

Sandia National Laboratories/New Mexico

**PROPOSALS FOR NO FURTHER ACTION
ENVIRONMENTAL RESTORATION PROJECT**

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EXECUTIVE SUMMARY

Sandia National Laboratories/New Mexico is proposing a risk-based no further action (NFA) decision for Solid Waste Management Units (SWMU) 275, 10, 12B, 65E, 94A, 57A, 61A, 71, and 85. Review and analysis of all relevant data for these SWMUs indicate that concentrations of constituents of concern (COC) at these sites are less than applicable risk assessment action background levels. Thus, these SWMUs are proposed for an NFA decision based upon confirmatory sampling data demonstrating that COCs that may have been released from the SWMUs into the environment pose an acceptable level of risk under current and projected future land use, as set forth by Criterion 5, which states, "The SWMU/AOC [area of concern] has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use" (NMED March 1998). Each of the above-listed SWMUs is briefly described below.

SWMU 275 (the Technical Area [TA] V Seepage Pits in Operable Unit [OU] 1306) contains two inactive septic tanks connected to six seepage pits. In 1994 preliminary investigations (including a subsurface active soil-gas survey that used direct-push borings and a surface passive soil-gas survey) were conducted at the site. Subsurface samples were taken from boreholes that had been drilled to the groundwater (520 feet) at the center of the seepage pit location. Based upon analysis results of these samples, the following residual COCs occur in isolated intervals within the borehole: metals, radionuclides, volatile organic compounds (VOC), and semivolatile organic compounds (SVOC). A separate ongoing groundwater investigation is being performed for the entire TA-V complex to address groundwater issues. The site assessment concludes that SWMU 275 does not have potential to affect human health under an industrial land use scenario. Because of the subsurface depth of the SWMU 275 seepage pits, no complete ecological pathways exist, and evaluation of ecological risk is not warranted.

SWMU 10 (the Burial Mounds in OU 1333) is an inactive site that contains primarily soil/debris from salvage operations that had been conducted after an accidental detonation of two mock weapons inside a bunker at the site. A radiological voluntary corrective measure (VCM) activities were performed in March 1995 and April—May 1996 to remove sources of radiological anomalies. A voluntary corrective action was taken in May 1998 to remove the vermiculite mound. The site assessment concludes that SWMU 10 does not have potential to affect human health under an industrial land-use scenario. After considering the uncertainties of related available data and modeling assumptions, it was determined that ecological risks associated with SWMU 10 were very low.

SWMU 12B (the Burial Site [Lurance Canyon] in OU 1333) is one of two subunits comprising SWMU 12. SWMU 12A (the Open Dump) had been previously submitted for an NFA decision in May 1997. SWMU 12B is located within the graded portion of SWMU 65D (the Lurance Canyon Explosive Test Site [LCETS]). The site is associated with debris generated during testing operations and historical grading activities in support of current Lurance Canyon Burn Site (LCBS) operations. In 1997 a VCM was performed at the site to excavate and characterize all fill material in the arroyo. The arroyo drainage was reestablished and stabilized. Analysis revealed the following residual COCs at SWMU 12B: metals, radionuclides, high explosives (HE), VOCs, and SVOCs. The site assessment concludes that SWMU 12B does not have significant potential to affect human health under a recreational land-use scenario. After



considering the uncertainties associated with the available data and modeling assumptions, it was determined that ecological risks associated with SWMU 12B were low.

SWMU 65E (the Far-Field Dispersion Area in OU 1333) is the farthest extent (far-field) fragmentation area associated with open-detonation tests at the LCETS. A radiological VCM was conducted at the site in March 1995, during May—June 1996, and in October 1996. Radiological VCM activities were conducted during March 1995 and May, June, and October 1996. Point sources and small area sources were removed in March 1995. Larger area sources were remediated in May, June, and October 1996. Sampling analysis revealed residual metals and radionuclides at the SWMU. The site assessment concludes that SWMU 65E does not have potential to affect human health under a recreational land-use scenario. After considering the uncertainties associated with the available data and modeling assumptions, it was determined that ecological risks associated with SWMU 65E were very low.

SWMU 94A (the LCBS Aboveground Tanks in OU 1333) is comprised of three aboveground storage tank locations: one active and two inactive areas where the tanks have been emptied and/or removed. The NFA addresses historical releases from all three aboveground storage tank locations. However, the active aboveground storage tank location is operating in compliance with all current applicable federal and state regulations and is not regulated under the Resource Conservation and Recovery Act. The aboveground storage tanks were used to store JP-4 and water in support of testing operations at the LCBS. Confirmatory sampling analysis at the site revealed the following COCs at the site: radionuclides, VOCs, and SVOCs. The site assessment concludes that SWMU 94A does not have significant potential to affect human health under a recreational land-use scenario. After considering the uncertainties associated with the available data and modeling assumptions, it was determined that ecological risks associated with SWMU 94A were very low.

SWMU 57A (the Workman Site: Firing Site in OU 1334) is a former artillery firing area that was active during World War II for the development of the proximity fuse—a radar-activated, variable-timed bomb fuse used in antiaircraft defense munitions. A variety of artillery pieces were used to fire test shells at targets suspended between the two former towers at SWMU 57B (the Workman Site: Target Area) located approximately 2 miles to the east. Confirmatory sampling analysis identified the following COCs at the site: metals, radionuclides, residual HE, SVOCs, VOCs, and polychlorinated biphenyl. The site assessment concludes that SWMU 57A does not have significant potential to affect human health under an industrial-use scenario. After considering the uncertainties associated with the available data and modeling assumptions, it was determined that ecological risks associated with SWMU 57A were low.

SWMU 61A (the Schoolhouse Mesa Test Site: Blast Area in OU 1334) is an inactive explosives test site located within the former Area Z explosives testing area. SWMU 61A contains a previously cleared area, one long low debris mound located southwest of the cleared area, a second former debris mound located northwest of the cleared area, and three concrete blocks. Both mounds were dismantled during confirmatory sampling. A radiological VCM was performed in March 1995 and in February, March, May, July, and October 1996. Sampling analysis revealed the following residual COCs at the SWMU: metals, radionuclides, HE, VOCs, and SVOCs. The site assessment concludes that SWMU 61A does not have potential to affect human health under an industrial land-use scenario. After considering the uncertainties associated with the available data and modeling assumptions, it was determined that ecological risks associated with SWMU 61A were low.



SWMU 71 (the Moonlight Shot in OU 1334) is an explosives test site that was active from 1956 to 1961. Testing activities examined the possible radioactive fallout dispersion patterns that could result from a noncritical weapon detonation during transport or assembly scenarios. These airborne dispersion tests used depleted uranium in place of fissionable materials and yielded no nuclear fission products. A radiological VCM was performed during January—March 1995 and January—March 1996. Confirmatory sampling analysis revealed the following residual COCs at the SWMU: metals, radionuclides, and residual HE. The site assessment concludes that SWMU 71 does not have potential to affect human health under an industrial land-use scenario. After considering the uncertainties associated with the available data and modeling assumptions, it was determined that ecological risks associated with SWMU 71 were insignificant.

SWMU 85 (the Firing Site [Building 9920] in OU 1335) is an active test site where both aboveground and subsurface firing tests and reactor meltdown tests have been performed. A radiological VCM was performed in July and September 1995 and during March—June 1996. Sampling analysis revealed residual metals and HE COCs at the site. The site assessment concludes that SWMU 85 does not have significant potential to affect human health under an industrial land-use scenario. After consideration of the uncertainties associated with the available data and modeling assumptions, it was determined that ecological risks associated with SWMU 85 were insignificant.

REFERENCES

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



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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
AOC	area of concern
AR/COC	analysis request/chain-of-custody
BCF	bioconcentration factor
bgs	below ground surface
BH	borehole
BLM	Bureau of Land Management
BTEX	benzene, toluene, ethylbenzene, and xylene
C	concrete sample
CA	Corrective Action
CCTA	Central Coyote Test Area
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeter(s)
cm ²	square centimeter(s)
COC	constituent of concern
COPEC	constituent of potential ecological concern
cps	count(s) per second
CTA	Coyote Test Area
CY	Canyon
D	debris sample
DCF	dose conversion factor
DOE	U.S. Department of Energy
dpm	disintegration(s) per minute
DQO	Data Quality Objective
DU	depleted uranium
EB	equipment blank
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ERCL	Environmental Restoration Chemistry Laboratory
FCI	fuel coolant interaction
FITS	Fully Instrumented Test System
FOP	field operating procedure
ft	feet
g	gram(s)
GC	gas chromatography
GEL	General Engineering Laboratories
GPS	Global Positioning System
GR	grab sample
HASP	health and safety plan
HE	high explosive(s)
HEAST	Health Effects Assessment Summary Tables



ACRONYMS AND ABBREVIATIONS (Continued)

HI	hazard index
HMX	1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctane
HP	Health Physics
HRMB	Hazardous and Radioactive Materials Bureau
HRS	Hazard Ranking System
HQ	hazard quotient
HSWA	Hazardous and Solid Waste Amendments
ID	identification
I.D.	inner diameter
IH	Industrial Hygiene
IRIS	Integrated Risk Information System
KAFB	Kirtland Air Force Base
kg	kilogram(s)
L	liter(s)
LAARC	Light Airtransport Accident Resistant Container
LAS	Lockheed Analytical Services
lb	pound(s)
LCETS	Lurance Canyon Explosives Test Site
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOAEL	lowest-observed-adverse-effect level
Log	logarithm (base 10)
LWDS	Liquid Waste Disposal System
m ³	cubic meter(s)
MDA	minimum detectable activity
MDC	melt development corium
MDL	method detection limit
mg	milligram(s)
mi	mile(s)
mL	milliliter(s)
mrem	millirem(s)
MS	mass spectrometry; matrix spike
MSD	matrix spike duplicate
µg	microgram(s)
µR/hr	microrentgen(s) per hour
NC	not calculated
ND	not detected
NFA	no further action
NG	nitroglycerin
NLM	National Library of Medicine
NMED	New Mexico Environment Department
NOAEL	no-observed-adverse-effect level
NRC	U.S. Nuclear Regulatory Commission
NT	not tested



ACRONYMS AND ABBREVIATIONS (Continued)

O.D.	outside diameter
OB	Oversight Bureau
OP	operating procedure
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
pCi	picocurie(s)
PID	photoionization detector
ppbv	part(s) per billion by volume
PPE	personal protective equipment
ppm	part(s) per million
PQL	practical quantitation limit
PRG	preliminary remediation goals
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RCT	radiation control technician
RDX	1,3,5-trinitro-1,3,5-triazacyclohexane
RFA	RCRA facility assessment
RFI	RCRA facility investigation
RME	reasonable maximum exposure
RMMA	Radioactive Materials Management Area
RP	Radiation Protection
RPD	relative percent difference
RPSD	Radiation Protection Sample Diagnostics
RSI	Request for Supplemental Information
S	soil sample
SAP	sampling and analysis plan
SD	soil sample duplicate
SFN	silt fence (north)
SFSW	silt fence (southwest)
SNL/NM	Sandia National Laboratories/New Mexico
SOV	soil organic vapor
SSO	soil sample
SVOC	semivolatile organic compound
SVS	soil vapor survey
SWHCP	Site-Wide Hydrogeologic Characterization Project
SWMU	solid waste management unit
SWTA	Southwest Test Area
TA	Technical Area
TABS	Torch-Activated Burn System
TAL	target analyte list



ACRONYMS AND ABBREVIATIONS (Concluded)

TCE	trichloroethylene
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TEDE	total effective dose equivalent
Tetryl	2,4,6-trinitrophenylmethylnitramine
TIC	total ion counts
TPH	total petroleum hydrocarbon
US	soil sample
USAF	U.S. Air Force
USFS	U.S. Forest Service
UTL	upper tolerance limit
UXO	unexploded ordnance
XRF	x-ray fluorescence
VCM	voluntary corrective measure
VOC	volatile organic compound
WACC	Water Quality Control Commission
yr	year



1.0 INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is proposing No Further Action (NFA) Proposals for nine Environmental Restoration (ER) Solid Waste Management Units (SWMUs). The following SWMUs are listed in the Hazardous and Solid Waste Amendments Module IV (EPA August 1993) of the SNL/NM Resource Conservation and Recovery Act Hazardous Waste Management Facility Permit (NM5890110518) (EPA August 1992). Proposals for each SWMU are located in this document as follows:

Operable Unit 1306

- SWMU 275, TA-V Seepage Pits (Section 2.0)

Operable Unit 1333

- SWMU 10, Burial Mounds (Section 3.0)
- SWMU 12B, Burial Site (Section 4.0)
- SWMU 65E, Far-Field Dispersion Area, Lurance Canyon Explosive Test Site (Section 5.0)
- SWMU 94A, Aboveground Tanks, Lurance Canyon Burn Site (Section 6.0)

Operable Unit 1334

- SWMU 57A, Workman Test Site: Firing Site (Section 7.0)
- SWMU 61A, Schoolhouse Mesa Test Site: Blast Site (Section 8.0)
- SWMU 71, Moonlight Shot Area (Section 9.0)

Operable Unit 1335

- SWMU 85, Firing Site (Building 9920) (Section 10.0)

These proposals each provide a site description, history, summary of investigatory activities, and the rationale for the NFA decision.



2.0 SOLID WASTE MANAGEMENT UNIT 275, TA-V SEEPAGE PITS

2.1 Summary

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Solid Waste Management Unit (SWMU) 275, Technical Area (TA) V Seepage Pits, Operable Unit (OU) 1306. SWMU 275 is comprised of two inactive septic tanks and six seepage pits. Review and analysis of all relevant data for SWMU 275 indicate that concentrations of constituents of concern (COC) at this site are less than applicable risk assessment action levels. An assessment of potential groundwater issues associated with SWMU 275 is being conducted under the TA-V groundwater investigation. Thus, SWMU 275 is proposed for an NFA decision based upon confirmatory sampling data demonstrating that COCs that may have been released from this SWMU into the environment pose an acceptable level of risk under current and projected future land use, as set forth by Criterion 5, which states, "The SWMU/AOC [area of concern] has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use" (NMED March 1998).

2.2 Description and Operational History

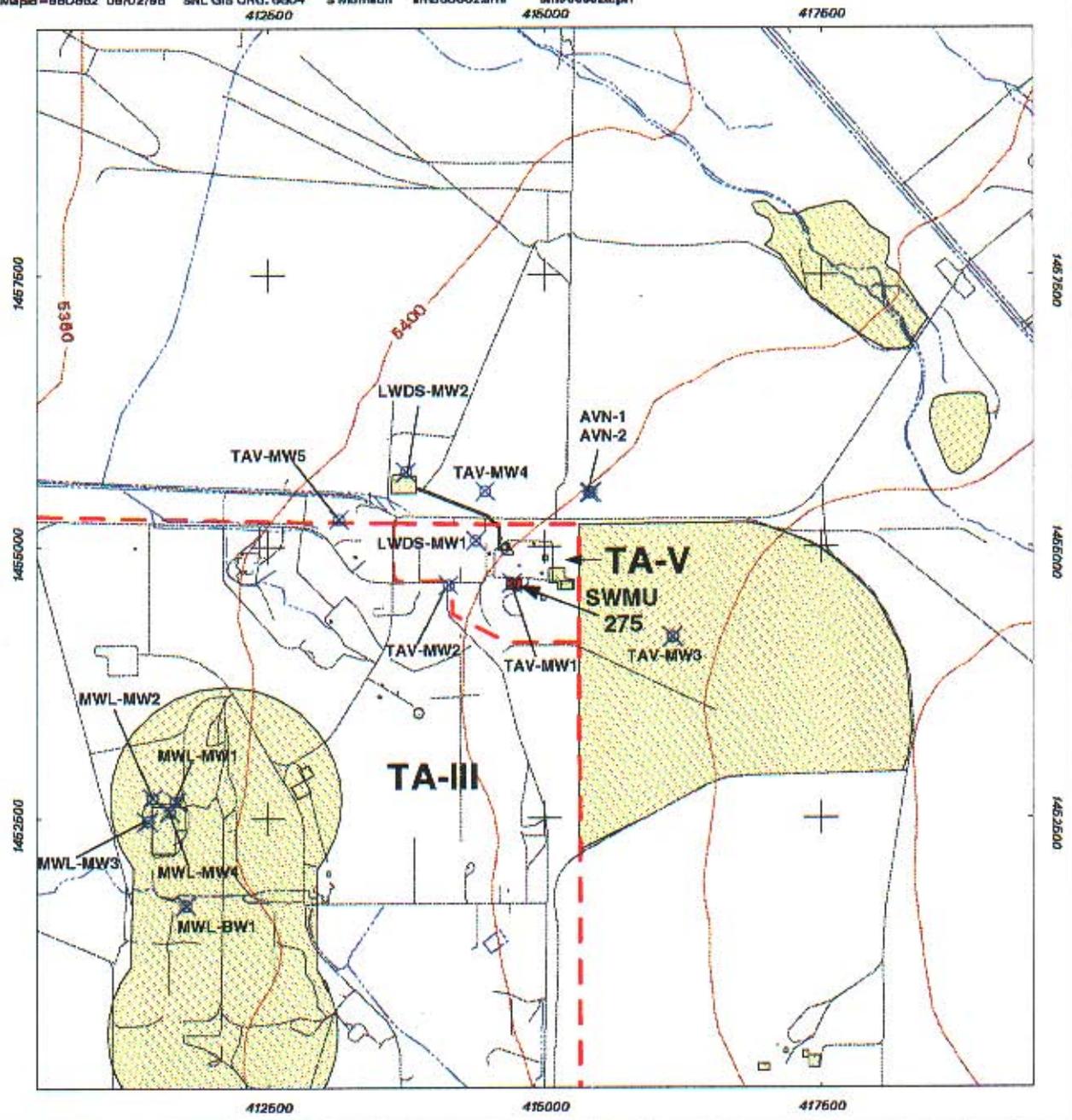
Section 2.2 describes the site and provides the operational history of SWMU 275.

2.2.1 Site Description

SWMU 275 is located within TA-V. TA-V is in the southern part of Kirtland Air Force Base (KAFB) immediately east of the TA-III gate and is approximately 1 mile southwest of Lovelace Road. It is reached by traveling southeast on Lovelace Road and then turning southwest on the paved TA-III/V access road (Figure 2.2.1-1). SWMU 275 encompasses approximately 0.26 acre of industrially developed, flat-lying land at an average elevation of 5,433 feet above mean sea level (amsl).

SWMU 275 consists of two septic tanks and six seepage pits that are located immediately south of Building 6588 near the center of TA-V (Figure 2.2.1-2). A security fence splits the site diagonally; the northern half is gravel-covered and contains three seepage pits. The southern half of the site contains the two septic tanks and three additional seepage pits (Figure 2.2.1-3). Figure 2.2.1-4a is a photograph of the southern portion of the site. Figures 2.2.1-4b and 2.2.1-4c are photographs of the northern portion of the site.

