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1991 ENVIRONMENTAL MONITORING REPORT SANDIA NATIONAL LABORATORIES ALBUQUERQUE, NEW MEXICO

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ABSTRACT

This 1991 report contains monitoring data from routine radiological and nonradiological environmental surveillance activities. Summaries of significant environmental compliance programs in progress such as National Environmental Policy Act (NEPA) documentation, environmental permits, environmental restoration (ER), and various waste management programs for Sandia National Laboratories in Albuquerque (SNL, Albuquerque) are included. The maximum offsite dose impact was calculated to be 1.3 x 10^{-3} mrem. The total population within a 50-mile radius of SNL, Albuquerque, received a collective dose of 0.53 person-rem during 1991 from SNL, Albuquerque, operations. As in the previous year, the 1991 operations at SNL, Albuquerque, had no discernible impact on the general public or on the environment. This report is prepared for the U.S. Department of Energy (DOE) in compliance with DOE Order 5400.1.

ACKNOWLEDGMENTS

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NOTE TO THE READER

The Sandia National Laboratories organization structure contained in this document changed effective April 1, 1992. Since this document was initiated prior to the change date, the former organization structure is used within this document. For reference to the new organization structure, see the following list:

FROM	TO
Directorate	Center
Division	Department
Department	Eliminated

CONTENTS

CONTENTS
(Continued)

CONTENTS
(Concluded)

FIGURES

FIGURES
(Concluded)

TABLES

TABLES
(Continued)

TABLES
(Continued)

TABLES
(Continued)

TABLES
(Concluded)

ABBREVIATIONS

International System Prefixes

Exponent	Prefix	Symbol
10^{6}	mega	M
10^{3}	kilo	K
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

Units

°C	Celsius degree
cm	centimeter
ft	feet
g	gram
gal	gallon
gpd	gallons per day
gpm	gallons per min
[illegible]	hour
[illegible]	10,000 square meters
in.	inch
J	Joule
kg	kilogram
km	kilometers
L	liter
lb	pound
lps	liters per second
m	meter
mi	mile
min	minute
ml	milliliter
ppb	parts per billion
ppm	parts per million
psi	pounds per square inch
qt	quart
s	second
TPY	tons per year
yr	year
% moisture	weight percent of water

Symbols

>	greater than
<	less than
~	approximately
$\bar{x}$	mean value
P	statistical probability
s	standard deviation
$s_{\bar{x}}$	standard error of the mean

Nuclide Symbols for Frequently Referenced Nuclides and Components

Ar	argon
^{241}Am	americium-241
Be	beryllium
Cs	cesium
Co	cobalt
^{3}H	tritium
HT	tritiated hydrogen
HTO	tritiated water vapor
K	potassium
Kr	krypton
PCB	polychlorinated biphenyl
Pu	plutonium
^{241}Pu	plutonium-241
S	sulphur
U	uranium
^{238}U	uranium-238 (principal component of depleted uranium [DU])
U_{nat}	natural uranium
U_{tot}	total uranium
Xe	xenon

ABBREVIATIONS (Continued)

Radioactivity Measurements

Ci	Curie (unit of radioactivity)
mR	milliroentgen (unit of radiation exposure)
mrem	millirem (unit of radiation dose)
person-rem	radiation dose to population (also man-rem)
pCi/l	picoCuries/liter
R	roentgen (unit of radiation dosage)
rem	r(oentgen) e(quivalent) m(an) (amount of ionizing radiation required to produce the same biological effect as 1R of high-penetration X-rays)
Sv	sievert (unit of radiation dosage, ~8.38 R)

Water Quality Measurements and Abbreviations

AMSL	above mean sea level
Cl	chloride ion
CN	cyanide
CNamenable	cyanide amenable to chlorination
CN_T	cyanide, total
F	filtered water
K-sat	saturated hydraulic conductivity
MCL	maximum contaminant level
mho	unit of conductance
NAPL	nonaqueous phase liquid
NTU	nephelometric turbidity unit
pH	hydrogen ion concentration, a measure of acidity
S	suspended solids
SP.Cond	specific conductivity (mho/l)
SWL	depth to water below measuring point
T	unfiltered water
TCA	1,1,1-trichloroethane
TCE	trichlorethylene
TDS	total dissolved solids
TOC	total organic carbon
TOX	total organic halogen
TR	trace
TSP	total suspended particulates
TTCE	tetrachloroethene
TTO	total toxic organics
VOC	volatile organic compound
WLEL	water level elevation above mean sea level

Acronyms

ACRR	Annular Core Research Reactor
ADM	Action Description Memorandum
ALARA	as low as reasonably achievable
AL/KAO	Albuquerque/Kirtland Area Office

ABBREVIATIONS
(Continued)

Acronyms

AMO	Albuquerque Microelectronics Operations
ANSI/IEEE	American National Standards Institute/Institute of Electrical and Electronic Engineers
API	American Petroleum Institute
AQCR	Air Quality Control Regulations
AR	averaged replicate
ARAR	Applicable or Relevant and Appropriate Requirements
AT&T	American Telephone & Telegraph
CA	Corrective Action
CAA	Clean Air Act
CAM	continuous air monitor
CAS	chemical abstract service
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERF	Civil Engineer Research Facility
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CNSAC	Center for National Security and Arms Control
CVAA	cold vapor atomic absorption
CWA	Clean Water Act
CWL	chemical waste landfill
CY	calendar year
DCP	direct current plasma
DCG	derived concentration guide
DNA	Defense Nuclear Agency
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/AL	DOE Albuquerque Operations Office
DOE/NV	DOE Nevada Operations Office
DOT	U.S. Department of Transportation
DU	depleted uranium
EA	Environmental Assessment
ECL	Environmental Checklist
ECF	Explosive Components Facility
EDE	effective dose equivalent
EIS	Environmental Impact Statement
EIS/ODIS	Effluent Information System/On-Site Discharge Information System
Encotec	Environmental Control Technology Corporation
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ES&H	Environment, Safety and Health
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FY	fiscal year
GC	gas chromatography

ABBREVIATIONS (Continued)

Acronyms

GFAA	graphite furnace atomic adsorption
GPP	General Plant Projects
HC	hydrocarbon
HCF	Hot Cell Facility
HEPA	high-efficiency particulates in air
HIIIA	HERMES-III Accelerator
HWDMS	Hazardous Waste Data Management System
HWMF	Hazardous Waste Management Facility
IC	ion chromatography
ICP	inductive coupled plasma
IDP	Integrated Demonstration Program
IMRL	Integrated Materials Research Laboratory
IT	International Technology Corporation
IT/AS	International Technology Corporation, Analytical Services
ITRI	Inhalation Toxicology Research Institute
IS	ion selective probe
KAFB	Kirtland Air Force Base
KUMSC	U.S. Army Field Offices
LANL	Los Alamos National Laboratory
LATA	Los Alamos Technical Associates
LDR	Land Disposal Restriction
LIHE	light initiated high explosives
LLW	low-level radioactive waste
MAP	Mitigation Action Plan
MCA	multichannel analyzer
MDL	minimum detection level
MOU	Memorandum of Understanding
MS	mass spectrometry
MSDS	Material Safety Data Sheet
MTF	memo-to-file
MW	mixed waste
MWL	mixed waste landfill
NAAQS	National Ambient Air Quality Standards
NBS	National Bureau of Standards
NCC	National Climatic Center
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGTF	Neutron Generator Test Facility
NIST	National Institute of Standards (formerly NBS)
NMED	New Mexico Environment Department
NMWQA	New Mexico Water Quality Authority
NMWQCC	New Mexico Water Quality Control Commission
NMWQR	New Mexico Water Quality Regulations
NOAA	National Oceanographic and Atmospheric Administration
NOD	Notice of Deficiency

ABBREVIATIONS
(Continued)

Acronyms

NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	National Response Center
NSPS	New Source Performance Standards
NTS	Nevada Test Site
OEL	Occupational Exposure Limit
OSHA	Occupational Safety and Health Administration
OSI	Onsite investigations
OU	operable unit
PA	Preliminary Assessment
PA/SI	Preliminary Assessment/Site Inspection
PBFA-II	Particle Beam Fusion Accelerator-II
PDL	Process Development Laboratory
PEIS	programmatic environmental impact statement
PETL	Processing and Environmental Technology Laboratory
PM	particulate matter
PMRF	Pacific Missile Range Facility
POTW	publicly-owned treatment works
PWA	process waste assessment
QA	quality assurance
QC	quality control
R&D	research and development
RAM	radiological air monitor
RCRA	Resource Conservation and Recovery Act
REECo	Reynold Electric and Engineering Company
RMWMF	Radioactive and Mixed Waste Management Facility
RPD	relative percent difference
RQ	reportable quantity
RSI	RCRA Site Investigation
RTC	Reactor Technology Center
SARA	Superfund Amendment and Reauthorization Act
SASN	silver acetylide-silver nitrate
SC	Special-case waste
SC-COM	special case - commercially held, DOE-owned materials
SC-GTCC	special case - DOE comparable greater-than-Class-C (waste)
SC-HLI	special case - high-level incidental (waste)
SC-PAL	special case - performance assessment limiting (waste)
SC-TRU	special case - noncertifiable, nontransportable TRU (waste)
SC-US	special case - uncertified or uncharacterized (waste)
SDF	Strategic Defense Facility
SDI	Strategic Defense Initiative
SFER	Small Force Engagement Range
SIC	Standard Industrial Classification
SNL	Sandia National Laboratories
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control and Countermeasure

ABBREVIATIONS
(Concluded)

<u>Acronyms</u>

SPR	Sandia Pulsed Reactor
STL	Simulation Technology Laboratory
SWMU	Solid Waste Management Unit
TA	Technical Area
TCLP	toxicity characteristics leaching procedure
TLD	thermoluminescent dosimeter
TRU	transuranic
TSCA	Toxic Substances Control Act
TSDF	Treatment Storage and Disposal Facility
TTF	Thermal Treatment Facility
TTR	Tonopah Test Range
UST	underground storage tank
USGS	United States Geological Survey
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
WIPPWAC	Waste Isolation Pilot Program Waste Acceptance Criteria
WMOA	waste minimization opportunity assessment
XRF	X-ray fluorescence

CHAPTER 1

EXECUTIVE SUMMARY

1.1 Assessment of Radiological Impact for the Public

Sandia National Laboratories (SNL), Albuquerque, is located southeast of Albuquerque on Kirtland Air Force Base (KAFB). Because radionuclides are potentially released in small quantities from its research activities to offsite areas, SNL, Albuquerque, has maintained an environmental monitoring program for radiological sampling and surveillance. The program includes annual sampling and analysis of soil and vegetation for tritium (^{3}H); soil is also monitored for uranium (U) and cesium (^{137}Cs). Also, gross alpha, beta, and gamma screening analysis and U and ^{3}H analyses are performed water samples. Environmental thermoluminescent dosimeters (TLDs) are used to measure gamma radiation. These sampling and analyses are performed at SNL, Albuquerque, onsite and perimeter locations, and at community locations. The majority of the onsite radionuclide concentrations measured in 1991 were consistent with historical values and also consistent with local background values measured in 1991 and in previous years.

A total of 3.54 Ci of argon-41 (^{41}Ar), 0.5 Ci of krypton-85 (^{85}Kr), approximately 0.2 Ci each of nitrogen-13 (^{13}N) and oxygen-15 (^{15}O), and 0.02 Ci of ^{3}H were released as a result of SNL, Albuquerque, operations in 1991. The maximum effective dose equivalent calculated for an offsite residence is 1.4×10^{-3} mrem, or 0.01 percent of the 10 mrem/yr dose limit specified in the National Emission Standards for Hazardous Air Pollutants (NESHAP) and DOE orders (see Appendix G, Table G-1). The total Albuquerque population received a collective dose of 0.52 person-rem during 1991 from SNL, Albuquerque, operations, whereas it received greater than 57,000 person-rem from natural background radiation (see Chapter 5).

1.2 Overview of 1991 Monitoring Results

Radiological Monitoring

Most of the 1991 radiological environmental monitoring results were consistent with the results of the previous years, and all were well below the DOE-derived concentration guides (DCGs) specified in DOE Order 5400.5, "Radiological Protection of the Public and the Environment," issued in February 1990.

In 1991, external gamma radiation doses for the Albuquerque community area averaged 91 mrem/yr as measured by the SNL, Albuquerque, environmental TLD monitoring system. This is approximately equal to the natural background radiation dose rate for the region, attributable to terrestrial and cosmic radiation. There was no statistically significant difference among the three groups of monitoring locations (SNL, Albuquerque; perimeter; and community) in the 1991 TLD results (see Chapter 5).

Nonradiological Monitoring

Wastewater--Discharges by SNL, Albuquerque, to publicly owned treatment works (POTW) are regulated by the City of Albuquerque. During 1991, SNL, Albuquerque, operated nine wastewater discharge permits issued by the City of Albuquerque. Five of the nine permits contained provisions for meeting categorical limits established by the EPA. The other four permits operated in 1991 were general discharge permits. The 1991 wastewater monitoring results were within the permit conditions except for minor pH excursions. No pH excursion of wastewater discharges, outside the permitted pH limits, occurred for greater than 1 hr during 1991 with the exception of a 2-hr (approximate) pH excursion that occurred on September 25, 1991, at permit 2069I. Corrective actions were taken immediately after the problems were identified.

More detailed wastewater information can be found in Chapter 6. Complete documentation concerning the wastewater sampling program can be found in the Wastewater Monitoring Program Quarterly Reports on file at SNL, Albuquerque, Environmental Programs Records Center.

Surface Water--Nonsanitary discharges to surface impoundments are under the authority of the State of New Mexico. A Discharge Plan (DP-530) covering two lagoons in Technical Area IV was amended in December 1989 by the state. Quarterly water-level measurements and semiannual analysis were all within the parameters and concentration limits specified in DP-530 with one exception. Chloride concentration in Lagoon I was reported slightly above the New Mexico Quality Control Commission (NMWQCC) standard. No organic compounds were detected in the lagoon samples in 1991.

More detailed information can be found in Chapter 6. The Semiannual Reports for Discharge Plan DP-530 are on file in the SNL, Albuquerque, Environmental Programs Records Center.

Air Quality--Air quality, except for radionuclide emissions, is regulated by the City of Albuquerque. Ambient air monitoring throughout the City is conducted by the Air Pollution Control Division of the City. SNL, Albuquerque, does not maintain any ambient air samplers on the site. A preliminary inventory of air emissions was conducted during 1991 for forty-four hazardous air pollutants (see Chapter 6). The results of the modeling show that none of these sources exceeded the concentration limits specified in the air quality standards. Therefore, none of the existing sources required an air quality permit from the City.

Groundwater Monitoring

The SNL, Albuquerque, Environmental Restoration (ER) Department conducted groundwater monitoring programs during calendar year 1991 at the SNL, Albuquerque, chemical waste landfill (CWL), mixed waste landfill (MWL), and throughout the SNL, Albuquerque/KAFB region. Site-specific groundwater sampling activities were conducted at the CWL and the MWL to satisfy the reporting requirements of 40 CFR 265.94; basewide groundwater sampling was mandated by DOE Order 5400.1. Monthly water-level measurements were also collected as part of an ongoing effort to supplement groundwater monitoring activities of the SNL, Albuquerque, Groundwater Monitoring Program.

SNL, Albuquerque, is located near the east-central edge of the Albuquerque Basin. The geology of the eastern section of the region (including SNL, Albuquerque, and KAFB) exhibits evidence of major faulting. The Hubbell Spring and Sandia Faults are a set of north-south trending faults located in the eastern section of the SNL, Albuquerque/KAFB area, forming a series of down-to-the-west blocks. The basin is filled with a thick sequence of alluvial fan sediments (up to 12,000 ft [3700 m]). This sequence, called the Santa Fe Group, thins toward the edge of the basin and is truncated at the bounding uplifts. Basin-fill alluvial fans of the Santa Fe Group consist of channels, debris flows, and flood plain deposits and are interlayered with eolian deposits.

The regional water table is separated by the faults into a relatively deep region west of the fault complex and a shallower region on the east side. The depth to saturated groundwater underlying SNL, Albuquerque, facilities varies from 50 to 100 ft (15 to 30 m) east of the faults, and from about 380 to 500 ft (116 to 152 m) west of the faults. The hydrogeology east of the fault systems is poorly understood, because there are few monitor wells, and the geology between the fault systems and the canyons of the Manzanita Mountains is complex. The hydraulic gradient is steep across the fault system but flattens rapidly west of the faults. Based on water level data, the apparent direction of groundwater flow across the SNL, Albuquerque/KAFB area is generally westward or northwestward.

Groundwater assessment monitoring activities at the CWL in 1991 were conducted in compliance with the requirements of 40 CFR 265.93(d). Annual sampling for Resource Conservation and Recovery Act (RCRA) Appendix IX parameters took place in February 1991; quarterly assessment monitoring for volatile organic compounds (VOC) was conducted in May, August, and November 1991. Analytical results from the annual Appendix IX sampling in February detected nickel at a concentration greater than the maximum contaminant level (MCL) designated in the New Mexico Water Quality Regulations (NMWQR). All other compounds detected in 1991 (acetone, methylene chloride, 2-butanone, 2-hexanone, trichloroethylene [TCE], barium, chromium, copper, and zinc) were at levels below NMWQR MCLs. The presence of some of the volatile organic compounds detected may be attributable to laboratory contamination of samples during analysis.

Groundwater monitoring activities at the MWL in 1991 were conducted with RCRA regulations functioning as applicable or relevant and appropriate requirements (ARAR). Four quarterly sampling events were conducted at the MWL in January, April, July, and October 1991. Of the compounds detected at the MWL in 1991 (barium, chromium, iron, manganese, sodium, chloride, fluoride, nitrate, phenolics, sulfate, and total organic carbons [TOC]), only phenolics were present in concentrations higher than NMWQR MCLs.

Water levels in 35 wells and one spring were measured on a monthly basis in 1991. In addition, the basewide groundwater sampling effort involved sampling 16 wells and four springs on a quarterly basis to establish background hydrogeochemical groundwater characteristics. Samples were collected in April, July, and October 1991 and analyzed for anions (F, Cl, Br, NO_3, SO_4), cations (Mg, Ca, K, Na), alkalinity, pH, and temperature. Preliminary statistical analysis of the data indicates a consistent, statistically significant difference between the groundwater sampled east of the faults compared to groundwater sampled west of the faults.

1.3 Other Compliance Activities

National Environmental Policy Act of 1969 (NEPA)--During 1991, SNL, Albuquerque, NEPA compliance activities focused on preparation for and assistance and response to the DOE Tiger Team NEPA Assessment. A major increase occurred in the number of Environmental Assessments (EAs) under preparation; policies and procedures were further developed to ensure environmental values are considered in the review of SNL, Albuquerque, proposed actions. An EA was approved for the Integrated Materials Research Laboratory (IMRL), a facility designed for materials development, characterization, processing research, and advanced concept development. (For further details, see Chapter 4.) A Finding of No Significant Impact (FONSI) was also issued for the Kauai Test Facility Two Experiment Rocket Campaign EA. (For further details, see Appendix J.)

Resource Conservation and Recovery Act RCRA--SNL, Albuquerque, has an inactive CWL that is permitted under interim status. A closure Plan was first submitted to DOE in May 1988. On February 20, 1992, New Mexico Environment Department (NMED) issued a notice of deficiency (NOD) for the Closure Plan. Revisions were submitted to NMED within the response time and this version of the Closure Plan is currently under review by NMED.

Two minor RCRA violations from the 1991 RCRA inspection were resolved with the NMED. A draft RCRA permit was issued in July 1991 for the Hazardous Waste Management Facility (HWMF) storage activities. Modifications to a RCRA Part B permit application for hazardous wastes were submitted to NMED in June and August 1991. A revised Part A permit application for hazardous waste was prepared and submitted to NMED in September 1991 to include new toxicity characteristics leaching procedures (TCLPs).

An interim status permit was prepared for mixed waste (MW) storage and submitted to the DOE in February 1990. A Part B permit application for MW is being prepared. (For further details, see Chapter 3.)

Low-Level Radioactive Waste and MW Disposal--SNL, Albuquerque, onsite disposal of low-level waste (LLW) was terminated in December 1988 at SNL, Albuquerque, by DOE Orders. Currently, all newly generated LLW and MW is stored temporarily aboveground at permitted generator sites or in transportation containers at the inactive Technical Area III disposal site. Base construction of the Radioactive and Mixed Waste Management Facility (RMWMF) was completed in 1990. This facility is to serve as a centralized packaging and storage facility for LLW and LLW-MW. It is projected that the RMWMF will be operational in 1993. An application was submitted to the Nevada Test Site (NTS) for disposal of both LLW and MW in 1990. The application was reviewed by the DOE Nevada Operations Office and is being revised by SNL, Albuquerque. (For further details, see Chapter 4.)

Permit/Notification

Tables 3-1, 6-1, and 6-7 list the current environmental permits issued to SNL, Albuquerque, and those that are in the process of being reviewed by various agencies. In addition to these environmental permits, notifications were made to the City of Albuquerque regarding asbestos removal (NESHAP, Subpart M). Several projects were evaluated for exemption and applicability of NESHAP, Subpart H, to facilities in Technical Area IV (see Chapter 5) and Technical Area V.

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CHAPTER 2

INTRODUCTION

2.1 Site Operation

SNL, Albuquerque, is operated by Sandia Corporation, a prime contractor of the DOE. Sandia Corporation, which is a subsidiary of AT&T Technologies, Incorporated, provides service to the U.S. Government on a nonprofit, no-fee, and no-loss basis. The major responsibilities are national security and energy projects (ERDA, 1977). Its mission includes the weaponization of nuclear explosives and the designing of arming, fusing, and firing systems used in nuclear bombs and warheads. Safety, reliability, and survivability of weapon systems receive primary emphasis.

Other projects include nuclear reactor safety studies for the U.S. Nuclear Regulatory Commission, development of safe transport and storage systems for special nuclear materials including plutonium (Pu) and uranium (U), radioactive waste disposal techniques and site studies, pulsed power research, thermonuclear fusion research, solar energy research, vertical axis wind turbine research, and fossil fuel and geothermal energy research.

2.2 Location and Population

SNL, Albuquerque, is located in Bernalillo County at the foot of the Manzano Mountains adjacent to Albuquerque, New Mexico. At their nearest points, SNL facilities are 2-1/2 mi south of Interstate 40 and approximately 6-1/2 mi east of downtown Albuquerque (Figure 2-1). The facilities are surrounded by Kirtland Air Force Base (KAFB) East, with co-use agreements on some U.S. Air Force (USAF) property. An area of the Manzano Mountains east of KAFB has been withdrawn from the Forest Service for the exclusive use of the Air Force and the DOE.

The laboratory consists of five technical areas and several remote test areas situated in the eastern half of the 190-km^2 KAFB military reservation. KAFB is located on two broad mesas bisected by the Tijeras Arroyo, an east/west canyon. These mesas are bound by the Manzano Mountains (Cibola National Forest) to the east and the Rio Grande River to the west. Elevations range from 1500 m at the Rio Grande River to 3255 m at Sandia Crest, which is in the Sandia Mountains adjacent to Albuquerque. KAFB is at a mean elevation of 1630 m.

The largest population center in Bernalillo County, and also the closest population center to KAFB, is Albuquerque, located slightly north of the base. The 1990 census figures show an Albuquerque population of 384,736 (U.S. Department of Commerce [DOC], Bureau of the Census, 1991). The Isleta Indian Pueblo, which borders KAFB on the south, is the next nearest population center with a 1980 census of 1872. An estimated total population of 578,313 people live within an 80-km radius of KAFB (DOC, 1991). This includes permanent residents of KAFB living in the KAFB housing areas.

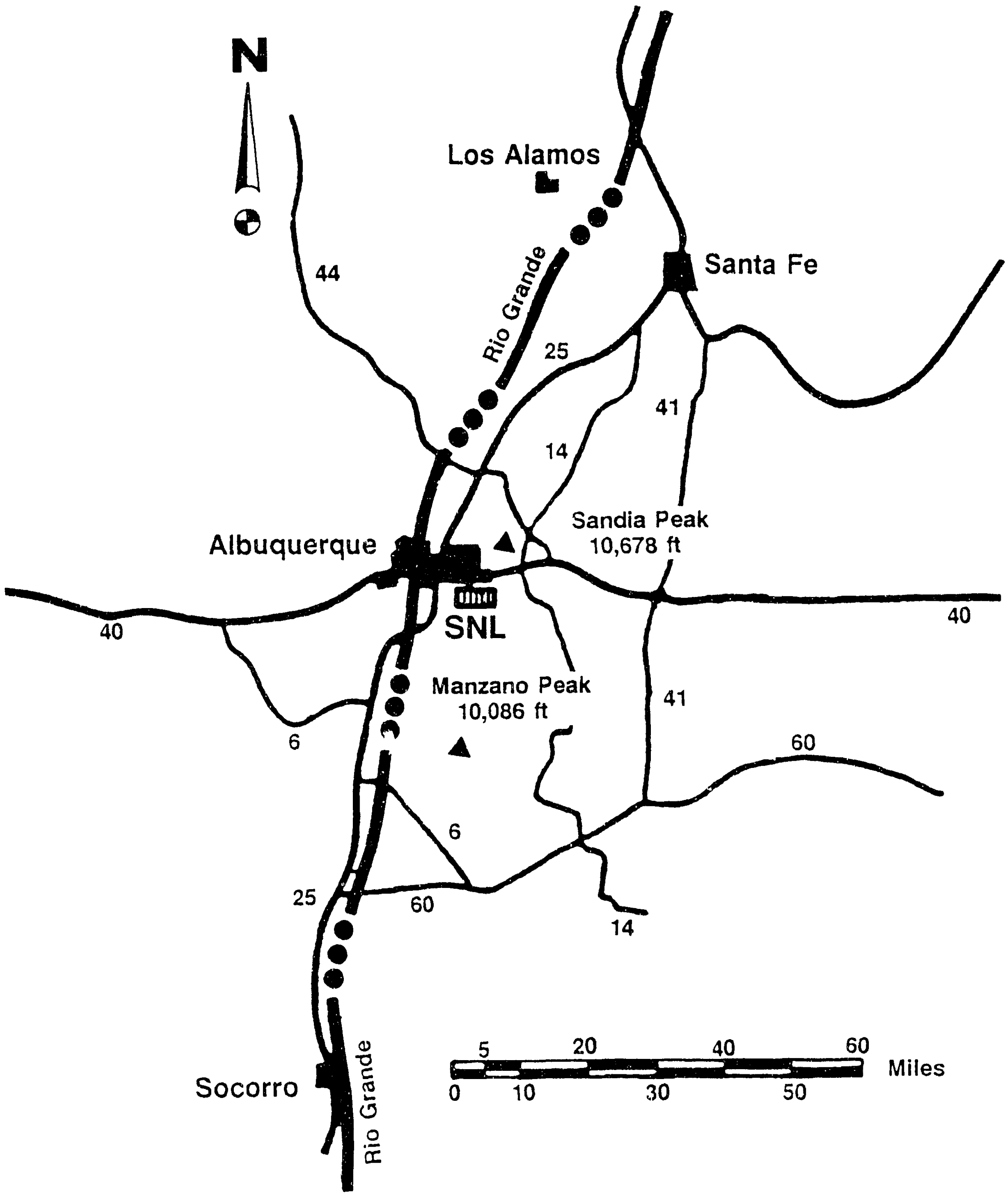

Figure 2-1. Albuquerque Site Regional Setting

2.3 Climate and Meteorology

The Albuquerque-Belen Basin is characterized by low precipitation; wide temperature extremes; frequent, drying winds; heavy rain showers, usually short in duration and often with erosive effects; and erratic, seasonal distribution of precipitation. Albuquerque air temperatures are characteristic of high-altitude, dry, continental climates. Daytime temperatures during the winter average about 10°C, and summer daytime temperatures average less than 32°C, except in July, when the maximum reaches 34°C (see Appendix A, Table A-1). The average annual precipitation is 21 cm; half of this precipitation occurs from July through September in the form of brief thundershowers. Winter months are typically dry with <5 cm of precipitation normally recorded. The average annual relative humidity is approximately 43 percent (Appendix A, Table A-2). Strong winds often accompanied by blowing dust occur mostly in late winter and early spring. The wind speed reaches 13.3 m/s for less than 48 days each year. Prevailing surface winds on KAFB are from the east (Figure 2-2) (Olson et al., 1970).

Table 2-1 summarizes meteorological data for 1991. The 30-yr annual average precipitation is 20.6 cm (see Appendix A, Table A-1).

2.4 Geology

The literature is replete with references on the geology of the Albuquerque Basin (e.g., Lozinsky et al., 1991; Anderholm, 1988; Kelley, 1977; Kelley and Northrop, 1975; and Bjorklund and Maxwell, 1961). The Albuquerque Basin is one of a north-south trending line of basins that make up the Rio Grande Rift Zone. The Rio Grande River enters the basin on the north near White Rock Canyon and flows roughly down the middle of the basin to where it is joined by the Rio Salado at the south end (Figure 2-3). On the east and west, the basin is bounded by uplifted fault blocks. The Sandia, Manzanita, and Manzano Mountains are uplifted on the eastern boundary. The west side of the basin is bounded by the Lucero Uplift and the south side by the Ladron Mountains. There is relatively little topographic relief along the Nacimiento Uplift on the northwest side of the basin. During the Miocene and Pliocene periods, the basin filled with as much as 12,000 ft (3650 m) of sediments eroded from the surrounding highlands. This sequence, called the Santa Fe Group, thins toward the edge of the basin and is truncated at the bounding uplifts. Santa Fe Group sediments are overlain in places by the Pliocene Ortiz gravel and Rio Grande fluvial deposits and are interbedded with Tertiary and Quaternary basalts and pyroclastics. Basin-fill alluvial fans of the Santa Fe Group consist of channels, debris flows, and floodplain deposits and are interlayered with eolian deposits. Grain sizes range from clay to boulders. Stratification can be moderately well-developed, and some graded bedding may occur. Bed thickness varies from inches to feet. Most of the bedding is lenticular with limited areal extent, although channel beds can extend downdip (westward) for long distances. Analyses of sediments collected during past SNL drilling activities have been unconsolidated cobbles, sands, and gravels, with inclusions of silty and clayey lenses intermixed with sand.

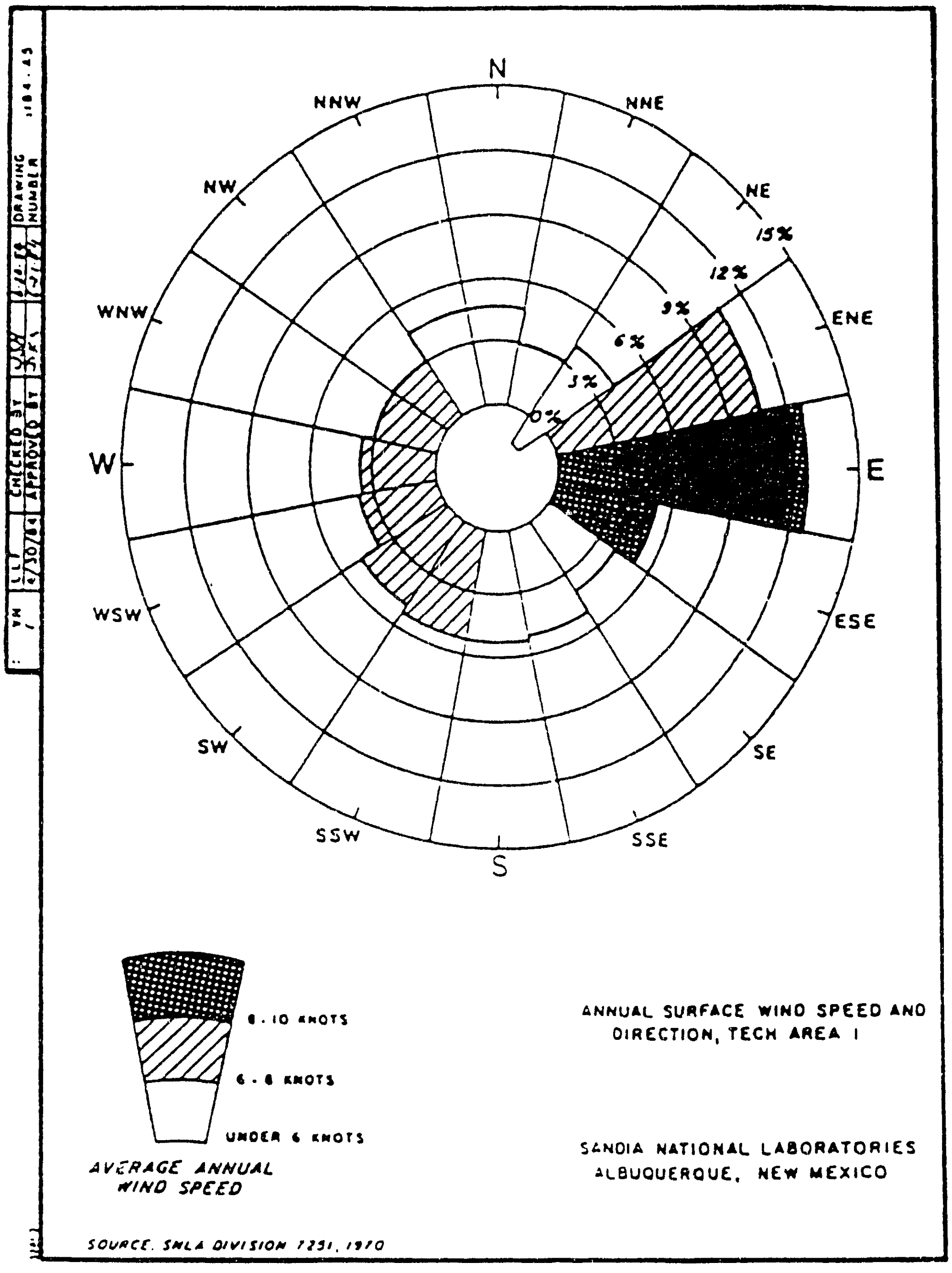

Figure 2-2. Annual Surface Wind Speed and Direction, SNL, Albuquerque, Technical Area I

Table 2-1. Summary Meteorological Data for the Albuquerque Area in 1991

	Temperatures (°C)		Precipitation	Wind	
	Daily Range		(cm) Water	Speed	
Month	Min	Max	Equivalent	m/s	Direction
January	-3.7	7.8	1.5	3.9	N
February	-0.9	14.8	0.2	4.1	N
March	0.1	15.5	0.4	5.0	W
April	4.5	22.1	a	5.0	W
May	9.6	27.6	2.9	5.4	S
June	14.6	31.3	1.6	4.3	S
July	17.7	32.2	6.7	3.7	E
August	17.2	31.1	3.2	2.8	SE
September	13.1	26.9	3.6	3.3	E
October	6.9	23.7	0.7	3.8	SE
November	-0.1	12.7	4.9	4.2	E
December	-2.4	8.3	3.8	3.1	E

[a]trace.

The geology underlying the eastern section of KAFB includes major faulting (Figure 2-4). The Hubbell Spring and Sandia Faults are north-south trending, down-to-the-west, en echelon faults (Lozinsky et al., 1991; Woodward, 1982; Kelley and Northrop, 1975). The Tijeras Fault is a strike-slip fault that appears to be downthrown to the east near KAFB (Kelley and Northrop, 1975). The Hubbell Spring Fault extends nearly due north from Socorro County, New Mexico, to near the southern portion of KAFB. Kelley (1961) speculated that it may continue north, nearly to Bernalillo, New Mexico. The Hubbell Bench (south of KAFB) is one of the most easily recognizable fault scarps in the basin, with offsets of 15 to 100 ft (5 to 30 m) (Machette, 1982). The Sandia Fault is thought to be the primary boundary between the Sandia Uplift and the main Albuquerque Basin (Kelley, 1977). Kelley (1977) also suggested it could actually be an extension of the Hubbell Spring Fault. The Tijeras Fault is assumed to be the boundary between the Sandia and Manzano Uplifts. Strike slippage is thought to have consisted of southwesterly movement of the northern block. The fault starts at least as far north as Madrid, New Mexico, and has been traced southwesterly through Tijeras Canyon and along the Four Hills. The Tijeras, Sandia, and Hubbell Spring Faults probably converge near the Chemical Waste Landfill (CWL) in SNL Technical Area (TA) III. Many smaller faults are undoubtedly associated with the three major offsets. To better

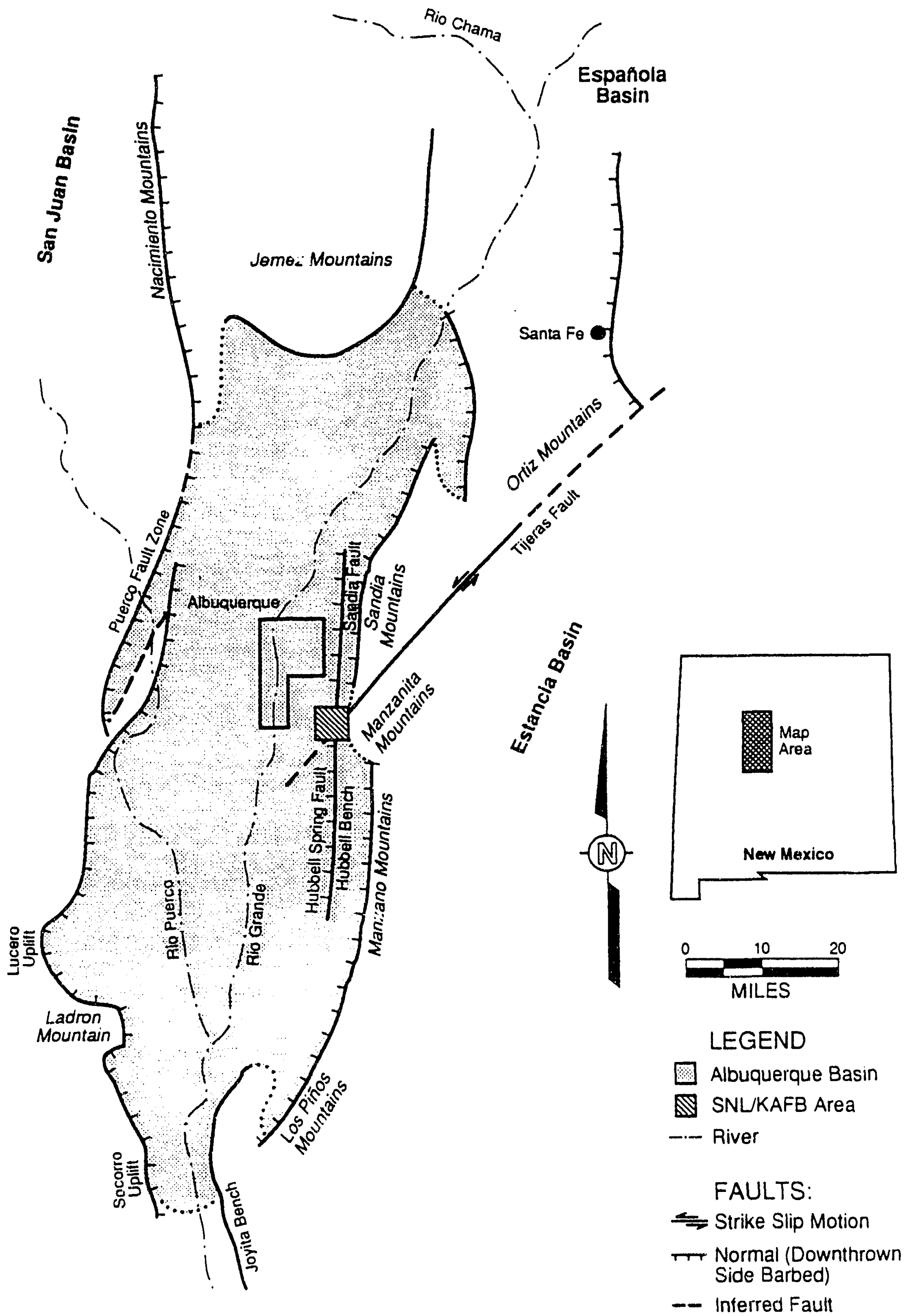

Figure 2-3. Albuquerque Basin, North Central New Mexico

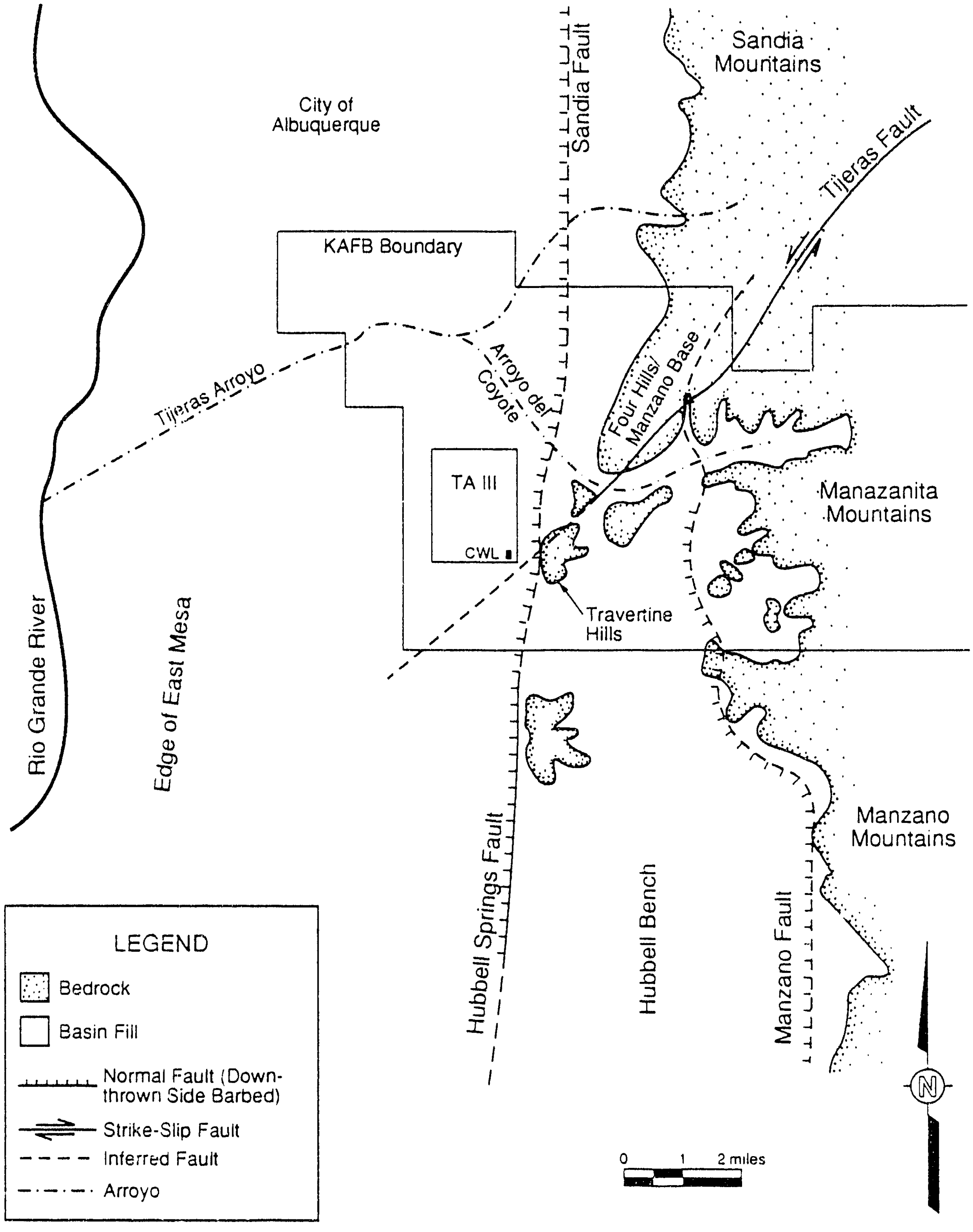

Figure 2-4. Generalized Geology in the Vicinity of SNL, Albuquerque/KAFB. Areas of bedrock outcrop, major drainages, faults, and land-forms are indicated.

determine the location of the fault complex and the depth to bedrock in the south-central portion of KAFB, a surface gravity survey was performed in May 1991 (Goodrich, in preparation).

2.5 Hydrology

Groundwater Hydrology

The faults separate the regional water table into a somewhat deep region west of the fault complex and a shallower region on the east side. The depth to saturated groundwater underlying SNL facilities varies from 50 to 100 ft (15 to 30 m) east of the faults and from about 380 to 500 ft (116 to 153 m) west of the faults. The hydrogeology east of the fault systems is poorly understood, because there are few monitoring wells, and the geology between the fault systems and the canyons of the Manzanita Mountains is complex. Groundwater typically flows out of the canyons and westward toward the fault system. Titus (1963), in describing flow across the Ojuelos Fault in Valencia County, goes so far as to say, "As water moves across the fault into the more permeable rocks of the Santa Fe, it cascades abruptly to the lower level within a short distance." On KAFB, a change in the water-surface elevation of more than 700 ft (213 m) has been observed in a 2-mi (3-km) distance (from the EOD Hill well west to the CWL), resulting in a hydraulic gradient of about 0.07. West of the faults, the hydraulic gradient decreases to about 0.005, and the depth to bedrock increases rapidly. The apparent direction of groundwater flow is generally westward (toward the Rio Grande) but trends northward approaching KAFB pumping wells. While the impact of the KAFB wells (and nearby City of Albuquerque wells) can be seen in fluctuating monitoring well water levels, the radial extent of the cone of depression is not clear at this time.

As a requirement of the Compliance Agreement between SNL, DOE, and the New Mexico Environment Department (NMED) to characterize the uppermost aquifer (SNL, 1991d), an aquifer test was conducted at the chemical waste landfill monitor well MW-2A over a period of 35 days in January and February 1991. Graphical analysis of the aquifer test data indicated a transmissivity of 13.7 square feet (ft^2)/day (1.3 square meters [m^2]/day); numerical analyses calculated a transmissivity of 6.2 ft^2/day (0.6 m^2/day), as well as a saturated hydraulic conductivity of 0.39 ft/day (1.4×10^{-4} centimeters/per second [cm/sec]). Further details of the aquifer test and resulting calculations are included in the compliance agreement final report (SNL, 1991d).

Surface-Water Hydrology

The major surface hydrologic feature in central New Mexico is the Rio Grande, which flows north to south through Albuquerque and lies approximately 6 miles (mi) (10 kilometers [km]) west of KAFB. Rio Grande water is primarily used for irrigation of agricultural crops. There are no continuously running streams on SNL property, although there are two perennial springs (Coyote and Sol Se Mete) on KAFB (the Burn Site Spring and G Spring do not run continuously) and one on Isleta Pueblo south of

KAFB (Hubbell Spring). The two primary surface channels at SNL are Tijeras Arroyo and the smaller Arroyo del Coyote (Figure 2-4). Arroyo del Coyote joins Tijeras Arroyo about 1 mi (2 km) west of the Tijeras Arroyo Golf Course; both flow intermittently during heavy thundershowers. Tijeras Arroyo (above the confluence with Arroyo del Coyote) drains about 80 square miles (mi^2) (208 square kilometers [km^2]), while Arroyo del Coyote (above the confluence with Tijeras Arroyo) drains about 27 mi^2 (70 km^2) (U.S. Army Corps of Engineers, 1979). Neither drainage is viewed as a significant flood hazard, and any impact on groundwater resources from flooding would likely be minimal. All SNL facilities are located well outside the 500-yr floodplain described by the U.S. Army Corps of Engineers (1979) for both arroyos.

2.6 Biology

The semidesert Southwest climate combines with the low water availability to produce many species of drought-resistant flora such as cacti (ERDA, 1977). The mesa vegetation on KAFB, consisting of grasses and shrubs, is illustrated in Figure 2-5. Figure 2-6 shows juniper trees and cacti that are present at the higher elevations bordering the mountains east of KAFB. Russian thistle (tumbleweeds) proliferate in mechanically disturbed areas. The City of Albuquerque, adjacent to KAFB, has flora typically found in urban environments.

2.7 Technical Areas

SNL, Albuquerque, consists of five technical areas and several additional test areas (Figure 2-7). Each area has its own distinctive operations. The following paragraphs describe the activities in each area and summarize potential sources for radioactive and nonradioactive effluent releases.

Technical Area I

Technical Area I (Figure 2-8) has the largest employee population (approximately 5000). This area is dedicated primarily to the design, research, and development of weapon systems; limited production of weapon system components; and energy programs. It also includes the main library and offices, laboratories, and shops used by administrative and technical staff. Generally, the only potential radioactive releases in Technical Area I are tritium (^3H) from two laboratory sources and activation products (such as argon-41 [^{41}Ar], nitrogen-13 [^{13}N], and oxygen-15 [^{15}O]) from two small accelerators. Only small quantities of activation products are released from these stacks annually. Potential sources for nonradioactive effluents include the paint shops, process development laboratory, emergency diesel generator plant, solvent spray booth, foundry, and steam plant.

Figure 2-5. Mesa Vegetation

Figure 2-6. Manzano Foothills Vegetation

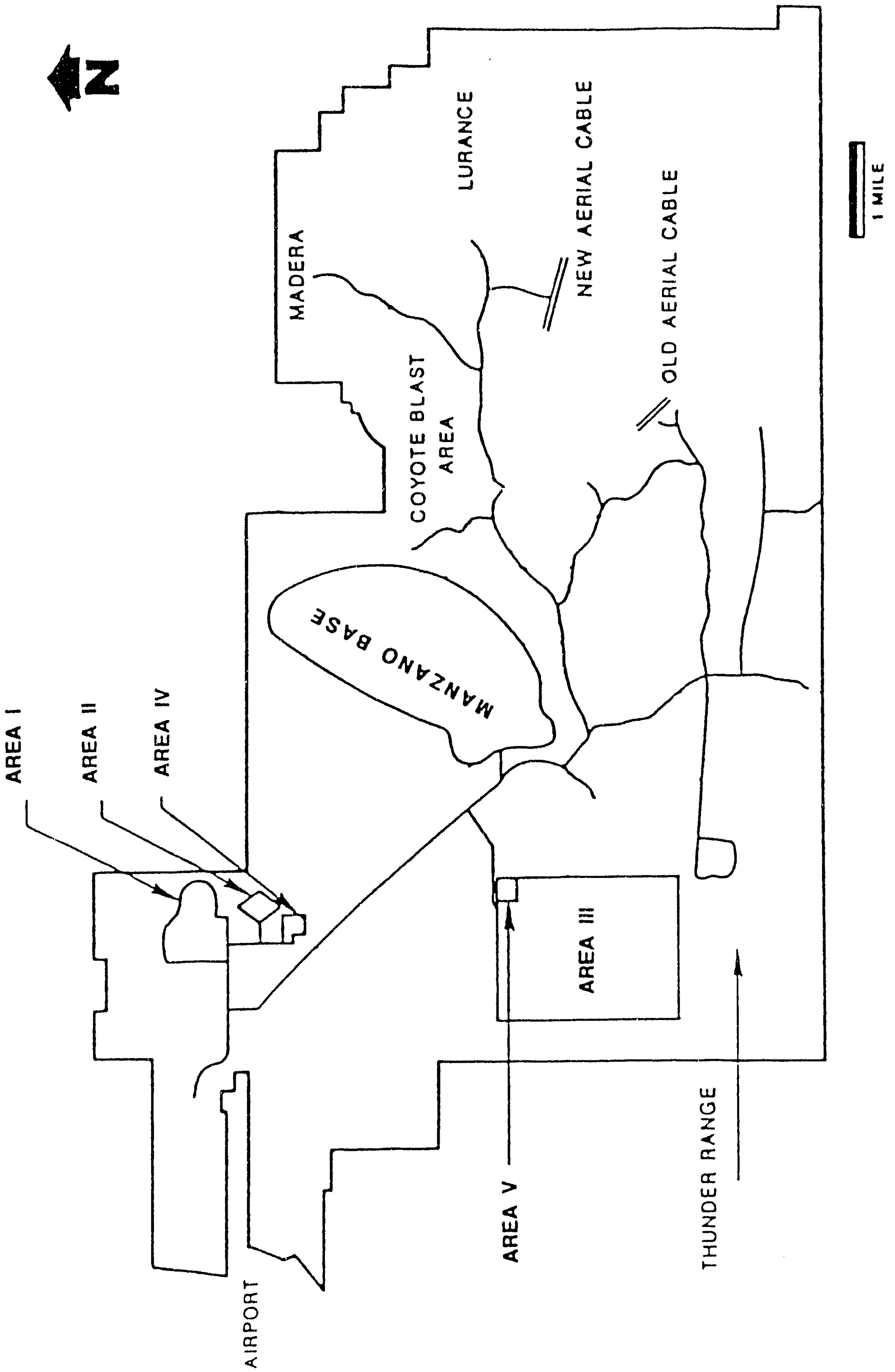

Figure 2-7. SNL, Albuquerque, Technical Areas (I-V) and Remote Areas

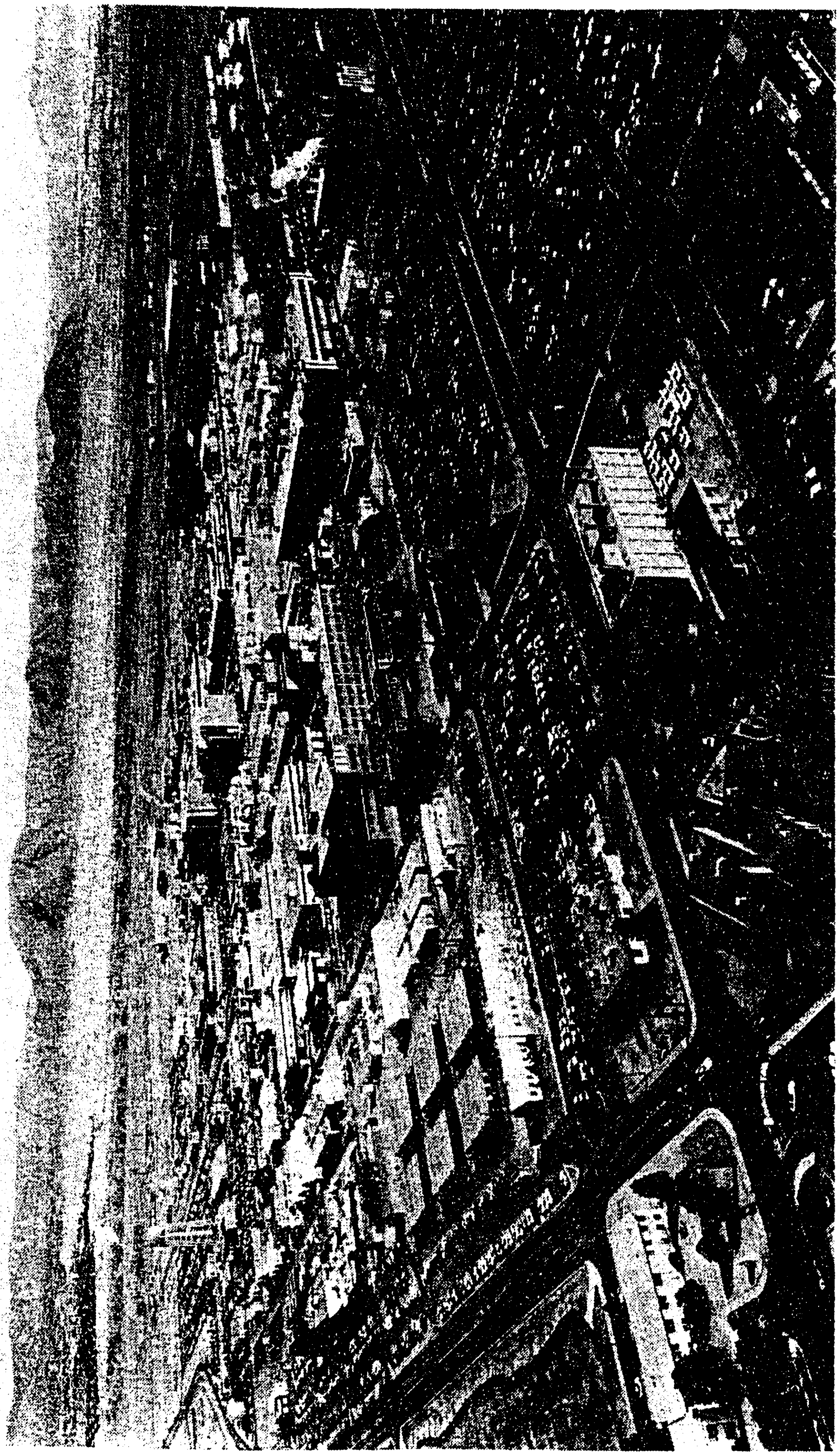

Figure 2-8. Technical Area I (looking east from the intersection of Wyoming and Gibson Boulevards)

Technical Area II

Technical Area II (the diamond-shaped area in Figure 2-9) is a small area used for explosive testing. MicroCurie amounts of ^3H may be released each year from component testing. Techniques for measuring fractures in geologic strata are developed at this facility. Also located in Technical Area II are an inactive low-level waste (LLW) disposal site, a small radioactive material decontamination and storage facility (Building 906), and a storage facility designed to temporarily hold polychlorinated biphenyl (PCB)-contaminated materials to be transported to an EPA-licensed disposal facility. The inactive LLW disposal site has not been used for over 20 yr. A new facility, the Explosive Components Facility (ECF) is planned for Technical Area II. This facility will integrate many of the existing Technical Area II activities as well as some remote testing activities currently performed in other test areas.

Technical Area III

Technical Area III (Figure 2-10) is located adjacent to and south of Technical Area V, and 8 km south of Technical Area I. It is comprised of 20 test facilities which include extensive environmental test facilities (such as sled tracks, centrifuges, and a radiant heat facility). No radioactive effluents are released through normal operations in the area. During 1991, there were a total of two NIKE motor tests that released 3.73 lb of lead per test at the sled-track area. Other facilities in Technical Area III include a paper incinerator, an inactive LLW and mixed waste (MW) disposal site, a large melt facility, a melting and solidification laboratory, and a solar tower facility.

The inactive radioactive waste disposal site in Technical Area III consists of two adjoining fenced areas that occupy approximately 0.6 ha (SNL, 1989b). One area was used for LLW disposal in seven shallow trenches. The second area was used for disposal of classified LLW in 37 pits. The LLW consisted primarily of tritium-contaminated materials. Three additional pits located in the classified waste disposal area were used exclusively for natural and depleted uranium (DU) waste disposal. The site is currently used as an interim storage facility for radioactive and MW. LLW will be stored at a new radioactive and MW storage facility which is scheduled for completion and use in fiscal year 1993. This new facility is located at the southern end of Technical Area III.

An inactive hazardous waste disposal and storage site is also located near the southern boundary of Technical Area III. This facility has not been used for disposal of hazardous wastes since November 7, 1985. It was used as an interim hazardous waste storage area from 1985 to 1988. A Closure Plan and Post-Closure Permit application was prepared in May 1988 for the no-longer-used hazardous waste disposal site. A new hazardous waste repackaging and storage building, located south of Technical Area I, has been in use since 1988.

