kg\text{-}day)^{-1}$
SF_{inh} - inhalation slope factor in $(mg/kg\text{-}day)^{-1}$
^ EPA 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
* total chromium assumed to be chromium VI (most conservative)

II.3.3.2 Risk Characterization

Table 3 shows that for the nonradioactive COCs, the Hazard Index value is 0.4 and the excess cancer risk is 6×10^{-5} for the current industrial land-use scenario. The numbers presented included exposure from soil ingestion and dust and volatile inhalation for the nonradioactive COCs. Table 4 shows that for the ER Site 13 associated background constituents, the Hazard Index is 0.02 and the excess cancer risk is 6×10^{-6} for the current industrial land-use scenario.

Table 3. Risk Assessment Values for ER Site 13 COCs.

Constituent Name	Maximum concentration (mg/kg)	Industrial Land-Use Scenario		Recreational Land-Use Scenario		Residential Land-Use Scenario	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	<98	0.32	6E-5	0.10	2E-5	5.6	1E-3
Barium	240	0.00	--	0.00	--	0.04	--
Beryllium	<0.44	0.00	8E-7	0.00	3E-7	0.00	4E-6
Cadmium	<8	0.02	3E-9	0.00	1E-10	6.54	5E-9
Chromium, total*	11	0.00	3E-8	0.00	1E-9	0.01	4E-8
Mercury	<0.24	0.00	--	0.00	--	0.41	--
Selenium	<191	0.04	--	0.01	--	67.19	--
Silver	<6.4	0.00	--	0.00	--	0.26	--
Acetone	0.017 J	0.00	--	0.00	--	0.00	--
2-Butanone (MEK)	0.021	0.00	--	0.00	--	0.00	--
Methylene Chloride	0.019 J	0.00	6E-11	0.00	2E-11	0.00	1E-7
TPH	2.9 J	--	--	--	--	--	--
TOTAL		**0.4**	**6E-5**	**0.1**	**2E-5**	**80**	**1E-3**

B - parameter detected in method blank
J - estimated value
-- information not available
* total chromium assumed to be chromium VI (most conservative)

Table 4. Risk Assessment Values for ER Site 13 Background Constituents.

COC Name	Maximum concentration (mg/kg)	Industrial Land-Use Scenario		Recreational Land-Use Scenario		Residential Land-Use Scenario	
		Hazard Index	**Cancer Risk**	**Hazard Index**	**Cancer Risk**	**Hazard Index**	**Cancer Risk**
Arsenic	7.4	0.02	5E-6	0.01	2E-6	0.42	8E-5
Barium	270	0.00	--	0.00	--	0.04	--
Beryllium	0.77	0.00	1E-6	0.00	4E-7	0.00	6E-6
Cadmium	1.6	0.00	6E-10	0.00	2E-11	1.31	9E-10
Chromium, total*	NC	--	--	--	--	--	--
Mercury	0.31	0.00	--	0.00	--	0.53	--
Selenium	3.5	0.00	--	0.00	--	1.23	--
Silver	2.0	0.00	--	0.00	--	0.08	--
TOTAL		**0.02**	**6E-6**	**0.01**	**2E-6**	**4**	**9E-5**

-- information not available
J - estimated value
* total chromium assumed to be chromium VI (most conservative)

Table 3 shows that for the nonradioactive COCs, the Hazard Index value is 0.1 and the excess cancer risk is 2 x 10^{-5} for the projected recreational land-use scenario. The numbers presented included exposure from soil ingestion and dust and volatile inhalation for the nonradioactive COCs. Table 4 shows that for the ER Site 13 associated background constituents, the Hazard Index is 0.01 and the excess cancer risk is 2 x 10^{-6} for the projected recreational land-use scenario.

For the residential land-use scenario, the Hazard Index value increases to 80 and the excess cancer risk is 1 x 10^{-3} (Table 3). The number presented included exposure from soil ingestion, dust and volatile inhalation and plant uptake. Although EPA (1991) generally recommends that inhalation not be included in a residential land-use scenario, this pathway is included because of the potential for soil in Albuquerque, 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 4 shows that for the ER Site 13 associated background constituents, the Hazard Index increases to 4 and the excess cancer risk is 9 x 10^{-5}.

II.4 Step 6 Comparison of Risk Values to Numerical Standards.

The risk assessment analyses considered the evaluation of the potential for adverse health effects for the current industrial land-use scenario, the projected recreational land-use scenario, and also a residential land-use scenario.

For the industrial land-use scenario, the Hazard Index calculated is 0.4; this is much less than the numerical standard suggested in RAGS (EPA, 1989a) of 1. The excess cancer risk is estimated at 6 x 10^{-5}. In RAGS, the EPA 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 the current industrial land-use scenario, the Hazard Index risk assessment values are significantly less than the established numerical standards and the excess cancer risk is in the middle of the acceptable risk range. This risk assessment also determined risks considering background concentrations of the potential COCs for the industrial, recreational and residential land-use scenarios. For the industrial land-use scenario, the Hazard Index is 0.02. The excess cancer risk is estimated at 6 x 10^{-6}. Incremental risk is determined by subtracting risk associated with background from potential COC risk. These numbers are not rounded before the difference is determined and therefore may appear to be inconsistent with numbers presented in tables and discussed in the text. The incremental Hazard Index is 0.36 and the incremental cancer risk is 5.4 x 10^{-5} for the industrial land-use scenario.

For the recreational land-use scenario, the Hazard Index calculated is 0.1; this is much less than the numerical standard suggested in RAGS (EPA, 1989a) of 1. The excess cancer risk is estimated at 2 x 10^{-5}. In RAGS, the EPA 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 the projected recreational land-use scenario, the Hazard Index risk assessment values are significantly less than the established numerical standards and the excess cancer risk is in the middle of the acceptable risk range. The hazard index for the associated background for the recreational land-use scenario is 0.01. The excess cancer

risk is estimated at 2 x 10^{-6}. The incremental Hazard Index is 0.1 and the incremental cancer risk is 1.8 x 10^{-5} for the recreational land-use scenario.

For the residential land-use scenario, the calculated Hazard Index is 80, which is above the numerical guidance. The excess cancer risk is estimated at 1 x 10^{-3}; this value is also greater than the suggested acceptable risk range. The hazard index for the associated background for the residential land-use scenario is 4. The excess cancer risk is estimated at 9 x 10^{-5}. For the residential land-use scenario, the incremental Hazard Index is 76.4 and the incremental cancer risk is 9.1 x 10^{-4}. The potential pathways considered for this calculation includes both soil ingestion, dust inhalation and plant uptake.