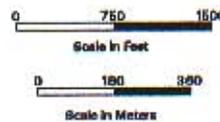
The surficial sediments at SWMU 275 consist of a thin veneer of recent (Holocene) alluvial fan deposits (see Plate I in SNL/NM December 1995). Subsurface sediments encountered in a borehole (TAV-BH-01) that was drilled in the center of the seepage pits area from the surface to the saturated zone in February 1995 consisted of interbedded gravelly sands, sands, silts, and clays. A thin (less than 5-foot) saturated zone was penetrated in the borehole at 380 feet below ground surface (bgs), but no water was produced. The regional aquifer was encountered at a depth of 491 feet bgs, and the borehole was drilled an additional 29 feet to a total depth of



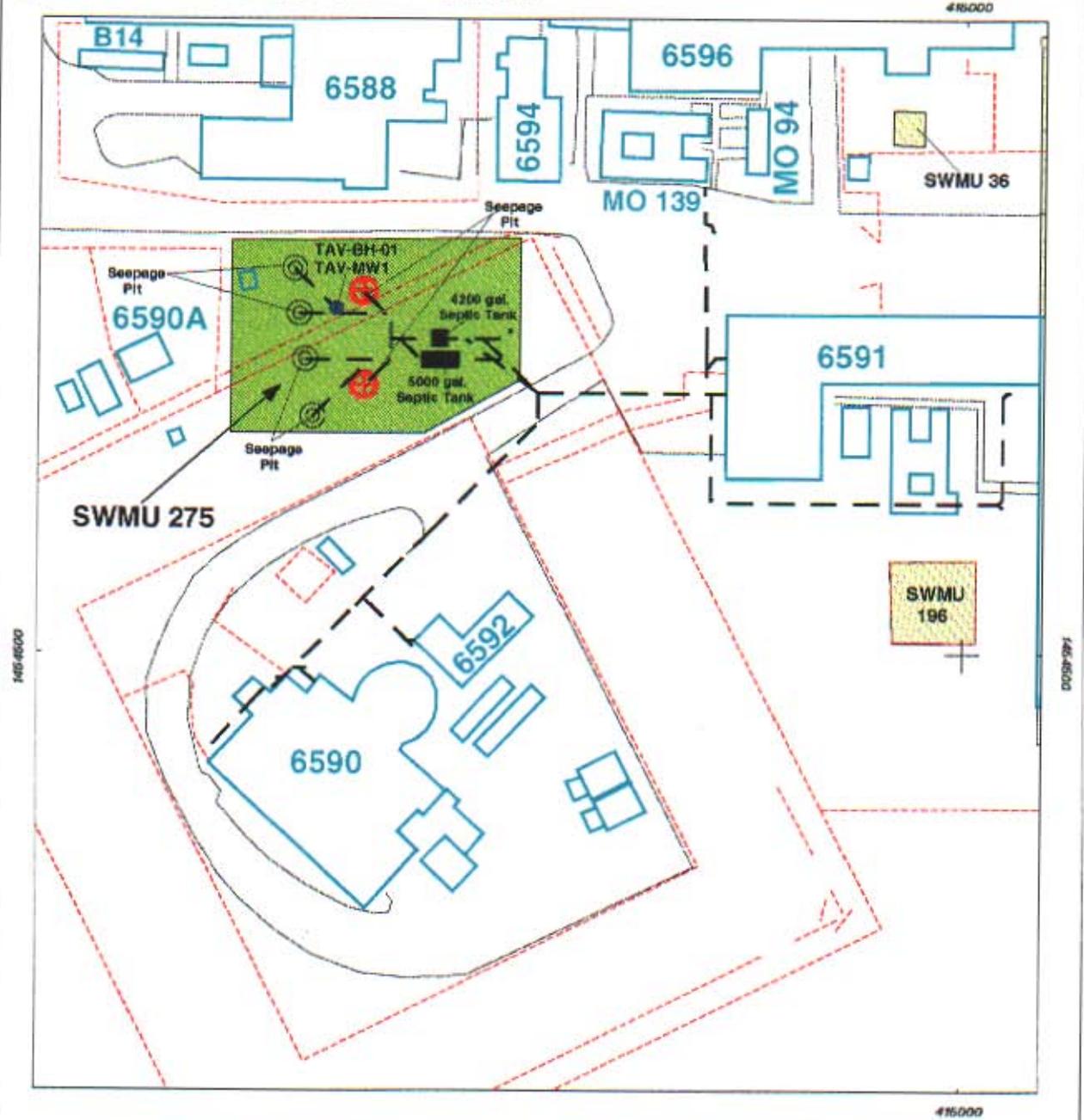
Legend

-  Monitoring Well
-  Road
-  Surface Drainage
-  40 Ft Contour
-  Technical Area
-  SWMU 275
-  Other SWMUs

**Figure 2.2.1-1
 Location of SWMU 275
 TA-V Seepage Pits**



Sandia National Laboratories, New Mexico
 Environmental Geographic Information System



Legend

- Seepage Pit with Manhole
- Seepage Pit
- Well/Borehole
- - - - - Fence
- — — — — Road
- - - - - Sewer Line
- (Green) SWMU 275
- (Yellow) Other SWMUs
- (Blue outline) Building
- (Black) Septic Tank

**Figure 2.2.1-3
Site Map for SWMU 275
Sandia National Laboratories,
New Mexico**



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

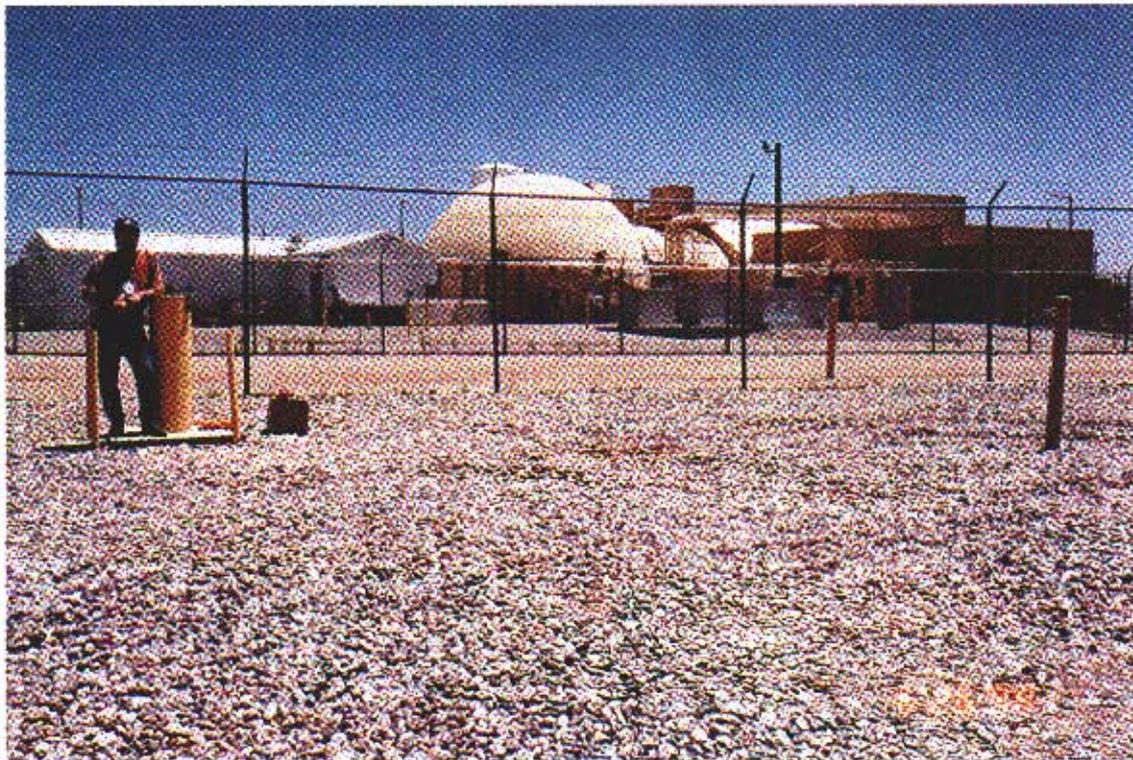


Figure 2.2.1-4a SWMU 275, TA-V, Seepage pits and monitor well TAV-MW1.
View looking west toward Building 6590.

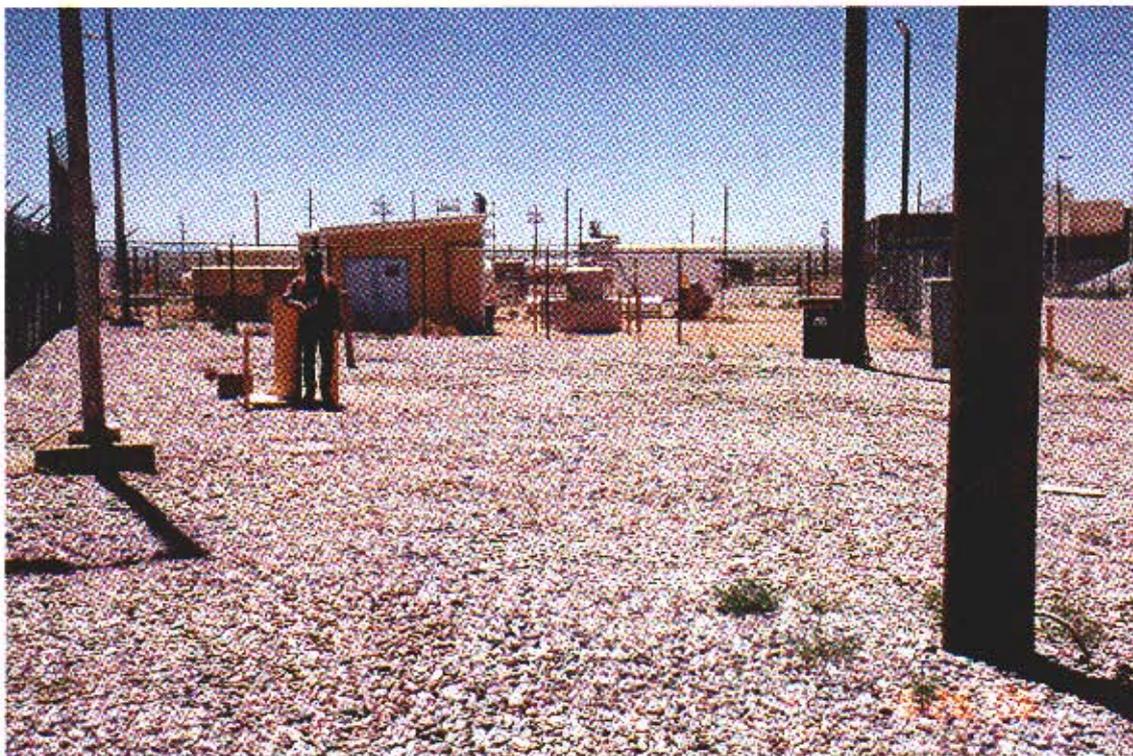


Figure 2.2.1-4b SWMU 275, TA-V, Seepage pits and monitor well TAV-MW1.
View looking West.

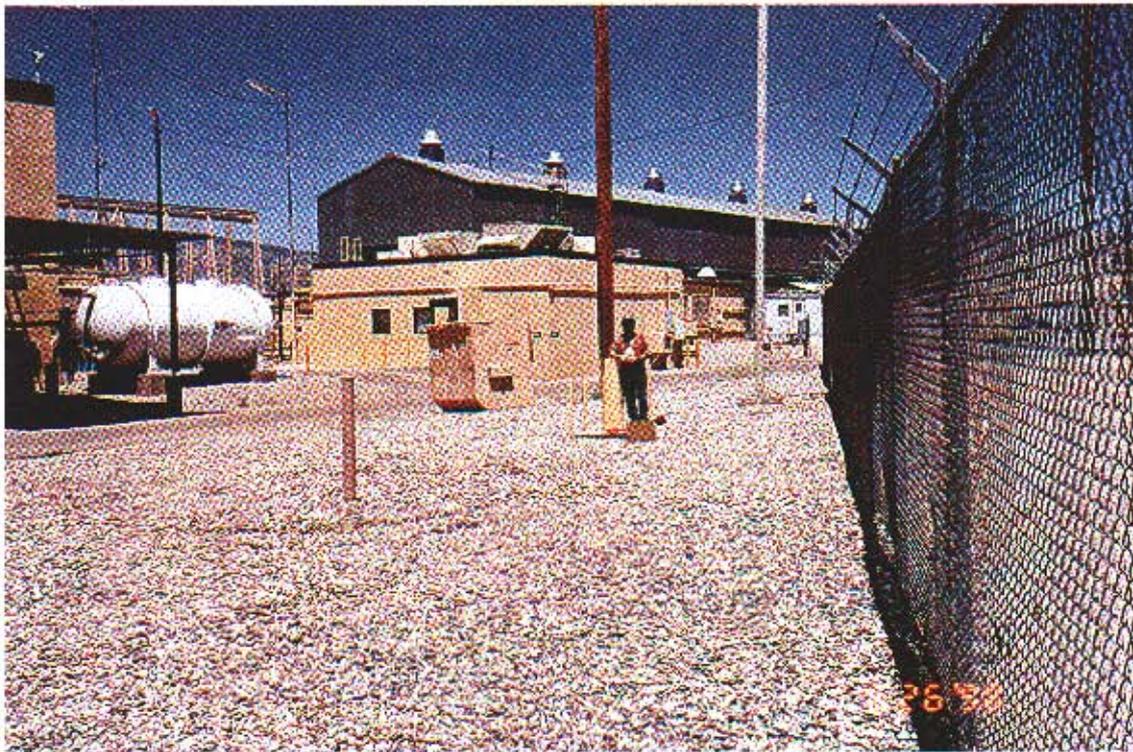


Figure 2.2.1-4c SWMU 275, TA-V, Seepage pits and monitor well TAV-MW1.
View looking northeast toward Building 6596.

520 feet. The boring was converted to monitoring well TAV-MW1 (Figures 2.2.1-4a, 2.2.1-4b, and 2.2.1-4c) at the conclusion of drilling. As part of the ongoing TA-V groundwater investigation, samples are routinely collected from this well.

The water table elevation in TAV-MW1 was approximately 4,930 feet amsl (approximately 503 feet bgs) in July 1998 (SNL/NM July 1998). Groundwater flow in the vicinity of TA-III and TA-V is in a westerly direction (SNL/NM March 1997). The nearest production wells are northwest of SWMU 275 and include KAFB-1, KAFB-2, KAFB-4, KAFB-7, and KAFB-11. They range from approximately 2.9 to 4.0 miles away from the site (SNL/NM August 1996).

2.2.2 Operational History

In 1993 trichloroethylene (TCE) was detected in the groundwater monitoring well LWDS-MW1, which was installed in May 1993 and is located on the northwestern edge of TA-V (Figure 2.2.1-1). This contamination was problematic in that no TCE had been detected in the adjacent SWMU 5 (Liquid Waste Disposal System [LWDS] Drainfield). The discovery of groundwater contamination led to a focused investigation to determine the contamination source. Following a background review (Section 2.4.3.1.1), a new site (the TA-V Seepage Pits) was identified as the most likely contamination source and was subsequently added to SNL/NM's list of SWMUs as SWMU 275.

The SWMU 275 seepage pit system is comprised of two septic tanks connected by distribution boxes to six seepage pits. The seepage pit system was connected by sewer lines to at least Buildings 6590, 6591, 6592, 6593, and 6596 and to an unnumbered building located immediately between Buildings 6594 and MO94 (Figures 2.2.1-3 and 2.2.2-1). The two septic tanks have capacities of 5,000 and 4,200 gallons and are constructed approximately 8 feet bgs (Figure 2.2.2-2). The seepage pits are concrete/cinder block construction and form open-bottomed cylinders approximately 20 feet tall with a diameter of 6.5 feet (Figure 2.2.2-2). The bottoms of the seepage pits are approximately 20 feet bgs and are filled with (approximately) a 3-foot-thick layer of 1- to 1.5-inch-diameter gravel.

Most process water at TA-V was disposed of into these seepage pits from the early 1960s until 1992. It is estimated that between 3,000 and 5,000 gallons of water were disposed of into these pits on a daily basis (SNL/NM January 1997). The seepage pits were abandoned when the City of Albuquerque sanitary sewer system was extended into the TA-III/TA-V area in 1992.

2.3 Land Use

Section 2.3 discusses the current and future land-use scenarios for SWMU 275.

2.3.1 Current Land Use

SWMU 275 is located in TA-V within the boundaries of KAFB. Current land use for TA-V and the site is industrial (Figure 2.3.1-1).

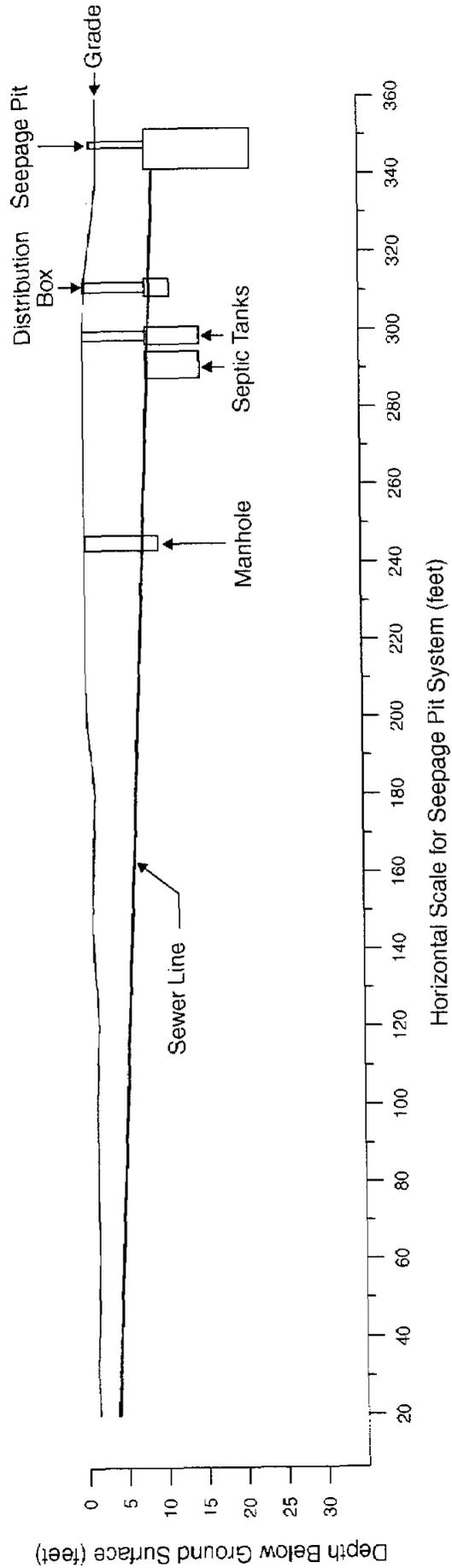
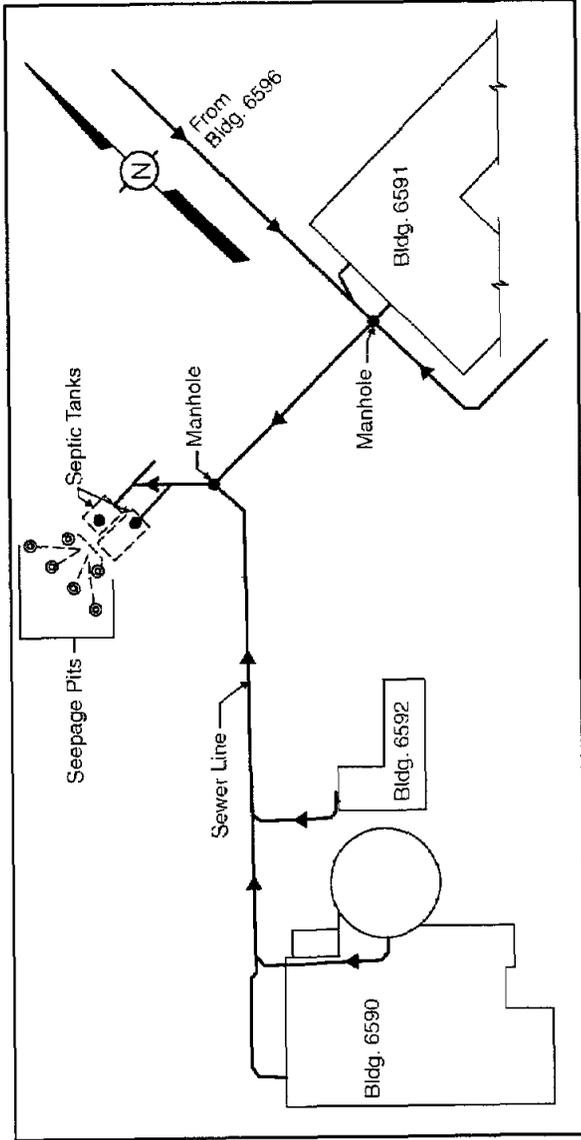
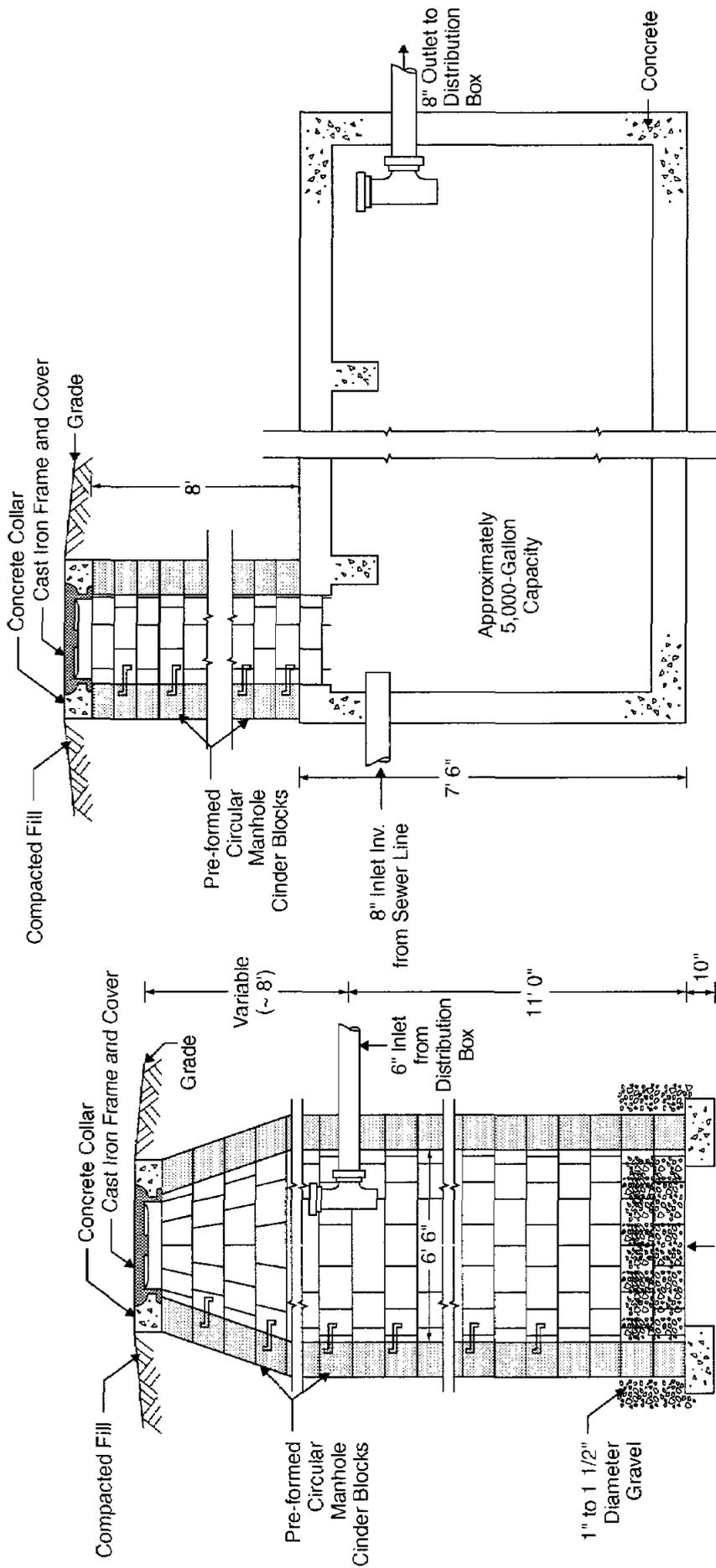