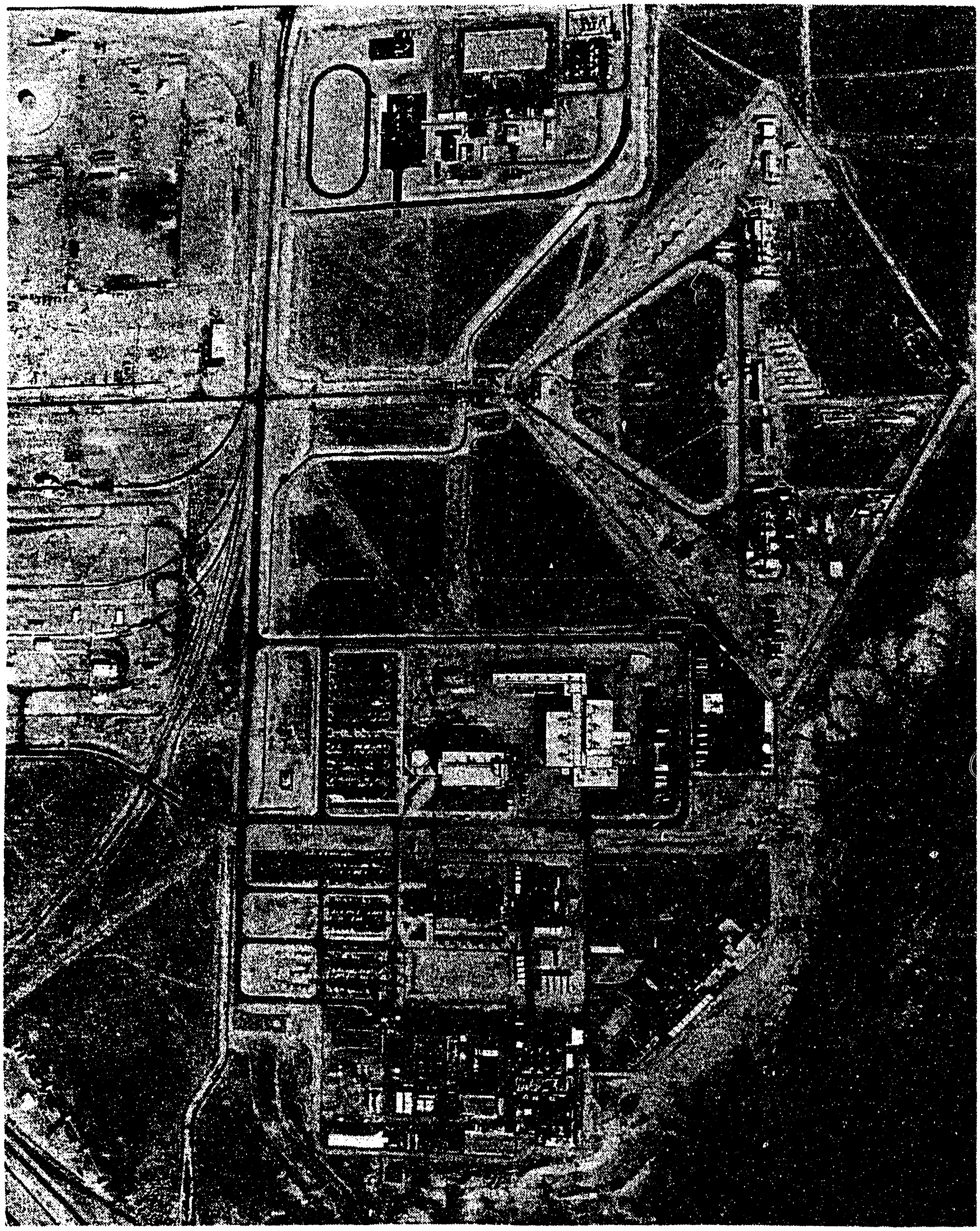

Figure 2-9. Top-Down View of Technical Areas II and IV

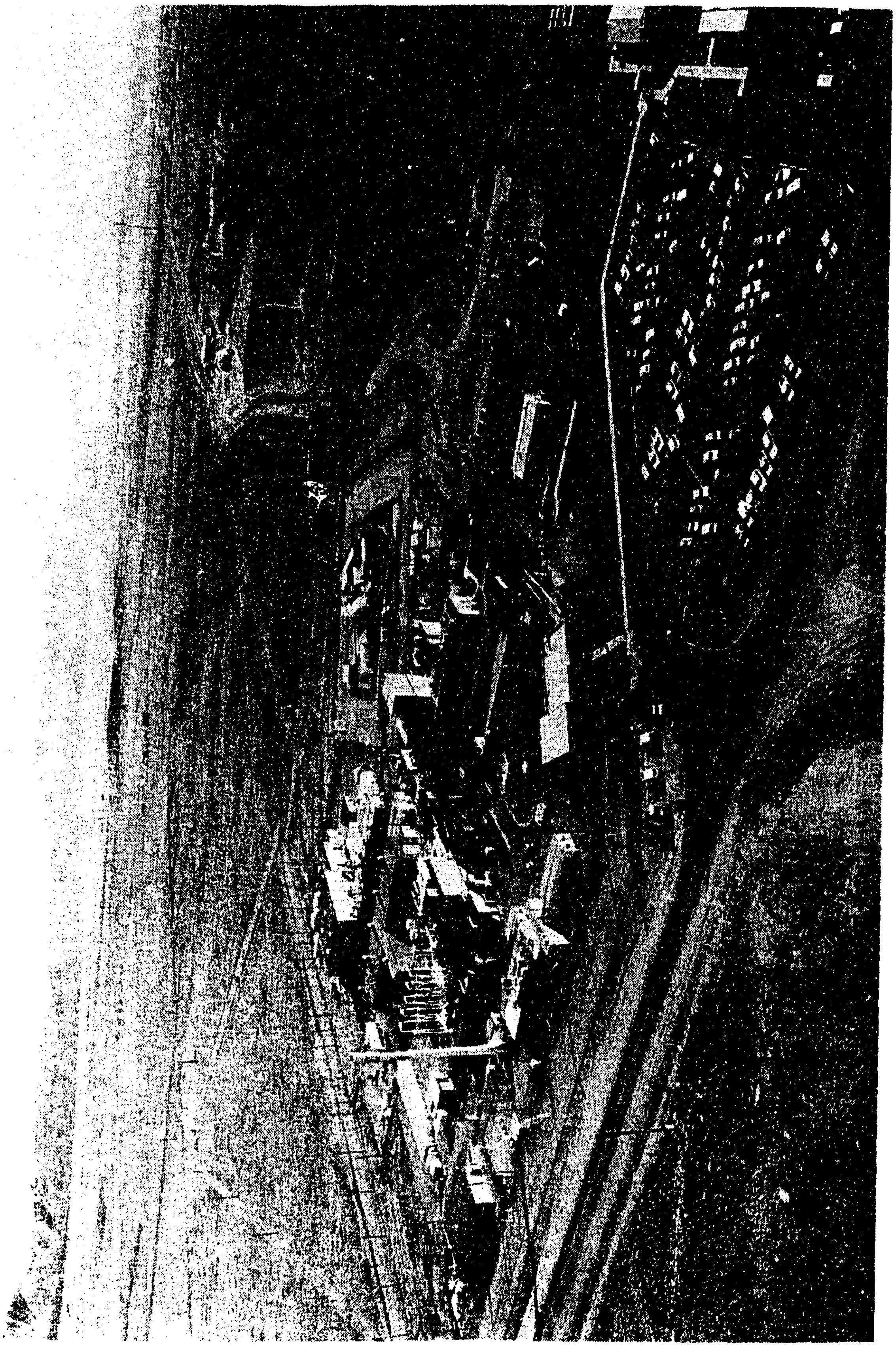

Figure 2-10. Technical Area V and Portion of Technical Area III (looking toward the southeast with the solar tower in the distance)

Technical Area IV

Technical Area IV (Figure 2-9) consists of several inertial confinement fusion research and pulsed power research facilities. One large accelerator, the Particle Beam Fusion Accelerator-II (PBFA-II), was completed in 1985. Gaseous tritium effluents (primarily tritiated hydrogen [HT]) will be released from fusion research efforts starting 1992. A large accelerator facility, the Simulation Technology Laboratory (STL), houses seven pulsed power accelerators: HERMES-III, RLA, TROLL, STF, SPEED, HYDRAMITE, and PROTO II. Several of these accelerators have been transferred from Technical Area V. HERMES-III became operational in 1988. Another accelerator facility, SATURN, was completed in 1987. A major research facility, the Strategic Defense Facility (SDF), is under construction and should be operational by 1993. During 1991, radioactive emissions from this facility were short-lived radionuclides, primarily ^{13}N and ^{15}O.

Technical Area V

Technical Area V (Figure 2-10) houses a large electron beam accelerator, two research reactors in two reactor facilities, an intense gamma irradiation facility (using cobalt-60 [^{60}Co] and cesium-137 [^{137}Cs]), and a hot cell facility. The large accelerator is HERMES-II.

The two research reactor facilities in Technical Area V are quite dissimilar: the Sandia Pulsed Reactor (SPR) is an unreflected, unmoderated assembly of enriched U; the Annular Core Research Reactor (ACRR) is an annular core of 226 fuel elements in an open water tank. Both the SPR and ACRR air exhaust systems are equipped with particulate effluent samplers. The ACRR also has a continuous gaseous effluent monitor. The only airborne releases are air activation products from reactor operations primarily composed of ^{41}Ar and xenon-133 (^{133}Xe). The reported amount of ^{41}Ar, released from both reactor areas, was computed from reactor operating parameters.

Remote Test Areas

SNL, Albuquerque, also has test areas outside of the five technical areas. These areas are located south of Technical Area III and in canyons on the west side of the Manzano Mountains. Coyote Canyon and Thunder Range are two examples of such areas. In these remote areas, wild animals including snakes, deer, coyotes, and owls are often present. Figure 2-11 shows the Main Burn Site located in the Coyote Canyon remote area.

DU was used in the past for explosive testing in these remote areas. The test areas were surveyed following each test, and contaminated materials were collected and disposed of in accordance with DOE requirements. Environmental monitoring is done as necessary. Operations in these areas are administratively controlled to avoid U contamination to public areas beyond the confines of KAFB.

Figure 2-11. Main Burn Site at the Entrance of Coyote Canyon (looking west)

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CHAPTER 3
COMPLIANCE SUMMARY

The environmental compliance activities at SNL, Albuquerque, are administered by the four Environmental Programs Departments: 7721, Chemical Waste; 7722, Radioactive and Mixed Waste; 7723, Environmental Restoration; and 7725, Pollution Prevention and Environmental Monitoring. This chapter summarizes the significant environmental compliance activities that occurred during 1991 for the four Environmental Program Departments and for the Risk Management and NEPA Department (7731).

3.1 Compliance Status

3.1.1 Background

SNL, Albuquerque, operates in compliance with environmental requirements established by federal and state statutes and regulations, executive orders, the DOE, and a State of New Mexico compliance order. SNL, Albuquerque, has been issued environmental permits in compliance with air emissions, water discharge, and solid waste disposal regulations. Compliance is enforced by Region VI EPA, the State of New Mexico Environment Department (NMED), Bernalillo County, and the City of Albuquerque (see Section 3.3). The following paragraphs summarize the compliance of SNL, Albuquerque, with the principal environmental statutes.

Clean Air Act (CAA)--From the Albuquerque/Bernalillo County Air Quality Control Board, SNL, Albuquerque, periodically receives open-burning permits as well as topsoil disturbance permits for the control of airborne particulates during construction projects. SNL, Albuquerque, also complies with the National Emissions Standards for Hazardous Air Pollutants (NESHAP) for radionuclide air emissions (Subpart H), beryllium (Be) air emissions (Subpart C), and asbestos emissions (Subpart M).

In September 1991, EPA Region VI inspected SNL, Albuquerque, for NESHAP compliance. Only a few minor observations were made in the draft report. SNL, Albuquerque, is committed to compliance with NESHAP for radionuclides and will work with EPA Region VI to obtain agreement on the implementation of NESHAP compliance for SNL, Albuquerque.

Various inventories of air emissions were performed during the first quarter of 1992 for calendar year (CY) 1991: criteria pollutants, hazardous air emissions, NESHAP radionuclide emissions, ozone-depleting substance inventories, and Superfund Amendment and Reauthorization Act (SARA) Title III, Section 313, Toxic Chemical Releases. As in the past, the criteria pollutant and hazardous air emission inventories will be submitted to the City of Albuquerque. The SARA III, Toxic Chemical Releases, and NESHAP radionuclides inventories and an annual report will be submitted to EPA. To date, the 1991 emissions are all in compliance with applicable standards.

Clean Water Act (CWA)--SNL, Albuquerque, has eight wastewater discharge permits from the City of Albuquerque for sanitary sewer discharges and has resolved past minor violations of the permits with the City. Two surface impoundments are permitted and seventy-eight septic tanks are registered with the NMED. The NMED has ruled that several categories of low-volume and/or clean wastewater surface discharges require no discharge plans.

On April 18, 1990, a compliance schedule to correct pH and fluoride violations at the Microelectronics Development Laboratory (Permit 2069 G) was submitted to the City of Albuquerque. The corrective construction began in 1990 and was completed in February 1991. Final system acceptance testing and full scale operations began on May 17, 1991.

Comprehensive Environmental Response Compensation and Liability Act (CERCLA)--CERCLA and the 1986 Superfund Amendments and Reauthorization Act (SARA) define certain assessment activities and reporting requirements for all federal facilities. As required, CERCLA section 103(c) notifications were provided to the EPA. In 1988 SNL, Albuquerque, completed the Preliminary Assessment/Site Inspection (PA/SI) as required by SARA 120(c). Based on the PA/SI, EPA has determined that none of the SNL, Albuquerque, inactive waste sites qualifies for the EPA list of high priority cleanups (i.e., EPA's National Priorities List [NPL]). With respect to the SNL, Albuquerque, inactive waste sites that are on Kirtland Air Force Base (KAFB), no other CERCLA or SARA activities are required.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)--EPA-registered pesticides are applied at SNL facilities. These pesticides are applied by an EPA-certified applicator. SNL, Albuquerque, retains records of the quantities and the types of pesticides that are used. Material Safety Data Sheets (MSDSs) are kept on each pesticide applied.

National Environmental Policy Act of 1969 (NEPA)--With the Secretary of Energy's National Environmental Policy Act Notice (SEN-15-90) of February 5, 1990, SNL, Albuquerque, has increased emphasis on NEPA reviews. DOE's commitment to (1) infusing environmental values into DOE decision-making and (2) disclosing federal activities through the NEPA process has resulted in a large increase in the number of environmental assessments (EAs) that are being written to cover SNL, Albuquerque, proposed actions.

Resource Conservation and Recovery Act (RCRA), Environmental Restoration Program--The potential release sites identified by the Environmental Restoration (ER) Program for facilities at SNL, Albuquerque, will be evaluated and corrected as required by the RCRA 3004(u). Corrective Action (CA) for releases from solid waste management units (SWMUs) will be a part of the final RCRA Part B permit, expected to be in force by summer 1992.

SNL, Albuquerque, has an inactive chemical waste landfill (CWL) that is permitted under interim status. A closure plan titled "Sandia National Laboratories Technical Area III Facilities Chemical Waste Landfill and Surface Impoundment Closure Plan and Post-Closure Permit Application" was first submitted to the NMED in May 1988. This first version described the necessary procedures for covering the CWL with an impermeable cap, which was scheduled for completion in November 1989.

In March 1990, during negotiations between the NMED and the DOE/SNL on details of the impermeable cap construction, trichloroethylene (TCE), a volatile organic compound (VOC), was detected in groundwater at levels slightly above the EPA's drinking water standard of 5 parts per billion (ppb). As a result of this discovery, a proposed strategy for developing a CA plan to assess and remediate the VOC problem was presented to the NMED in the summer of 1990.

A second version of the Closure Plan was submitted to the NMED in December 1990. This version of the Closure Plan included NMED's requirements of April 15, 1990, on impermeable cap construction and a proposal to include the CA plan as a part of the closure process. The DOE/SNL and the NMED agreed to this second version which contained a revised closure schedule that would allow completion of source and unsaturated zone assessment and remediation activities before an impermeable cap is installed.

In April 1991, the NMED requested through a notice of deficiency (NOD) that additional information be included in the Closure Plan and that it be resubmitted by May 15, 1991. The NMED's greatest concern with the plan was the length of the proposed schedule delays for completing closure activities, caused by the time needed to assess and remediate volatile VOC contamination at the CWL.

The DOE/SNL and the NMED met in June 1991 to discuss how to coordinate the CA plan, the Closure Plan, and the DOE's Integrated Demonstration Program (IDP). At this meeting, all three organizations agreed that the CA plan should be incorporated into the final Closure Plan. In July 1991, the DOE/SNL received a written requirement from the NMED that the Closure Plan must detail all the "technical investigation proposals" necessary to characterize the hazardous constituents at the CWL. In August 1991, the DOE/SNL submitted a third revision of the Closure Plan that included the proposed CA plan, with associated technical investigation proposals, an outline, and a schedule. The RCRA Site Investigation (RSI) work plan to complete contamination assessment was scheduled as the first deliverable (December 1991) in the closure process. Because the DOE/SNL had not received NMED review comments, however, it was unclear how the NMED wanted to coordinate VOC assessment and remediation activities with impermeable cap construction activities. Also, the DOE Office of Technology Development had selected the CWL as a demonstration site. The purpose of the IDP is to demonstrate in the field the use of technological advances that will increase compliance with remedial performance standards at hazardous waste sites. The IDP will initiate pilot field tests of assessment and remedial action technologies at the CWL in 1992. Because of these complications, the DOE requested a 90-day extension to submit the third revision of the Closure Plan so that these issues could be resolved.

In September 1991, the NMED issued a notice of violation (NOV) on the third revision of the Closure Plan. The NOV stated that the DOE/SNL had failed to meet the requirements of 40 CFR 265.111 (HWMR-6, Part VI, Section 265.111) with respect to completion of a Closure Plan, and the NMED letter of July 17, 1991. Specific points of deficiency were not enumerated.

On October 15, 1991, the DOE/SNL received a letter that formally described the requirements for submitting a "Closure Plan that includes Corrective Action plan information." During a conference call, the DOE/SNL and the NMED discussed the NMED letter and changes to it. On October 22, 1991, the DOE/SNL submitted a formal response to the NOV.

On December 3, 1991, NMED sent a settlement agreement to DOE/SNL for signature by both parties. NMED's proposed settlement agreement required submittal of the Closure Plan by December 31, 1991. The plan was submitted by the due date and is currently under review by NMED.

On February 20, 1992, NMED issued a NOD for the Closure Plan. Most of the comments were editorial in nature, and revisions were submitted to NMED within the 30-day response time. This version of the Closure Plan is currently under review.

The State of New Mexico issued a groundwater monitoring compliance order for the CWL in May 1988. A compliance agreement between the state, the DOE, and SNL concerning actions to close out the compliance order was completed on December 29, 1989, and signed on January 11, 1990. The compliance agreement activities included (1) revising the Sampling and Analysis Plan, (2) installing an additional monitor well, and (3) performing aquifer characterization. The first two activities were completed in 1990, and an aquifer test was conducted in early 1991. The compliance agreement final report, which included the aquifer characterization results, was submitted to NMED on May 29, 1991.

In January 1990, the State of New Mexico adopted the federal underground storage tank (UST) regulations (40 CFR 280), basing the state's regulations on the age of the USTs rather than depth to groundwater. Eleven USTs went into noncompliance with the regulation change. By the end of 1991, all USTs were in compliance and 40 tanks were removed. At present, 24 remaining USTs are registered with the NMED.

<u>RCRA, Hazardous Waste Management</u>--The Chemical Waste Department, 7721, is responsible for providing guidance to SNL waste generators; performing spot checks of generator compliance; operating an interim status (greater than 90 day) storage facility; providing the interface to the DOE, NMED, and EPA on matters concerning chemical waste; and preparing, revising, and submitting applications for the storage permit for the Hazardous Waste Management Facility (HWMF).

As required by RCRA, SNL, Albuquerque, submitted a Part A permit application in May 1980. Interim status was recognized in August 1982. In December 1983 the EPA, Region VI, requested a Part B submittal. SNL submitted the first Part B in June 1984. Part A and B modifications have been submitted several times between the first submittal and 1991. A draft

RCRA permit was issued on July 12, 1991 (see Permitting Activities, Section 4.3.1). Part B modifications were submitted to the NMED in June 1991 and August 1991. The first modification was in response to comments issued by the NMED. The second modification contained clarifications of the permit application in response to the draft permit that NMED issued. A revised Part A permit application for hazardous waste was prepared and submitted to the NMED in September 1991 to modify the estimated volumes handled. Comments on the draft RCRA permit were submitted to the NMED and EPA Region VI in September and October 1991.

At the end of the HWMF draft permit comment period, the NMED and EPA set a public hearing date of March 20, 1992. The hearing involved NMED, EPA, DOE/AL, Albuquerque/Kirtland Area Office (AL/KAO), and SNL, Albuquerque, personnel, as well as several community groups. A permit should be issued before the end of CY 1992 after all comments have been considered.

The NMED performs annual RCRA audits of the SNL HWMF and generator locations throughout SNL facilities. The NMED 1991 audit included NMED enforcement bureau personnel and NMED onsite Agreement-In-Principle personnel. No violations were cited from storage activities at the HWMF. Additionally, the NMED reviewed generator locations for two days. One generator location was found to have deficiencies concerning a one-gallon container of hazardous waste. Two violations were issued based on that container. These two minor violations were corrected and resolution was suitable to the NMED.

<u>RCRA, Mixed Waste Management</u>--The State of New Mexico was granted regulatory authority for mixed waste (MW) under RCRA on July 25, 1990. In August 1990, SNL, Albuquerque, submitted a Part A permit application for MW to NMED. In August 1991 NMED inspected the MW storage facilities at SNL, Albuquerque, which are permitted under interim status. No findings or areas of concern were noted.

During the first quarter of 1992, SNL, Albuquerque, initiated discussions with NMED concerning future permitting activities for MW storage units. These discussions will result in the identification of the number and type of units that will be permitted and the schedule for permitting. After the discussions are completed, SNL, Albuquerque, will prepare a Part B permit application for mixed waste units.

3.1.2 Current Issues and Actions

<u>Chemical Waste Landfill</u>--The State of New Mexico issued a NOV for groundwater monitoring in 1989, and because the Corrective Actions could not be completed within the statutory 30-day limit, the state subsequently issued a compliance order on the same matter. A compliance agreement between the DOE, SNL, and the NMED was signed on January 11, 1990, to close the compliance order. The compliance agreement included (1) revising the Sampling and Analysis Plan, (2) installing a fourth downgradient monitor

well, and (3) characterizing the uppermost aquifer at the CWL. SNL, Albuquerque, submitted the final report on May 29, 1991, fulfilling the compliance agreement requirements. An annual groundwater monitoring report for the CWL was submitted on March 1, 1991. Resubmission of a closure and post-closure plan for the CWL, which has undergone several revisions, was completed in December 1991.

Low-Level Radioactive Waste and Mixed Waste Disposal--SNL, Albuquerque, submitted an application to the Nevada Test Site (NTS) for disposal of both low-level radioactive waste (LLW) and LLW-MW in 1990. The application was reviewed by the DOE Nevada Operations Office (DOE/NV) and is currently being revised by SNL, Albuquerque. Upon review and approval, all radioactive waste sent to the NTS must meet the waste acceptance criteria set forth in NVO-325, "Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements."

Land Disposal Restrictions--In 1984, Congress amended RCRA by imposing a schedule for restrictions on the land disposal of hazardous waste. These restrictions are referred to collectively as land disposal restrictions (LDRs). On May 8, 1990, the final LDRs were implemented, forbidding the land disposal of hazardous waste that does not meet prescribed treatment standards. However, due to a nation-wide absence of treatment and disposal facilities for MW, the EPA granted a National Capacity Variance that delays the implementation of most LDRs for mixed wastes until May 1992. The EPA also implemented the toxicity characteristics leaching procedures (TCLPs) in 1990. Those analytical procedures and the associated regulatory changes have increased the volume and complexity of RCRA-regulated waste generated by SNL, Albuquerque.

The volatile organic emission standards proposed in July 1991 for hazardous waste containers, tanks, and impoundments will impact operations at the HWMF, the 90-day satellite accumulation storage areas, and the generator locations (SNL, Albuquerque, is a large-quantity generator). To meet the requirements of this type of rule, SNL, Albuquerque, will increase generator awareness, increase sampling, and purchase and/or install new equipment.

During the first quarter of CY 1992, the NMED held public meetings concerning setting of fees to oversee hazardous waste programs. The fees were to be payable to the NMED, and were to be based on the volume of generated hazardous waste; they are proposed to begin in the third quarter of CY 1992. The current New Mexico Hazardous Waste Management Act supports this fee.

Mixed Waste Authority--The State of New Mexico was granted regulatory authority for MW under RCRA on July 25, 1990. In August 1990 SNL, Albuquerque, submitted a RCRA Part A permit application for the storage and limited treatment (pH neutralization, compaction, solidification, shredding/baling) of mixed wastes to the NMED. SNL, Albuquerque, is currently in the process of preparing a Part B permit application for these wastes and is negotiating with NMED concerning the strategy and schedule for permitting the MW units under RCRA.

Low-Level Radioactively Contaminated Wastewater--In 1990 SNL, Albuquerque, proposed to discharge 50,500 gallons of low-level radioactively contaminated wastewater from SNL, Albuquerque, to the City of Albuquerque publicly-owned treatment works (POTW). Analysis of this wastewater indicated that it met all discharge standards established by the current wastewater permit issued by the City of Albuquerque for SNL. Two notifications of SNL's intent to discharge were issued in November 1990. A meeting was convened December 20, 1990, to discuss this discharge and to resolve any concerns of the City of Albuquerque over the discharge of this water. Written notification of denial of permission to discharge was received January 15, 1991. This wastewater is currently stored onsite while negotiations with the City of Albuquerque continue.

3.2 Environmental Permits

As part of its commitment to full compliance with all applicable environmental laws and regulations, SNL, Albuquerque, holds environmental permits which are governed by the following:

A. Air

The Clean Air Act is enforced by the NMED and the joint Albuquerque/Bernalillo County Air Quality Control Board. They administer the following regulations:

1. National Ambient Air Quality Standards (NAAQS)
2. NESHAP, except for the radionuclide NESHAP, which is managed by EPA Region VI (Dallas)
3. New Source Performance Standards (NSPS), which regulate atmospheric emissions from certain types of facilities
4. Open Burning permits
5. Nitrogen dioxide emissions from gas-burning equipment
6. Topsoil Disturbance permits

B. Water

1. The Clean Water Act is administered through EPA Region VI. The act encompasses the following regulations:

    a. National Pollutant Discharge Elimination System (NPDES), including pretreatment effluent guidelines and standards

    b. NPDES permit system for storm water runoff, which will require a permit for storm water discharges from industrial point sources

    c. Spill Prevention Control and Countermeasure (SPCC) Plan

2. Sanitary sewer regulations are based on federal pretreatment standards and are promulgated by the City of Albuquerque.

3. Surface and near-surface discharge regulations are administered by the NMED.

4. Groundwater monitoring regulations of the RCRA are also administered by the NMED.

C. Solid Waste

1. The federal Comprehensive Environmental Response, Compensation, and Liability Act regulates inactive waste sites and contains requirements for reporting hazardous material spills to the National Response Center (NRC).

2. The RCRA regulates generation, storage, treatment, recycling, transport, and disposal of hazardous, mixed, and nonhazardous solid waste in the following ways:

   - Chemical hazardous waste is regulated by the RCRA
   - USTs for hazardous substances are regulated by the RCRA
   - Documented waste minimization programs are required by the RCRA
   - LDRs and treatment standards for chemical waste applied by the RCRA were fully implemented in 1990
   - Radioactive MW is dually regulated by the Atomic Energy Act and the RCRA

3. The New Mexico Hazardous Waste Act allows the NMED to promulgate regulations equivalent to or more stringent than federal regulations to manage RCRA hazardous waste. The NMED received authority to regulate MW from the EPA in July 1990.

4. The New Mexico Hazardous Waste Management Regulations are equivalent to RCRA regulations in governing hazardous waste.

5. The Toxic Substances Control Act (TSCA) regulates the manufacture, distribution, use, handling, and disposal of certain toxic chemicals and materials, including polychlorinated biphenyls (PCBs) and asbestos.

Summary of the Status of Current Permits and Other Notifications

Table 3-1 (and Table 6-7) lists the current environmental permits issued to SNL, Albuquerque, and those that are under review by various agencies.

Table 3-1. Summary of the Environmental Permits Issued or in Process

Permit No.	Type	Location	Agency	Expiration Date
2069 A	Wastewater	WW001	City of Albuquerque	09/30/93
2069 C-3	Wastewater	WW003	City of Albuquerque	09/30/93
2069 D-3	Wastewater	WW004	City of Albuquerque	09/30/93
2069 E-2	Wastewater	WW005[a]	City of Albuquerque	06/30/93
2069 F-2	Wastewater	WW006	City of Albuquerque	09/30/93
2069 G	Wastewater	WW007[b]	City of Albuquerque	07/31/[illegible]
2069 H	Wastewater	WW009[c]	City of Albuquerque	09/30/93
2069 I	Wastewater	WW008	City of Albuquerque	09/30/93
2069 J	Wastewater	WW010[d]	City of Albuquerque	In process
2069 K	Wastewater	WW011[e]	City of Albuquerque	In process
DP-530	Wastewater	Technical Area IV Lagoons	State of New Mexico	03/08/93
NM5890110518	HW	958, 959[f]	NMED (EPA)	In process
NM5890110518	HW	6715[f]	NMED (EPA)	In process
NM5890110518	MW (Part A)	Technical Areas I, III, V[f] and seven Manzano bunkers	NMED (EPA)	In process

[a]WW005 is located at the Albuquerque Microelectronics Operation.
[b]WW007 is located at the Microelectronics Development Laboratory.
[c]WW009 is located at the Process Development Laboratory.
[d]WW010 is for the Explosives Component Facility (ECF).
[e]WW011 is for Technical Areas III and IV, and the Coyote Area sewer lines.
[f]HW and MW are currently operating under interim status.

Besides these environmental permits, notifications were given to the City of Albuquerque regarding asbestos removal (NESHAP, Subpart M) and beryllium emission/relocation (NESHAP, Subpart C). Also, several projects were evaluated for exemption and applicability of NESHAP, Subpart H, to facilities in Technical Areas IV and V. In 1990, 13 additional septic tanks were registered with the NMED, as required by the State of New Mexico discharge regulations. In 1991 no additional septic tanks were registered and none was removed from the registration list.

3.3 DOE Tiger Team Assessment

DOE has established teams of environment, safety, and health (ES&H) experts ("Tiger Teams") to inspect the various DOE laboratories for compliance with federal, state, and local environmental and safety regulations, permit agreements, DOE orders, best management practices and internal laboratory requirements. A DOE Tiger Team assessment of the ES&H operations at SNL, Albuquerque, was conducted from April 15 through May 24, 1991. This assessment was comprehensive, encompassing ES&H disciplines, management, self-assessments, and quality assurance; transportation; and the waste management operations. In response to the Tiger Team findings, DOE and SNL, Albuquerque, prepared an Action Plan. The initial draft of the Action Plan was submitted to DOE/Albuquerque Operations Office (DOE/AL) for review in July 25, 1991. The purpose of the Action Plan is to provide a formal written response to each of the findings and concerns cited in the Tiger Team report and to prepare plans, schedules, and costs for activities to be conducted to correct the identified deficiencies. The Tiger Team Action Plan was approved on February 28, 1992. The following paragraphs summarize the Tiger Team findings for the Environmental Programs Departments (7721, 7722, 7723, and 7725).

3.3.1 Tiger Team Summary, Chemical Waste Department (7721)

The hazardous waste management findings include inadequate programs for waste characterization, classified waste management, generator training, and programs which do not ensure compliance at treatment, storage, and disposal facilities. The toxic chemical material finding is associated with inadequacies in the program that is designed to prevent releases during storage of toxic and chemical substances. Department 7721 personnel are responsible for responding to Tiger Team findings in the areas of hazardous waste management and toxic chemical material.

Additionally, Department 7721 personnel are assisting in planned actions related to findings on the programs which ensure that hazardous waste is not co-mingled with sanitary or classified sanitary waste.

Department 7721 has prepared an Action Plan for all the Tiger Team findings. In CY 1992, planned actions include the drafting of project plans (resource management), the formation of project teams, and correspondence with DOE and NMED for clarification on regulatory guidance.

3.3.2 Tiger Team Summary, Radioactive and Mixed Waste Department (7722)

The 1991 Tiger Team audit resulted in a total of nine findings that addressed storage, characterization, tracking, and the lack of available disposal capacity for radioactive and mixed wastes (LLW and transuranic [TRU]) that are generated and stored at SNL, Albuquerque. All nine findings dealt with potential noncompliances with DOE orders. In addition, three of the nine findings dealt with potential noncompliances with federal RCRA regulations applicable to MW. Action Plans have been prepared and submitted to DOE Headquarters to correct these potential noncompliances. These action plans include additional training for SNL, Albuquerque, personnel who generate or store radioactive or mixed wastes, preparing and implementing specific procedures, developing a database to track locations of stored wastes and associated sample results, and constructing additional facilities to store or treat wastes.

3.3.3 Tiger Team Summary, Environmental Restoration Department (7723)

The 1991 Tiger Team audit resulted in 11 findings, five of which were for lack of best management practices. The 11 findings addressed groundwater monitoring, groundwater sampling, well and borehole closure, UST program management, closure and monitoring of the MWL, ER site identification and tracking, community relations, fencing and posting of certain ER sites, and planning documentation.

Department 7723 has developed action plans to address all findings. Fiscal year (FY) 1992 planned milestones relate largely to the development of programmatic guidance documents.

3.3.4 Tiger Team Summary, Pollution Prevention and Environmental Monitoring Department (7725)

Tiger Team findings related to activities of the Pollution Prevention and Environmental Monitoring Department (7725) fell into the areas of air quality, surface water protection, groundwater protection, waste minimization, management of environmental records, and control of radiological releases. Actions to resolve the findings include developing a cost center for funding implementation of the Pollution Prevention Program, designing and installing monitoring and surveillance equipment, development and implementation of appropriate procedures, and implementation of a coordinated approach to flow and management of information related to multimedia environmental protection.

3.3.5 Tiger Team Summary, Risk Management and NEPA Department (7732)

The NEPA portion of the Tiger Team assessment resulted in the following five compliance findings:

1. NEPA review procedures and decision makings at SNL, Albuquerque
2. The sitewide EA
3. Appropriate NEPA reviews

4. Tracking and recordkeeping for NEPA and project documentation
5. Defining authority for NEPA determinations

SNL, Albuquerque, was found to share responsibility with the DOE for four of the these five findings. The lack of adequate sitewide NEPA documentation was found to be DOE responsibility exclusively.

Positive NEPA program elements were noted by the Tiger Team:

> The general impression of NEPA compliance at SNL, Albuquerque, is of a NEPA staff at SNL, KAO, and AL that has good understanding of the present requirements for compliance with DOE, and all of which are working hard to develop procedures that will ensure complete and timely compliance.

In regard to unauthorized NEPA determinations, the Tiger Team found:

> SNL, Albuquerque has begun to correct this problem with the issuance of the NEPA Program on January 29, 1991. . . , which clearly and accurately defines responsibilities for NEPA compliance at SNL.

A Tiger Team Action plan has been developed to correct NEPA program deficiencies which were uncovered by the Tiger Team assessment.

CHAPTER 4

ENVIRONMENTAL PROGRAMS INFORMATION

4.1 Environmental Restoration Program

The Environmental Restoration (ER) Program is a phased DOE program to identify, assess, and remediate past spill, release, or disposal sites at all DOE facilities including SNL, Albuquerque.

The initial identification of sites at the Albuquerque location was completed in 1987. The Installation Assessment Report identified 117 sites that would require further evaluation. Since completion of the Installation Assessment, additional sites have been identified, and the number of potential release sites at Albuquerque now totals 151. New sites identified since the last annual report have been small release and burial sites. It is anticipated that a few additional sites may be identified in the future. The 1990 annual report listed 157 sites. Since publication, the list has been reviewed and some duplication in sites and site numbers has been corrected. In addition, two sites were determined to be the responsibility of others agencies.

The individual potential release sites identified in the Installation Assessment and subsequent evaluations are grouped together within geographic and event-related boundaries. These groups of release sites are called Operable Units (OUs) for budget development and program tracking purposes. Table B-1 (see Appendix B) identifies the specific potential release sites that are assigned within an individual OU.

The grouping of potential release sites will allow the assessment investigations to collect samples efficiently and cost-effectively. The geographically derived groups will also provide an opportunity to collect installation generic data on a regional basis during a single sampling campaign.

The assessment and remediation of potential release sites identified by the ER Program at SNL, Albuquerque, will be monitored by the EPA under the Hazardous and Solid Waste Amendments of 1984 (HSWA) module of the Resource Conservation and Recovery Act (RCRA) Part B Operating Permit. The authority to investigate all Solid Waste Management Units (SWMUs) is directed by Section 3004(u) of the HSWA, which requires investigation of all past and present SWMUs which may have a potential for release of hazardous waste or hazardous constituent(s). Facilities seeking a RCRA permit are required to conduct these assessments and subsequent investigations if a release is found or suspected. Because the Part B permit is expected to be issued in 1992, the ER Program began utilizing the guidance for RCRA Corrective Action (CA) evaluations. During 1991, assessment efforts continued at the chemical waste landfill (CWL); the mixed waste landfill (MWL); Technical Area II; Technical Areas III and V, Septic Tanks and Drainfields; and the Liquid Waste Disposal System. One new groundwater monitor well was installed at the chemical waste landfill (see Chapter 7).

4.2 Underground Storage Tank Management and Spill Prevention Control Plan

Spill control activities at SNL, Albuquerque, are orchestrated by several plans and programs. Spill Prevention Control and Countermeasure (SPCC) Plans for SNL, Albuquerque, Tonopah, and Livermore are augmented at SNL, Albuquerque, by an Oil Spill Response Plan and a Hazardous and Radioactive Materials SPCC Plan.

4.2.1 Underground Storage Tank Management

Underground storage tanks (USTs) at SNL, Albuquerque, are managed in accordance with the State of New Mexico UST Regulations. The New Mexico UST Regulatory program has been approved by the EPA Region VI in accordance with 40 CFR 281.

SNL, Albuquerque's, inventory of active USTs was reduced in calendar year (CY) 1991 from 33 to 16. Fourteen out-of-service USTs at six sites (605-7 through 11, 876-1, 6028-1, 6500-1, 6503-1, and 6595-1 through 5) were permanently closed by removal, two USTs registered in error (970-3 and 983-9) were deregistered, and one UST (888-3) was abandoned in place for later removal.

The New Mexico Environment Department (NMED) was notified at least 30 days in advance of each removal. An NMED representative was present at each removal to inspect the tank, piping, and excavation zone soils. Soil samples were taken from the excavation zone in locations identified in the NMED Soil Sampling Guidelines. All samples were sent to an approved laboratory for analysis as required by NMED UST regulations. Releases confirmed by soil sample analytical results greater than the regulatory thresholds were reported immediately to the NMED. Visual contamination in the excavation zone from spill/overfill was present at five of the six removal sites. Three USTs (876-1, 6500, and 6503-1) were found to have released hazardous products through penetrations in the tanks. One UST system (6028-1) showed no visible evidence of release; laboratory analytical results confirmed contamination levels were below regulatory concern for this site.

Onsite investigations (OSIs) were performed at the five confirmed release sites by advancing boreholes through the contamination zones. The locations of the borings were negotiated with the NMED before the OSIs began. Final reports of the OSIs were submitted to the DOE for transmittal to the NMED for review and approval. NMED approval for the majority of these sites is pending.

Two USTs (970-3 and 983-9) that were incorrectly registered as containing hazardous products were deregistered when it was discovered they were sumps and registration was not required.

One out-of-service UST (888-3) was closed through abandonment in place rather than removal because it is close to two other USTs that remain in service. The abandonment was performed in compliance with the NMED UST regulations and American Petroleum Institute (API) guidelines. The tank will be removed when the adjacent tanks are removed.

4.2.2 Spill Prevention Control and Countermeasure Plan

Oil spill control activities at SNL, Albuquerque, are coordinated by the Spill Prevention Control and Countermeasure (SPCC) Plan. This plan was prepared in accordance with 40 CFR 112. The 3-yr review and rewrite of the SPCC Plan, completed in 1990, was sent to the DOE for approval.

Activities for 1991 included:

- Completed preparation of an Oil Spill Contingency Plan
- Annual update of the SPCC Plan
- Design completion of projects to upgrade the 42 Priority I sites, in the SNL, Albuquerque SPCC Plan
- Annual inspection of the regulated facilities, for SNL, Albuquerque
- Initiated training courses for spill prevention

4.3 Waste Management Programs

4.3.1 Hazardous Waste and the Resource Conservation and Recovery Act (RCRA)

All RCRA-regulated wastes generated by SNL, Albuquerque, are transported offsite for disposal at EPA-permitted Treatment, Storage, and Disposal Facilities (TSDFs). The CWL located in Technical Area III was used for onsite disposal from 1962 through November 1985. A RCRA Closure Plan for the facility was submitted to the NMED in May 1988. Negotiations with the NMED on the closure continued during 1991. This landfill is no longer used for disposal of hazardous chemicals.

Chemical wastes generated by SNL, Albuquerque, research and development (R&D) activities are collected from generator locations, segregated according to DOT hazard class, and transported to the Hazardous Waste Management Facility (HWMF) for storage. At the HWMF, the wastes are consolidated and packaged according to U.S. Department of Transportation (DOT) and EPA requirements. Packaged wastes are transported by EPA-permitted carriers to EPA-permitted TSDFs or recyclers for final disposition.

The EPA-permitted commercial transporters used to transport SNL hazardous waste during 1991 are listed in Table 4-1. The permitted TSDFs, recyclers, and the waste treatment methods employed at each facility are listed in Table 4-2.

During CY 1991, 847,094 kg of chemical wastes were managed by SNL, Albuquerque's, chemical waste management program, including 293,583 kg of RCRA-regulated hazardous waste and 553,511 kg of nonregulated industrial wastes. In CY 1991, a total of 36,339 packages were collected from SNL, Albuquerque, generators put into 6605 containers, and sent to TSDFs and recyclers. The continuing laboratory-wide environment, safety, and health

Table 4-1. SNL, Albuquerque, Hazardous Waste Transporters Used in CY91[a]

1. Rinchem Company, Inc.
2. Safety-Kleen Corp.
3. Sandia
4. USPCI
5. EASE
6. SW Radiographics
7. Mesa Oil
8. Custom Environmental Transport
9. Technical Transporters, Inc.
10. ETSC
11. ENSCO, Inc.

[a]Identification of these companies is not necessarily an endorsement of their services by SNL, Albuquerque.

Table 4-2. SNL, Albuquerque, Waste Disposal Facilities Used in CY91[a]

Disposal Facility	Treatment
1. Hydrocarbon Recycles, Inc.	Kiln Fuel/Recycling
2. USPCI (Grassy Mountain, UT)	Stabilization, Encapsulation, Landfill
3. ENSCO, Inc.	Incineration
4. Rollins Env. Svcs., Inc. (LA)	Incineration
5. Rollins Env. Svcs., Inc. (TX)	Incineration
6. RSR Corporation	Recycling
7. Inmetco	Metals Recycling
8. Exide	Metals Recycling
9. Mercury Refining	Metals Recycling
10. Chemical Waste Management-OSCO	Kiln Fuel/Recycling
11. BDT, Inc.	Hydrolysis of Reactive Metals
12. Mesa Oil	Recycling
13. Southwest Radiographics	Metals Recovery
14. Kirtland Landfill	Non-RCRA/Non-Environmentally Hazardous Trash
15. USPCI (Lone Mountain, OK)	Stabilization, Encapsulation, Landfill
16. Kirtland EOD Range	Open Detonation/Open Burn
17. Safety-Kleen	Solvent Recycling
18. Kenbruski Bros.	Metal Recycling

[a]Identification of these companies is not necessarily an endorsement of their services by SNL, Albuquerque.

(ES&H) compliance improvement initiative at SNL, Albuquerque, and site remediation activities resulted in a two-fold increase over the volume of chemical waste managed in CY 1990.

SNL, Albuquerque's, Thermal Treatment Facility (TTF) is operated under EPA interim status and is part of the light initiated high explosives (LIHE) site, Building 6715. This facility simulates the X-ray-induced blowoff impulse effects from an exoatmospheric nuclear burst on space structures by remotely spraying a space structure with silver acetylide-silver nitrate (SASN) and detonating the SASN at a capacitor bank-powered light source. The TTF was constructed to thermally treat residual explosives that are formulated and used at the LIHE facility. In CY 1991 the TTF treated 49 kg of these residual explosives, which are too reactive to be transported offsite.

Permitting Activities

The NMED issued a draft RCRA permit for the HWMF storage activities. Treatment activities at the TTF continue to operate under interim status. A draft permit for the TTF will be issued later.

At the end of the HWMF draft permit comment period, the NMED and EPA Region VI decided that a public hearing would be held in the first quarter of CY 1992. A permit should be issued after consideration of all comments before the end of CY 1992.

4.3.2 Radioactive Waste

Onsite disposal of low-level waste (LLW) was terminated in December 1988 at SNL, Albuquerque, by DOE order. Presently, all newly generated LLW and mixed waste (MW) are stored temporarily aboveground at permitted generator sites or in transportation containers at the inactive Technical Area III disposal site. During 1991 approximately 3300 ft^3 of waste weighing 3400 kg was accepted at the Technical Area III storage site. This waste consisted primarily of fission product and uranium (U)-contaminated waste on a volumetric basis, and tritium (^3H)-contaminated waste on an activity basis.

Base construction of the Radioactive and Mixed Waste Management Facility (RMWMF) was completed in 1990. When operational this 6000-ft^2 facility will serve as a centralized packaging and storage facility for LLW and LLW-MW that meets the facility waste acceptance criteria (WAC). An environmental assessment (EA) was prepared for the RMWMF and submitted to the DOE in 1990, with a request for approval of a Finding of No Significant Impact (FONSI). In addition, a Safety Analysis Report for the RMWMF was submitted to DOE for review in 1991. It is projected that the RMWMF will be operational in 1993.

SNL, Albuquerque, generates approximately 5 ft^3 of transuranic (TRU) waste per year. Ultimately, the TRU waste generated at SNL, Albuquerque, will be disposed of at the Waste Isolation Pilot Plant (WIPP). Currently, all TRU waste is packaged and stored at generator-controlled locations.

4.3.3 Mixed Waste

In August 1990 SNL, Albuquerque, submitted a RCRA Part A permit application to NMED for the storage and treatment of mixed waste. SNL, Albuquerque, is currently preparing a RCRA Part B permit application for submittal to NMED. In 1991 development of programs, plans, and procedures was initiated so that requirements specified by the following regulations will be met for radioactive and mixed wastes generated at SNL, Albuquerque:

- Characterization of MW, 40 CFR 261
- Storage and treatment of MW, 40 CFR 265
- Land disposal restrictions (LDRs) applicable to the storage and treatment of MW, 40 CFR 268
- DOE requirements for the management of radioactive and MW, DOE Order 5820.2A
- Waste acceptance criteria for the disposal of LLW and MW at the Nevada Test Site, NVO-325
- Waste packaging and certification of TRU wastes, WIPP Waste Acceptance Criteria

4.3.4 Special-Case Waste

In 1991 SNL, Albuquerque, initiated a site-wide inventory of six categories of special-case (SC) waste:

- DOE comparable greater-than-Class-C (SC-GTCC)
- Performance assessment limiting (SC-PAL)
- Uncertified or uncharacterized (SC-US)
- Noncertifiable, nontransportable TRU (SC-TRU)
- High-level, incidental (SC-HLI)
- Commercially held, DOE-owned materials (SC-COM)

It is anticipated that this inventory will be completed in September 1993. The scope of this identification and characterization effort is significantly larger than that of previous efforts to identify similar types of wastes, which consisted mainly of identifying SC-GTCC wastes. The current scope includes existing and potential wastes in the above six SC waste categories and will provide information necessary for EPA permits. Potential waste is included because these wastes must be disposed of in the short-term future and may require development of special management and disposal strategies. Potential SC waste includes materials which are not now waste but may be declared waste (and meet the special-case criteria) in the future. Information on potential waste will be used to assist in long-term management planning.

4.3.5 Polychlorinated Biphenyl Waste

SNL, Albuquerque, is in the process of phasing out polychlorinated biphenyl (PCB) waste oils and equipment to the greatest extent possible. All electrical distribution equipment (transformers and switches) found to contain PCBs in concentrations of ≥50 ppm have been either removed from service for disposal or retrofitted to contain <50 ppm PCBs.

Nondistribution electrical devices, such as high-voltage power supplies, and a wide variety of oil-containing equipment, such as vacuum and hydraulic systems, have been checked for PCBs at SNL, Albuquerque. All but a few of these items were found to be free of PCBs. The items that do contain PCBs in concentrations ≥2 ppm are on an inventory list and will be properly disposed of when the users no longer need the items for service.

4.3.6 Waste Minimization Program

A formal waste minimization and pollution prevention awareness program was initiated in 1989 to comply with EPA regulations and DOE Orders 5400.1, 5400.3, and 5820.2A. It addresses nonhazardous, hazardous, mixed, and radioactive wastes, with the following goals:

- Foster a cradle-to-grave philosophy in order to conserve resources
- Minimize waste and pollution while achieving strategic objectives

A Waste Minimization Network (MinNet) was formed with representatives from all SNL organizations, providing a communication link between waste-generating organizations and waste management organizations. MinNet representatives will help their organizations carry out the pollution prevention program in the following ways:

- Develop and maintain detailed process waste assessments to identify opportunities for pollution prevention
- Provide necessary information for waste characterization and certification
- Implement pollution prevention strategies and technologies

A Waste Minimization and Pollution Prevention Awareness Plan was completed in December 1991. The plan addresses activities and methods that will be used to reduce the quantity and toxicity of waste and materials at all SNL sites. Process waste assessments (PWAs) will identify the use of hazardous and radioactive materials and the generation of waste in specific operations. As a result of the PWAs, waste minimization opportunity assessments (WMOAs) will be conducted on those processes and operations that need to be improved or replaced in order to promote waste minimization. Preliminary PWA guidance, based on DOE and EPA guidance, has been completed and four preliminary PWA prototypes have been conducted.

The waste minimization schedule projects completion of a joint EPA/SNL process waste assessment, final PWA guidance, and a prototype PWA from each major waste-generating organization during fiscal year (FY) 1992. The joint EPA/SNL PWA project will focus on tailoring the assessment process to the R&D environment rather than the industrial/production environment of previous PWAs. Then the SNL PWA guidance will be appropriately modified and the directorate prototype PWAs will be conducted.

In 1993, PWAs on all processes at SNL, Albuquerque, are expected to be completed, and formal waste minimization opportunity assessments will be initiated.

A cost accounting system is being developed which will allow a financial charge-back to waste generating organizations based on their waste production. Funds collected through this system will support MinNet activities. The Waste Minimization Implementation Center, a centralized waste management information hub, will manage this cost accounting system; it will be operational in October 1992.

A comprehensive material tracking system to support the waste minimization methodology is being developed. This system will follow the movement of material from procurement, through use in processes and operations, to final disposition. Bar-coded tracking systems will be used for incoming material and for waste management; PWAs will follow materials within processes and operations. At this time, the operational portions include the Chemical Exchange Program (initiated in 1989) and the Hazardous Waste Data Management System (HWDMS). In 1992, a bar-coded chemical procurement control system and a Chemical Information System, modeled after a similar system installed at SNL, Livermore, will begin operation.

The Chemical Exchange Program is a centralized operation that redistributes surplus chemicals to avoid the unnecessary disposal of usable materials. This program has doubled in volume since 1989. Efforts are underway to increase the distribution network outside SNL, Albuquerque. Although the program is expanding its supply base, it is expected that as waste minimization efforts increase, the overall supply of excess chemicals will level off or decrease.

An SNL Halogenated Materials Elimination Project is being developed to address growing concerns about the use of chlorofluorocarbons (CFCs) and other halogenated chemicals. This project will facilitate the SNL-wide transition to nonhalogenated materials.

An informal survey of waste minimization activities was completed in 1991. It requested that operations describe their waste minimization accomplishments since 1989. The responses were compiled into a form that will allow organizations to share experiences and ideas. The survey results identify options that can reduce the volume and toxicity of materials and wastes generated by various types of operations.

4.4 National Environmental Policy Act of 1969 Compliance Activities and Documentation

Background

The National Environmental Policy Act (NEPA) is the nation's most comprehensive legislative and public policy statement for environmental protection. It applies to all agencies of the federal government.

Executive and DOE orders and DOE guidance apply NEPA and NEPA-related activities to SNL.

The Council on Environmental Quality (CEQ), created by the Executive Office of the President under the authority of NEPA, established regulations that were formally adopted by the DOE in August 1979. DOE NEPA guidelines were last published in full in the Federal Register on December 15, 1987.

On November 2, 1990, the DOE proposed (55 FR 46444) to revise its existing rule of 10 CFR 1021, entitled "Compliance with the National Environmental Policy Act." The proposed rule incorporates certain policy initiatives instituted by the Secretary of Energy and will revise the DOE NEPA guidelines as regulations. The final rule, expected to be issued soon, is more specific and detailed regarding NEPA requirements than the current guidelines. In particular, public review opportunities will be enhanced.

Although only the DOE has authority to decide the appropriate level of NEPA documentation, SNL assists the DOE by drafting appropriate documentation (such as environmental checklists [ECLs], action description memoranda [ADMs], and EAs) for DOE approval.

NEPA documents serve as vehicles for assessing potential environmental impacts of proposed federal actions and disclosing federal activities.

At SNL, Albuquerque, Department 7731 conducts various NEPA-related activities, including consulting with and training line organization personnel in NEPA compliance, coordinating document preparation, maintaining a corporate NEPA document file, and reviewing NEPA documents before their submittal to the DOE. These responsibilities are documented in the SNL's NEPA Program Document (PG470110), which was approved in early 1991.

1991 Activities

A third staff member was assigned in late 1991 to assist in maintaining NEPA compliance.

The Secretary of Energy's February 5, 1990, National Environmental Policy Act Notice (SEN-15-90) with directives intended to bring the DOE into full compliance with NEPA, set in motion events that have led toward a major increase in commitment to the principles and practices underlying the NEPA. New compliance and guidance procedures are being developed by both the DOE and SNL. These new requirements have greatly increased the number of EAs that must be written.

SNL worked with the DOE to provide input for the DOE's NEPA rulemaking. SNL also provided information for the preparation of the DOE "Nuclear Weapons Complex Reconfiguration Programmatic Environmental Impact Statement" (PEIS). This PEIS is one of the most important DOE projects undergoing NEPA review.

Compliance with environmental laws concerning cultural resources, such as the National Historic Preservation Act, helps fulfill NEPA policy objectives and provides information on the environmental impacts that must be addressed in the NEPA process. SNL provided DOE information on historic preservation for a New Mexico Archaeological Council Section 196 Compliance Handbook. In support of NEPA documentation, several archaeological surveys were completed for SNL, Albuquerque, and the Tonopah Test Range (TTR). No significant cultural resources were located on DOE-owned properties.

Several surveys for threatened, endangered, and sensitive species and habitats were conducted in 1991 to achieve NEPA policy objectives and to provide information on environmental impacts that must be addressed in the NEPA process. No federally-listed threatened or endangered species are known to occur on Kirtland Air Force Base (KAFB). However, state-listed endangered plants do occur within KAFB.

Professional trainers coached SNL, Albuquerque, employees on NEPA processes. The objectives of the training were to enhance efficiency and effectiveness in complying with NEPA. A one-day "NEPA Executive Overview" was conducted for 89 employees (mainly managers and supervisors). A three-day course, "Applying the NEPA Process," focused on making NEPA an integral part of the regular planning and management process. A total of 71 SNL, Albuquerque, professional staff attended this course.

Gathering information for a baseline report to characterize the existing environment on lands used by SNL, Albuquerque, was initiated in 1991. In 1992 this information will be compiled into a report designed to promote uniformity in the quality of baseline information in SNL, Albuquerque, NEPA documents.

Environmental Checklists

Environmental checklists (ECLs) are used to document the use of a categorical exclusion (a category of actions for which neither an EA nor an environmental impact statement [EIS] is normally required).

Action Description Memoranda

Action description memoranda (ADMs) are documents that contain concise descriptions of proposed actions and brief discussions of relevant potential environmental issues. The DOE uses ADMs to determine the appropriate level of NEPA documentation for proposed actions. Actions which are not categorically excluded or covered in approved NEPA documents require preparation of EAs or EISs.

Environmental Assessments

An environmental assessment (EA) is a concise public document intended to provide, in brief, sufficient evidence and analysis for determining whether to prepare an EIS or a FONSI. The primary purpose of an EA is to evaluate a proposal for the possibility of significant impacts. The EA also aids in the compliance with NEPA when no EIS is required and facilitates preparation of an EIS when one is necessary.

Figure 4.1 describes the sequence for creating and reviewing NEPA documents.

EA Findings of No Significant Impact

Two FONSIs were issued in 1991: the Integrated Materials Research Laboratory (IMRL), February 15, 1991, and the Kauai Test Facility Two Experiment Rocket Campaign, March 6, 1991.

At the end of 1991, 16 EAs were under development (see Appendix I). The approval status of ECLs and ADMs are listed in Appendix I in Table 1 and Table 2.

Environmental Impact Statements

An EIS is a detailed written statement on major federal actions that significantly affect the quality of the human environment.

Figures 4-2 and 4-3 are flow charts of the EA and EIS processes.

Mitigation Action Plan

A mitigation action plan (MAP) describes the plan for implementing commitments made in DOE NEPA documents to mitigate adverse environmental impacts associated with an action.

4.5 Environmental Monitoring Programs

The Environmental Monitoring Program at SNL, Albuquerque, ensures compliance with pertinent environmental monitoring requirements. This program began in 1959; its original objective was to monitor radioactive effluents and associated environmental impacts resulting from SNL, Albuquerque, operations. The program has expanded greatly to encompass nonradioactive effluent monitoring, hazardous and radioactive waste site monitoring, and other environmental compliance activities. The program has grown in response to new environmental regulations as well as expanded SNL, Albuquerque, research programs.

The current environmental monitoring and compliance activities at SNL, Albuquerque, are described and documented in this report as required by DOE Order 5400.1, "General Environmental Protection Program." New programs which have been initiated within the past 4 yrs include a remedial action program (Section 4.1), a groundwater monitoring program (Chapter 7), a greatly expanded wastewater sampling program (Section 6.1), a UST removal program (Section 4.2.1), and an improved spill prevention program (Section 4.2.2).