II.5 Step 7 Uncertainty Discussion

The data used to characterize Site 13 was provided by 4 surface samples and 8 subsurface samples from the surface impoundment. The number of samples was increased 3-fold from the number of samples proposed in the Draft OU 1333 RFI Work Plan based on discussions with the DOE-OB. In addition, the samples were collected using a backhoe to excavate a trench, allowing more subsurface soil to field screened with the PID and visually examined for signs of contamination. Since the impoundment is approximately 175 ft in diameter at the top rim and 25 ft deep, with a relatively flat bottom less than 75 ft in diameter, the 4 surface and 8 subsurface samples from the four trench locations are sufficient to determine the nature and extent of potential contamination resulting from the 9 documented uses of the impoundment for accepting wastewater with fuel residues from the Large Open Burn Pool (LOBP). The constituents of concern (COCs) at the site included JP-4 fuel and RCRA metals, primarily lead. VOC and SVOC analyses were conducted to look for organic fuel constituents and TPH/DRO analyses were run to screen for hydrocarbons that would potentially be missed in VOC or SVOC analyses. Soil and water samples (water = discharge pipe water and QA/QC samples) were analyzed for SVOCs (EPA Method 8270) and total petroleum hydrocarbons by diesel range organics (TPH/DRO) (EPA Method 8015 modified) at an offsite laboratory, and VOCs (EPA Method 8240/8260) and RCRA metals (plus beryllium) (EPA Method 6010, 7000, and 7471) at the onsite ER Chemistry Laboratory (ERCL). Metals analyses that were conducted onsite had high detection levels relative to Burn Site-Specific UTL/95th percentile values for arsenic, cadmium, selenium, and silver. These three metals are not known to be specific COCs for ER Site 13. To evaluate the potential risk associated with these metals that were not detected at the site, the detection limits (PQLs) were used as the maximum values in the site risk assessment (see Section 3.4). QA/QC samples consisted of a trip blank, field blank, equipment rinsate blank, and soil sample duplicate, and were run at the offsite laboratory. Offsite VOC analyses were run by EPA Method 8240A. Offsite analyses were performed by a CLP laboratory and a Level III data package was provided, which was verified/validated according to "Data Verification/Validation Level 2-DV2" in TOP 94-03 Rev. 0. Onsite analytical QA/QC included MS/MSD analyses for metals and VOC analyses, and a continuing calibration verification was performed for the VOC analyses. Based on the laboratory QA/QC results, the data is considered suitable for use in a risk assessment.

The conclusion from the risk assessment analysis is that the potential effects caused by potential COCs on human health are small compared to established numerical standards for the industrial and recreational land-use scenarios. Calculated incremental risk between potential COCs and associated background indicate small contribution of risk from the COCs when considering both the industrial and recreational land-use scenarios. This is further

supported by the fact that the concentrations for the COCs that have the greatest impact on the risk assessment are actually detection limits and not measured concentrations of those COCs.

The potential effects on human health, for the COCs, are greater when considering the residential land-use scenario. Incremental risk between potential COCs and associated background also indicates a greater contribution of risk from the 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 either an industrial or recreational 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. These constituents bioaccumulate in plants. Because Site 13 is designated currently as an industrial land-use area with a projected future recreational land-use (CAB, 1996 and DOE, 1996), the likelihood of significant plant uptake in this area is highly unlikely. The uncertainty in this conclusion is also considered to be small.

Because of the location, history of the site and the current and projected future land-use (CAB, 1996 and DOE, 1996), there is low uncertainty in the land-use scenario and the potentially affected populations that were considered in making the risk assessment analysis.

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 2 shows the uncertainties (confidence) in the toxicological parameter values. There is a mixture of estimated values and values from the Health Effects Assessment Summary Tables (HEAST) (EPA, 1996b) and Integrated Risk Information System (IRIS) (EPA, 1988, 1994b) databases. Where values are not provided, information is not available from HEAST, IRIS, or EPA regions. The constituents without toxicological parameters have low concentrations and are judged to be insignificant contributors to the overall risk. 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 risk assessment values are low for both the industrial and recreational land-use scenarios compared to the established numerical standards. Though the residential land-use Hazard Index is above the numerical standard, it has been determined that future land-use at this locality will not be residential (CAB, 1996 and DOE, 1996). The overall uncertainty in all of the steps in the risk assessment process is therefore considered insignificant with respect to the conclusion reached.

II.6 Summary

ER Site 13, identified as Oil Surface Impoundment, had relatively minor contamination consisting of some inorganic and organic nonradioactive compounds. The inorganic compounds that had the greatest impact on the risk assessment were not detected. The detection limits were used in the risk assessment process. Because of the location of the site

on KAFB, the current industrial and projected recreational land-use scenarios (CAB, 1996 and DOE, 1996) and the nature of the contamination, the potential exposure pathways identified for this site included soil ingestion and dust and volatile inhalation for chemical.

The residential land-use scenario includes the soil ingestion, inhalation, and plant uptake exposure pathways. Because the site is designated currently as industrial and the projected use is recreational (DOE, 1996), the residential land-use scenario is presented to only provide perspective. The stated exposure pathways were included but provide a conservative risk assessment.

Using conservative assumptions and employing a RME approach to the risk assessment, the calculations for the COCs show that for the current industrial land-use scenario the Hazard Index (0.4) is significantly less than the accepted numerical guidance from the EPA. The estimated cancer risk is in the middle of the suggested acceptable risk range. The incremental Hazard Index is 0.36 and the incremental cancer risk is 5.4×10^{-5} for the industrial land-use scenario. Incremental risk calculation indicate that insignificant contribution to risk from the COCs considering the current land-use scenario.

The calculations for the COCs show that for the projected recreational land-use scenario the Hazard Index (0.1) is significantly less than the accepted numerical guidance from the EPA. The estimated cancer risk (2×10^{-5}) is in the middle of the suggested acceptable risk range. The incremental Hazard Index is 0.1 and the incremental cancer risk is 1.8×10^{-5} for the recreational land-use scenario. Incremental risk calculation indicate that insignificant contribution to risk from the COCs considering the projected recreational land-use scenario.

The calculations for the COCs show that for the residential land-use scenario the Hazard Index (80) is above the accepted numerical guidance from the EPA. The estimated cancer risk (1×10^{-3}) is also above the suggested acceptable risk range. The majority of the risk is associated with the inclusion of the plant uptake exposure pathway. Constituents that posed little to no risk considering an industrial and recreational 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. These constituents bioaccumulate in plants. Because ER Site 13 is currently an industrial site and future landscape will be recreational, the likelihood of significant plant uptake in this area is highly unlikely. For the residential land-use scenario, the incremental Hazard Index is 76.4 and the incremental cancer risk is 9.1×10^{-4}. Contribution of risk from the COCs was evident considering residential land-use, due to the plant uptake exposure pathway, but current use will be restricted to industrial and recreational land-use.

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

III. Ecological Risk Assessment

III.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPECs) in soils from SNL/NM ER Site 13. 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 (1997a). The methodology was based on screening level guidance presented by EPA (EPA, 1992c; 1996c; 1996d) and by Wentsel, et al. (1996) and is consistent with a phased approach. This assessment utilizes conservatism in the estimation of ecological risks, however, ecological relevance and professional judgment are also incorporated as recommended by EPA (1996c) and Wentsel et al., (1996) to insure that the predicted exposures of selected ecological receptors reasonably reflect those expected to occur at the site.

III.2 Site Description and Ecological Pathways

ER Site 13, identified as Oil Surface Impoundment (within the Lurance Canyon Burn Site complex) in the Hazardous and Solid Waste Amendment (HSWA) Module, comprises approximately 0.5 acres of USAF land withdrawn from the Bureau of Land Management and permitted to the Department of Energy. This inactive site was constructed in the canyon-floor alluvium in the upper reaches of the Lurance Canyon drainage. Site 13 was constructed in 1982 and was connected to the Large Open Burn Pan (LOBP). Site 13 is a manmade, unlined surface impoundment, which is located approximately 200 ft south of the LOBP. The impoundment is approximately 175 ft in diameter at the top rim and 25 feet deep. A buried 24-in.-diameter corrugated culvert discharge pipeline connects the LOBP and the impoundment. Wastewater from the LOBP was drained through a pipeline to a discharge manhole located on top of a concrete spillway at the north edge of the impoundment. The pipeline and discharge manhole were constructed so that wastewater flows under a hydrostatic head form the LOBP to the manhole. The wastewater was discharged into the surface impoundment only when the manhole cover was opened. The flow rate into the impoundment was controlled by closing the manhole cover.