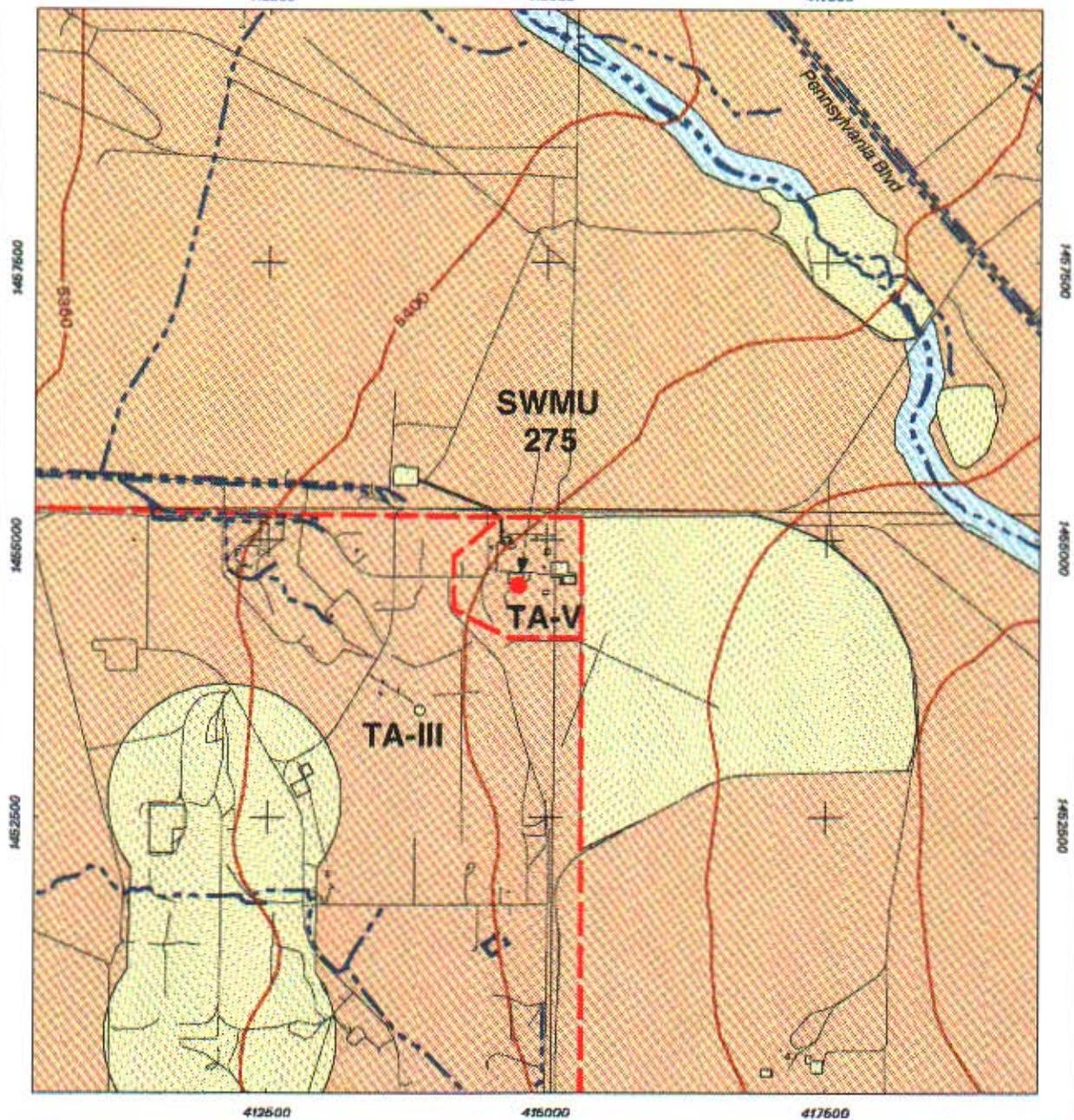
Figure 2.2.2-1
Plan view schematic and cross-section showing septic tanks, distribution box, and seepage pits,
SWMU 275, TA-V



Seepage Pit Schematic

Septic Tank Schematic

Figure 2.2.2-2
 Engineering schematic of SWMU 275,
 TA-V seepage pits and septic tanks.



Legend

-  Road
-  Surface Drainage
-  40 Ft Contour
-  Technical Area
-  SWMU 275
-  Other SWMUs
-  Recreational Land Use
-  Industrial Land Use

Figure 2.3.1-1
Land Use Map Relevant to
SWMU 275 TA-V Seepage Pits



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

2.3.2 Future/Proposed Land Use

The projected land use for SWMU 275 is industrial (DOE et al. September 1995).

2.4 Investigatory Activities

SWMU 275 has been characterized in a series of three investigations as described in this section.

2.4.1 Summary

Numerous SNL/NM septic systems (not including SWMU 275) were identified as part of the U.S. Department of Energy Comprehensive Environmental Assessment and Response Program (CEARP) in the mid-1980s (Investigation #1). In 1994 preliminary investigations (including a subsurface active soil-gas survey that used direct-push borings and a surface passive soil-gas survey) were begun (Investigation #2). Following discovery of the SWMU 275 seepage pits in 1994, in 1995 a borehole (TAV-BH-01) was drilled near the center of the seepage pit system to the groundwater and was completed as a groundwater monitoring well (TAV-MW1) (Investigation #3).

2.4.2 Investigation #1—Comprehensive Environmental Assessment and Response Program

2.4.2.1 *Nonsampling Data Collection*

Numerous septic tanks and drainfields at SNL/NM were identified during the investigation conducted under the CEARP (DOE September 1987). The CEARP Phase I report documented that many of the septic systems received industrial effluent as well as sanitary wastes. The septic tanks and seepage pits associated with SWMU 275 had not been discovered when the report was written and were not identified until mid-1994 (Dawson December 1994).

2.4.2.2 *Sampling Data Collection*

No sampling activities were conducted at SWMU 275 as part of the CEARP.

2.4.2.3 *Data Gaps*

At the time of the CEARP, none of the septic systems had been evaluated under the New Mexico regulations for sanitary waste. The CEARP Phase I report recommended an evaluation of the septic systems for discharge plans under the New Mexico Environment Department (NMED) Water Quality Control Commission (WQCC) Regulations (DOE September 1987). SWMU 275 was not identified during the RCRA Facility Assessment (EPA April 1987).

2.4.2.4 *Results and Conclusions*

The CEARP Phase I report concluded that the septic tanks and drainfields at TA-V should be evaluated pursuant to the NMED WQCC Regulations, and therefore, no additional CEARP investigations were performed and no Hazard Ranking System scores were calculated for the sites.

2.4.3 Investigation #2—SNL/NM ER Preliminary Investigations

2.4.3.1 *Nonsampling Data Collection*

This section presents the nonsampling data collected at SWMU 275.

2.4.3.1.1 *Background Review*

A background review was conducted in order to collect available and relevant information regarding SWMU 275. Background information sources included interviews with SNL/NM staff and contractors who were familiar with site operational history and existing historical site records and reports. The study was documented and has provided traceable references that sustain the integrity of the NFA proposal. The following information sources were used to assist in evaluating SWMU 275:

- SNL/NM Facilities Engineering building drawings No. 90206 M-1 and No. 90206 M-12.1 (SNL/NM June 1967), and No. 82378 M-18 (SNL/NM June 1987)
- An interview with Mr. Joe Jones, SNL/NM Waste Management and Regulatory Projects Department (SNL/NM January 1997)

2.4.3.1.2 *UXO/HE Survey*

An unexploded ordnance (UXO)/high explosives (HE) survey was not performed at SWMU 275. The UXO/HE surveys were focused on testing areas outside TA-I through V (Young September 1994).

2.4.3.1.3 *Radiological Survey(s)*

Because of the nature of the liquid release from the seepage pits into the ground, no surface radiological surveys were performed at SWMU 275.

2.4.3.1.4 *Cultural-Resources Survey*

No cultural resources were identified at TA-V (Hoagland and Dello-Russo February 1995, Lord November 1990).

2.4.3.1.5 *Sensitive-Species Survey*

SWMU 275 is located in an active industrial area of TA-V. No sensitive-species surveys were performed at the site because the SWMU contains no unaltered habitat suitable for supporting sensitive species (IT February 1995).

2.4.3.1.6 *Geophysical Survey(s)*

No surface geophysical surveys were performed at SWMU 275.

2.4.3.2 *Sampling Data Collection*

One active subsurface soil-vapor survey (SVS) and two passive surface (less than 1.5 feet bgs) SVSs that included the vicinity of the SWMU 275 Seepage Pits were performed at TA-V.

2.4.3.2.1 *Subsurface Active Soil-Vapor Survey*

On July 15, 1994, an active SVS investigation was conducted in the vicinity of the tanks and seepage pits in order to identify potential contaminant sources. The soil-vapor samples were collected from three boreholes drilled with a geoprobe. Soil-vapor samples were collected at the 15-foot depth interval—until refusal. One borehole was drilled to 30 feet bgs, the second borehole was drilled to 44 feet bgs, and the third borehole was drilled to 45 feet bgs. All soil-vapor samples were analyzed on site with a gas chromatograph (GC)/mass spectrometer (MS). The on-site laboratory identified trace concentrations of benzene (up to 19 parts per billion by volume [ppbv]), TCE (up to 25 ppbv), toluene (up to 22 ppbv), and tetrachloroethene (PCE) (up to 5 ppbv). Except for TCE detected in soil vapor at concentrations of 25 ppbv at 44 feet bgs in the deep borehole, all on-site detections were identified below the quantitation limit (i.e., J values).

In addition to the on-site analyses, ENCOTEC laboratory analyzed soil-vapor samples collected from the 30-foot depth in each borehole. In the deep borehole, ENCOTEC detected 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113) in soil vapor at 0.1 parts per million (ppm) by volume at 30 feet bgs.

Annex 2-A includes the locations of the boreholes and the results of all active soil-vapor sampling.

2.4.3.2.2 *Surface Passive SVSs*

This section summarizes two phases of passive SVS investigations conducted in TA-V during 1994. The results of the passive SVSs are recorded in total ion counts (TIC) as measured on a mass spectrometer. The primary purpose of these passive SVSs was to help identify potential source areas for TCE and other constituents detected in groundwater in monitoring well LWDS-MW1 (Figure 2.2.1-2). Annex 2-B provides details of these two SVSs.

Phase I Passive SVSs

The first SVS was conducted between August 1 and 30, 1994. The survey consisted of 49 passive SVS collectors installed at or near the seepage pits and in the area between the seepage pits and monitoring well LWDS-MW1. In addition, the survey included two quality assurance (QA)/quality control (QC) samples and five duplicate samples. Time-series collectors also were installed to determine the length of the exposure time, which was approximately 28 days. Northeast Research Institute (NERI) in Lakewood, Colorado, analyzed the samples. The locations of the passive collectors were recorded using a Global Positioning System (GPS) and are shown on the Phase I passive SVS map in Annex 2-B.

Regarding interpretation of passive soil-gas collector ion count values, NERI states

Please keep in mind that levels below 100,000 ion counts for a given compound such as PCE and TCE, under normal site conditions generally do not represent detectable levels by standard quantitative methods for soils and/or groundwater. Normal site conditions are considered to be sites in which the depth to groundwater is less than 100 feet below the surface, groundwater flow rates are undisturbed, and normal precipitation occurs during sampler exposure. Corresponding levels for a class of compounds such as BTEX and TPH, in which several masses are summed and reported, are equivalent to 200,000 ion counts. Areas of subsurface contamination are generally illustrated by a number of spatially contiguous samples exhibiting elevated response rather than isolated occurrences. (NERI December 1994)

Low levels of TCE (a maximum of 3,791 TICs) were identified in the vicinity of the TA-V seepage pits. These levels, however, were not sufficiently high to identify the seepage pits conclusively as a potential source area for TCE in groundwater 500 feet beneath TA-V. PCE (at up to 5,932 TICs) and benzene, toluene, ethylbenzene, and xylene (BTEX) (at a maximum of 169,011 TICs in the duplicate sample at location #7) were also identified in the vicinity of TA-V seepage pits during the passive SVS (NERI September 1994). Annex 2-B provides a summary of all Phase I passive soil-vapor sample locations and related data.

Phase II Passive SVS

The second phase of passive SVS investigations was conducted between October 13 and November 12, 1994. The second passive SVS covered a larger portion of TA-V. Seventy-three passive soil-vapor sample collectors were installed throughout the northern part of TA-V; the survey also included two QA/QC samples and six duplicate samples, which also were analyzed by NERI. The soil-vapor sample collectors were installed in all TA-V SWMUs as well as at surface disturbances, areas containing visible stains, and dry wells. The locations of the soil-vapor samples were determined using a GPS and are shown on the map of the Phase II passive SVSs in Annex 2-B.

Detectable levels of BTEX (up to 2,849,939 TICs), total petroleum hydrocarbon (TPH) (up to 19,959,176 TICs), TCE (up to 400,989 TICs), and PCE (a maximum of 2,487,530 TICs) were identified in samples from locations 200 to 300 feet away from the seepage pits and are likely not associated with the seepage pits themselves. These detectable concentrations may suggest leaks in other TA-V drain lines. Annex 2-B provides a summary of all Phase II passive soil-vapor sample locations and related data. The NERI table (Table 1) in Annex 2-B that summarizes analytical results for the Phase II samplers lists results for five samplers (numbers

29, 34, 41, 42, and 67) that are not shown on the corresponding Phase II sample location map. In-house GPS computer files generated when the survey was performed in late 1994 were researched in an attempt to determine locations for these five samples but was unsuccessful. These points were evidently missed when the GPS survey was performed. The original location markers for these samples have long since disappeared from the site, so the location of these five sample points is unknown.

2.4.3.3 *Data Gaps*

No data gaps are associated with the objectives of the passive SVS.

2.4.3.4 *Results and Conclusions*

Significant levels of contaminants were not detected in any of the Phase I passive collectors, based upon NERIs 100,000 and 200,000 TIC criteria for individual and compound groups respectively (NERI December 1994). In Phase II passive collectors, BTEX was identified throughout TA-V, but the majority of the highest concentrations were detected in areas of known oil releases (including HERMES [SWMU 36] and PROTO [SWMU 37]). In addition, areas of high BTEX concentrations were usually accompanied by high concentrations of TPH, which are likely indicative of vehicle fluid leakage. TCE was not detected in soil vapor in the vicinity of the seepage pits that conclusively identify a TCE source near these units. As stated earlier, VOCs in soil vapor that measure below about 100,000 TICs for single compounds like TCE and PCE or 200,000 TICs for multiple constituents like BTEX and TPH generally do not represent detectable levels by standard quantitative methods for soils and/or groundwater (NERI December 1994).

2.4.4 Investigation #3—SNL/NM ER Project TA-V Borehole Drilling and Well Installation

This section presents detailed descriptions of drilling activities conducted in January and February 1995 at the TA-V seepage pits. These activities included

- Drilling a borehole in the approximate center of the seepage pit area from the surface to groundwater
- Collecting soil and active soil-vapor samples from the borehole at selected depth intervals
- Conducting geophysical logging in the borehole
- Completing the seepage pit borehole as a groundwater monitoring well and collecting groundwater samples.

2.4.4.1 *Nonsampling Data Collection*

No nonsampling data collection activities were related to the borehole drilling and SVS activities.

2.4.4.2 *Sampling Data Collection*

This section discusses soil-sampling and soil-vapor sampling activities during the borehole drilling and installation of well TAV-MW1. This borehole sampling and well installation work was requested by EPA Region 6 (Dawson January 1995).

2.4.4.2.1 *Borehole Drilling and Geophysical Logging*

Borehole TAV-BH-01 was drilled and sampled as part of the seepage pit investigation at TA-V and was completed as monitoring well TAV-MW1. TAV-BH-01 was located in the approximate center of the SWMU 275 seepage pit group (Figure 2.2.1-3). To drill Borehole TAV-BH-01, Stewart Brothers of Grants, New Mexico, used a Chicago Pneumatic 650 (CP-650) drill rig, which included an air rotary casing hammer with 11.75- and 10.5-inch outer-diameter (O.D.) steel casing. The borehole was logged from drill cuttings, and frequent drive samples were collected to record the lithology of the subsurface material. Soil samples were collected from most 10-foot depth intervals between 10 and 100 feet bgs, all but one from 20-foot depth intervals between 120 and 480 feet bgs, and from the 490- and 500-foot depth intervals at the bottom of the hole. Samples were collected with a 2-inch inner-diameter (I.D.) split-spoon sampler driven through an 8.6- or 10-inch O.D. open-center button bit. All soil samples were collected in steam-cleaned stainless steel liners, sealed with Teflon tape and plastic end caps, wrapped with duct tape, labeled, and immediately placed on ice. Annex 2-C provides the borehole and sample log for this hole.

Two subsurface geophysical surveys were performed in the TAV-BH-01 borehole: a natural gamma log and a neutron log. Both geophysical surveys were performed through the steel drive casing after reaching the total depth of the borehole prior to installing the well casing. The natural gamma log was conducted to help characterize lithology and correlate lithologic units on the basis of natural gamma radiation. A neutron log was run to evaluate the relative moisture content in the soil. Both logs were also used to assist in monitoring well design.