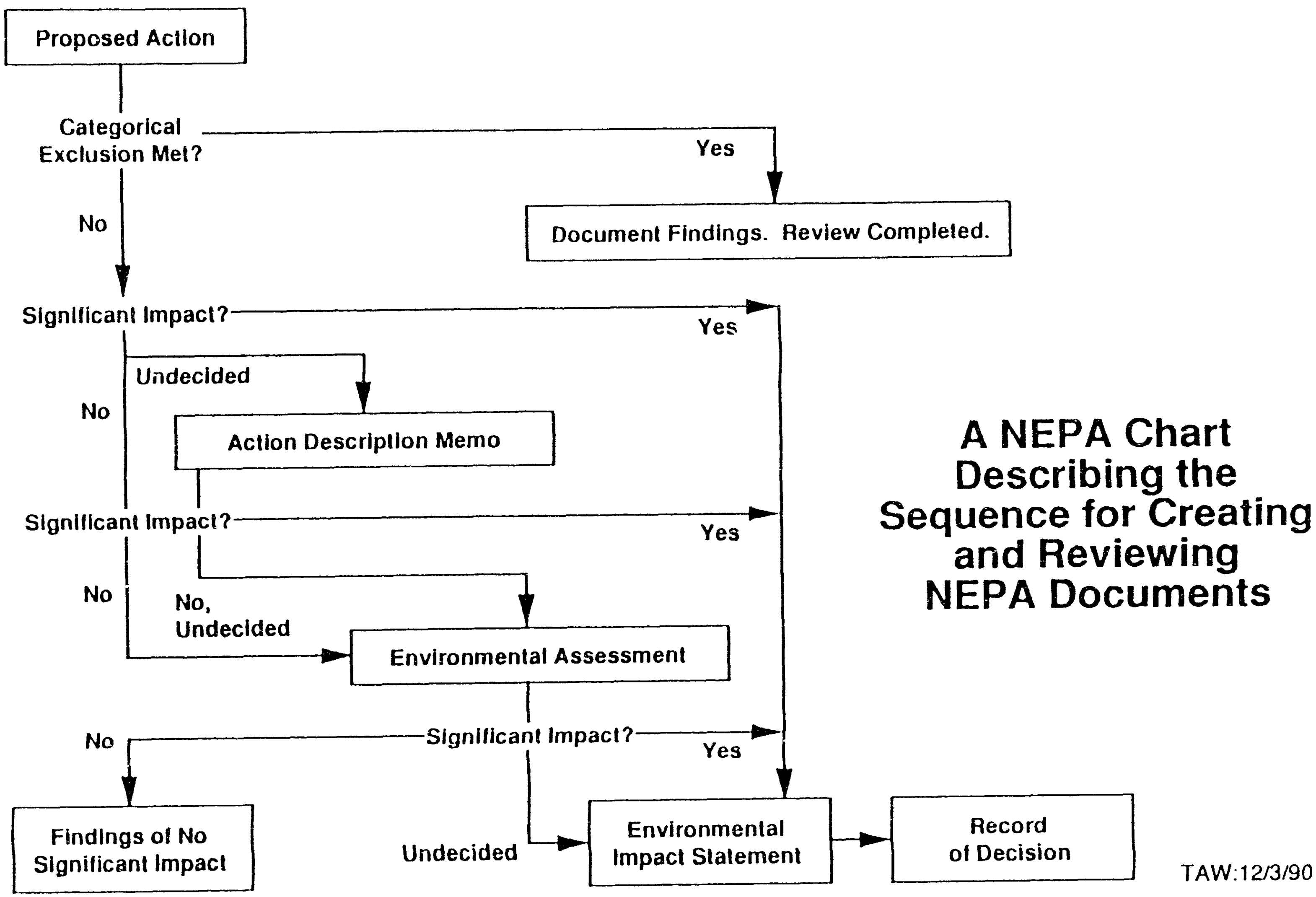

Figure 4-1. Sequence for Creating and Reviewing NEPA Documents

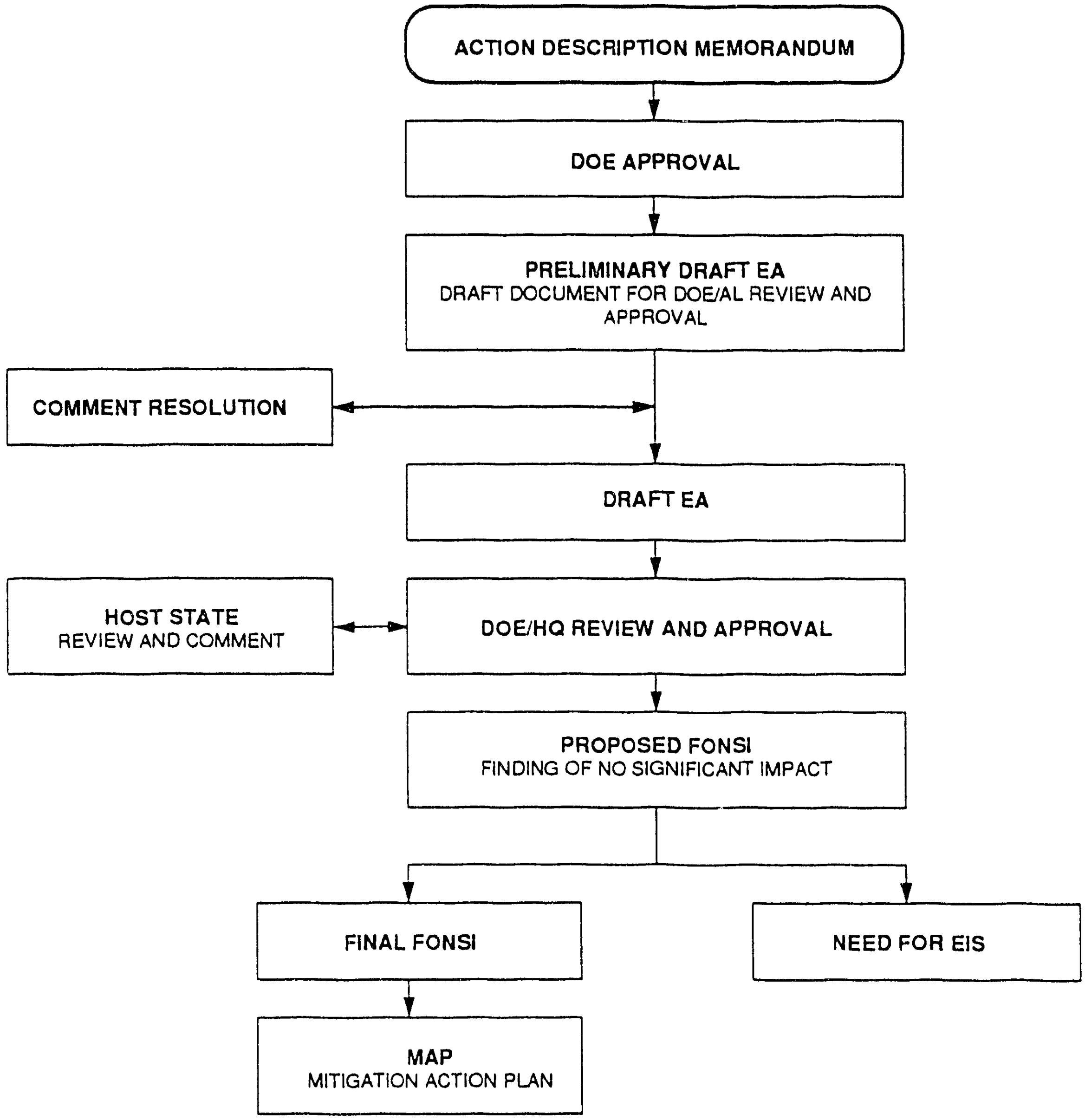

Figure 4-2. Flow Chart of the EA Process

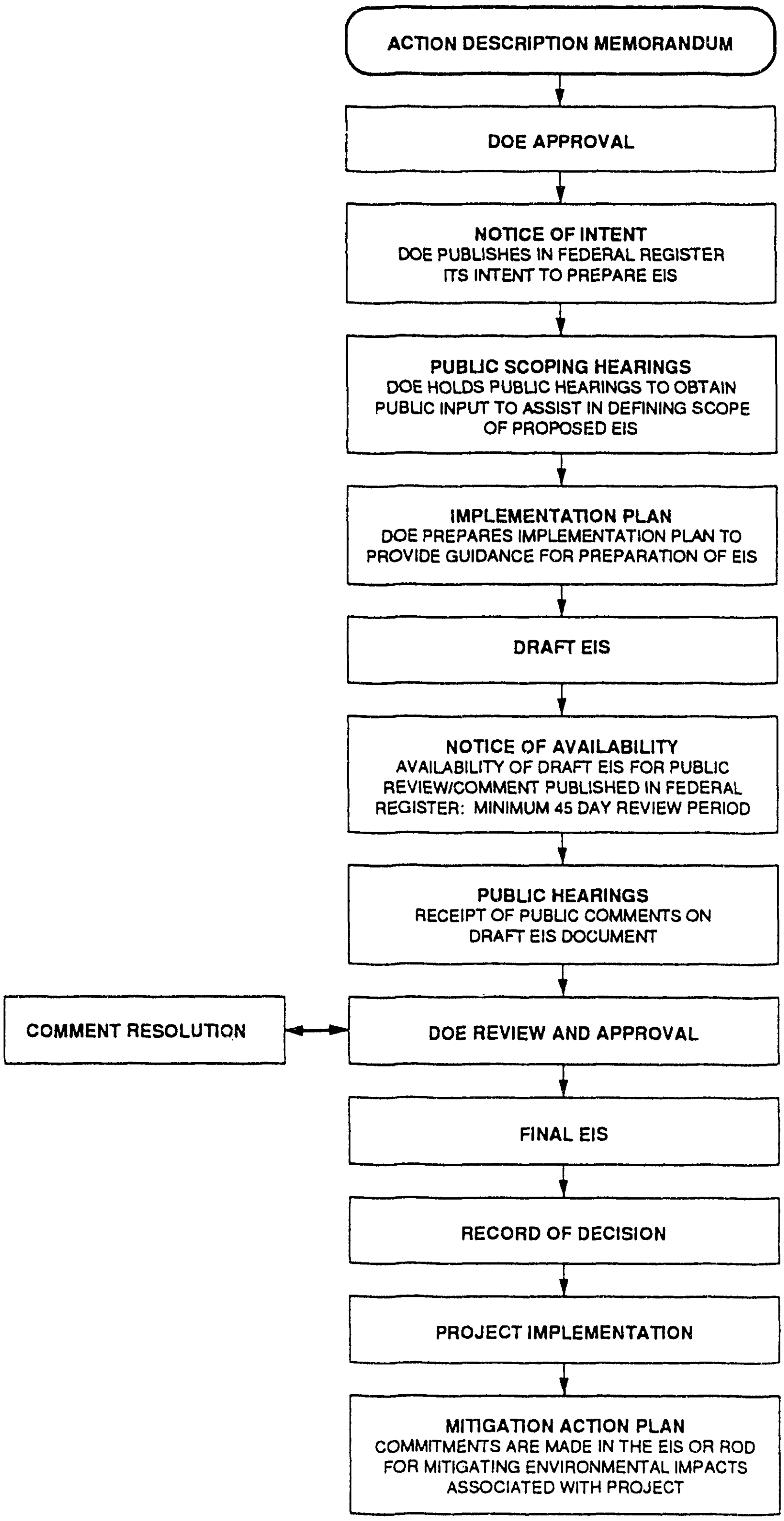

Figure 4-3. Flow Chart of the EIS Process

The radiological monitoring programs, which consist of environmental surveillance of soil, vegetation, surface water and well water, and external gamma radiation measurements by thermoluminescent dosimeters (TLDs), are summarized in Chapter 5. The sampling locations are reviewed and, if necessary, modified each year to reflect any operational changes. The number of sampling stations increased significantly in the past several years to include more perimeter and community locations (see Section 5.2).

The nonradiological monitoring programs, including those for wastewater monitoring, groundwater monitoring, and selected air quality monitoring, are summarized in Chapters 6 and 7. The nonradiological monitoring results were submitted to regulatory agencies (e.g., State of New Mexico or City of Albuquerque) in accordance with the regulations and permit requirements.

4.6 Summary of 1991 Release and Environmental Incidence Reporting

Reporting Requirements

The four types of external release reporting requirements are (1) the Reportable Quantity (RQ) Release Reporting, (2) the Radioactive Effluent Information System/Onsite Discharge Information System (EIS/ODIS) Annual Report, (3) the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Radionuclides (Subpart H) Annual Report, and (4) the Superfund Amendment and Reauthorization Act (SARA), Section 313, Toxic Chemical Release Report.

RQ Reporting

RQ reporting is required by the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the SARA, Title III. It requires that any release to the environment in any 24-hr period of any pollutant or hazardous substance in a quantity that was equal to or greater than the RQ be reported immediately to the National Response Center (NRC). However, if the release is "Federally permitted" under CERCLA Section 101(10)(H), it is exempted from CERCLA reporting. This reporting exemption also applied to any federally-permitted release under the SARA, Title III.

The Annual Summary of 1991 RQ Release Reporting for SNL, Albuquerque, is listed in Table 4-3. Both releases were caused by routine testing utilizing NIKE rocket motors, which contain lead acetate as part of the propellant. These tests were conducted under the approval of an ADM dated June 5, 1986. Other accidental releases are discussed individually in the Summary of 1991 Environmental Incidence Reporting in this section.

EIS/ODIS Reporting

DOE Order 5400.1 requires that the radioactive effluent and onsite discharge data of the previous year for all planned and unplanned releases must be reported to the Waste Information System Branch, Edgerton, Germeshausen, & Grier Corp. (EG&G) Idaho, Inc., by April 1 each year.

Table 4-3. Annual Summary of 1991 Reportable Quantity (RQ) Release Reporting

Date	SNL, Albuquerque, Location	Material	Quantity (lb)	RQ (lb)	Release To	NRC Number	Report Date
01/30/91	Sled Track	Lead	3.73	1.0	Air	57297	01/30/91
01/31/91	Sled Track	Lead	3.73	1.0	Air	57466	01/31/91

The EIS/ODIS report for 1991 was submitted to the Waste Information System Branch, EG&G Idaho, Inc., in March 1992. It covered all routine and non-routine releases from SNL, Albuquerque, operations. The Technical Area V reactors (the Annular Core Research Reactor [ACRR] and the Sandia Pulsed Reactor [SPR]) produced the major radioactive air releases. During 1991, SNL, Albuquerque, released a total of 3.5 Ci of argon-41 (^{41}Ar), 0.5 Ci of krypton-85 (^{85}Kr), ~0.2 Ci each of nitrogen-13 (^{13}N) and oxygen-15 (^{15}O), and 0.02 Ci of ^{3}H and other μCi levels of fission and activation products. All of these releases were within regulatory limits.

National Emission Standards for Hazardous Air Pollutants Reporting

The NESHAP Standards of 40 CFR 61, Subpart H, for radionuclides requires that an annual report from each DOE site must be submitted to the EPA by June 1 each year. The report includes the calculated maximum offsite dose impacts (effective dose equivalent) to the nearby public receptors and the associated input data for this calculation (40 CFR 61.94[c]). The NESHAP annual report will be submitted to EPA Region VI before June 1, 1992.

The results of the dose assessment for the public due to SNL, Albuquerque, operations in 1991 is discussed in detail in Section 5.3.

Toxic Chemical Release Reporting

The Toxic Chemical Release Report is required by the SARA, Title III, Section 313 (40 CFR 372). The SARA requires that facilities (within Standard Industrial Code [SIC] of 22 to 39) report releases of listed toxic chemicals if the usage quantity is greater than 10,000 lb/yr for any of the listed chemicals. Although SNL, Albuquerque, operation is not categorized within the specified SIC code, it will report the toxic chemical releases to the DOE and EPA in June 1992.

Environmental Incidence Reporting

For CY 1991, there was a total of 33 environmental incidents reported (Table F-6). One environmental incident number was reserved but not used because a release did not occur. The total number of documented environmental releases was 32.

There were 9 facilities system cooling water releases, 6 hazardous materials releases, 11 hydraulic or motor oils releases, 4 petroleum product releases, 1 liquid carbon dioxide release, and 1 potentially radioactive contaminated water release. Of the 32 environmental incidents reported, there were no reportable quantities.

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CHAPTER 5

RADIOLOGICAL MONITORING

SNL, Albuquerque, has maintained an environmental radiological monitoring program since February 1959 (Burnett et al., 1961; Brewer, 1973, 1974; Holley, 1975; Holley and Simmons, 1976; Simmons, 1977, 1978, 1979, 1980; Millard, 1981; Millard et al., 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989; Hwang et al., 1990, 1991). The objectives of this surveillance program are to detect any potential releases and/or migration of radioactive material related to onsite operations to offsite locations. Another objective of this program is to determine potential (if any) impacts of site-related activities to the offsite population and the surrounding environment. This monitoring program also provides a check on the effectiveness of reactor radiological safety systems in effect at Technical Area V. Soil and vegetation are monitored for tritium (^{3}H) and undergo gamma screening analysis; soil is also monitored for uranium (U). Gross alpha, beta, and gamma screening analysis and U and ^{3}H analysis are performed on water samples.

In addition to these elements of the SNL, Albuquerque, radiological surveillance program, another program was begun in 1981 which uses thermoluminescent dosimeters (TLDs) to measure ambient levels of external gamma radiation at each major facility. TLD monitoring locations are also present around the SNL, Albuquerque, perimeter, and locations in the surrounding community. Before a facility's contribution to a population dose can be calculated for an unplanned release, a good estimate of ambient background with its inherent variability must be available. This can be achieved by setting up TLD stations around a new facility, such as the Radioactive and Mixed Waste Management Facility (RMWMF), before it begins operation. Natural background radiation levels are affected by many environmental factors, including ground cover and seasonal variations in precipitation.

5.1 Radioactive Effluent Monitoring

Few facilities within SNL, Albuquerque, routinely generate radioactive effluents or emissions. These facilities include the accelerators in Technical Area IV (e.g., HERMES-III Accelerator and Particle Beam Fusion Accelerator-II [PBFA-II]), the reactor facilities in Technical Area V (e.g., the Annular Core Research Reactor [ACRR], Hot Cell Facility [HCF], and Sandia Pulsed Reactor [SPR]), the Neutron Generator Test Facility (NGTF) in Technical Area II, and small accelerators and tritium labs in Technical Area I.

Calculations indicate that small quantities of ^{3}H, nitrogen-13 (^{13}N), oxygen-15 (^{15}O), argon-41 (^{41}Ar), krypton-85 (^{85}Kr), and xenon-135 (^{135}Xe) emissions were released to the atmosphere as a result of SNL, Albuquerque, 1991 operations. Because SNL, Albuquerque's, radionuclide air emissions are so small, they are not measurable, and the release data are calculated based on theoretical parameters such as reactor operating power (in MJ) and the conversion factor for the activation products (in μCi/MJ) for the generation of noble gases (e.g., ^{41}Ar) from the reactors in Technical Area V. Figure 5-1 summarizes these annual air emissions from 1978 to 1991.

Technical Area V Reactors

Noble gases and small quantities of tritium are released from Technical Area V reactor stacks. High-efficiency particulate air (HEPA) filters are used to filter out particulates from the Sandia Pulsed Reactor (SPR), ACRR, and HCF exhaust air. Charcoal filters are used to collect noble gases and halogen from the SPR and ACRR stack exhaust air. Gamma scans are performed on the filters to check for specific activities. Particulate or gaseous grab samples are collected periodically or as necessary for specific radionuclide analyses. These results were used as a confirmatory measure to verify the calculated values.

The SPR reactor filter banks consist of a prefilter, HEPA filter, and charcoal filter. A radiological air monitor (RAM) is located on the stack exhaust downstream of the filter banks. Grab samples are collected periodically using a low-volume particulate air filter which is analyzed using gamma spectroscopy techniques.

The ACRR reactor filter banks also consist of a prefilter, HEPA filter, and charcoal filter. The ACRR has two exhaust stacks. The main room stack in the high bay is equipped with two continuous air monitors (CAMs), a particulate and a gaseous air monitor, as well as a RAM which is located on the HEPA filter housing. Gamma and beta scans are performed on the filters to determine the gross activity. Particulate or gaseous grab samples are also collected, if necessary, for more detailed analysis (i.e., ^{41}Ar) with a multichannel analyzer (MCA). The second ACRR exhaust stack, the central cavity purge stack, has a particulate CAM as well as a RAM which is located directly on the HEPA filter housing. Grab samples for the MCA analysis can also be collected.

The Technical Area V HCF filter banks are equipped with a prefilter and HEPA filters. RAMs are located on the filter banks on both the cold exhaust and hot exhaust. Grab samples for particulates can also be collected, if needed for further analyses. These results have been used for evaluation of the exhaust filtration system.

Isokinetic sampling equipment has been installed within the main stack of the HCF and the ACRR stack to collect air samples. Both monitoring systems were being calibrated and tested in 1991. Continuous effluent sampling and analyses are performed for gross alpha and beta, noble gases, and iodine. When the monitoring system becomes operational, the results of the continuous air sampling and analyses will be reported.

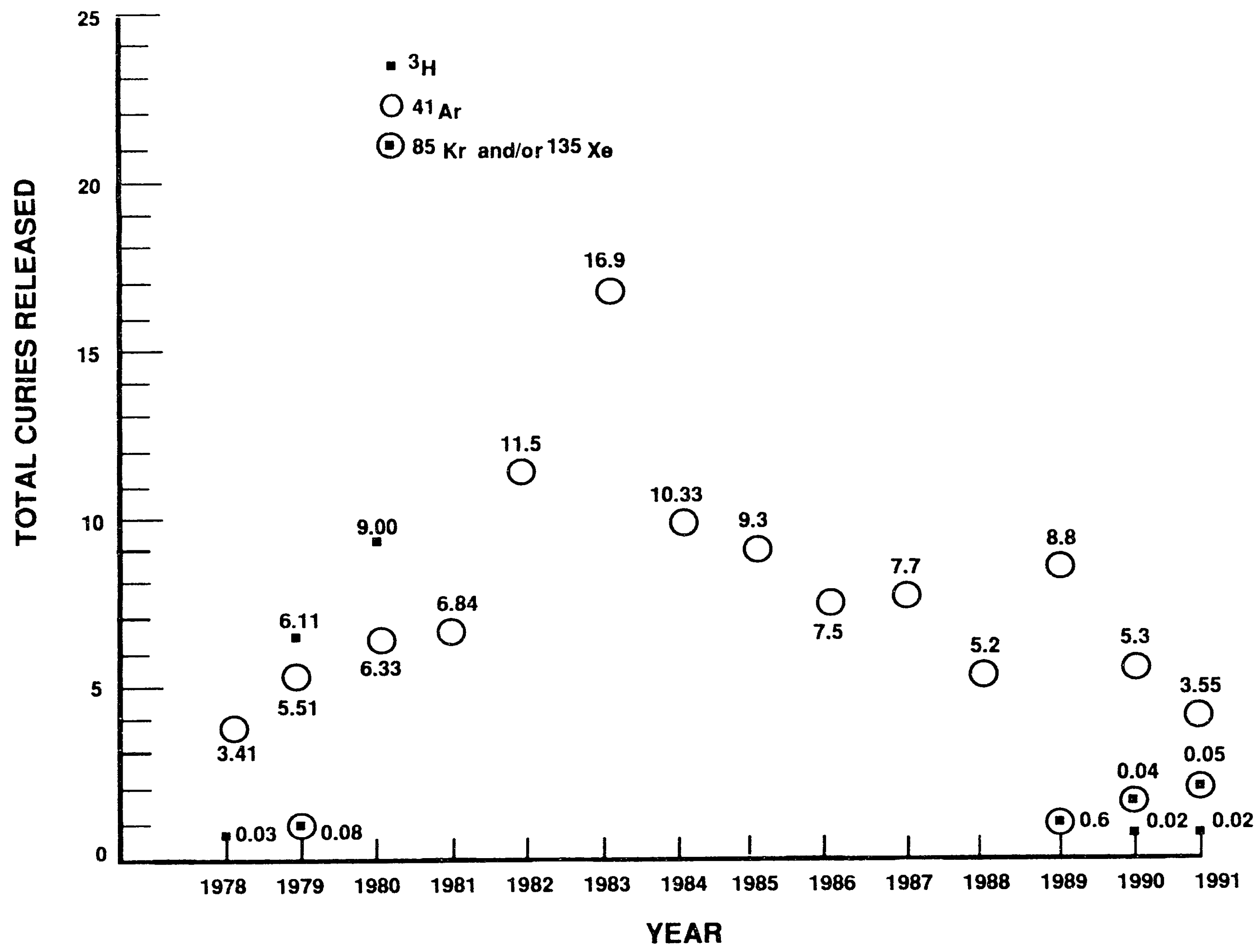

Figure 5-1. Summary of Atmospheric Releases of ^{41}Ar, ^{3}H, ^{85}Kr, and ^{135}Xe From SNL, Albuquerque, Facilities Since 1978. Values reported as less than one Curie are not to scale.

5.2 Environmental Sampling and Surveillance

Monitoring Locations

Most environmental surveillance locations remain essentially the same from year to year (Figures 5-2 and 5-3). Selection of these sampling locations was based on potential releases, past contamination areas, and other potential impacts to the offsite residents and the surrounding environment.

Table 5-1 lists the SNL, Albuquerque, environmental monitoring locations and specifies the type of sample collected (vegetation, water, and soil) and the presence of a TLD station for each location. There are a total of 70 sampling locations: 40 onsite at SNL, Albuquerque; 14 within KAFB boundaries; and 16 community or background sites distributed in and around Albuquerque within an 80-km radius of SNL, Albuquerque. Water monitoring locations include ten KAFB wells and three surface water locations. Groundwater samples for radiological analysis are collected from base wells in use at the time of sample collection; sampled wells may differ from one year to the next. In cases of replicate sampling, only the first sample collected (sample A) is used in summary calculations to avoid skewing summary data toward replicate sample data.

New monitoring locations are added as necessary to monitor new facilities or operations, or to supplement data from existing stations. During 1991, five new stations were added to the environmental surveillance network; two perimeter stations (labeled "P"), one community station (labeled "C"), and two onsite stations (see Table 5-1 and Figure 5-2).

The new 1991 sampling locations are stations 63, 64, 65, 66, and 67. Stations 63 and 64 are located on the northeastern site boundary. These stations are used for vegetation and soil sampling. Station 65 is a community location in the vicinity of the Eubank gate entrance to Kirtland Air Force Base (KAFB) and is used to sample soil and vegetation. Station 66 is an onsite location for vegetation and soil sampling. This station is located between Technical Areas III and IV. Station 67 is Base Well 13, located onsite in the northeastern portion of the site; it is used for groundwater sampling.

Sample Collection and Analysis

Samples are gathered and stored in accordance with methods described in USDOE/EP-0023 (DOE, 1981). These procedures have been documented in an Environmental Monitoring Manual (Millard, 1986) and sampling procedure (Procedure 90-07). Native vegetation (mostly grasses), soil, and water samples are collected annually at the end of the growing season. Appendix C describes analytical procedures. Appendix D lists detection limits for each type of radionuclide analysis. The 1991 samples were analyzed by Accu-Labs Research, Inc., Golden, Colorado.

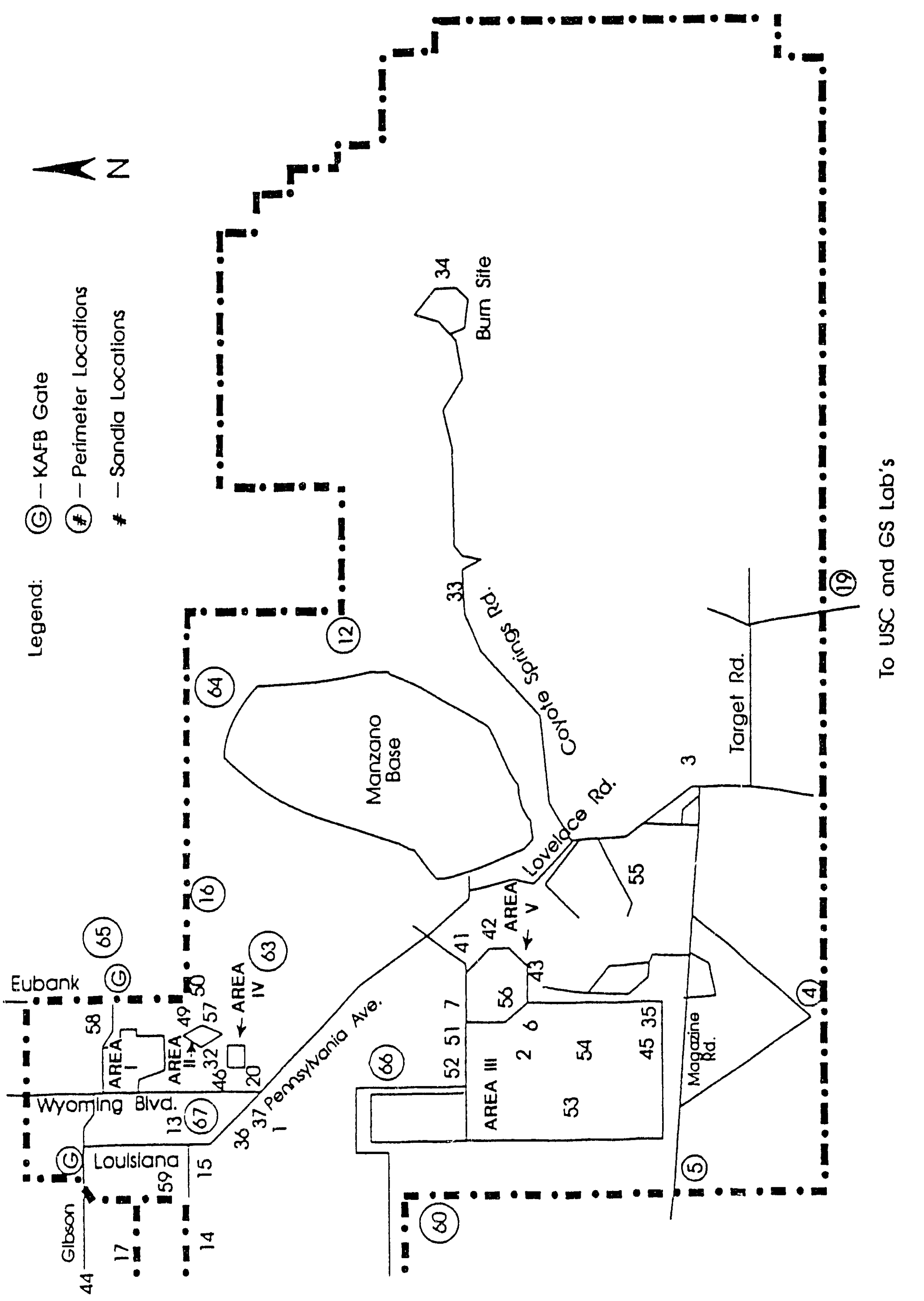

Figure 5-2. Environmental Monitoring Locations in Technical Areas I-V and Kirtland Air Force Base

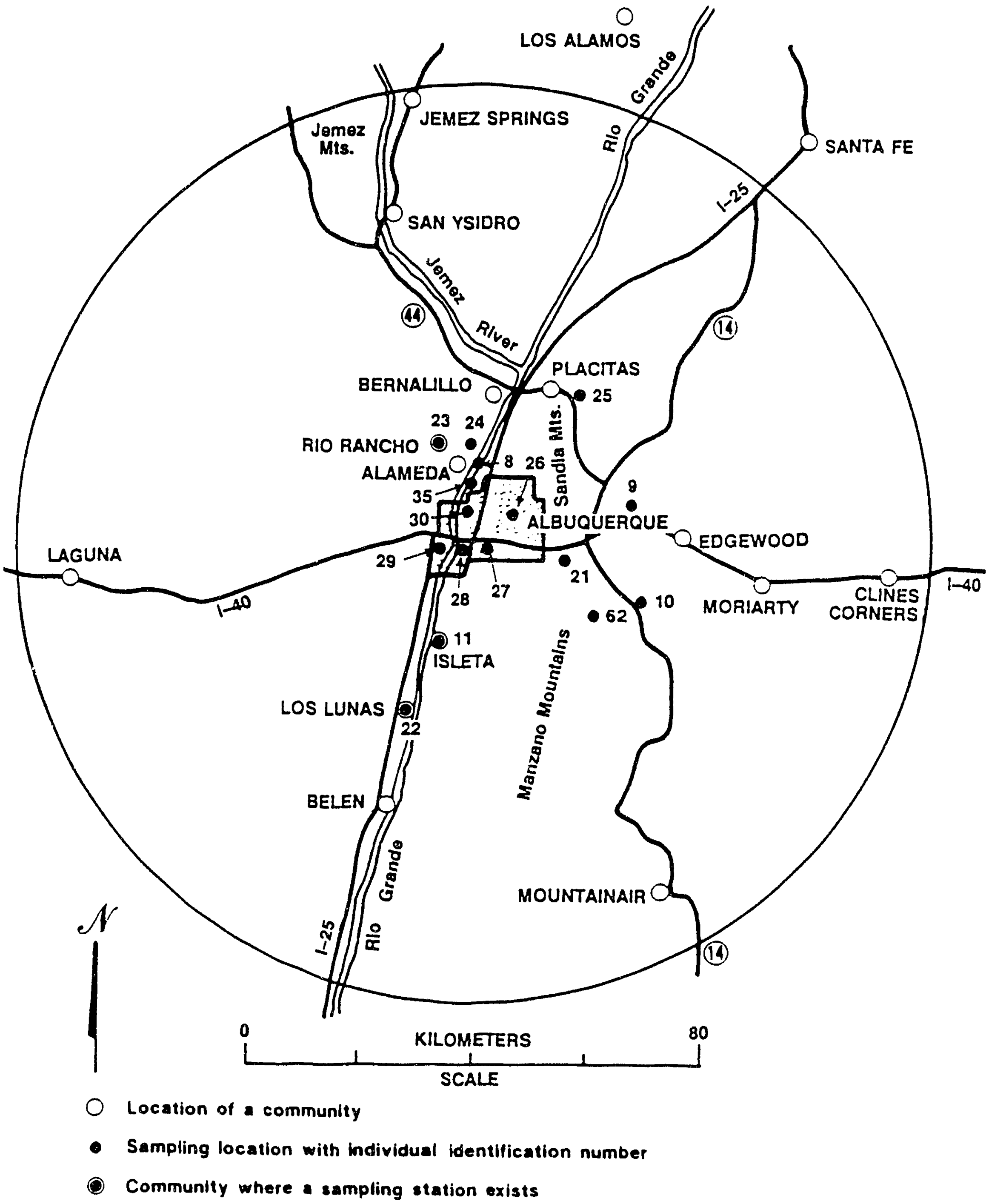

Figure 5-3. Community Monitoring Locations in the Albuquerque Area

Table 5-1. SNL, Albuquerque, Environmental Monitoring Locations and Sample Types for Radioactive Surveillance

Location Number	Location	Sample Description[a]	Type[b]
1	Pennsylvania Avenue	S	V,S,T
2 NW	Radioactive Waste Disposal Site NW	S	V,S,T
2 NE	Radioactive Waste Disposal Site NE	S	V,S
2 SE	Radioactive Waste Disposal Site SE	S	V,S
2 SW	Radioactive Waste Disposal Site SW	S	V,S
3	Coyote Canyon Control	S	V,S,T
4	Isleta Reservation Gate	P	V,S,T
5	McCormick Gate	P	V,S,T
6	East of Technical Area III, Water Tower	S	V,S,T
7[c]	North of Technical Area V, Arroyo	S	V,S,T
8	Corrales Bridge	C	V,S,W
9	Sedillo Hill, I-40, East of Albuquerque	C	V,S
10	Oak Flats	C	V,S,T
11	Isleta Pueblo, Rio Grande	C	V,S,T,W
12	NE Perimeter	P	V,S
13	Base Well 1 (Not running)	S	W
14	Base Well 2 (Not running)	S	W
15	Base Well 7	S	W
16[c]	Four Hills	P	V,S,T
17	Base Well 14 (Not running)	S	W
18	North Perimeter Road	P	T
19	Seismic Center Gate	P	V,S,T
20	Technical Area IV, SW	S	V,S,T
21	Bernalillo Fire Station 10, Tijeras	C	T
22	Los Lunas Fire Station	C	T
23	Rio Rancho Fire Station, 19th Avenue	C	T
24	Corrales Fire Station	C	T
25	Placitas Fire Station	C	V,S,T
26	ABQ[d] Fire Station 9, Menaul NE	C	T
27	ABQ Fire Station 11, Southern SE	C	T
28	ABQ Fire Station 2, High SE	C	T
29	ABQ Fire Station 7, 47th NW	C	T

[a]S = SNL, Albuquerque; P = Perimeter of SNL, Albuquerque; and C = Community.

[b]V = Vegetation, S = Soil, W = Water, and T = TLD (thermoluminescent dosimeters).

[c]Replicate sampling sites: {7, 16, and 60 for V and S.
{33 for W only.

[d]ABQ = Albuquerque.

Table 5-1. SNL, Albuquerque, Environmental Monitoring Locations and Sample Types for Radioactive Surveillance (Continued)

Location Number	Location	Sample Description[a]	Type[b]
30	ABQ[c] Fire Station 6, Griegos NW	C	T
31	Technical Area II Guard Gate	S	T
32S	Technical Area II, Building 935 (South Bay Door)	S	S
32E	Technical Area II, Building 935 (East Personnel Door)	S	S
33[d]	Coyote Spring	S	V,S,W
34	Lurance Canyon	S	V,S
35	Chemical Waste Disposal Site	S	V,S
36	Base Well 4	S	W
37	Base Well 8	S	W
38	Base Well Lift Station to Manzano	S	W
39	NW DOE Complex	P	T
40	Technical Area I NE by Building 852	P	T
41	Technical Area V, NE Fence	S	V,S,T
42	Technical Area V, E Fence	S	V,S,T
43	Technical Area V, SE Fence	S	V,S,T
44	Base Well 12	S	W
45	Technical Area III, RMWMF Site, NW Corner	S	V,S,T
46	Technical Area II, South Corner	S	T
47	Tijeras Canyon East of AIV	S	T
48	Tijeras Canyon Northeast of AIV	S	T
49	Near the proposed ECF Site	S	V,S
50	Base Well 11	S	W
51	Ditch, Technical Area V, N	S	V,S
52	Technical Area III, NE/6563	S	V,S
53	Track, Technical Area III, S	S	V,S
54	Technical Area III, 6630	S	V,S
55	Technical Area III, 9939	S	V,S
56	Technical Area V, W/6488	S	V,S
57	Technical Area IV, NE/970	S	V,S
58	N Base Housing	P	V,S
59	Zia Park/SE	P	V,S

[a]S = SNL, Albuquerque; P = Perimeter of SNL, Albuquerque; and C = Community.
[b]V = Vegetation, S = Soil, W = Water, and T = TLD (thermoluminescent dosimeters).
[c]ABQ = Albuquerque.
[d]Replicate sampling sites: {7, 16, and 60 for V and S. 33 for W only.

Table 5-1. SNL, Albuquerque, Environmental Monitoring Locations and Sample Types for Radioactive Surveillance (Concluded)

Location Number	Location	Sample Description[a]	Type[b]
60[c]	Tijeras Arroyo	P	V,S
61	Airport (west end)	P	V,S
62	East Resident	C	V,S
63	No Sweat Boulevard	P	V,S
64	North Manzano	P	V,S
65	Sandia Research Park	C	V,S
66	KUNSC	S	V,S
67	Base Well 13	S	W

[a]S = SNL, Albuquerque; P = Perimeter of SNL, Albuquerque; and C = Community.
[b]V = Vegetation, S = Soil, W = Water, and T = TLD (thermoluminescent dosimeters).
[c]Replicate sampling sites: {7, 16, and 60 for V and S. 33 for W only.

A total of 128 samples were submitted for ^3H and gamma spectrometry analysis in 1991. Seventy-eight samples were analyzed for U. Thirty-eight water and filter samples were screened for gross alpha and beta. Table C-1 (see Appendix C) summarizes sampling frequencies.

Monitoring Results

Appendix F lists the monitoring results for all sample stations. Calculated summary data tables are discussed in the following paragraphs. Less-than-detection values were set equal to the detection value in the calculation of mean values.

Vegetation

Table F-1 in Appendix F lists concentrations of ^3H, potassium-40 (^{40}K), and percent water in vegetation (primarily grass species) for the 25 SNL, Albuquerque, onsite stations; 11 perimeter stations; and 7 community stations. Table 5-2 summarizes the mean concentrations and respective standard deviations, as well as range of values for ^3H in vegetation for the three types of sampling locations. The ^3H concentrations are reported as pCi/ml of extracted water. Most reported ^3H concentrations for the onsite monitoring stations fall within the range of values found at the perimeter and community stations. Where vegetation ^3H concentrations are

Table 5-2. Mean Concentration of ^{3}H in Vegetation

			Concentratior (pCi/ml)		
Nuclide	Location	Sample Size	Mean ($\bar{x}$)	Standard Deviation (s)	Range
^{3}H	SNL	24	0.47	0.97	-0.07 to 4.4
(pCi/ml)	Perimeter	11	0.08	0.04	0.04 to 0.15
	Community	7	0.08	0.06	-0.01 to 0.15
	Total	42			

elevated but soil samples collected at the same station are not, the location will continue to be monitored to determine if the data are representative or anomalous. Where both vegetation and soil concentrations are elevated the monitoring stations are located near sites known to be contaminated. These sites are currently undergoing characterization for eventual environmental restoration and are located in areas of restricted access. Monitoring will continue at these locations so as to identify and monitor contaminant migration.

Soil

Concentrations of U, ^{3}H, and ^{137}Cs in soil samples are reported in Appendix F, Table F-2, for the 27 SNL, Albuquerque, onsite stations; 11 perimeter stations; and six community stations. Table 5-3 summarizes the mean concentrations, standard deviations, and range of values for radionuclides in the three types of sampling locations.

Station 16, sample A, reported a total U concentration of 51 $\mu g/g$. This value is considered anomalous as it is inconsistent with the other two replicate samples collected from this location (0.5 and 0.4 $\mu g/g$) and with data from previous monitoring of this location. This station will be sampled again in replicate in 1992. Without this value the perimeter mean and standard deviation for U is 0.5 ± 0.2 $\mu g/g$ with a range of 0.2 to 1.0 $\mu g/g$. With the exception of this one value, uranium concentrations at all location types are consistent with observations from previous years. The ^{137}Cs concentrations for all location types are consistent with background observations from previous years and appear to reflect fallout levels of ^{137}Cs. The majority of the individually reported ^{3}H concentrations for the onsite soil monitoring stations are within the range of values observed for the perimeter and community stations. These values are consistent with observations from previous years. Where onsite ^{3}H concentrations are

Table 5-3. Mean Concentrations of U, ^{137}Cs, and ^{3}H in Soil Samples

Nuclide	Location	Sample Size	Concentration Mean ($\bar{x}$)	Standard Deviation (s)	Range
U (μg/g)	SNL	29	0.73	0.41	0.1 to 2.0
	Perimeter[a]	11	5.1	15	0.2 to 51
	Community	6	1.0	0.9	0.2 to 2.4
^{137}Cs (pCi/g)	SNL	29	0.31	0.26	<0.05 to 1.0
	Perimeter	11	0.6	0.6	<0.04 to 0.92
	Community	6	0.38	0.38	0.08 to 1.1
^{3}H (pCi/ml)	SNL	29	3.2	11.1	-0.13 to 55
	Perimeter	11	0.09	0.08	-0.01 to 0.27
	Community	6	-0.06	0.03	-0.10 to -0.01

[a]Without the value considered anomalous (51 μg/g) the statistics are; mean 0.5 $\pm$ 0.2 μg/g, range 0.2 to 1.0 μg/g.

elevated, the sample location is found in an area of restricted access at SNL and in an area of known or potential contamination. Where onsite ^{3}H concentrations are elevated but vegetation samples collected at the same stations are not, the location will continue to be monitored to determine if the data are representative or anomalous. Where both vegetation and soil samples are elevated, the stations are near sites known to be contaminated. In this case the sites are currently undergoing characterization for eventual environmental restoration and are located in areas of restricted access. Monitoring will continue at all stations that are known or believed to be contaminated so as to identify and monitor potential contaminant migration.

Water

Concentrations of gross alpha, beta, U, and ^{3}H in surface and groundwater are reported in Appendix F, Table F-3, for all stations that were sampled. Tables 5-4 and 5-5 summarize total (unfiltered) water, filtered water, and associated suspended solids for surface and groundwater, respectively. Groundwater samples include onsite KAFB wells; surface water samples

Table 5-4. Mean Concentrations of Gross Alpha, Gross Beta, U, and ^3H in Surface Water (Streams)[a]

Analysis (Units)	Station	Location	Total Water $\bar{x} \pm s$[b]	Filtered Water $\bar{x} \pm s$[b]	Suspended Solids $\bar{x} \pm s$[b]
Gross Alpha (pCi/l)	8	C	190 ± 90	2 ± 3	4 ± 2
	11	C	35 ± 27	0 ± 3	5 ± 1
	33	S	-8 ± 19	8 ± 23	0 ± 1
Gross Beta (pCi/l)	8	C	240 ± 60	4 ± 2	6 ± 1
	11	C	100 ± 20	6 ± 2	5 ± 1
	33	S	28 ± 16	26 ± 16	0 ± 1
U (mg/l)	8	C	0.013	0.009	--
	11	C	<0.001	<0.001	--
	33	S	0.003	0.002	--
^3H (pCi/ml)	8	C	0.06 ± 0.15	-0.04 ± 0.15	--
	11	C	-0.06 ± 0.15	0.04 ± 0.15	--
	33	S	-0.04 ± 0.15	-0.06 ± 0.14	--

[a]Individual data for three surface water locations. Individual values are also in Appendix F, Table F-3.
[b]Variability of the radioactive disintegration process (counting) error at the 95 percent confidence level, 1.96 sigma.

include community samples from two stations and an onsite sample from one station.

For the onsite surface water sample (station 33), gross alpha, beta, U, and ^3H concentrations were all lower than those taken from community sampling locations and are consistent with observations from previous years. Station 8 (Corrales Bridge, Rio Grande) is upgradient from SNL, Albuquerque, and appears to be elevated in gross alpha and beta concentrations in total (unfiltered) water. Station 11 (Isleta Pueblo, Rio Grande) is downgradient from SNL, Albuquerque, and appears to have slightly elevated gross alpha and beta concentrations in unfiltered water. Analytical results from these samples will be investigated. At stations 8 and 11, U and ^3H concentrations for total water, filtered water, and suspended solids were consistent with observations from previous years. Concentrations for filtered water and suspended solids at stations 8 and 11 were also consistent with what was anticipated. Where the results were greater than expected, locations will continue to be monitored to determine if the

Table 5-5. Mean Concentrations of Gross Alpha, Gross Beta, U, and ^{3}H in Groundwater (Base Wells)[a]

Analysis (Units)	Total Water $\bar{x} \pm s$	Filtered Water $\bar{x} \pm s$	Suspended Solids $\bar{x} \pm s$
Gross Alpha (pCi/l)	0.7 ± 1.2	0.8 ± 1.1	0 ± 0
Gross Beta (pCi/l)	1.7 ± 1.6	2 ± 2	0 ± 0
U (mg/l)	0.001 ± 0.001[b]	0.001 ± 0.001[b]	--
^{3}H (pCi/ml)	-0.04 ± 0.08	0.001 ± 0.05	--

[a]Summary data for six well water locations. Individual values are in Appendix F, Table F-4.
[b]When individual measurements are reported as less than the detection limit, the detection limit is used for determination of averages.

results were representative or anomalous. Gross alpha, beta, U, and ^{3}H concentrations in onsite groundwater were consistent with observations from previous years.

TLD

Table 5-6 summarizes the annual TLD dose equivalent estimates for the SNL, Albuquerque, perimeter and community locations listed in Table 5-1. Data for individual stations are provided in Appendix F, Table F-5. These estimates include natural background and facility contributions (if any). The mean for 12 community and perimeter (SNL, Albuquerque, and boundary) locations were 91 mrem and 89 mrem, respectively. The mean of the 15 locations adjacent to onsite facilities was 92 mrem/yr. No significant difference in annual dose equivalent estimates (alpha = 0.05) existed between the three location types.

5.3 Potential Dose Assessment for the Public

The EPA promulgated National Emission Standards for Hazardous Air Pollutants (NESHAP) standards for radionuclides in December 1989. The NESHAP standard (40 CFR Part 61, Subpart H) requires that a radiation dose be calculated for the maximally exposed individual who is at a public

Table 5-6. Summary of TLD Measurements[a]

Location	Number of Locations	Mean Annual External Dose Equivalent (mrem/yr)		
		$\bar{x}$	$s_{\bar{x}}$	Range
SNL (S)	15	92	6	86 to 104
Perimeter (P)	7	89	10	79 to 110
Community (C)	12	91	9	80 to 108

[a]Detailed results are listed in Appendix F, Table F-5.

access location including an office, school, or residence. A comprehensive survey of all public access locations on KAFB was conducted during 1990 to address this new requirement. In addition, a determination has been made that all non-SNL personnel who work or live on KAFB are considered "members of the public" in accordance with the definition in DOE Order 5400.5 (published February 1990). The 1991 dose assessment was performed for all KAFB receptors including residences, schools, and other locations where non-SNL personnel work.

All dose calculations presented in this section were performed using EPA-authorized AIRDOS-PC or CAP-88 computer codes. The cumulative dose at each receptor was calculated and compared with the new effective dose equivalent (EDE) limit of 10 mrem/yr for the maximally exposed individual. As indicated in Section 5.1, few facilities within SNL, Albuquerque, routinely generate radioactive emissions. Most of these facilities are located in Technical Areas IV and V, and most of the radioactive releases are air emissions. Therefore, air doses represent the main radiological dose impact to offsite locations from routine operations at SNL, Albuquerque.

Release Sources

A number of small releases of radiological material from various sources occurred at the SNL, Albuquerque, facility during 1991. Figure 5-4 depicts the locations of facilities at SNL, Albuquerque. Table 5-7 summarizes the kinds and quantities of radionuclides released during 1991. The more significant releases included 3.02 Ci of ^{41}Ar from the ACRR, 0.49 Ci of ^{41}Ar from the SPR, 0.5 Ci of ^{85}Kr, and 0.02 Ci of ^{3}H from the HCF. Releases of 0.2 Ci each of ^{13}N and ^{15}O from the HERMES III (HIIIA) and (to a lesser extent) from the PBFA-II, while potentially significant, were of such short

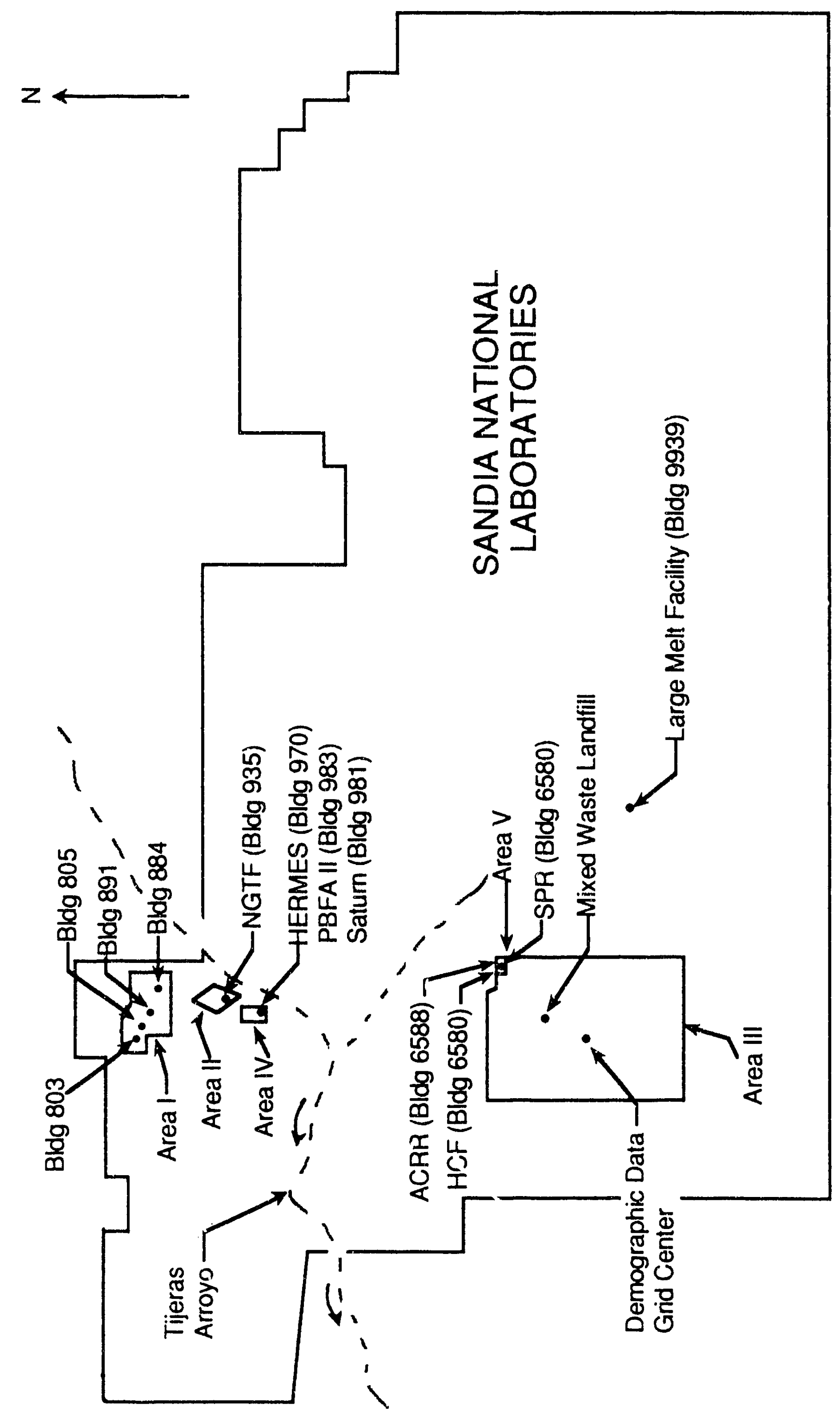

Figure 5-4. Facilities Locations at SNL, Albuquerque

Table 5-7. Summary of Radionuclide Releases for 1991

Facility	Radionuclide	Release (Ci/yr)
ACRR	^{41}Ar	3.02
ACRR-FALCON	^{41}Ar	2.6×10^{-2}
	^{135}Xe	1.3×10^{-2}
	^{88}Kr	2.2×10^{-3}
	^{88}Rb	2.4×10^{-3}
	^{87}Kr	6.0×10^{-6}
	^{85M}Kr	3.8×10^{-6}
HCF	^{85}Kr	0.50
	^{3}H	2.0×10^{-2}
	^{133}Xe	5.2×10^{-5}
SPR/CX	^{41}Ar	0.49
SATURN	^{3}H	3.0×10^{-6}
HERMES III	^{13}N	0.20
	^{15}O	0.18
	^{41}Ar	1.0×10^{-5}
	^{88}Kr	2.0×10^{-6}
PBFA II	^{13}N	<0.042
	^{15}O	<0.005
NGTF	^{3}H	1.0×10^{-5}
Building 891 - 2422 Lab	^{3}H	3.6×10^{-6}
Building 891 Tube Lab	^{3}H	6.0×10^{-5}
Building 803 Accelerator	^{13}B	1.95
	^{15}C	4.5×10^{-3}
	^{16}N	2.3×10^{-3}
	^{19}O	6.3×10^{-5}
	^{41}Ar	3.2×10^{-6}
Building 884 TANDEM	^{15}O	2.1×10^{-3}
	^{13}N	1.3×10^{-4}
	^{18}F	1.2×10^{-5}
	^{11}C	5.2×10^{-5}
Building 805 Radiation Lab	^{3}H	1.0×10^{-5}
	^{14}C	1.0×10^{-5}

half-lives (10 min for ^{13}N and 2 min for ^{15}O) that decay during plume transport greatly reduced doses at most of the receptor locations considered. The SATURN project, located in Technical Area IV, Building 981, released 3 μCi of ^{3}H in 1991. The other facilities that released radiological air emissions during 1991 from Technical Area I were Buildings 803, 805, and 884 (very short-lived activation gases) and tritium labs located in Building 891 that released microCurie quantities of tritium. The Large Melt Facility (Building 9935) had no release during 1991.

Five projects were evaluated during 1991 as new sources or modified sources. Two new sources were the two-stage diode project (Hwang, 1991b) and the MIDEP-TNA project. Neither of the two were started-up in 1991. The three modified sources were HERMES-EDNA, SABRE, and the ACRR-FREC II projects involved small releases of ^{41}Ar and noble gases (ACRR-FRAC II and HERMES-EDNA) and ^{13}N,^{15}O for SABRE (Hwang, 1991a, 1991c, 1991d).

Public Receptors

The population of the five KAFB housing areas is approximately 6600. The nonresidential areas include the security offices, guard gates, credit unions, banks, restaurants, the KAFB landfill, golf course, U.S. Army Field Offices (KUMSC), Manzano area offices, Inhalation Toxicology Research Institute (ITRI), RINCHEM, Raytheon/Defense Nuclear Agency (DNA), and other U.S. Air Force and Army research facilities and engineering offices (LATA, 1991). The maximum exposure dose to individuals was calculated for all these public receptors on KAFB in addition to other locations outside the KAFB boundaries. The population doses were calculated for the KAFB residence (6636) and all other people living within a 50-mi radius of SNL, Albuquerque (571,677) from the 1990 population census data.

Meteorological Data

The meteorological data used in the dose calculations for SNL, Albuquerque, are from the Albuquerque International Airport, an average distance of approximately 3.5 mi from the SNL, Albuquerque, release locations. The joint frequency wind distribution is a 5-yr average, provided by the National Climatic Center (NCC) in Ashville, South Carolina. The Pasquill stability class analysis was performed using the STAR Program provided by the NCC. The period of record is from 1960 to 1964 inclusive for Albuquerque, New Mexico. All meteorological data were updated in March 1990 before the final dose calculation was performed.

Demographic Data

The calculation of demographic data includes population, beef cattle, dairy cattle, and food crops used for human consumption. These four parameters were calculated for each of the CAP-88 gridded zones (total of 80). In general, demographic data are available by county, and the densities for population, beef cattle, dairy cattle, and food crops are calculated as the quotient of the most recent county data and the county land area. For 1990 calculations, the census (U.S. Department of Commerce [DOC], Bureau of the Census, 1991) and the 1988 agricultural data were utilized. These calculations were based on a total of 571,677 people; 32,335 beef cattle; 7290 diary cattle; and 2.4 x 10^8 m^2 of food crops from the surrounding nine counties (LATA, 1991).

Results of the Dose Assessment

The EDEs for two receptor groups were calculated for the 1991 releases. The two groups are boundary and KAFB receptors. The EPA-authorized CAP-88 computer code was used to calculate EDEs for maximum exposure to individuals and to the population within a 50-mi radius.

The nine boundary locations are the Tijeras Arroyo, City Landfill, airport (west end), Northwest Base Housing (southeast corner), Eubank Gate, Northeast Resident, East Resident, Isleta Mine, and West Resident. The 1991 results are presented in Table 5-8 for comparison with the previous year's results. The dose at Tijeras Arroyo, consistent with the 1990 result (Hwang et al., 1991), is the highest of the nine boundary locations. The nine boundary locations are demonstrated in Figure 5-5.

Dose calculations were also performed for 10 KAFB receptor locations including the KUMSC, KAFB Landfill, Raytheon/DNA, RINCHEM, golf shop, golf maintenance, riding club, Civil Engineer Research Facility (CERF), ITRI, and Manzano area offices. Because of the shorter distance from the release sources to these KAFB receptors, the doses (Table 5-9) at these receptors are generally higher than those presented in Table 5-8.

The composite dose analysis revealed maximum exposure (based on NESHAP compliance standards) at the KUMSC receptor site approximately 1610 m northwest of SNL, Albuquerque, Technical Area V. The EDE to maximally-exposed individual at the KUMSC was calculated to be 1.4 x 10^{-3} mrem due principally to an external air submersion exposure to ^{41}Ar. The ^{41}Ar dose represents 95 percent of the total EDE. Most of the ^{41}Ar dose comes from the ACRR and SPR/CX facilities. Several receptor locations are within a factor of 10 of the EDE assessed for the KUMSC receptor location (see Table 5-9).

Population Dose at KAFB

A population dose was calculated for the KAFB public receptors. There are five major base housing areas on the KAFB. Table 5-10 presents the distances and direction of the base housing compounds from the ACRR, SPR, and HCF facilities and the associated population distribution. A 100-percent occupancy of all the units was assumed, yielding a total KAFB population of 6636.

The composite population dose of 5.1 x 10^{-1} mrem EDE was calculated for all KAFB housing areas resulting from all SNL 1991 releases. The composite dose was smaller than the 1990 result of 7.9 x 10^{-1} mrem for all KAFB housing areas.

Table 5-8. Annual Effective Dose Equivalents (mrem/yr) to Boundary Receptors

Receptor	ACRR	HOTCELL	FALCON	SPR/CX	SATURN	PBFAII	HERMES	NGT	Bldg. 891	Bldg. 805	Bldg. 803	Bldg. 884	Total
Tijeras Arroyo	1.5E-04	2.1E-07	1.7E-06	1.6E-05	5.0E-11	5.6E-08	2.5E-07	9.4E-11	2.3E-09	2.1E-08	4.2E-07	5.9E-10	1.7E-04
City Landfill	2.7E-05	1.3E-07	9.1E-07	9.2E-06	4.9E-11	1.1E-08	4.9E-08	9.1E-11	2.2E-09	2.1E-08	4.6E-07	1.2E-10	3.1E-05
Airport (west end)	1.1E-04	1.9E-07	1.3E-06	1.3E-05	5.6E-11	4.1E-07	1.8E-06	1.0E-10	2.4E-09	2.2E-08	6.7E-07	2.2E-09	1.3E-04
SE of Zia Park	8.4E-05	1.7E-07	9.5E-07	9.3E-06	1.3E-10	4.3E-06	1.7E-05	1.8E-10	3.2E-09	2.2E-08	3.4E-06	1.7E-08	1.2E-04
Eubank Gate	1.0E-04	1.9E-07	1.2E-06	1.1E-05	7.4E-11	1.2E-06	5.5E-06	1.5E-10	3.7E-09	2.2E-08	1.7E-06	1.4E-07	1.2E-04
NE Resident	2.5E-05	1.3E-07	2.8E-07	3.1E-06	5.0E-11	2.5E-08	1.2E-07	9.3E-11	2.3E-09	2.1E-08	1.5E-07	2.8E-10	2.9E-05
E Resident	4.9E-06	1.1E-07	6.0E-08	6.5E-07	4.9E-11	1.4E-09	6.3E-09	9.1E-11	2.2E-09	2.1E-08	5.3E-08	2.2E-11	5.8E-06
Isleta Mine	8.1E-06	1.1E-07	9.8E-08	1.1E-06	4.9E-11	1.0E-09	4.7E-09	9.1E-11	2.2E-09	2.1E-08	6.9E-08	2.4E-11	9.6E-06
W Resident	1.4E-05	1.2E-07	1.6E-07	1.6E-06	4.9E-11	4.1E-09	1.8E-08	9.1E-11	2.2E-09	2.1E-08	1.3E-07	4.8E-11	1.6E-05

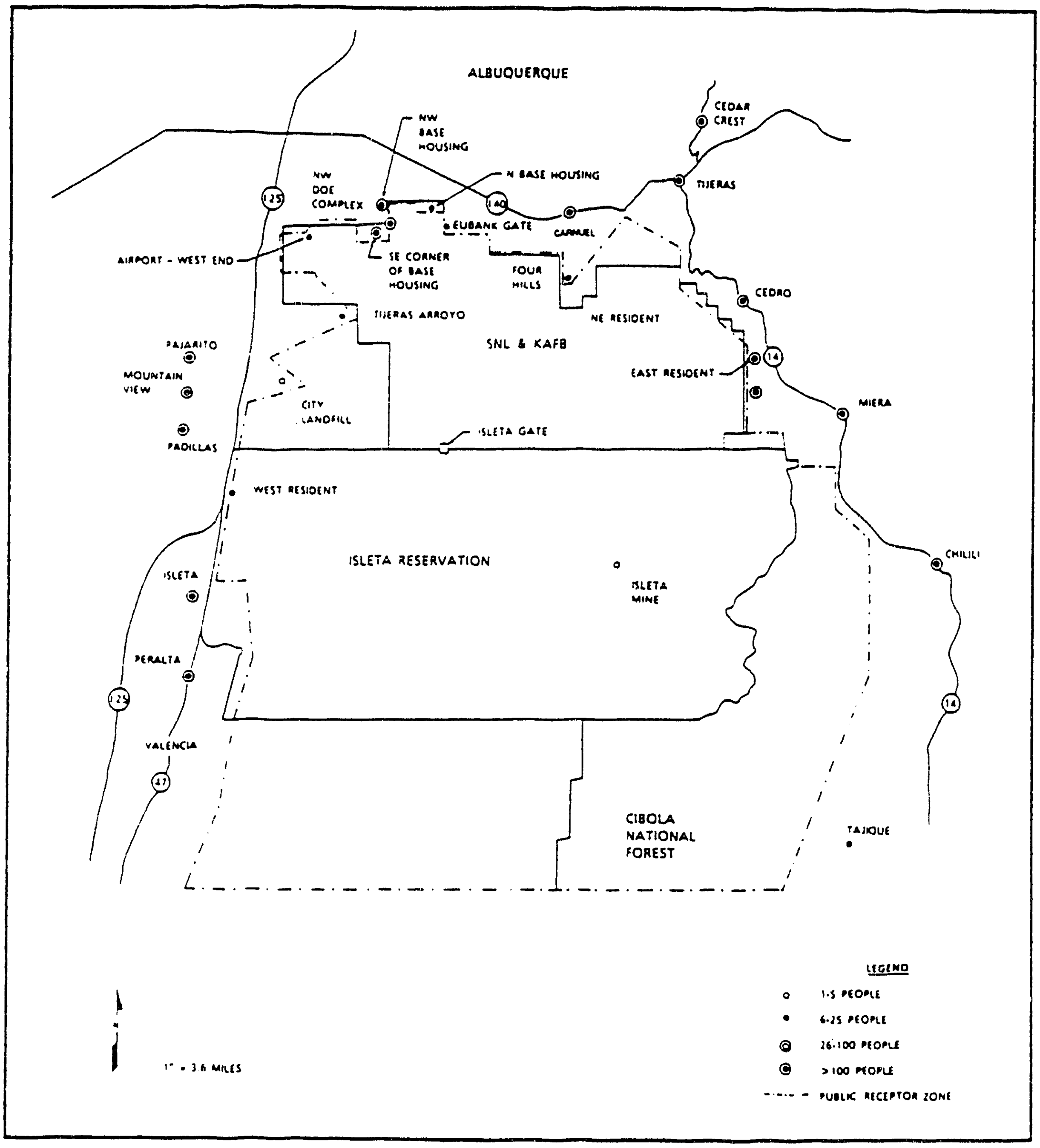

Figure 5-5. Boundary Receptor Locations Around SNL, Albuquerque

Table 5-9. Annual Effective Dose Equivalents (mrem/yr) to KAFB Receptors

Receptor	ACRR	HCF	FALCON	SPR	SAT	PBF	HERM	NGT	Bldg. 891	Bldg. 805	Bldg. 803	Bldg. 884	Total
KUMSC	1.3E-03	6.6E-07	1.4E-05	6.0E-05	3.3E-10	6.7E-07	2.9E-06	1.5E-09	2.9E-09	2.9E-08	1.0E-06	3.8E-09	1.4E-03
KAFB Landfill	1.8E-04	5.3E-07	2.0E-06	1.8E-05	4.3E-10	6.9E-06	2.5E-05	1.9E-09	3.3E-09	2.9E-08	1.3E-06	2.7E-08	2.3E-04
Raytheon/DNA	1.3E-04	4.9E-07	1.5E-06	1.3E-05	6.1E-10	2.3E-05	6.0E-05	2.0E-09	6.1E-09	3.1E-08	6.7E-06	4.5E-08	2.3E-04
RINCHEM	1.3E-04	5.1E-07	1.5E-06	1.4E-05	5.1E-10	1.4E-05	3.8E-05	4.7E-09	5.1E-09	3.0E-08	5.6E-06	3.9E-07	2.0E-04
Golf Course Lobby	2.5E-04	5.5E-07	2.8E-06	2.1E-05	3.3E-10	8.2E-07	3.7E-06	1.5E-09	2.8E-09	2.8E-08	5.8E-07	2.9E-09	2.8E-04
Golf Course Maintenance	4.1E-04	6.1E-07	4.6E-06	3.3E-05	3.7E-10	2.7E-06	1.1E-05	1.5E-09	2.9E-09	2.8E-08	6.7E-07	9.6E-09	4.6E-04
Riding Club	4.6E-04	5.4E-07	5.1E-06	3.3E-05	3.2E-10	3.0E-07	1.4E-06	1.5E-09	2.7E-09	2.8E-08	3.9E-07	1.3E-09	5.0E-04
Civil Engineering Research Center	6.7E-05	4.6E-07	7.5E-07	7.5E-06	3.2E-10	2.5E-08	1.1E-07	1.5E-09	2.7E-09	2.8E-08	1.5E-07	1.6E-10	7.6E-05
ITRI	6.8E-05	4.6E-07	7.6E-07	8.0E-06	3.2E-10	1.8E-08	8.1E-08	1.5E-09	2.7E-09	2.8E-08	3.0E-07	2.8E-10	7.8E-05
Manzano Offices	1.7E-04	5.1E-07	1.9E-06	1.5E-05	3.2E-10	1.8E-07	8.2E-07	1.5E-09	2.7E-09	2.8E-08	2.6E-07	7.4E-10	1.9E-04

Table 5-10. Residential Population Distribution at KAFB

Residential Area Receptor	AIRDOS-EPA Sector	Distance from ACRR/SPR/HCF (km)	Population
Base Housing North (Area A)	NNW	7.36	831
Base Housing North (Area B)	N	7.05	1475
Base Housing Northwest (Area C)	NNW	6.44	1960
Base Housing Northwest (Area D)	NNW	6.38	250
Base Housing Northwest (Area E)	NW	9.04	1816
Total			6636

Population Dose for the 50-mi Radius

A population dose was calculated for the 50-mi radius surrounding SNL, Albuquerque, using a single, common grid analysis for all SNL, Albuquerque, sources. Because the analysis area is so large, the relatively small distances between sources will have minimal impact on the resulting population dose. The CAP-88 computer code was again used for exposure estimates. Demographic data based on 1990 population data and 1988 agricultural data were employed. These calculations were based on a total of 571,677 people; 32,335 beef cattle; 7290 dairy cattle; and 2.4×10^8 m^2 of food crops from the nine counties included in the study area. The population dose from 1991 SNL, Albuquerque, operations was calculated to be 1.7×10^{-2} person-rem EDE for the surrounding population (residing outside KAFB). This dose results mostly from an external exposure (air submersion) to ^{41}Ar. The 1991 dose to the population within a 50-mi radius KAFB was also smaller than the 1990 measurement of 2.6×10^{-2} mrem, because the total emission of ^{41}Ar was smaller compared to the 1990 emission.