Nine burn tests were conducted in the LOBP between May 1984 and March 1987 that involved discharges to the Site 13 pit. The discharge line was capped and the Site 13 pit deactivated in 1987. In each of the burn tests, test objects were suspended above the LOBP, and water was filled in the pool to a depth of approximately 2.5 ft (about 34,000 gal). A layer of JP-4 fuel (approximately 9,000 to 17,000 gal) was placed on top of the water. The JP-4 fuel/water mixture, and possibly lead and aluminum oxide residue from the test units, was discharged from the LOBP through the corrugated culvert discharge pipeline to ER Site 13. Wastewater discharge into the Oil Surface Impoundment was left to evaporate and infiltrate in the impoundment, potentially resulting in the deposition of JP-4 fuel residue on the soil and within the impoundment.

ER Site 13 is highly disturbed and little natural habitat remains. This area was previously surveyed as part of a biological assessment of the Burn Site (Biggs, 1991). No sensitive species were found during this survey. Complete ecological pathways may exist at this site through the exposure of plants and wildlife to COPECs in surface and subsurface soil.

III.3 Constituents of Potential Ecological Concern

The potential COCs at this site include RCRA metals and volatile organic compounds. Following the screening process used for the selection of potential COCs for the human health risk assessment, the inorganic COCs were screened against background upper tolerance limits (UTLs). Only samples collected from depths of 5 ft. or less were considered in the ecological assessment (IT, 1997). Five inorganic analytes, arsenic, cadmium, chromium (total), and silver were identified as COPECs at Site 13. Four of these (arsenic, cadmium, selenium, and silver) were not detected in either surface or subsurface samples; however, the detection limits exceeded the UTLs of the background soil concentrations, and therefore, these analytes could not be excluded from the list of COPECs. Two organic compounds, acetone and 2-butanone, were also identified as COPECs at Site 13. Chemicals that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium were not included in this risk assessment per EPA 1989a.

III.4 Receptors and Exposure Modeling

A non-specific perennial plant was used as the receptor to represent plant species at the site. Two wildlife receptors (deer mouse and burrowing owl) were used to represent wildlife use of the site. Exposure modeling for the wildlife receptors was limited to the food ingestion pathway. Inhalation and dermal contact were considered insignificant pathways with respect to ingestion. Drinking water was also considered an insignificant pathway because of the lack of surface water at this site. The deer mouse was modeled as an omnivore (50 percent of the diet as plants and 50 percent as soil invertebrates) and the burrowing owl as a strict predator on small mammals (100 percent of the diet as deer mice). Both were modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 5 presents the species-specific factors used in modeling exposures in the wildlife receptors. Although home range is also included in this table, exposures for this screening-level assessment were modeled using an area use factor of 1, implying that all food items and soil ingested are from the site being investigated.

The maximum measured COPEC concentrations from both surface and subsurface soil samples were used to conservatively estimate potential exposures and risks to plants and wildlife at this site. In the case of arsenic, the detection limit from the on-site laboratory exceeded the measured concentrations of arsenic from the off-site laboratory. Therefore, the detection limit from the on-site laboratory was used as the maximum arsenic concentration in soil at this site. Detection limits from the on-site laboratory were also used for cadmium, selenium, and silver, which were not otherwise detected but were retained due to the high detection limit.

Table 6 presents the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 7 presents the maximum concentrations of COPECs in soil, the derived concentrations in the various food-chain elements, and the modeled dietary exposures for each of wildlife receptor species.

III.5 Toxicity Benchmarks

Benchmark toxicity values for the plant and wildlife receptors are presented in Table 8. For plants, the benchmark soil concentrations are based on the Lowest-Observed-Adverse-Effect-Level (LOAEL) with the adverse effect being a 20 percent reduction of growth. Phytotoxicity data specific to acetone and 2-butanone were not found in the open literature. For wildlife, the toxicity benchmarks are based on the No-Observed-Adverse-Effect-Level (NOAEL) for chronic oral exposure (with emphasis on reproductive effects) in a taxonomically similar test species. Total chromium was assumed to be primarily composed of Cr+3. Insufficient toxicity information was found to estimate the NOAELs for birds exposed to acetone, 2-butanone, and silver.

Table 5. Exposure Factors for Ecological Receptors at Environmental Restoration Site 13, Sandia National Laboratories, New Mexico

Receptor species	Class/Order	Trophic level	Body weight (kg)[a]	Food intake rate (kg/d)[b]	Dietary Composition[c]	Home range (acres)
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Omnivore	0.0239[d]	0.00372	Plants: 50% Invertebrates: 50% (+ Soil at 2% of intake)	0.27[e]
Burrowing owl (*Speotyto cunicularia*)	Aves/ Strigiformes	Carnivore	0.155[f]	0.0173	Rodents: 100% (+ Soil at 2% of intake)	34.6[g]

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

Table 6. Transfer Factors Used in Exposure Models for Constituents of Potential Ecological Concern at Environmental Restoration Site 13, Sandia National Laboratories, New Mexico

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Arsenic	4.00×10^{-2} [a]	1.00×10^{0} [b]	2.00×10^{-3} [a]
Cadmium	5.50×10^{-1} [a]	6.00×10^{-1} [c]	5.50×10^{-4} [a]
Chromium (total)	4.00×10^{-2} [d]	1.30×10^{-1} [e]	3.00×10^{-2} [d]
Selenium	5.00×10^{-1} [d]	1.00×10^{0} [b]	1.00×10^{-1} [d]
Silver	1.00×10^{0} [d]	2.50×10^{-1} [c]	5.00×10^{-3} [d]
Acetone	5.33×10^{1} [f]	1.28×10^{1} [g]	1.04×10^{-8} [f]
2-butanone	2.63×10^{1} [f]	1.36×10^{1} [g]	3.67×10^{-8} [f]

[a]From Baes et al. (1984).
[b]Default value.
[c]From Stafford et al. (1991).
[d]From NCRP (1989).
[e]From Ma (1982).
[f]From equations developed in Travis and Arms (1988).
[g]From equations developed in Connell and Markwell (1990).

Table 7. Media Concentrations for Constituents of Potential Ecological Concern at Environmental Restoration Site 13,Sandia National Laboratories, New Mexico

Constituent of Potential Ecological Concern	Soil (maximum)[a]	Plant Foliage[a,b]	Soil Invertebrate[a,b]	Deer Mouse Tissues[a,c]
Arsenic	9.80×10^{1}	3.92×10^{0}	9.80×10^{1}	3.31×10^{-1}
Cadmium	8.00×10^{0}	4.40×10^{0}	4.80×10^{0}	8.18×10^{-3}
Chromium (total)	1.10×10^{1}	4.40×10^{-1}	1.43×10^{0}	1.08×10^{-1}
Selenium	1.91×10^{2}	9.55×10^{1}	1.91×10^{2}	4.60×10^{1}
Silver	6.40×10^{0}	6.40×10^{0}	1.60×10^{0}	6.45×10^{-2}
Acetone	1.70×10^{-2}	9.06×10^{-1}	2.18×10^{-1}	1.83×10^{-8}
2-butanone	5.80×10^{-3}	1.53×10^{-1}	7.89×10^{-2}	1.33×10^{-8}

[a]Milligrams per kilogram. All are based on dry weight of the media.
[b]Product of the soil concentration and the corresponding transfer factor.
[c]Product of the average concentration in food times the food-to-muscle transfer factor times the wet weight-dry weight conversion factor of 3.125 (from EPA, 1993).