2.4.4.2.2 *Soil and Soil-Vapor Sampling*

A single soil sample from 10 feet bgs was analyzed for gamma-emitting radionuclides by SNL/NMs Radiation Protection Sample Diagnostics (RPSD) laboratory (Department 7713) using gamma spectroscopy (EPA November 1986).

Except as noted below, samples were collected every 10 feet from 20 to 100 feet bgs and were analyzed by the Quanterra laboratory for VOCs using EPA Method 8240, semivolatile organic compounds (SVOC) using EPA Method 8270, and target analyte list (TAL) metals using EPA Methods 6010 and 7471 (EPA November 1986). Samples from these intervals were also analyzed by the TMA Eberline laboratory for tritium by distillation in soil using EPA Method 600-906.0, and for gamma-emitting radionuclides by the SNL/NM RPSD laboratory. Exceptions included no samples from the 50-foot depth interval (no soil was recovered from that interval) and no VOC and SVOC samples from 60 and 70 feet bgs because of insufficient soil volume recovered.

Soil samples were also collected every 20 feet from between 120 and 480 feet bgs. Except as noted below, samples from each of these intervals were analyzed by Quanterra for VOCs using

EPA Method 8240 and for tritium by TMA using EPA Method 600-906.0 (EPA November 1986). Exceptions included no samples from the 280-foot depth because no soil was recovered from that interval. SVOC samples were also collected from the 180-, 300-, 320-, 400-, and 480-foot intervals and were analyzed by Quanterra. Additional TAL metals samples were collected from the 160-, 240-, 320-, and 400-foot intervals and were also analyzed by Quanterra.

Soil samples were collected from the 490 and 500-foot depth intervals and were analyzed by Quanterra for VOCs using EPA Method 8240, and tritium by TMA Eberline using EPA Method 600-906.0 (EPA November 1986). An extra sample was also collected from the 490-foot interval and was analyzed for total petroleum hydrocarbons (TPH) by ATI laboratory. The single TPH sample was collected from the deepest vadose zone sampling interval in the borehole to determine if detectable levels of mineral oil from the nearby HERMES site (SWMU 36) were present immediately above groundwater at this location (none were detected).

Soil samples were also collected from selected intervals between 340 and 500 feet and were submitted to the Environmental Restoration Chemistry Laboratory (ERCL) for volumetric moisture content and grain size determinations.

Analytical results for the RCRA metals portion of the TAL metals list are summarized in Table 2.4.4-1, and the complete TAL metals analyses are presented in Annex 2-F. Selected gamma spectroscopy radionuclide analytical results are summarized in Table 2.4.4-2, and the gamma spectroscopy analyses are presented in their entirety in Annex 2-G. Tritium analyses are summarized in Table 2.4.4-3. VOC analytical results are summarized in Table 2.4.4-4, and the EPA Method 8240 analyte list and reporting limits are presented in Table 2.4.4-5. SVOC analytical results are summarized in Table 2.4.4-6, and the complete analyte list and reporting limits for EPA Method 8270 are presented in Table 2.4.4-7.

Active soil-vapor samples were collected from the 10- and 20-foot depth intervals using a hollow steel rod lined with Teflon tubing, capped with a slotted drive point, and driven about 1 foot beyond the open-center button bit. A constant-flow sample pump (pumping at 4 liters [L]/minute) was connected to the surface end of the tubing. After purging a minimum of 3 tubing volumes (i.e., 1,500 milliliter [mL]), a soil-vapor sample was collected in a 500-mL glass bulb and submitted to the ERCL for analysis. The soil-vapor samples were relinquished to the ERCL immediately after collection and were analyzed within 24 hours of receipt. Annex 2-D presents and Section 2.4.4.4.1 summarizes soil-vapor results for all soil-gas samples collected from borehole TAV-BH-01.

2.4.4.2.3 TAV-MW1 Monitoring Well Installation

Borehole TAV-BH-01 was initiated on January 31, 1995, within the TA-V seepage pits and was completed as monitoring well TAV-MW1 on February 28, 1995 (Figure 2.2.1-3). During the first installation of the polyvinyl chloride (PVC) well casing, the bentonite seal placed above the sand pack seized the steel drive casing to the PVC casing. As a result, the PVC casing had to be drilled out and replaced with another string of PVC casing. Monitoring well TAV-MW1 was completed on February 28, 1995, and was developed with a bailer and surge block between April 11 and 13, 1995. Annex 2-E provides well construction specifications.

Table 2.4.4-1
 Summary of SWMU 275 RCRA Metals Plus Beryllium and Cobalt Analytical Results from Borehole TAV-BH-01, January-February 1995

Sample Attributes		Metals (EPA 60107471) ^a (mg/kg)										
Record Number ^b	ER Sample ID (Figure 2.2.1-3)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Lead	Mercury	Selenium	Silver
2598	TA5-BH-01-20.50	20.5	2.5	46.4	0.26	ND (0.5)	6.4	3.2	3.4 J (5)	ND (0.1)	ND (0.85)	ND (1)
2598	TA5-BH-01-30.50	30.5	1.5	29.0	ND (0.40)	ND (1)	12.5	2.4	ND (10)	0.048 J (0.10)	ND (0.5)	ND (2)
2598	TA5-BH-01-41.50	41.5	1.6 J (2)	59.0	ND (0.40)	ND (1)	15.5	3.3	ND (10)	0.065 J (0.10)	ND (1.6)	ND (2)
2602	TA5-BH-01-61.0	61	2.6	86.4	0.26	ND (0.5)	10.4	3.7	46.2 ^c	ND (0.1)	ND (0.5)	ND (1)
2602	TA5-BH-01-70.0	70	2.0	75.4	0.21	ND (0.5)	6.8	2.9	4.1 J (5)	ND (0.1)	ND (0.5)	ND (1)
2602	TA5-BH-01-80.50	80.5	0.44 J (1)	40.6	0.39	ND (0.5)	8.4	5.5	ND (5)	ND (0.1)	ND (0.92)	ND (1)
2602	TA5-BH-01-90.50	90.5	3.5	89.2	0.43	ND (0.5)	8.8	4.5	7.1	ND (0.1)	ND (0.56)	ND (1)
2602	TA5-BH-01-101.0	101	2.3	42.4	0.38	ND (0.5)	7.0	3.8	4.9 J (5)	ND (0.1)	ND (0.5)	ND (1)
2605	TA5-BH-01-160.0	160	2.1	57.7	0.36	ND (0.5)	19.5	3.4	9.7	ND (0.1)	ND (0.51)	ND (1)
2621	TA5-BH-01-241.0	241	2.3	39.7	0.24	ND (0.5)	7.2	3.3	3.7 J (5)	ND (0.1)	ND (0.52)	ND (1)
2626	TA5-BH-01-320.25	320.25	3.5	70.9	0.86	ND (0.5)	10.9	5.6	64.6	ND (0.1)	ND (0.64)	ND (1)
2629	TA5-BH-01-400.50	400.5	4.7	67.4	0.65	ND (0.5)	9.8	6.6	7.2	ND (0.1)	ND (0.67)	ND (1)
2738	TA5-BH-01-480.50	480.5	3.4	120	0.44	ND (0.5)	6.4	4.1	6.2	ND (0.1)	ND (0.8)	ND (1)
Background Subsurface Soil Concentrations Southwest and Other Super Groups (mg/kg) ^d			4.4	214	0.65	0.9	15.9	5.2	11.8	<0.1	<1	<1
Quality Assurance/Quality Control Samples (mg/L)												
2613	TA5-BH-01-EB1	NA	ND (0.01)	ND (0.01)	ND (0.0020)	ND (0.005)	ND (0.01)	ND (0.010)	0.0054	ND (0.0002)	ND (0.005)	ND (0.01)
2629	TA5-BH-01-EB2	NA	ND (0.01)	ND (0.01)	ND (0.0020)	ND (0.005)	0.0065 J (0.010)	ND (0.010)	0.0039	ND (0.0002)	ND (0.005)	ND (0.01)

^aEPA November 1986.
^bAnalysis request/chain-of-custody.
^cValues in bold exceed background soil concentrations.
^dFrom Dinwiddie September 1997.

BH = Borehole.
 EB = Equipment blank.
 EPA = U.S. Environmental Protection Agency.
 ER = Environmental Restoration.
 ft = Foot (feet).
 ID = Identification.
 J () = The reported value is less than the reporting limit.

mg/kg = Milligram(s) per kilogram.
 mg/L = Milligram(s) per liter.
 NA = Not applicable.
 ND = Not detected above the reporting limit, shown in parenthesis.
 SWMU = Solid waste management unit.

Table 2.4.4-2
 Summary of SWMU 275 Confirmatory Soil Sampling Gamma Spectroscopy Analytical Results from Borehole TAV-BH-01,
 January-February 1995

Sample Attributes		Activity (pCi/g)											
Record Number ^a	ER Sample ID (Figure 2.2.1-3)	Sample Depth (ft)	Uranium-238		Thorium-232		Uranium-235		Cesium-137		Error ^b	Error ^b	
			Result	Error ^b									
02599	TA5-BH-01-10	10	ND(2.22E+00)	--	2.48E-01	1.18E-01	ND(3.05E-01)	--	ND(6.49E-02)	--			
02599	TA5-BH-01-20	20	ND(3.25E+00)	--	4.38E-01	1.92E-01	ND(4.34E-01)	--	ND(8.88E-02)	--			
02599	TA5-BH-01-30	30	ND(4.75E+00)	--	4.07E-01	2.46E-01	ND(7.08E-01)	--	ND(1.45E-01)	--			
02599	TA5-BH-01-41	41	ND(2.28E+00)	--	2.40E-01	1.18E-01	ND(3.40E-01)	--	ND(6.60E-02)	--			
02603	TA5-BH-01-61.5	61.5	ND(2.16E+00)	--	3.68E-01	1.43E-01	ND(2.92E-01)	--	ND(5.16E-02)	--			
02603	TA5-BH-01-70.5	70.5	ND(1.95E+00)	--	4.39E-01	1.58E-01	ND(2.67E-01)	--	ND(4.90E-02)	--			
02603	TA5-BH-01-80	80	ND(2.23E+00)	--	5.88E-01	2.14E-01	ND(3.35E-01)	--	ND(6.13E-02)	--			
02603	TA5-BH-01-90	90	ND(2.67E+00)	--	6.11E-01	2.18E-01	ND(3.46E-01)	--	ND(6.45E-02)	--			
02603	TA5-BH-01-101.5	101.5	ND(3.07E+00)	--	4.97E-01	2.02E-01	ND(4.08E-01)	--	ND(7.72E-02)	--			
Background Soil Activity, Southwest Super Group ^c			1.4	NA	1.01	NA	0.16	NA	0.079	NA			
Quality Assurance/Quality Control Samples (pCi/L)													
2609	TA5-BH-01-EB1	NA	ND(8.46E-01)	NA	ND(1.23E-01)	NA	ND(1.32E-01)	NA	ND(2.13E-02)	NA			

^aAnalysis request/chain-of-custody.

^bTwo standard deviations above the mean detected activity.

^cFrom Dinwiddie September 1997.

- BH = Borehole.
- EB = Equipment blank.
- ER = Environmental Restoration.
- ft = Foot (feet).
- ID = Identification.
- NA = Not applicable.
- ND () = Not detected above the minimum detectable activity, shown in parenthesis.
- pCi/g = Picocurie(s) per gram.
- pCi/L = Picocurie(s) per liter.
- SWMU = Solid waste management unit.
- = Error not calculated for nondetectable results.

Table 2.4.4-3
Summary of SWMU 275 Confirmatory Soil Sampling Tritium Analytical
Results from Borehole TAV-BH-01, January-February 1995

Sample Attributes			Activity (pCi/L)		Activity (pci/g) ^a
Record Number ^b	ER Sample ID (Figure 2.2.1-3)	Sample Depth (ft)	Tritium (EPA-600 906.0)		
			Result	Error ^c	Result
02600	TA5-BH-01-21.5	21.5	400	210	0.01
02600	TA5-BH-01-31.25	31.25	ND (3,200) ^d	2000	0.04
02600	TA5-BH-01-42.5	42.5	ND (3,200) ^d	2000	0.12
02604	TA5-BH-01-60.5	60.5	ND (3,300) ^d	2100	0.02
02604	TA5-BH-01-71	71	ND (3,200) ^d	1900	0.31
02604	TA5-BH-01-81.5	81.5	ND (3,200) ^d	2000	0.13
02604	TA5-BH-01-91	91	ND (320)	200	0.02
02604	TA5-BH-01-100.5	100.5	ND (320)	190	0.03
02606	TA5-BH-01-120	120	ND (320)	200	0.01
02606	TA5-BH-01-140	140	360	200	0.01
02606	TA5-BH-01-160.5	160.5	ND (320)	200	0.02
02606	TA5-BH-01-180.5	180.5	320	200	0.02
02606	TA5-BH-01-200.5	200.5	420 ^e	210	0.02
02624	TA5-BH-01-220.5	220.5	ND (320)	190	0.01
02624	TA5-BH-01-240.25	240.25	4,600 ^d	2100	0.07
02624	TA5-BH-01-260	260	ND (320)	200	0.01
02623	TA5-BH-01-300	300	440	210	0.01
02623	TA5-BH-01-321	321	420	210	0.03
02623	TA5-BH-01-340.5	340.5	430	210	0.02
02623	TA5-BH-01-360	360	ND (320)	200	0.03
02623	TA5-BH-01-380.25	380.25	ND (320)	190	0.04
02630	TA5-BH-01-400	400	ND (320)	200	0.02
02630	TA5-BH-01-420	420	390	210	0.03
02737	TA5-BH-01-440	440	ND (350)	210	0.03
02737	TA5-BH-01-460	460	ND (360)	210	0.02
02737	TA5-BH-01-480	480	ND (360)	210	0.03
02737	TA5-BH-01-490	490	ND (3,500)	2100	0.22
02737	TA5-BH-01-500	500	ND (3,500)	2100	0.21
Quality Assurance/Quality Control Samples					
02608	TA5-BH-01-EB1	NA	ND(220)	140	NA
02630	TA5-BH-01-EB2	NA	250	140	NA
Nationwide Tritium Range in Precipitation and Drinking Water (pCi/L)			100-400	NA	NA
Background Tritium Concentrations in Soils at SNL/NM (pCi/g) ^g			NA	NA	0.043

^aCalculated for use in Risk Analysis; calc brief included in Annex 2-H.

^bAnalysis request/chain-of-custody.

^cTwo standard deviations about the mean detected activity.

^dLaboratory reported that the distillation of samples TA5-BH-01-31.25, TA5-BH-01-42.5, TA5-BH-01-60.5, TA5-BH-01-71, TA5-BH-01-81.5, and TA5-BH-01-240.25 yielded low soil moisture volumes suits for tritium analysis, resulting in 1 mL aliquots. The relatively high tritium activity level or minimum detected activity (MDA) reported for these samples was due entirely to the analysis of such small aliquots.

^eValues in bold exceed tritium range in precipitation and drinking water.

^fEPA October 1993.

^gFrom Oldewage September 1998.

BH = Borehole.

EB = Equipment blank.

ER = Environmental Restoration.

ft = Foot (feet).

ID = Identification.

NA = Not applicable.

ND () = Not detected at or above the minimum

detectable activity, shown in parentheses.

pCi/g = Picocurie(s) per gram.

pCi/L = Picocurie(s) per liter.

SNL/NM = Sandia National Laboratories/New Mexico.

SWMU = Solid waste management unit.

Table 2.4.4-4
 Summary of SWMU 275 VOC Analytical Results for Soil and QA/QC Samples from Borehole TAV-BH-01, January-February 1995

Record Number	Sample Attributes		VOCs (EPA 8240) ^a (µg/kg)							
	ER Sample ID (Figure 2.2.1-3)	Sample Depth (ft)	Acetone	2-Hexanone	2-Butanone	4-Methyl 2-Pentanone	Methylene Chloride	Xylene		
2598	TA5-BH-01-21	21	7.3 J (10) ^c	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)		
2598	TA5-BH-01-31	31	6.1 J (10)	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)		
2598	TA5-BH-01-42	42	15	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)		
2602	TA5-BH-01-81	81	7	ND (10)	ND (10)	ND (10)	1 J (5)	ND (5)		
2602	TA5-BH-01-91.75	91.75	13	ND (10)	ND (10)	ND (10)	1 J (5)	ND (5)		
2602	TA5-BH-01-100.25	100.25	7.2 J (10)	ND (10)	ND (10)	ND (10)	1.2 J (5)	ND (5)		
2605	TA5-BH-01-120.5	120.5	5.2 J (10)	ND (10)	ND (10)	ND (10)	2.4 J (5)	ND (5)		
2605	TA5-BH-01-140.25	140.25	6.8 J (10)	ND (10)	ND (10)	ND (10)	2.7 J (5)	ND (5)		
2605	TA5-BH-01-160.75	160.75	9 J (10)	ND (10)	ND (10)	ND (10)	3.5 J (5)	ND (5)		
2605	TA5-BH-01-181	181	5.5 J (10)	ND (10)	ND (10)	ND (10)	3.3 J (5)	ND (5)		
2605	TA5-BH-01-200.25	200.25	7.3 J (10)	ND (10)	ND (10)	ND (10)	3.2 J (5)	ND (5)		
2621	TA5-BH-01-221	221	9.7 JB (10)	ND (10)	ND (10)	ND (10)	1.4 J (5)	ND (5)		
2621	TA5-BH-01-240.75	240.75	7.9 JB (10)	ND (10)	ND (10)	ND (10)	1.2 J (5)	ND (5)		
2621	TA5-BH-01-260.5	260.5	6 JB (10)	ND (10)	ND (10)	ND (10)	1.2 J (5)	ND (5)		
2626	TA5-BH-01-300.5	300.5	22 B	6 J (10)	ND (10)	4.2 J (10)	3.4 J (5)	ND (5)		
2626	TA5-BH-01-320.75	320.75	34 B	ND (10)	ND (10)	ND (10)	4.7 J (5)	ND (5)		
2626	TA5-BH-01-341	341	11 B	ND (10)	ND (10)	ND (10)	1.2 J (5)	ND (5)		
2626	TA5-BH-01-360.5	360.5	8.4 JB (10)	ND (10)	ND (10)	ND (10)	1.1 J (5)	ND (5)		
2626	TA5-BH-01-380.75	380.75	ND (10)	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)		
2629	TA5-BH-01-420.5	420.5	7.2 JB (10)	ND (10)	ND (10)	ND (10)	1.6 J (5)	ND (5)		
2738	TA5-BH-01-440.5	440.5	ND (10)	ND (10)	ND (10)	ND (10)	1.6 J (5)	ND (5)		
2738	TA5-BH-01-460.5	460.5	ND (10)	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)		
2738	TA5-BH-01-481	481	ND (10)	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)		
2738	TA5-BH-01-491	491	ND (10)	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)		

Refer to footnotes at end of table.

Table 2.4.4-4 (Concluded)
 Summary of SWMU 275 VOC Analytical Results for Soil and QA/QC Samples from Borehole TAV-BH-01, January-February 1995

Record Number ^b	Sample Attributes		VOCs (EPA 8240) ^a (µg/kg)						
	ER Sample ID (Figure 2.2.1-3)	Sample Depth (ft)	Acetone	2-Hexanone	2-Butanone	4-Methyl 2-Pentanone	Methylene Chloride	Xylene	
2738	TA5-BH-01-500.75	500.75	ND (10)	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)	
Quality Assurance/Quality Control Samples (µg/L for water, µg/kg for soil)									
2613	TA5-BH-01-EB1 (aqueous EB)	NA	10 J	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)	
2629	TA5-BH-01-TB (soil TB)	NA	180 B	16	110	7.5 J (10)	2.6 J (5)	1.3 J (5)	
2629	TA5-BH-01-EB2 (aqueous EB)	NA	ND (10)	ND (10)	ND (10)	ND (10)	ND (5)	ND (5)	

^aEPA November 1986.

^bAnalysis request/chain-of-custody.

^cValues in bold exceed background concentrations.