5.4 Summary of the 1991 Offsite Dose Impacts

During 1991, the NESHAP maximally exposed individual was determined to be at the KUMSC facility site, approximately 1610 m northwest of SNL, Albuquerque, Technical Area V. The maximum EDE at this location was calculated to be 1.4×10^{-3} mrem. In addition, a population dose to the public was calculated to be 1.7 x 10^{-2} person-rem to the 571,677 people living within a 50-mi radius of SNL, Albuquerque. The population dose to the 6636 residents of KAFB was calculated to be 0.51 person-rem. The population dose at KAFB is disproportionately greater than the dose to the much larger regional population because of the proximity to the SNL, Albuquerque, release locations. The cumulative dose to the total population, including the KAFB population and the 50-mi-radius population, was 0.52 person-rem from all 1991 releases. The dose impacts are summarized in Table 5-11.

Table 5-11. Summary of Offsite Dose Impacts in Comparison to NESHAP Standards and Natural Background Radiation

Parameters	1991 SNL, Albuquerque, Calculated Dose	NESHAP Standard	Natural Background Radiation in Albuquerque Area
Maximum Effective Dose Equivalent (mrem/yr)	0.0014	10	93[a]
Annual Population Dose[b] (person-rem)	0.52	--	>57,000

[a]Based on the average of community TLD values (dose from external penetrating radiation).
[b]Dose over the population in 50-mi radius surrounding SNL, Albuquerque, including the population on KAFB.

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CHAPTER 6

NONRADIOLOGICAL MONITORING

6.1 Wastewater, Storm Water, and Surface Discharge Programs

6.1.1 Wastewater Programs

Discharges to Publicly Owned Treatment Works

SNL, Albuquerque, contains over 15 mi of sewer lines interconnected with those of Kirtland Air Force Base (KAFB). At the start of 1991 SNL, Albuquerque, had five categorical pretreatment operations and three general wastewater streams discharging to the City of Albuquerque publicly owned treatment works (POTW). During 1991 two categorical permits were discontinued (May 1991) and one general discharge permit (2069 K) became active (March 31, 1991). The permits in Table 6-1 that have 40 CFR designation in the "Issuing Agency" column contain EPA categorical discharge limitations.

Discharges by SNL, Albuquerque, to the POTW are regulated by the City of Albuquerque Public Works Department, Liquid Waste Division, under the authority of the City's Sewer Use and Wastewater Control Ordinance. The City's ordinance is approved by the EPA in accordance with the Clean Water Act (CWA) as amended.

To comply with EPA regulations, the City of Albuquerque has implemented an industrial wastewater pretreatment program. This program requires SNL, Albuquerque, to obtain permits for wastewater discharges to the City's POTW. These permits specify the required quality of discharges, and the frequency of reporting the results of the monitoring.

Complete documentation concerning the wastewater sampling program can be found in the Wastewater Monitoring Program Quarterly Reports on file at SNL, Albuquerque, Environmental Programs Records Center. Tables 6-2 and 6-3 and Figure 6-1 describe the wastewater sampling locations and brief characteristics of each. The sampling procedures, permit limits for individual sampling stations, dates of sample collection and sample frequency, analytical methods, and quality control/quality acceptance criteria are defined in the Wastewater Sampling Plan for SNL, Albuquerque, on file in the Environmental Programs Records Center.

Compliance Summary

This section addresses those instances in which the monitoring results did not comply with the permit limits described in the Wastewater Monitoring Program Quarterly Reports for 1991.

Table 6-1. SNL, Albuquerque, Wastewater Discharge Permits

Permit Number	Station Manhole	Waste Stream Process	Issuing Agency	Permit Expiration
2069A-2	WW001	General	City of Albuquerque/ I.C.-7391[a]	9/30/93
2069C-3	WW003	Electroplating/ Printed Circuit Board	City of Albuquerque/ 40 CFR 413.84	Inactive 5/91
2069D-3	WW004	Metal Finishing	City of Albuquerque/ 40 CFR 433.A15	9/30/93
2069E-2	WW005	Electronics	City of Albuquerque/ 40 CFR 469.A	Inactive 5/91
2069F-2	WW006	General	City of Albuquerque/ I.C.-3674, 3694, and 9711[a]	9/30/93
2069G-2	WW007	Microelectronics Development Laboratory	City of Albuquerque/ 40 CFR 469.A	7/31/94
2069H-2	WW009	Process Development Laboratory	City of Albuquerque/ 40 CFR 433	9/30/93
2069I	WW008	General	City of Albuquerque/ I.C.-3674, 3679, and 9711[a]	9/30/93
2069K	WW011	General	City of Albuquerque/ I.C.-3674, 3679, and 9711[a]	3/31/94

[a]I.C. = Industrial classification.

Table 6-2. SNL, Albuquerque, Wastewater Sample Locations

Permit Number	Station Manhole	Location	Average Flow (gpd)[a]
2069A-2	WW001	South Technical Area IV Tijeras Arroyo	28,849
2069C	WW003	Technical Area I Building 841 SW	15,000[b]
2069D-3	WW004	Technical Area I Building 841 SE	39,154
2069E	WW005	Technical Area I Building 841 SW	91,476
2069F-2	WW006	East of KAFB Lagoons	514,123
2069G-2	WW007	Technical Area I Building 858 Basement	110,939
2069H-2	WW009	Technical Area I Building 878 Basement	3,659
2069I	WW008	South Technical Area I Tijeras Arroyo	25,576
2069K	WW011	Technical Area III	10,000

[a]gpd = Gallons/day.
[b]Estimated.

Table 6-3. Summary of Characteristics for SNL, Albuquerque, Wastewater Sampling Stations

Station Number	Flumes	Flow Meter and Sampling Equipment
WW001	3-in. Parshall	Isco 3210 Flow Meter Isco 2700R Sampler Leeds and Northrop pH Analyzer System
WW003	None	Isco 2700 Sampler
WW004	2-in. Parshall	Isco 3210 Flow Meter Isco 2700R Sampler Leeds and Northrop pH Analyzer System
WW005	3-in. Parshall	Isco 3210 Flow Meter Isco 2700R Sampler Leeds and Northrop pH Analyzer System
WW006	6-in. Parshall	Isco 3210 Flow Meter Isco 2700R Sampler Leeds and Northrop pH Analyzer System
WW007	45° V-Notch Weir	Isco 3210 Flow Meter Isco 2700R Sampler Leeds and Northrop pH Analyzer System
WW008	6-in. Parshall	Isco 3210 Flow Meter Isco 2700R Sampler Leeds and Northrop pH Analyzer System
WW009	2-in. Parshall	Isco 3210 Flow Meter Isco 2700R Sampler Leeds and Northrop pH Analyzer System
WW011	6-in. Parshall	Isco 3210 Flow Meter Isco 2700R Sampler Leeds and Northrop pH Analyzer System

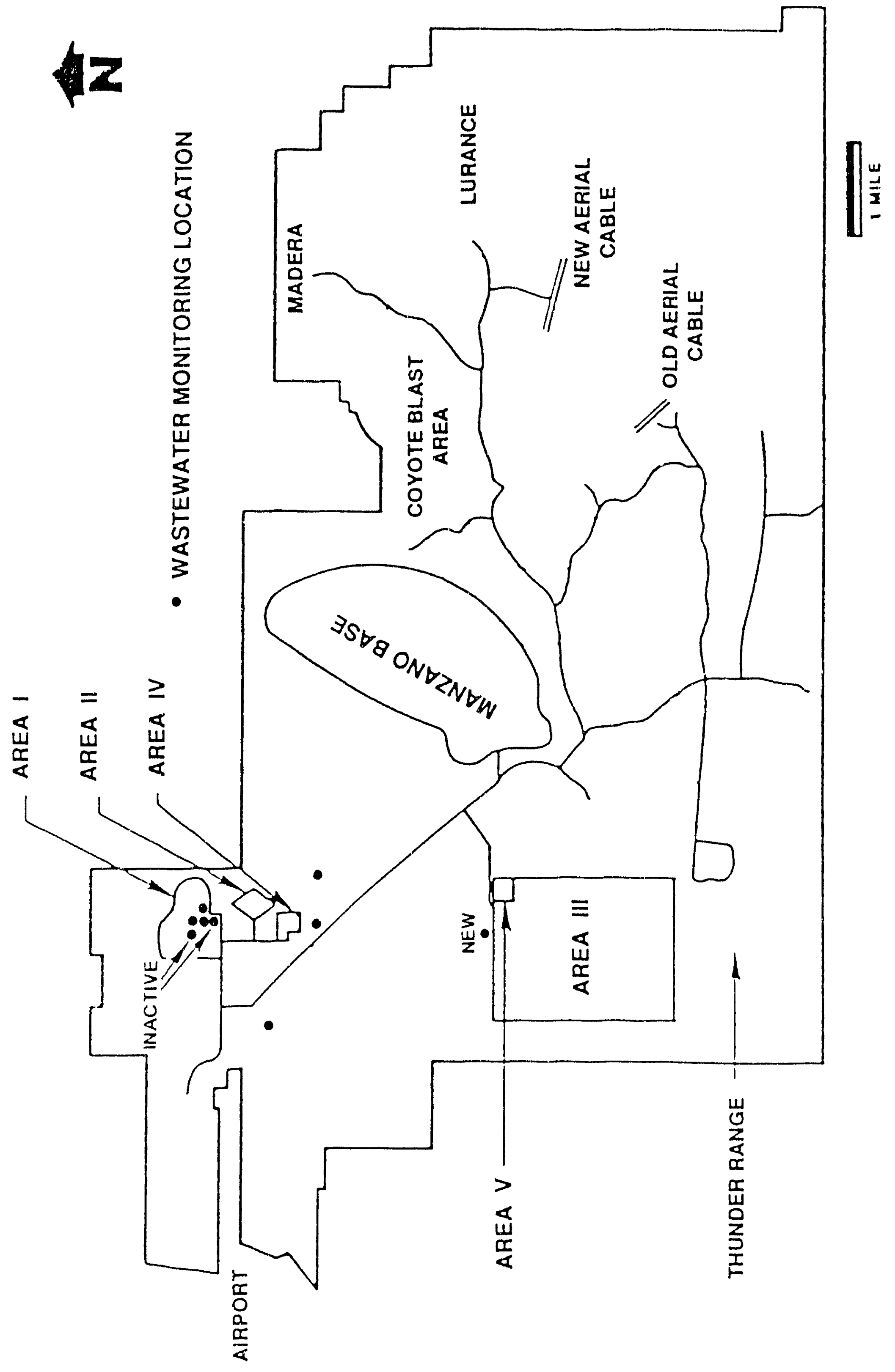

Figure 6-1. Wastewater Discharge Sampling Locations

Permit 2069A-2--This permit is a general wastewater discharge permit for wastewater discharges from a portion of Technical Area I, SNL, Albuquerque.

Analytical Results: Analytical results from laboratory analyses show all analyte concentrations to be less than permitted requirements.

pH

No pH excursion of wastewater discharges above the permitted pH limits occurred for greater than 1 hr during 1991. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069A-2 are contained in the Wastewater Monitoring Program Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

Permit 2069C-3--This permit covers discharges from the categorical, regulated, printed circuit activity in Building 841, Technical Area I, SNL, Albuquerque. This permit became inactive on April 30, 1991.

Analytical Results: Analytical results from laboratory analyses show all analyte concentrations to be less than permitted requirements.

pH

No pH excursion of wastewater discharges above the permitted pH limits occurred for greater than 1 hr during 1991. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069C-3 are contained in the Wastewater Monitoring Program Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

Permit 2069D-3--This permit covers discharges from the categorical, regulated, metal-plating activity in Building 841, Technical Area I, SNL, Albuquerque.

Analytical Results: Analytical results from laboratory analyses show all analyte concentrations to be less than permitted requirements.

pH

No pH excursion of wastewater discharges above the permitted pH limits occurred for greater than 1 hr during 1991. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069D-3 are contained in the Wastewater Monitoring Program Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

Permit 2069E-2--This permit covers discharges from the categorical, regulated, production activity conducted by Allied Signal Corporation, Albuquerque Microelectronics Operations (AMO) in Building 870, Technical Area I, SNL, Albuquerque. This permit became inactive on April 30, 1991.

Analytical Results: Analytical results from laboratory analyses show all analyte concentrations to be less than permitted requirements.

pH

No pH excursion of wastewater discharges above the permitted pH limits occurred for greater than 1 hr during 1991. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069E-2 are contained in the Wastewater Monitoring Program Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

Permit 2069F-2--This permit is a general wastewater discharge permit for wastewater discharges from a portion of Technical Area I, SNL, Albuquerque, and some KAFB facilities.

Analytical Results: Analytical results from laboratory analyses show all analyte concentrations to be less than permitted requirements.

pH

No pH excursions of wastewater discharges above the permitted pH limits occurred for greater than 1 hr during 1991. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069F-2 are contained in the Wastewater Monitoring Program Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

Permit 2069G-2--This permit covers discharges from the categorical, regulated, semiconductor production activity in Building 858, Technical Area I, SNL, Albuquerque.

Analytical Results: Analytical results from laboratory analyses show all analyte concentrations to be less than permitted requirements.

pH

By verbal agreement with the City of Albuquerque the pH limits were changed from 6 and 9 to 5 and 11 for daily excursion reporting until the acid waste neutralization system was completed and operational. The quarterly reporting continued to cite the regulatory pH limits of 6 and 9. These excursions caused no impacts on the operations of the POTW. The violations are tabulated in Table 6-4. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069G-2 are contained in the Wastewater Monitoring Program

Table 6-4. Summary of pH Violations for Permit 2069G-2, Station WW007, During 1991

Date	pH Limit/ pH Value	Duration (hr)	Monthly Total (hr)
March 4	<6/5.8	1.25	1.25
March 9	<6/5.8	5.92	7.17
March 27	>9/10.5	1.25	8.42

Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

Permit 2069H-2--This permit covers discharges from the categorical, regulated, printed circuit activity at the Process Development Laboratory (PDL) in Building 878, Technical Area I, SNL, Albuquerque.

Analytical Results: Analytical laboratory analyses show all analyte concentrations to be less than permitted requirements with the exception of a zinc concentration from a sample collected on September 27, 1991. This violation exceeding the permit limit caused no impact on the operation of the POTW. The sample concentration and permit limits are summarized in Table 6-5.

Table 6-5. Summary of Concentration Violations for Permit 2069H-2, Station WW009, During 1991

Sample Date/Type	Concentration (mg/l)	Permit Limit (mg/l)
September 27 1991: 24 hr	3.3	1.875

pH

No pH excursions of wastewater discharges above the permitted pH limits for greater than 1 hr during 1991. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069H-2 are contained in the Wastewater Monitoring Program Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

Permit 2069I--This permit 2069I is a general wastewater discharge permit for wastewater discharges from Technical Areas I, II, and IV, SNL, Albuquerque.

Analytical Results: Analytical results from laboratory analyses show all analyte concentrations to be less than permitted requirements.

pH

No pH excursion of wastewater discharges above the permitted pH limits occurred for greater than 1 hr during 1991 with the exception of a pH excursion that occurred on September 25, 1991, that exceeded the daily permit limit. This excursion caused no impact on the operations of the POTW. The violation is tabulated in Table 6-6. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069I are contained in the Wastewater Monitoring Program Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

Table 6-6. Summary of pH Violations for Permit 2069I, Station WW008, During 1991

Date	pH Limit/ pH Value	Duration (hr)	Monthly Total (hr)
September 25	>11/13	1.75	1.75

Permit 2069K--This permit is a general wastewater discharge permit for wastewater discharges from Technical Areas III and IV, SNL, Albuquerque. This permit was granted on March 31, 1991, and became active during May 1991.

Analytical Results: Analytical results from laboratory analyses show all analyte concentrations to be less than permitted requirements.

pH

No pH excursions of wastewater discharges above the permitted pH limits for greater than 1 hr during 1991. Dates of pH excursions for 1 hr or less, total time for pH out of permit limits, dates of sample collection, and sampling frequencies for each month for Permit 2069K are contained in the Wastewater Monitoring Program Quarterly Reports for 1991 on file at SNL, Albuquerque, Environmental Programs Records Center.

6.1.2 Storm Water Program

An amendment to the regulations enforcing the CWA was promulgated on November 16, 1990, in the Federal Register. This amendment implements Section 402[p] of the CWA, which was added by Section 405 of the Water Quality Act of 1987. The implementing regulations are published in 40 CFR Parts 122 through 124. This modification requires the EPA to regulate storm water discharges associated with industrial activities. Industrial activities covered by these new regulations included Standard Industrial Classification (SIC) Codes 21 through 39. SNL, Albuquerque, has several activities that may fall under these SIC codes. These include the Microelectronics Development Laboratory, Process Development Laboratory, Albuquerque Microelectronics Operation, and the plating shops in Building 840.

There are also new requirements for permitting construction activities that disturb 5 acres or more and for permitting of hazardous waste management facilities (HWMF). SNL has ongoing construction activities that disturb 5 acres or more and a HWMF that will require National Pollutant Discharge Elimination System (NPDES) permit applications. At SNL, Albuquerque, these permits will be reviewed and approved by the EPA with State of New Mexico review and concurrence.

During 1991 draft permit applications were prepared for sitewide activities and for the construction of the Countermine Test Track Facility, and for the Explosive Components Facility. These permits were due in November 1991, but in late October 1991 the deadline was extended to October 1, 1992. Storm water sampling was conducted at selected locations to support the sitewide permit application.

6.1.3 Surface Discharge Programs

Nonsanitary discharges to surface impoundments for SNL, Albuquerque, are under the authority of the New Mexico Water Quality Control Commission (NMWQCC) Regulations as implemented by the New Mexico Environment Department (NMED) Ground Water Bureau.

Storm water from oil storage tank areas and building basements associated with the SNL, Albuquerque, Pulsed Power Development Facilities in Technical Area IV are collected in two lagoons. Discharge Plan DP-530 was approved for these discharges in March 1988 and amended in December 1989. The approved discharge plan, as amended, requires quarterly measurement of water levels and semiannual sampling and analysis. During 1991, water-level measurements were taken in January, April, July, and October. Sampling was done in January, July, and October. Reports containing water-level measurements and monitoring results were submitted in January and July to the NMED Ground Water Bureau. The results are documented in the Semiannual Reports for Discharge Plan DP-530 on file in the SNL, Albuquerque, Environmental Programs Records Center.

NMED approval of Discharge Plan Application DP-771 was received in March 1991 This groundwater discharge plan application was submitted by the Solar Detoxification Facility for the discharge of up to 2700 gallons per day of tap water from solar detoxification of water experiments. The permit requires notification of any experiment modifications to NMED prior to the discharge of any water from the modified test. This surface discharge permit also requires quarterly monitoring of listed contaminants, discharge volumes, starting concentrations and discharge concentrations for each test at the Solar Detoxification Facility. The results of monitoring are documented in the Quarterly Reports for Discharge Plan DP-770 on file in the SNL, Albuquerque, Environmental Programs Records Center.

Summary of Analytical Results

This section contains the January 1991 analytical report from Lagoons I and II Analysis.

Organic constituents detected above method detection limits in the January 1991 samples were limited to 12 μg/L acetone reported in the sample SNLA004978-1 from Lagoon I. As noted in the analytical report narrative, acetone was also detected in the associated laboratory method blank at a concentration less than the detection limit of 10 μg/L. Because the acetone concentration in SNLA0049-1 is less than twice the limit of detection, and because acetone was reported in the laboratory method blank sample, laboratory contamination is suspected and the reported acetone concentration in SNLA004978-1 is not considered reliable.

Organic constituents, with the exception of acetone discussed above, were not detected above method detection limits in the January 1991 samples from either Lagoon I or Lagoon II.

The major cations, anions, and total dissolved solids (TDS) are documented in the Semiannual Reports for Discharge Plan DP-530 on file in the SNL, Albuquerque, Environmental Programs Records Center.

Discussion of Results

TDS, chloride, and sulfate were detected in January 1991 samples from Lagoons I and II at concentrations less than one-half (approximate) the applicable NMWQCC standards. TDS were detected in the Lagoon I sample at 534 mg/L. The NMWQCC standard is 1000 mg/L. Chloride and sulfate ions were detected in the Lagoon I sample at 167 and 59.4 mg/L. The NMWQCC standards are 250 and 600 mg/L. Concentrations of analytes in the Lagoon II samples were less than those reported for Lagoon I.

The July and October 1991 analytical reports from Lagoons I and II analysis show organic constituents were not detected above method detection limits in the July or October 1991 samples.

The major cations, anions, and TDS are documented in the Semiannual Reports for Discharge Plan DP-530 on file in the SNL, Albuquerque, Environmental Programs Records Center.

Discussion of Results

Concentration values for TDS, chloride, and sulfate are less than the applicable NMWQCC standards for the July and October 1991 samples from Lagoons I and II with one exception. Chloride concentration in Lagoon I was reported at 253 mg/L slightly above the NMWQCC standard of 250 mg/L. TDS in Lagoon I measured 809 mg/L, while sulfate concentration was 23.1 mg/L. Data from Lagoon II shows TDS at 285 mg/L; chloride, 9.1 mg/L; and sulfate at 36.5 mg/L.

6.2 Air Quality Management

6.2.1 Air Quality Regulations

Ambient air quality for SNL, Albuquerque, is regulated by the Albuquerque/Bernalillo County Air Quality Control Regulations (AQCRs). These include the following:

- Ambient Air Quality Standard (regulates As, Cu, Zn, Be, CO, H_2S, Pb, NO_X, SO_2, total suspended particulates [TSP], hydrocarbons, soiling index, and total reduced sulfur)
- AQCR 3: Open Burning
- AQCR 5: Visible Air Contaminants
- AQCR 8: Airborne Particulate Matter (PM)
- AQCR 11: Volatile Organic Compounds (VOCs)
- AQCR 15 to 18: Process equipment emissions (NO_X, SO_2, and particulates) for oil- and gas-burning equipment
- AQCR 20: Authority-to-Construct Permit
- AQCR 22: Registration of Air Contaminant Sources
- AQCR 29: Prevention of Significant Deterioration
- AQCR 30: New Source Performance Standards
- AQCR 31: National Emission Standards for Hazardous Air Pollutants (NESHAP) (radionuclides excluded)
- AQCR 37: Stratospheric Ozone Protection

The Air Pollution Control Division under the Albuquerque City Environmental Health Department has established several ambient air sampling stations throughout the city, including the area near SNL, Albuquerque, to monitor TSP, ozone, PM-10, CO, and NO_X. The results were published periodically in the local newspaper. No exceedance results of the measured pollutants were observed at the station near SNL, Albuquerque.

6.2.2 Airborne Emissions and Permits

Several sources at SNL, Albuquerque, emit air pollutants that are regulated by the AQCR. The emissions from these sources are described below:

- Topsoil Disturbance (AQCR 8)

  Before disturbing the soil, SNL, Albuquerque, or its contractor applies for a Topsoil Disturbance Permit and implement a plan for controlling dust emissions generated by construction activities in accordance with the requirements of AQCR 8, Airborne Particulate Matter. These mitigation measures include watering, phasing of construction, rescheduling of construction during windy periods, limitations on vehicle access and vehicle speed, and use of dust palliatives where watering is ineffective.

- Open Burning (AQCR 3)

  Open Burn permits were obtained from the City of Albuquerque prior to each scheduled burn test according to the requirement of AQCR 3 (Open Burning). A total of 10 multiuse Open Burn permits were issued or extended to SNL, Albuquerque, during 1991 (see Table 6-7).

- Beryllium (Be) Machining Operation (AQCR 31)

  The relocation of the toxic shop did not occur during 1991 as originally planned because the asbestos removal was required at the proposed location. Currently, no beryllium machining operations are conducted onsite.

- Steam Boilers and Emergency Diesel Generators (AQCR 15-18)

  SNL, Albuquerque, currently has five steam boilers with capacities that range from 71.5 to 190.8 MBtu/hr. Because these generators were grandfathered sources, no permits were required or obtained. The four emergency diesel generators are permitted by the City of Albuquerque.

6.2.3 Criteria Pollutants Inventory

Seven point-sources including six steam boilers and four identical emergency diesel power generators plus other mobile generators were inventoried in early 1992 for the 1991 criteria pollutant emissions. The calculated 1991 emission data were reported to the City of Albuquerque for NO_X, SO_2, TSP, CO, and hydrocarbon (HC). Most operating schedules were intermittent. Specifically, the diesel generators operated 4 hr each month. Inventory results are shown in Table 6-8. The 1989 data (submitted in 1990 to the City) were revised for the actual operating hours for each boiler. In general, the emission data of 1991 were comparable to those of 1989 (revised). Once the steam plant is modernized, the overall emissions should be lower because the efficiency of each boiler will be improved.

Table 6-7. Summary of 1991 Air Permits

Facility Name	Location	Permit Type	Issue Date	Expiration Date	Regulatory Agency
1. 1991 OPEN BURN PERMITS					
Thermal Treatment Facility	TA III/6715	Open Burn	12/23/91	12/31/92	City of Albuquerque
Onsite Container	Lurance Canyon	Open Burn	1/20/92	1/31/92	City of Albuquerque
Fire Fighter Training	TA 1/9th Street	Open Burn	12/4/90	12/31/91	City of Albuquerque
Propylene Oxide	9927	Open Burn	7/17/91	7/1/92	City of Albuquerque
Hydrocarbons	9920/9940	Open Burn	7/17/91	7/1/92	City of Albuquerque
Open Pool Fire Tests	Lurance Canyon	Open Burn	3/26/90	12/31/91	City of Albuquerque
Wood Fire Tests	Lurance Canyon	Open Burn	8/27/90	12/31/91	City of Albuquerque
Shipping Containers	Lurance Canyon	Open Burn	8/3/90	12/31/91	City of Albuquerque
H1501A	Lurance Canyon	Open Burn	10/91	7/1/92	City of Albuquerque
Air Force Fire Protection	Lurance Canyon	Open Burn	1/92	12/31/92	City of Albuquerque
2. OTHER EXISTING AIR PERMITS					
Document Destruction	TA III	#144	8/28/85	No exp. date	City of Albuquerque[a]
Solvent Cleaning Booth	TA IV	#147	12/2/85	No exp. date	City of Albuquerque
Wind Shield Fire Test	Lurance Canyon	#196	5/19/88	No exp. date	City of Albuquerque
Emergency Generator	TA 1/862	#150	2/13/86	No exp. date	City of Albuquerque
PBFA-II	TA IV	NESHAP-H	3/23/89	No exp. date	EPA VI
SDA (PT2)	TA IV	NESHAP-H	7/8/88	No exp. date	EPA VI
HERMES III	TA IV	NESHAP-H	6/29/88	No exp. date	EPA VI

[a]Not active.

Table 6-8. 1991 Criteria Pollutant Inventory (tons per year)

Pollutants/ Source	Steam Generators[a] #1	#2	#3	#5	#6	Emergency Diesel Generator	Mobile Generators	Total Emissions
NO_X	11.68	7.50	8.98	16.19	67.71	1.025	5.014	118.10
SO_2	0.05	0.03	0.04	0.02	0.07	0.145	0.334	0.69
TSP	0.42	0.27	0.32	0.15	0.62	0.121	0.358	1.90
CO	2.92	1.88	2.24	1.18	4.92	0.047	1.957	15.14
HC	0.23	0.15	0.18	0.04	0.17	0.032	0.505	1.31

[a]Number 4 boiler was retired and no emissions were generated.

6.2.4 Inventory and Assessment of Hazardous Air Emissions

A. Scope

A hazardous air emission inventory was conducted in 1991 for 44 chemicals used in Technical Area I. The chemicals listed for the inventory were selected from a listing of substances in 40 CFR 61.01 (a) and (b) (inventory for radionuclides was conducted separately) and the toxic chemicals listed under 40 CFR 372.65 for the purpose of air quality assessment and compliance with SARA Title III, Section 313. Others listed were chemicals exceeding a 2000-lb purchase by SNL and chemicals listed on the 1987 Air Toxic Register (see Table 6-9 for a list of chemicals inventoried). A second source of chemical user information was obtained from the SNL Industrial Hygiene/ChemMaster database of chemicals that were purchased throughout SNL, Albuquerque.

The inventory forms were sent directly to the individuals responsible for the fume hoods, listed under the SNL Industrial Hygiene database for ventilation systems. Approximately 1000 inventory forms were received and the data were imputed to the database for modeling calculation.

Table 6-9. Example of Modeling Results for Selected Chemicals

Chemical	Max. Impact 8-hr Avg. ($\mu g/m^3$)	OEL/100[a] 8-hr Avg. ($\mu g/m^3$)	Max. Impact Ref. to NMAQ Stds. Avg. Time ($\mu g/m^3$)	NMAQ Stds. Corrected to 5560-ft Elevation ($\mu g/m^3$)	Approx. Location (Fig. 6-2)
Xylene	51.459	4350.00	66.382	91.810[b]	NE fence
Toluene	46.950	3750.00	60.553	92.035[b]	NE fence
Methyl Chloroform	39.250	19000.00	50.633	96.637[b]	NE fence
Freon	18.665	450.00	24.078	96.637[b]	SW fence
HCl Acid	3.194	70.00	1.821	122.276[c]	SW fence
Copper Compounds	2.881	----	1.642	122.276[c]	SW fence
Chlorine	2.867	30.00	----	none	SE fence
Cadmium Compounds	2.818	00.50	1.606	122.276[c]	SW fence

[a]OEL/100 = 1 percent of the Occupational Exposure Limit (OEL).
[b]3 hr New Mexico Hydrocarbon Standard.
[c]24 hr particulate monitoring.

B. Model Description

The EPA-approved Industrial Source Complex (ISC) model accepts data, which describe the emission source(s), from the inventory database. This data include source location, stack height and diameter, exhaust velocity and temperature, and quantity of contaminant emitted per unit of time. Additional input data to the model include descriptions of buildings in the vicinity of the source, desired impact averaging time, desired receptor locations, and meteorological information.

C. Receptor Fields

Four receptor location fields have been generated for use by the model:

- Receptor field 1 locates receptors at 100-m intervals within the Zia Park and Sandia Base housing areas. In addition, discrete receptors are placed at the Wherry and Sandia Base Elementary Schools, the East Preschool, and the Education Center.
- Receptor field 2 outlines the Technical Area I fence, with receptors spaced a maximum of 25 m apart.
- Receptor field 3 includes the receptors of field 2 and a square grid of receptors spaced every 100 m and located within one km of E359000, N879500 (near Building 894). This receptor field is used primarily to determine the highest concentrations outside Technical Area I.
- Receptor field 4 includes the receptors of field 2 and a grid of receptors within the Technical Area I fence. The receptors within the area fence are spaced 25 m apart.

The relationship of the first three receptor fields is shown in Figure 6-2.

D. Results

The maximum impacts from the various chemicals were compared with the New Mexico Ambient Air Quality Standards and 1 percent Occupational Exposure Limit (OEL) values. A complete summary of the results is provided in Appendix F, Table F-7, Modeling Results and Chemical Air Emission Standards. Table 6-9 is an example of information that is available for selected chemicals.

Compliance with air quality standards is determined on an individual-source basis: Unlike other industrial sources, the R&D sources within SNL are operated on an intermittent and infrequent basis. Therefore, the impact of each emission source of a given chemical is considered as standing alone when compared to its applicable air standard. Output data from the modeling for this report were based on considering all sources for each chemical in Technical Area I contributing to the impact. Therefore, output information is very conservative (high) when it is used to determine compliance with ambient air standards. The result is that if the maximum

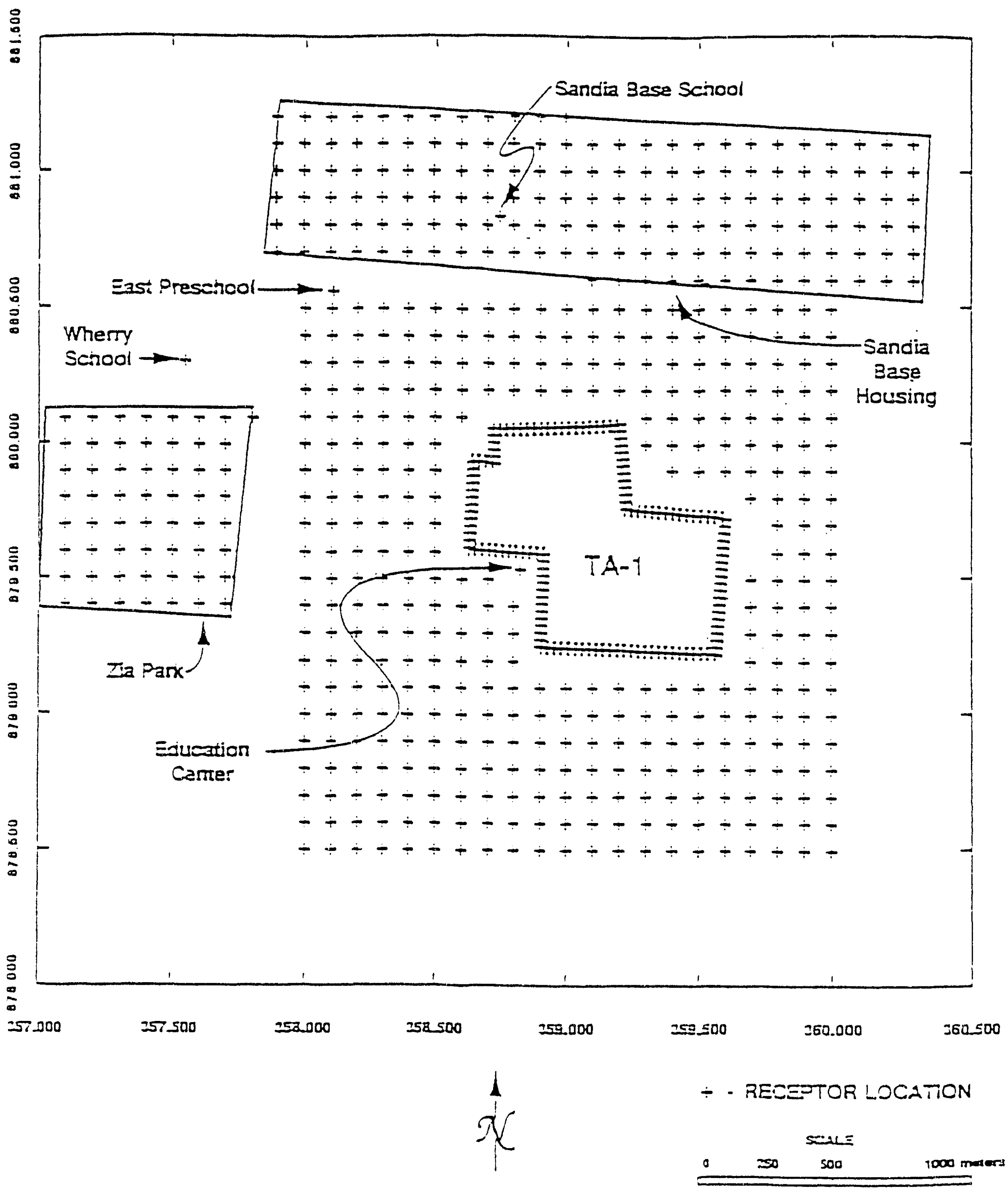

Figure 6-2. Combined Receptor Field Locations

impact for a given chemical, when referenced to the appropriate standard, is less than that standard, any of the individual sources emitting the chemical in question will be in compliance with the standard. This may be quickly determined by reference to Table F-7.

E. Conclusions

The chemical inventory was completed and the data were entered into a computer database. This database included the name of each chemical, the chemical abstract source (CAS) number, the quantity used, the estimated quantity emitted into the atmosphere, organizational details, and the building location of the emission point(s). For each chemical, the information was compiled into a source input file for use by an atmospheric dispersion model. The calculation was performed for four receptor groups including KAFB housing, schools, education center, the Technical Area I fence lines, and receptors within the fence lines.

The maximum impact values for all the chemicals in the inventory database have been tabulated in Table F-7. In addition, these data have been referenced to the New Mexico Ambient Air Quality Standards and listed in this same table.

A review of this information indicates that all of the ambient impacts of the emissions of all of the chemicals in the inventory database are in compliance with the New Mexico standards (Hwang, 1991e).

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CHAPTER 7

GROUNDWATER MONITORING

Groundwater monitoring activities conducted by Sandia National Laboratories (SNL), Albuquerque, during 1991 included measuring the water-level elevations of monitor wells in the SNL, Albuquerque, area and sampling the chemical waste landfill (CWL), mixed waste landfill (MWL), and the basewide monitor wells for water-quality analyses. Sampling at the CWL in 1991 included quarterly assessment monitoring and annual groundwater quality monitoring. MWL quarterly background monitoring continued throughout 1991. Kirtland Air Force Base (KAFB) basewide groundwater monitoring was conducted in order to establish background characteristics of the regional groundwater flow system. The following sections describe these activities and present the results for calendar year (CY) 1991.

7.1 Regulatory Overview

DOE Order 5400.1 requires SNL, Albuquerque, to design and implement a groundwater monitoring program to (1) obtain data for the purpose of determining baseline conditions of groundwater quality and quantity, (2) demonstrate compliance with and implementation of all applicable regulations and DOE orders, (3) provide data to permit the early detection of groundwater pollution or contamination, (4) identify existing and potential groundwater contamination sources and maintain surveillance of these sources, and (5) provide data upon which decisions can be made concerning land disposal practices and the management and protection of groundwater resources. Therefore, the ultimate goal of the groundwater monitoring program is to aid in the detection of any contaminants leaving SNL, Albuquerque, and any contaminants entering SNL, Albuquerque, from outside sources.

In addition, the CWL currently must meet the interim status Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Regulations (40 CFR 265, Subpart F). Groundwater monitoring activities at the MWL in 1991 were dictated by DOE Order 5400.4, which sets forth the policy that DOE facilities will respond to all releases in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, 42 U.S.C. 9601 et seq., and the National Oil and Hazardous Substances Pollution Contingency Plan (NESHAP), regardless of whether the site is on the National Priority List. The Superfund Amendments and Reauthorization Act of 1986 incorporated the concept of applicable or relevant and appropriate requirements (ARAR) into the CERCLA statute. The ARARs require that when a hazardous substance will remain onsite, a remedial action must attain at least the legally applicable or relevant and appropriate standards, requirements, criteria, or limitations provided by federal environmental law. With this standard in mind, SNL, Albuquerque, has judged the RCRA Groundwater Monitoring Regulations to fall under the category of an ARAR. SNL, Albuquerque, has concluded that the requirements of 40 CFR 265, Subpart F, are not specifically applicable to the MWL, in as much as the MWL was never under interim status or permitted prior to the final disposal of waste at the site in December 1988. Therefore, information pursuant to 40 CFR 265, Subpart F, is submitted for informational purposes because it is an ARAR, rather than a mandated requirement.

7.2 The SNL, Albuquerque, Groundwater Monitor Well Network

The SNL, Albuquerque, groundwater monitor well network includes 36 SNL, Albuquerque, and KAFB wells and five springs (Figures 7-1 through 7-3). Five of the wells and springs are east of the faults, with depth to groundwater varying from 0 to 100 ft (0 to 30 m); all others are west of the faults, with depths to groundwater on the order of 480 ft (146 m). All available well construction diagrams for these monitor wells can be found in the 1991 Ground-Water Monitoring Annual Calendar Year 1991 Program Report (SNL, 1992).

A monitor well network was established at the CWL to satisfy the requirements of 40 CFR 265.91 beginning in the summer of 1985, when five monitor wells (MW-1, MW-2, MW-3, BW-1, and BW-2) were installed using a mud-rotary drilling method. These were completed at various depths within the aquifer, with screened intervals ranging from 70 to 460 ft in length. Monitor well MW-1 was lost as a usable well in July 1988, when a baler and baler recovery equipment were left permanently lodged in the well bore. In 1988, four additional monitor wells were installed at the CWL using air-rotary casing hammer techniques. The 1988 wells (MW-1A, MW-2A, MW-3A, and BW-3) have 20-ft screened intervals located from 5 ft above the water table to 15 ft below the water table. An additional well (CWL-MW4) was drilled in 1990, using a combination of auger and mud-rotary techniques. Figure 7-2 shows the location of all CWL monitor wells.

A monitor well network was established at the MWL beginning in 1988, when MW-1 was installed. Three additional monitor wells (MW-2, MW-3, and BW-1) were installed between June and September 1989 (Figure 7-3). These wells have 20-ft screened intervals located from 5 ft above the water table to 15 ft below the water table. The monitor wells were not fully developed until the summer of 1990, due to the relatively low permeability of the sediments in the upper portion of the aquifer.

7.3 Groundwater Elevation

To determine the general horizontal hydraulic gradient throughout the SNL, Albuquerque/KAFB area, groundwater surface elevations have been measured in all accessible SNL, Albuquerque, monitor wells and adjacent KAFB and State of New Mexico monitor wells on a monthly basis since May 1989. Monthly depth-to-water measurements were collected from January through December 1991 in accordance with instructions contained in SNL SOP 90-02 (Goodrich, 1990). Water-level elevations were estimated, using topographic map locations to provide approximate wellhead elevations for those wells in the monitor-well network which have not yet been surveyed. The locations of monitor wells used for SNL, Albuquerque, water-level measurements are shown in Figure 7-1 and listed in Appendix F.

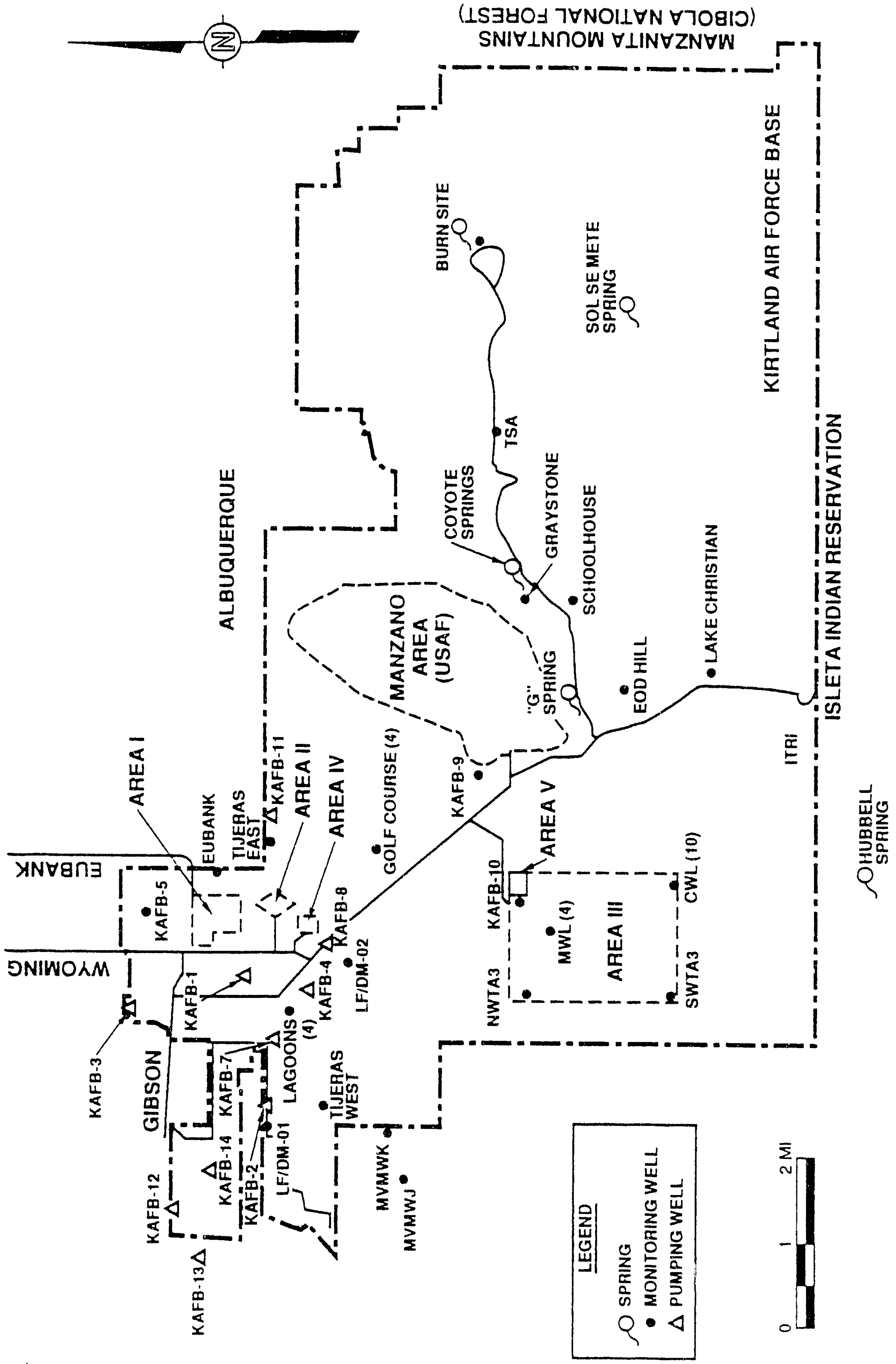

Figure 7-1. Location Map of SNL, Albuquerque, and KAFB Wells and Springs

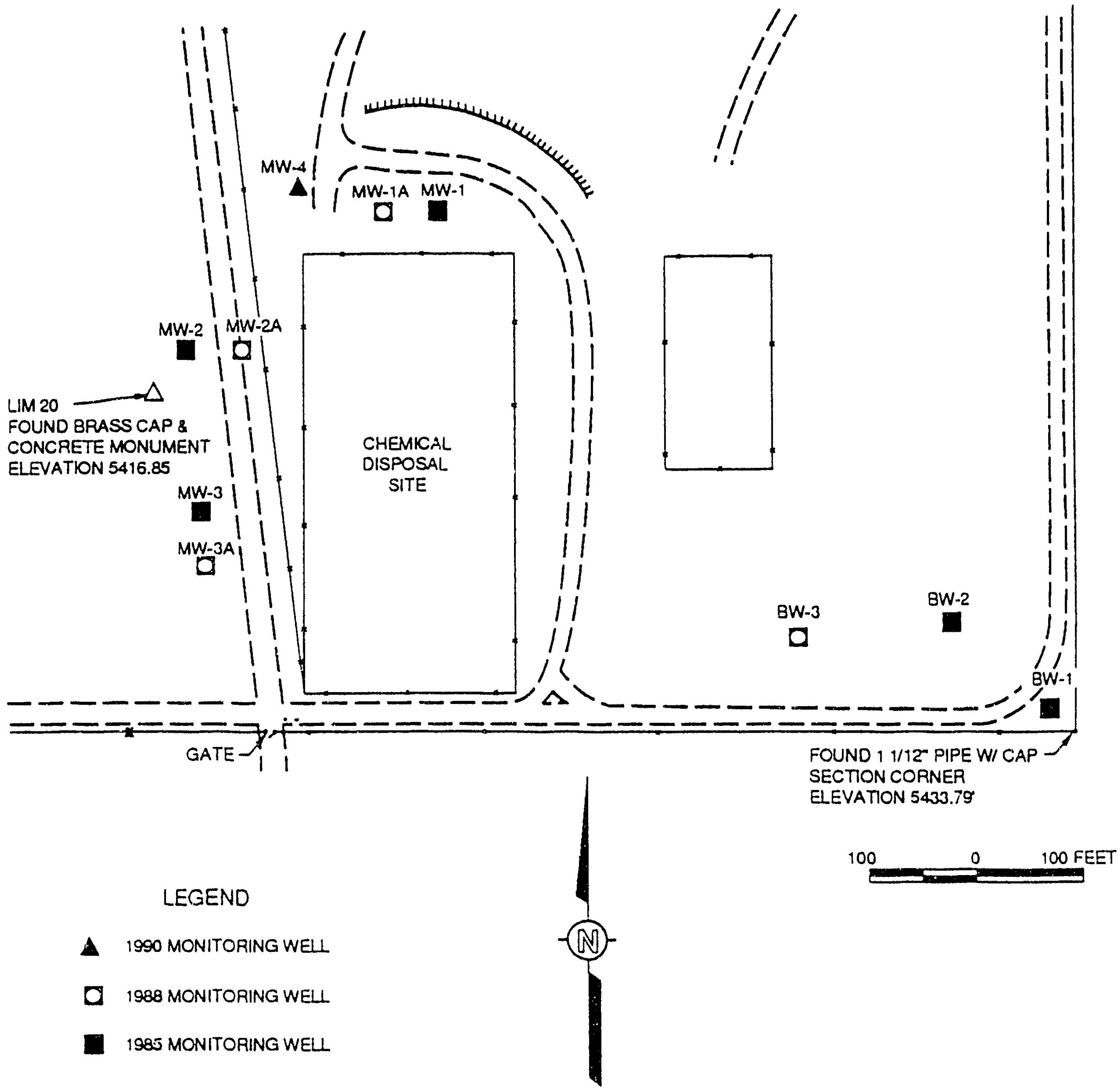

Figure 7-2. Chemical Waste Landfill Monitor Well Locations

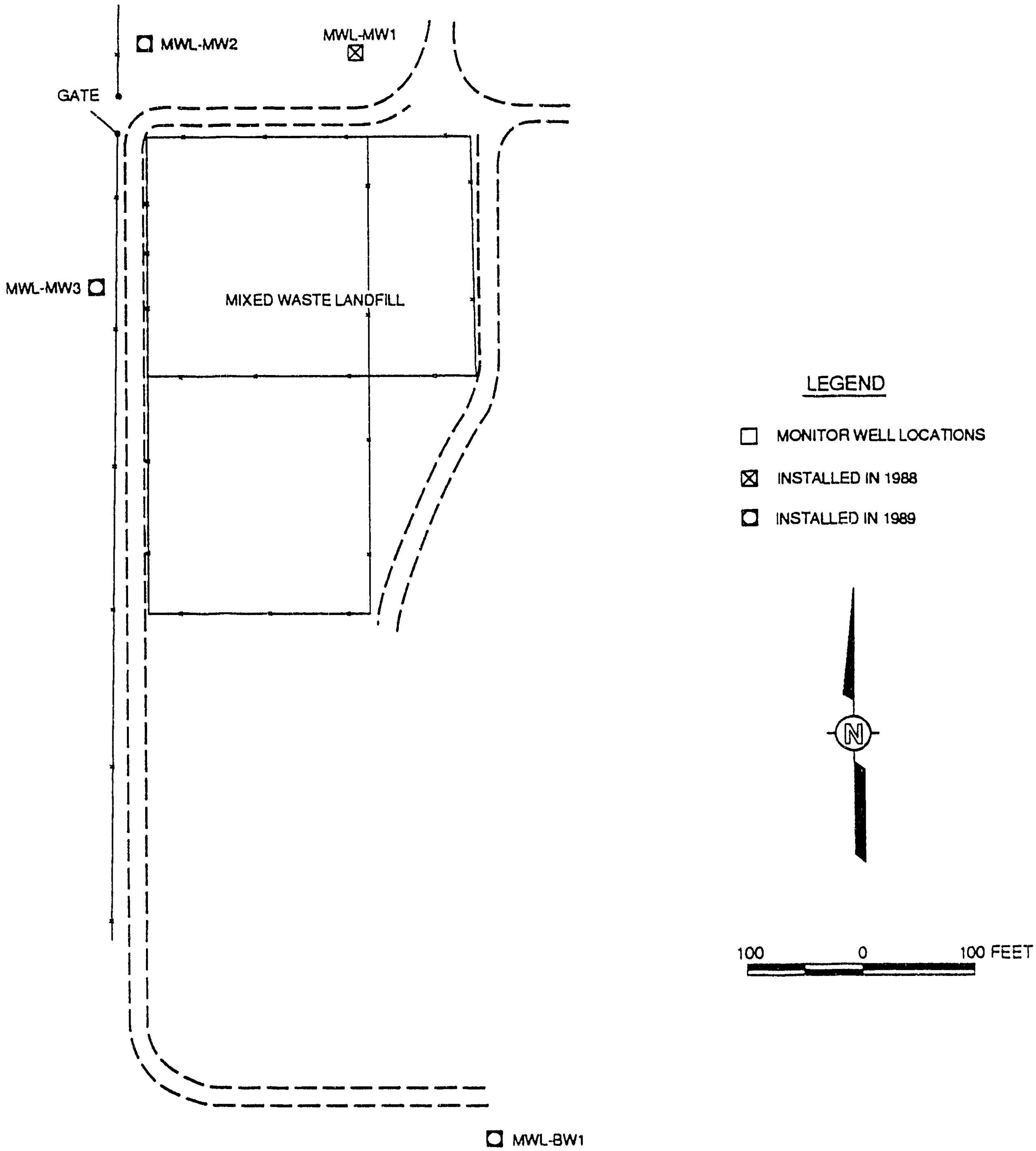

Figure 7-3. Mixed Waste Landfill Monitor Well Locations

The rate and direction of groundwater flow through a given medium is controlled by the hydraulic gradient and the distribution of the hydraulic conductivity. The hydraulic gradient is determined from measurements of water levels in wells screened near the water table. Given a homogeneous and isotropic medium under steady-state flow conditions, one can assume that the direction of groundwater flow is perpendicular to the potentiometric contour lines. If the assumption of homogeneity and isotropy is valid in KAFB's complex alluvial environment, potentiometric contour maps show the apparent direction of groundwater flow. All the contour maps shown in this report were constructed using SURFER (Golden Software, Inc.) interpolation and contouring software.

Water-level data from all the monitor wells in the SNL, Albuquerque, area and some old, unused KAFB production wells (listed in Appendix F) were utilized to generate the potentiometric surface elevation contours of the KAFB/SNL, Albuquerque, area. Assuming that the vertical gradient can be ignored (an assumption that is currently under investigation), static water levels are considered to be representative of the elevation of the water table at that location. The KAFB production wells are screened over large intervals, usually starting at the water table and extending several hundred feet into the saturated zone. The monitor wells typically have 20-ft screens placed right at the water table. However, differences in screen length between wells is not considered to be a problem because the aquifer is unconfined (again, ignoring the vertical gradient). A representative potentiometric surface contour map of the KAFB/SNL, Albuquerque, area (May 1991) depicts the apparent groundwater flow direction generally to the west and northwest (Figure 7-4).

The potentiometric surface at the CWL is fairly constant from one quarter to the next (IT, 1991a, 1991f, 1991g, 1992; SNL, 1992). Based on the water-level data, the apparent groundwater flow direction at the CWL is consistently northwest. Therefore, the groundwater monitor well network at the CWL satisfies the 40 CFR 265.91 requirements in that the wells are located such that BW-3 is hydraulically upgradient, while MW-1A, MW-2A, MW-3A, and MW-4 are hydraulically downgradient from the site.

Potentiometric surface elevation contours have not been determined for the MWL, but the potentiometric surface contour map for Technical Area III (Figure 7-5) shows an apparent groundwater flow direction of approximately west and northwest. (Note that the potentiometric surface contours shown in Figure 7-5 were derived by using all the data from Appendix F and "zooming in" on Technical Area III.) Hydrographs of the MWL monitor well network (Figure 7-6) indicate the network does not satisfy the requirements of 40 CFR 265.91. A work plan has been prepared to address the adequacy of the MWL well network. This work will commence during 1992 (SNL, 1991a).

The generally west and northwest apparent direction of groundwater flow in the KAFB area is different from the southwesterly direction reported by Bjorklund and Maxwell (1961). This difference is probably caused by KAFB and nearby City of Albuquerque production wells which have affected the hydraulic gradient in the area by creating a cone of depression in the

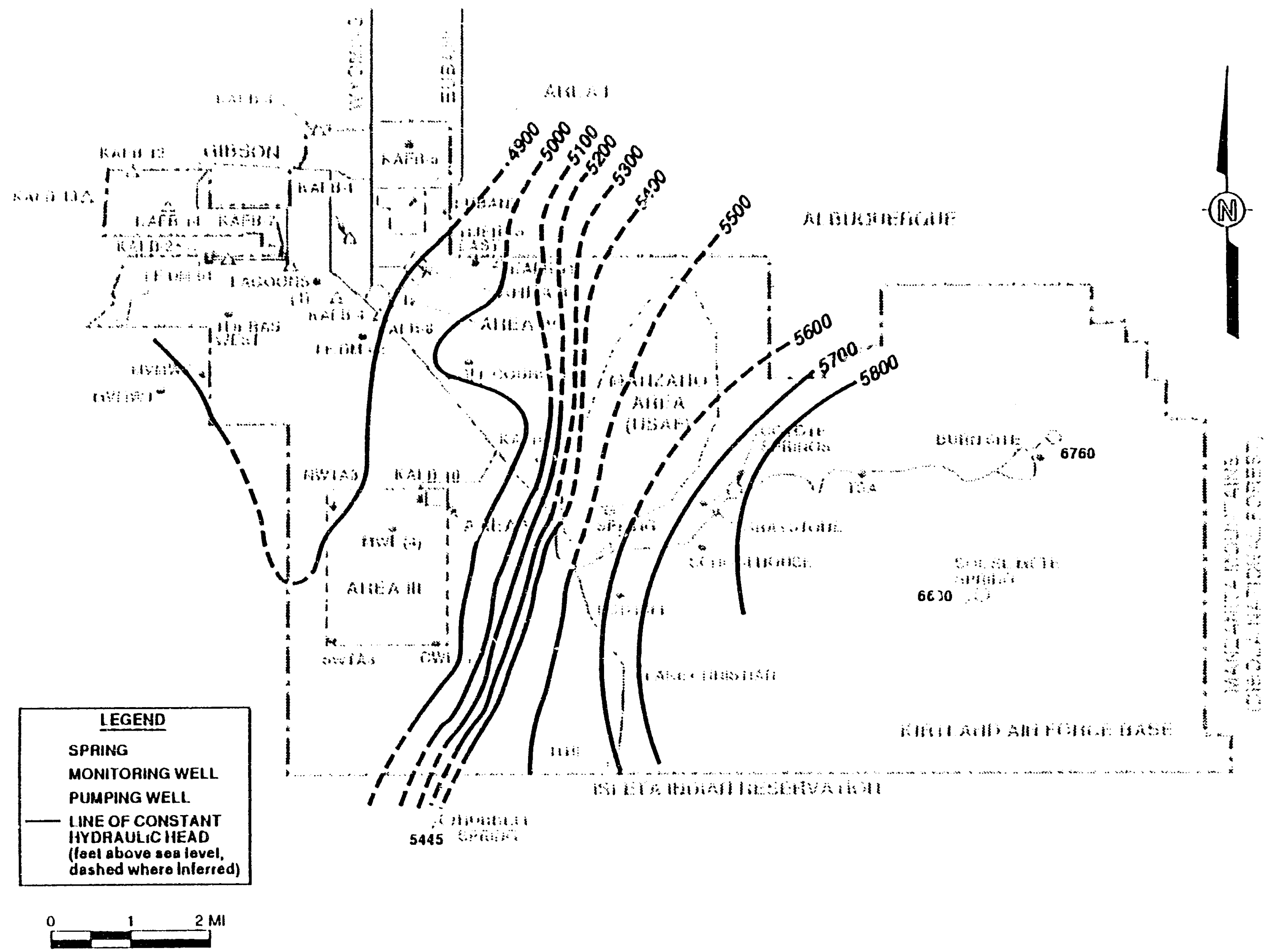

Figure 7-4. KAFB Potentiometric Surface Map, May 1991. Contours are derived from monitor well water levels only.