Table 8. Toxicity Benchmarks for Ecological Receptors at Environmental Restoration Site 13, Sandia National Laboratories, New Mexico

		Mammalian NOAELs (mg/Kg/d)			Avian NOAELs (mg/Kg/d)		
Constituent of Potential Ecological Concern	Plant Benchmark[a] (mg/Kg)	Mammalian Test Species[b]	Test Species NOAEL[c]	Deer Mouse NOAEL[d]	Avian Test Species[e]	Test Species NOAEL[e]	Burrowing Owl NOAEL[f]
Arsenic	10	Lab mouse	0.126	0.133	Mallard	5.14	5.14
Cadmium	3	Lab rat	0.008	0.0156	Mallard	1.45	1.45
Chromium (total)	1	Lab rat	3.28	6.42	Black duck	1	1
Selenium	1	Lab rat	0.2	0.391	Screech owl	0.44	0.44
Silver	2	Lab rat[g]	17.8[g]	34.8	---[h]	---	---
Acetone	---	Lab rat	10	19.6	---	---	---
2-butanone	---	Lab rat	1771	3460	---	---	---

[a]From Will and Suter (1995).
[b]From Sample et al. (1996), except where noted. Body weights (in kilograms) for NOAEL conversion are: lab mouse, 0.030; lab rat, 0.350 (except where noted); and mink, 1.0.
[c]From Sample et al. (1996), except where noted.
[d]Based on NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.239 kilograms and a mammalian scaling factor of 0.25.
[e]From Sample et al. (1996).
[f]Based on NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.
[g]From EPA (1997).
[h]--- designates insufficient toxicity data.

III.6 Risk Characterization

The maximum measured soil concentrations or detection limits, and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. The results of these comparisons are presented in Table 9. Hazard quotients (HQs) are used to quantify the comparison with the benchmarks for wildlife exposure. The maximum soil concentration for chromium exceeded the plant benchmark value. The same was true for the maximum detection limits associated with arsenic, cadmiu, selenium, and silver. Hazard quotients greater than one were also predicted for the deer mouse when detection limits for arsenic, cadmium, and selenium were used to estimate exposure. Selenium (detection limit) was the only COPEC found to have a HQ greater than one for the burrowing owl HQ.

Table 9. Comparisons to Toxicity Benchmarks for Ecological Receptors at Environmental Restoration Site 13, Sandia National Laboratories, New Mexico

Constituent of Potential Ecological Concern	Plant Hazard Quotient	Deer Mouse Hazard Quotient	Burrowing Owl Hazard Quotient
Arsenic	**9.80×10^{0}**	**6.18×10^{1}**	4.97×10^{-2}
Cadmium	**2.67×10^{0}**	**4.73×10^{1}**	1.29×10^{-2}
Chromium	**1.10×10^{1}**	2.80×10^{-2}	3.66×10^{-2}
Selenium	**1.91×10^{2}**	**5.85×10^{1}**	**1.26×10^{1}**
Silver	**3.20×10^{0}**	1.85×10^{-2}	---[a]
Acetone	---	4.47×10^{-3}	---
2-butanone	---	5.21×10^{-6}	---

Bold text indicates hazard quotient greater than unity.
[a]--- designates insufficient toxicity data available for risk estimation purposes.

III.7 Uncertainties

Many uncertainties are associated with the characterization of ecological risks at ER Site 13. These uncertainties result in the use of assumptions in estimating risk which may lead to an overestimation or underestimation of the true risk presented at a site. For this screening level risk assessment, assumptions are made that are more likely to overestimate risk rather than to underestimate it. These conservative assumptions are used to be more protective of the ecological resources potentially affected by the site. Conservatisms incorporated into this risk assessment include the use of the maximum measured soil concentration or maximum detection limit to evaluate risk, the use of wildlife toxicity benchmarks based on NOAEL values, the use of maximum transfer factors found in the literature for modeling plant and mouse tissue concentrations, the use of earthworm-based transfer factors or a default factor of 1.0 for modeling COPECs into soil invertebrates, and the use of 1.0 as the use factor for wildlife receptors regardless of seasonal use or home range size. Risks to plants exposed to acetone and 2-butanone, and birds exposed to silver and these two organic compounds could not be estimated due to insufficient published toxicity data.

III.8 Summary

Potential risks were indicated for all three ecological receptors at ER Site 13; however, the use of the maximum measured soil concentration or maximum detection limit to evaluate risk provided the "worst case" scenario for the risk assessment and may not reflect actual site conditions. Detection limits were used to evaluate risk for arsenic, cadmium, selenium, and silver. All of these exceeded their respective plant benchmark values. The use of maximum detection limits for non-detected COPECs indicated potential risk to the deer mouse following exposure to arsenic, cadmium, and selenium. Maximum measured soil concentrations for chromium (total) exceeded the plant

benchmark value, but did not result in HQs greater than 1.0 for the wildlife receptors. The detection limit for selenium resulted in a potential risk to all ecological receptors, and was the only COPEC concentration that resulted in an HQ greater than 1.0 for the burrowing owl. Insufficient toxicity information was found to estimate the potential ecological risk associated with exposure to acetone and 2-butanone for plants and the burrowing owl. This is also true for birds exposed to silver.

An additional source of conservatism in the estimated exposure to arsenic and selenium in the two wildlife receptors is the use of 1.0 as the soil-to-invertebrate transfer factor for both of these elements, which probably overestimates the actual concentrations of these COPECs in the invertebrate prey at this site. Thus, the potential risk posed by ER Site 13 to wildlife is expected to be much less than that indicated by the results of this screening-level assessment. It should also be noted that the HQs for exposures in the deer mouse to background concentrations of arsenic (HQ = 4.66) and selenium (HQ = 1.07) also exceed unity.

Because of the small size (0.5 acres) and disturbed nature of this site and surrounding areas, habitat conditions are poor. Vegetation in the impoundment is limited to ruderal species that have been able to become established in the bed of the impoundment. The use of the site by wildlife will be limited by its small size, which is insufficient to support most species except those with very small home ranges, such as rodents. The burrowing owl, for example, is a small bird-of-prey and has a home range of about 34 acres or more (Haug et al., 1993). A similarly sized bird-of-prey in the area of ER Site 13 would be expected to have a similarly sized home range. ER Site 13 would account for 1/68th of the home range of these species, giving a use factor of about 0.014. The area use factor utilized in this assessment was 1.0.

Based on the results of this screening-level ecological risk assessment, no analytes/compounds can be justified for elimination as a COPEC at ER Site 13; however, it is very likely that the modeled risk results are driven by conservatisms in data analysis. Actual risks to wildlife from the three COPECs showing HQs greater than unity when their maximum detection limits are used as exposure concentrations in the risk assessment is unlikely at this site. The potential risks to plants due to COPEC exposure is probably less than the effects of the physical disturbance at this site. More realistic HQs based on 95% upper confidence limits of the mean or average concentrations will be lower than the values predicted here. Based on site history information, predicted HQs, the size of the site, and condition of the habitat, ecological risks are predicted to be low at ER Site 13. A high degree of uncertainty is, however, associated with this conclusion due to the use of high detection limits in the estimation of risk.