- B = Analyte detected in associated blank.
- BH = Borehole.
- EB = Equipment blank.
- EPA = U.S. Environmental Protection Agency.
- ER = Environmental Restoration.
- ft = Foot (feet).
- ID = Identification.
- J = The reported value is less than the reporting limit.
- NA = Not applicable.
- ND = Not detected above the reporting limit, shown in parenthesis.
- QA/QC = Quality assurance/quality control.
- SWMU = Solid waste management unit.
- TB = Trip blank.
- VOC = Volatile organic compound.
- µg/kg = Microgram(s) per kilogram.
- µg/L = Microgram(s) per liter.

Table 2.4.4-5
 Summary of VOC Compound Analytical
 Reporting Limits Used for SWMU 275 Soil Sampling from
 Borehole TAV-BH-01, January-February 1995,
 EPA Method 8240

Analyte	Reporting Limit ($\mu\text{g}/\text{kg}$)
Acetone	10
Benzene	5
Bromodichloromethane	5
Bromoform	5
Bromomethane	10
2-butanone	10
Carbon disulfide	5
Carbon tetrachloride	5
Chlorobenzene	5
Chloroethane	10
Chloroform	5
Chloromethane	10
Dibromochloromethane	5
1,1-dichloroethane	5
1,2-dichloroethane	5
1,1-dichloroethene	5
1,2-dichloroethene	5
1,2-dichloropropane	5
Cis-1,3-dichloropropene	5
Trans-1,3-dichloropropene	5
Ethylbenzene	5
2-Hexanone	10
4-Methyl-2-pentanone	10
Methylene chloride	5
Styrene	5
1,1,2,2-Tetrachloroethane	5
Tetrachloroethene	5
Toluene	5
1,1,1-Trichloroethane	5
1,1,2-Trichloroethane	5
Trichloroethene	5
Vinyl acetate	10
Vinyl chloride	10
Xylenes (total)	5

$\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.
 SWMU = Solid waste management unit.
 VOC = Volatile organic compound.

Table 2.4.4-6
Summary of SWMU 275 SVOC Analytical Results for Soil and QA/QC Samples from Borehole
TAV-BH-01, January-February 1995

Sample Attributes			SVOC (EPA 8270) ^a (µg/kg)			
Record Number ^b	ER Sample ID (Figure 2.2.1-3)	Sample Depth (ft)	Bis(2-ethylhexyl)phthalate	N-Nitrosodiphenylamine	N-Nitrosopropylamine	Di-n-butyl phthalate
2598	TA5-BH-01-30.5	30.5	ND (330)	140 J^c (330)	ND (330)	ND (330)
2598	TA5-BH-01-41.5	41.5	ND (330)	230 J (330)	ND (330)	81 J (330)
2602	TA5-BH-01-80.5	80.5	ND (330)	ND (330)	ND (330)	ND (330)
2602	TA5-BH-01-91.5	91.5	ND (330)	ND (330)	ND (330)	ND (330)
2602	TA5-BH-01-101	101	ND (330)	ND (330)	ND (330)	ND (330)
2605	TA5-BH-01-181.25	181.25	ND (330)	ND (330)	ND (330)	ND (330)
2626	TA5-BH-01-301.25	301.25	66 J (330)	570	ND (330)	ND (330)
2626	TA5-BH-01-320.25	320.25	ND (1600)	14,000^d	ND (1600)	ND (1,600)
2738	TA5-BH-01-480.5	480.5	ND (330)	ND (330)	130 J (330)	ND (330)
Quality Assurance/Quality Control Samples (µg/L)						
2613	TA5-BH-01-EB1	NA	8.8 J (10)	ND (10)	ND (10)	ND (10)
2629	TA5-BH-01-EB2	NA	ND (10)	ND (10)	ND (10)	ND (10)

^aEPA November 1986.

^bAnalysis request/chain-of-custody.

^cValue in bold exceed background soil concentrations.

^dPieces of plastic sand catcher were found in sample TA5-BH-01-320.25, most likely accounts for the 14,000 µg/kg n-nitrosodiphenylamine detected in this sample.

BH = Borehole.

EB = Equipment blank.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ft = Foot (feet).

ID = Identification.

J () = The reported value is less than the reporting limit shown in parenthesis.

NA = Not applicable.

ND = Not detected above the reporting limit, shown in parenthesis.

QA/QC = Quality assurance/quality control.

SVOC = Semivolatile organic compound.

SWMU = Solid waste management unit.

TB = Trip blank.

µg/kg = Microgram(s) per kilogram.

µg/L = Microgram(s) per liter.

Table 2.4.4-7
 Summary of SVOC Analytical Reporting
 Limits Used for SWMU 275 Soil Sampling from
 Borehole TAV-BH-01, January-February 1995,
 EPA Method 8270

Analyte	Reporting Limit (µg/kg)
1,2,4-Trichlorobenzene	330-1600
1,2-Dichlorobenzene	330-1600
1,3-Dichlorobenzene	330-1600
1,4-Dichlorobenzene	330-1600
2,4,5-Trichlorophenol	1600-8000
2,4,6-Trichlorophenol	330-1600
2,4-Dichlorophenol	330-1600
2,4-Dimethylphenol	330-1600
2,4-Dinitrophenol	1600-8000
2,4-Dinitrotoluene	330-1600
2,6-Dinitrotoluene	330-1600
2-Chloronaphthalene	330-1600
2-Chlorophenol	330-1600
2-Methyl-4,6-dinitrophenol (Dinitro-o-cresol)	1600-8000
2-Methylnaphthalene	330-1600
2-Methylphenol (o-Cresol)	330-1600
2-Nitroaniline	1600-8000
2-Nitrophenol	330-1600
3,3-Dichlorobenzidine	660-3300
3-Nitroaniline	1600-8000
4-Bromophenyl phenyl ether	330-1600
4-Chloro-3-methylphenol	330-1600
4-Chloroaniline (4-Chlorobenzenamine)	330-1600
4-Chlorophenyl phenyl ether	330-1600
4-Methylphenol	330-1600
4-Nitroaniline	1600-8000
4-Nitrophenol	1600-8000
Acenaphthene	330-1600
Acenaphthylene	330-1600
Anthracene	330-1600
Benzo(a)anthracene	330-1600
Benzo(a)pyrene	330-1600
Benzo(b)fluoranthene	330-1600
Benzo(g,h,i)perylene	330-1600
Benzo(k)fluoranthene	330-1600
Benzoic Acid	1600-8000
Benzyl Alcohol	330-1600
Bis(2-chloroethoxy) methane	330-1600
Bis(2-chloroethyl) ether	330-1600
Bis(2-chloroisopropyl) ether	330-1600

Refer to footnotes at end of table.

Table 2.4.4-7 (Concluded)
 Summary of SVOC Analytical Reporting
 Limits Used for SWMU 275 Soil Sampling from
 Borehole TAV-BH-01, January-February 1995,
 EPA Method 8270

Analyte	Reporting Limit (µg/kg)
Bis(2-ethylhexyl)phthalate	330-1600
Butylbenzylphthalate	330-1600
Carbazole	330-1600
Chrysene	330-1600
Dibenzo(a,h)anthracene	330-1600
Dibenzofuran	330-1600
Diethylphthalate	330-1600
Dimethylphthalate	330-1600
Di-n-butylphthalate	330-1600
Di-n-octylphthalate	330-1600
Fluoranthene	330-1600
Fluorene	330-1600
Hexachlorobenzene	330-1600
Hexachlorobutadiene	330-1600
Hexachlorocyclopentadiene	330-1600
Hexachloroethane	330-1600
Indeno(1,2,3-cd)pyrene	330-1600
Isophorone	330-1600
Naphthalene	330-1600
Nitrobenzene	330-1600
N-nitroso-di-n-propylamine	330-1600
N-nitrosodiphenylamine	330-1600
Pentachlorophenol	1600-8000
Phenanthrene	330-1600
Phenol	330-1600
Pyrene	330-1600

µg/kg = Microgram(s) per kilogram.
 SVOC = Semivolatile organic compound.
 SWMU = Solid waste management unit.

2.4.4.3 *Data Gaps*

Characterization activities of SWMU 275 contain no data gaps.

2.4.4.4 *Results and Conclusions*

This section summarizes analytical results for both the soil-vapor and soil samples collected during the drilling of borehole TAV-BH-01.

2.4.4.4.1 *Active Soil-Vapor Sample Results*

On-site soil-vapor samples were analyzed by SNL/NM's ERCL within 24 hours of receipt. The GC/MS was calibrated according to EPA SW-846 Method 8260 (EPA November 1986). The instrument passed all QC criteria (i.e., bromofluorobenzene tune, system performance check compounds, and calibration check compounds) without alteration of initial calibration mass spectrometer parameters. The soil-vapor sample was subsequently injected into a Viking or Hewlett-Packard GC/MS. The analytical instrument was calibrated according to the EPA Method 8260 described in EPA SW-846 (EPA November 1986). The target compounds (reported in ppbv) that were identified in soil-vapor samples from the pilot borehole for monitoring well TAV-MW1 are summarized as follows:

- Ethylbenzene at 76 ppbv at the 10-foot depth
- Xylene at 140 ppbv at the 10-foot depth and 12 ppbv at the 20-foot depth
- Toluene at 26 ppbv at the 70-foot depth.
- 1,1,2-trichloroethane at 9 ppbv (J value) at the 70-foot depth.
- TCE at 44 ppbv at the 80-foot depth
- PCE at 4 ppbv (J value) at the 80-foot depth.

Compound detections qualified with a "B" footnote (indicates that constituent was also found in an associated method blank) are not included in the above summary—they are likely because of external or laboratory contamination.

The National Bureau of Standards organic compound library data were used in identifying chromatographic peaks appearing on each sample chromatogram that were not target compounds. From between 10 and 200 feet bgs, these tentatively identified compounds both included and contained ketones, alcohols, aliphatic hydrocarbons, and aldehydes. Estimated concentrations in these samples ranged from 1 to 800 ppbv. From 200 feet to the deepest soil-vapor sample collected from 500 feet bgs, these compounds were less prevalent and typically contained more branched alkanes (i.e., fuel artifacts up to an estimated concentration of 5 ppm); only one sample contained TCE. Minor concentrations (estimated concentrations from 1 to 500 ppbv) of hexanol, xylene, phenol, carboxylic acid, and 2-butanone were identified in the soil-vapor samples. These compounds also were identified in an analysis of a lubricant used to thread drill casing and pipe. Therefore, the presence of hexanol, xylene, phenol, carboxylic acid, and 2-butanone may be the result of equipment contamination. In addition, some of these compounds also were detected in the method blanks. Complete active soil-vapor sample results are provided in Annex 2-D.

2.4.4.4.2 Soil Analytical Results

This section summarizes soil analytical results from samples that were collected during drilling of borehole TAV-BH-01. Soil samples are numbered with codes that identify specifics of the samples. For example, TA5-BH-01-20.50 refers to a sample from TA-5 (also referred to as TA-V), Borehole 01, and from the depth interval beginning at 20.5 feet bgs.

Metals

Soil samples were collected from selected depths of between 20 and 480 feet bgs and were analyzed for total metals (using EPA Method 6010/7471 [November 1986]). Table 2.4.4-1 summarizes sample depths and lists the RCRA metals plus beryllium and cobalt results. Beryllium and cobalt were identified as potential COCs at the TA-V LWDS, therefore, they are considered potential COCs at SWMU 275 as well. RCRA metals that were detected include arsenic, barium, chromium, lead, and mercury plus beryllium and cobalt. Cadmium, selenium, and silver were not detected in borehole TAV-BH-01 at the method reporting limits. Arsenic (at 4.7 milligrams [mg]/kilogram [kg]) was slightly above the approved maximum background concentration of 4.4 mg/kg, at the 400.5-foot depth. The maximum barium concentration (120 mg/kg) was detected at the 480.5-foot depth; this is well below the approved maximum background concentration of 214 mg/kg. Chromium slightly exceeded the maximum approved background concentration of 15.9 mg/kg in one sample at a value of 19.5 mg/kg at the 160-foot depth. Lead exceeded the maximum approved background concentration of 11.8 mg/kg in two samples from TAV-BH-01. Lead was detected at 46.2 and 64.6 mg/kg at the 61- and 320.25-foot depths, respectively. Mercury has no quantifiable background concentration. Mercury was detected in two samples ranging from 0.048 (J) to 0.065 (J) mg/kg at the 30.5- and 41.5-foot depths, respectively. Beryllium very slightly exceeded the maximum approved background concentration of 0.65 mg/kg in the 320.5-foot sample (at 0.66 mg/kg) and was detected at 0.65 mg/kg in the 400.5-foot sample. Cobalt very slightly exceeded the maximum approved background concentration of 5.2 mg/kg in three samples (at 5.5, 5.6, and 6.6 mg/kg in samples from 80.50, 320.5, and 400.5 feet bgs, respectively). Annex 2-F provides complete TAL metal results.

Gamma Spectroscopy

Nine soil samples were collected for gamma spectroscopy analysis from between 10 and 101.5 feet bgs. Table 2.4.4-2 summarizes selected gamma spectroscopy analyses for the nine soil samples from TAV-BH-01. Gamma activity for uranium-238 and uranium-235 was not detected in any of the samples, although the minimum detectable activities (MDA) for all samples exceeded the approved background limit of 1.4 picocuries per gram (pCi/g) and 0.16 pCi/g, respectively. However, the MDA for uranium-235 was still several orders of magnitude less than a preliminary remedial goal for that isotope; therefore, there is no human health or environmental concern. Thorium-232 gamma activity was well below the 1.01-pCi/g background limit. Cesium-137 gamma activity was not detected in any of the samples; however, the MDA exceeded the approved background limit in two of the nine samples. Annex 2-G provides complete gamma spectroscopy results.

Tritium

Samples for tritium analysis (using EPA Method 600-906.0 [November 1986]) were collected from intervals of approximately 10 feet between the 20- and 100-foot depths (except for the 50-foot interval), where no samples were recovered, and from 480 to 500 feet bgs. Between the 120- and 480-foot depths, tritium samples were collected from approximately every 20 feet, except for the 280-foot interval where no samples were recovered. The tritium soil analytical results ranged from no detections (less than 320 to 3,500 pCi/L in soil moisture) to 4,600 pCi/L at 240.25 feet bgs (Table 2.4.4-3). At some depth intervals, low soil moisture volumes yielded relatively high activity levels or high MDAs because of the insufficient soil moisture aliquots. The data were converted from pCi/L in water to pCi/g in soil for the purposes of comparison to SNL/NM background tritium concentrations in soils, which are expressed in pCi/g. Conversion of data to pCi/g in soil indicates that except for the sample from the 240.25 foot depth, no tritium detections for soil were identified above the background tritium concentration of 0.043 pCi/g in soil at SNL/NM (Oldewage September 1998). The relatively high tritium activity level detected in the 240.25-foot sample was attributed (by the laboratory) to an insufficient soil moisture aliquot. Annex 2-H provides a calculation brief for the converting tritium from pCi/L in soil moisture to pCi/g in soil.

VOCs

Samples for VOC analysis (using EPA Method 8240 [November 1986]) were typically collected from intervals of approximately 10 feet between the 20- and 100-foot depths, except for the 50-, 60-, and 70-foot depth intervals, where insufficient or no sample recovery precluded VOC sample collection, and from 480 to 500 feet bgs. Between the 120- and 480-foot depths, VOC samples were collected approximately every 20 feet except for the 280- and 400-foot intervals, where insufficient or no sample recovery precluded collection of VOC samples. Table 2.4.4-4 summarizes all VOCs that were detected in the samples. Table 2.4.4-5 lists the complete method analytes and their respective reporting limits. Acetone and methylene chloride were the most prevalent compounds detected in soil samples from the borehole. Acetone was detected at a maximum concentration of 34 (B) micrograms (μg)/kg at the 320.75-foot depth (acetone was also detected in the associated laboratory method blank). Only estimated values for methylene chloride were identified below the reporting limit of 5 μg /kg. Two additional VOCs (2-hexanone and 4-methyl 2-pentanone [methyl isobutyl ketone]) were detected in the sample from the 300.5-foot depth at below reporting limit concentrations of 6 and 4.2 μg /kg, respectively.

These constituents may represent laboratory contamination because several of these compounds were detected in associated laboratory method blank analyses and in soil trip blank sample TA5-BH-01-TB (Table 2.4.4-4).

SVOCs

Nine soil samples from selected intervals of between 30 and 480 feet bgs were analyzed for SVOCs using EPA Method 8270 (EPA November 1986). Table 2.4.4-6 summarizes the detected SVOCs in soil samples from TAV-BH-01. Table 2.4.4-7 provides the complete method analytes and their respective reporting limits. SVOCs that were identified at below reporting limits (330 μg /kg) in soil samples include bis(2-ethylhexyl)phthalate at 66 (J) μg /kg from

the 301.25-foot depth; di-n-butyl phthalate at 81 (J) $\mu\text{g}/\text{kg}$ from the 41.5-foot depth; and n-nitrosopropylamine at 130 (J) $\mu\text{g}/\text{kg}$ from the 480.5-foot depth. N-nitrosodiphenylamine was detected below the reporting limit of 330 (J) $\mu\text{g}/\text{kg}$ in two soil samples from TAV-BH-01: at 140 (J) $\mu\text{g}/\text{kg}$ from the 30.5-foot depth and at 230 (J) $\mu\text{g}/\text{kg}$ from the 41.5-foot depth. N-nitrosodiphenylamine was also detected in samples from the 301.25-foot depth at a concentration of 570 $\mu\text{g}/\text{kg}$ and from the 320.25-foot depth at a concentration of 14,000 $\mu\text{g}/\text{kg}$. The sample from the 320.25-foot depth was later found to contain a piece of a plastic sand catcher, part of the split spoon sampling equipment. Phthalates are a common component in plastics, and are recognized as common SVOC laboratory contaminants.

TPH

A single sample was collected from 490.5 feet bgs and was analyzed for TPH by EPA Method 418.1 (EPA November 1986). The single TPH sample was collected from the deepest vadose zone sampling interval in the borehole to determine if detectable levels of mineral oil from the nearby HERMES site (SWMU 36) were present immediately above groundwater at this location (none were detected). TPH was not detected at the reporting limit of 20 mg/kg.

Data Validation

SNL/NM Department 7713 (RPSD) reviewed all gamma spectroscopy results according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 02 (SNL/NM July 1996). In addition, all off-site laboratory results were reviewed and verified/validated according to "Data Verification/Validation Level 2—DV-2" in Attachment C of the Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994). Annex 2-1 summarizes off-site data validation results. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 275.

2.5 Site Conceptual Model

The site conceptual model for SWMU 275 is based upon the COCs identified in the soil samples that were collected during the drilling of borehole TAV-BH-01. Active and passive SVSs are not included in the site conceptual model because results from these surveys proved inconclusive, and because there is no way to definitively correlate soil-gas concentrations to soil concentrations, which are used in risk assessment.

2.5.1 Nature and Extent of Contamination

The data collected during drilling activities at SWMU 275 were based upon the assumption that the most likely COCs in the soil are metals, radionuclides, VOCs, and SVOCs (Table 2.5.1-1). Whether any metal or radiological COCs exceeded the background concentration limits in any sample was the determining factor in designating potential contaminants. In the case of no-detection results, the highest reporting limit (for metals) or MDA (for radionuclides) was compared to the background limit.