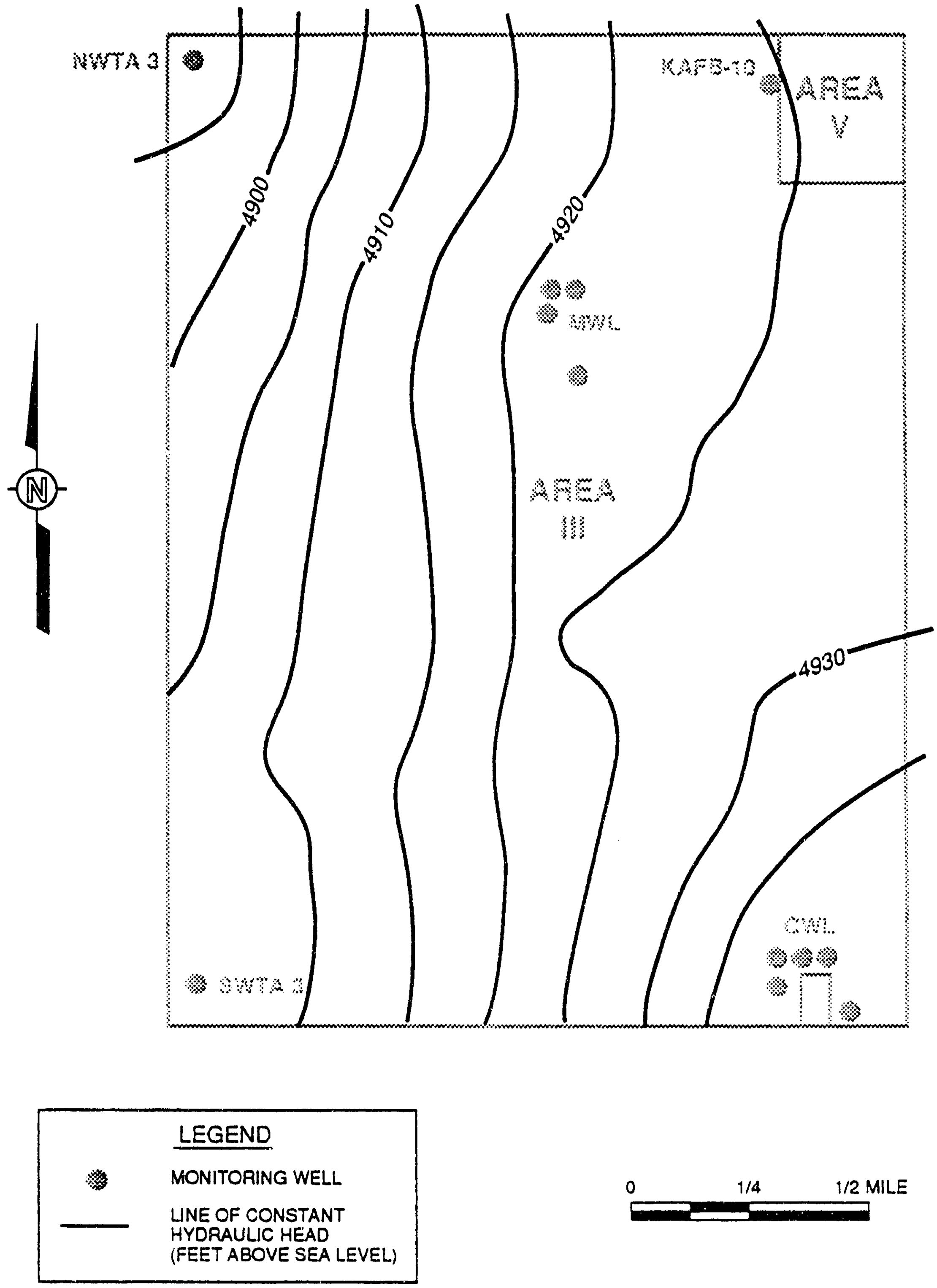

Figure 7-5. Technical Area III Potentiometric Surface Map, May 1991 (5-ft contour interval)

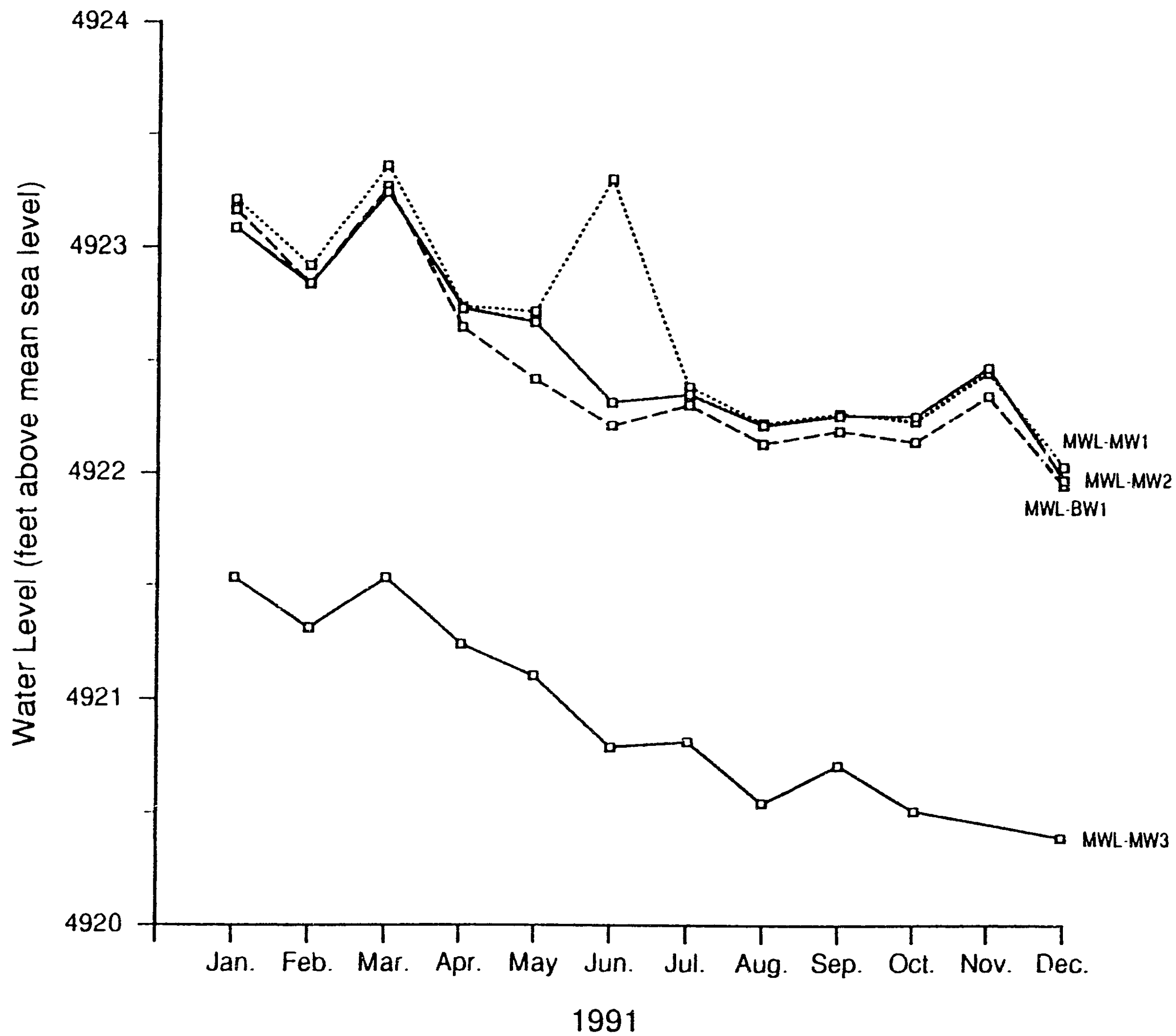

Figure 7-6. Hydrograph of Water Levels in SNL, Albuquerque, Mixed Waste Landfill Monitor Wells, 1991

groundwater surface in the northern portion of KAFB. Over 1.6 billion gal of water are pumped from the KAFB production wells annually (Figure 7-7 and Table 7-1) (Schelor, 1991). About twice as much water is pumped during the summer months when there is a higher water demand compared to the winter months. It is possible that KAFB production well pumping is the cause of water-level fluctuations noted in some monitor wells located west of the faults. SNL (1992) presents further discussion and data pertaining to seasonal and long-term water-level fluctuations observed in the SNL, Albuquerque/KAFB monitor-well network.

7.4 Groundwater Sampling

The following sections describe the groundwater sampling activities conducted at SNL, Albuquerque, during CY 1991.

7.4.1 Sampling Procedures and Methods

The protocols for collection and analysis of representative groundwater samples at the CWL and MWL are specified in the "Chemical Waste Landfill Sampling and Analysis Plan" (SNL, 1990a) and in the draft "Mixed Waste Landfill Sampling and Analysis Plan" (SNL, 1990b), respectively. Samples for the basewide hydrogeochemical characterization were collected in accordance with the "Regional Hydrogeochemical Sampling and Analysis Plan" (Goodrich and Stein, 1991a), as well as the "Chemical Waste Landfill Sampling and Analysis Plan" (SNL, 1990a). The general procedure for collecting groundwater samples at all areas in 1991 included (1) monitoring the wellhead atmosphere for the presence of organic vapors that may indicate the presence of nonaqueous phase liquids, (2) monthly measurement of the groundwater elevation and annual measurement of the total depth of each well, (3) purging the well of three casing volumes at rates that minimize turbulence during recharge (with exceptions for low-yield wells as noted in quarterly reports), (4) collecting the desired groundwater sample and appropriate quality control (QC) samples in specified containers provided by the analytical laboratory with appropriate preservatives as needed, and (5) sending the samples to the analytical laboratory for analysis under strict chain-of-custody documentation. Quarterly sampling included measurements of pH, SC, and temperature during purging to determine stabilization of water quality during environmental sampling so that representative samples could be collected. Specific details pertaining to each assessment groundwater sampling event are described in the individual annual and quarterly groundwater sampling reports. These reports contain summary tables, raw field and laboratory data, QC data, and descriptions of the analytical methods employed by the analytical laboratories.

7.4.2 Chemical Waste Landfill Assessment Groundwater Monitoring

In accordance with the RCRA regulations, the background conditions of the groundwater quality at the CWL were determined for all of the current RCRA monitor wells (40 CFR 265.92[c][1]) (IT, 1989a, 1989b, 1989c, 1989d, 1990a, 1990d; SNL, 1991c). Trichloroethylene (TCE) was detected in MW-2A

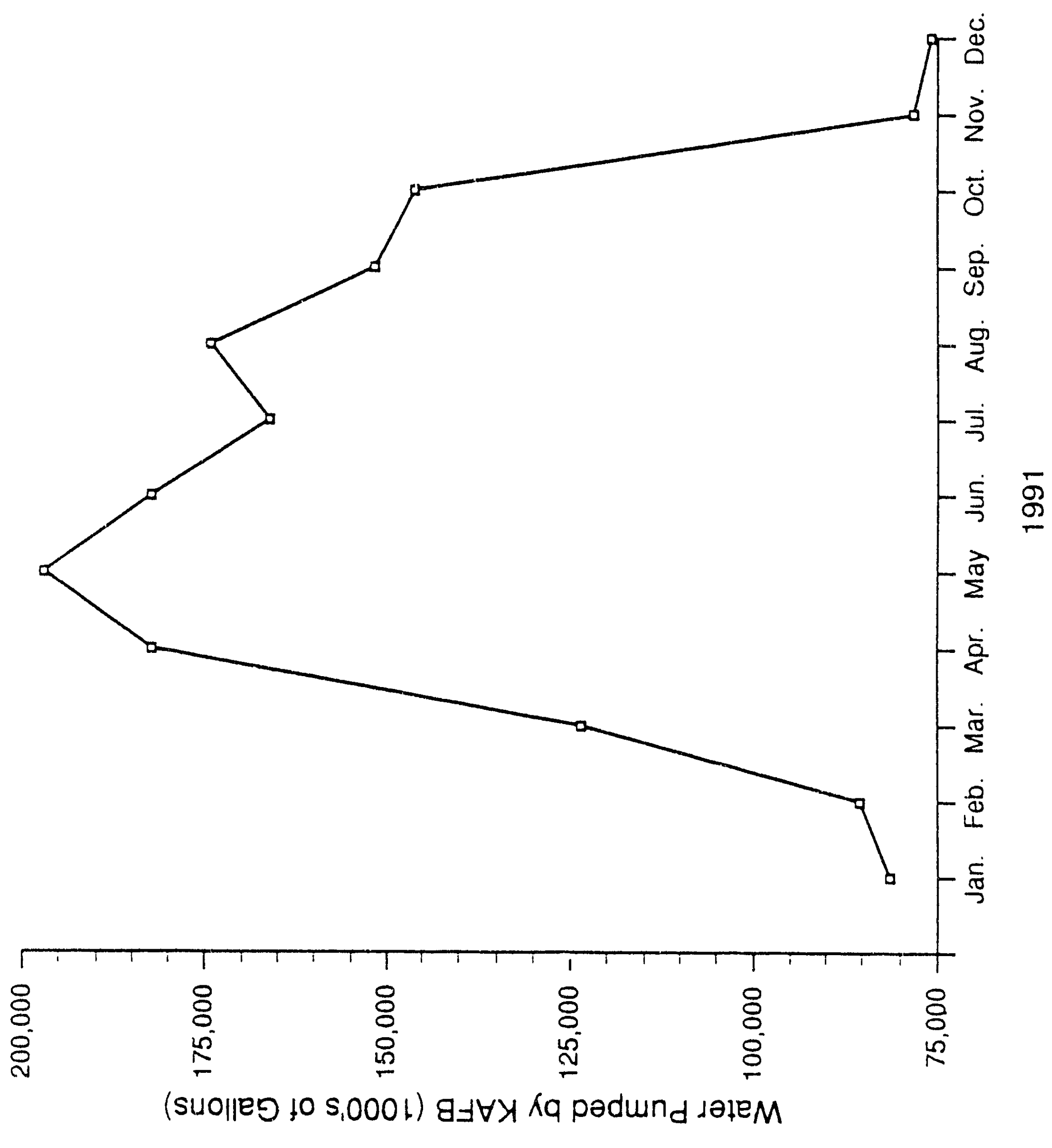

Figure 7-7. Water Pumped by KAFB Production Wells, 1991

Table 7-1. Water Produced by KAFB Pumping Wells, 1991 (Thousands of Gallons)

Well	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
KAFB-01	0	0	0	0	0	0	0	0	0	0	0	0	0
KAFB-02	0	0	0	0	0	0	0	0	0	0	0	0	0
KAFB-03	0	115	12,924	25,867	25,331	20,488	26,411	25,246	19,199	12,198	1,286	819	169,884
KAFB-04	30,854	27,792	30,824	37,282	41,226	41,593	26,353	33,721	39,716	44,165	9,487	26,547	389,560
KAFB-07	10,772	18,343	19,290	53,134	56,397	52,553	57,724	57,447	27,765	24,840	30,286	14,100	422,651
KAFB-08	0	0	0	0	0	0	0	0	0	0	0	0	0
KAFB-11	23,890	22,140	36,146	28,951	32,835	31,693	21,055	19,862	36,951	36,759	21,527	21,249	333,058
KAFB-12	0	13,003	13,712	14,467	15,372	14,107	13,537	8,831	14,776	15,916	15,113	12,512	151,346
KAFB-13	13,825	3,991	10,795	22,758	25,852	21,781	20,960	10,212	11,440	12,315	364	0	154,293
KAFB-14	2,037	0	0	0	0	0	0	18,962	1,957	22	0	0	22,978
Total	81,378	85,384	123,691	182,459	197,013	182,215	166,040	174,281	151,804	146,215	78,063	75,227	1,643,770

during the first detection monitoring event in March 1990 (IT, 1990b). After resampling results in May 1990 confirmed the presence of TCE in the groundwater (IT, 1990f), an assessment monitoring program was begun in accordance with 40 CFR 265.93(d)(2). The CWL assessment monitoring program includes quarterly monitoring for the constituents of concern (TCE and chromium) and annual monitoring for Appendix IX parameters (SNL, 1990c).

Annual groundwater assessment monitoring for CWL monitor wells BW-3, MW-1A, MW-2A, MW-3A, and MW-4 was conducted in February 1991; quarterly assessment monitoring took place in May, August, and November 1991. These sampling events were conducted in accordance with the CWL assessment monitoring plan (SNL, 1990c), which includes annual sampling for Appendix IX parameters and quarterly sampling for volatile organic compounds (VOCs) as well as total and dissolved chromium. The results of both annual groundwater quality monitoring and quarterly assessment monitoring conducted in 1991 are presented in SNL (1992). Details of the sampling events may be found in the CWL annual groundwater assessment monitoring report (IT, 1991a) and in the quarterly groundwater assessment monitoring reports (IT, 1991e, 1991f, 1992; SNL, 1992). Compounds detected during the quarterly sampling events are summarized in Tables 7-2 through 7-5.

Laboratory results from the quarterly assessment sampling in May 1991 detected TCE only in well MW-2A at a concentration of 4.8 μg/L. The maximum contaminant level (MCL) for TCE established by the New Mexico Water Quality Regulations (NMWQR, 1991) is 100 μg/L. TCE was not found in any other CWL wells in May 1991 nor in any CWL wells during any other quarterly sampling in 1991. Other VOCs detected in CWL samples during 1991 include acetone, methylene chloride, 2-butanone, and 2-hexanone. Concentrations of these compounds are summarized in Tables 7-2 through 7-5. The presence of these compounds is attributed to sample contamination (laboratory contamination), as noted in the quarterly reports.

Metals detected in the February 1991 annual Appendix IX sampling include barium in all CWL wells, copper in MW-1A, nickel in BW-3 and MW-3A, and zinc in all CWL wells except MW-2A. All metals were detected at concentrations lower than the MCL, with the exception of nickel which was detected in BW3 at 0.27 mg/L; the MCL is 0.2 mg/L. These metals were only analyzed in the February sampling. Table 7-2 contains detailed information of detected amounts.

Total chromium was detected at levels below the MCLs established by the NMWQR of 0.05 mg/L in some wells during February (BW-3, MW-2A, and MW-4), May (MW-2A), August (MW-2A, MW-3A), and November (MW-2A) of 1991. Only well BW-3 groundwater samples exceeded the MCL for total chromium at levels of 0.078 mg/L, 0.077 mg/L, and 0.070 mg/L. Dissolved chromium was found in MW-1A in February at a concentration of 0.0051 mg/L. No other CWL samples in 1991 were found to contain dissolved chromium (Table 7-3). Stein et al. (1991) suggest that a likely source of chromium, which is in particulate form, is corrosion of stainless steel in well casings, screens, and/or

Table 7-2. Summary of Detected Compounds, SNL, Albuquerque, Chemical Waste Landfill, February 1991

Sample No. SNLA00- Monitor Well ID			Environmental Groundwater Samples						
			MCL mg/L	5501 BW-3	5502 MW-1A	5506 MW-1A Dup.	5503 MW-2A	5504 MW-3A	5505 MW-4
Parameter	Method	Reporting Limit							
Acetone	8240	10 µg/L	NE	14 µg/L	ND	ND	ND	ND	ND
Methylene Chloride	8240	5 µg/L	100	14 µg/L	ND	ND	ND	ND	6.4 µg/L
2-Butanone	8240	10 µg/L	NE	ND	ND	ND	ND	ND	ND
Barium	6010	0.010 mg/L	1.0	0.034 mg/L	0.065 mg/L	0.064 mg/L	0.065 mg/L	0.060 mg/L	0.110 mg/L
Chromium, Total	7191	0.0050 mg/L	0.05	0.011 mg/L	ND	ND	0.036 mg/L	ND	0.0061 mg/L
Chromium, Dissolved	7191	0.0050 mg/L	NE	ND	0.0051 mg/L	ND	ND	ND	ND
Copper	6010	0.020 mg/L	1.0	ND	0.042 mg/L	ND	ND	ND	ND
Nickel	6010	0.040 mg/L	0.2	0.27 mg/L	ND	ND	0.063 mg/L	ND	ND
Zinc	6010	0.02 mg/L	10.0	0.040 mg/L	0.032 mg/L	ND	ND	0.030 mg/L	0.024 mg/L

MCL = Maximum contaminant level, established by NMWQR (1991).
ND = Not detected at method reporting limit indicated.
NE = Not established.

Table 7-2. Summary of Detected Compounds, SNL, Albuquerque, Chemical Waste Landfill, February 1991 (Concluded)

			Equipment Blank	Trip Blank	
Sample No. SNLA00- Monitor Well ID			5499 MW-3A	5378 Feb. 22	5380 Feb. 28
Parameter	Reporting Method	Limit			
Acetone	8240	10 µg/L	ND	ND	ND
Methylene Chloride	8240	10 µg/L	ND	ND	ND
2-Butanone	8240	10 µg/L	ND	ND	ND
Barium	6010	0.010 mg/L	ND	19 µg/L	20 µg/L
Chromium, Total	7191	0.0050 mg/L	0.0052 mg/L	ND	ND
Chromium, Dissolved	7191	0.0050 mg/L	ND	ND	ND
Copper	6010	0.020 mg/L	ND	ND	ND
Nickel	6010	0.040 mg/L	ND	ND	ND
Zinc	6010	0.2 mg/L	ND	ND	ND

ND = Not detected at method reporting limit indicated.

Table 7-3. Summary of Detected Compounds, SNL, Albuquerque, Chemical Waste Landfill, May 1991[a]

Sample No. SNLA00- Monitor Well ID				Environmental Groundwater Samples					
				5659 BW-3	5660 MW-1A	5661 MW-2A	5662 MW-3A	5664 MW-3A Dup	5663 MW-4
Parameter	Method	Reporting Limit	MCL						
Acetone	8260	2.0	NE	2400	ND<16	2.8	7.8	10	ND<2.0
Methylene Chloride	8260	1.0	NE	ND<25	ND<8.0	ND<1.0	ND<2.5	ND<2.5	ND<1.0
2-Butanone (MEK)	8260	2.0	NE	360	ND<16	3.6	ND<5	ND<5	ND<2.0
2-Hexanone	8260	2.0	NE	120	ND<16	ND<2.0	ND<5	ND<5	ND<2.0
Trichloroethylene (TCE)	8260	1.0	100[a,b]/5[c]	ND<25	ND<8.0	4.8	ND<2.5	ND<2.5	ND<1.0
Chromium, Total	7191	0.0050 mg/L	NE[b]/0.05 mg/L[c]	0.078 mg/L	ND	0.011 mg/L	ND	ND	ND
Chromium, Dissolved	7191	0.0050 mg/L	0.05 mg/L[b,c]	ND	ND	ND	ND	ND	ND

[a]All results in μg/L unless otherwise noted.
[b]NMWQR (1991).
[c]National Revised Primary Drinking Water Regulations (40 CFR 141.61).
MCL = Maximum contaminant level.
ND = Not detected at method reporting limit indicated.
NE = Not established.

Table 7-3. Summary of Detected Compounds, SNL, Albuquerque, Chemical Waste Landfill, May 1991[a] (Continued)

				Field Blank Samples			
Sample No. SNLA00- Date Sampled				5666 May 20	5665 May 21	5667 May 22	5668 May 23
Parameter	Method	Reporting Limit	MCL				
Acetone	8260	2.0	NE	24	23	28	22
Methylene Chloride	8260	1.0	NE	ND	ND	1.1	ND
2-Butanone (MEK)	8260	2.0	NE	17	14	18	20
2-Hexanone	8260	2.0	NE	ND	ND	1.1	ND
Trichloroethylene (TCE)	8260	1.0	100[a,b]/5[c]	ND	ND	ND	ND

[a]All results in μg/L unless otherwise noted.
[b]NMWQR (1991).
[c]National Revised Primary Drinking Water Regulations (40 CFR 141.61).
MCL = Maximum contaminant level.
ND = Not detected at method reporting limit indicated.
NE = Not established.

Table 7-3. Summary of Detected Compounds, SNL, Albuquerque, Chemical Waste Landfill, May 1991[a] (Concluded)

				Field Blank Samples		
Sample No. SNLA00-				5670	5672	5673
Date Sampled				May 20	May 21	May 22
Parameter	Method	Reporting Limit	MCL			
Acetone	8260	2.0	NE	76	4.4	3.5
Methylene Chloride	8260	1.0	NE	ND	ND	ND
2-Butanone (MEK)	8260	2	NE	14	2.8	ND
2-Hexanone	8260	2	NE	3.0	ND	ND
Trichloroethylene (TCE)	8260	1.0	100[b]/5[c]	ND	ND	ND

[a]All results in μg/L unless otherwise noted.
[b]NMWQR (1991).
[c]National Revised Primary Drinking Water Regulations (40 CFR 141.61).
MCL = Maximum contaminant level.
ND = Not detected at method reporting limit indicated.
NE = Not established.

Table 7-4. Summary of Detected Compounds, SNL, Albuquerque, Chemical Waste Landfill, August 1991[a]

Sample No. SNLA00- Monitor Well ID				Environmental Groundwater Samples					
				6539 BW-3	6540 MW-1A	6541 MW-2A	6542 MW-3A	6544 MW-3A Dup	6543 MW-4
Parameter	Method	Reporting Limit	MCL						
Total Cr	7191	0.0050	NE[b]/0.05[c]	0.077	ND	0.0071	0.0061	0.0071	ND
Dissolved Cr	7191	0.0050	0.05[b,c]	ND	ND	ND	ND	ND	ND
VOA	8240	10/5.0[d]	Various	ND	ND	ND	ND	ND	ND

[a]All results in mg/L unless otherwise noted.
[b]NMWQR (1991).
[c]National Revised Primary Drinking Water Regulations (40 CFR 141.61).
[d]Results in μg/L.
MCL = Maximum contaminant level.
ND = Not detected at method reporting limit indicated.
NE = Not established.

Table 7-5. Summary of Detected Compounds, SNL, Albuquerque, Chemical Waste Landfill, November 1991[a]

Sample No. SNLA00- / Monitor Well ID				Environmental Groundwater Samples					
				7215 BW-3	7216 MW-1A	7217 MW-2A	7220 MW-2A Dup	7218 MW-3A	7219 MW-4
Parameter	Method	Reporting Limit	MCL						
Total Cr	7191	0.0050	NE[b]/0.05[c]	0.070	ND	0.016	0.015	ND	ND
Dissolved Cr	7191	0.0050	0.05b[b,c]	ND	ND	ND	ND	ND	ND
Methylene Chloride	8240	5.0[d]	100[b,d]/NE[c]	5.2	5.4	ND	ND	ND	5.2
Toluene	8240	5.0[d]	750[b,d]/NE[c]	11	ND	ND	ND	ND	ND
Other VOA	8240	10/5.0[d]	Various	ND	ND	ND	ND	ND	ND

[a]All results in mg/L unless otherwise noted.
[b]NMWQR (1991).
[c]National Revised Primary Drinking Water Regulations (40 CFR 141.61).
[d]Results in μg/L.
MCL = Maximum contaminant level.
ND = Not detected at method reporting limit indicated.
NE = Not established.

downhole pump components, as opposed to naturally occurring sediment and that chromium migration from the landfill to the groundwater is the least likely mechanism for the occurrence of chromium in groundwater at the CWL.

7.4.3 Mixed Waste Landfill Background Conditions Groundwater Monitoring

Baseline groundwater sampling began at the MWL in September 1990 (IT, 1990e); subsequent quarterly sampling for groundwater quality monitoring at the MWL was performed in January, April, July, and October 1991. These sampling events were conducted using procedures in the draft "Mixed Waste Landfill Sampling and Analysis Plan" (SNL, 1990d). The extremely low yields of monitor wells MWL-MW2 and MWL-MW3 do not allow the field parameters (pH and SC) to stabilize before running dry. These wells are purged once to dryness, allowed to recover, then sampled.

Baseline monitoring parameters include Appendix III drinking-water supply parameters (metals, pesticides, herbicides, nitrate, coliform bacteria, alpha activity, beta activity, and radium), groundwater quality parameters (Cl, Fe, Mn, Na, sulfate, and phenols), and groundwater contamination parameters (pH, SC, total organic halogen [TOX], and total organic carbon [TOC]). Analyses for metals included both a filtered fraction (<0.45 μ) for dissolved metals and an unfiltered fraction for total metals. Additional radioisotope data is being collected and will be documented in a future report for information purposes.

Quarterly reports summarizing the results of the January and April sampling events have been submitted in draft status (IT, 1991h, 1991i). Reports for the July and October events will be submitted when complete analytical results have been received (i.e., for radionuclide fractions). SNL (1992) includes summaries of the monitoring results for all four quarters.

Detected parameters from the 1991 quarterly sampling events include barium, chromium, iron, manganese, sodium, chloride, fluoride, nitrate, phenolics, sulfate, and TOC (Tables 7-6 through 7-9). Only TOC (MWL-MW2, January 1991) and phenolics (MWL-MW1 and MWL-BW1, January and April 1991) were detected in amounts above the MCLs established by the NMWQR. Although phenolics are not a common laboratory contaminant, the lab reported a contaminated method blank for January 1991. Therefore, the reporting limit for phenolics is at least twice as high as the level required by the NMWQR, as a result of these laboratory limitations. Phenolics were also detected in the field blank from July 1991. The possibility that these results may be false positive cannot be ruled out at this time.

7.4.4 SNL, Albuquerque/KAFB Basewide Sampling Results

Quarterly sampling to establish the baseline water quality parameters (Goodrich and Stein, 1991a) was conducted by the Groundwater Monitoring Program in April, July, and October 1991; another series of samples were collected in January 1992. Samples were collected from 16 wells and 4 natural springs on KAFB and Isleta Pueblo (Tables 7-10 through 7-12). All samples were analyzed for cations (Mg, Ca, K, Na, Fe), anions (F, Cl, Br,

Table 7-6. Summary of Detected Compounds, SNL, Albuquerque, Mixed Waste Landfill, January 1991[a]

Sample No. SNLA00- Well ID				Environmental Groundwater Samples				
				5139 MWL-MW1	5140 MWL-MW2	5141 MWL-MW3	5138 MWL-BW1	5142 MWL-BW1 Dup.
Parameter	Method	Reporting Limit	MCL					
Barium, Total	6010	0.010	1.0	0.069	0.11	0.098	0.11	0.11
Barium, Dissolved	6010	0.010	NE	0.070	0.011	0.10	0.10	0.10
Chromium, Total	6010	0.010	0 05	0.021	0.017	0.021	ND	ND
Chromium, Dissolved	6010	0.010	NE	ND	ND	0.016	ND	ND
Iron, Total	6010	0.10	1.0	0.44	0.85	ND	0.28	ND
Manganese, Total	6010	0.010	0.2	0.019	0.016	ND	ND	ND
Sodium, Total	6010	5.0	NE	50.2	56.5	55.4	57.8	55.7
Sodium, Dissolved	6010	5.0	NE	49.8	57.3	56.6	54.7	55.4
Chloride	300.0	3.0	250	29.9	32.2	29.9	26.4	27.9
Fluoride	340.2	0.10	1.6	1.30	0.74	1.0	0.67	0.60
Nitrate as N	353.2	0.50	10.0	4.9	4.4	4.4	5.4	5.2
Phenolics	9065	0.010	0.005	0.011	ND<0.019	ND<0.019	0.021	ND<0.027
Sulfate	300.0	5.0	600	42.3	41.3	41.1	41.7	43.4
Total Organic Carbon (TOC)	9060	0.50	NE	ND	0.64	ND	0.52	0.51

[a]All results in mg/L.
MCL = Maximum contaminant level, established by NMWQR (1991).
ND = Not detected at reporting limit indicated.
NE = Not established.

Table 7-7. Summary of Detected Compounds, SNL, Albuquerque, Mixed Waste Landfill, April 1991[a]

Sample No. SNLA00- Well ID				Environmental Groundwater Samples					
				5890 MWL-MW1	5878 MWL-MW2	5876 MWL-MW3	5887 MWL-BW1	5893 MWL-BW1 Dup.	5879 Field Blank
Parameter	Method	Reporting Limit	MCL						
Barium, Total	6010	0.010	1.0	0.065	0.099	0.091	0.093	0.080	ND
Barium, Dissolved	6010	0.010	NE	0.067	0.11	0.10	0.098	0.10	ND
Chromium, Total	6010	0.010	0.05	0.015	0.014	0.017	ND	ND	ND
Chromium, Dissolved	6010	0.010	NE	ND	ND	ND	ND	ND	ND
Iron, Total	6010	0.10	1.0	0.76	0.20	0.24	ND	0.10	0.15
Manganese, Total	6010	0.010	0.2	0.015	ND	ND	ND	ND	ND
Sodium, Total	6010	5.0	NE	50.3	55.4	55.3	53.2	44.4	ND
Sodium, Dissolved	6010	5.0	NE	50.6	62.1	59.7	52.0	54.4	ND
Chloride	300.0	3.0	250	28.5	36.5	31.9	26.7	26.8	3.0
Fluoride	300.0	0.10	1.6	0.63	0.57	0.57	0.60	0.60	ND
Nitrate as N	353.2	0.20	10.0	2.4	5.1	4.7	6.2	2.6	ND
Phenolics	9065	0.010	0.005	0.013	ND	ND	ND	0.021	ND
Sulfate	300.0	5.0	600	42.4	45.2	42.7	42.6	42.8	ND

[a]All results in mg/L.
MCL = Maximum contaminant level, established by NMWQR (1991).
ND = Not detected at reporting limit indicated.
NE = Not established.

Table 7-8. Summary of Detected Compounds, SNL, Albuquerque, Mixed Waste Landfill, July 1991[a]

Sample No. SNLA00- Well ID				Environmental Groundwater Samples				
				6438 MWL-MW1	6439 MWL-MW2	6440 MWL-MW3	6437 MWL-BW1	6441 MWL-BW1 Dup.
Parameter	Method	Reporting Limit	MCL					
Barium, Total	6010	0.010	1.0	0.066	0.098	0.089	0.097	0.090
Barium, Dissolved	6010	0.010	NE	0.064	0.081	0.082	0.082	0.081
Chromium, Total	6010	0.010	0.05	0.011	ND	0.027	ND	ND
Chromium, Dissolved	6010	0.010	NE	ND	ND	0.015	ND	ND
Iron, Total	6010	0.10	1.0	0.71	ND	0.25	ND	ND
Manganese, Total	6010	0.010	0.2	0.019	ND	ND	ND	ND
Sodium, Total	6010	5.0	NE	54.2	57.2	52.5	63.7	62.4
Sodium, Dissolved	6010	5.0	NE	51.7	55.7	49.6	49.8	48.5
Chloride	300.0	3.0	250	28.2	31.9	30.6	26.7	27.9
Fluoride	340.2	0.10	1.6	0.95	0.92	1.1	0.84	0.84
Nitrate as N	353.2	0.50	10.0	4.7	4.3	3.7	5.1	5.1
Phenolics	9065	0.010	0.005	ND<0.010	ND<0.010	ND<0.010	ND<0.010	ND<0.010
Sulfate	300.0	5.0	600	41.0	41.2	38.6	43.3	44.3
Total Organic Carbon (TOC)	9060	0.50	NE	ND	ND	ND	ND	ND

[a]All results in mg/L.
MCL = Maximum contaminant level, established by NMWQR (1991).
ND = Not detected at reporting limit indicated.
NE = Not established.

Table 7-9. Summary of Detected Compounds, SNL, Albuquerque, Mixed Waste Landfill, October 1991[a]

				Environmental Groundwater Samples				
Sample No. SNLA00- Well ID				6584 MWL-MW1	6585 MWL-MW2	6586 MWL-MW3	6583 MWL-BW1	6587 MWL-BW1 Dup.
Parameter	Method	Reporting Limit	MCL					
Barium, Total	6010	0.010	1.0	0.068	0.10	0.094	0.097	0.095
Barium, Dissolved	6010	0.010	NE	0.068	0.095	0.088	0.092	0.099
Chromium, Total	6010	0.010	0.05	0.019	0.020	0.018	ND	ND
Chromium, Dissolved	6010	0.010	NE	ND	ND	ND	ND	ND
Iron, Total	6010	0.10	1.0	0.49	0.12	0.14	ND	ND
Manganese, Total	6010	0.010	0.2	0.017	ND	ND	ND	ND
Sodium, Total	6010	5.0	NE	50.7	55.1	55.9	57.0	56.4
Sodium, Dissolved	6010	5.0	NE	53.3	56.2	58.9	54.7	53.7
Chloride	300.0	3.0	250	28.2	32.1	31.1	27.4	27.8
Fluoride	340.2	0.10	1.6	0.85	1.0	1.1	0.81	0.85
Nitrate as N	353.2	0.50	10.0	5.5	5.1	4.3	5.6	5.6
Phenolics	9065	0.010	0.005	ND	ND	ND	ND	ND
Sulfate	300.0	5.0	600	43.1	42.7	40.0	44.8	44.6
Total Organic Carbon (TOC)	9060	0.50	NE	ND	ND	ND	ND	0.54

[a]All results in mg/L.
MCL = Maximum contaminant level, established by NMWQR (1991).
ND = Not detected at reporting limit indicated.
NE = Not established.

Table 7-10. Summary of Analytical Results, SNL, Albuquerque/KAFB Basewide Hydrogeochemical Sampling, April 1991[a]

Well	pH	Temperature	Mg	Ca	K	Na	Fe
CWL-BW3	7.72	20.8	17.3	64.6	7.1	146.8	0.40
MWL-BW1	7.62	20.7	17.2	47.7	3.4	51.0	0.02
NWTA3	7.57	19.4	13.3	50.6	4.0	22.0	ND
SWTA3	7.95	20.7	6.50	23.1	4.4	76.0	0.03
KAFB-10	8.49	NM	8.10	46.3	10.0	82.0	ND
KAFB-09	7.55	NM	16.0	64.5	3.0	44.0	ND
Tijeras East	7.51	20.1	10.3	63.4	1.6	27.0	ND
Golf South	7.62	19.7	13.8	67.1	2.1	25.0	ND
LF-01	7.59	20.1	4.40	22.8	1.6	19.0	ND
LF-02	7.14	20.6	11.5	57.3	2.1	28.0	ND
MVMWJ	7.50	20.1	3.80	27.7	1.3	18.0	0.03
MVMWK	7.57	20.0	7.00	57.2	1.5	29.0	ND
EOD	6.46	18.2	77.5	323.9	24.1	311.6	0.10
Schoolhouse	6.98	17.7	24.4	137.2	6.7	77.0	0.02
G Spring	6.60	10.0	40.7	130.3	8.20	107.0	ND
Coyote Springs	6.38	10.6	51.0	80.3	16.0	119.0	ND
Sol Se Mete Spring	7.85	7.80	14.5	83.6	1.3	14.0	ND
Hubbell Spring	6.60	13.3	25.7	75.2	1.0	58.0	ND
Minimum	6.38	7.8	3.80	22.8	1.0	14.0	0.02
Maximum	8.49	20.8	77.5	323.9	24.1	311.6	0.40
Mean	7.37	17.5	20.2	79.0	5.52	69.7	0.10
Variance	0.32	19.5	356.3	4680	36.9	5148	0.02

[a]All concentrations are in μg/mL (ppm) unless otherwise indicated.
NM = Not measured.
ND = Not detected.

Table 7-10. Summary of Analytical Results, SNL, Albuquerque/KAFB Basewide Hydrogeochemical Sampling, April 1991[a] (Concluded)

Well	F	Cl	Br	NO_3[b]	SO_4	Alkalinity[c]
CWL-BW3	1.37	141.0	0.93	8.88	125.3	4.72
MWL-BW1	0.55	18.0	0.34	25.4	4.32	4.32
NWTA3	0.27	11.5	0.33	22.9	62.7	2.90
SWTA3	0.85	24.6	0.31	16.4	58.9	3.24
KAFB-10	0.72	140.5	0.38	ND	23.0	0.40
KAFB-09	0.85	68.2	1.20	22.8	119.3	1.93
Tijeras East	0.15	6.60	0.22	13.3	70.9	3.48
Golf South	0.22	23.7	ND	99.9	46.6	2.57
LF-01	0.33	5.00	ND	0.27	23.6	1.92
LF-02	0.19	12.9	0.33	18.2	73.5	3.10
MVMWJ	0.26	6.60	ND	4.95	28.6	2.41
MVMWK	0.21	11.3	ND	141.6	28.2	1.81
EOD	0.80	181.1	1.80	1.60	73.3	32.7
Schoolhouse	0.59	117.3	0.75	16.8	49.6	7.12
G Spring	0.87	198.1	0.95	1.90	82.8	NM
Coyote Springs	1.30	441.5	2.44	3.60	120.4	20.2
Sol Se Mete Spring	0.24	17.9	0.42	6.00	75.1	4.80
Hubbell Spring	0.61	28.1	0.35	3.30	195.2	NM
Minimum	0.15	5.0	0.22	0.27	23.0	0.40
Maximum	1.37	441.5	2.44	141.6	195.2	32.7
Mean	0.58	80.8	0.77	24.0	71.9	6.1
Variance	0.14	1.2E4	0.43	1448	1993	70.7

[a]All concentrations are in $\mu g/mL$ (ppm) unless otherwise indicated.
[b]Reported as nitrate.
[c]Reported as milliequivalents as bicarbonate.
NM = Not measured.
ND = Not detected.

Table 7-11. Summary of Analytical Results, SNL, Albuquerque/KAFB Basewide Hydrogeochemical Sampling, July 1991[a]

Well	pH	Temp	Mg	Ca	K	Na
CWL-BW3	8.56	NM	18.4	37.2	5.4	91.2
MWL-BW1	7.61	21.1	29.6	58.9	3.5	51.2
NWTA3	7.57	22.0	22.0	61.6	4.4	20.8
SWTA3	8.31	NM	11.5	30.4	4.7	76.4
KAFB-10	8.84	NM	11.3	51.0	12.0	70.9
KAFB-09	7.67	NM	28.0	82.0	3.5	40.2
Tijeras East	6.60	20.3	17.4	75.0	1.7	26.7
Golf South	7.69	20.1	15.4	82.4	1.8	20.4
LF-01	8.08	20.4	9.40	29.9	2.2	18.4
LF-02	6.69	21.1	20.3	72.4	2.6	24.3
MVMWJ	7.94	20.9	8.00	34.4	2.2	17.6
MVMWK	7.97	20.4	5.70	56.2	1.6	20.8
EOD	6.61	18.6	146.3	406.5	38.3	347.2
Schoolhouse	7.16	17.3	37.1	151.0	6.7	71.6
G Spring[b]	NM	NM	NM	NM	NM	NM
Coyote Springs	6.26	15.5	112.8	111.9	17.8	72.9
Sol Se Mete Spring	7.65	14.5	25.5	78.2	1.6	9.00
Hubbell Spring	7.65	15.9	46.6	49.7	1.2	39.6
Minimum	6.26	14.5	5.70	29.9	1.2	9.00
Maximum	8.84	22.0	146.3	406.5	38.3	347.2
Mean	7.58	19.1	33.2	86.4	6.54	60.0
Variance	0.52	6.11	1463	7753	85.6	6137

[a]All concentrations are in μg/mL (ppm) unless otherwise indicated.
[b]Spring was dry; no sample was taken.
NM = Not measured.
ND = Not detected.

Table 7-11. Summary of Analytical Results, SNL, Albuquerque/KAFB Basewide Hydrogeochemical Sampling, July 1991[a] (Concluded)

Well	F	Cl	Br	NO_3[b]	SO_4	Alkalinity[c]
CWL-BW3	1.38	86.5	0.49	9.54	83.4	3.63
MWL-BW1	0.47	16.6	0.41	18.9	29.2	5.78
NWTA3	0.25	10.5	0.42	0.77	42.2	3.28
SWTA3	0.92	19.6	0.27	14.3	38.4	3.54
KAFB-10	0.61	163.0	0.50	ND	22.2	0.73
KAFB-09	0.86	41.8	0.91	17.9	77.5	2.03
Tijeras East	0.20	8.94	0.37	13.8	54.7	4.07
Golf South	0.26	18.2	ND	62.2	35.8	3.10
LF-01	0.42	6.20	ND	0.27	16.4	2.22
LF-02	0.26	11.1	0.25	14.1	44.4	3.67
MVMWJ	0.35	6.80	ND	3.70	19.0	2.00
MVMWK	0.30	9.25	ND	57.2	18.9	2.17
EOD	0.69	194.0	0.83	ND	36.8	33.8
Schoolhouse	0.60	74.1	0.57	14.3	33.0	7.12
G Spring[d]	NM	NM	NM	NM	NM	NM
Coyote Springs	1.11	295.0	1.36	1.89	67.2	19.7
Sol Se Mete Spring	0.25	16.1	0.39	8.17	44.5	4.85
Hubbell Spring	0.54	21.3	0.32	1.95	129.5	4.00
Minimum	0.25	6.20	0.00	0.00	16.4	0.73
Maximum	1.38	295.0	1.36	62.2	129.5	33.8
Mean	0.56	58.8	0.42	14.1	46.6	6.22
Variance	0.12	6840	0.13	340	844	68.2

[a]All concentrations are in μg/mL (ppm) unless otherwise indicated.
[b]Reported as nitrate.
[c]Reported as milliequivalents as bicarbonate.
[d]Spring was dry; no sample was taken.
NM = Not measured.
ND = Not detected.

Table 7-12. Summary of Analytical Results, SNL, Albuquerque/KAFB Basewide Hydrogeochemical Sampling, October 1991[a]

Well	pH	Temp	Mg	Ca	K	Na
CWL-BW3	8.36	NM	8.9	22.4	4.9	115.1
MWL-BW1	7.69	20.8	17.7	40.9	3.0	49.6
NWTA3	7.66	20.0	12.9	37.8	4.0	21.6
SWTA3	8.10	NM	5.80	19.9	4.7	73.8
KAFB-10	8.02	NM	6.40	49.1	11.6	86.3
KAFB-09	7.60	NM	17.9	64.4	2.9	41.3
Tijeras East	7.62	18.1	5.30	50.5	2.2	23.6
Golf Course Spring	8.09	18.5	10.1	65.1	3.0	18.4
LF-01	8.07	13.7	4.30	19.6	1.8	16.9
LF-02	7.84	17.1	11.5	46.2	2.2	22.5
MVMWJ	7.97	19.4	3.60	22.5	1.5	16.9
MVMWK	7.82	19.5	5.10	35.3	1.7	21.7
EOD	6.08	17.9	115.8	631.2	53.6	85.1
Schoolhouse	6.82	16.3	20.5	119.6	8.4	62.4
Burn Site	7.35	17.3	22.1	75.2	3.4	26.2
Greystone	7.76	13.9	19.4	78.8	5.5	50.7
G Spring	7.60	15.3	91.3	276.2	35.5	156.9
Coyote Springs	6.30	17.0	57.6	235.8	29.8	141.1
Sol Se Mete Spring	7.97	9.90	15.0	70.9	1.2	11.1
Hubbell Spring	8.10	14.4	91.3	276.2	35.5	156.9
Minimum	6.08	9.90	4.30	19.6	1.20	11.1
Maximum	8.36	20.8	115.8	631.2	53.6	156.9
Mean	7.64	17.2	27.1	111.9	10.8	59.9
Variance	0.36	7.80	1130	2.2E4	226	2374

[a]All concentrations are in μg/mL (ppm) unless otherwise indicated.
NM = Not measured.
ND = Not detected.

Table 7-12. Summary of Analytical Results, SNL, Albuquerque/KAFB Basewide Hydrogeochemical Sampling, October 1991[a] (Concluded)

Well	F	Cl	Br	NO_3[b]	SO_4	Alkalinity[c]
CWL-BW3	***	***	***	***	***	***
MWL-BW1	0.55	20.7	0.33	20.4	32.3	4.85
NWTA3	0.21	10.7	0.28	16.4	41.3	3.25
SWTA3	1.28	96.2	0.52	5.14	79.7	4.05
KAFB-10	0.47	183.2	0.35	ND	14.8	ND
KAFB-09	0.72	107.6	0.80	39.4	162.6	2.11
Tijeras East	0.20	9.85	0.23	13.4	50.4	3.99
Golf Course Spring	0.24	23.1	ND	60.5	34.7	2.82
LF-01	0.40	5.28	ND	ND	14.8	[illegible]04
LF-02	0.21	10.6	0.26	11.9	53.3	3.39
MVMWJ	0.30	4.10	ND	5.96	15.1	1.83
MVMWK	0.27	6.73	ND	60.8	18.8	2.14
EOD	1.67	236.2	ND	1.16	73.5	49.0
Schoolhouse	0.57	89.3	0.56	15.5	38.3	9.23
Burn Site	0.43	35.2	0.65	26.5	105.6	4.82
Greystone	0.28	59.4	0.43	18.2	29.4	7.33
G Spring	3.87	553.1	2.54	2.15	280.1	14.5
Coyote Springs	0.96	275.6	1.30	3.74	70.4	17.8
Sol Se Mete Spring	0.30	15.6	0.42	3.05	47.8	4.94
Hubbell Spring	0.42	16.9	0.33	1.81	150.7	4.00
Minimum	0.20	4.10	0.23	1.16	14.8	1.83
Maximum	3.87	553.1	2.54	60.8	280.1	49.0
Mean	0.70	92.6	1.05	16.1	69.1	7.48
Variance	0.74	1.9E4	6.15	353.1	4423	120.6

[a]All concentrations are in $\mu g/mL$ (ppm) unless otherwise indicated.
[b]Reported as total nitrate.
[c]Reported as milli-equivalents as bicarbonate.
NM = Not measured.
ND = Not detected.
***Analyses not yet completed.

NO_4, SO_4), alkalinity, pH, and temperature; results are listed in Tables 7-10 through 7-12. An additional 100-mL sample was collected from each well for immediate on-site alkalinity titration. The titrations were performed at each well or spring immediately after sample collection. The analysis was performed using a Hach digital titrater and Cole-Parmer or Corning portable pH meter, in accordance with published methods (USGS, 1979). The water samples were analyzed for major anions and cations by a SNL, Albuquerque, laboratory. Sample collection logs, chain-of-custody forms, field titration results, and other data pertinent to each sampling event are documented in IT reports (1991b, 1991c, 1991d).

All of the analytical results are listed Tables 7-10 through 7-12. The population of sampling sites was divided into two groups (east or west of the faults) based on water-level elevation at a given site. The Burn Site well, Sol Se Mete Spring, Coyote Springs, Graystone well, Schoolhouse well, G Spring, EOD well, and Hubbell Spring were assumed to be east of the faults. All other sampling sites were assumed to be west of the faults (Figure 7-1). Tables 7-10 through 7-12, and Appendix F show samples from the east side of the faults (assumed to be completed in limestone) that are characterized by low pH, high alkalinity, high calcium, and a relatively shallow water table (less than 100 ft [30 m]). Results from wells west of the faults (completed in alluvium) are characterized by a higher pH, lower alkalinity, lower calcium, and a relatively deep water table (greater than 300 ft [100 m]).

The Mann-Whitney test (Davis, 1986; Conover, 1980) was used to determine if there was a statistically significant difference between the two groups of data. The Mann-Whitney test was applied at the 90-percent confidence level to all the parameters that were measured, independently of each of the groundwater sampling events. Preliminary results (Goodrich and Stein, 1991b) indicate a significant statistical difference exists between the populations east and west of the faults for the parameters pH, temperature, Mg, Ca, Cl, Br, and alkalinity. The statistical difference holds true for all three 1991 sampling events (see Table 7-13). The rest of the parameters (K, Na, F, SO_4, and NO_3) show inconsistent statistical differences in the sample populations collected from the east and west of the faults.

It is not immediately clear why these statistical differences exist (SNL, 1992). Some possible reasons include simple mixing as groundwater moves across the faults from east to west, different groundwater flow paths and travel times on each side of the faults (e.g., fracture flow to the east versus porous media flow to the west), or the fact that some ions may precipitate as the cooler water east of the faults mixes with the warmer water to the west, thus resulting in significantly different concentrations. Further study is required to resolve this issue satisfactorily.

The raw laboratory data and the corresponding charge balances are listed in Appendix F. The charge balance (the ratio of cations to anions) should equal 1 and an error of about 10 percent is generally acceptable (i.e., a charge balance ranging from 0.90 to 1.10). The charge balances for the

Table 7-13. Mann-Whitney Test Results for Basewide Hydrogeochemical Sampling[a]

Analyte	April	July	October
pH	Yes	Yes	Yes
Temp	Yes	Yes	Yes
Mg	Yes	Yes	Yes
Ca	Yes	Yes	Yes
K	No	No	Yes
Na	No	No	Yes
F	No	No	Yes
Cl	Yes	Yes	Yes
Br	Yes	Yes	Yes
NO3	Yes	No	No
SO4	No	No	Yes
Alkalinity	Yes	Yes	Yes

[a]Results are in response to the question, "Are the data from east of the faults different from the data west of the faults?" The test was performed at the 90-percent confidence level.

April sampling look reasonably good with the exception of Coyote Springs, MVMWJ, and KAFB-10 wells. However, the charge balances for the July sampling are generally high (about 1.10 to 1.50) and the charge balances for the October sampling are mostly low (about 0.70 to 0.90). KAFB-10 and Coyote Springs are again notably different in July and October. The charge balance for KAFB-10 is probably off because zinc carbonate was present in the well (personal communication, Carol Stein, SNL, 1991) which may interfere with the alkalinity titration. The Coyote Springs charge balance is probably off because a significant quantity of dissolved carbon dioxide was present in the water (not included in the titration for bicarbonate alkalinity). The reason for the other charge imbalances is not immediately clear. Significant deviation from an acceptable charge balance is usually attributable to omission of a major anion or cation from the analysis or laboratory error. With all major ionic species accounted for in this study, laboratory error is the most logical explanation for charge balance errors in July and October.

CHAPTER 8

QUALITY ASSURANCE PROGRAMS

8.1 Quality Assurance (QA) for Environmental Programs

Policies and Responsibilities

The Environment, Safety, and Health (ES&H) Center (7700) has the overall responsibility for ensuring the quality of all activities related to environmental protection and compliance. A Quality Assurance (QA) Program Plan was issued in June 1989 to address the policies, activities, and responsibilities of this Center for the promotion of quality throughout its operations. It was revised and reissued as the ES&H Center 7700 Quality Plan in April 1991.

The Environmental Programs Departments (7721, 7722, 7723, and 7725), under the direction of the ES&H Center (7700), developed and implemented their own Quality Plan. This Quality Plan defines an approach to ensure that Department 7720's work (items and services) meet or exceed that of SNL, Albuquerque; the DOE (DOE Order 5700.6B); and applicable regulatory (EPA, Occupational Safety and Health Administration [OSHA], state, and local) requirements. The Department 7720 Quality Plan supplements the SNL Corporate Quality Improvement Plan and the SNL ES&H Center Quality Plan. A copy of the Department 7720 Quality Plan is distributed to all Department 7720 personnel and contractors and the SNL Department 7720 Records Center maintains a copy on file.

Each employee in Department 7720 is responsible for ensuring that all activities performed by or for ˜ partment 7720 are in accordance with the policies and guidelines set in the Center 7700 ES&H Quality Plan and the Department 7720 Quality Plan.

New Programs

The Department 7720 Quality Plan, issued in November 1989 and revised in April 1991, is written in accordance with the guidelines set in DOE Order 5700.6B, "General Operations Quality Assurance"; the SNL Corporate ES&H Quality Assurance Plan; and the ES&H Center 7700 Quality Plan.

This comprehensive Quality Plan describes quality guidelines and standards for all activities and functions conducted by or for Department 7720. It stresses prevention of problems by ensuring that requirements are defined in documents such as plans and procedures, that the requirements are understood through familiarization and training, and that all activities necessary for fulfilling the requirements are performed by qualified personnel. There is an ongoing effort to include applicable quality elements from the Department 7720 Quality Plan into implementation plans and procedures within Department 7720 for all hazardous, radioactive and mixed waste (MW) operations, and environmental protection, remediation, and compliance activities.

8.2 Quality Assurance of Environmental Sampling and Analysis

There were various types of informal (unwritten) and formal (written) QA plans that covered the activities of the Environmental Protection Program in the past. All QA-related activities and results are summarized and published every year in this Report. Sampling and analyses plans are prepared in accordance with Department 7720 requirements and meet appropriate regulatory guidelines.

The existing environmental monitoring activities that are under the auspices of the Department 7720 Quality Plan are as follows:

A. Environmental Sampling

Environmental and waste media sampling are conducted and documented in accordance with the Department 7720 Quality Plan and follow applicable EPA guidelines for sample collection. Sample collection is performed by trained personnel only.

B. Radiological Analyses

Environmental samples submitted for radiological analyses were analyzed using validated test procedures. Instrument calibration is verified using certified standard reference materials to ensure the accuracy of data generated.

The analytical laboratory used by SNL, Albuquerque, for radiological analyses of environmental monitoring samples collected during 1991 operates under a documented quality plan. In order to assess the laboratory's ability to provide accurate data, laboratory performance was evaluated through participation in the EPA (Environmental Monitoring Systems Laboratory) interlaboratory comparison programs. Table 8-1 provides results of laboratory performance studies for the laboratory used by SNL, Albuquerque (Accu-Labs Research, Inc.). Performance evaluation sample analyses included gross alpha, gross beta, cesium-137 (^{137}Cs), tritium (^{3}H), and uranium (U) determinations in water. For comparison purposes, EPA reference values and contractor laboratory values are included. Data indicate the accuracy of analyses are acceptable.

In addition to performance evaluation samples, replicate environmental samples were collected and submitted to the laboratory to assess the overall variability (precision) of data associated with a particular sampling location. Table 8-2 lists results of replicate sample analyses, including the average concentration value for each location and the standard error of the mean for replicate sample analyses. This estimate includes the variability associated with sampling and analytical errors. Reported values reflect background fallout concentrations.

Table 8-1. 1991 Quality Assurance Results for Selected Radiochemical Analysis

EPA/Accu-Labs Intercomparison Study, Cross-Check Results[a]

Gross Alpha in Water

Date	EPA Result (pCi/L ±1 Sigma)	Accu-Labs Results (pCi/L ±2 Sigma)	Deviation from Known (Sigma)	Grand Average	Deviation from Grand Average
10/1991	82.0 ± 21.0	98 ± 4; 93 ± 4; 89 ± 4	0.93	75.57	1.46
8/1991	10.0 ± 5.0	10 ± 2; 11 ± 2; 11 ± 2	0.23	10.36	0.10
5/1991	24.0 ± 6.0	27 ± 3; 29 ± 3; 29 ± 3	1.25	20.94	2.13
4/1991	54.0 ± 14.0	43 ± 6; 10 ± 6; 39 ± 6	-1.65	49.71	-1.12
1/1991	5.0 ± 5.0	7 ± 2; 8 ± 2; 9 ± 2	1.04	5.69	0.80

Gross Beta in Water

Date	EPA Result (pCi/L ±1 Sigma)	Accu-Labs Results (pCi/L ±2 Sigma)	Deviation from Known (Sigma)	Grand Average	Deviation from Grand Average
10/1991	65.0 ± 10.0	58 ± 2; 59 ± 2; 54 ± 2	-1.39	55.53	0.25
8/1991	20.0 ± 5.0	19 ± 2; 19 ± 2, 21 ± 2	-0.12	20.30	-0.22
5/1991	46.0 ± 5.0	47 ± 2; 48 ± 2; 48 ± 2	0.58	44.73	1.02
4/1991	115.0 ± 17.0	102 ± 6; 116 ± 6; 109 ± 6	-0.61	108.60	0.04
1/1991	5.0 ± 5.0	5 ± 1; 5 ± 1; 5 ± 1	0.00	6.30	-0.45

[a]Calculations performed by EPA according to "Environmental Radioactivity Laboratory Intercomparison Studies Program, February 1981," EPA 600/4-81-004.