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APPENDIX 1.

Sandia National Laboratories Environmental Restoration Program

EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

BACKGROUND

Sandia National Laboratories (SNL) 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 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 views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the EPA Region VI and NMED, SNL 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/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 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)

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

where

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

The total risk/dose (either cancer risk or 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, 1989) and the RESRAD Manual (ANL, 1993). Table 2 shows the default parameter values suggested for used by SNL 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 is to use default values that are consistent with regulatory guidance and consistent with the RME approach. Therefore, the values chosen will, in general, provide a conservative estimate of the actual risk parameter. These parameter values are suggested for use for the various exposure pathways based 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.

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, 1992.

Summary

SNL 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 ER sites, but this scenario has been requested to be considered by the NMED. For sites designated as industrial or recreational land-use, SNL 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 will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

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RSI

Statement of Basis
Approval of No Further Action

January 2000

ER Site 13
Operable Unit 1333
Round 8

RSI Originally Submitted September 1999

Site-Specific Comments

OU 1333

ER Site 13, Oil Surface Impoundment, Lurance Canyon Burn Site

ER Site 13 may be appropriate for NFA petition, pending submittal and approval of the following information:

1. **Figure 1-1 is labeled "draft". See general comment 1.**

   Response: The draft label has been removed. See Attachment A.

2. **Figure 1-2 is labeled "draft". See general comment 1.**

   Response: The draft label has been removed. See Attachment A.

3. **Figure 3.1 is labeled "draft". See general comment 1.**

   Response: The draft label has been removed. See Attachment A.

4. **DOE/SNL must provide a complete list of all VOC's and SVOC's analyzed for and their MDL's (for soil and wastewater samples). See general comments 2-4.**

   Response: A complete list of compound and method detection limits for volatile organic compounds (on site and off site) and semivolatile organic compounds (off site) is provided in Attachment B for soil and water samples.

5. **Section 3.2.8, page 3-9 – Analytical results reported in this section for the wastewater (0.0016 μg/L TPH) does not match the value of 1600 μg/L shown in Table 3-2. Which value is correct?**

   Response: The correct value is 0.0016 μg/L. Table 3-2 has been corrected and is provided in Attachment C.

6. **The water contained within the discharge pipe, which is contaminated with HE and TPH, should be pumped out and properly disposed of.**

   Response: The water was pumped out of the discharge pipe in June 1999, placed in drums, and disposed of in the sanitary sewer system based on the analytical results presented in the NFA.