Elevated metal concentrations occur sporadically with depth in borehole TAV-BH-01. Arsenic and chromium only slightly exceeded the approved maximum background concentrations in

Table 2.5.1-1
Summary of COCs for SWMU 275

COC Type	Number of Samples	COCs Greater than Background	Maximum Background Limit/Southwest Super Group ^a (mg/kg except where noted)	Maximum Concentration (mg/kg except where noted)	Average Concentration ^b (mg/kg except where noted)	Sampling Locations Where Background Concentration is Exceeded
Metals	13 environmental	Arsenic	4.4	4.7	2.5	TA5-BH-01-400.50
		Beryllium	0.65	0.66	0.39	TA5-BH-01-320.5
		Cadmium	0.9	ND (1)	0.6	TA5-BH01-30.5 TA5-BH-01-41.50
		Chromium	15.9	19.5	10.0	TA5-BH-01-160.0
		Cobalt	5.2	6.6	4.02	TA5-BH-01-80.5 TA5-BH-01-320.5 TA5-BH-01-400.5
		Lead	11.8	64.6	14	TA5-BH-01-61.0 TA5-BH-01-320.25
		Mercury	<0.1	ND (0.1)	0.09	TA5-BH-01-20.50 TA5-BH-01-61.0 TA5-BH-01-70.0 TA5-BH-01-80.50 TA5-BH-01-90.50 TA5-BH-01-101.0 TA5-BH-01-160.0 TA5-BH-01-241.0 TA5-BH-01-320.25 TA5-BH-01-400.50 TA5-BH-01-480.50
Radionuclides	9 environmental	Selenium	<1	ND (1.6)	0.70	TA5-BH-01-41.50
		Silver	<1	ND (2)	1.2	All Samples
		Uranium-238	1.4 pCi/g	ND (4.75E+00)	Not calculated ^d	All Samples
		Uranium-235	0.16 pCi/g	ND (7.08E-01)	Not calculated ^d	All Samples
VOCs	25 environmental	Cesium-137	0.079 pCi/g	ND (1.45E-01)	Not calculated ^d	TA5-BH-01-20 TA5-BH-01-30
		Acetone	NA	34 (B) (µg/kg)	10.2 (µg/kg)	TA5-BH-01-21 TA5-BH-01-31 TA5-BH-01-42 TA5-BH-01-81 TA5-BH-01-91.75 TA5-BH-01-100.25 TA5-BH-01-120.5 TA5-BH-01-140.25 TA5-BH-01-160.75 TA5-BH-01-181 TA5-BH-01-200.25 TA5-BH-01-221 TA5-BH-01-240.75 TA5-BH-01-260.5 TA5-BH-01-300.5

Refer to footnotes at end of table.

Table 2.5.1-1 (Concluded)
Summary of COCs for SWMU 275

COC Type	Number of Samples	COCs Greater than Background	Maximum Background Limit/Southwest or Other Super Group (mg/kg except where noted)	Maximum Concentration (mg/kg except where noted)	Average Concentration ^b (mg/kg except where noted)	Sampling Locations Where Background Concentration is Exceeded
VOCs (continued)	25 environmental	Acetone (continued)	NA	34 B (µg/kg)	10.2 (µg/kg)	TA5-BH-01-320.75 TA5-BH-01-341 TA5-BH-01-360.5 TA5-BH-01-420.5
		2-Hexanone	NA	6 J (10) (µg/kg)	9.8 (µg/kg)	TA5-BH-01-300.5
		4-Methyl 2-Pentanone (MIBK)	NA	4.2 J (10) (µg/kg)	9.8 (µg/kg)	TA5-BH-01-300.5
		Methylene Chloride	NA	4.7 J (5) (µg/kg)	3.0 (µg/kg)	TA5-BH-01-81 TA5-BH-01-91.75 TA5-BH-01-100.25 TA5-BH-01-120.5 TA5-BH-01-140.25 TA5-BH-01-160.75 TA5-BH-01-181 TA5-BH-01-200.25 TA5-BH-01-221 TA5-BH-01-240.75 TA5-BH-01-260.5 TA5-BH-01-300.5 TA5-BH-01-320.75 TA5-BH-01-341 TA5-BH-01-360.5 TA5-BH-01-420.5 TA5-BH-01-440.5
SVOCs	9 environmental	Bis(2-ethylhexyl)phthalate	NA	66 J (330) (µg/kg)	442 (µg/kg)	TA5-BH-01-301.25
		N-nitrosodiphenylamine	NA	14,000 (µg/kg)	1843 (µg/kg)	TA5-BH-01-30.5 TA5-BH-01-41.5 TA5-BH-01-301.25 TA5-BH-01-320.25
		N-nitrosopropylamine	NA	130 J (330) (µg/kg)	449 (µg/kg)	TA5-BH-01-480.5
		Di-n-butylphthalate	NA	81 J (330) (µg/kg)	443 (µg/kg)	TA5-BH-01-41.5

^a From Dinwiddie September 1997.
^b Average concentration includes all samples, duplicates, and splits. For nondetectable results, the reporting limit is used to calculate the average.
^c Includes samples with nondetect results where the MDL or MDA exceeds the approved background limit.
^d An average minimum detectable activity is not calculated due to the variability in instrument counting error and the number of reported nondetectable activities.
B = Analyte detected in associated blank.
COC = Constituent of concern.
J () = The reported value is less than the reporting shown in parenthesis.
MDA = Minimum detectable activities.
MDL = Minimum detection limit.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
ND () = Not detected at or above the MDL or MDA, shown in parenthesis.

pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories, New Mexico.
SVOC = Semivolatile organic compound.
SWMU = Solid waste management unit.
VOC = Volatile organic compounds.
µg/kg = Microgram(s) per kilogram.

soils. Lead concentrations exceeding the approved maximum background concentration were encountered in two samples: one at 61 feet bgs, and the second at 320 feet bgs. These variances are most likely the result of natural variations of soil metal concentrations that are expected in natural soil environments. Mercury was detected in only two samples at below reporting-limit concentrations of 0.048 and 0.065 mg/kg. Although cadmium, selenium, and silver were not detected in soil samples from TAV-BH-01, they are included in the list of COCs because the associated reporting limit was equivalent to or greater than the approved maximum background concentrations for these analytes.

Radiological COCs included uranium-238, uranium-235, and cesium-137 because the associated MDAs exceeded the approved background limit. VOCs detected in soil samples from borehole TAV-BH-01 include acetone, 2-hexanone, 4-methyl 2-pentanone, and methylene chloride. Acetone and methylene chloride were found to be the most prevalent VOCs; this may be associated with laboratory contamination. Acetone was detected in the laboratory method blank analyses. With the exception of five samples containing acetone, the remaining analytes were detected at concentrations below the laboratory reporting limits.

SVOCs detected at SWMU 275 include bis(2-ethylhexyl)phthalate, n-nitrosodiphenylamine, n-nitrosopropylamine, and di-n-butyl phthalate. With the exception of n-nitrosodiphenylamine, the detected analytes were reported below laboratory reporting limits and may be attributed to laboratory contamination. N-nitrosodiphenylamine is associated with plastics and was identified as part of a sand catcher used to collect split-spoon samples.

All releases of COCs would have been to subsurface soils because the gravel-bottomed drain of the seepage pits is approximately 20 feet bgs. A uniform distribution of COCs at SWMU 275 is expected because the industrial sanitary liquid waste was mixed in the septic tanks prior to distribution to the six seepage pits. A single boring in the center of the seepage pits area would, therefore determine the potential extent of vertical contamination from the seepage pits to the groundwater. Because the borehole was located in essentially the center of the group of seepage pits, maximum concentrations of COCs in the subsurface would be expected at this location. Therefore, concentrations of COCs through lateral migration at SWMU 275 are expected to be less than maximum concentrations found in the center of the pit area.

The sample collection protocol used at SWMU 275 is representative of the media potentially impacted by the site activities and is sufficient to determine the vertical extent of COC migration.

In summary, the design of the confirmatory sampling event was appropriate and adequate to determine the nature, rate, and extent of contamination at this site.

2.5.2 Environmental Fate

The most likely COCs at SWMU 275 are metals, radionuclides, VOCs, and SVOCs associated with uncontained disposal of liquid waste to a seepage pit system. Figure 2.5.2-1 diagrams the environmental fate for the constituents at SWMU 275. The current and future land use for the site is industrial. Because the first occurrence of COCs is expected to be at a depth greater than 20 feet bgs, there are no surface pathways to receptors. This depth also realistically precludes the possibility of uptake by biota and ingestion by animals. The potential human receptor is the industrial worker. There are no primary pathways of the COCs to the industrial worker.

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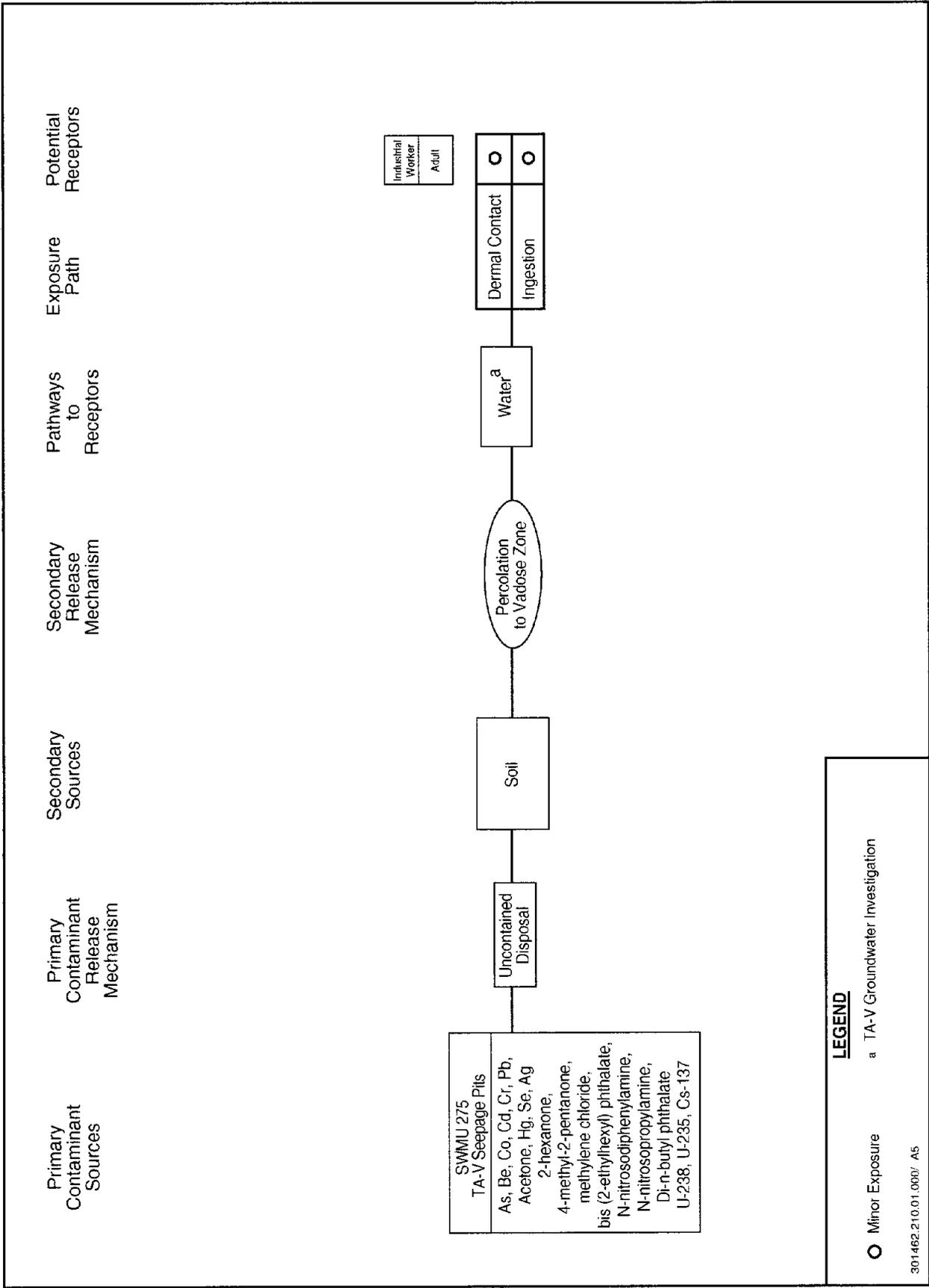


Figure 2.5.2-1
Conceptual Model Flow Diagram for SWMU 275, TA-V Seepage Pits



Depth to groundwater is approximately 500 feet bgs. High partitioning coefficients and low mobility of the COCs in the transporting medium would even further dilute the low detected concentrations of these constituents. A separate groundwater assessment is being performed under the TA-V groundwater investigation. This assessment task will be described in the TA-V groundwater data report, which is expected to be completed in December 1998.

2.6 Site Assessments

The site assessment process for SWMU 275 includes risk screening assessments followed by risk baseline assessments (as required) for both human health risk and ecological risk. The following sections briefly summarize the site assessment results. Annex 2-J provides details of the site assessment.

2.6.1 Summary

The site assessment concludes that SWMU 275 does not have potential to affect human health under an industrial land use scenario. Because of the subsurface depth of the SWMU 275 seepage pits, no complete ecological pathways exist and evaluation of ecological risk is not warranted. This section briefly describes and Annex 2-J provides details of the site assessments.

2.6.2 Screening Assessments

Risk screening assessments were performed for both human health risk and ecological risk for SWMU 275. This section briefly summarizes the risk screening assessment results.

2.6.2.1 Human Health

SWMU 275 has been recommended for industrial land-use (DOE et al. September 1995). A complete discussion of the risk assessment process, results, and uncertainties is provided in Annex 2-J. Because of the presence of COCs in concentrations or activities greater than background levels, it was necessary to perform a health risk analysis for the site. Besides COC metals, any VOCs or SVOCs detected above their reporting limits and any radionuclide compounds detected above either background levels and/or MDAs were included in this assessment. The risk assessment process provides a quantitative evaluation of the potential adverse human health effects caused by constituents in the site's soil. The Risk Screening Assessment Report calculated the hazard index (HI) and excess cancer risk for both an industrial land-use and residential land-use setting. The excess cancer risk from nonradiological COCs and the radiological COCs is not additive (EPA 1989).

In summary, the HI calculated for SWMU 275 nonradiological COCs is 0.02 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 the risk associated with background levels from potential nonradiological COC risk. The incremental HI is 0.01. The total excess cancer risk for SWMU 275 nonradiological COCs is 4E-6 for an industrial land-use setting. Guidance from the NMED indicates that excess lifetime risk of developing cancer by an

individual must be less than 1E-6 for Class A and B carcinogens and less than 1E-5 for Class C carcinogens (NMED March 1998). Thus, the total excess cancer risk for this site is above the suggested acceptable risk value (1E-6). The incremental excess cancer risk for SWMU 275 is 1.1E-6. The excess cancer risk is driven by arsenic. However, if the average arsenic concentration (2.5 mg/kg) is used in the risk calculations, the incremental risk (7E-8) is below the NMED proposed guidelines. Because the site is adequately characterized, use of average arsenic concentrations is more realistic than use of the maximum arsenic concentration in the risk calculations. The detection occurred at depth so, realistically, no inhalation or ingestion pathway exists.

The incremental total effective dose equivalent for radionuclides for an industrial land-use setting for SWMU 275 is 0.12 millirem (mrem) per year (yr), which is well below the recommended dose limit of 15 mrem/yr found in EPA's OSWER Directive No. 9200.4-18 and reflected in a document entitled "Sandia National Laboratories/New Mexico Environmental Restoration Project—RESRAD Input Parameter Assumptions and Justification" (SNL/NM February 1998). The incremental excess cancer risk for radionuclides is 1.4E-6 for an industrial land-use scenario, which is much less than risk values calculated from naturally occurring radiation and from intakes considered background concentration values.

The residential land-use scenarios for this site are provided only for comparison in the Risk Screening Assessment Report (Annex 2-J), which concludes that SWMU 275 has insignificant potential to affect human health under an industrial land-use scenario.

2.6.2.2 *Ecological*

An ecological screening assessment that corresponds with the screening procedures (NMED March 1998) in EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1989) was performed as set forth by the NMED Risk-Based Decision Tree. An early step in the evaluation is a comparison of COC concentration levels and identification of potentially bioaccumulative constituents. This is presented in Annex 2-I Sections III, VI, and VII.2. This methodology requires the development of a site conceptual model and food web model, and selection of ecological receptors. Each of these items is presented in the "Predictive Ecological Risk Assessment Methodology for SNL/NM ER Program, Sandia National Laboratories/New Mexico" (IT July 1998) and will not be duplicated here. The screen also includes estimating exposure and ecological risk.

All COCs at SWMU 275 are found at depths greater than 5 feet bgs. For this reason, none of the COCs is considered a constituent of potential ecological concern, and bioaccumulation potential is not evaluated. No ecological receptors or viable habitat exist at the site to support receptors. Therefore, food-chain uptake is not expected to be a potential transport mechanism for COCs associated with this site. For these reasons, no ecological pathways are expected to exist at this site and no further evaluation of ecological risk is warranted.

2.6.3 *Baseline Risk Assessments*

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

2.6.3.1 *Human Health*

Based upon the fact that the human health results of the screening assessment (Section 2.6.2.1) indicate that SWMU 275 does not have potential to affect human health under an industrial land-use scenario, a baseline human health risk assessment is not required for SWMU 275.

2.6.3.2 *Ecological*

Based upon the fact that ecological results of the screening assessment (Section 2.6.2.2) indicate that SWMU 275 has no ecological pathways at the site, a baseline ecological risk assessment is not required for SWMU 275.

2.6.4 Other Applicable Assessments

2.6.4.1 *Groundwater*

The TA-V groundwater investigation includes quarterly monitoring and assessment of TAV-MW1.

2.7 **No Further Action Proposal**

SWMU 275 is proposed for an NFA decision based upon all the supporting information contained in this chapter. This section provides the rationale and criterion for the NFA proposal.

2.7.1 Rationale

Based upon field investigation data and the human health risk assessment analysis, an NFA is recommended for SWMU 275 for the following reason: No COCs (metals, radionuclides, VOCs, and SVOCs) are present in concentrations considered hazardous to human health for an industrial land use scenario.

2.7.2 Criterion

Based upon the evidence provided above, SWMU 275 is proposed for an NFA decision in conformance with Criterion 5 (NMED March 1998), which states that "The SWMU/AOC has been characterized or remediated in accordance with current applicable state or federal regulations and that available data indicate that contaminants pose an acceptable level of risk under current and projected future land use."

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ANNEX 2-J
Risk Screening Assessment



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SWMU 275: RISK SCREENING ASSESSMENT**I. Site Description and History**

The following sections provide the description and operational history of SWMU 275.

I.1 Site Description

Solid Waste Management Unit (SWMU) 275 is located within Technical Area (TA)-V, in the southern part of Kirtland Air Force Base (KAFB). TA-V is located immediately east of the TA-III gate, and is approximately 1 mile southwest of Lovelace Road. It is reached by traveling southeast on Lovelace Road, and then turning southwest on the paved TA-III/V access road. SWMU 275 encompasses 0.26 acre of industrially developed, flat-lying land at an average mean elevation of 5,433 feet above mean sea level (amsl).

SWMU 275 consists of two septic tanks and six seepage pits located immediately south of Building 6588 near the center of TA-V. A security fence splits the site diagonally; the northern half is gravel-covered and contains three seepage pits. The southern half of the site contains the two septic tanks and three additional seepage pits.

The surficial sediments at SWMU 275 consist of a thin veneer of recent (Holocene) alluvial fan deposits (Plate I, "Surficial Geologic Map of SNL/KAFB, Albuquerque, New Mexico," SNL/NM December 1995). Subsurface sediments encountered in a borehole (TAV-BH-01) that was drilled in the center of the seepage pits area from the surface to the saturated zone in February 1995 consisted of interbedded gravelly sands, sands, silts, and clays. A thin (less than 5 feet) saturated zone was penetrated in the borehole at 380 feet bgs but no water was produced. The regional aquifer was encountered at a depth of 491 feet bgs, and the borehole was drilled an additional 29 feet to a total depth of 520 feet. The boring was converted to monitoring well TAV-MW1 at the conclusion of drilling, and groundwater samples are being routinely collected from this well as part of the ongoing TA-V groundwater investigation.

The water-table elevation in TAV-MW1 was approximately 4,930 feet amsl in July 1998 (SNL/NM July 1998). Groundwater flow in the vicinity of TA-III and TA-V is in a westerly direction (SNL/NM March 1997). The nearest production wells are northwest of SWMU 275 and include KAFB-1, KAFB-2, KAFB-4, KAFB-7, and KAFB-11, which range from approximately 2.9 to 5.0 miles away from the site (SNL/NM August 1996).

II. Comparison of Results to Data Quality Objectives

The confirmatory sampling conducted at SWMU 275 was designed to collect adequate samples to:

- Determine if hazardous waste or hazardous constituents that may have been released via the seepage pits at the site remained in the vadose zone in significant concentrations

- Characterize the nature and extent of any releases
- Provide Level 2 analytical data to support screening risk assessments.