Table 8-1. 1991 Quality Assurance Results for Selected Radiochemical Analysis (Continued)

EPA/Accu-Labs Intercomparison Study, Cross-Check Results[a]

Tritium in Water

Date	EPA Result (pCi/L ±1 Sigma)	Accu-Labs Results (pCi/L ±2 Sigma)	Deviation from Known (Sigma)	Grand Average	Deviation from Grand Average
10/1991	2454 ± 354	1300 ± 100; 1310 ± 100; 1240 ± 100	-5.76	2531.91	-6.14
6/1991	12480 ± 1248	12200 ± 300; 12000 ± 300; 11900 ± 300	-0.62	12434.92	-0.56
2/1991	4418 ± 442	4290 ± 240; 4000 ± 230; 4380 ± 240	-0.76	4437.54	-0.84

Uranium in Water

Date	EPA Result (pCi/L ±1 Sigma)	Accu-Labs Results (pCi/L ±2 Sigma)	Deviation from Known (Sigma)	Grand Average	Deviation from Grand Average
10/1991	13.5 ± 3.0	13.5; 13.1; 12.6	-0.25	13.25	-0.10
7/1991	14.2 ± 3.0	14.0; 15.0; 15.6	0.38	13.38	0.86
4/1991	29.8 ± 3.0	29.2; 30.3; 27.0	-0.56	28.88	-0.03
3/1991	7.6 ± 3.0	6.6; 5.8, 5.8	-0.89	7.30	-0.71

[a]Calculations performed by EPA according to "Environmental Radioactivity Laboratory Intercomparison Studies Program, February 1981," EPA 600/4-81-004.

Table 8-1. 1991 Quality Assurance Results for Selected Radiochemical Analysis (Concluded)

EPA/Accu-Labs Intercomparison Study, Cross-Check Results[a]

CS-137 Gamma Spec. on Water

Corresponding Date	EPA Result (pCi/L ±1 Sigma)	ALR Result	Deviation from Known (Sigma)
2/1991	10 ± 2		
		9 ± 2	
	8.0 ± 5.0	10 ± 2	0.56
4/1991	28 ± 4		
(Blind)	29 ± 4		
	25.0 ± 5.0	28 ± 4	1.15
6/1991	16 ± 3		
		17 ± 3	
	14.0 ± 5.0	18 ± 3	1.04
10/1991	12 ± 2		
		12 ± 2	
	11.0 ± 5.0	12 ± 1	0.35
10/1991	11 ± 2		
(Blind)	11 ± 2		
	10.0 ± 5.0	10 ± 2	0.23

[a]Calculations performed by EPA according to "Environmental Radioactivity Laboratory Intercomparison Studies Program, February 1981," EPA 600/4-81-004.

Table 8-2. Determination of Sample Variability in Replicate Samples for Selected Radionuclide Analysis in Soil, Vegetation, and Surface Water[a]

Sample Matrix	Location	Number of Samples	U (μg/g)/(mg/l)[b] $\bar{x} \pm s_{\bar{x}}$ (C.V.)[c]	^{3}H (pCi/ml) $\bar{x} \pm s_{\bar{x}}$ (C.V.)[c]	^{137}Cs (pCi/g) $\bar{x} \pm s_{\bar{x}}$ (C.V.)[c]	^{40}K (pCi/g) $\bar{x} \pm s_{\bar{x}}$ (C.V.)[c]
Soil	7	3	0.8 ± 0.08 (100)	0.19 ± 0.08 (42)	0.63 ± 0.21 (33)	20 ± 0.6 (3)
Soil	16	3	17 ± 29 (170)	0.15 ± 0.05 (33)	0.16 ± 0.05 (31)	30 ± 1.5 (5)
Soil	32	2	0.6 ± 0.1 (13)	27 ± 39 (140)	0.19 ± 0.04 (9)	23 ± 1.4 (6.1)
Soil	60	3	0.4 ± 0.2 (50)	0.06 ± 0.09 (150)	0.1 ± 0.1 (100)[d]	20 ± 0.6 (0.5)
Vegetation	7	3		0.07 ± 0.05 (140)		6.0 ± 0.4 (7)
Vegetation	16	3		0.1 ± 0.1 (100)		8.7 ± 1.2 (14)
Vegetation	60	3		0.1 ± 0.07 (73)		12 ± 5.2 (41)
Water						
Solution	33	3	0.003 ± 0.001 (300)	-0.08 ± 0.02 (20)		
Total	33	3	0.003 ± 0.001 (300)	-0.04 ± 0.08 (200)		

[a]All individual results are listed in Tables F-1, F-2, and F-3 of Appendix F.
[b]Results of μg/g for uranium in soil and mg/l for uranium in water.
[c]Coefficient of Variation (C.V.) = (Standard deviation ÷ mean) x 100.
[d]Where values are reported as less than detection limit, the detection limit is used in averaging.

C. Stable Chemistry Analyses

The majority of analyses of waste and environmental samples collected at SNL, Albuquerque, during 1991 were performed by contracted analytical laboratories. The contracted laboratories operate under QA plans which comply with the Department 7720 Quality Plan, and applicable EPA requirements and guidelines. Analyses are performed using EPA test procedures wherever possible or other validated test procedures. Concurrently-analyzed quality control (QC) sample data are provided with each analytical report prepared for SNL, Albuquerque. QC sample requirements vary between programs. Minimal laboratory QC requirements include laboratory control sample analyses using certified standard reference materials to document analytical accuracy and precision, method blank analysis to assess and document analytical contamination, and use of surrogate standards for samples analyzed by gas chromatography/mass spectrometry to document sample bias. Additional QC samples may include environmental duplicate samples; field, equipment, and trip blanks; and matrix spike/matrix spike duplicate analyses. Specific QC requirements are described in the individual sampling and analysis plans.

8.3 Quality Assurance of Data Management

Measurement data received from test laboratories were reviewed for laboratory and field precision and accuracy, completeness, representativeness, and comparability with respect to the data quality objectives of the particular program. Data were reviewed at a minimum of two levels: (1) by a member of the staff or a contractor, and (2) by the project leader. During 1991, project records were maintained by the Department 7720 Records Center in accordance with the requirements of the Department 7720 Quality Plan (Section 17). Copies of project records are maintained by the project leaders. The Records Center maintains all data files related to this report.

8.4 Quality Assurance of Outside Analytical Laboratories

Appraisals of contractor laboratories (preaward audits) are conducted in accordance with Section 4 of the Department 7720 Quality Plan before an analysis laboratory is selected. No preaward audits were conducted in 1991 because no new analytical laboratory contracts were initiated. Annual appraisals (e.g., inspections or audits) are subsequently conducted at the contractor laboratories in accordance with Sections 10 and/or 18 of the Department 7720 Quality Plan. Annual audits/inspections of Enseco Rocky Mountain Analytical Laboratory (Enseco-RMAL) and Environmental Control Technology Corporation (ENCOTEC) were conducted in January and February 1991. Audit reports are on file at the Department 7720 Records Center. Check samples are submitted quarterly to the contractor laboratories. Project-specific quality control samples (i.e., trip, equipment, or field blanks, environmental duplicate samples, or matrix spike samples) are submitted to the contractor labs in accordance with project-specific data quality objectives and the sampling and analysis plans.

Contractor QA Overview

Department 7720 has several contractors who provide consulting, waste management and disposal, water sampling and analysis, and other analytical services. These contractors are monitored by contract monitors (with support from the Department 7720 Quality Coordinator) through one of the following mechanisms:

A. Monitored by task (for consulting services)--The project evaluation sheet was developed to evaluate individual projects. The contractors provide monthly reports on the status of progress and budget.

B. Performance checks and annual onsite appraisals (for analytical laboratories)--Quarterly blind samples, replicates, and blanks are submitted to the laboratories for performance checks. Corrective Actions are documented and implemented.

C. Cost-plus-award-fee contract for hazardous waste management and the Environmental Restoration (ER) Program--The contract has a 30-percent fixed and 70-percent variable award fee based on quarterly performance evaluations.

In October 1988 SNL, Albuquerque, entered into 4-yr contracts (2-yr fixed with renewal options to extend the contracts for a total of 4 yr) with two commercial laboratories to provide analytical services to SNL, Albuquerque, in conjunction with the environmental and hazardous waste programs. Laboratories that provided the majority of analytical support to SNL, Albuquerque, environmentally related sampling activities during 1991 were Enseco-RMAL, Arvada, Colorado, and ENCOTEC of Ann Arbor, Michigan. The contract with ENCOTEC expired in April 1991 and SNL, Albuquerque, did not exercise its option for renewal. Consequently, ENCOTEC was not utilized for analytical services after April 1991. Other laboratories providing limited analytical support during 1991 included IT Analytical Services; Assaigai Analytical Laboratories, Inc.; TMA-Eberline; Accu-Labs Research, Inc.; and Western Research Institute (see Appendix E, Table E-1). Quantities and types of analyses performed during 1991 are presented in Appendix E, Table E-2.

The contractor laboratories operate under strict QA/QC programs and routinely participate in the EPA's blind audit check sample programs. In addition, contracts with these laboratories stipulate that the laboratories concurrently analyze laboratory QC samples with all analytical batches containing SNL, Albuquerque, samples to monitor laboratory control and include results of these analyses in the analytical report.

To enhance confidence in the quality of data generated by the contractor laboratories, SNL, Albuquerque, has implemented its own laboratory performance program to monitor the contractor laboratories' overall analytical precision and accuracy for analyses routinely performed on SNL, Albuquerque, samples. During 1991, a total of 235 environmental duplicate samples and 80 check samples were submitted to the contractor laboratories at defined frequencies as double-blind samples along with routine environmental samples. Replicate environmental samples were submitted to each laboratory in accordance with project-specific-data quality objectives and sampling and analysis plans to monitor and document analytical precision. Check samples were submitted to the laboratories on a quarterly basis based on the frequency and type of samples submitted to assess and document laboratory precision and accuracy.

Check samples submitted to the contractor laboratories were prepared by the EPA or Environmental Resource Associates, Arvada, Colorado, and submitted to the contractor laboratories at frequencies indicated above. The check samples used were prepared in batch quantities and subjected to round-robin analyses for verification of check sample analyte concentrations. The samples were prepared by spiking concentrated solutions containing analytes of interest into reagent-grade water free of analytical interferents or soil, to create check samples at concentration ranges at one to five times the method detection limit. The check samples were prepared in duplicate so that analytical precision as well as accuracy could be assessed. Check samples submitted to the laboratories consisted of solutions containing trace metals, cyanides, phenolic compounds, and other selected anions, cations, and organic compounds. In addition to aqueous and soil samples, oil samples prepared by the EPA containing known concentrations of polychlorinated biphenyls (PCBs) were submitted to the laboratories for analysis.

Results of each set of check sample analyses for contract analyses are summarized in Appendix E, Tables E-3 and E-6. The tables include average percent recoveries for each suite of samples analyzed and the relative range of actual recoveries and relative percent differences for each analyte tested. The resulting data were used to assess each laboratory's performance using relative percent difference and percent recovery for respective indicators of precision and accuracy.

Review of laboratory performance data generated during 1991 (see Appendix E, Tables E-4, E-5, and E-7) indicates that the majority of analytes tested by the SNL, Albuquerque, analytical laboratories are within EPA (or interlaboratory, round-robin), prescribed control limits. Analytes identified during 1991 with overall poor accuracy and/or precision performance for the Enseco laboratory were limited to analyses of oil and grease in water. Deficiencies in analytical accuracy or precision also occurred in the analyses of semivolatile organics in soil, and metals analyzed by atomic absorption (arsenic, selenium, lead, mercury, and thallium) in water but were limited to single sample analyses which did not reflect trends of overall poor performance. ENCOTEC laboratory only participated in the first quarter check sample analyses and showed deficient performance on single analyses of mercury and sulfate in water.

During 1991, SNL, Albuquerque, worked with the contracted analytical laboratories, to resolve problem areas identified in previous check sample analyses (e.g., laboratory deficiencies for analytical test procedures). In response to the identified deficiency in oil and grease analysis, Enseco laboratory stopped accepting samples for oil and grease for several weeks while conducting tests to define and correct problems. Continued poor performance in oil and grease check sample analyses may be attributable to the check sample supplier and the matter remains under investigation. Enseco laboratory responses (and Corrective Actions) to deficiencies identified during check sample analyses are documented in the Department 7720 Records Center.

REFERENCES

Albuquerque District Corps of Engineers, 1979. *Albuquerque Greater Urban Area Water Supply Study*, Albuquerque, NM.

Anderholm, S. K., 1988. "Ground-Water Geochemistry of the Albuquerque-Belen Basin, Central New Mexico," Report 86-4094, U. S. Geological Survey (USGS) Water-Resources Investigations.

Bjorklund, L. J., and B. W. Maxwell, 1961. "Availability of Ground Water in the Albuquerque Area, Bernalillo and Sandoval Counties, New Mexico," Technical Report 21, New Mexico State Engineer Report.

Brewer, L. W., 1973. "Environmental Monitoring Report for Sandia National Laboratories From 1964 Through 1972," SLA73-0339, Sandia National Laboratories, Albuquerque, NM.

Brewer, L. W., 1974. "Environmental Monitoring Report for Sandia National Laboratories for 1973," SLA-74-0167, Sandia National Laboratories, Albuquerque, NM.

Burnett, W. D., D. J. Coleman, R. G. Elsbrock, and R. J. Everett, 1961. "Radioactive Environmental Survey at Sandia Corporation," SC-4628(M), Sandia National Laboratories, Albuquerque, NM.

Clean Air Act (CAA) of 1955, as amended. Title 42 U.S.C. 7401.

Clean Water Act (CWA) of 1948, (Federal Water Pollution Control Act), as amended. Title 33 U.S.C. 1251.

10 CFR 1021, 1986, as amended.

40 CFR 61, 1973, as amended.

40 CFR 112, 1973, as amended March 26, 1976.

40 CFR 122, 1980, as amended November 5, 1991.

40 CFR 123, 1980, as amended November 16, 1990.

40 CFR 124, 1980, as amended November 16, 1990.

40 CFR 141, 1975, as amended January 15, 1992.

40 CFR 261, 1980, as amended January 2, 1992.

40 CFR 265, 1980, as amended December 23, 1991.

40 CFR 268, 1986, as amended August 19, 1991.

40 CFR 280, 1985, as amended December 23, 1991.

40 CFR 281, 1988, as amended.

40 CFR 372, 1988, as amended.

40 CFR 413, 1986, as amended.

40 CFR 433, 1986, as amended.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended. Title 40 U.S.C. 9601.

Conover, W. J., 1980. *Practical Nonparametric Statistics*, 2nd ed., John Wiley and Sons, New York, 493 pp.

Davis, J. C., 1986. *Statistics and Data Analysis in Geology*, 2nd ed., John Wiley and Sons, New York, 646 pp.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended. Title 7 U.S.C. 136.

Goodrich, M. T., 1990. "A Technical Procedure for the Measurement of Static Water Levels in Groundwater Monitor Wells," SOP 90-02, Sandia National Laboratories, Albuquerque, NM.

Goodrich, M. T., in preparation. "Preliminary Report on a Surface Gravity Survey for Fault Delineation and Hydrogeologic Characterization," International Technology Corporation, Albuquerque, NM, prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

Goodrich, M. T., and C. L. Stein, 1991a. "A Regional Hydrogeochemical Sampling and Analysis Plan," Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

Goodrich, M. T., and C. L. Stein, 1991b. "A Regional Hydrogeochemical Investigation of the Albuquerque Basin, New Mexico," abstract in EOS, *Transactions of the American Geophysical Union*, Vol. 72, No. 44, p. 178.

Holley, W. L., 1975. "Environmental Monitoring Report, Sandia Laboratories 1974," SAND75-0257, Sandia National Laboratories, Albuquerque, NM.

Holley, W. L., and T. N. Simmons, 1976. "Environmental Monitoring Report, Sandia Laboratories 1975," SAND76-0209, Sandia National Laboratories, Albuquerque, NM.

Hwang, H. S., 1990. "NESHAP Subpart H Exemption Justification for D38 Experiment in HERMES III Accelerator, Area IV, SNL, Albuquerque," Memo-to-file, Albuquerque, NM, October 4, 1990.

Hwang, H. S., et al., 1990. "1989 Environmental Monitoring Report," SAND90-0301, Sandia National Laboratories, Albuquerque, NM.

Hwang, H. S., 1991a. "NESHAP Subpart H Exemption Update for D38 Experiments in HERMES III Accelerator, Area IV, SNL, Albuquerque," Memo-to-file, Albuquerque, NM, April 23, 1991.

Hwang, H. S., 1991b. "NESHAP Subpart H Exemption Justification for N-13 Production from the Two-Stage Accelerator by Division 1264, SNL, Albuquerque," Memo-to-file, Albuquerque, NM, May 15, 1991.

Hwang, H. S., 1991c. "NESHAP Subpart H Exemption Justification for Radionuclide Emissions from the Laser Experiments in ACRR/FREC-II Facility, Area V, SNL Albuquerque," Memo-to-file, Albuquerque, NM, June 20, 1991.

Hwang, H. S., 1991d. "NESHAP Subpart H Exemption Justification for Radionuclide Emissions from the SABRE Experiment, Area IV, SNL, Albuquerque," Memo-to-file, Albuquerque, NM, October 7, 1991.

Hwang, H. S., 1991e. "Final Report Air Emission Inventory and Emission Impact Assessment," prepared for Sandia National Laboratories, Albuquerque, NM, December 1991.

Hwang, H. S., et al., 1991. "1990 Environmental Monitoring Report," SAND91-0592, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1985. "RCRA Interim Status Groundwater Monitoring Plan," prepared for Sandia National Laboratories, Albuquerque, NM.

International Technologies Corporation (IT) 1989a, "Quarterly Ground-Water Sampling Report, December 12 through 28, 1988," prepared for Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1989b. "Quarterly Ground-Water Sampling Report, March 22 through 29, 1989," prepared for Sandia National Laboratories, Albuquerque, NM, May 1989.

International Technology Corporation (IT), 1989c. "Quarterly Ground-Water Sampling Report, June 12 through 16, 1989," prepared for Sandia National Laboratories, Albuquerque, NM, August 1989.

International Technology Corporation (IT), 1989d. "Quarterly Ground-Water Sampling Report, September 6 through 29, 1989," prepared for Sandia National Laboratories, Albuquerque, NM, November 1989.

International Technologies Corporation (IT), 1990a, "Supplemental Ground-Water Sampling Report, January 8 through 11, 1990," prepared for Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1990b. "Semi-Annual Groundwater Sampling Report for the Chemical Waste Landfill, Sandia National Laboratories, Albuquerque, March 26-30, 1990," prepared for Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1990c. "Indicator Parameter Resampling Report for the Chemical Waste Landfill, Sandia National Laboratories, Albuquerque, May 15-30, 1990," prepared for Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1990d. "Monitor Well MW-4 Background Parameters Sampling, Sandia National Laboratories, Albuquerque, Chemical Waste Landfill, June 16, 1990," prepared for Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1990e. "Report on Background Ground-Water Sampling at Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, September 29 through October 7, 1990."

International Technology Corporation (IT), 1990f. "Groundwater Sampling for Halogenated Volatile Organic Compounds at the Chemical Waste Landfill," prepared for Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991a. "Report on Annual Ground-Water Assessment Monitoring at the Chemical Waste Landfill, Sandia National Laboratories, Albuquerque, February 1991," prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991b. "Report on Ground-Water Sampling for Regional Hydrogeologic Characterization, Sandia National Laboratories, Albuquerque, April 1991," prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991c. "Report on Ground-Water Sampling for Regional Hydrogeologic Characterization, Sandia National Laboratories, Albuquerque, July 1991," prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991d. "Report on Ground-Water Sampling for Regional Hydrogeologic Characterization, Sandia National Laboratories, Albuquerque, October 1991," prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991e. "Report on Quarterly Ground-Water Assessment Monitoring the Chemical Waste Landfill, Sandia National Laboratories, Albuquerque, May 1991," prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991f. "Report on Quarterly Ground-Water Assessment Monitoring at the Chemical Waste Landfill, Sandia National Laboratories, Albuquerque, August 1991," prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991g. "Report on Quarterly Ground-Water Assessment Monitoring at the Chemical Waste Landfill, Sandia National Laboratories, Albuquerque, August 30 through September 7, 1990," prepared for Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991h. "Report on Quarterly Ground-Water Sampling at the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, January 1991," prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1991i. "Report on Quarterly Ground-Water Sampling at the Mixed Waste Landfill, Sandia National Laboratories, Albuquerque, April 1991," prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1992 (in preparation). "Report on Quarterly Ground-Water Assessment Monitoring at the Chemical Waste Landfill, Sandia National Laboratories, Albuquerque, November 1991," draft report, prepared for the Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

Kelley, V. C., 1961. "Tectonic Map of a Part of the Upper Rio Grande Area, New Mexico," in *Albuquerque Country*, New Mexico Geological Society, 12th Field Conference, S. A. Northrup, editor.

Kelley, V. C., 1977. "Geology of Albuquerque Basin, New Mexico," Memoir 33, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

Kelley, V. C., and S. A. Northrup, 1975. "Geology of Sandia Mountains and Vicinity, New Mexico," Memoir 29, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

Los Alamos Technical Associates (LATA), 1991. "AIRDOS-EPA Data Upgrade and Dose Calculations for SNL, Albuquerque," LATA, Los Alamos, NM.

Lozinsky, R. P., J. W. Hawley and D. W. Lowe, 1991. "Geologic Overview and Pliocene-Quaternary History of the Albuquerque Basin, Central New Mexico," *Field Guide to Geologic Excursions in New Mexico and Adjacent Areas of Texas and Colorado, Bulletin 37*, B. Julian and J. Zidek, editors, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

Machette, M. N., 1982. "Quaternary and Pliocene Faults in the La Jencia and Southern Part of the Albuquerque-Belen Basins, New Mexico: Evidence of Fault History from Fault-Scarp Morphology and Quaternary Geology," *Albuquerque Country II*, New Mexico Geological Society Guidebook, 33rd Field Conference.

Millard, G. C., 1981. "Environmental Monitoring Report, Sandia National Laboratories 1980," SAND81-0566, Sandia National Laboratories, Albuquerque, NM.

Millard, G. C., 1986. "Environmental Monitoring Manual," Sandia National Laboratories, Albuquerque, NM.

Millard, G. C., C. E. Gray, T. N. Simmons, and B. L. O'Neal, 1982. "1981 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND82-0833, Sandia National Laboratories, Albuquerque, NM.

Millard, G. C., C. E. Gray, T. N. Simmons, and B. L. O'Neal, 1983. "1982 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND83-0789, Sandia National Laboratories, Albuquerque, NM.

Millard, G. C., C. E. Gray, and B. L. O'Neal, 1984. "1983 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND84-0429, Sandia National Laboratories, Albuquerque, NM.

Millard, G. C., C. E. Gray, and D. J. Thompson, 1985. "1984 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND85-0550, Sandia National Laboratories, Albuquerque, NM.

Millard, G. C., C. E. Gray, and D. J. Thompson, 1986. "1985 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND86-0752, Sandia National Laboratories, Albuquerque, NM.

Millard, G. C., G. Yeager, J. Phelan, T. Wolff, P. Pei, D. Dionne, C. Gray, D. Thompson, and R. Hamilton, 1989. "1988 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND89-1368, Sandia National Laboratories, Albuquerque, NM.

Millard, G. C., P. Pei, S. Felicetti, C. Gray, D. Thompson, and J. Phelan, 1987. "1986 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND87-0606, Sandia National Laboratories, Albuquerque, NM.

Millard, G., C. P. Pei, S. Felicetti, C. Gray, D. Thompson, and J. Phelan, 1988. "1987 Environmental Monitoring Report, Sandia National Laboratories, Albuquerque, New Mexico," SAND88-0697, Sandia National Laboratories, Albuquerque, NM.

National Environmental Policy Act (NEPA) of 1969, as amended. Title 42 U.S.C. 4321.

New Mexico Hazardous Waste Act, 1978. New Mexico Statute Amendment §74-4-1 through 74-4-12, 1978, amended as laws 1983, Chapter 302.

New Mexico Water Quality Regulations (NMWQR), 1991. New Mexico Water Quality Control Commission Regulations (1967, as amended through August 17, 1991).

Olson, O., M. H. Hall, and H. J. Plagge, 1970. "Wind Data for the Albuquerque Area," SC-M-70-144, Sandia National Laboratories, Albuquerque, NM.

Resource Conservation and Recovery Act (RCRA) of 1976. Public Law 94-580, 1976, 90 Statute 2795.

Sandia National Laboratories (SNL), 1989a. "Environmental Protection Division 3202 Quality Assurance Plan," EPD-QA Plan, SNL, Albuquerque, NM.

Sandia National Laboratories (SNL), 1989b. "Site Development Plan," Facilities Planning Division, SNL, Albuquerque, NM.

Sandia National Laboratories (SNL), 1990a. "Chemical Waste Landfill Sampling and Analysis Plan, Revision 2.0," Environmental Impact and Restoration Division, SNL, Albuquerque, NM.

Sandia National Laboratories (SNL), 1990b. "Draft Mixed Waste Landfill Sampling and Analysis Plan, Ground-Water Monitoring Program," SNL, Albuquerque, NM.

Sandia National Laboratories (SNL), 1990c. "Groundwater Quality Assessment Program for the Sandia Chemical Waste Landfill," prepared by Alva M. Parsons, Environmental Impact and Restoration Division, SNL, Albuquerque, NM.

Sandia National Laboratories (SNL), 1990d (Draft). "Mixed Waste Landfill Sampling and Analysis Plan," Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories (SNL), 1991a. "Compliance Activities for the Mixed Waste Landfill," Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories (SNL), 1991b. "Compliance Agreement Final Report: Hydrogeologic Characterization," Environmental Impact and Restoration Division, Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories (SNL), 1991c. "Ground-Water Monitoring Program Calendar Year 1990 Annual Report," SNL, Albuquerque, NM, March 1991.

Sandia National Laboratories (SNL), 1991d. "Groundwater Monitoring Program Mixed Waste Landfill Calendar Year 1990 Annual Report," SNL, Albuquerque, NM, March 1991.

Sandia National Laboratories (SNL), 1991e. "National Environmental Policy Act (NEPA) Program," PG470110, SNL, Albuquerque, NM.

Sandia National Laboratories (SNL), 1992. "Ground-Water Monitoring Program Calendar Year 1991 Annual Report Sandia National Laboratories, Albuquerque," SNL, Albuquerque, NM, March 1992.

Schelor, K., 1991. Personal communication, 1606th Air Base Wing, Civil Engineering Group, Kirtland Air Force Base, Albuquerque, NM.

Simmons, T. N., 1977. "Environmental Monitoring Report, Sandia Laboratories 1976," SAND77-0616, Sandia National Laboratories, Albuquerque, NM.

Simmons, T. N., 1978. "Environmental Monitoring Report, Sandia Laboratories 1977," SAND78-0620, Sandia National Laboratories, Albuquerque, NM.

Simmons, T. N., 1979. "Environmental Monitoring Report, Sandia Laboratories 1978," SAND79-1033, Sandia National Laboratories, Albuquerque, NM.

Simmons, T. N., 1980. "Environmental Monitoring Report, Sandia Laboratories 1979," SAND80-0342, Sandia National Laboratories, Albuquerque, NM.

Stein, C., 1991. Personal communication from C. Stein, Division 7723, to A. Parsons, Division 7723, SNL, Albuquerque, Albuquerque, NM.

Stein, C. L., K. M. Kimball, H. R. Westrich, and J. L. Krumhansl, 1991 (Draft). "Chromium in Groundwater Monitoring Wells at the Chemical Waste Landfill, SNL Technical Area III," SAND91-0131, Sandia National Laboratories, Albuquerque, NM.

Superfund Amendments and Reauthorization Act (SARA) of 1986. Title III, Section 313, "Toxic Chemical Release Reporting."

Titus, F. B., 1963. "Geology and Ground-Water Conditions in Eastern Valencia County, New Mexico," *Ground-Water Report No. 7,* State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro, NM.

U.S. Army Corps of Engineers, 1979. "Special Flood Hazard Information, Tijeras Arroyo and Arroyo del Coyote, Kirtland AFB, New Mexico," U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, NM.

U.S. Department of Commerce (DOC), Bureau of the Census, 1991. "1990 United States Census--Preliminary Report," DOC, U.S. Government Printing Office, Washington, D.C.

U.S. Department of Energy (DOE), 1979. "Compliance With the National Environmental Policy Act," 10 CFR 1021, DOE, Washington, D.C.

U.S. Department of Energy (DOE), 1981. "A Guide for Environmental Radiological Surveillance at U.S. Department of Energy Installations," DOE/EP-0023, DOE, Washington, D.C.

U.S. Department of Energy (DOE), 1986. "Quality Assurance," DOE Order 5700.6B, DOE, Washington, D.C.

U.S. Department of Energy (DOE), 1988a. "General Environmental Protection Program," DOE Order 5400.1, DOE, Washington, D.C.

U.S. Department of Energy (DOE), 1988b. "Radioactive Waste Management," DOE Order 5820.2A, DOE, Washington, D.C.

U.S. Department of Energy (DOE), 1989. "Comprehensive Environmental Response Compensation and Liability Act Requirements," DOE Order 5400.4, DOE, Washington, D.C.

U.S. Department of Energy (DOE), 1989. "Hazardous and Radioactive Mixed Waste Program," DOE Order 5400.3, DOE, Washington, D.C.

U.S. Department of Energy (DOE), 1990. "Radiological Protection of the Public and the Environment," DOE Order 5400.5, DOE, Washington, D.C.

U.S. Energy Research and Development Administration (ERDA), 1977. "Environmental Impact Assessment, Sandia National Laboratories, Albuquerque, New Mexico," EIA/MA 77-1, ERDA.

U.S. Geological Survey (USGS), 1979. "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," *Techniques of Water-Resources Investigations*, Book 5, Chap. A1, pp. 517-520 (Alkalinity).

Water Quality Act of 1987. Public Law 100-4, 1987, 100 Statute 7.

Woodward, L. A., 1982. "Tectonic Framework of Albuquerque Country," *Albuquerque Country II*, New Mexico Geological Society Guidebook, 33rd Field Conference.

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APPENDIX A
METEOROLOGICAL DATA

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Table A-1. Long-Term Historical Data (1961 to 1990) for Albuquerque, New Mexico[a]

Month	Temperature Daily Range (°C) Minimum	Temperature Daily Range (°C) Maximum	Precipitation Water Equivalent (cm)	Wind Speed (m/s)	Wind Direction
January	-5.4	8.4	1.04	3.6	N
February	-3.4	11.6	1.02	4.0	N
March	-0.2	15.9	1.32	4.5	SE
April	4.2	21.4	1.02	4.9	S
May	9.2	26.6	1.17	4.7	S
June	14.7	32.6	1.30	4.5	S
July	18.2	33.8	3.30	4.1	SE
August	17.1	31.9	3.84	3.7	SE
September	12.7	28.3	2.16	3.8	SE
October	6.2	22.1	2.18	3.7	SE
November	-0.7	14.0	0.97	3.5	N
December	-4.9	8.9	1.32	3.4	N

[a]NOAA, Local Climatological Data, Annual Summary with Comparative Data, Albuquerque, New Mexico, 1990. Temperature and precipitation values are normals recorded for the 1961 to 1990 period. Wind direction is the prevailing direction through 1963. Average wind speeds are reported. The data were collected at the Albuquerque International Airport, elevation 1.62 km. The original measurements have been converted to metric units.

Table A-2. Normals, Means, and Extremes, Albuquerque, New Mexico for 1961 to 1990 (NOAA, 1990)

LATITUDE: 35°03'N LONGITUDE: 106°37'W ELEVATION: FT. GRND 5311 BARO 5313 TIME ZONE: MOUNTAIN WBAN: 23050

	(a)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F:														
Normals														
-Daily Maximum		47.2	52.9	60.7	70.6	79.9	90.6	92.8	89.4	83.0	71.7	57.2	48.0	70.3
-Daily Minimum		22.3	25.9	31.7	39.5	48.6	58.4	64.7	62.8	54.9	43.1	30.7	23.2	42.1
-Monthly		34.8	39.4	46.2	55.1	64.3	74.5	78.8	76.1	69.0	57.4	44.0	35.6	56.2
Extremes														
-Record Highest	51	69	76	85	89	98	105	105	101	100	91	77	72	105
-Year		1971	1986	1971	1989	1951	1980	1980	1979	1979	1979	1975	1958	JUN 1980
-Record Lowest	51	-17	-5	8	19	28	40	52	52	37	25	-7	-7	-17
-Year		1971	1951	1948	1980	1975	1980	1985	1968	1971	1980	1976	1990	JAN 1971
NORMAL DEGREE DAYS:														
Heating (base 65°F)		936	717	583	302	81	0	0	0	12	242	630	911	4414
Cooling (base 65°F)		0	0	0	0	59	285	428	344	132	6	0	0	1254
% OF POSSIBLE SUNSHINE	51	73	73	73	77	79	83	76	75	79	79	77	72	76
MEAN SKY COVER (tenths)														
Sunrise - Sunset	51	4.8	5.0	5.0	4.6	4.2	3.4	4.5	4.4	3.6	3.5	4.0	4.6	4.3
MEAN NUMBER OF DAYS:														
Sunrise to Sunset														
-Clear	51	13.0	11.2	11.4	12.6	14.4	17.6	12.0	13.5	16.7	17.3	15.2	14.0	168.8
-Partly Cloudy	51	7.7	7.6	9.8	9.5	10.3	8.6	14.3	12.4	7.8	7.7	7.6	7.5	110.9
-Cloudy	51	10.3	9.5	9.7	8.0	6.3	3.8	4.7	5.1	5.5	6.0	7.2	9.5	85.5
Precipitation														
.01 inches or more	51	4.0	4.0	4.6	3.4	4.4	3.9	8.8	9.5	5.7	4.8	3.4	4.2	60.6
Snow, Ice pellets														
1.0 inches or more	51	1.0	1.0	0.7	0.2	0.*	0.0	0.0	0.0	0.0	0.*	0.4	0.9	4.2
Thunderstorms	51	0.1	0.3	0.9	1.6	3.9	5.0	10.9	10.9	4.6	2.3	0.5	0.2	41.4
Heavy Fog Visibility														
1/4 mile or less	51	1.1	1.0	0.6	0.2	0.*	0.*	0.1	0.*	0.1	0.4	0.6	1.5	5.6
Temperature °F														
-Maximum														
90° and above	30	0.0	0.0	0.0	0.0	2.6	17.2	23.2	15.9	3.9	0.1	0.0	0.0	62.9
32° and below	30	2.3	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.8	5.2
-Minimum														
32° and below	30	29.0	22.8	15.8	4.5	0.2	0.0	0.0	0.0	0.0	2.0	16.1	28.5	118.9
0° and below	30	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.6
AVG. STATION PRESS. (mb)	18	838.9	837.8	835.1	835.8	836.0	838.1	840.4	840.7	840.1	840.0	838.8	839.1	838.4
RELATIVE HUMIDITY (%)														
Hour 05	30	70	65	56	49	48	46	60	66	62	62	65	70	60
Hour 11 (Local Time)	30	51	44	34	26	25	24	34	40	40	38	42	50	37
Hour 17 (Local Time)	30	40	33	24	19	18	18	27	30	31	30	36	43	29
Hour 23	30	61	53	43	36	34	33	47	53	52	50	54	61	48
PRECIPITATION (inches):														
Water Equivalent														
-Normal		0.41	0.40	0.52	0.40	0.46	0.51	1.30	1.51	0.85	0.86	0.38	0.52	8.12
-Maximum Monthly	51	1.32	1.42	2.18	1.97	3.07	2.57	3.33	3.30	2.63	3.08	1.45	1.85	3.33
-Year		1978	1948	1973	1942	1941	1986	1968	1967	1988	1972	1940	1959	JUL 1968
-Minimum Monthly	51	T	T	T	T	T	T	0.08	T	T	0.00	0.00	0.00	0.00
-Year		1970	1984	1966	1989	1945	1975	1980	1962	1957	1952	1949	1981	DEC 1981
-Maximum in 24 hrs	51	0.87	0.51	1.11	1.66	1.14	1.64	1.77	1.75	1.92	1.80	0.76	1.35	1.92
-Year		1962	1981	1973	1969	1969	1952	1961	1980	1955	1969	1940	1958	SEP 1955
Snow, Ice pellets														
-Maximum Monthly	51	9.5	10.3	13.9	8.1	1.0	T	T	0.0	T	3.2	9.3	14.7	14.7
-Year		1973	1986	1973	1973	1979	1990	1990		1971	1986	1940	1959	DEC 1959
-Maximum in 24 hrs	51	5.1	6.0	10.7	10.9	1.0	T	T	0.0	T	3.2	5.5	14.2	14.2
-Year		1973	1986	1973	1988	1979	1990	1990		1971	1986	1946	1958	DEC 1958
WIND:														
Mean Speed (mph)	51	8.1	8.9	10.1	11.0	10.6	10.0	9.1	8.3	8.6	8.3	7.9	7.7	9.0
Prevailing Direction through 1963		N	N	SE	S	S	S	SE	SE	SE	SE	N	N	SE
Fastest Obs. 1 Min.														
-Direction (!!!)	6	09	09	28	17	28	08	36	27	25	09	27	09	09
-Speed (MPH)	6	52	40	41	46	46	40	52	41	40	32	48	47	52
-Year		1990	1989	1986	1985	1986	1990	1990	1990	1985	1986	1988	1987	JAN 1990
Peak Gust														
-Direction (!!!)	7	E	W	NW	E	S	E	N	E	W	NW	W	E	N
-Speed (mph)	7	70	63	66	64	61	67	72	63	61	51	63	71	72
-Date		1990	1984	1986	1990	1987	1986	1990	1989	1985	1986	1988	1987	JUL 1990

Notes:

T = Trace amount. Blank entries denote missing/unreported data. # indicates a station or instrument relocation. (a) = Length of record in years, although individual months may be missing. 0.* or * = the value is between 0.0 and 0.05.

Normals are based on the 1961-1990 record period. Extremes dates are the most recent occurrence.

Wind direction numerals show tens of degrees clockwise from true north. "00" indicates calm. Resultant directions are given to whole degrees.

REFERENCES

National Oceanographic and Atmospheric Administration (NOAA), 1990. "Local Climatological Data, Annual Summary with Comparative Data, Albuquerque, NM, NOAA."

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APPENDIX B
SANDIA NATIONAL LABORATORIES, ALBUQUERQUE ENVIRONMENTAL RESTORATION PROGRAM SITES

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Table B-1. Solid Waste Management Units

Operable Unit Name	ADS No.	CEARP No.	Solid Waste Management Unit	RFA Site No.	Comment
Technical Area II	1303	1	Radioactive Waste Landfill	32-37	Contains Haz
		2	Classified Waste Landfill	38, 39	
		3	Chemical Disposal Pit	40	
		43	Radioactive Storage Yard	57	
		44	Decontamination Site and Uranium Calibration Pits	130	
		50	Old Centrifuge Site	None	
		113	Technical Area II Firing Sites	None	
		114	Explosive Burn Pit	None	
		165	Building 901 Septic System	79	
		48	Building 904 Septic System	79	
		135	Building 906 Septic System	79	
		136	Building 907 Septic System	79	
		166	Building 919 Septic System	79	
		159	Building 935 Septic System	79	
		167	Building 940 Septic System	79	
		168	Building 901-1 LUST	None	
		169	Building 910-1 LUST	None	
		170	Building 911-1 LUST	None	
		171	Building 912-1 LUST	None	
Mixed Waste Landfill	1289	76	Mixed Waste Landfill	24-30 115,116	

LUST = Leaking Underground Storage Tank.

Table B-1. Solid Waste Management Units (Continued)

Operable Unit Name	ADS No.	CEARP No.	Solid Waste Management Unit	RFA Site No.	Comment
Septic Tanks, Drainfields	1295	137	Building 6540/6542 Septic	U	
		138	Building 6630 Septic System	79	
		139	Building 9964 Septic System	79	
		140	Building 9965 Septic System	79	
		141	Building 9967 Septic System	79	
		142	Building 9970 Septic System	79	
		143	Building 9972 Septic System	79	
		144	Building 9980 Septic System	79	
		145	Building 9981/9982 Septic	U	
		49	Building 9820 Drains	126	
		116	Building 9990 Septic System	79	
		101	Explosive Contaminated Sumps, Drains (Building 9920)	None	
		146	Drain Fields (Building 9920)	79	
		147	Building 9925 Septic System	79	
		148	Building 9927 Septic System	79	
		149	Building 9930 Septic System	79	
		150	Building 9939/9939A Septic	U	
		151	Building 9940 Septic System	79	
		152	Building 9950 Septic System	79	
		153	Building 9956 Septic System	79	
		154	Building 9960 Septic System	79	
		160	Building 9832 Septic System	79	
		161	Building 6636 Septic System	79	
Chemical Waste Landfill	1267	74	Chemical Waste Landfill	1-9, 20 110, 200	Under RCRA Closure

Table B-1. Solid Waste Management Units (Continued)

Operable Unit Name	ADS No.	CEARP No.	Solid Waste Management Unit	RFA Site No.	Comment
Technical Areas III and V	1306A	18	Storage and Salvage Yards	54	
		26	Burial Site (west of Technical Area III)	None	
		31	Electric Transformer Oil Spill	None	
		34	Centrifuge Oil Spill	R	
		35	Vibration Facility Oil Spill	R	
		36	Oil Spill - HERMES	S	
		37	PROTO Oil Spill	T	
		51	Building 6924 Pad, Tank, Pit	10, 11	
		52	SER Liquid Waste Disposal	135	
		78	Gas Cylinder Disposal Pit	31	
		83	Sled Tracks	I	
		84	Gun Facilities (Technical Area III)	None	
		100	Building 6620 HE Sump/Drain	84, 85	
		102	Radioactive Disposal (east of Technical Area III)	None	May Contain Haz
		107	Explosive Test Area (SE Technical Area III)	None	
		111	Building 6715 Sump/Drains	79	
		188	Building 6597 Aboveground Containment Spill Tank	99	
Liquid Waste Disposal System	1306B	4	Radioactive Surface Impoundments	18, 19	May Contain Haz
		5	Radioactive Seepage Basin	16, 17	May Contain Haz

Table B-1. Solid Waste Management Units (Continued)

Operable Unit Name	ADS No.	CEARP No.	Solid Waste Management Unit	RFA Site No.	Comment
Coyote Canyon Blast Area	1270	8	Open Dump (Coyote Canyon Blast Area)	23	
		58	Coyote Canyon Blast Area	136-139	
Leaking Underground Storage Tanks	1300	155	Building 6597 - 25,000 Gal	None	
		172	Building 888-4	None	
		173	Building 6525	None	
		174	Building 6581-2	None	
		175	Building 6588-1	None	
		176	Building 605-18	None	
		178	Building 6587-3	None	
		179	Manzano AFB Building 7570-1	None	
		180	Building 6503	None	
		181	Building 6500	None	
Thunder Range	1308	6	Gas Cylinder Disposal Pit	72	
		17	Scrap Yards/Open Dump (Thunder Range)	74-76	
		39	Oil Spill - Solar Facility	V	
		54	Pickax Site	14, 15	
		55	Red Towers Site	K	
		56	Old Thunderwells	A	
		89	Shock Tube Site	56	
		90	Beryllium Firing Site	B	

Table B-1. Solid Waste Management Units (Continued)

Operable Unit Name	ADS No.	CEARP No.	Solid Waste Management Unit	RFA Site No.	Comment
		91	Lead Firing Site	132	
		191	Equus Red	None	
		193	Sabotage Test Area	None	
Coyote Springs Area	1272	21	Metal Scrap (Coyote Springs)	73	
		27	Building 9820 - Animal Disposal Pit	42	
		62	Graystone Manor Site	None	
		88	Firing Site (SW of Coyote Springs)	J	
Central Coyote Test Field	1266	11	Radioactive/Explosive Burial Mounds	68, 69, 70	
		19	Scrap Yard (NW End of Old Aerial Cable)	65	
		22	Storage/Burn (W of DEER)	106	
		57	Workman Site	G	
		66	Boxcar Site	H	
		68	Old Burn Site	111	
		70	Explosive Test Pit (Water Towers)	127	
		71	Moonlight Shot Area	F	
		87	Building 9990 (Firing Site)	108, D	
		82	Old Aerial Cable Site Scrap	66, 67	
Lurance Canyon	1282	12	Burial Site/Open Dump	41	
		13	Oil Surface Impoundment (Lurance Canyon Burn Site)	13	

Table B-1. Solid Waste Management Units (Continued)

Operable Unit Name	ADS No.	CEARP No.	Solid Waste Management Unit	RFA Site No.	Comment
		63	Balloon Test Area	E1	
		64	Gun Site (Madera Canyon)	E2	
		65	Lurance Canyon Explosive Test Site	None	
		94	Lurance Canyon Burn Site	119	
		81	New Aerial Cable Site Burial Site/Dump/Test Area	22, 50, 51, 59	
		93	Madera Canyon Rocket Launcher Pads	E3	
Pendulum Area	1288	10	Burial Mounds (Bunker Area North of Pendulum Site)	60-63	
		59	Pendulum Site	None	
		60	Bunker Area (North of Pendulum Site)	124	
		92	Pressure Vessel Test Site (Coyote Canyon Blast Area)	64	
SW Coyote Test Field	1298	14	Burial Site (Building 9920)	45	
		38	Oil Spill (Building 9920)	U	
		85	Firing Site (Building 9920)	125	
		86	Firing Site (Building 9927)	C	
		103	Scrap Yard (Building 9939)	None	
		108	Firing Site (Building 9940)	None	

Table B-1. Solid Waste Management Units (Continued)

Operable Unit Name	ADS No.	CEARP No.	Solid Waste Management Unit	RFA Site No.	Comment
Septic Tanks, Drainfields	1295	137	Building 6540/6542 Septic	U	
		138	Building 6630 Septic System	79	
		139	Building 9964 Septic System	79	
		140	Building 9965 Septic System	79	
		141	Building 9967 Septic System	79	
		142	Building 9970 Septic System	79	
		143	Building 9972 Septic System	79	
		144	Building 9980 Septic System	79	
		145	Building 9981/9982 Septic	U	
		49	Building 9820 Drains	126	
		116	Building 9990 Septic System	79	
		101	Explosive Contaminated Sumps, Drains (Building 9920)	None	
		146	Drain Fields (Building 9920)	79	
		147	Building 9925 Septic System	79	
		148	Building 9927 Septic System	79	
		149	Building 9930 Septic System	79	
		150	Building 9939/9939A Septic	U	
		151	Building 9940 Septic System	79	
		152	Building 9950 Septic System	79	
		153	Building 9956 Septic System	79	
		154	Building 9960 Septic System	79	
		160	Building 9832 Septic System	79	
		161	Building 6636 Septic System	79	
Chemical Waste Landfill	1267	74	Chemical Waste Landfill	1-9, 20 110, 200	Under RCRA Closure

Table B-1. Solid Waste Management Units (Concluded)

Operable Unit Name	ADS No.	CEARP No.	Solid Waste Management Unit	RFA Site No.	Comment
Schoolhouse Mesa	1293	9	Burial Site/Open Dump	43	
		20	Uranium Burn Site	None	
		61	Schoolhouse Mesa Test Site	None	
Tijeras Arroyo	1309	23	Disposal Trenches	46, 48, 49	
		45	Liquid Discharge (behind Technical Area IV)	None	
		7	Gas Cylinder Disposal (Arroyo del Coyote)	44	
		16	Open Dumps (Arroyo del Coyote)	21, 55	
		40	Oil Spill (600 Igloo Area)	W	
		46	Old Acid Waste Line Outfall	112	
South Coyote Test Field	1297	15	Trash Pits (Frustration Site)	46	
		28	Mine Shafts	None	
		47	Doomed Bunker Outfall	133, 134	
		67	Frustration Site	None	
		69	Firing Pits (near USGS)	None	
		72	Operation Beaver Site	None	

APPENDIX C
SAMPLE COLLECTION AND ANALYSIS

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C.1 Sample Collection for Radioactive Effluents

Samples are collected and stored in accordance with methods described in DOE/EP-0023 (DOE, 1981). These procedures have been documented in the SNL, Albuquerque, "Environmental Monitoring Manual" (SNL, 1986). Native vegetation, soil, and water samples are collected annually at the end of the growing season. Thermoluminescent dosimeters (TLDs) are exchanged quarterly (Table C-1).

Vegetation

Native vegetation samples are collected in late summer from a 9-m^2 area at each sampling location. Because the native desert vegetation is sparse, a sample includes a mixture of species, with grass species predominating. Each sample weighs approximately 0.5 kg and consists of stems and leaves representative of the species at each site. Consequently, radionuclide concentrations for vegetation vary due to species uptake, retention, or deposition as well as location. Three samples are collected and composited at each location to ensure an adequate sample size for subsequent analysis. Replicate samples consisting solely of grasses are collected at each of three adjacent sample plots in order to estimate variability due to location. Each vegetation sample is cut and blended before radiochemical analysis for tritium and gamma spectrum analysis.

Water

Water samples are collected in acid-cleaned, plastic containers that have been rinsed in distilled water. Replicate samples of approximately 3.8 L of water are collected at each water sampling location. One sample is acidified immediately to 10 percent by volume with 2N HNO and is used for total water radiochemical analysis.

The second sample is filtered immediately and the water is then acid-treated to prevent plating of any radionuclides on the container walls. A radiochemical analysis for gross alpha, gross beta, and gamma spectrum analysis, and uranium (U) and tritium (^{3}H) is then performed on the water and filter samples.

Soil

Soil samples are randomly collected from the same 9-m^2 quadrant as the vegetation samples. Three 100-cm^2 samples of the top 5 cm of soil are collected and composited at each station. Each soil sample is dried, ball-milled, and sieved prior to a cesium-137 (^{137}Cs) and U analysis. A separate aliquot is used for ^{3}H analysis following EPA-recommended procedures. Replicate samples are collected at three or more locations to access sample variability.

Table C-1. Sampling Frequencies and Types of Analysis for Radioactive Environmental Monitoring Program

	Sample Media				
			Water		
Parameter	Vegetation	Soil	Total Filtered	Filters[a]	TLDs
Number of Stations	44	45	10	10	34
Number of Samples	50	52	26[b]	12	130
Sample Frequency	Annual	Annual	Annual	Annual	Quarterly
Analysis Performed					
Gross Alpha	--[c]	--	X	X	--
Gross Beta	--	--	X	X	--
U	--	X	X	--	--
Gamma Spectrometry	X	X	X	--	--
Tritium	X	X	X	--	--
% HO	X	X	--	--	
TLD	--	--	--	--	X
Number of Analyses	150	208	130	24	130

[a]These filter samples are for analysis of suspended solids.
[b]Includes 12 samples for total unfiltered water, 12 samples for filtered water, and 2 blanks.
[c]No analysis performed.

C.2 Radiochemical Analysis

Vegetation

Aliquots of the vegetation samples are taken for each radiochemical analysis. One aliquot of vegetation is air-dried to reach a constant dry mass, finely ground up, and then placed in a 500-ml Marinelli beaker for gamma spectrum analysis. A 70-g sample (250-ml calibration geometry) is used for each gamma spectrum analysis. A second (100-g) aliquot of vegetation is heated with cyclohexane in a 1,000-ml distillation flask, and the water is collected in a Barrett trap. The water collected in the trap is analyzed for ^{3}H with a liquid scintillation detector using a 1-ml sample volume.

Soil

Soil samples are analyzed for uranium by leaching a 2-g aliquot with mixed acids (HNO/HF) and diluting with water to a 10-ml volume to extract uranium and other acid-soluble metals. A 0.1-ml aliquot of acid solution is diluted to 10 ml with 2N HNO. Fifteen milliliters of aluminum nitrate and 10 ml of ethyl acetate are added and mixed for 10 min to selectively extract uranium into the organic phase. Three 0.1-ml aliquots are then fused with an NaF/LiF flux and tested by fluorescence.

Percent Moisture

Percent moisture for soil samples is determined by one of two methods. A moisture balance is used that provides a direct readout of percent moisture in 10 g of soil. The alternative method is to dry 10 g of soil at 110°C until a constant dry weight is reached. This weight is then used in calculating percent moisture.

Gamma Spectrum Analysis

Water, soil, and vegetation samples are analyzed according to American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) Standard 680-1978, "Standard Techniques for Determination of Germanium Semiconductor Detector Gamma Ray Efficiency Using a Standard Marinelli Beaker Geometry." They are analyzed for gamma-emitting radionuclides by placing approximately 450 g of water, or 862 g of soil in 500-ml Marinelli beakers and counting for 1,000 min (100 min for soil) by using high-efficiency, high-resolution intrinsic Ge or Ge (Li) detectors and multichannel analyzers. The 70 g vegetation samples are analyzed in a 250-ml geometry. The detectors are calibrated and checked routinely by using either a mixed radionuclide standard obtained from the National Institute of Standards (NIST) or by using a standard for specific radionuclides traceable to the NBS. The data are analyzed by computer software developed by Canberra Industries.

Water

Water samples are further analyzed for gross alpha and gross beta activity by evaporating an aliquot of water (100 ml for alpha analysis, 400 ml for beta analysis) on a 5-cm-diameter stainless steel planchet and counting for 100 min by using a low-background, gas-proportional detector. The detector is calibrated and checked routinely by using radionuclide standards traceable to the NBS.

C.3 External Penetrating Radiation

TLDs are placed at current locations. The type of TLD phosphor used is LiF in chip form. All dosimeters are placed in open areas over soil substrates 1 m above ground level. A minimum of five TLDs are placed at each location to get an estimate of the variability in TLD response at that location. TLDs are exchanged on a quarterly basis. A dedicated set of environmental TLDs is maintained for this program.

All TLDs are annealed at 400°C for 1 hr before field placement. Transit controls are used to document additional exposure received during transit from SNL, Albuquerque, to field locations. The TLD readout equipment is calibrated by exposing TLDs to 0, 10, 20, 30, and 50 mR of ^{137}Cs midway through each quarterly field cycle. Ten TLDs are exposed at each level.

Procedures used in the SNL, Albuquerque, environmental dosimetry program are documented in the "Dosimetry Procedures Manual" (Federal Register, 1988).

C.4 Sample Collection and Analysis for Groundwater Samples

C.4.1 Sample Collection

Sampling protocol is as follows: Water-level measurements are taken using a chalked tape. After four to ten well volumes are evacuated from each well, pumping continues until pH, temperature, and conductivity stabilize. The pH is considered stable when three consecutive measurements agree within 0.2 pH units. Temperature is considered stable when three consecutive measurements agree within 0.2°C. Conductivity is considered stable when two consecutive measurements agree within 10 micromhos. All groundwater samples are collected and preserved as described in Table C-2. Organic sample bottles are filled with a restricted water flow to minimize splashing which would volatilize low molecular weight compounds. Volatile aromatic organics are sampled by filling the bottle until a miniscus forms above the lip of the bottle to ensure no headspace. The concern is that the volatile materials will escape into the headspace and result in an erroneous reading. Because of the depth of the groundwater wells, dissolved carbon dioxide volatilizes when the samples are brought to the surface. The evolving carbon dioxide inevitably results in a headspace in the samples. This phenomena is documented in the field logs. The EPA is reviewing the significance of headspace in samples containing organics.

Table C-2. Recommended Analytical Methods, Sample Containers, Preservation Techniques, and Holding Times

Parameter	Method No. (SW-846)[a]	Estimated Method Detection Limit[b]	Container Type[c]	Minimum Volume	Preservation[d]	Maximum Holding Time
Indicator Parameters						
pH	9040	NA	P,G	50 ml	NA	Field measurement
Specific Conductance	Modified 9050	NA	P,G	100 ml	NA	Field measurement
Total Organic Carbon (TOC)	9060	1 mg/l	P,G	4 x 250 ml	Cool to 4°C, HCL or HSO to pH <2	28 days
Total Organic Halogens (TOX)	9020	30 µg/l	G,AG,Teflon-lined cap	4 x 250 ml	Cool to 4°C, HSO to pH <2	28 days
Groundwater Quality Parameters						
Chloride	9250/9251 color EPA 300.0[e] IC	1 mg/l 3 mg/l	P,G	50 ml	None required	28 days
Phenols	9065 4AAP	10 µg/l	G,Teflon-lined cap	500 ml	Cool to 4°C, HSO to pH <4	28 days
Sulfate	9035 color 9036 color 9038 color EPA 300.0[e] IC	10 mg/l 0.5 mg/l 1 mg/l 5 mg/l	P,G	50 ml	Cool to 4°C	28 days
Iron	6010 ICP	0.10 mg/l	P	1000 ml[f]	HNO to pH <2	6 months
Manganese	6010 ICP	0.01 mg/l	P	1000 ml[f]	HNO to pH <2	6 months

[a]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, EPA-SW-846, unless otherwise noted. Color = Color metric technique; IC = ion chromatography; ICP = inductively coupled plasma spectroscopy; GFAA = graphite furnace atomic absorption; CVAA = cold vapor atomic absorption; GC = gas chromatography; IS = ion selective probe; and GC/MS = gas chromatography/mass spectrometry.
[b]Method detection limit as listed for specified method. Detection limits listed as mg/l = milligrams per liter; µg/l = micrograms per liter; and pCi/l = picocuries per liter.
[c]P = Linear polyethylene; G = Glass; and AG = Amber glass.
[d]Preservatives and holding times as specified in EPA-SW-846, Third Edition.
[e]U.S. Environmental Protection Agency, 1984, "Methods for Chemical Analysis of Water and Wastewater," EPA-600-84-017.
[f]All metals analytes from single sample.

Table C-2. Recommended Analytical Methods, Sample Containers, Preservation Techniques, and Holding Times (Continued)

Parameter	Method No. (SW-846)[a]	Estimated Method Detection Limit[b]	Container Type[c]	Minimum Volume	Preservation[d]	Maximum Holding Time
Sodium	6010 ICP	5.0 mg/l	P	1000 ml[f]	HNO to pH <2	6 months
EPA Interim Drinking Water Parameters						
Arsenic	7060 GFAA	0.005 mg/l	P	1000 ml[f]	HNO to pH <2	6 months
Barium	6010 ICP	0.01 mg/l	P	1000 ml[f]	HNO to pH <2	6 months
Cadmium	7131 GFAA 6010 ICP	0.0005 mg/l 0.005 mg/l	P	1000 ml[f]	HNO to pH <2	6 months
Total Chromium	7191 GFAA 6010 ICP	0.001 mg/l 0.01 mg/l	P	1000 ml[f]	HNO to pH <2	6 months
Lead	7421 GFAA	0.005 mg/l	P	1000 ml[f]	HNO to pH <2	6 months
Mercury	7470 CVAA	0.0002 mg/l	P,G	1000 ml[f]	HNO to pH <2	13 days in plastic 38 days in glass
Selenium	7740 GFAA	0.002 mg/l	P	1000 ml[f]	HNO to pH <2	6 months
Silver	EPA 272.2[e] GFAA 6010 ICP	0.0005 mg/l 0.01 mg/l	P Dark, AG	1000 ml[f]	HNO to pH <2	6 months
Gross Alpha	9310	3 pCi/l	P	1 gal[g]	HNO to pH <2	6 months
Gross Beta	9310	4 pCi/l	P	1 gal[g]	HNO to pH <2	6 months

[a]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, EPA-SW-846, unless otherwise noted. Color = Color metric technique; IC = ion chromatography; ICP = inductively coupled plasma spectroscopy; GFAA = graphite furnace atomic absorption; CVAA = cold vapor atomic absorption; GC = gas chromatography; IS = ion selective probe; and GC/MS = gas chromatography/mass spectrometry.
[b]Method detection limit as listed for specified method. Detection limits listed as mg/l = milligrams per liter; μg/l = micrograms per liter; and pCi/l = picocuries per liter.
[c]P = Linear polyethylene; G = Glass; and AG = Amber glass.
[d]Preservatives and holding times as specified in EPA-SW-846, Third Edition.
[e]U.S. Environmental Protection Agency, 1984, "Methods for Chemical Analysis of Water and Wastewater," EPA-600-84-017.
[f]All metals analytes from single sample.
[g]All radionuclide analytes from single container.

Table C-2. Recommended Analytical Methods, Sample Containers, Preservation Techniques, and Holding Times (Continued)

Parameter	Method No. (SW-846)[a]	Estimated Method Detection Limit[b]	Container Type[c]	Minimum Volume	Preservation[d]	Maximum Holding Time
Total Radium	9315	3 pCi/l	P,G	1 gal[g]	HNO to pH <2	6 months
Endrin	8080 GC	0.10 μg/l	AG,Teflon-lined cap	2 x 1000 ml[h]	Cool to 4°C, pH 5-9	7 days to extraction, 40 days after extraction
Lindane (q-BHC)	8080 GC	0.05 μg/l	AG,Teflon-lined cap	2 x 1000 ml[h]	Cool to 4°C, pH 5-9	7 days to extraction, 40 days after extraction
Methoxychlor	8080 GC	0.5 μg/l	AG,Teflon-lined cap	2 x 1000 ml[h]	Cool to 4°C, pH 5-9	7 days to extraction, 40 days after extraction
Toxaphene	8080 GC	1.0 μg/l	AG,Teflon-lined cap	2 x 1000 ml[h]	Cool to 4°C, pH 5-9	7 days to extraction, 40 days after extraction
2,4-D	8150 GC	20 μg/l	AG,Teflon-lined cap	2 x 1000 ml[h]	Cool to 4°C, pH 5-9	7 days to extraction, 40 days after extraction
2,4,5-TP Silvex	8150 GC	10 μg/l	AG,Teflon-lined cap	2 x 1000 ml[h]	Cool to 4°C, pH 5-9	7 days to extraction, 40 days after extraction

[a]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, EPA-SW-846, unless otherwise noted. Color = Color metric technique; IC = ion chromatography; ICP = inductively coupled plasma spectroscopy; GFAA = graphite furnace atomic absorption; CVAA = cold vapor atomic absorption; GC = gas chromatography; IS = ion selective probe; and GC/MS = gas chromatography/mass spectrometry.