Attachment A

ATTACHMENT A

ER SITE 13
REVISED FIGURES

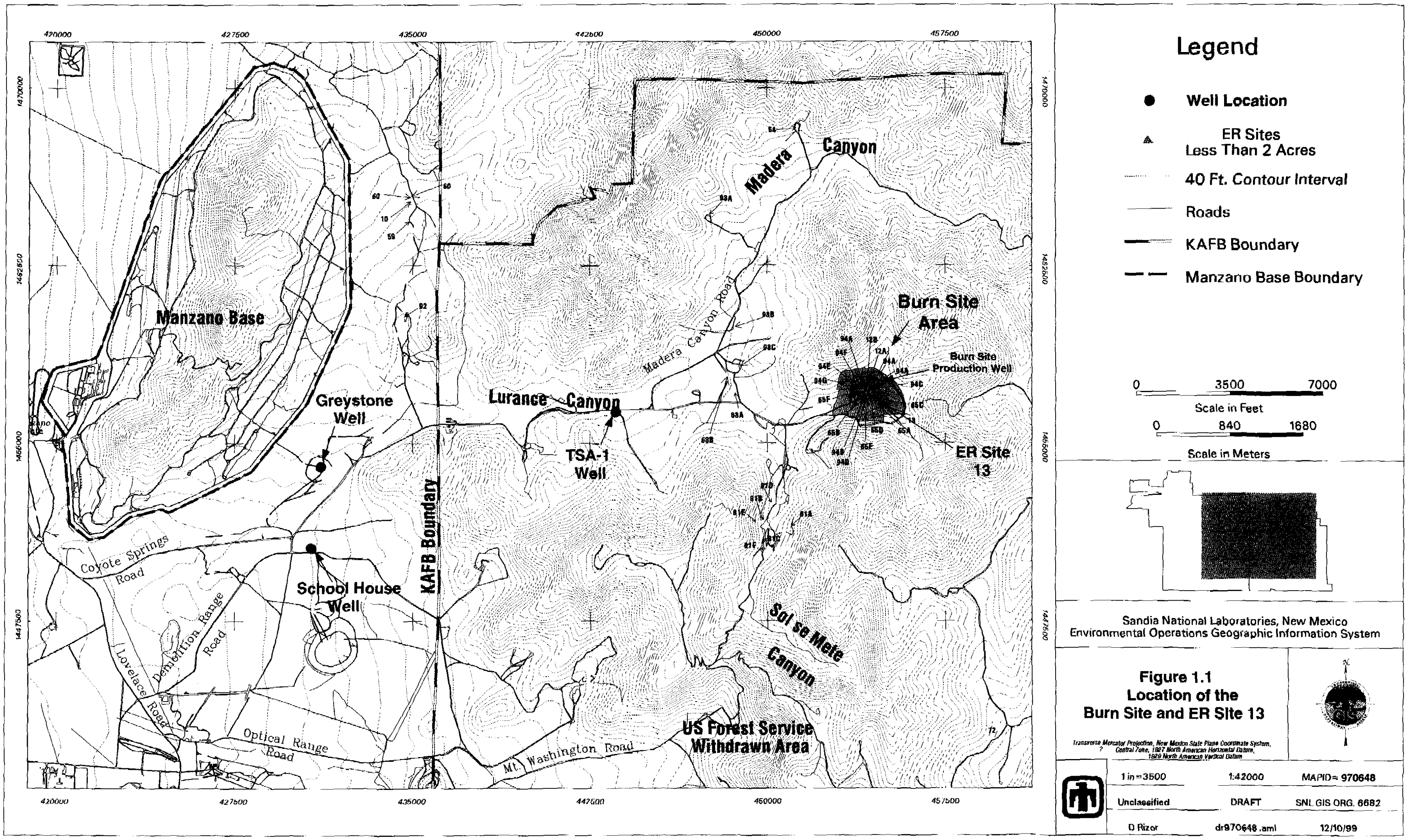

Figure 1.1
Location of the Burn Site and ER Site 13

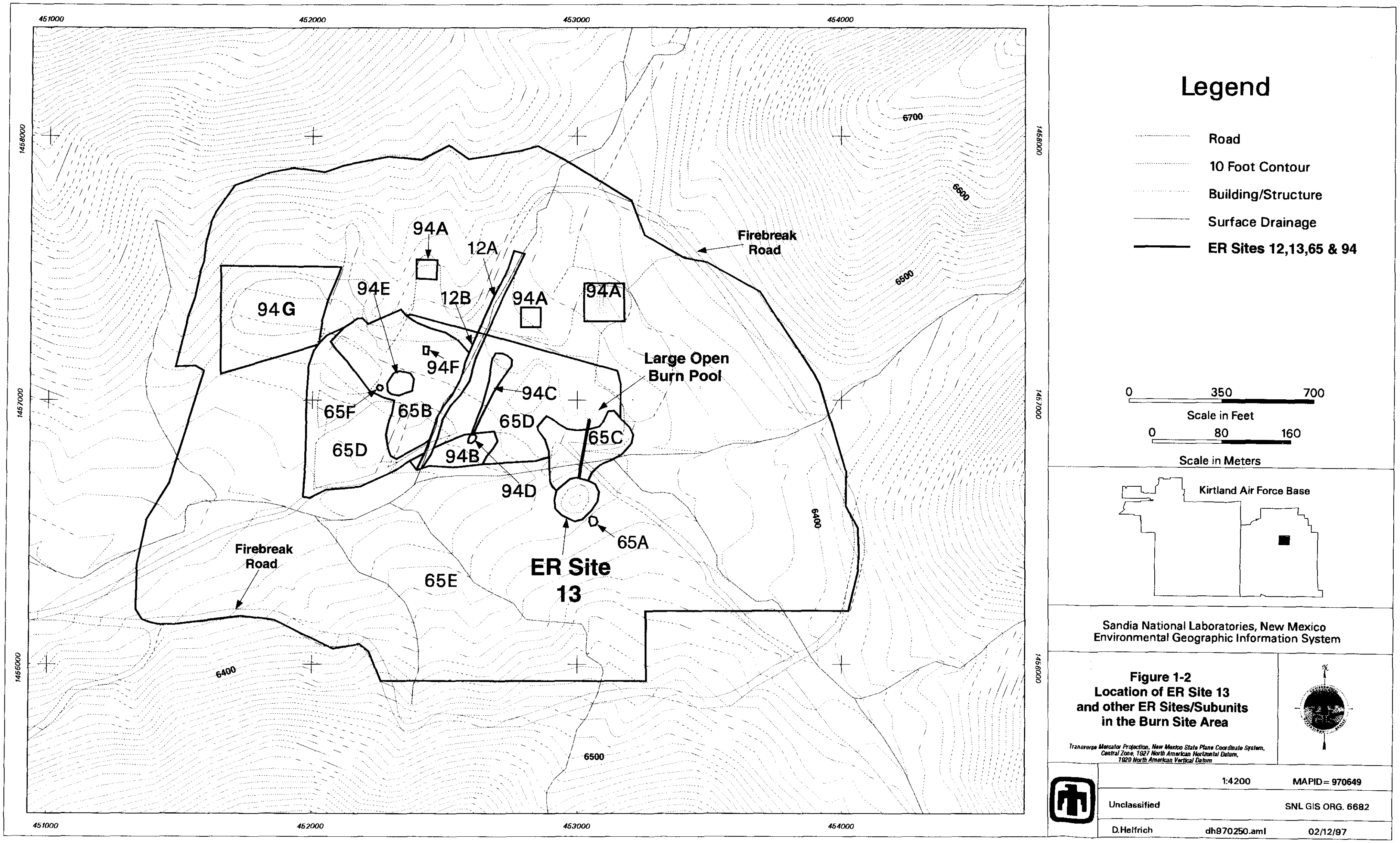

Figure 1-2
Location of ER Site 13 and other ER Sites/Subunits in the Burn Site Area

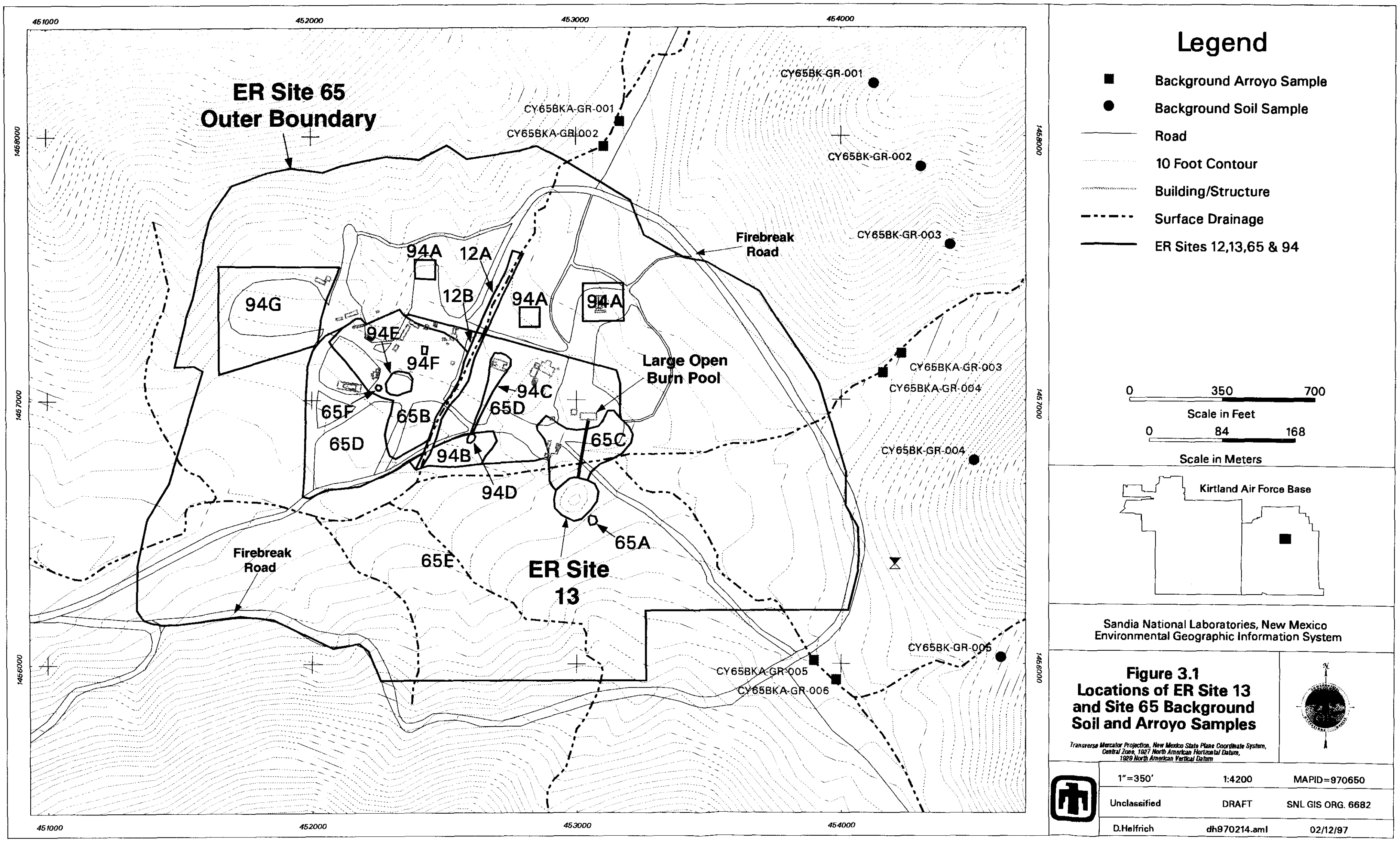

Figure 3.1
Locations of ER Site 13 and Site 65 Background Soil and Arroyo Samples

Attachment B

ATTACHMENT B

ER SITE 13
METHOD DETECTION LIMITS OF VOLATILE ORGANIC COMPOUNDS AND SEMIVOLATILE ORGANIC COMPOUNDS SUPPLEMENTAL LABORATORY REPORT

SNL ER Chemistry Laboratory

On Site Lab (ERCL)
VOC's + MDL

Carole Lojek MS1148 6685

AR/COC: 5180
Project Name: Canyons Test Area
Site: 13

Datafile:
Lab ID: 9605-5180-01
Sample Site #: CY13-GR-002-0-SS
Sample #-Fraction: 029608-01
Matrix: soil
Analytical Method: EPA8260
QC_Batch:

Collection Date: 21-MAY-96
Date Received: 22-MAY-96
Date Digest/Extracted:
Date Analyzed: 23-MAY-96

Analyte	CAS #	DF	MDL	PQL	Final Result		Units
1,1 Dichloroethane (SPCC)	75-34-3	1X	1	4	U		ug/kg
1,1 Dichloroethene (CCC)	75-35-4	1X	5	20	U		ug/kg
1,1,1 Trichloroethane	71-55-6	1X	1	4	U		ug/kg
1,1,2 Trichloroethane	79-00-5	1X	1	4	U		ug/kg
1,1,2,2 Tetrachloroethane (SPCC)	79-34-5	1X	1	4	U		ug/kg
1,2 Dichloroethane	107-06-2	1X	1	4	U		ug/kg
1,2 Dichloropropane (CCC)	78-87-5	1X	1	4	U		ug/kg
2-Butanone (MEK)	78-93-3	1X	5	20	U		ug/kg
2-Hexanone (MBK)	591-78-6	1X	5	20	U		ug/kg
4-Methyl-2-pentanone (MIBK)	108-10-1	1X	5	20	U		ug/kg
Acetone	67-64-1	1X	5	20	11	J	ug/kg
Benzene	71-43-2	1X	1	4	U		ug/kg
Bromodichloromethane	75-27-4	1X	1	4	U		ug/kg
Bromoform (SPCC)	75-25-2	1X	5	20	U		ug/kg
Carbon disulfide	75-15-0	1X	5	20	U		ug/kg
Carbon tetrachloride	56-23-5	1X	1	4	U		ug/kg
Chlorobenzene (SPCC)	108-90-7	1X	1	4	U		ug/kg
Chlorodibromomethane	124-48-1	1X	1	4	U		ug/kg
Chloroform (CCC)	67-66-3	1X	1	4	U		ug/kg
Ethylbenzene (CCC)	100-41-4	1X	1	4	U		ug/kg
Methylene chloride	75-09-2	1X	1	4	U		ug/kg
O-Xylene	95-47-6	1X	1	4	U		ug/kg
P/M Xylenes	106-42-3,108-38-3	1X	2	8	U		ug/kg
Styrene	100-42-5	1X	1	4	U		ug/kg
T-1,2 Dichloroethene	156-60-5	1X	1	4	U		ug/kg
Tetrachlorethene	127-18-4	1X	1	4	U		ug/kg
Toluene (CCC)	108-88-3	1X	1	4	U		ug/kg
Trichloroethene	79-01-6	1X	1	2	U		ug/kg
Vinyl chloride (CCC)	75-01-4	1X	5	20	U		ug/kg
cis-1,2 Dichloroethene	156-59-2	1X	1	4	U		ug/kg
cis-1,3 Dichloropropene	10061-01-5	1X	1	4	U		ug/kg
t-1,3 Dichloropropene	10061-02-6	1X	1	4	U		ug/kg

U-The associated analyte was not observed above the MDL.
B-The associated analyte was observed in the method blank.
J-The associated concentration was observed below the PQL.
E- The associated concentration was observed above the highest calibration level.

Soil MDL for Method 8240

Analyte	MDL (ug/kg)
Chloromethane	1.5
Bromomethane	4.4
Vinyl Chloride	1.6
Chloroethane	2.5
Methylene Chloride	1.3
Acetone	4.0
Carbon Disulfide	1.3
1,1-Dichloroethene	1.0
1,1-Dichloroethane	1.0
1,2-Dichloroethene (Total)	1.2
Chloroform	1.0
1,2-Dichloroethane	1.0
2-Butanone (MEK)	2.2
1,1,1-Trichloroethane	0.71
Carbon Tetrachloride	1.1
Vinyl Acetate	4.4
Bromodichloromethane	0.59
1,2-Dichloropropane	0.82
cis-1,3-Dichloropropene	1.2
Trichloroethene	2.6
Dibromochloromethane	1.3
1,1,2-Trichloroethane	0.73
Benzene	0.75
trans-1,3-Dichloropropene	0.80
Bromoform	1.1
4-Methyl-2-pentanone (MIBK)	4.3
2-Hexanone	3.3
1,1,2,2-Tetrachloroethane	2.1
Tetrachloroethene	1.0
Toluene	1.0
Chlorobenzene	0.86
Ethylbenzene	0.84
Styrene	0.78
Xylenes (Total)	2.7

Quanterra Environmental Services

Aqueous MDLs for Method 8240

Analyte	MDL (ug/L)
Chloromethane	1.4
Bromomethane	1.1
Vinyl Chloride	1.6
Chloroethane	3.0
Methylene Chloride	1.2
Acetone	2.2
Carbon Disulfide	1.4
1,1-Dichloroethene	1.4
1,1-Dichloroethane	1.3
1,2-Dichloroethene (Total)	1.4
Chloroform	1.2
1,2-Dichloroethane	1.1
2-Butanone (MEK)	2.4
1,1,1-Trichloroethane	1.2
Carbon Tetrachloride	1.2
Vinyl Acetate	2.0
Bromodichloromethane	1.2
1,2-Dichloropropane	1.2
cis-1,3-Dichloropropene	1.3
Trichloroethene	1.2
Dibromochloromethane	1.2
1,1,2-Trichloroethane	1.2
Benzene	1.2
trans-1,3-Dichloropropene	1.3
Bromoform	1.2
4-Methyl-2-pentanone (MIBK)	1.7
2-Hexanone	2.2
Tetrachloroethene	1.2
Toluene	1.2
1,1,2,2-Tetrachloroethane	1.2
Chlorobenzene	1.2
Ethylbenzene	1.2
Styrene	1.1
Xylenes (Total)	2.9

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Soil MDL for Method 8270

Analyte	MDL (ug/kg)
Phenol	51
bis(2-Chloroethyl) ether	64
2-Chlorophenol	37
1,3-Dichlorobenzene	49
1,4-Dichlorobenzene	40
Benzyl Alcohol	83
1,2-Dichlorobenzene	38
2-Methylphenol	46
bis(2-Chloroisopropyl) ether	123
4-Methylphenol	80
N-Nitroso-di-n-propylamine	101
Hexachloroethane	44
Nitrobenzene	32
Isophorone	44
2-Nitrophenol	67
2,4-Dimethylphenol	101
Benzoic Acid	885
bis(2-Chloroethoxy) methane	64
2,4-Dichlorophenol	111
1,2,4-Trichlorobenzene	54
Naphthalene	85
4-Chloroaniline	21
Hexachlorobutadiene	38
4-Chloro-3-methylphenol	39
2-Methylnaphthalene	43
Hexachlorocyclopentadiene	198
2,4,6-Trichlorophenol	46
2,4,5-Trichlorophenol	74
2-Chloronaphthalene	66
2-Nitroaniline	97
Dimethyl phthalate	157
Acenaphthylene	82
3-Nitroaniline	244
Acenaphthene	19
2,4-Dinitrophenol	904
4-Nitrophenol	418
Dibenzofuran	80
2,4-Dinitrotoluene	79
2,6-Dinitrotoluene	61
Diethyl phthalate	120
4-Chlorophenyl phenyl ether	29

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Environmental Services

Soil MDL for Method 8270 (continued)