Table 1 summarizes the sample location design for SWMU 275. The source of potential Constituent of Concern (COCs) at this site is effluent discharged to the subsurface via the seepage pit system. Specific COCs that may have been released to the seepage pits are unknown, but potentially include volatile organic compounds (VOCs), semivolatle organic compounds (SVOCs), RCRA metals, tritium, and other miscellaneous radionuclides.

Table 1
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU	Potential COC Source	Area of Site (acres)	Number of Sampling Locations	Sample Frequency	Sampling Location Rationale
275	Seepage pits	0.26	1 vertical boring	<ul style="list-style-type: none"> • Samples every 10 feet from 10 to 100 feet bgs • Samples every 20 feet at from 120 to 500 feet bgs 	A single boring, located in the center of the seepage pits area, was drilled to determine the nature and extent of potential contamination from the surface to groundwater (at approximately 500 feet bgs). Soil samples were collected at 10 to 20-foot intervals throughout the length of the borehole to determine the vertical extent of potential contamination.

COC = Constituent of concern.

bgs = Below ground surface.

SWMU = Solid waste management unit.

The location of the borehole (designated TAV-BH-01) and the sampling depth and number of intervals was designed to determine the potential extent of contamination from the surface to groundwater.

Table 2 summarizes the analytical methods and data quality requirements necessary to (1) adequately characterize hazardous waste or hazardous constituents considered most likely to be associated with the seepage pits, and (2) to support screening risk assessments.

A total of 85 separate analyses were performed on samples collected from borehole TAV-BH-01 at SWMU 275 and were analyzed by off-site laboratories. The minimum detection limits (MDLs) for the RCRA metals analyses were in most cases lower than the maximum approved background concentrations for arsenic, barium, chromium, and lead. The cadmium MDL range was 0.5 to 1 mg/kg versus the maximum background concentration limit of 0.9 mg/kg. Mercury, selenium, and silver do not have quantified maximum background

Table 2
Summary of Data Quality Requirements

Analytical Requirement	Data Quality Level	Radiation Protection Sample Diagnostics Laboratory Department 7713 SNL/NM	Quanterra Environmental Services laboratory, Arvada, CO.	TMA/Eberline Albuquerque Laboratory
RCRA metals, EPA Method 6010/7471	Level 2	NA	13 samples	NA
VOCs, EPA Method 8240	Level 2	NA	25 samples	NA
SVOCs, EPA Method 8270	Level 2	NA	9 samples	NA
TPH, EPA Method 418.1	Level 2	NA	1 sample	NA
Tritium by distillation, EPA Method 600-906.0	Level 2	NA	NA	28 samples
Gamma Spectroscopy	Level 2	9 samples	NA	NA

EPA = U.S. Environmental Protection Agency.
 NA = Not applicable.
 RCRA = Resource Conservation and Recovery Act.
 SNL/NM = Sandia National Laboratories/New Mexico.
 SVOC = Semivolatile organic compound.
 TPH = Total petroleum hydrocarbons.
 VOC = Volatile organic compound.

concentrations. The silver MDL ranged from 1 to 2 milligrams per kilogram (mg/kg). The mercury MDL was 0.1 mg/kg. The MDL for selenium ranged from 0.5 to 1.6 mg/kg.

The SNL/NM Sample Management Office conducted Data Validation I and Data Validation II reviews in accordance with Technical Operating Procedure 94-03. Rev. 0 (SNL/NM July 1994). An independent review of the validation process confirmed that the reviews performed by SNL/NM were accurate and that the data are acceptable for use in the NFA proposal for SWMU 275. The data quality objectives (DQOs) for SWMU 275 have been met.

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

III.1 Introduction

The determination of the nature, rate and extent of contamination at SWMU 275 was based upon an initial conceptual model validated by confirmatory sampling at the site. The conceptual model was developed from historical background information including site inspections,

personnel interviews, historical aerial photograph review, active soil vapor surveys, and passive soil vapor surveys. The DQOs are contained in a Record of Verbal Communication with EPA Region VI (Dawson January 1995) that identified the sample locations, sample density, sample depths, and analytical requirements. The sample data were subsequently used to develop the final conceptual model for SWMU 275, presented in Section 2.5 of the associated No Further Action (NFA) proposal. The quality of the data specifically used to determine the nature, rate, and extent of contamination are described below.

III.2 Nature of Contamination

The nature of contamination at SWMU 275 was determined with analytical testing of soil media and the potential for degradation of relevant COCs (Section V). The analytical requirements included VOCs, SVOCs, total petroleum hydrocarbons (TPH) (one sample), and RCRA metals to characterize nonradiological organic and inorganic constituents potentially released at the site. Gamma spectroscopy was used to characterize miscellaneous radionuclides. Tritium analysis was also performed on samples from SWMU 275. These analytes and methods are appropriate to characterize the COCs and potential degradation products associated with the historical activities at SWMU 275.

III.3 Rate of Contaminant Migration

SWMU 275 is an inactive site, therefore all primary sources of COCs (disposal of liquid waste to septic tanks and seepage pits) have been removed. Only secondary sources of COCs in soil remain at SWMU 275. The rate of COC migration is dependent predominantly on site meteorological and subsurface hydrologic processes as described in Section V. Data available from the Site-Wide Hydrogeologic Characterization Project (published annually); numerous SNL/NM air, surface water, and radiological monitoring programs; biological surveys; and other governmental atmospheric monitoring at the Kirtland Air Force Base (i.e., National Oceanographic and Atmospheric Administration) are adequate to estimate the rate of COC migration at SWMU 275.

III.4 Extent of Contamination

Subsurface soil samples were collected during the drilling of borehole TAV-BH-01, located in the center of the 0.26-acre seepage pits area at SWMU 275. A uniform distribution of COCs at SWMU 275 is expected due to the materials from the septic tanks through the distribution box and into the seepage pits. Because the waste entered the septic tanks prior to distribution to the seepage pits, COCs at SWMU 275 were potentially homogenized. A single boring in the center of the seepage pits area would therefore determine the potential extent of vertical contamination from the seepage pits to the groundwater. Because the borehole was located in the center of the seepage pits, maximum concentrations of COCs at this location would be expected.

Because of the relatively low solubility of most metals and organic compounds, and isolated lithologic units of low to very low permeabilities encountered during drilling activities, the vertical rate of migration is expected to be low. The first sample collected was from 10 feet bgs and

was analyzed for radionuclides. From 10 feet bgs to 100 feet bgs, samples were collected from most 10-foot intervals and were analyzed for VOCs, SVOCs, metals, and radionuclides. From 120 to 480 feet bgs, samples were collected from selected 20-foot intervals and were analyzed mainly for VOCs and tritium. One sample (from 490 feet bgs) was also analyzed for TPH. The sample collection protocol used at SWMU 275 is appropriate for the media potentially impacted by the site activities and is sufficient to determine the vertical extent of COC migration.

In summary, the design of the confirmatory sampling was appropriate and adequate to determine the nature, rate, and extent of contamination.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities are used to a limited extent 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 SWMU 275 NFA proposal. Generally, COCs evaluated in this risk assessment include all detected organics and radiological contaminants and all inorganic COCs that were analyzed for. If the detection limit of an organic compound was too high (could possibly cause an adverse effect to human health or the environment), the compound was retained. Nondetect organics that were not included in this assessment were determined to have low enough detection limits to ensure protection of human health and the environment. 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. The approved SNL/NM maximum background concentration (Dinwiddie September 1997) was selected to provide the background screen in Tables 3 and 4. If applicable, human health nonradiological COCs were also compared to proposed RCRA Subpart S action levels (Table 3) (IT July 1994).

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

Nonradiological COCs for Human Health and Ecological Risk Assessment at SWMU 275 are listed in Table 3. Radiological COCs are listed in Table 4. All tables show the associated approved SNL/NM maximum background concentration values (Dinwiddie September 1997). Discussion of Tables 3 and 4 is provided in Sections VI.4 and VII.2. All samples were collected at 5 feet bgs or deeper; therefore, evaluation of ecological risk was not performed.

V. Fate and Transport

The primary releases of COCs at SWMU 275 were to the subsurface soil in association with waste water discharges from a septic system that was abandoned in 1992. It is estimated that 3,000 to 5,000 gallons of water were disposed into these pits on a daily basis between the early 1960s and 1992. The COCs may have migrated through the soil from the point of release as the water migrated. The migration of water would be principally downward (with gravity),

Table 3
Nonradiological COCs for Human Health Risk Assessment at SWMU 275 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC Name	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg) ^a	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K _{ow} (for organic COCs)	Is COC a Bioaccumulator? ^b (BCF > 40, log K _{ow} > 4)
Arsenic	4.7	4.4	No	44 ^c	NA	Yes
Barium	120	214	Yes	170 ^d	NA	Yes
Beryllium	0.66	0.65	No	19 ^e	NA	No
Cadmium	0.5 ^f	0.9	Yes	64 ^c	NA	Yes
Chromium, total	19.5	15.9	No	16 ^c	NA	No
Cobalt	6.6	5.2	No	10,000 ^g	NA	Yes
Lead	64.6	11.8	No	49 ^c	NA	Yes
Mercury	0.065 J	<0.1	Unknown	5500 ^c	NA	Yes
Selenium	0.8 ^h	<1	Unknown	800 ^g	NA	Yes
Silver	1 ⁱ	<1	No	0.5 ^c	NA	No
Acetone	0.034 B	NA	NA	0.69 ^h	-0.24 ^h	No
2-Hexanone	0.006 J	NA	NA	6 ⁱ	1.38 ⁱ	No
Methyl isobutyl ketone	0.0042 J	NA	NA	5 ^h	1.19 ^h	No
Methylene chloride	0.0047 J	NA	NA	5 ^h	1.25 ^h	No
Bis(2-ethylhexyl) phthalate	0.066 J	NA	NA	851 ⁱ	7.6 ^k	Yes
N-nitrosodiphenylamine	14	NA	NA	217 ^k	3.13 ^k	Yes
N-nitrosodipropylamine	0.13 J	NA	NA	3.2 ^l	1.4 ^l	No
Di-n-butyl phthalate	0.081 J	NA	NA	6,761 ⁱ	4.61 ^k	Yes

B = Analyte detected in associated blank.

BCF = Bioconcentration factor.

COC = Constituent of concern.

J = Estimated concentration.

K_{ow} = Octanol-water partition coefficient.

Log = Logarithm (base 10).

mg/kg = Milligrams per kilogram.

NA = Not applicable.

NMED = New Mexico Environment Department.

SNL/NM = Sandia National Laboratories/New Mexico.

SWMU = Solid waste management unit.

^aFrom Dinwiddie (September 1997) Southwest Test Area.

^bBased upon NMED criteria (NMED March 1998).

^cBCF and/or Log K_{ow} from Yanicak (March 1997).

^dBCF from Neumann (1976).

^eCOC not detected, concentration assumed to be one-half of the highest detection limit.

^fBCF from Vanderploeg et al. (1975).

^gBCF from Callahan et al. (1979).

^hBCF and/or Log K_{ow} from Howard (1990).

ⁱBCF and/or Log K_{ow} from Howard (1993).

^jBCF and/or Log K_{ow} from Howard (1989).

^kBCF and/or Log K_{ow} from NLM (1998).

^lBCF and/or Log K_{ow} from EPA (1995).

Table 4
Radiological COCs for Human Health at SWMU 275 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC Name	Maximum Concentration (pCi/g)	SNL/NM Background Concentration (pCi/g) ^a	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background ^a Screening Value?	BCF (maximum aquatic)	Is COC a Bioaccumulator? ^b (BCF > 40, log K _{ow} > 4)
Cs-137	0.14	0.079	No	3000 ^c	Yes
U-238	4.75 (ND)	1.4	No	900 ^c	Yes
U-235	0.06 ^d	0.16	Yes	900 ^c	Yes
U-234	0.59 ^d	1.6	Yes	900 ^c	Yes
H-3	0.07	0.043	No	Not a bioaccumulator	No

^aFrom Dinwiddle (September 1997), Southwest Test Area.

^bBased upon NMED Criteria (NMED March 1998).

^cFrom Baker and Soldat (1992).

^dU-234 and U-235 values were calculated using the U-238 concentration and assuming that the U-238 to U-234 ratio was equal to that detected during waste characterization of depleted uranium-contaminated soils generated during the radiological voluntary corrective measures project, where U-234=U-238/8 and U-235=U-238/73 (Brown January 1998).

BCF = Bioconcentration factor.

COC = Constituent of concern.

K_{ow} = Octanol-water partition coefficient.

Log = Logarithm (base 10).

MDA = Minimum detectable activity.

NA = Not applicable.

ND = Not detected. Value shown is sample MDA. Although not actually quantified, MDA value will be the assumed concentration for this screening exercise.

pCi/g = Picocuries per gram.

SNL/NM = Sandia National Laboratories/New Mexico.

SWMU = Solid waste management unit.

although some lateral and upward migration (capillary flow) is also expected to have occurred. Upward migration due to capillary flow, however, is not expected to be sufficient to reach surface soils. The groundwater at SWMU 275 is approximately 500 feet bgs. Currently, water is received at the site as precipitation (rain or occasionally snow). The average annual precipitation in this area is about 8 inches (NOAA 1990) and the evapotranspiration value is ... 95 percent of the total rainfall (Thomson and Smith 1985). Therefore, it is also unlikely that the infiltration and percolation of precipitation at the site will be sufficient to reach groundwater. Volatile COCs can migrate by diffusion through the pore space of soil in vapor phase and may migrate beyond the area of subsurface-water migration. The site is currently covered with gravel and contains no vegetative cover or habitat that supports wildlife. Therefore, food chain uptake is not a potential mechanism of transport at this site.

Degradation of COCs at SWMU 275 may result from biotic (microbial) or abiotic processes. The COCs at this site include organic and inorganic analytes, and radionuclides. Degradation processes for organic COCs may include hydrolysis and biotransformation. Hydrolysis includes chemical transformations in water, and may occur in the soil solution. Biotransformation is the metabolization of COCs in biota (microorganisms). Inorganic COCs are considered elemental in form, and therefore are not considered to be degradable. Radiological COCs are also elemental, but will undergo decay to stable isotopes or radioactive daughter elements.

Table 5 summarizes the fate and transport processes that may occur at SWMU 275. Because the release of COCs was to subsurface soil and the site does not contain vegetation, the potential for transport by wind, surface water, and food chain uptake is negligible. Because no additional discharges of water from the septic system are occurring, COCs are not expected to migrate further through soil due to water migration. Low annual precipitation and high evaporation rates make it unlikely that the percolation of rainwater will result in significant migration of COCs to groundwater. VOCs and SVOCs may migrate in vapor phase. Degradation of these compounds may occur by hydrolysis and biotransformation; however, these processes are likely to be slow in subsurface soil. Inorganic COCs are unlikely to migrate further and no degradation of these COCs is expected. Loss of radiological COCs through decay will be insignificant due to the long half-lives of the radionuclides.

Table 5
Summary of Fate and Transport at SWMU 275

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

SWMU = Solid waste management unit.

VI. Human Health Risk Screening Assessment

VI.1 Introduction

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

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

VI.2 Step 1. Site Data

The description and history for SWMU 275 is provided in Section I. Comparison of results to DQOs is presented in Section II. The determination of the nature, rate, and extent of contamination is described in Section III.

VI.3 Step 2. Pathway Identification

SWMU 275 has been designated a future land-use scenario of industrial (DOE et al. September 1995) (see Appendix 1 for default exposure pathways and parameters). Because of the location and the characteristics of the potential contaminants, the primary pathway for human

exposure is considered to be soil ingestion for the nonradiological COCs and, for the radiological COCs, direct gamma exposure. The inhalation pathway for both nonradiological and radiological COCs is included because of the potential to inhale dust and volatiles (nonradiological constituents only). Soil ingestion is included for the radiological COCs as well. No water pathways to the groundwater are considered. Depth to groundwater at SWMU 275 is approximately 500 feet bgs. Because of the lack of surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered not to be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate for the industrial land-use scenario. However, plant uptake is considered for the residential land-use scenario, per New Mexico Environment Department (NMED) guidance.

Pathway Identification

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

VI.4 Step 3. COC Screening Procedures

Step 3 is discussed in this section and includes two screening procedures. The first screening procedure is a comparison of the maximum COC concentration to the approved background screening level. The second screening procedure compares maximum COC concentrations to proposed RCRA Subpart S action levels. This second procedure is applied only to COCs that are not eliminated during the first screening procedure.

VI.4.1 Background Screening Procedure

VI.4.1.1 Methodology

Maximum concentrations of COCs are compared to the approved SNL/NM maximum screening level for this area (Dinwiddie September 1997). The approved SNL/NM maximum background concentration is selected to provide the background screen in Table 3 and used to calculate risk attributable to background in Table 9. Only the COCs that are above their respective SNL/NM maximum background screening level or do not have a quantifiable background screening level are considered in further risk assessment analyses.

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

assessment at their maximum levels. The resultant radiological COCs remaining after this step are referred to as background-adjusted radiological COCs.

VI.4.1.2 Results

Tables 3 and 4 present a comparison of SWMU 275 maximum COC concentrations to the approved SNL/NM maximum background values (Dinwiddie September 1997) for human health risk assessment. For the nonradiological COCs, six constituents have maximum measured values greater than their respective background screening levels. Two other nonradiological COCs do not have quantifiable background concentrations, so it is not known whether those COCs exceeded background. Eight COCs are organic compounds and do not have background screening levels.

The maximum concentration value for lead is 64.6 mg/kg. The EPA intentionally provides no human health toxicological data on lead, and therefore no risk parameter values can be calculated. However, EPA Region 6 guidance for the screening value for lead for an industrial land-use scenario is 2,000 mg/kg (EPA 1996a); for a residential land-use scenario, the EPA screening guidance value is 400 mg/kg (EPA July 1994). The maximum concentration value for lead at this site is less than both screening values, and therefore lead is eliminated from further consideration in the human health risk assessment.

For the radiological COCs, only cesium-137 exceeded the SNL/NM background screening values (subsurface value) (Table 4). However, in all cases the minimum detectable activity (MDA) of the sample exceeded the SNL/NM background value for uranium. Therefore, the highest value of MDA was reported and assumed to be the actual concentration. In this case, U-238 and Cs-137 were the only radiological COCs that were subject to the RESRAD analysis.

VI.4.2 Subpart S Screening Procedure

VI.4.2.1 Methodology

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

VI.4.2.2 Results

Because the SWMU 275 sample set has more than ten COCs that continue past the first screening level (including COCs that have no background screening values), the proposed

Subpart S screening process was not performed. All COCs not eliminated during the background screening process for SWMU 275 have a calculated hazard quotient (HQ) and excess cancer risk value.

Radiological COCs do not have predetermined action levels analogous to proposed Subpart S levels, and therefore this step in the screening process is not performed for radiological COCs.

VI.5 Step 4. Identification of Toxicological Parameters

Tables 6 (nonradiological) and 7 (radiological) show the COCs retained in the risk assessment and the values for the available toxicological information. The toxicological values used for nonradiological COCs in Table 6 are from the Integrated Risk Information System (IRIS) (EPA 1998), Health Effects Assessment Summary Tables (HEAST) (EPA 1997a), EPA Region 9 (EPA 1996b), or EPA Region 3 (EPA 1997b) databases. Dose conversion factors (DCF) used in determining the excess TEDE values for radiological COCs for the individual pathways were the default values provided in the RESRAD computer code (Yu et al. 1993b) as developed in the following documents:

- DCFs for ingestion and inhalation are taken from Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion (EPA 1988).
- DCFs for surface contamination (contamination on the surface of the site) were taken from DOE/EH-0070, External Dose-Rate Conversion Factors for Calculation of Dose to the Public (DOE 1988).
- DCFs for volume contamination (exposure to contamination deeper than the immediate surface of the site) were calculated using the methods discussed in "Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil" (Health Physics 28:193-205 [Kocher 1983]), and ANL/EAIS-8, "Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil" (Yu et al. 1993b).