[b]Method detection limit as listed for specified method. Detection limits listed as mg/l = milligrams per liter; μg/l = micrograms per liter; and pCi/l = picocuries per liter.

[c]P = Linear polyethylene; G = Glass; and AG = Amber glass.

[d]Preservatives and holding times as specified in EPA-SW-846, Third Edition.

[e]U.S. Environmental Protection Agency, 1984, "Methods for Chemical Analysis of Water and Wastewater," EPA-600-84-017.

[f]All metals analytes from single sample.

[g]All radionuclide analytes from single container.

[h]All pesticide and herbicide analytes from single set of containers.

Table C-2. Recommended Analytical Methods, Sample Containers, Preservation **Techniques**, and Holding Times (Concluded)

Parameter	Method No. (SW-846)[a]	Estimated Method Detection Limit[b]	Container Type[c]	Minimum Volume	Preservation[d]	Maximum Holding Time
Fluoride	EPA 300.0[e] IC EPA 340.2[e] IS	0.005 mg/l 0.1 mg/l	P	300 ml	None required	28 days
Turbidity	EPA 180.1[e]	<1 NTU	P,G	200 ml	Cool to 4°C	48 hr
Nitrate (as Nitrogen)	EPA 300.0[e] IC EPA 353.2[e] color	0.1 mg/l 0.1 mg/l	P,G P,G	100 ml 100 ml	Cool to 4°C Cool to 4°C, HSO to pH <2	48 hr 28 days
Total Coliform Bacteria	9132	<2 colony/100 ml	P/G (sterilized)	200 ml	Cool to 4°C	6 hr
Supplemental Parameters						
Volatile Organics	8240 GCMS	5-100 µg/l	G,Teflon-lined Septa	3 x 40 ml	Cool to 4°C, 4 drops HCL optional	14 days
Semivolatile Organics	8270 GCMS	10-50 µg/l	AG	2 x 1/2 gal, or 1 x 1 gal	Cool to 4°C	7 days to extraction 40 days after extraction

[a]U.S. Environmental Protection Agency, 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, EPA-SW-846, unless otherwise noted. Color = Color metric technique; IC = ion chromatography; ICP = inductively coupled plasma spectroscopy; GFAA = graphite furnace atomic absorption; CVAA = cold vapor atomic absorption; GC = gas chromatography; IS = ion selective probe; and GC/MS = gas chromatography/mass spectrometry.
[b]Method detection limit as listed for specified method. Detection limits listed as mg/l = milligrams per liter; µg/l = micrograms per liter; and pCi/l = picocuries per liter.
[c]P = Linear polyethylene; G = Glass; and AG = Amber glass.
[d]Preservatives and holding times as specified in EPA-SW-846, Third Edition.
[e]U.S. Environmental Protection Agency, 1984, "Methods for Chemical Analysis of Water and Wastewater," EPA-600-84-017.
[f]All metals analytes from single sample.
[g]All radionuclide analytes from single container.
[h]All pesticide and herbicide analytes from single set of containers.

For analysis, analytical methods described in EPA (1982; 1983) are used. If a method is not available in either of the above, an appropriate method from one of the standard references is used.

Inorganic analyses is performed primarily using inductively coupled plasma emission spectrometry (ICP), ion chromatography, and graphite furnace atomic absorption (GFAA). Organic analyses are performed primarily using gas chromatography and GC/MS.

C.4.2 Sources of Error

The purpose of statistical testing for changes in groundwater parameter values over time is to utilize a methodology that can quantitatively show a significant change at a specified level. Identifying a significant change is not in itself a confirmation of a release from the Chemical Waste Landfill (CWL) reaching the groundwater. One must review the data, the sampling and analytical methods, and the assumptions for the statistical tests in order to confirm that the statistical change represents a true change.

pH

Because relatively small changes in parameter values may show a significant change, the data must reflect similar methods for collection and analysis, including calibration methods and corrections for changes in conditions affecting the measurement.

A review of the field data collection logs reveals that all pH measurements were made with a field pH instrument. Potential sources of error include temperature, gas exchange, and suspension effects. The meter was calibrated in the field using standard buffer solutions. A potential source of error for the pH measurements was thought to be in the calibration procedure if the buffer solutions were at a different temperature than the groundwater being measured. A review of the sensitivity of pH to temperature changes shows that the measurement is somewhat insensitive to temperature changes. Standard buffer solutions in the pH range near 7 will have a variation in pH of 0.02 to 0.03 units over a temperature range of 10 to 50°C. The field measurements of temperature of the solutions measured for pH ranged from 15 to 30°C.

Because it is impractical to make in-situ measurements of the groundwater pH, the sample must be brought to the surface. Two methods are used to evacuate and sample the wells: (1) pumping with a small-diameter piston pump and (2) baling. The potential for gas exchange occurring exists when the groundwater flows into the wellbore and continues until the groundwater sample is measured at the surface. The use of the piston pump to purge and sample the well reduces the contact of the groundwater with the atmosphere. Generally, the water is pumped into a sample container, and the pH is measured as soon as practical. Water collected by baling in the wellbore is generally surged and mixed with the atmosphere existing in the wellbore above the water. The water within the baler is then removed and placed into a bucket.

Wells MW1 and BW1, both 2-in. wells that do not allow a pump to pass restricted zones within the casing, must be baled for purging and sampling. The water in wells MW1 and BW1 was extremely turbid; therefore, the suspension was allowed to settle for approximately 15 min before baling. The loss or gain of certain volatile constituents that participate in controlling the solution pH, such as carbon dioxide (CO) and hydrogen sulfide, will alter the pH as a time-dependent phenomenon. The absorption of CO into the solution will generate carbonic acid, release hydrogen ions from carbonate-bicarbonate reactions, and cause a decrease in the pH. The equilibrium pH due to the partial pressure of atmospheric CO is about 5 (Garrels and Christ, 1965). Currently, the magnitude of this potential source of error for groundwater is not understood; however, a standard geochemistry textbook reveals a change of 1.5 pH units for a deaerated alkaline solution allowed to absorb atmospheric constituents (Garrels and Christ, 1965).

The effects of mineral suspensions on the results of a pH determination are also an important source of error. Carbonate minerals such as calcite (limestone) and aragonite (caliche) hydrolyze in solution, releasing carbonate. The carbonate removes hydrogen ions from the solution using the same carbonate-bicarbonate reaction noted above and acts to increase the pH. The equilibrium pH due to calcite is approximately 9.5 (Garrels and Christ, 1965).

The negative charges on the surfaces of clays are also capable of removing hydrogen ions from solutions and increasing the pH. A small laboratory experiment was performed to determine the effect of a clay (found near the water table during the drilling of well MW1A, 50 ft to the west of MW1) on the pH of distilled water. The results showed that the addition of small amounts of the clay would linearly increase the pH from 7.2 to 8.9. Due to the large screen size and the necessity to bail MW1 for purging and sampling, well MW1 showed very high turbidity levels. During the February 1988 sampling event, a measurement of the turbidity revealed a value of 8,400 nephelometric turbidity unit (NTU) for MW1 and 3,100 for BW1.

<u>Specific Conductivity</u>

All data for the specific conductance parameter was found in the field data collection logs. These data were not corrected for temperature. Temperature differences of 1°C can lead to about a 2-percent difference in the value of specific conductance. All field data were corrected to 25°C.

<u>Statistical Assumptions</u>

The statistical procedure used to test for significant change in this report is specified in the groundwater monitoring regulations. A critical review of the assumptions that support this statistical test must be performed to see if the assumptions are upheld. If not, the validity of the conclusion of the statistical test must be questioned.

The CABF method was developed to analyze independent samples with unequal population variances. Because of the inherently high false positive rate, there was sufficient criticism of this method, that the EPA issued a final rule October 11, 1988, that amended the statistical tests required for groundwater monitoring (Federal Register, 1988). The rule specifies five other tests, more appropriate to groundwater monitoring than the CABF method, for permitted facilities under 40 CFR Part 264. The EPA believed that most land disposal facilities would have permits by November 1988 and did not see the need to modify the interim status regulations of 40 CFR Part 265.

Two sources have identified potential problems with using the CABF as a method to detect releases from a hazardous waste management unit. The EPA "Technical Enforcement Guidance Document" discusses t-tests available for facilities under interim status (EPA, 1986). In that document, the authors detail an alternative t-test, the Averaged Replicate (AR) t-test, that is recommended as more appropriate than the CABF t-test for groundwater monitoring.

The October 1988 Final Rule on statistical methods for groundwater monitoring points out several reasons for rejecting the CABF method: (1) the replicate sampling method required by the regulations is not appropriate for the CABF method, (2) the CABF method does not adequately consider the number of comparisons that must be made under the regulations, and (3) the CABF method has no control for seasonal variations in parameter values (Federal Register, 1988). Concern arose regarding potential false positive errors and false negative errors exceeding reasonable rates for a regulated concern. As a result, four specific statistical tests, not including the CABF or the AR t-tests, and an option for the owner/operator to propose any other test, were issued as a final rule on October 11, 1988. Until SNL, Albuquerque, certifies closure of the CWL and becomes a permitted facility requiring postclosure monitoring, the statistical tests must remain t-tests as specified in 40 CFR Part 265 for interim status facilities or by the New Mexico Environment Department (NMED).

C.5 Sample Collection and Analysis for Wastewater Sampling

Complete documentation for the wastewater sampling program can be found in the Wastewater Monitoring Program Quarterly Reports on file at SNL, Albuquerque, Environmental Programs Records Center. These documents describe the methods and procedures used for the samples collected from the nine locations (see Table 6-2 in this document). Analytical methods and detection limits for each parameter are listed in Table D-2 of this document.

REFERENCES

American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE), 1978. "Standard Techniques for Determination of Germanium Semiconductor Detector Gamma Ray Efficiency Using a Standard Marinelli Beaker Geometry," ANSI/IEEE 689-1780, ANSI/IEEE.

Federal Register, 1988. "Dosimetry Procedures Manual."

Federal Register, 1988. "40 .CFR 264, Statistical Methods for Evaluating Ground-Water Monitoring from Hazardous Waste Facilities: Final Rule," October 11, 1988.

Garrels, R. M., and C. L. Christ, 1965. "Solutions, Minerals and Equilibria," New York, NY: Harper and Row.x.

Sandia National Laboratories (SNL), 1986. "Environmental Monitoring Manual," SNL, Albuquerque, NM.

U.S. Department of Energy (DOE), 1981. "A Guide for Environmental Radiological Surveillance at U.S. Department of Energy Installations," DOE/EP-0023, DOE.

U.S. Environmental Protection Agency (EPA), 1984. "Methods for Chemical Analysis of Water and Waste Water," EPA-600-84-017, EPA, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1986. "RCRA Technical Enforcement Guidance Document (TEGD)," OSWER-9950.1, EPA, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1986. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition," EPA-SW-846, EPA, Washington, D.C.

APPENDIX D

MINIMUM DETECTION LIMITS
AND
ANALYTICAL METHODS

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Table D-1. Radiochemical Analysis Minimum Detection Limits (MDLs)

Analysis	Method	Sample Type	Sample Size	MDLs[a] Value	MDLs[a] Units	Count Time (min)
^{3}H	Liquid Scintillation	Water	75 ml	0.45	pCi/ml	30 x 3
		Vegetation[b]	20 g[c]	2.74	pCi/ml (wet)	30 x 3
		Soil[b]	20 g[c]	1.69	pCi/g (wet)	30 x 3
U_{tot}	Flourescence	Water	5 ml	1.5×10^{-3}	μg/ml	Not Applicable
	Gamma	Soil[b]	600-700 g (dry)	1.08	μg/g (dry)	60
Gross Alpha	Gas Proportional	Water	60-300 ml	1.68	pCi/ml	60
Gross Beta	Gas Proportional	Water	6C-300 ml	8.3×10^{-2}	pCi/ml	120
^{137}Cs	Gamma Spectral Analysis[d]	Water	900 ml	1.0	pCi/ml	60
		Vegetation[b]	600-700 g (dry)	4.4×10^{-3}	pCi/g (dry)	240
		Soil[b]	600-700 g (dry)	2.8×10^{-2}	pCi/g (dry)	120
^{40}K	Gamma Spectral Analysis[d]	Vegetation[b]	600-700 g (dry)	1.31	pCi/g (dry)	240
		Soil[b]	600-700 g (dry)	7.36	pCi/g (dry)	60

[a] These are typical MDL values at 95-percent confidence level.
[b] Soil and vegetation sample size is geometric volume. Sample mass varies from sample to sample. The marinelli water standard is a 450-ml standard. The marinelli soil standard is 890 g.
[c] Provided percent moisture is ≥50 percent.
[d] Gamma isotopics were analyzed using a PGT intrinsic/germanium detector.

Table D-2. Analytical Methods, Detection Limits, and Quality Control (QC) Acceptance Criteria for Analysis of Wastewater Samples

Parameter	Analytical Methods (EPA, 1983)	Detection Limits (µg/l)	QC Acceptance Criteria Matrix Spike Recovery	QC Acceptance Criteria Laboratory Recovery
Arsenic	EPA 206.2	5	75-125%	90-110%
Barium	EPA 208.1/200.7	<10/5	75-125%	75-125%
Cadmium	EPA 213.1/200.7	5/5	75-125%	75-125%
Chromium	EPA 218.1/200.7	50/10	75-125%	75-125%
Copper	EPA 220.1/200.7	<10/10	75-125%	75-125%
Cyanide, Total	EPA 335.2	20	75-125%	85-115%
Fluoride	EPA 340.2	100	75-125%	75-125%
Lead	EPA 239.2/200.7	5/50	75-125%	75-125%
Manganese	EPA 243.1	<10/5	75-125%	75-125%
Mercury, Total	EPA 245.1	0.2	75-125%	85-115%
Nickel	EPA 249.1/200.7	10/30	75-125%	75-125%
Oil and Grease	EPA 413.1/413.2	5000/200	75-125%	75-125%
Phenolic Compounds	EPA 420.1	5	75-125%	75-125%
Selenium	EPA 270.2	5	75-125%	75-125%
Silver	EPA 272.1/200.7	<10/10	75-125%	75-125%
Zinc	EPA 289.1/200.7	10/10	75-125%	75-125%

REFERENCES

U.S. Environmental Protection Agency (EPA), 1983. "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, EPA, March 1983.

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APPENDIX E
QUALITY ASSURANCE DATA

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Table E-1. List of Laboratories Used During 1991

Assaigai Analytical Laboratories, Incorporated

Environmental Control Technology Corporation (Encotec)

Enseco

International Technology Corporation, Analytical Services (IT/AS), Radiological Services Laboratories

TMA-Eberline

Western Research Institute

Accu-Labs Research, Inc.

Table E-2. List of Environmental Samples, or Sample Fractions Collected During 1991

Type	Number of Samples	Number of Analyses
Groundwater	427	1830
Wastewater	1924	5534
Oils/PCBs (including wipes)	89	89
Hazardous Wastes	282	1245
Soil	238	613
Other	1229	5282
Total	4189	14,593

Note: "Other" includes QC check samples, QC blank samples, cooling tower water samples, storm- and surface-water samples, vegetation samples, filter samples, and air samples.

Table E-3. Summary of Analytical Results for Check Samples Submitted to Enseco-RMAL During 1991

Parameter	First Quarter		Second Quarter		Third Quarter		Fourth Quarter	
	Percent Recovery	Relative Percent Difference	Percent Recovery	Relative Percent Difference	Percent Recovery	Relative Percent Difference	Percent Recovery	Relative Percent Difference
Alkalinity	103/102	0	100/101	1	90/94	5	98/99	1
Arsenic	97/93	5	106/74	35	88/98	11	94/86	9
Barium	94/99	5	114/107	6	94/92	9	95/95	0
Boron	110/95	15	--	--	--	--	--	--
Cadmium	97/97	0	95/88	7	94/94	0	86/86	0
Chloride	101/101	0	100/99	1	95/95	0	96/95	1
Chromium	99/106	7	103/96	6	94/92	2	102/97	5
COD	--	--	88/114	26	105/115	9	92/110	18
Copper	104/122	15	102/98	5	94/96	2	97/97	0
Cyanide	71/88	22	95/98	0	87/87	0	78/67	15
Fluoride	105/93	11	97/81	18	99/112	12	96/94	2
Iron	110/128	15	--	--	--	--	--	--
Lead	94/82	13	91/125	32	101/95	6	94/98	4
Manganese	96/102	6	99/94	6	100/91	10	103/97	5
Mercury	108/103	5	83/88	6	50/48	6	47/61	26
Nickel	97/103	6	101/93	8	92/90	2	96/96	0
NO_3/NO_2 as N	--	--	105/102	2	108/101	7	95/90	5
Oil and Grease	--	--	23/77	109	191/176	8	66/54	20
Phenol	99/94	6	87/90	3	100/90	11	104/108	4
Selenium	107/85	22	82/73	12	95/20	132	83/93	11
Silver	92/92	0	98/98	0	81/87	8	85/85	0
Sulfate	100/100	0	93/93	1	93/94	1	97/97	0
TDS	97/95	1	--	--	--	--	--	--
Thallium	102/98	4	81/81	0	84/162	64	NC/NC[a]	NC[a]
TOC	--	--	106/106	1	101/99	2	102/101	1
Zinc	94/124	27	118/118	0	96/96	0	98/92	6

[a]NC = Not calculated, analyte was not detected.

Table E-4. Summary of Blind Spike Analysis Results - Volatile Organic Compounds in Water - Enseco-RMAL Laboratory[a]

	First Quarter CY91		
Analyte	Percent Recovery Sample 1	Percent Recovery Sample 2	Relative Percent Difference
Benzene	90	98	9
Bromodichloromethane	94	97	4
Bromoform	112	90	22
Carbon Tetrachloride	75	73	2
Chlorobenzene	87	90	4
Chloroform	83	91	9
Dibromochloromethane	109	101	7
1,2-Dichloroethane	95	102	7
Ethyl-Benzene	85	87	2
Methylene Chloride	67	72	7
1,1,2,2-Tetrachloroethane	106	76	33
Tetrachloroethene	78	NC	NC
1,1,1-Trichloroethane	81	81	0
Trichloroethane	88	94	6
Toluene	85	90	6
Vinyl Acetate	NC	NC	NC
Xylenes, total	84	82	2

[a]All units in micrograms per Liter (μg/L).
NC = Not calculated.

Table E-4. Summary of Blind Spike Analysis Results - Volatile Organic Compounds in Water - Enseco-RMAL Laboratory[a] (Concluded)

	First Quarter CY91		
Analyte	Percent Recovery Sample 1	Percent Recovery Sample 2	Relative Percent Difference
Acetone	131	101	25
Benzene	116	102	13
Bromodichloromethane	110	88	22
Bromoform	100	88	13
Carbon Tetrachloride	98	91	7
Chlorobenzene	92	89	3
Chloroform	106	101	5
Dibromochloromethane	103	90	13
1,2-Dichloroethane	111	106	4
1,2-Dichloropropane	111	101	10
Ethyl-Benzene	96	96	0
Methylene Chloride	112	126	12
4-Methyl-2-Pentanone	126	NC	NC
Tetrachloroethane	89	91	3
1,1,1-Trichloroethane	104	96	9
Trichloroethane	95	90	6
Toluene	99	91	9
Xylenes, total	84	87	4

[a]All units in micrograms per liter (μg/L).
NC = Not calculated.

Table E-5. Summary of Blind Spike Analysis Results - Semivolatile Organic Compounds in Soil - Enseco-RMAL Laboratory[a]

	Second Quarter CY91		
Analyte	Percent Recovery Sample 1	Percent Recovery Sample 2	Relative Percent Difference
Phenol	67	67	0
2-Chlorophenol	75	79	6
1,4-Dichlorobenzene	65	66	2
Benzyl Alchohol	65	69	6
1,2-Dichlorobenzene	68	68	0
2-Methylphenol	53	53	0
Hexachloroethane	59	59	0
1,2,4-Trichlorobenzene	74	74	0
Naphthalene	72	77	6
2-Methylnaphthalene	68	75	9
2,4,6-Trichlorophenol	68	71	4
Acenaphthene	87	93	7
Dibenzofuran	71	78	9
2,4-Dinitrotoluene	63	69	9
Pentachlorophenol	52	56	8
Di-n-butyl Phthalate	65	67	4
bis(2-Ethylhexyl)Phthalate	76	82	7

[a]All units in micrograms per liter ($\mu g/L$)

Table E-5. Summary of Blind Spike Analysis Results - Semivolatile Organic Compounds in Soil - Enseco-RMAL Laboratory[a] (Continued)

Analyte	Third Quarter CY91		
	Percent Recovery Sample 1	Percent Recovery Sample 2	Relative Percent Difference
Phenol	NC	34	NC
Bis(2-Chloroethyl) Ether	NC	NC	NC
1,4-Dichlorobenzene	NC	35	NC
2-Methylphenol	NC	38	NC
4-Methylphenol	NC	NC	NC
Hexacloroethane	NC	25	NC
4-Chlorophenyl Phenyl Ether	FP	FP	NC
1,2,4-Trichlorobenzene	NC	42	NC
Phenanthrene	NC	46	NC
2,4,5-Trichlorophenol	NC	NC	NC
2,4,6-Trichlorophenol	NC	39	NC
Dibenzofuran	NC	48	NC
Pentachlorophenol	NC	NC	NC
Bis(2-Ethylhexyl)Phthalate	NC	44	NC

[a]All units in micrograms per kilogram (μg/kg).
NC = Not calculated.
FP = Suspected false positive.

Table E-5. Summary of Blind Spike Analysis Results - Semivolatile Organic Compounds in Soil - Enseco-RMAL Laboratory[a] (Concluded)

	Fourth Quarter CY91		
Analyte	Percent Recovery	Percent Recovery	Relative Percent Difference
Acenaphthene	54	61	12
Acenaphthylene	45	48	6
Anthracene	34	37	7
Benzo(a)Anthracene	NC	NC	NC
Benzo(b)Fluoranthene	NC	NC	NC
2-Chloronaphthalene	50	61	20
Dibenzofuran	56	68	19
1,2-Dichlorobenzene	48	56	16
1,3-Dichlorobenzene	39	46	17
2,4-Dinitrotoluene	57	67	15
Bis(2-Ethylhexyl)Phthalate	61	82	30
Fluoranthene	44	50	12
Hexacloroethane	39	48	21
Naphthalene	50	69	32
Pyrene	48	NC	NC
1,2,4-Trichlorobenzene	48	60	21
4-Chloro-3-Methylphenol	64	64	0
2-Chlorophenol	51	60	16
2,4-Dimethylphenol	NC	NC	NC
2-Methylphenol	48	44	10
Pentachlorophenol	NC	53	NC
Phenol	58	63	8
2,4,6-Trichlorophenol	57	60	5

[a]All units in micrograms per kilogram (μg/kg).
NC = Not calculated.

Table E-6. Summary of Analytical Results for Check Samples Submitted to Encotec During 1991

	First Quarter	
Parameter	Percent Recovery	Relative Percent Difference
Alkalinity	103/103	0
Arsenic	84/137	48
Barium	99/99	0
Boron	76/70	7
Cadmium	97/88	10
Chloride	102/101	1
Chromium	99/113	13
COD	--	--
Copper	113/104	8
Cyanide	99/93	7
Fluoride	99/105	6
Iron	116/107	8
Lead	94/100	6
Manganese	102/102	0
Mercury	93/NR	NC
Nickel	103/97	6
NO_3/NO_2 as N	--	--
Oil and Grease	--	--
Phenol	88/88	0
Selenium	107/93	14
Silver	98/87	12
Sulfate	942/101	161
TDS	98/103	6
Thallium	84/84	0
TOC	--	--
Zinc	103/98	4

NR = Not reported.
NC = Not calculable.

Table E-7. Summary of Blind Spike Analysis Results - Volatile Organic Compounds in Water - Encotec Laboratory[a]

	Fourth Quarter CY91		
Analyte	Percent Recovery	Percent Recovery	Relative Percent Difference
Benzene	82	82	0
Bromodichloromethane	82	82	0
Bromoform	59	61	4
Carbon Tetrachloride	75	77	2
Chlorobenzene	84	87	4
Chloroform	98	100	2
Dibromochloromethane	80	80	0
1,2-Dichloroethane	88	88	0
Ethyl-Benzene	96	96	0
Methylene Chloride	93	94	2
1,1,2,2-Tetrachloroethane	56	60	8
Tetrachloroethene	80	82	3
1,1,1-Trichloroethylene	81	81	0
Trichloroethylene	83	83	0
Toluene	85	88	3
Vinyl Acetate	43	52	18
Xylenes, total	77	82	6

[a]All units in micrograms per liter (μg/L).

REFERENCES

Sandia National Laboratories (SNL), 1988. "Sandia National Laboratories Laboratory Data Quality Evaluation Plan for the Wastewater Monitoring Program," SNL, Albuquerque, NM.

APPENDIX F
ENVIRONMENTAL MONITORING DATA

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Table F-1. 1991 Vegetation Sample Analysis

Location	Location Type	^3H (pCi/ml)	^3H SDEV[a]	H_2O (%)	^{40}K (pCi/g)	^{40}K SDEV[a]
1	S[b]	0.12	0.12	76.8	36	4
2 NW	S	1.8	0.2	33.1	8.8	2.1
2 SE	S	1.7	0.4	33.5	10	2
2 NE	S	4.4	0.2	49.2	8.4	2.9
2 SW	S	0.30	0.17	49.6	8.9	2.4
3	S	0.04	0.14	53.8	8.5	2.1
4	P[c]	0.10	0.15	38.5	8.1	2.3
5	P	0.10	0.15	27.1	12	1
6	S	0.04	0.16	50.4	7.4	2.2
7 A	S	0.10	0.12	68.8	5.6	2.0
7 B	S	0.01	0.12	39.4	6.1	2.1
7 C	S	0.09	0.12	42.2	6.4	2.1
8	C[d]	0.15	0.12	64.3	6.2	2.1
9	C	0.04	0.12	59.0	16	3
10	C	0.11	0.12	64.1	6.8	2.0
11	C	0.06	0.12	71.2	9.0	2.1
12	P	0.06	0.14	42.4	7.8	2.4
16 A	P	0.15	0.15	36.2	9.2	2.2
16 B	P	0.17	0.15	15.8	9.6	2.9
16 C	P	-0.01	0.14	31.8	7.3	2.4
19	P	0.10	0.15	38.5	8.1	2.3

[a]Variability of the radioactive disintegration process (counting error) at the 95 percent confidence level, 1.96 sigma.
[b]Sandia.
[c]Perimeter.
[d]Community.

Table F-1. 1991 Vegetation Sample Analysis (Continued)

Location	Location Type	^3H (pCi/ml)	^3H SDEV[a]	H_2O (%)	^{40}K (pCi/g)	^{40}K SDEV[a]
20	S	0.02	0.12	35.2	6.4	2.0
25	C	-0.01	0.12	78.0	19	3
33	S	0.86	0.16	82.3	11	3
34	S	-0.07	0.14	43.2	6.1	3.2
35	S	0.3	0.16	59.4	40	4
41	S	0.08	0.16	42.1	5.4	2.1
42	S	-0.02	0.16	49.6	46	5
43	S	-0.03	0.16	49.8	5.9	2.0
45	S	0.01	0.16	45.8	7.3	2.0
46	S	0.02	0.12	53.4	8.0	2.4
49	S	0.16	0.12	40.9	5.0	2.0
51	S	--[e]	--	--	10	2
52	S	0.21	0.13	29.7	4.3	1.7
53	S	0.14	0.16	49.1	6.6	2.1
54	S	0.14	0.16	45.0	7.5	2.1
55	S	0.55	0.16	64.8	8.8	2.2
56	S	0.15	0.16	43.3	4.7	2.0
57	S	0.25	0.13	78.3	86	7
58	P	0.00	0.14	27.4	12	2
59	P	0.12	0.15	33.0	6.7	2.9

[a]Variability of the radioactive disintegration process (counting error) at the 95 percent confidence level, 1.96 sigma.
[b]Sandia.
[c]Perimeter.
[d]Community.
[e]Sample lost in analysis.

Table F-1. 1991 Vegetation Sample Analysis (Concluded)

Location	Location Type	^3H (pCi/ml)	^3H SDEV[a]	H_2O (%)	^{40}K (pCi/g)	^{40}K SDEV[a]
60 A	P	0.11	0.15	32.9	12	2
60 B	P	0.02	0.14	38.7	18	3
60 C	P	0.16	0.15	26.5	7.7	2.8
61	P	0.04	0.14	61.1	6.2	2.3
62	C	0.04	0.12	73.8	19	3
63	P	0.05	0.14	37.8	12	2
64	P	0.06	0.14	44.9	5.4	2.1
65	C	0.15	0.12	41.0	6.9	2.1
66	S	0.15	0.15	29.3	10	2

[a]Variability of the radioactive disintegration process (counting error) at the 95 percent confidence level, 1.96 sigma.
[b]Sandia.
[c]Perimeter.
[d]Community.

Table F-2. 1991 Soil Sample Analysis

Location	Location Type	U_{tot} (µg/g)	^3H (pCi/ml)	^3H SDEV[a]	H_2O (%)	^{137}Cs (pCi/g)	^{137}Cs SDEV[a]	^{40}K (pCi/g)	^{40}K SDEV[a]
1	S[b]	0.7	-0.05	0.15	2.5	<0.04	NC[c]	22	1
2 NW	S	0.6	6.5	0.3	1.2	0.28	0.05	18	1
2 SE	S	0.6	1.9	0.2	1.5	0.32	0.06	18	1
2 NE	S	1	26	1	1.4	0.19	0.07	18	1
2 SW	S	0.8	0.47	0.32	1.4	0.60	0.08	18	1
3	S	0.1	0.11	0.15	11.8	0.44	0.07	20	1
4	P[d]	0.5	0.27	0.15	1.6	0.46	0.06	20	1
5	P	0.5	-0.01	0.14	2.3	0.49	0.06	18	1
6	S	0.8	0.19	0.16	3.5	0.29	0.06	20	1
7 A	S	1.7	0.20	0.16	8.1	0.48	0.08	20	1
7 B	S	0.5	0.26	0.16	9.8	0.86	0.08	21	1
7 C	S	0.2	0.11	0.16	6.5	0.53	0.08	20	1
8	C[e]	1.3	-0.07	0.15	16.5	0.30	0.06	20	1
9	C	0.1	-0.02	0.15	15.6	0.19	0.05	13	1
10	C	1.4	-0.07	0.15	13.2	0.48	0.06	14	1
11	C	0.8	-0.06	0.15	10.1	0.11	0.04	19	1
12	P	0.9	0.03	0.14	2.5	1.8	0.1	16	1
16 A	P	51	0.10	0.15	1.9	0.19	0.05	31	1
16 B	P	0.5	0.16	0.15	1.5	0.19	0.06	30	1
16 C	P	0.4	0.20	0.15	1.6	0.11	0.04	28	2
19	P	0.5	0.14	0.15	2.3	1.1	0.1	22	1
20	S	0.7	0.01	0.15	4.9	0.54	0.08	19	1
25	C	0.2	-0.01	0.16	8.1	0.08	0.04	20	1
32S	S	0.5	55	1	5.8	0.21	0.05	24	1
32E	S	0.6	-0.12	0.15	8.2	0.16	0.05	22	1
33	S	1.2	-0.01	0.14	17.9	<0.05	--	21	1
34	S	1.0	0.12	0.15	4.3	0.89	0.07	16	1
35	S	1.2	0.86	0.18	1.9	0.20	0.07	20	1

[a]Variability of the radioactive disintegration process (counting error) at the 95 percent confidence level, 1.96 sigma.
[b]Sandia.
[c]Not calculable.
[d]Perimeter.
[e]Community.

Table F-2. 1991 Soil Sample Analysis (Concluded)

Location	Location Type	U_{tot} (μg/g)	^3H (pCi/ml)	^3H SDEV[a]	H_2O (%)	^{137}Cs (pCi/g)	^{137}Cs SDEV[a]	^{40}K (pCi/g)	^{40}K SDEV[a]
41	S	0.4	0.06	0.16	1.4	0.19	0.05	17	1
42	S	0.3	0.05	0.16	1.4	0.10	0.05	19	1
43	S	0.3	-0.13	0.15	0.95	0.09	0.05	19	1
45	S	0.8	0.12	0.16	1.5	0.25	0.07	18	1
46	S	0.2	0.02	0.15	7.2	0.30	0.07	20	1
49	S	0.3	1.9	0.2	6.9	0.26	0.06	24	1
51	S	0.8	-0.05	0.15	5.7	<0.04	--	18	1
52	S	0.5	-0.10	0.15	8.2	0.25	0.07	19	1
53	S	2.0	0.37	0.16	2.7	0.10	0.04	17	1
54	S	0.8	0.06	0.16	1.9	0.28	0.05	19	1
55	S	0.7	0.04	0.15	10.3	0.63	0.07	21	1
56	S	0.8	0.13	0.16	1.9	<0.05	--	19	1
57	S	0.6	0.16	0.16	5.5	<0.05	--	21	1
58	P	0.4	0.05	0.15	1.5	0.24	0.06	25	1
59	P	0.2	0.14	0.15	1.4	<0.23	0.06	20	1
60 A	P	0.6	0.02	0.14	1.5	<0.04	--	20	1
60 B	P	0.4	0.00	0.14	1.8	0.23	0.05	19	1
60 C	P	0.2	0.17	0.15	1.6	<0.04	--	20	1
61	P	0.2	0.14	0.15	1.8	<0.04	--	13	1
62	C	2.4	-0.10	0.15	20.1	1.1	0.1	16	1
63	P	1.0	0.04	0.15	3.6	0.92	0.08	14	1
64	P	0.5	0.11	0.15	2.2	1.0	0.1	33	2
65	S	0.7	0.00	0.15	5.0	1.0	0.1	20	1
66	S	0.4	0.16	0.15	2.8	0.80	0.08	19	1

[a]Variability of the radioactive disintegration process (counting error) at the 95 percent confidence level, 1.96 sigma.
[b]Sandia.
[c]Not calculated.
[d]Perimeter.
[e]Community.

Table F-3. 1991 Water Sample Analysis: Surface Water

Location	Location Type	Gross Alpha (pCi/l)	Gross Alpha SDEV[a]	Gross Beta (pCi/l)	Gross Beta SDEV[a]	Gross Gamma (pCi/l)	U_{tot} (mg/l)	^{3}H (pCi/ml)	^{3}H SDEV[a]
<u>Number 8</u>									
Filter[b]	C	4	2	6	1				
Solution		2	3	4	2	--[c]	0.009	-0.04	0.15
Total		190	90	240	60	--	0.013	0.06	0.15
<u>Number 11</u>									
Filter[b]	C	5	1	5	1				
Solution		0	3	6	2	--	<0.001	0.04	0.15
Total		35	27	100	20	d	<0.001	-0.06	0.15
<u>Number 33-1</u>									
Filter[b]	S	0	1	0	1				
Solution		8	23	26	16	--	0.002	-0.06	0.14
Total		-8	19	28	16	--	0.003	-0.04	0.15
<u>Number 33-2</u>									
Filter[b]	S	0	1	0	1				
Solution		8	23	30	16	--	0.003	-0.09	0.14
Total		4	12	29	19	--	0.004	-0.12	0.14
<u>Number 33-3</u>									
Filter[b]	S	0	1	0	1				
Solution		9	20	28	18	c	0.003	-0.10	0.14
Total		17	17	-2	18	--	0.003	0.03	0.15

[a]Variability of the radioactive disintegration process (counting error) at the 95 percent confidence level, 1.96 sigma.
[b]Values for all filter samples are pCi/filter.
[c]No gamma emitting radionuclides detected above instrument background.
[d]^{40}K detected above instrument background, 100 ± 80 pCi/l.
[e]^{40}K detected above instrument background, 91 ± 88 pCi/l.

Table F-4. 1991 Water Sample Analysis: Well Water

Location	Location Type	Gross Alpha (pCi/l)	Gross Alpha SDEV[a]	Gross Beta (pCi/l)	Gross Beta SDEV[a]	Gross Gamma (pCi/l)	U_{tot} (mg/l)	^3H (pCi/ml)	^3H SDEV[a]
Number 15									
Filter[b]	S	0	1	0	1				
Solution		1	2	2	2	c	<0.001	0.06	0.15
Total		1	2	1	2	--	<0.001	-0.08	0.14
Number 36									
Filter[b]	S	0	1	0	1				
Solution		1	3	0	2	--	<0.001	-0.06	0.14
Total		2	3	1	2	--	<0.001	0.01	0.15
Number 37									
Filter[b]	S	0	1	0	1				
Solution		0	2	1	2	d	<0.001	0.08	0.15
Total		1	2	-1	2	--	<0.001	0.09	0.15
Number 38									
Filter[b]	S	0	1	0	1				
Solution		3	3	5	2	--	<0.001	-0.05	0.15
Total		2	3	4	3	--	<0.001	-0.13	0.14
Number 44									
Filter[b]	S	0	1	0	1				
Solution		0	2	2	2	--	<0.001	0.02	0.15
Total		-1	2	2	2	--	0.003	-0.09	0.14
Number 50									
Filter[b]	S	0	1	0	1				
Solution		1	3	-1	2	--	0.003	-0.02	0.15
Total		1	3	2	3	--	<0.001	-0.07	0.14
Number 67									
Filter[b]	S	0	1	0	1				
Solution		0	2	3	2	--	<0.001	-0.02	0.15
Total		1	2	3	2	--	<0.001	-0.01	0.15
Blank 1[e]	99	0	1	-1	2	--	0.004	-0.08	0.15
Blank 2[e]	99	0	1	0	2	--	0.002	-0.05	0.16

[a]Variability of the radioactive disintegration process (counting error) at the 95 percent confidence level, 1.96 sigma.
[b]Values for all filter samples (F) are pCi/filter.
[c]No gamma emitting radionuclides detected above instrument background.
[d]Thallium-208 (^{208}Tl) and lead-212 (^{212}Pb) detected above instrument background, ^{208}Tl 27 ± 18 pCi/l and ^{212}Pb 20 ± 18 pCi/l.
[e]Laboratory blanks.

Table F-5. 1991 Thermoluminescent Dosimeter (TLD) Summary Radiation Exposure Data

Report No.	1st Quarter Field Days	1st Quarter Exposure (mR)	2nd Quarter Field Days	2nd Quarter Exposure (mR)	3rd Quarter Field Days	3rd Quarter Exposure (mR)	4th Quarter Field Days	4th Quarter Exposure (mR)	Annual Exposure mR/yr	Annual Exposure (error)[a]
Location Type: Community										
10	91	22.4	97	24.3	84	23.8	91	18.6	89	11
11	91	23.9	97	20.3	84	18.0	91	17.6	80	7
21	91	26.3	97	24.3	84	19.9	91	19.4	90	10
22	91	24.6	97	20.0	84	17.9	91	17.2	80	11
23	91	24.0	97	21.1	84	19.0	91	18.4	82	8
24	91	25.5	97	22.1	84	21.3	91	19.7	89	10
25	91	28.6	97	27.6	84	26.4	91	17.1	100	11
26	91	29.2	97	28.7	84	25.2	91	25.4	108	14
27	91	27.5	97	22.9	84	21.9	91	20.7	93	8
28	91	27.1	97	24.2	84	21.8	91	20.6	94	11
29	91	21.0	97	22.8	84	20.1	91	19.3	83	11
30	91	27.9	97	24.0	84	22.8	91	24.8	100	11
Location Type: Perimeter										
4	89	24.9	99	24.5	84	21.7	91	17.9	89	9
5	89	23.0	99	20.4	84	18.7	91	16.9	79	8
16	89	31.2	99	28.7	84	25.5	91	25.0	110	10
18	89	22.4	99	23.0	84	19.7	91	20.4	86	13
19	89	27.0	99	23.3	84	22.0	91	19.8	92	13
39	89	23.0	99	22.0	84	18.8	91	17.3	81	9
40	89	23.0	99	23.2	84	20.1	91	18.6	89	10
Location Type: SNL										
1	89	28.3	99	25.2	84	21.3	91	22.3	97	10
2	89	26.5	99	21.8	84	20.9	91	18.9	88	13
3	89	26.8	99	24.2	84	21.4	91	18.7	91	9
6	89	25.8	99	22.0	84	20.0	91	20.0	88	12
7	89	26.6	99	25.0	84	21.1	91	21.1	94	10
20	89	28.0	99	24.6	84	22.4	91	20.6	96	8
31	89	29.3	99	23.1	84	21.9	91	21.1	95	10
41	89	24.2	99	23.8	84	20.4	91	17.7	86	8
42	89	24.7	99	23.4	84	19.3	91	18.5	86	9
43	89	25.4	99	22.7	84	20.1	91	18.8	87	11
45 A	89	24.2	99	23.8	84	19.6	91	18.8	86	8
45 B	89	26.3	99	23.8	84	20.7	91	19.8	91	7
46	89	27.9	99	29.3	84	24.1	91	21.4	103	12
47	89	29.0	99	27.7	84	23.1	91	24.6	104	13
48	89	28.3	99	25.2	84	21.7	91	20.4	96	9

[a]Estimate of error at the 95-percent confidence level, includes uncertainty of calibration.

Table F-6. CY 1991 Environmental Incident Summary

EIF #	Incident Date	Quantity	Material	RQ#	Corrective Action Status
91-001	01/03/91	500 gal	NALCO 8330 M/Water @300 ppm nitrate	No	Open
91-002	01/02/91	1 pint	Sulfuric Acid, dry crystal from lead acid battery	No	Open
91-003	01/24/91	<1 gal	Transformer Oil w/2.4 ppm PCB	No	Closed
91-004	01/24/91	<5 gal	50% Ethylene Glycol/50% Water	No	Closed
91-005	01/15/91	20 gal	NALCO 2827/Water	NA	Open
91-006	02/10/91	Link	Sanitary Wastewater	No	Closed
91-007	02/22/91	0.5 gal	<40% Hydrochloric Acid	No	Open
91-008	02/08/91	40 gal	38% Hydrochloric Acid	NA	Open
91-009	03/08/91	<2 gal	Dextron Brand, Automatic Transmission Fluid	No	Closed
91-010	03/28/91	<8 gal	Sulfuric Acid	NA	Open
91-011	03/27/91	2 gal	Dextron Brand, Heavy EQ Hydraulic Oil	No	Closed
91-012	03/29/91	2 gal	Dextron Brand EQ Hydraulic Oil	No	Closed
91-013	04/08/91	1 qt	Mobil Brand, DTE 24 Hydraulic Oil	No	Closed
91-014	04/11/91	100 ml	Acid PH 3.5, Copper Plating Bath	No	Closed
91-015	04/11/91	<5 gal	Transformer Oil	No	Closed
91-016	04/24/91	<5 gal	Diesel Fuel Grade #2	No	Closed
91-017	06/11/91	40 cu ft	Water potentially contaminated w/Radionuclide	NA	Open
91-018	04/18/91	<5 gal	Chevron Brand, AW 32 Hydraulic Oil	No	Closed
91-019	05/07/91	0.25 oz	Elemental Mercury	NA	Open
91-020	05/14/91	<25 gal	20/20 Coolant/Water Mixture	No	Closed
91-021	05/15/91	20-30 gal	Unknown	No	Closed
91-022	07/10/91	<4 gal	Hydraulic Oil (No PCB)	NA	Open
91-023	07/12/91	2 gal	Hydraulic Oil (No PCB)	NA	Open
91-024	UNK	UNK	UNK; No Release	NA	Open
91-025	07/03/91	<4 gal	49% Sodium Hydroxide	NA	Open
91-026	07/23/91	1 gal	Diesel Fuel	No	Closed
91-027	08/30/91	50 gal	Ethylene Glycol	NA	Open
91-028	09/12/91	2 gal	Gasoline	NA	Closed
91-029	10/16/91	2400 gal	Water w/<150 ppm NALCO 2827	No	Closed
91-030	10/18/91	<5 gal	Vehicle Transmission Fluid	NA	Closed
91-031	11/16/91	12 tons	Liquid CO_2	NA	Open
91-032	12/16/91	0.5 gal	Kerosene	NA	Open
91-033	11/26/91	2.25 gal total	Fuel Oil, Hydraulic Oil, Motor Oil, Ethylene Glycol	NA	Closed
91-034	10/16/91	2500 gal	Water w/<150 ppm NALCO 2827	No	Closed

NA = Not available.

Table F-7. Modeling Results and Chemical Air Emission Standards

CAS No.	Chemical Name	Daily Max. Impact 8-Hr. Avg. ($\mu g/m^3$)	OEL/100[a] (mg/m^3)	Max. Impact Referred to Air. Std. Avg. Time ($\mu g/m^3$)	NMAQCR 201 Equiv. Air Std. at 5560 ft ($\mu g/m^3$)	Comments	Other Applicable Reg./Std.
67641	acetone	14.825	17.800	19.124	94.489	NMHC	----[b]
107131	acrylonitrile	0.626	0.045	0.808	94.489	NMHC	----
7440382	arsenic/arsenic compounds	----	0.002	----	8.152	30-day avg.	40 CFR 61
----		2.706	----	1.542	122.276	particle	----
1332214	asbestos	0.334	.1 f/cc	----	0.008	30-day avg.	40 CFR 61
71432	benzene	0.671	0.320	0.866	92.342	NMHC	----
7440417	beryllium	0.512	0.00002	0.292	8.152 g	per 24 hr.	40 CFR 61
----		----	----	----	0.08 μg	30-day avg.	----
106990	1,3-butadiene	0.326	22.0	0.421	93.416	NMHC	----
7440439	cadmium compounds	2.818	0.0005	1.606	122.276	particle	----
----		----	----	----	8.152	30-day avg.	----
56235	carbon tetrachloride	2.749	0.30	3.546	103.080	NMHC	----
108907	chlorinated benzenes	0.616	3.50	0.795	92.342	NMHC	----
7782505	chlorine	2.876	0.03	----	none	gas	----
67663	chloroform	1.137	0.50	1.467	103.080	NMHC	----
126998	chloroprene	0.028	0.35	0.036	93.416	NMHC	----
7440473	chromium/chromium compounds	----	0.05	----	8.152	30-day avg.	----
----		0.279	----	1.590	122.276	particle	----
8007452	coke oven emissions						
	(benzene)	----	0.001	----	92.342	NMHC	----
7440408	copper/copper compounds	2.881	----	1.642	122.276	particle	----
----	fume	----	0.002	----	8.152	30-day avg.	----
----	dust	----	0.01	----	8.152	30-day avg.	----
106898	epichlorhydrin	0.520	0.10	0.671	94.489	NMHC	----
107062	ethylene dichloride	0.595	0.40	0.768	96.637	NMHC	----
107211	ethylene glycol	3.048	1.25	3.932	96.637	NMHC	----
75218	ethylene oxide	0.028	0.02	0.036	96.637	NMHC	----
0	freon-113 (CFCS)	18.665	0.45	24.078	96.637	NMHC	----
77474	hexachlorocyclopentadiene	0.028	0.001	0.036	92.773	NMHC	----
7647010	hydrochloric acid gas	----	0.07	----	none	gas	----
----	hydrochloric acid gas	3.194	----	1.821	122.276	aerosol	----

[a]This value is in milligrams per cubic meter.
[b]Data not available or not applicable.

Table F-7. Modeling Results and Chemical Air Emission Standards (Concluded)

CAS No.	Chemical Name	Daily Max. Impact 8-Hr. Avg. ($\mu g/m^3$)	OEL/100[a] (mg/m^3)	Max. Impact Referred to Air. Std. Avg. Time ($\mu g/m^3$)	NMAQCR 201 Equiv. Air Std. at 5560 ft ($\mu g/m^3$)	Comments	Other Applicable Reg./Std.
7664393	hydrogen fluoride	3.317	0.025	1.891	122.276	aerosol	----[b]
67630	isopropyl alcohol	8.489	9.8	10.950	94.489	NMHC	----
7439965	manganese/manganese comp.	2.943	----	1.678	122.276	particle	----
----	fume	----	0.01	----	8.152	30-day avg.	----
----	dust	----	0.05	----	8.152	30-day avg.	----
7439976	mercury/mercury compounds	2.739	0.0005	1.561	122.276	particle	----
----		----	----	----	8.152	30-day avg.	----
67561	methyl alcohol (methanol)	9.615	2.60	12.403	103.080	NMHC	----
71556	methyl chloroform (1,1,1-trichloroethane)	39.250	19.0	50.633	96.637	NMHC	----
75092	methylene chloride	4.505	3.5	5.811	103.080	NMHC	----
7440020	nickel/nickel compounds	----	0.001	----	8.152	30-day avg.	----
----		2.943	----	1.679	122.276	particle	----
7697372	nitric acid	2.977	0.05	1.708	122.276	aerosol	----
127184	perchloroethylene	0.595	3.35	0.768	103.080	NMHC	----
108952	phenol	0.571	0.19	0.737	92.342	NMHC	----
7664382	phosphorus acid	2.778	0.01	1.583	122.276	aerosol	----
----	polycyclic organic matter	0.626	none	----	depends on MW & state		----
7664939	sulfuric acid	2.947	0.01	1.680	122.276	aerosol	----
7550450	titanium tetrachloride	0.355	0	0.202	122.276	fume	----
----		----	----	----	8.152	30-day avg.	----
108883	toluene	46.940	3.75	60.553	92.035	NMHC	----
79016	trichloroethylene (TCE)	5.076	2.70	6.548	96.637	NMHC	----
75014	vinyl chloride	2.711	0.12	3.497	96.637	NMHC	----
75354	vinylidene chloride	0.028	0.20	0.036	96.637	NMHC	----
1330207	xylene	51.459	4.35	66.382	91.810	NMHC	----
7440666	zinc/zinc oxide	2.943	0.05	1.678	122.276	particle	----
----		----	----	----	8.152	30-day avg.	----

[a]This value is in milligrams per cubic meter.
[b]Data not available or not applicable.

The following explanations are related to information presented in Table F-7.

Column 1: Chemical Identification (CAS number)

Column 2: Name of chemical inventoried

Column 3: Maximum 8-hr average impact data obtained from the modeling runs

Column 4: 1 percent of the occupational exposure limit (OEL) value.

Column 5: Maximum impact data referenced to the federal air quality standards averaging time

Column 6: New Mexico Ambient Air Quality Standards referenced to an altitude of 5500 ft

Column 7: Comments

Column 8: Other applicable regulations and standards

<u>Notes to Table F-7</u>

- The chemical name and CAS number are listed as they are found in the inventory database.

- One percent of the OEL value has been adopted by several states as a guide to acceptable continuous exposure to the listed chemical when in the ambient air by humans without their suffering any adverse effects.

- The New Mexico Ambient Air Quality Standard (NMAAQS) has been referenced to 5560 ft so that they may be more easily compared to the modeling output data.

- The 8-hr average impact data is output information obtained from the modeling process. For this data to be compared with the NMAAQS, its value must be adjusted to reflect the difference in averaging times of the New Mexico standards. If the standard is based on a 24-hr average, the 8-hr data is multiplied by 0.57. If the standard is based on a 3-hr average, the 8-hr data is multiplied by 1.29. The results of this procedure are listed in Table 8-1 as the "maximum impact data referenced to the air quality standards averaging time."

- The multipliers (0.57 and 1.29) used to convert 8-hr data to 24- or 3-hr data were obtained by extrapolation from an averaging-time ratio table found in Section 4.2, "Estimating Maximum Short-Term Concentrations," of the EPA document EPA-450/4-88-010, "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources."

- The 8-hr average impact data may also be compared with the 1 percent OEL limit values. However, it is important to remember that the mass of the 8-hr impact data is measured in micrograms (μg), whereas the OEL mass values are measured in milligrams (mg). Therefore, the OEL values must be multiplied by 1000 to make a direct comparison.

- The "Other Applicable Reg./Std." column lists the reference for those chemicals that have been designated by the EPA as hazardous air pollutants.

- NMHC (nonmethane hydrocarbons) standards vary inversely with the number of carbon atoms in the molecule. The value listed is the New Mexico (state) standard converted to an ambient condition of 20°C/24.39 in. Hg for a 3-hr averaging period.

- New Mexico ambient air quality standards are least as stringent as EPA standards. Albuquerque/Bernalillo air quality standards are guideline values and thus are not enforceable. The local agency enforces the state standards.

- Unless noted, all standards except NMHC are for a 24-hr averaging period at an ambient condition of 20°C/24.39 in. Hg.

Table F-8. KAFB and SNL, Albuquerque, Monitor Well Location Data

Well Identification	Surveyed Elevation, ft (above mean sea level)	State Planar X-Coordinates (ft x 1000)	State Planar Y-Coordinates (ft x 1000)
CWL-BW1	5435.28	414.93	1444.64
CWL-BW2	5433.54	414.83	1444.71
CWL-BW3	5430.23	414.69	1444.69
CWL-MW1A	5421.49	414.30	1445.11
CWL-MW2	5418.55	414.13	1444.97
CWL-MW2A	5418.58	414.17	1444.98
CWL-MW3	5418.83	414.14	1444.82
CWL-MW3A	5417.78	414.14	1444.77
CWL-MW4	5420.33	414.20	1445.11
MWL-MW1	5381.54	411.66	1452.66
MWL-MW2	5377.26	411.45	1452.69
MWL-MW3	5381.32	411.41	1452.48
MWL-BW1	5384.51	411.76	1451.70
NW-TA3	5333.81	407.30	1455.31
SW-TA3	5320.57	407.37	1444.91
KAFB-09	5498.52	421.09	1457.41
KAFB-10	5415.98	413.85	1455.09
LF/DM-01	5333.22	399.89	1470.77
LF/DM-02	5294.59	409.39	1465.45
MVMW-J	5115.37	391.92	1461.77
MVMW-K	5183.38	399.45	1464.32
Greystone	5840.00[a]	430.24	1455.45
Coyote Springs	5865.00[a]	434.19	1457.43
TSA-1	6083.00[a]	443.83	1458.29
Schoolhouse	5802.00[a]	431.86	1453.79
EOD Hill	5806.00[a]	426.68	1450.63
Lake Christian	5700.00[a]	427.71	1445.18
Golf - E	5361.95	416.79	1464.35
Golf - S	5361.49	416.73	1464.08
Golf - W	5355.60	416.33	1464.03
Golf - N	5357.23	416.46	1464.42
Lagoons - NE	5361.21	406.86	1470.18
Lagoons - NW	5357.72	406.30	1470.19
Lagoons - SE	5358.04	406.93	1468.87
Lagoons - SW	5354.23	406.22	1468.99
Tijeras - East	5387.13	417.07	1471.44
Tijeras - West	5227.30	397.81	1467.75
KAFB-05	NR	413.30[a]	1480.00[a]
Eubank	NR	415.62	1474.67

[a]Elevation/location estimated, using USGS topographic map.
NR = Not reported.

Table F-9. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, January 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
15 Jan 91	CWL-BW1	5435.28	477.34	4957.94
15 Jan 91	CWL-BW2	5433.54	495.07	4938.47
15 Jan 91	CWL-BW3	5430.23	489.56	4940.67
15 Jan 91	CWL-MW1A	5421.49	483.53	4937.96
15 Jan 91	CWL-MW2	5418.55	483.19	4935.36
NM	CWL-MW2A	5418.58	NM	NC
15 Jan 91	CWL-MW3	5418.83	483.06	4935.77
15 Jan 91	CWL-MW3A	5417.78	479.02	4938.76
15 Jan 91	CWL-MW4	5420.33	483.58	4936.75
15 Jan 91	MWL-MW1	5381.54	458.33	4923.21
15 Jan 91	MWL-MW2	5377.26	454.18	4923.08
15 Jan 91	MWL-MW3	5381.32	459.79	4921.53
15 Jan 91	MWL-BW1	5384.51	461.35	4923.16
15 Jan 91	NW-TA3	5333.81	440.49	4893.32
15 Jan 91	SW-TA3	5320.57	417.55	4903.02
16 Jan 91	KAFB-09	5498.52	543.81	4954.71
16 Jan 91	KAFB-10	5415.98	492.54	4923.44
16 Jan 91	LF/DM-01	5333.22	439.13	4894.09
14 Jan 91	LF/DM-02	5294.59	396.43	4898.16
16 Jan 91	MVMW-J	5115.37	209.05	4906.32
16 Jan 91	MVMW-K	5183.38	283.33	4900.05
14 Jan 91	Greystone	5840.00[a]	53.92	5786.08
14 Jan 91	Coyote Springs	5865.00[a]	5.56	5859.44
14 Jan 91	TSA-1	6083.00[a]	158.52	5924.48
14 Jan 91	Schoolhouse	5802.00[a]	95.78	5706.22
14 Jan 91	EOD Hill	5806.00[a]	142.26	5663.74
14 Jan 91	Lake Christian	5700.00[a]	53.38	5646.62
14 Jan 91	Golf - E	5361.95	320.20	5041.75
14 Jan 91	Golf - S	5361.49	321.87	5039.62
14 Jan 91	Golf - W	5355.60	308.05	5047.55
14 Jan 91	Golf - N	5357.23	313.58	5043.65
16 Jan 91	Lagoons - NE	5361.21	485.25	4875.96
16 Jan 91	Lagoons - NW	5357.72	481.48	4876.24
16 Jan 91	Lagoons - SE	5358.04	481.05	4876.99
16 Jan 91	Lagoons - SW	5354.23	476.49	4877.74
14 Jan 91	Tijeras - East	5387.13	475.50	4911.63
16 Jan 91	Tijeras - West	5227.30	342.31	4884.99

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

Table F-10. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, February 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
15 Feb 91	CWL-BW1	5435.28	477.53	4957.75
15 Feb 91	CWL-BW2	5433.54	495.28	4938.26
15 Feb 91	CWL-BW3	5430.23	489.80	4940.43
15 Feb 91	CWL-MW1A	5421.49	483.77	4937.72
15 Feb 91	CWL-MW2	5418.55	483.44	4935.11
15 Feb 91	CWL-MW2A	5418.58	480.30	4938.28
15 Feb 91	CWL-MW3	5418.83	483.31	4935.52
15 Feb 91	CWL-MW3A	5417.78	479.23	4938.55
15 Feb 91	CWL-MW4	5420.33	483.80	4936.53
15 Feb 91	MWL-MW1	5381.54	458.62	4922.92
15 Feb 91	MWL-MW2	5377.26	454.42	4922.84
15 Feb 91	MWL-MW3	5381.32	460.01	4921.31
15 Feb 91	MWL-BW1	5384.51	461.67	4922.84
15 Feb 91	NW-TA3	5333.81	440.79	4893.02
15 Feb 91	SW-TA3	5320.57	417.65	4902.92
14 Feb 91	KAFB-09	5498.52	543.75	4954.77
15 Feb 91	KAFB-10	5415.98	492.71	4923.27
14 Feb 91	LF/DM-01	5333.22	439.08	4894.14
15 Feb 91	LF/DM-02	5294.59	396.41	4898.18
14 Feb 91	MVMW-J	5115.37	208.02	4907.35
14 Feb 91	MVMW-K	5183.38	281.93	4901.45
14 Feb 91	Greystone	5840.00[a]	53.99	5786.01
14 Feb 91	Coyote Springs	5865.00[a]	5.62	5859.38
14 Feb 91	TSA-1	6083.00[a]	158.56	5924.44
14 Feb 91	Schoolhouse	5802.00[a]	96.56	5705.44
14 Feb 91	EOD Hill	5806.00[a]	142.31	5663.69
14 Feb 91	Lake Christian	5700.00[a]	53.48	5646.52
14 Feb 91	Golf - E	5361.95	320.03	5041.92
14 Feb 91	Golf - S	5361.49	321.87	5039.62
14 Feb 91	Golf - W	5355.60	307.93	5047.67
14 Feb 91	Golf - N	5357.23	314.17	5043.06
15 Feb 91	Lagoons - NE	5361.21	485.33	4875.88
15 Feb 91	Lagoons - NW	5357.72	482.54	4875.18
15 Feb 91	Lagoons - SE	5358.04	481.29	4876.75
15 Feb 91	Lagoons - SW	5354.23	476.62	4877.61
14 Feb 91	Tijeras - East	5387.13	475.69	4911.44
14 Feb 91	Tijeras - West	5227.30	342.33	4884.97

[a]Elevation estimated using topographic map.