Fluorene	42
4-Nitroaniline	369
4,6-Dinitro-2-methylphenol	921
N-Nitrosodiphenylamine	43
4-Bromophenyl phenyl ether	43
Hexachlorobenzene	72
Pentachlorophenol	583
Phenanthrene	49
Anthracene	64
Carbazole	58
Di-n-butyl phthalate	54
Fluoranthene	85
Pyrene	34
Butyl benzyl phthalate	41
3,3'Dichlorobenzidine	225
Benzo(a)anthracene	54
bis(2-Ethylhexyl) phthalate	90
Chrysene	56
Di-n-octyl phthalate	164
Benzo(b)fluoranthene	62
Benzo(k)fluoranthene	78
Benzo(a)pyrene	50
Indeno(1,2,3-cd)pyrene	50
Dibenz(a,h)anthracene	46
Benzo(g,h,i)perylene	48

Quanterra Environmental Services

Aqueous MDLs for Method 8270

Analyte	MDL (ug/L)
Phenol	1.1
bis(2-Chloroethyl) ether	1.8
2-Chlorophenol	1.3
1,3-Dichlorobenzene	1.4
1,4-Dichlorobenzene	1.8
Benzyl Alcohol	1.2
1,2-Dichlorobenzene	1.5
2-Methylphenol	1.5
bis(2-Chloroisopropyl) ether	1.1
4-Methylphenol	1.8
N-Nitroso-di-n-propylamine	1.1
Hexachloroethane	1.5
Nitrobenzene	1.2
Isophorone	1.2
2-Nitrophenol	1.6
2,4-Dimethylphenol	1.9
Benzoic Acid	24
bis(2-Chloroethoxy) methane	1.4
2,4-Dichlorophenol	0.82
1,2,4-Trichlorobenzene	1.1
Naphthalene	1.2
4-Chloroaniline	4.2
Hexachlorobutadiene	1.2
4-Chloro-3-methylphenol	1.4
2-Methylnaphthalene	1.3
Hexachlorocyclopentadiene	3.2
2,4,6-Trichlorophenol	0.97
2,4,5-Trichlorophenol	1.2
2-Chloronaphthalene	1.4
2-Nitroaniline	0.95
Dimethyl phthalate	1.1
Acenaphthylene	0.95
3-Nitroaniline	0.70
Acenaphthene	1.4
2,4-Dinitrophenol	6.5
4-Nitrophenol	2.0
Dibenzofuran	0.63
2,4-Dinitrotoluene	0.85
2,6-Dinitrotoluene	0.87
Diethyl phthalate	0.41
4-Chlorophenyl phenyl ether	0.85

Aqueous MDLs for Method 8270 (continued)

Fluorene	0.79
4-Nitroaniline	0.94
4,6-Dinitro-2-methylphenol	0.83
N-Nitrosodiphenylamine	1.2
4-Bromophenyl phenyl ether	0.79
Hexachlorobenzene	0.75
Pentachlorophenol	1.3
Phenanthrene	0.68
Anthracene	0.79
Carbazole	0.66
Di-n-butyl phthalate	0.84
Fluoranthene	0.79
Pyrene	0.75
Butyl benzyl phthalate	1.3
3,3'Dichlorobenzidine	3.1
Benzo(a)anthracene	0.64
bis(2-Ethylhexyl) phthalate	2.4
Chrysene	0.56
Di-n-octyl phthalate	1.5
Benzo(b)fluoranthene	2.9
Benzo(k)fluoranthene	1.9
Benzo(a)pyrene	0.64
Indeno(1,2,3-cd)pyrene	0.66
Dibenz(a,h)anthracene	0.73
Benzo(g,h,i)perylene	6.8

Attachment C

ATTACHMENT C

ER SITE 13
REVISED TABLE 3-2

Table 3-2
Summary of Site 13 Confirmatory Soil Sample Organic Analytical Results, May 1996

Site Area Sampled	Sample Attributes			Volatile Organic Compounds (mg/kg)		SVOCs (mg/kg)	TPH (mg/kg)
	Sample Number	ER Sample ID	Depth (ft)	Acetone	2-Butanone		
Surface	029608	CY13-GR-002-0-SS	0-0.5	0.011J	ND	ND	ND
	029611	CY13-GR-003-0-SS	0-0.5	0.014J	ND	ND	ND
	029615	CY13-GR-004-0-SS	0-0.5	0.017J	ND	ND	ND
	029618	CY13-GR-005-0-SS	0-0.5	0.014J	ND	ND	2.2J
Subsurface North Trench	029609	CY13-GR-002-2.5-S	2.5	ND	ND	ND	2.9J
	029610	CY13-GR-002-5-S	5	ND	ND	ND	ND
Subsurface West Trench	029612	CY13-GR-003-2.5-S	2.5	ND	ND	ND	ND
	029613	CY13-GR-003-5.5-S	5.5	ND	ND	ND	ND
	029614	CY13-GR-003-5.5-SD	5.5	ND[1]	ND[1]	ND	ND
Subsurface South Trench	029616	CY13-GR-004-2.5-S	2.5	ND	ND	ND	ND
	029617	CY13-GR-004-5-S	5	ND	ND	ND	ND
Subsurface East Trench	029619	CY13-GR-005-4.5-S	4.5	0.013J	0.0058J	ND	ND
	029620	CY13-GR-005-12.5-S	12.5	ND	ND	ND	ND
Practical Quantitation Limit (mg/kg)				0.020	0.020	0.330-1.60	4.0
Water from Discharge Pipe (in µg/L)							
Collection Point	Sample Number	ER Sample ID	Depth (ft)	VOCs (µg/L) Sample was non-detect for all VOC analytes		SVOCs (µg/L) 2,6 - Dinitro-toluene	TPH (µg/L)
Discharge manhole	029621	CY13-GR-006	NA	ND	ND	17	0.0016 ~~1,600~~ ql[2]
Practical Quantitation Limit (µg/L)				5.0 - 10.0		9.5 - 48.0	95
Quality Assurance/Quality Control Samples (all in µg/L)							
Sample Type	Matrix	ER Sample ID	Depth (ft)	VOCs µg/L Sample was non-detect for all VOC analytes		SVOCs µg/L	TPH µg/L
Equipment Blank	Water	CY13-GR-007-EB	NA	ND	ND	ND	ND
Trip Blank	Water	CY13-GR-008-TB	NA	ND	ND	NA	NA
Practical Quantitation Limit (µg/L)				5.0 - 10.0		9.5 - 48.0	95

Notes: mg/kg - Milligrams per kilogram; µg/L - Micrograms per liter; ft - feet.
SVOC - Semivolatile organic compound; TPH - Total petroleum hydrocarbon; VOC - volatile organic compound.
J - Concentration below the practical quantitation limit (PQL) and above the method detection limit (MDL);
B - Analyte was detected in the laboratory method blank.
ND - Not detected at the MDL; NA - Not applicable/analyzed.
[1] This duplicate soil sample was analyzed for VOCs at the off-site laboratory only. Detections of acetone, 2-butanone, and methylene chloride were qualified as "non-detects" during the DV2 validation process because of higher detections of the same compounds in the soil field blank. See Section 3.2.8.1 for explanation.
[2] q = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.
l = Sample analytical results resembles a hydrocarbon product occurring within the n-alkane range of C10-C28. Sample was re-analyzed after re-extraction outside of hold time because initial run had duplicate control sample QC precision outside acceptable limits. Highest result of the two analyses is shown in table; it is from the re-analysis.