VI.6 Step 5. Exposure Assessment and Risk Characterization

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

VI.6.1 Exposure Assessment

Appendix 1 shows the equations and parameter input values used in calculating intake values and subsequent HI and excess cancer risk values for the individual exposure pathways. The appendix shows parameters for both industrial and residential land-use scenarios. The equations for nonradiological COCs are based upon RAGS (EPA 1989). Parameters are based

Table 6
Toxicological Parameter Values for SWMU 275 Nonradiological COCs

COC Name	RfD _o (mg/kg-day)	Confidence ^a	RfD _{inh} (mg/kg-day)	Confidence ^a	SF _o (mg/kg-day) ⁻¹	SF _{inh} (mg/kg-day) ⁻¹	Cancer Class ^b
Arsenic	3E-4 ^c	M	--	--	1.5E+0 ^c	1.5E+1 ^c	A
Beryllium	3E-3 ^c	L to M	5.7E-6 ^c	M	--	8.4E+0	B1
Chromium III	1E+0 ^c	L	5.7E-7 ^a	--	--	--	--
Chromium VI	5E-3 ^c	L	--	--	--	4.2E+1 ^c	A
Cobalt	6E-2 ^f	--	2.9E-4 ^f	--	--	--	--
Mercury	3E-4 ^d	--	8.6E-5 ^c	M	--	--	D
Selenium	5E-3 ^c	H	--	--	--	--	D
Silver	5E-3 ^c	L	--	--	--	--	D
Acetone	1E-1 ^c	L	1E-1 ^f	--	--	--	D
2-Hexanone	4E-2 ^a	--	--	--	--	--	--
Methyl isobutyl ketone	8E-2 ^d	--	2.3E-2 ^f	--	--	--	--
Methylene chloride	6E-2 ^c	M	8.6E-1 ^d	--	7.5E-3 ^c	1.7E-3 ^c	B2
bis (2-ethylhexyl) phthalate	2E-2 ^f	--	2.2E-2 ^f	--	1.4E-2 ^f	1.4E-2 ^f	--
n-Nitrosodiphenylamine	--	--	--	--	4.9E-3 ^c	4.9E-3 ^f	B2
n-Nitrosodipropylamine	--	--	--	--	7E+0 ^c	7E+0 ^f	B2
Di-n-butyl phthalate	1E-1 ^c	L	1E-1 ^f	--	--	--	D

^aConfidence associated with IRIS (EPA 1998) database values (L = low, M = medium, H = high).

^bEPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 1998):

A - human carcinogen.

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

D - not classifiable as to human carcinogenicity.

^cToxicological parameter values from IRIS electronic database (EPA 1998).

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

^eToxicological parameter values from EPA Region 3 (EPA 1997b).

^fToxicological parameter values from EPA Region 9 (EPA 1996b).

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

HEAST = Health Effects Assessment Summary Tables.

IRIS = Integrated Risk Information System.

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

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

RfD_{inh} = Inhalation chronic reference dose.

RfD_o = Oral chronic reference dose.

SF_{inh} = Inhalation slope factor.

SF_o = Oral slope factor.

SWMU = Solid waste management unit.

-- = Information not available.

Table 7
Toxicological Parameter Values for SWMU 275 Radiological COCs Obtained from
RESRAD Risk Coefficients^a

COC Name	SF_o (1/pCi)	SF_{inh} (1/pCi)	SF_{ev} (g/pCi-yr)	Cancer Class^b
Cs-137	3.20E-11	1.90E-11	2.10E-06	A
U-238	6.2E-11	1.20E-08	6.60E-08	A
H-3	7.2E-14	9.6E-14	0.0	A

^aFrom Yu et al. (1993a).

^bEPA weight-of-evidence classification system for carcinogenicity (EPA 1989): A - human carcinogen.

1/pCi = One per picocurie.

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

g/pCi-yr = Gram(s) per picocurie-year.

SF_{ev} = External volume exposure slope factor.

SF_{inh} = Inhalation slope factor.

SF_o = Oral (ingestion) slope factor.

SWMU = Solid waste management unit.

upon information from RAGS (EPA 1989) and other EPA guidance documents and reflect the reasonable maximum exposure (RME) approach advocated by the RAGS (EPA 1989). For radiological COCs, the coded equations provided in RESRAD computer code are used to estimate the incremental TEDE and cancer risk for individual exposure pathways. Further discussion of this process is provided in the Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0 (Yu et al. 1993a).

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

VI.6.2 Risk Characterization

Table 8 shows that for the SWMU 275 nonradiological COCs, the HI value is 0.02, and the excess cancer risk is 4E-6 for the designated industrial land-use scenario. The numbers presented included exposure from soil ingestion and dust and volatile inhalation for the nonradiological COCs. Table 9 shows that assuming the maximum background concentrations of the SWMU 275 associated background constituents, the HI is 0.01, and the excess cancer risk is 2E-6 for the designated industrial land-use scenario.

For the radioactive COCs, contribution from the direct gamma exposure pathway is included. For the industrial land-use scenario, a TEDE was calculated for an industrial office worker who spends a majority of his time indoors and for an industrial worker who splits his time evenly indoors and outdoors on the site. After analyzing these two scenarios, the most conservative is the 50/50 time split. This resulted in an incremental TEDE of 0.12 millirem per year (mrem/yr). In accordance with EPA guidance found in OSWER Directive No.9200-4-18 (EPA 1997c), an

Table 8
Risk Assessment Values for SWMU 275 Nonradiological COCs

COC Name	Maximum Concentration (mg/kg)	Industrial Land-Use Scenario ^a		Residential Land-Use Scenario ^a	
		HI	Cancer Risk	HI	Cancer Risk
Arsenic	4.7	0.02	3E-6	0.27	5E-5
Beryllium	0.66	0.00	3E-10	0.00	5E-10
Chromium, total ^b	19.5	0.00	4E-8	0.02	7E-8
Cobalt	6.6	0.00	--	0.00	--
Mercury	0.065 J	0.00	--	0.11	--
Selenium	0.8 ^c	0.00	--	0.28	--
Silver	1 ^c	0.00	--	0.04	--
Acetone	0.034 B	0.00	--	0.01	--
2-Hexanone	0.006 J	0.00	--	0.00	--
Methyl isobutyl ketone	0.0042 J	0.00	--	0.00	--
Methylene chloride	0.0047 J	0.00	3E-10	0.00	4E-8
bis (2-ethylhexyl) phthalate	0.066 J	0.00	3E-10	0.00	1E-9
n-Nitrosodiphenylamine	14	0.00	3E-8	0.00	6E-6
n-Nitrosodipropylamine	0.13 J	0.00	9E-7	0.00	7E-4
Di-n-butyl phthalate	0.081 J	0.00	--	0.00	--
TOTAL		0.02	4E-6	0.7	8E-4

^aEPA (1989).

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

^cCOC not detected, concentration assumed to be one-half of the detection limit.

B = Analyte detected in associated blank.

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

HI = Hazard index.

J = Estimated.

mg/kg = Milligram(s) per kilogram.

SWMU = Solid waste management unit.

-- = Information not available.

Table 9
Risk Assessment Values for SWMU 275 Nonradiological Background Constituents

COC Name	Background Concentration ^a (mg/kg)	Industrial Land- Use Scenario ^b		Residential Land- Use Scenario ^b	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	4.4	0.01	2E-6	0.25	5E-5
Beryllium	0.65	0.00	3E-10	0.00	5E-10
Chromium, total ^c	15.9	0.00	--	0.01	--
Cobalt	5.2	0.00	--	0.00	--
Mercury	<0.1	--	--	--	--
Selenium	<1	--	--	--	--
Silver	<1	--	--	--	--
TOTAL		0.01	2E-6	0.3	5E-5

^aFrom Dinwiddie (September 1997), Southwest Test Area.

^bEPA (1989).

^cChromium, total assumed to be chromium III.

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

mg/kg = Milligram(s) per kilogram

SWMU = Solid waste management unit.

-- = Information not available.

incremental TEDE of 15 mrem/yr is used for the probable land-use scenario (industrial in this case); the calculated dose value for SWMU 275 for the industrial land use is well below this guideline. The estimated excess cancer risk is 1.4E-6.

For the residential land-use scenario nonradiological COCs, the HI value increases to 0.7, and the excess cancer risk is 8E-4 (Table 8). The numbers presented include 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, New Mexico, to be eroded and, subsequently, for dust to be present in predominantly residential areas. Because of the nature of the local soil, other exposure pathways are not considered (see Appendix 1). Table 9 shows that for the SWMU 275 associated background constituents, the HI is 0.3, and the excess cancer risk is 5E-5.

For the radiological COCs, the incremental TEDE for the residential land-use scenario is 0.34 mrem/yr. The guideline being used is an excess TEDE of 75 mrem/yr (SNL/NM February 1998) for a complete loss of institutional controls (residential land use in this case); the calculated dose value for SWMU 275 for the residential land-use is well below this guideline. Consequently, SWMU 275 is eligible for unrestricted radiological release as the residential land-use scenario resulted in an incremental TEDE to the on-site receptor of less than 75 mrem/yr. The estimated excess cancer risk is 4.3E-6. The excess cancer risk from the nonradiological COCs and the radiological COCs is not additive, as noted in RAGS (EPA 1989).

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

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

For the industrial land-use scenario nonradiological COCs, the HI calculated is 0.02 (much less than the numerical guideline of 1 suggested in RAGS [EPA 1989]). The excess cancer risk is estimated at $4E-6$. Guidance from the NMED indicates that excess lifetime risk of developing cancer by an individual must be less than $1E-6$ for Class A and B carcinogens and less than $1E-5$ for Class C carcinogens (NMED March 1998). The excess cancer risk is driven by arsenic which is a Class A carcinogen. Thus, the total excess cancer risk for this site is above the suggested acceptable risk value of $1E-6$.

This risk assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the industrial and residential land-use scenarios. For nonradiological COCs, assuming the industrial land-use scenario, the HI is 0.01. The excess cancer risk is estimated at $2E-6$. Incremental risk is determined from subtracting risk associated with background from potential COC risk. These numbers are not rounded before the difference is determined and therefore may appear to be inconsistent with numbers presented in tables and within the text. The incremental HI is 0.01, and the incremental cancer risk is $1.1E-6$ for the industrial land-use scenario.

For radiological COCs in the industrial land-use scenario, the incremental TEDE is 0.12 mrem/yr, which is significantly less than EPA's numerical guideline of 15 mrem/yr. The incremental estimated excess cancer risk is $1.4E-6$.

For the residential land-use scenario nonradiological COCs, the calculated HI is 0.7, which is below the numerical guidance. The excess cancer risk is estimated at $8E-4$. The excess cancer risk is again driven by arsenic which is a Class A carcinogen. Therefore, the total excess cancer risk for this site is above the suggested acceptable risk value of $1E-6$. The HI for associated background for the residential land-use scenario is 0.3. The excess cancer risk is estimated at $5E-5$. The incremental HI is 0.47, and the incremental cancer risk is $7E-4$ for the residential land-use scenario. These incremental risk calculations indicate potentially significant contribution to human health risk from the COCs considering a residential land-use scenario.

The incremental TEDE for a residential land-use scenario from the radiological components is 0.34 mrem/yr, which is significantly less than the numerical guideline of 75 mrem/yr suggested in SNL/NM RESRAD Input Parameter Assumptions and Justification (SNL/NM February 1998). The estimated excess cancer risk is $4.3E-6$.

VI.8 Step 7. Uncertainty Discussion

The nature, rate, and extent of contamination at SWMU 275 were determined using an initial conceptual model validated with confirmatory sampling at the site. The confirmatory sampling was implemented in accordance with the Sampling and Analysis Plan (Dawson January 1995) which is consistent with NMED guidelines (NMED March 1998). The DQOs in the Sampling and Analysis Plan (Dawson January 1995) are appropriate for use in screening risk

assessments. The data collected based upon sample location and depth intervals are representative of the site. The analytical requirements and results satisfy the DQOs. Data quality was validated in accordance with SNL/NM procedures (SNL/NM July 1994) (Annex 2-H). Therefore, there is no uncertainty associated with the data quality used to perform the screening risk assessment at SWMU 275.

Because of the location, history of the site, and future land-use (DOE et al. September 1995), there is low uncertainty in the land-use scenario and the potentially affected populations that were considered in making the risk assessment analysis. Because the COCs are found in soils and because of the location and physical characteristics of the site, there is little uncertainty in the exposure pathways relevant to the analysis.

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

Table 6 shows the uncertainties (confidence) in nonradiological toxicological parameter values. There is a mixture of estimated values and values from IRIS (EPA 1998), HEAST (EPA 1997a), EPA Region 9 (EPA 1996b) and EPA Region 3 (EPA 1997b) electronic databases. Where values are not provided, information is not available from the HEAST (EPA 1997a), IRIS (EPA 1998), or the EPA regions (EPA 1996b and 1997b). Because of the conservative nature of the RME approach, the uncertainties in toxicological values are not expected to be sufficiently high to change the conclusion from the risk assessment analysis.

Incremental excess cancer risk for nonradiological COCs is above the human health acceptable range for the industrial land-use scenario compared to established numerical guidance. The excess cancer risk is driven by arsenic. If the average arsenic concentration (2.5 mg/kg) is used in the risk calculations, the incremental risk ($7E-8$) is below the NMED proposed guidelines. Because the site is adequately characterized, use of average arsenic concentrations is more realistic than use of maximum arsenic concentrations in the risk calculations. Also, the detections occurred at depth, so realistically no inhalation or ingestion exposure pathways exist.

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

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

VI.9 Summary

Inorganic, organic, and radiological COCs have been identified at SWMU 275. Because of the location of the site, the designated industrial land-use scenario, and the nature of contamination, potential exposure pathways identified for this site included soil ingestion and dust and volatile inhalation for chemical constituents, and soil ingestion, dust inhalation, and

direct gamma exposure for radiologicals. Plant uptake was included as an exposure pathway for the residential land-use scenario.

Using conservative assumptions and employing an RME approach to risk assessment, calculations for nonradiological COCs show that for the industrial land-use scenario the HI of 0.02 is significantly less than the accepted numerical guidance from the EPA. The total excess cancer risk is $4E-6$ and is above the acceptable risk value provided by the NMED for an industrial land use and the presence of a Class A carcinogen (NMED March 1998). The incremental HI is 0.01, and the incremental cancer risk is $1.1E-6$ for the industrial land-use scenario. Incremental excess cancer risk is above proposed guidelines to human health for an industrial land-use scenario. The excess cancer risk is driven by arsenic. If the average concentration (2.5 mg/kg) is used in the risk calculations, the incremental risk ($7E-8$) is below the NMED proposed guidelines. Because the site is adequately characterized, use of average arsenic concentrations is more realistic than use of maximum arsenic concentrations in the risk calculations. Also, the detections occurred at depth so realistically no exposure pathways exist.

Incremental TEDE and corresponding estimated cancer risk from radiological COCs are much less than EPA guidance values; the estimated TEDE is 0.12 mrem/yr for the industrial land-use scenario. This value is much less than the numerical guidance of 15 mrem/yr in EPA guidance (EPA 1997c). The corresponding incremental estimated cancer risk value is $1.4E-6$ for the industrial land-use scenario. Furthermore, the incremental TEDE for the residential land-use scenario that results from a complete loss of institutional control is only 0.34 mrem/year with a corresponding risk of $4.3E-6$. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore SWMU 275 is eligible for unrestricted radiological release.

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

VII. Ecological Risk Screening Assessment

VII.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPEC) in soils at the TA-V seepage pits. A component of the NMED Risk-Based Decision Tree is to conduct an ecological assessment that corresponds with that presented in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997d). The current methodology is tiered and contains an initial scoping assessment, which determines whether further evaluation is warranted for the site. Initial components of NMED's decision tree (a discussion of DQOs, a data assessment, and evaluations of bioaccumulation and fate-and-transport potential) are addressed in the scoping assessment (Section VII.2), with the exception of DQOs, which are reviewed in Section II of this report. At the end of the scoping assessment, a determination is made as to whether a more detailed examination of potential ecological risk is necessary.

VII.2 Scoping Assessment

The scoping assessment focuses primarily on the likelihood of exposure of biota at or adjacent to the site being exposed to constituents associated with site activities. Included in this section are an evaluation of existing data and a comparison of maximum detected concentrations to background concentrations (if applicable), an examination of bioaccumulation potential, and an evaluation of fate-and-transport potential. A Scoping Risk Management Decision will involve a summary of the scoping results and a determination as to whether further examination of potential ecological impacts is necessary.

VII.2.1 Data Assessment

As indicated in Section IV, all COCs at SWMU 275 are at depths greater than 5 feet bgs. For this reason, none of the COCs are considered to be COPECs.

VII.2.2 Bioaccumulation

Because no COCs at SWMU 275 are considered to be COPECs (Section VII.2.1), bioaccumulation potential is not evaluated as part of the ecological risk scoping assessment.

VII.2.3 Fate and Transport Potential

The potential for the COCs to move from the source of contamination to other media or biota is discussed in Section V. As noted in Table 5 (Section V), COCs at this site were released to subsurface soil (>5 feet bgs) and no transport mechanism is expected to result in significant upward migration of COCs. SWMU 275 is in TA-V, which is highly developed, and the SWMU is covered by gravel. No ecological receptors or viable habitat to support receptors exist at the site. Therefore, food-chain uptake is not expected to be a potential transport mechanism for COCs associated with this site. For these reasons, no ecological pathways are expected to exist at this site.

VII.2.4 Scoping Risk Management Decision

Based upon information gathered through the scoping assessment, it was concluded that complete ecological pathways do not exist at SWMU 275. For this reason, further evaluation of ecological risk at this site is not warranted.

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**APPENDIX 1
EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL
AND RADIONUCLIDE CONTAMINATION**

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

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

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

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

- Ingestion of contaminated drinking water
- Ingestion of contaminated soil
- Ingestion of contaminated fish and shell fish
- Ingestion of contaminated fruits and vegetables
- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming
- Dermal contact with chemicals in water
- Dermal contact with chemicals in soil
- Inhalation of airborne compounds (vapor phase or particulate)

- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

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

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

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

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

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

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

Equations and Default Parameter Values for Identified Exposure Routes

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation may also be significant for radionuclides. All of the above routes will, however, be considered for their appropriate land use scenarios. The general equations for calculating potential intakes via these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund (RAGS): Volume 1 (EPA 1989a, 1991). These general equations also apply to calculating potential intakes for radionuclides. A more in-depth discussion of the equations

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

used in performing radiological pathway analyses with the RESRAD code may be found in the RESRAD Manual (ANL 1993). Also shown are the default values SNL/NM ER suggests for use in RME risk assessment calculations for industrial, recreational, and residential scenarios, based upon EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants. RESRAD input parameters that are left as the default values provided with the code are not discussed. Further information relating to these parameters may be found in the RESRAD Manual (ANL 1993).

Generic Equation for Calculation of Risk Parameter Values

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

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

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

where

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

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

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the constituents of concern (COC) present at the site. This estimate

is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk range of 10^{-4} to 10^{-6} . The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the HI) for the toxicity resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of this quantitative estimate with the EPA standard HI of unity (1). The evaluation of the health hazard due to radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site.

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

Summary

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

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DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

Table 2
Default Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency (day/yr)	***	***	***
Exposure duration (yr)	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 day/yr)	25550 ^a	25550 ^a	25550 ^a
for noncarcinogenic compounds (= ED x 365 day/yr)	10950	10950	10950
Soil Ingestion Pathway			
Ingestion rate	100 mg/day ^c	6.24 g/yr ^d	114 mg-yr/kg-day ^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/day)	2 ^{a,b}	2 ^{a,b}	2 ^{a,b}
Food Ingestion Pathway			
Ingestion rate (kg/yr)	NA	NA	138 ^{b,d}
Fraction ingested	NA	NA	0.25 ^{b,d}
Dermal Pathway			
Surface area in water (m ²)	2 ^{b,e}	2 ^{b,e}	2 ^{b,e}
Surface area in soil (m ²)	0.53 ^{b,e}	0.53 ^{b,e}	0.53 ^{b,e}
Permeability coefficient	chemical specific	chemical specific	chemical specific

***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 hr/day for 250 day/yr; for the recreational land use, a value of 2 hr/wk for 52 wk/yr is used (EPA 1989b); for a residential land use, all contact rates are given per day for 350 day/yr.

^aRAGS, Vol 1, Part B (EPA 1991).

^bExposure Factors Handbook (EPA 1989b)

^cEPA Region VI guidance.

^dFor radionuclides, RESRAD (ANL 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.

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