Table F-11. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, March 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
15 Mar 91	CWL-BW1	5435.28	477.55	4957.73
15 Mar 91	CWL-BW2	5433.54	495.07	4938.47
14 Mar 91	CWL-BW3	5430.23	489.42	4940.81
15 Mar 91	CWL-MW1A	5421.49	483.47	4938.02
15 Mar 91	CWL-MW2	5418.55	483.20	4935.35
15 Mar 91	CWL-MW2A	5418.58	480.00	4938.58
15 Mar 91	CWL-MW3	5418.83	483.09	4935.74
15 Mar 91	CWL-MW3A	5417.78	479.03	4938.75
15 Mar 91	CWL-MW4	5420.33	483.51	4936.82
14 Mar 91	MWL-MW1	5381.54	458.18	4923.36
14 Mar 91	MWL-MW2	5377.26	454.02	4923.24
14 Mar 91	MWL-MW3	5381.32	459.79	4921.53
14 Mar 91	MWL-BW1	5384.51	461.24	4923.27
15 Mar 91	NW-TA3	5333.81	440.68	4893.13
15 Mar 91	SW-TA3	5320.57	417.69	4902.88
14 Mar 91	KAFB-09	5498.52	543.30	4955.22
15 Mar 91	KAFB-10	5415.98	492.41	4923.57
15 Mar 91	LF/DM-01	5333.22	438.87	4894.35
14 Mar 91	LF/DM-02	5294.59	396.18	4898.41
18 Mar 91	MVMW-J	5115.37	208.38	4906.99
18 Mar 91	MVMW-K	5183.38	282.22	4901.16
14 Mar 91	Greystone	5840.00[a]	53.23	5786.77
14 Mar 91	Coyote Springs	5865.00[a]	5.67	5859.33
14 Mar 91	TSA-1	6083.00[a]	158.52	5924.48
14 Mar 91	Schoolhouse	5802.00[a]	95.77	5706.23
14 Mar 91	EOD Hill	5806.00[a]	142.17	5663.83
14 Mar 91	Lake Christian	5700.00[a]	55.91	5644.09
14 Mar 91	Golf - E	5361.95	319.43	5042.52
14 Mar 91	Golf - S	5361.49	321.29	5040.20
14 Mar 91	Golf - W	5355.60	307.44	5048.16
14 Mar 91	Golf - N	5357.23	313.96	5043.27
14 Mar 91	Lagoons - NE	5361.21	484.79	4876.42
14 Mar 91	Lagoons - NW	5357.72	481.05	4876.67
14 Mar 91	Lagoons - SE	5358.04	480.67	4877.37
14 Mar 91	Lagoons - SW	5354.23	476.10	4878.13
14 Mar 91	Tijeras - East	5387.13	475.23	4911.90
14 Mar 91	Tijeras - West	5227.30	342.17	4885.13

[a]Elevation estimated using topographic map.

Table F-12. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, April 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
17 Apr 91	BW1	5435.28	477.36	4957.92
17 Apr 91	BW2	5433.54	495.40	4938.14
NM	BW3	5430.23	NM	NC
17 Apr 91	MW1A	5421.49	483.87	4937.62
17 Apr 91	MW2	5418.55	483.60	4934.95
17 Apr 91	MW2A	5418.58	480.43	4938.15
17 Apr 91	MW3	5418.83	483.45	4935.38
17 Apr 91	MW3A	5417.78	479.43	4938.35
17 Apr 91	MW4	5420.33	483.90	4936.43
17 Apr 91	MWL-MW1	5381.54	458.80	4922.74
17 Apr 91	MWL-MW2	5377.26	454.53	4922.73
17 Apr 91	MWL-MW3	5381.32	460.08	4921.24
17 Apr 91	MWL-BW1	5384.51	461.86	4922.65
17 Apr 91	NW-TA3	5333.81	442.17	4891.64
17 Apr 91	SW-TA3	5320.57	421.82	4898.75
17 Apr 91	KAFB-9	5498.52	543.74	4954.78
17 Apr 91	KAFB-10	5415.98	492.69	4923.29
NM	LF/DM-01	5333.22	NM	NC
17 Apr 91	LF/DM-02	5294.59	396.78	4897.81
17 Apr 91	MVMW-J	5115.37	208.25	4907.12
NM	MVMW-K	5183.38	NM	NC
17 Apr 91	Greystone	5840.00[a]	53.09	5786.91
17 Apr 91	Coyote Springs	5865.00[a]	5.69	5859.31
NM	TSA-1	6083.00[a]	NM	NC
17 Apr 91	Schoolhouse	5802.00[a]	95.73	5706.27
17 Apr 91	EOD Hill	5806.00[a]	142.51	5663.49
17 Apr 91	Lake Christian	5700.00[a]	53.62	5646.38
17 Apr 91	Golf Course - E	5361.95	319.54	5042.41
17 Apr 91	Golf Course - S	5361.49	321.89	5039.60
17 Apr 91	Golf Course - W	5355.60	307.55	5048.05
17 Apr 91	Golf Course - N	5357.23	314.38	5042.85
17 Apr 91	Lagoons - NE	5361.21	485.81	4875.40
17 Apr 91	Lagoons - NW	5357.72	482.16	4875.56
17 Apr 91	Lagoons - SE	5358.04	481.61	4876.43
17 Apr 91	Lagoons - SW	5354.23	476.96	4877.27
NM	Tijeras East	5387.13	NM	NC
17 Apr 91	Tijeras West	5227.30	342.51	4884.79

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

Table F-13. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, May 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
21 May 91	CWL-BW1	5435.28	477.21	4958.07
21 May 91	CWL-BW2	5433.54	495.51	4938.03
NM	CWL-BW3	5430.23	NM	NC
22 May 91	CWL-MW1A	5421.49	484.33	4937.16
22 May 91	CWL-MW2	5418.55	483.61	4934.94
22 May 91	CWL-MW2A	5418.58	480.48	4938.10
NM	CWL-MW3	5418.83	NM	NC
22 May 91	CWL-MW3A	5417.78	479.48	4938.30
22 May 91	CWL-MW4	5420.33	483.96	4936.37
21 May 91	MWL-MW1	5381.54	458.82	4922.72
21 May 91	MWL-MW2	5377.26	454.59	4922.67
21 May 91	MWL-MW3	5381.32	460.22	4921.10
21 May 91	MWL-BW1	5384.51	462.09	4922.42
NM	NW-TA3	5333.81	NM	NC
NM	SW-TA3	5320.57	NM	NC
21 May 91	KAFB-09	5498.52	544.25	4954.27
22 May 91	KAFB-10	5415.98	493.48	4922.50
21 May 91	LF/DM-01	5333.22	439.83	4893.39
21 May 91	LF/DM-02	5294.59	397.29	4897.30
22 May 91	MVMW-J	5115.37	208.55	4906.82
22 May 91	MVMW-K	5183.38	282.60	4900.78
22 May 91	Greystone	5840.00[a]	53.09	5786.91
22 May 91	Coyote Springs	5865.00[a]	5.67	5859.33
NM	TSA-1	6083.00[a]	NM	NC
22 May 91	Schoolhouse	5802.00[a]	95.70	5706.30
22 May 91	EOD Hill	5806.00[a]	142.41	5663.59
22 May 91	Lake Christian	5700.00[a]	53.66	5646.34
22 May 91	Golf - E	5361.95	319.40	5042.55
22 May 91	Golf - S	5361.49	321.71	5039.78
22 May 91	Golf - W	5355.60	306.45	5049.15
22 May 91	Golf - N	5357.23	313.85	5043.38
21 May 91	Lagoons - NE	5361.21	486.76	4874.45
21 May 91	Lagoons - NW	5357.72	483.28	4874.44
21 May 91	Lagoons - SE	5358.04	482.51	4875.53
21 May 91	Lagoons - SW	5354.23	477.79	4876.44
22 May 91	Tijeras - East	5387.13	475.73	4911.40
21 May 91	Tijeras - West	5227.30	342.92	4884.38
May 91	KAFB-05	NR	NR	4856.30[b]
May 91	Eubank	NR	NR	4901.30[b]

[a]Elevation estimated using topographic map.
[b]USGS monthly average.
NR = Not reported.
NM = Not measured.
NC = Not calculated.

Table F-14. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, June 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
18 Jun 91	CWL-BW1	5435.28	477.53	4957.75
18 Jun 91	CWL-BW2	5433.54	495.92	4937.62
18 Jun 91	CWL-BW3	5430.23	490.22	4940.01
18 Jun 91	CWL-MW1A	5421.49	484.30	4937.19
18 Jun 91	CWL-MW2	5418.55	483.97	4934.58
18 Jun 91	CWL-MW2A	5418.58	480.78	4937.80
18 Jun 91	CWL-MW3	5418.83	483.85	4934.98
18 Jun 91	CWL-MW3A	5417.78	479.93	4937.85
18 Jun 91	CWL-MW4	5420.33	484.26	4936.07
18 Jun 91	MWL-MW1	5381.54	458.24	4923.30
18 Jun 91	MWL-MW2	5377.26	454.95	4922.31
18 Jun 91	MWL-MW3	5381.32	460.53	4920.79
18 Jun 91	MWL-BW1	5384.51	462.30	4922.21
NM	NW-TA3	5333.81	NM	NC
NM	SW-TA3	5320.57	NM	NC
19 Jun 91	KAFB-09	5498.52	544.06	4954.46
18 Jun 91	KAFB-10	5415.98	493.01	4922.97
20 Jun 91	LF/DM-01	5333.22	440.16	4893.06
20 Jun 91	LF/DM-02	5294.59	397.79	4896.80
19 Jun 91	MVMW-J	5115.37	208.86	4906.51
19 Jun 91	MVMW-K	5183.38	282.91	4900.47
18 Jun 91	Greystone	5840.00[a]	53.25	5786.75
18 Jun 91	Coyote Springs	5865.00[a]	5.67	5859.33
18 Jun 91	TSA-1	6083.00[a]	NM	NC
18 Jun 91	Schoolhouse	5802.00[a]	94.68	5707.32
18 Jun 91	EOD Hill	5806.00[a]	142.46	5663.54
18 jun 91	Lake Christian	5700.00[a]	53.70	5646.30
18 Jun 91	Golf - E	5361.95	319.43	5042.52
18 Jun 91	Golf - S	5361.49	321.65	5039.84
18 Jun 91	Golf - W	5355.60	307.46	5048.14
18 Jun 91	Golf - N	5357.23	314.75	5042.48
19 Jun 91	Lagoons - NE	5361.21	487.66	4873.55
19 Jun 91	Lagoons - NW	5357.72	484.14	4873.58
19 Jun 91	Lagoons - SE	5358.04	483.30	4874.74
19 Jun 91	Lagoons - SW	5354.23	478.61	4875.62
19 Jun 91	Tijeras - East	5387.13	476.23	4910.90
18 Jun 91	Tijeras - West	5227.30	343.14	4884.16

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

Table F-15. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, July 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
18 Jul 91	CWL-BW1	5435.28	477.39	4957.89
18 Jul 91	CWL-BW2	5433.54	495.76	4937.78
18 Jul 91	CWL-BW3	5430.23	490.17	4940.06
18 Jul 91	CWL-MW1A	5421.49	484.18	4937.31
18 Jul 91	CWL-MW2	5418.55	483.93	4934.62
18 Jul 91	CWL-MW2A	5418.58	480.71	4937.87
18 Jul 91	CWL-MW3	5418.83	483.80	4935.03
18 Jul 91	CWL-MW3A	5417.78	479.74	4938.04
18 Jul 91	CWL-MW4	5420.33	484.22	4936.11
17 Jul 91	MWL-MW1	5381.54	459.16	4922.38
17 Jul 91	MWL-MW2	5377.26	454.91	4922.35
17 Jul 91	MWL-MW3	5381.32	460.51	4920.81
17 Jul 91	MWL-BW1	5384.51	462.21	4922.30
15 Jul 91	NW-TA3	5333.81	441.90	4891.91
15 Jul 91	SW-TA3	5320.57	419.31	4901.26
16 Jul 91	KAFB-09	5498.52	543.97	4954.55
16 Jul 91	KAFB-10	5415.98	493.11	4922.87
25 Jul 91	LF/DM-01	5333.22	440.72	4892.50
24 Jul 91	LF/DM-02	5294.59	398.20	4896.39
25 Jul 91	MVMW-J	5115.37	209.06	4906.31
8 Aug 91	MVMW-K	5183.38	283.42	4899.96
18 Jul 91	Greystone	5840.00[a]	54.13	5785.87
18 Jul 91	Coyote Springs	5865.00[a]	5.57	5859.43
NM	TSA-1	6083.00[a]	NM	NC
18 Jul 91	Schoolhouse	5802.00[a]	96.44	5705.56
18 Jul 91	EOD Hill	5806.00[a]	142.39	5663.61
18 Jul 91	Lake Christian	5700.00[a]	56.01	5643.99
24 Jul 91	Golf - E	5361.95	319.20	5042.75
24 Jul 91	Golf - S	5361.49	321.53	5039.96
24 Jul 91	Golf - W	5355.60	307.36	5048.24
24 Jul 91	Golf - N	5357.23	314.51	5042.72
26 Jul 91	Lagoons - NE	5361.21	488.03	4873.18
26 Jul 91	Lagoons - NW	5357.72	485.54	4872.18
26 Jul 91	Lagoons - SE	5358.04	483.38	4874.66
26 Jul 91	Lagoons - SW	5354.23	478.98	4875.25
24 Jul 91	Tijeras - East	5387.13	476.32	4910.81
26 Jul 91	Tijeras - West	5227.30	343.51	4883.79

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

Table F-16. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, August 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
12 Aug 91	CWL-BW1	5435.28	477.59	4957.69
12 Aug 91	CWL-BW2	5433.54	496.01	4937.53
12 Aug 91	CWL-BW3	5430.23	490.38	4939.85
12 Aug 91	CWL-MW1A	5421.49	484.46	4937.03
12 Aug 91	CWL-MW2	5418.55	484.17	4934.38
12 Aug 91	CWL-MW2A	5418.58	480.95	4937.63
12 Aug 91	CWL-MW3	5418.83	484.04	4934.79
12 Aug 91	CWL-MW3A	5417.78	479.97	4937.81
12 Aug 91	CWL-MW4	5420.33	484.45	4935.88
12 Aug 91	MWL-MW1	5381.54	459.32	4922.22
12 Aug 91	MWL-MW2	5377.26	455.05	4922.21
12 Aug 91	MWL-MW3	5381.32	460.77	4920.55
12 Aug 91	MWL-BW1	5384.51	462.38	4922.13
12 Aug 91	NW-TA3	5333.81	442.21	4891.60
12 Aug 91	SW-TA3	5320.57	419.20	4901.37
13 Aug 91	KAFB-09	5498.52	544.12	4954.40
12 Aug 91	KAFB-10	5415.98	493.22	4922.76
12 Aug 91	LF/DM-01	5333.22	440.94	4892.28
13 Aug 91	LF/DM-02	5294.59	398.24	4896.35
13 Aug 91	MVMW-J	5115.37	209.05	4906.32
13 Aug 91	MVMW-K	5183.38	283.33	4900.05
8 Aug 91	Greystone	5840.00[a]	53.96	5786.04
12 Aug 91	Coyote Springs	5865.00[a]	5.75	5859.25
NM	TSA-1	6083.00[a]	NM	NC
13 Aug 91	Schoolhouse	5802.00[a]	95.51	5706.49
12 Aug 91	EOD Hill	5806.00[a]	142.52	5663.48
13 Aug 91	Lake Christian	5700.00[a]	55.91	5644.09
13 Aug 91	Golf - E	5361.95	318.94	5043.01
13 Aug 91	Golf - S	5361.49	321.45	5040.04
13 Aug 91	Golf - W	5355.60	307.25	5048.35
13 Aug 91	Golf - N	5357.23	314.05	5043.18
12 Aug 91	Lagoons - NE	5361.21	488.16	4873.05
12 Aug 91	Lagoons - NW	5357.72	484.75	4872.97
12 Aug 91	Lagoons - SE	5358.04	483.19	4874.85
12 Aug 91	Lagoons - SW	5354.23	478.97	4875.26
12 Aug 91	Tijeras - East	5387.13	476.40	4910.73
12 Aug 91	Tijeras - West	5227.30	343.57	4883.73

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

Table F-17. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, September 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
17 Sep 91	CWL-BW1	5435.28	477.52	4957.76
17 Sep 91	CWL-BW2	5433.54	495.98	4937.56
17 Sep 91	CWL-BW3	5430.23	490.35	4939.88
17 Sep 91	CWL-MW1A	5421.49	484.38	4937.11
17 Sep 91	CWL-MW2	5418.55	484.15	4934.40
17 Sep 91	CWL-MW2A	5418.58	480.88	4937.70
17 Sep 91	CWL-MW3	5418.83	484.03	4934.80
17 Sep 91	CWL-MW3A	5417.78	479.87	4937.91
17 Sep 91	CWL-MW4	5420.33	484.38	4935.95
17 Sep 91	MWL-MW1	5381.54	459.27	4922.27
17 Sep 91	MWL-MW2	5377.26	455.00	4922.26
17 Sep 91	MWL-MW3	5381.32	460.61	4920.71
17 Sep 91	MWL-BW1	5384.51	462.32	4922.19
17 Sep 91	NW-TA3	5333.81	442.31	4891.50
17 Sep 91	SW-TA3	5320.57	418.96	4901.61
19 Sep 91	KAFB-09	5498.52	544.13	4954.39
17 Sep 91	KAFB-10	5415.98	493.15	4922.83
19 Sep 91	LF/DM-01	5333.22	441.51	4891.71
19 Sep 91	LF/DM-02	5294.59	398.75	4895.84
19 Sep 91	MVMW-J	5115.37	209.54	4905.83
19 Sep 91	MVMW-K	5183.38	283.86	4899.52
19 Sep 91	Greystone	5840.00[a]	52.92	5787.08
17 Sep 91	Coyote Springs	5865.00[a]	5.82	5859.18
NM	TSA-1	6083.00[a]	NM	NC
17 Sep 91	Schoolhouse	5802.00[a]	94.77	5707.23
17 Sep 91	EOD Hill	5806.00[a]	142.50	5663.50
17 Sep 91	Lake Christian	5700.00[a]	53.24	5646.76
18 Sep 91	Golf - E	5361.95	318.70	5043.25
18 Sep 91	Golf - S	5361.49	321.13	5040.36
18 Sep 91	Golf - W	5355.60	307.04	5048.56
18 Sep 91	Golf - N	5357.23	313.74	5043.49
18 Sep 91	Lagoons - NE	5361.21	488.68	4872.53
18 Sep 91	Lagoons - NW	5357.72	485.66	4872.06
18 Sep 91	Lagoons - SE	5358.04	484.26	4873.78
18 Sep 91	Lagoons - SW	5354.23	479.61	4874.62
18 Sep 91	Tijeras - East	5387.13	476.44	4910.69
19 Sep 91	Tijeras - West	5227.30	344.06	4883.24

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

Table F-18. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, October 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
17 Oct 91	CWL-BW1	5435.28	477.26	4958.02
17 Oct 91	CWL-BW2	5433.54	495.66	4937.88
17 Oct 91	CWL-BW3	5430.23	490.08	4940.15
17 Oct 91	CWL-MW1A	5421.49	484.11	4937.38
17 Oct 91	CWL-MW2	5418.55	483.87	4934.68
17 Oct 91	CWL-MW2A	5418.58	480.61	4937.97
17 Oct 91	CWL-MW3	5418.83	483.72	4935.11
17 Oct 91	CWL-MW3A	5417.78	479.64	4938.14
17 Oct 91	CWL-MW4	5420.33	484.15	4936.18
8 Oct 91	MWL-MW1	5381.54	459.31	4922.23
8 Oct 91	MWL-MW2	5377.26	455.00	4922.26
8 Oct 91	MWL-MW3	5381.32	460.81	4920.51
8 Oct 91	MWL-BW1	5384.51	462.37	4922.14
17 Oct 91	NW-TA3	5333.81	442.43	4891.38
17 Oct 91	SW-TA3	5320.57	419.17	4901.40
17 Oct 91	KAFB-09	5498.52	543.96	4954.56
17 Oct 91	KAFB-10	5415.98	492.87	4923.11
18 Oct 91	LF/DM-01	5333.22	440.35	4892.87
18 Oct 91	LF/DM-02	5294.59	397.98	4896.61
18 Oct 91	MVMW-J	5115.37	208.04	4907.33
18 Oct 91	MVMW-K	5183.38	281.96	4901.42
17 Oct 91	Greystone	5840.00[a]	53.88	5786.12
17 Oct 91	Coyote Springs	5865.00[a]	5.73	5859.27
NM	TSA-1	6083.00[a]	NM	NC
17 Oct 91	Schoolhouse	5802.00[a]	95.39	5706.61
17 Oct 91	EOD Hill	5806.00[a]	142.34	5663.66
17 Oct 91	Lake Christian	5700.00[a]	55.81	5644.19
17 Oct 91	Golf - E	5361.95	318.69	5043.26
17 Oct 91	Golf - S	5361.49	321.15	5040.34
17 Oct 91	Golf - W	5355.60	307.01	5048.59
17 Oct 91	Golf - N	5357.23	313.81	5043.42
18 Oct 91	Lagoons - NE	5361.21	487.81	4873.40
18 Oct 91	Lagoons - NW	5357.72	484.41	4873.31
18 Oct 91	Lagoons - SE	5358.04	482.80	4875.24
18 Oct 91	Lagoons - SW	5354.23	478.57	4875.66
17 Oct 91	Tijeras - East	5387.13	476.29	4910.84
17 Oct 91	Tijeras - West	5227.30	343.31	4883.99

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

Table F-19. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, November 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
19 Nov 91	CWL-BW1	5435.28	477.04	4958.24
19 Nov 91	CWL-BW2	5433.54	495.41	4938.13
19 Nov 91	CWL-BW3	5430.23	490.32	4939.91
19 Nov 91	CWL-MW1A	5421.49	483.86	4937.63
19 Nov 91	CWL-MW2	5418.55	483.61	4934.94
19 Nov 91	CWL-MW2A	5418.58	480.38	4938.20
19 Nov 91	CWL-MW3	5418.83	483.46	4935.37
NM	CWL-MW3A	5417.78	NM	NC
19 Nov 91	CWL-MW4	5420.33	483.93	4936.40
19 Nov 91	MWL-MW1	5381.54	459.03	4922.51
19 Nov 91	MWL-MW2	5377.26	454.72	4922.54
NM	MWL-MW3	5381.32	NM	NC
19 Nov 91	MWL-BW1	5384.51	462.10	4922.41
19 Nov 91	NW-TA3	5333.81	442.24	4891.57
19 Nov 91	SW-TA3	5320.57	418.97	4901.60
19 Nov 91	KAFB-09	5498.52	543.97	4954.55
19 Nov 91	KAFB-10	5415.98	493.23	4922.75
19 Nov 91	LF/DM-01	5333.22	440.11	4893.11
19 Nov 91	LF/DM-02	5294.59	397.12	4897.47
19 Nov 91	MVMW-J	5115.37	208.04	4907.33
19 Nov 91	MVMW-K	5183.38	284.00	4899.38
19 Nov 91	Greystone	5840.00[a]	53.85	5786.15
19 Nov 91	Coyote Springs	5865.00[a]	5.75	5859.25
NM	TSA-1	6083.00[a]	NM	NC
19 Nov 91	Schoolhouse	5802.00[a]	95.36	5706.64
19 Nov 91	EOD Hill	5806.00[a]	142.27	5663.73
19 Nov 91	Lake Christian	5700.00[a]	55.81	5644.19
19 Nov 91	Golf - E	5361.95	318.54	5043.41
19 Nov 91	Golf - S	5361.49	320.98	5040.51
19 Nov 91	Golf - W	5355.60	306.85	5048.75
19 Nov 91	Golf - N	5357.23	313.64	5043.59
19 Nov 91	Lagoons - NE	5361.21	487.47	4873.74
19 Nov 91	Lagoons - NW	5357.72	484.10	4873.62
19 Nov 91	Lagoons - SE	5358.04	482.46	4875.58
19 Nov 91	Lagoons - SW	5354.23	478.25	4875.98
19 Nov 91	Tijeras - East	5387.13	476.05	4911.08
19 Nov 91	Tijeras - West	5227.30	343.15	4884.15

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

Table F-20. KAFB and SNL, Albuquerque, Monitor Well Water Level Data, December 1991

Date Measured	Well Identification	Surveyed Elevation, ft	Depth to Water, ft	Water Surface Elevation, ft
18 Dec 91	CWL-BW1	5435.28	477.29	4957.99
18 Dec 91	CWL-BW2	5433.54	496.02	4937.52
18 Dec 91	CWL-BW3	5430.23	490.49	4939.74
18 Dec 91	CWL-MW1A	5421.49	484.34	4937.15
19 Dec 91	CWL-MW2	5418.55	483.94	4934.61
19 Dec 91	CWL-MW2A	5418.58	480.43	4938.15
19 Dec 91	CWL-MW3	5418.83	483.86	4934.97
NM	CWL-MW3A	5417.78	NM	NC
19 Dec 91	CWL-MW4	5420.33	484.34	4935.99
18 Dec 91	MWL-MW1	5381.54	459.44	4922.10
18 Dec 91	MWL-MW2	5377.26	455.22	4922.04
18 Dec 91	MWL-MW3	5381.32	460.87	4920.45
18 Dec 91	MWL-BW1	5384.51	462.50	4922.01
19 Dec 91	NW-TA3	5333.81	442.64	4891.17
19 Dec 91	SW-TA3	5320.57	419.19	4901.38
19 Dec 91	KAFB-09	5498.52	544.38	4954.14
19 Dec 91	KAFB-10	5415.98	493.50	4922.48
19 Dec 91	LF/DM-01	5333.22	440.70	4892.52
19 Dec 91	LF/DM-02	5294.59	397.43	4897.16
NM	MVMW-J	5115.37	NM	NC
19 Dec 91	MVMW-K	5183.38	284.25	4899.13
19 Dec 91	Greystone	5840.00[a]	52.93	5787.07
19 Dec 91	Coyote Springs	5865.00[a]	5.72	5859.28
NM	TSA-1	6083.00[a]	NM	NC
19 Dec 91	Schoolhouse	5802.00[a]	95.42	5706.58
19 Dec 91	EOD Hill	5806.00[a]	142.61	5663.39
NM	Lake Christian	5700.00[a]	NM	NC
19 Dec 91	Golf - E	5361.95	318.05	5043.90
19 Dec 91	Golf - S	5361.49	320.24	5041.25
19 Dec 91	Golf - W	5355.60	306.48	5049.12
19 Dec 91	Golf - N	5357.23	313.00	5044.23
19 Dec 91	Lagoons - NE	5361.21	487.69	4873.52
19 Dec 91	Lagoons - NW	5357.72	484.55	4873.17
19 Dec 91	Lagoons - SE	5358.04	482.90	4875.14
19 Dec 91	Lagoons - SW	5354.23	478.78	4875.45
19 Dec 91	Tijeras - East	5387.13	476.39	4910.74
19 Dec 91	Tijeras - West	5227.30	344.13	4883.17

[a]Elevation estimated using topographic map.
NM = Not measured.
NC = Not calculated.

REFERENCES

U.S. Department of Energy (DOE), 1990. "Radiation Protection of the Public and the Environment," DOE Order 5400.5, DOE, February 1990.

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APPENDIX G

ENVIRONMENTAL REGULATIONS AND STANDARDS

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Table G-1. Radiation Standards[a] for Protection of the Public in the Vicinity of DOE Facilities for CY 1991

Dose Limits

All Pathways

The effective dose equivalent for any member of the public from all routine DOE operations[b] (natural background and medical exposures excluded) shall not exceed the values given below:

	Effective Dose Equivalent[c] mrem/yr	(mSv/yr)
Primary limit	100	(1)
Occasional limit[d]	500	(5)

Air Pathway

	Effective Dose Equivalent mrem/yr	(mSv/yr)
Maximum off-site residence	10	(0.10)

[a]DOE Order 5400.5, Chapters I and II.
[b]Routine DOE operations means normal planned activities, including remedial actions and naturally occurring radionuclides released by DOE processes and operations.
[c]Effective dose equivalent will be expressed in rem (or millirem) with the corresponding value in sievert (or millisievert) in parentheses.
[d]Occasional annual limits may be authorized for a limited period if unusual operating conditions warrant.

Table G-2. Derived Concentration Guides (DCG) For Selected Radionuclides[a]

	Drinking Water		Inhaled Air[b]	
Nuclide	DCG μCi/L	f, Value	DCG μCi/m³	Solubility Class
^{3}H (Water)	2E+00	--	1E-01	--
^{137}Cs	3E-03	1E+00	4E-04	D
Gross Alpha[a]	15E-06	--	--	--
Gross Beta[c]	3E-05	--	--	--
Total U[d]	6E-04	--	6E-6	--

[a]DOE Order 5400.5, Chapter III.
[b]DCG for ^{3}H in air (2E-01) is adjusted for skin absorption.
[c]EPA-570/9-76-003.
[d]One curie of natural uranium is equivalent to 3000 kg of natural uranium. A conversion from μg to μCi may be made by multiplying μg by 3.3×10^{-7}.

Table G-3. Groundwater Monitoring Parameters Required by 40 CFR 265, Subpart F

Parameter[a]		
Contamination Indicator	Groundwater Quality	Appendix III Drinking Water Supply
pH	Chloride	Arsenic
Specific Conductivity	Iron	Barium
Total Organic Halogen (TOX)	Manganese	Cadmium
Total Organic Carbon (TOC)	Phenol	Chromium
	Sodium	Fluoride
	Sulfate	Lead
		Mercury
		Nitrate (as N)
		Selenium
		Silver
		Endrin
		Lindane
		Methoxychlor
		Toxaphene
		2,4-D
		2,4,5-TP Silvex
		Radium
		Gross Alpha
		Gross Beta
		Coliform Bacteria
		Turbidity

[a]RCRA (40 CFR 265).

Table G-4. EPA Interim Primary Drinking Water Supply Parameters

Parameter	Standard[a]	Units
Arsenic[b]	0.05	mg/l
Barium[b]	1.0	mg/l
Cadmium[b]	0.01	mg/l
Chromium[b]	0.05	mg/l
Lead[b]	0.05	mg/l
Mercury[b]	0.002	mg/l
Selenium[b]	0.01	mg/l
Silver[b]	0.05	mg/l
Fluoride	1.4-2.4	mg/l
Nitrate	10	mg/l
Total Coliform	1/100 ml	col/100 ml
Turbidity	1 TU	NTU[c]
Radium-226	5 pCi/l	pCi/l
Radium-228	5 pCi/l	pCi/l
Gross Alpha	15 pCi/l	pCi/l
Gross Beta	4 mR/yr	pCi/l
Endrin	0.0002	mg/l
Lindane	0.004	mg/l
Methoxychlor	0.1	mg/l
Toxaphene	0.005	mg/l
2,4-D	0.1	mg/l
2,4,5-TP Silvex	0.01	mg/l

[a] 40 CFR 265, Appendix III.
[b] Total metals (unfiltered sample).
[c] NTU = nephelometric turbidity unit.

REFERENCES

U.S. Department of Energy (DOE), 1990. Chapter I, "General Radiological Protection of the Public and the Environment;" Chapter II, "Requirements for Radiation Protection of the Public and the Environment;" and Chapter III, "Derived Concentration Guides for Air and Water," DOE Order 5400.5, DOE, February 1990.

U.S. Environmental Protection Agency (EPA), 1990. Title 40, "Protection of the Environment," Part 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Appendix III," EPA Interim Primary Drinking Water Standards, EPA, July 1, 1990.

U.S. Environmental Protection Agency (EPA), "USEPA National Interim Primary Drinking Water Regulations," EPA-570/9-76-003, EPA, Washington, D.C.

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APPENDIX H
OTHER ENVIRONMENTAL COMPLIANCE RECORDS

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Table H-1. Septic Tank Registration, SNL, Albuquerque

Area	Building	Location Description
Technical Area I	898	Optical Maintenance Building
Technical Area I	8895/MO100	Sandia Guard House
Technical Area I	MO14/MO15	Office/Laboratory
East of Technical Area II	6969, MO118, MO251, and MO252	Robotic Vehicle Range
6000 Igloo Area	6020	Explosives Receiving and Packaging
6000 Igloo Area	6030	Guard Station
Technical Area II	901/902	Systems Analysis Facility
Technical Area II	904	Environmental Testing Laboratory
Technical Area II	906	Safety Chemicals Laboratory
Technical Area II	907	Explosives Application Facility
Technical Area II	913/913A	Component Assembly Building/ Pressure Laboratory and Training Building
Technical Area II	915/922	Explosive Device Laboratories
Technical Area II	914	Equipment for Building 913
Technical Area II	919	Explosive Devices Building
Technical Area II	935	Component Test Facility
Technical Area II	940	Explosive Testing Laboratory
Technical Area III	6584 - East end	Administration for Test Engineering
Technical Area III	6584 - West end	Armory Facility
Technical Area III	6589 and 6600	Guard House and Sensor Test Laboratory
Technical Area III	6501	Nonhazardous Assembly Area
Technical Area III	6620	Hazardous Assembly Building
Technical Area III	6505	Sodium Purification Loop
Technical Area III	6520/6526	Hydraulic Centrifuge Facility
Technical Area III	6523	Pump Building
Technical Area III	6530/6531	Radiant Heat Test Facility
Technical Area III	6536	Thermal/Radiant Heat Testing
Technical Area III	6540/6542	Photometrics
Technical Area III	6560/6562/6563	Vibration Test Facility
Technical Area III	6570/6571	Dynamic Shock Test Facility
Technical Area III	6587	Maintenance and Shop
Technical Area III	6610	Complex Wave Test Facility
Technical Area III	6630	Climatic Test Facility

Table H-1. Septic Tank Registration, SNL, Albuquerque (Concinued)

Area	Building	Location Description
Technical Area III	6631	Remote Control Building
Technical Area III	6635/6638	Radiography Bunker
Technical Area III	6640	Acoustical Test Facility
Technical Area III	6643	Establishment Type Unknown
Technical Area III	6650	Vibration Data Control Center
Technical Area III	6710	Air Gun Test Facility
Technical Area III	6715	Explosive Test Facility
Technical Area III	6720	Irradiated Sludge Facility
Technical Area III	6721	Photography/Control for Building 6720
Technical Area III	6730-31/6734-35/M0128	Dynamic Shock Facility
Technical Area III	6741	Control Building for 5000 Foot Sled Track
Technical Area III	6743	Rocket Motor Conditioning Facility
Technical Area III	6750	Small Arms Range/Impact Test Facility
Technical Area III	6920	Mixed Waste Management Facility
Technical Area III	6922	Explosive Test Facility
Technical Area III	T12/T42/T43	N/A
Technical Area III	T-52	N/A
Technical Area III	M0231-234	Offices
Technical Area III	M0228-230	Offices
Technical Area III	M0242-245	Offices
Technical Area V	6580/6588/6590-93/ 6596-97	Reactor Facilities and Storage
Technical Area V	6500	Gate House Security Operations Building
Technical Area V	6581-82/M032/M057-58	Febetron Building/Emergency Evaluation Center/Offices/ Shock Test Laboratory
Coyote Test Field	9950	Material Test Laboratory
Coyote Test Field	9956	Intermediate Velocity Gun Facility
Coyote Test Field	9965	Remote Control Building for Shock Facility
Coyote Test Field	9967	HE Assembly Building
Coyote Test Field	9970	Antenna Measurement Facility
Coyote Test Field	9972	EMP Studies Facility A
Coyote Test Field	9980	Solar Tower Facility
Coyote Test Field	9981/9982	N/A

Table H-1. Septic Tank Registration, SNL, Albuquerque (Concluded)

Area	Building	Location Description
Coyote Test Field	Live Fire Range	Live Fire Range
Coyote Test Field	SFER M0127-128/M0130	Small Force Engagement Range
Coyote Test Field	9927	Explosive Test Facility
Coyote Test Field	9930	Explosive Test and Laboratory Building
Coyote Test Field	9939/9939A	Evaluation Explosive Facility Control Building
Coyote Test Field	9940	Explosive Test Facility
Coyote Test Field	9925	Coyote Test Field Headquarters
Coyote Test Field	9926/9920	Explosive Test Facility
Coyote Test Field	9960	Explosives Preparation Facility
Coyote Test Field	9990	Earth to Orbit Launching Facility

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APPENDIX I

LIST OF NEPA DOCUMENTATION

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Table I-1. 1991 EAs and Approval Status

Title	DOE Request for EA	EA Sent to DOE	FONSI
Kauai Facility Sitewide	11/08/88	4/5/91	
Kauai Facility Two Experiment Rocket Campaign	1/4/91	1/10/91	3/6/91
Explosives Components Facility	08/7/89	1/14/91	
Lurance Canyon Burn Site	8/11/89		
Construction and Occupancy of Robotic Manufacturing Science Facility	5/3/91	2/21/92	
Construction and Occupancy of Radioactive and Mixed Waste Assay Facility	3/25/91		
Countermine Technology Test Facility	12/17/91	7/31/91	
Explosives Shipping and Receiving Facility at Tonopah Test Range	11/15/91		
Radiography Addition	03/25/91		
Construction and Occupancy of Processing and Environmental Technology Laboratory	3/25/91		
Technical Support Center	12/19/90	1/22/91	
Neutron Measurement Laboratory	12/10/90		
Integrated Materials Research Laboratory	01/29/90	11/19/90	1/3/91
Radioactive/Mixed Waste Facility	01/22/90	10/1/90	

Table I-1. 1991 EAs and Approval Status (Concluded)

Title	DOE Request for EA	EA Sent to DOE	FONSI
Fusion Activated Laser Concept	08/11/88		
Containment Technology Test Facility	09/25/91		

Table I-2. List of NEPA Documentation[a]

1991 Environmental Checklists (ECLs), Action Description Memoranda (ADMs), and Approval Status

Title	Memo to DOE	DOE Approval	EA Request
ECLs and/or ADMs			
Explosives Storage Buildings Moved to EA 75-01	12/16/91		
Burn Test - 5320 Plutonium Shipping Container	11/15/91		
Building 6920 Road and Parking Lot	11/19/91		
Special Technologies Expo '91 (No NEPA Required)	11/13/91	12/04/91	
Building T-1 Relocation	11/12/91		
Aerial Cable Site	11/12/91		
Gate One Renovations	11/01/91	01/17/92	
Temporary Trailer Siting	10/25/91	01/17/92	
Rock Cutting Chain Saw-Tech Trans	10/21/91		
Rocket Sled Continuing Activity	10/22/91		
Hazmat Container Tests	10/18/91		
Building 815 Demolition	10/18/91		
Building 814 Demolition	10/17/91		
RCRA Metal Removal From Wastewater	10/17/91	01/17/92	
Acid/Base Neutralizer	10/17/91	01/17/92	
Relocate/Operation of PCB and Chemical Storage Facility	10/17/91	01/17/92	

[a]This list includes documents initiated or completed in 1991.

Table I-2. List of NEPA Documentation[a] (Continued)

1991 Environmental Checklists (ECLs), Action Description Memoranda (ADMs), and Approval Status

Title	Memo to DOE	DOE Approval	EA Request
Hazardous Waste Management Facility Improvements	10/17/91	10/17/91	
Laser Kinetics Test Device (Kite) III Test	10/17/91		
Reverse Boiling Fixture and Test (Verbal KAO Approval)	10/14/91	10/30/91	
W91 Warhead Pull-Down Impact Test	10/09/91	10/15/91	
Solar Tracking Machine at the PTEL	10/08/91		
Technical Area V Drainage Modifications	10/07/91	01/17/92	
Chemical Waste Landfill Electrical Power	10/08/91	01/17/92	
Building 6542 Laboratories Remodeling Project	10/07/91	01/16/92	
Asbestos Abatement Building 8802	10/07/91	10/24/91	
Video Technology Laboratory	10/04/91		
Earth Leveling, Technical Area II Landfill	10/02/91	10/28/91	
Containment Technology Test Facility	09/05/91		
Routine Operating and Maintenance Activities, FY92	08/28/91	01/17/92	
Routine Operating and Maintenance Activities, FY91	08/28/91		
Asbestos Abatement - Building 880	08/23/91	10/24/91	

[a]This list includes documents initiated or completed in 1991.

Table I-2. List of NEPA Documentation[a] (Continued)

1991 Environmental Checklists (ECLs), Action Description Memoranda (ADMs), and Approval Status

Title	Memo to DOE	DOE Approval	EA Request
Parking Lot Lighting at Robotic Vehicle Range	08/21/91	10/28/91	
Upgrades at Burn Site	08/20/91	09/26/91	
Gas Storage Building	08/15/91	10/24/91	
Parking Lot Lighting at Technical Area III	08/21/91	10/24/91	
Power Socket Rewire	08/15/91	10/24/91	
Asbestos Management FY92	08/19/91	01/17/92	
Asbestos Management FY91	08/18/91	09/26/91	
Asbestos Abatement Building 892	07/31/91	09/13/91	
Consolidated Waste Management Complex	07/19/91		
Environmental Restoration Site Characterization	07/26/91		
Routine Maintenance Activities	07/18/91		
Roadway Between 9920 and Building 9940 Complexes	07/10/91		
Pex Slow Heat (No NEPA Required)	07/11/91		
Building 9930 Expansion	07/11/91	09/13/91	
Technical Area I Fiber Optic Trunk Upgrade	07/11/91	08/26/91	
Emergency/Alternative Power for Remote Area I for Utility Rest Project	07/11/91	08/26/91	

[a]This list includes documents initiated or completed in 1991.

Table I-2. List of NEPA Documentation[a] (Continued)

1991 Environmental Checklists (ECLs), Action Description Memoranda (ADMs), and Approval Status

Title	Memo to DOE	DOE Approval	EA Request
Utility Restoration Project to Replace Generators	06/27/91	08/26/91	
Activity Descrip Series of Combustion Exp. at Site 9920/9940	06/24/91		
Relocation of Bunker No. 6722	06/21/91	08/26/91	
Addition to Building 6630, Melting Technology Center	06/12/91		
Air Permit and Act Descrip for A Series of Counter FAE Tests	06/05/91	07/01/91	
TSC-V and H1501A Impact and Pool Fire Tests (Cont. Activity)	05/16/91		
Relocate Hydrogen Trailers	04/17/91	07/22/91	
Relocation of T-Buildings, T-2, T-3	04/24/91	06/19/91	
Modification of Building 6620	03/29/91	06/19/91	
Facility Asbestos Management Program	03/27/91		
Sodium-Potassium Alloy Reactivity and Fire-Control Test	03/26/91		01/17/92
Relocation and Operation of PCB Storage Facilities	03/14/91		
Modifications at the Hazardous Waste Management Facility	03/04/91	04/11/91	
Countermine Tech Project	02/26/91		
5-kV Tap Boxes	02/18/91	04/11/91	

[a]This list includes documents initiated or completed in 1991.

Table I-2. List of NEPA Documentation[a] (Continued)

1991 Environmental Checklists (ECLs), Action Description Memoranda (ADMs), and Approval Status

Title	Memo to DOE	DOE Approval	EA Request
Electrical Metering - Phase II	01/22/91	04/02/91	
Construction and Occupancy of Robotic Manufacturing Science	01/18/91		05/03/91
Teleoperated Countermine Program (TCP)	01/08/91	01/16/91	
Communication Duct System Upgrade	09/27/90	12/20/90	
Vital Records Storage Vault	09/27/90	12/20/90	
Rehabilition of Security Lighting, Area I	09/27/90	12/20/90	
Relocate 46-kV Line in Area I	11/27/90	04/02/91	
Construction and Occupancy of the Radioactive and MW Assay Facility	10/11/90	10/24/91	03/25/91
Utility Restoration Projects (12 Checklists)	12/21/90	03/18/91	
Building 880 Remodeling	12/18/90	02/11/91	
Remodeling of Evacuation and Conferencing Building 6582	12/07/90	02/11/91	
PCB Transformer Removal	12/03/90	04/02/91	
Open Pool Fire Tests of a Fire Extinguisher System	09/14/90		
Explosives Shipping and Receiving Facility at TTR	04/29/91		11/15/91
STRYPI/Lace Experiment	11/21/90		01/04/91

[a]This list includes documents initiated or completed in 1991.

Table I-2. List of NEPA Documentation[a] (Continued)

1991 Environmental Checklists (ECLs), Action Description Memoranda (ADMs), and Approval Status

Title	Memo to DOE	DOE Approval	EA Request
Lighting System for the Live Range at TTR	11/01/90	02/11/91	
Construction and Occupancy of the Processing and Environmental Technology Lab (PETL)	10/23/90		03/25/91
Rocket Sled Track for 5000-ft Aerial Cable Facility	10/08/90	04/02/91	
Quiescent Bottle II Tests	09/10/90		
Demolition of Buildings 824, 829, and 834 SNL Labs	09/07/90	02/11/91	
Office and Chemical Exchange Building Relocation	09/07/90	12/20/90	
H1556 Shipping Container Pool Fire Tests (Continuing Activity)	09/07/90		
Archaeological Survey, and ADM for Proposed Reactor Tech	09/06/90		12/19/90
Hydrological Studies DOE Environmental Checklist	08/30/90	01/28/91	
W89 Core Simulation Abnormal Thermal Environment Tests	08/29/90	12/04/90	
Radiography Addition	08/18/89		03/25/91
30-Day Notification of Intent to Remove UST	02/12/91	06/19/91	
30-Day Notification of Intent to Remove UST	02/12/91	06/19/91	

[a]This list includes documents initiated or completed in 1991.

Table I-2. List of NEPA Documentation[a] (Concluded)

1991 Environmental Checklists (ECLs), Action Description Memoranda (ADMs), and Approval Status

Title	Memo to DOE	DOE Approval	EA Request
30-Day Notification of Intent to Remove UST	02/12/91	06/19/91	
30-Day Notification of Intent to Remove UST	02/12/91	06/19/91	
30-Day Notification of Intent to Remove UST	02/12/91	06/19/91	
Underground Storage Tank (UST) 6500-1	03/19/91	06/19/91	
30-Day Notification of Intent to Remove UST	03/04/91	06/19/91	
30-Day Notification of Intent to Remove UST	10/16/90	04/02/91	
30-Day Notification of Intent to Remove UST	04/15/91	06/19/91	
30-Day Notification of Intent to Remove UST	04/15/91	06/19/91	
30-Day Notification of Intent to Remove UST	04/15/91	06/19/91	
30-Day Notification of Intent to Remove UST	04/15/91	06/19/91	
30-Day Notification of Intent to Remove UST	04/15/91	06/19/91	

[a]This list includes documents initiated or completed in 1991.

REFERENCES

U.S. Department of Energy (DOE), Albuquerque Operations, 1991. "Integrated Materials Research Laboratory (IMRL) Environmental Assessment," DOE/EA-0481, Albuquerque, NM.

U.S. Department of Energy (DOE), Albuquerque Operations, 1991. "Kauai Test Facility Two Experiment Rocket Campaign Environmental Assessment," DOE/EA-0492, DE91 008894, Albuquerque, NM.

APPENDIX J

1991 ENVIRONMENTAL COMPLIANCE ACTIVITIES AT KAUAI TEST FACILITY

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J.1 Introduction

Sandia National Laboratories (SNL) operates a rocket preparation and launch facility called the Kauai Test Facility (KTF) at the U.S. Navy's Pacific Missile Range Facility (PMRF), Barking Sands, for the DOE. The PMRF is located on the west side of the island of Kauai, Hawaii (Figure J-1). The KTF is used to launch rockets in support of DOE missions, as well as other U.S. government projects (SNL, 1986).

Facilities and Operations

SNL's KTF is located on the north part (near Nohili Point) of the Navy's PMRF. Most facilities at the KTF were constructed in the early 1960s to support the National Readiness Program. The most recent construction, completed in 1989, added five buildings and a new launch pad to support future DOE and Strategic Defense Initiative (SDI) launches.

The KTF has been, and is being, used for testing rocket systems with science and technology payloads, advanced development of maneuvering reentry vehicles, scientific studies of atmospheric and exoatmospheric phenomena, and SDI programs. Nuclear devices have never been launched from KTF.

The KTF launcher field was originally designed to accommodate 40 launch pads, but only 15 pads were constructed. Of these, 12 are presently inactive, with the launchers removed. Since the original plan, two additional launch pads have been constructed, Pad 41 at Kokole Point and Pad 42, the STARS launch pad. The launcher field site has a number of permanent facilities used to support the rocket operations.

The administrative area of the KTF is located in a fenced compound near the North Nohili access road from the PMRF. Within the fenced compound, a number of trailers and vans are interconnected with a network of concrete docks and covered walkways. The majority of these temporary facilities are used during operational periods to support field staff at the KTF. In the non-operational periods, they are in standby condition with only dehumidifiers in operation. In addition, there are a small number of permanent buildings, most of which are in use year-round to support and maintain the KTF facilities (Helgesen, 1990).

Geology and Hydrology

The KTF and PMRF are located on the seaward margin of the broad Mana Coastal Plain of Kauai. The Mana Coastal Plain is composed of alluvium washed from uplands, calcareous and clayey lagoon deposits, sand dunes, and beach rock. The poorly consolidated deposits of the present plain were formed in a shallow lagoon behind an ancient beach ridge. The large wetland was largely filled in and planted with sugar cane by 1936, leaving only some small areas of wetland near Mana, about 10,000 ft from the KTF.

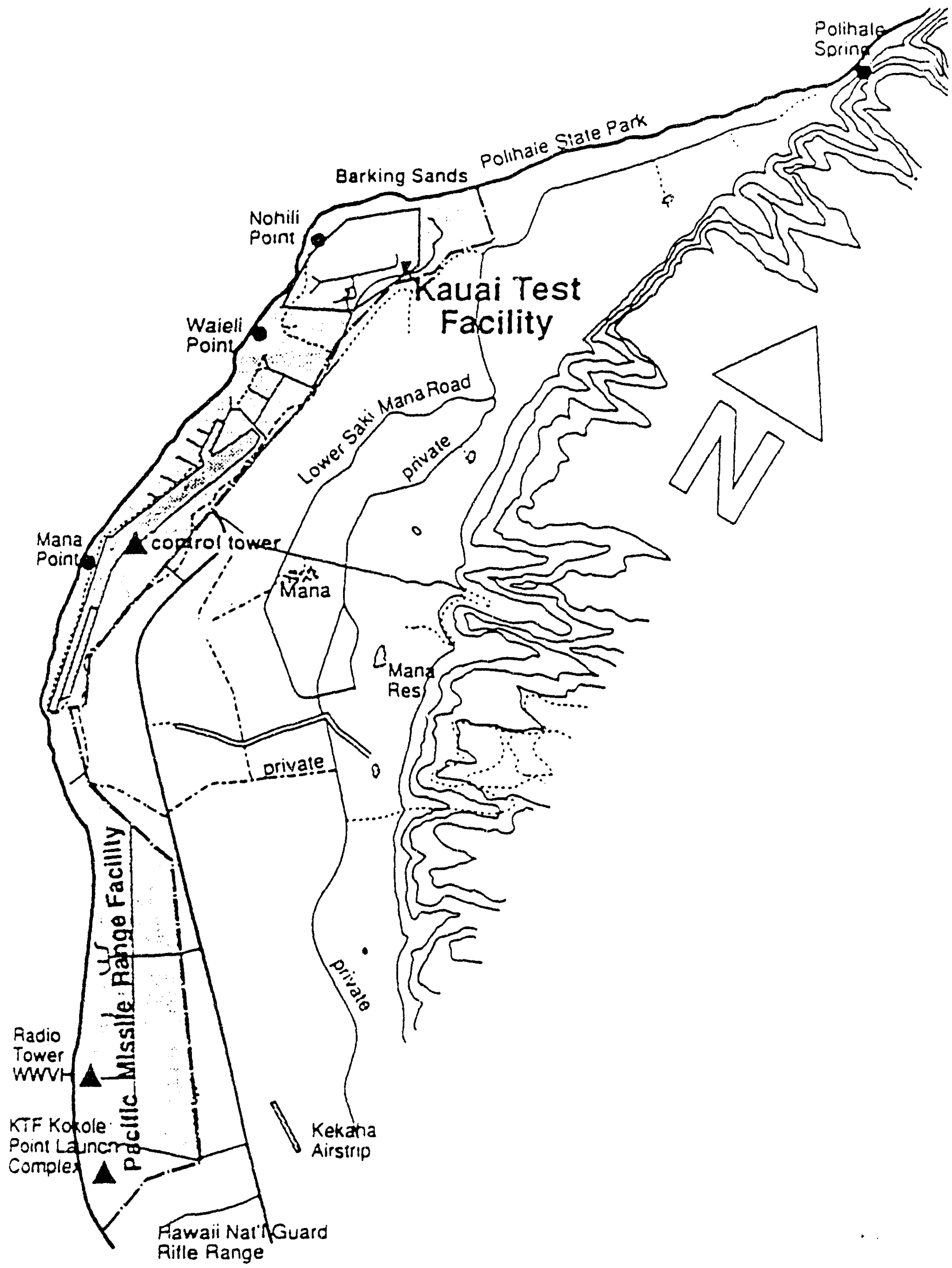

Figure J-1. Map of the PMRF and the Adjacent Area. The KTF is to the north, near Nohili Point.

The KTF lies in the rain shadow of Mounts Kawaikini and Waialeale. The annual rainfall is about 20 in. per year. There is no integrated surface drainage on the site. The sand is so permeable and its moisture-holding capacity so low that no drainage pattern has become established on the surface. Rain simply sinks into the sand and disappears.

The Mana Coastal Plain is composed of a wedge of terrestrial and marine sediments overlaying a volcanic basement. The basement rock forms an outcrop at the inland edge of the plain; its steep slope is a cliff formed during a former high-stand of the sea. The volcanic basement plunges below the plain at a dip of about 5 degrees and continues to the coast, where it is about 400 ft deep.

The seaward edge of the plain is covered by fossil sand dunes formed when the sea was lower than it is now. The PMRF is located almost entirely on these dunes, which are now no higher than 10 ft or so, except to the north of the KTF, where they are ≤100 ft high.

The three geological formations (bedrock, alluvium, and dunes) constitute hydraulically connected aquifers. The basement volcanics are highly permeable, containing brackish water floating on seawater. The overlaying sediments act as a cap rock because of their low permeability; they are saturated but are not exploitable as an aquifer because of their unfavorable hydraulic characteristics.

The dune sand aquifer, on which the PMRF lies, has a moderate hydraulic conductivity and a reasonable porosity. It consists of a lens of brackish groundwater floating on seawater, and is recharged by storm rainfall and by seepage from the underlying sediments. The only record of an attempt to exploit this groundwater is of a well drilled for the Navy in 1974, 4 to 5 mi south of the KTF. It was dug to a depth of 42 ft, encountering only fine sand and coral gravel. Tested at 300 gpm, it initially yielded water having 2800 mg/l chloride, which is too brackish for plants. This well is not used (SNL, 1986).

Biology and Population

The principal vegetation found on Kauai consists of two introduced shrub species: kiawe, a mesquite, and koa-haole, a wild tamarind. Portions of the island are covered with nearly impenetrable thickets of kiawe and koa-haole (SNL, 1986). The land on which the present KTF facilities lie has been cleared from brush and has a thin cover of grasses and herbs. The sandy soil is barren and appears incapable of supporting agriculture unless it is improved by being mixed with organically rich soil, fertilized extensively, and irrigated.

No mammals or signs of mammals were encountered during a 1986 field survey (SNL, 1986). However, it is quite likely that there may be populations of mice and rats. The endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) may also be found, at least occasionally, as there are breeding populations elsewhere on Kauai.

Twenty-two species of birds were found on the range, as well as three more just outside the range (SNL, 1986). These 25 include five species native to Hawaii. There are also several species of waterfowl present on the range during some portion of the year, even though they were not seen during the 1986 survey.

The nearest off-base community is the village of Mana (estimated population 30) 10,000 ft to the south. The population at the KTF fluctuates between 10 and 70, depending on mission schedules. The majority of approximately 200 military personnel are stationed at the PMRF.

Meteorology

The KTF lies in the rain shadow of Mounts Kawaikini and Waialeale. This part of the island is sheltered from the predominant northeast tradewinds and as such is one of the driest sections of Kauai. Average rainfall is just over 20 in./yr, mostly occurring between October and April. Under normal conditions, winds are generally light and variable; abnormal conditions can result in gusty winds in excess of 30 knots from the south, west, or north directions. The mean monthly temperature is 70°F, with maximums in the low 90s and minimums in the mid 50s.

J.2 Significant Environmental Compliance Activities

NEPA Compliance

For the KTF, development of a comprehensive sitewide EA--"Kauai Test Facility (KTF) Environmental Assessment"--was essentially completed in 1991. This sitewide EA was submitted to the DOE for Headquarters review on April 5, 1991. DOE Headquarters comments were received in late June, 1991, and the EA was extensively revised and resubmitted on December 20, 1991. A draft proposed Finding of Significant Impact (FONSI) accompanied the revised EA.

In completing this EA, several environmental surveys were carried out. Reports included the following:

- A Green Sea Turtle Survey Report--This survey found at least 32 green sea turtles *(Chelonia mydas agassizi)* at up to five locations at the KTF. The study concluded that constructing an additional launch pad and conducting further launches similar to those conducted at the KTF since 1962 probably will not have any quantifiable effects on green sea turtles residing in waters near the KTF (IT, 1990a).

- A Botanical Survey Report--This survey identified four major vegetation types at the KTF and recommended that vehicles be kept off the beach and dunes. The report recommended moving the entire *Ophioglossum concinnum* colony (a Category 1 proposed endangered fern) to a compatible area within the PMRF because of the colony's proximity to a beach access road and its location in a frequently-mowed kiawe/koa-haole vegetation zone (IT, 1990b).

- An Ornithological Survey Report--This survey determined relative densities of bird species and identified mammalian species at the KTF (IT, 1990c).

- A Soil Sampling Report--This sampling was undertaken to delineate the extent and concentration of lead, aluminum, and beryllium in the soil at the KTF, and to determine whether the concentrations threaten human health or the environment. The soil sampling results were used to estimate the potential for future soil contaminations or human exposure from use of the KTF as a launch facility. For results of the data analysis, see IT, 1990d.

- An Archaeological Survey and Sampling--This survey found no significant cultural resources on the surface at the KTF, but subsurface testing within one area indicated a potential for subsurface cultural resource materials (Gonzalez and Berryman, 1990).

Data from these letter reports were incorporated into the KTF EA.

The "KTF Two Experiment Rocket Campaign Environmental Assessment" was published in April 1991 (DOE, 1992) after a FONSI was issued on March 6, 1991.

The 2 DOE KTF EAs written or approved in 1991 and their approval status are listed in Table J-1.

Table J-1. 1991 KTF DOE NEPA Approval Status

Title	EA to DOE	FONSI
<u>EAs</u>		
Kauai Test Facility Two Experiment Rocket Campaign	01/10/91	3/06/91
Kauai Facility Sitewide EA	04/05/91	Pending

In addition to the two DOE National Environmental Policy Act (NEPA) EAs written in 1991, SNL participated in reviewing, commenting, and providing technical assistance in the preparation of the U.S. Department of Defense (DoD) experimental launches proposed for the KTF. The DoD Strategic Defense Initiative Organization (SDIO) completed the EA for the "Zest Flight Test Experiments" and issued a FONSI on July 25, 1991. The DoD will use data gathered from the two Zest flights to develop space-based sensors essential to SDIO's strategic defense effort. DOE accepted the DoD Zest EA and did not require a separate DOE EA or FONSI.

In addition to the Zest EA, a Strategic Targeting System (STARS) EIS is being prepared by the US Army Strategic Defense Command. The purpose of the STARS launches (up to four each year for 10 years) is to test nonnuclear elements of the Strategic Defense Initiative (SDI). SNL's Rocket Systems and Data Analysis Department provided technical assistance to support the DoD assessment effort. NEPA review and related support was provided through SNL's Risk Management and NEPA Division.

Pursuant to DOE Order 5400.1, "General Environmental Protection Program," a "Kauai Test Facility Environmental Monitoring Plan" (EMP) was drafted in September 1991. This EMP will provide a comprehensive description of planned and ongoing environmental activities at the KTF and demonstrate compliance with regulatory requirements imposed by applicable federal, state, and local agencies. The EMP will also support DOE environmental management decisions for the facility.

Environmental Permits

Air

There are no PSD or National Emission Standards for Hazardous Air Pollutants (NESHAP) sources for the facility and no air permits are held either by the DOE for the KTF or by DoD for the PMRF. However, the two electrical generators at the KTF are permitted by the State of Hawaii to monitor air emissions.

Water

Wastewater is treated onsite by a wastewater treatment system consisting of septic tanks and leach fields into brackish water. The limited quantities of sewage released from the KTF do not impact any protected water. Periodic drainage of septic tanks is accomplished by State of Hawaii licensed contractors who dispose of wastes according to state regulations. The facility currently holds two permits for the two septic tanks on the site.

Solid Waste

The PMRF holds a Resource Conservation and Recovery Act (RCRA) Interim Status Permit for treatment and storage of hazardous waste. The KTF, as a tenant of the PMRF, is a small-quantity hazardous waste generator. These small quantities of hazardous chemical wastes are disposed of according to the PMRF tenant agreement. The PMRF also transports nonhazardous solid waste to the county landfill.

One or two rocket explosions near a launch pad have scattered debris in close proximity to the pads. All debris was collected and disposed of according to the PMRF program.

1991 Release Reporting

All of the 1991 releases from KTF are air emissions of lead (Pb) as results of Rocket System tests. The reportable quantity (RQ) for lead is one pound. The release reporting was initially made by KTF staff to the Pollution Prevention and Environmental Monitoring Department (7725) at SNL, Albuquerque. The final reporting was then made by SNL, Albuquerque, to the National Response Center (NRC) by telephone reporting and in written reports. Table J-2 lists the 1991 release reports from the KTF.

Table J-2. Summary of 1991 RQ Release Reporting

Date	Location	Material	Quantity	RQ	Site of Release	NRC No.	Report Date
02/19/91	KTF	Lead	3.7 lb	1.0 lb	Air	60241	02/19/91
04/17/91	KTF	Lead	20.4 lb	1.0 lb	Air	68398	04/17/91
09/02/91	KTF	Lead	46.0 lb	1.0 lb	Air	86659	09/02/91
09/11/91	KTF	Lead	46.0 lb	1.0 lb	Air	87974	09/11/91

J.3. Environmental Restoration and Monitoring Program

There is no routine environmental monitoring program for the KTF because of the nature of the operations occurring at the site. However, special sampling and monitoring are done on a case-by-case basis. The Environmental Restoration (ER) Program has performed a preliminary assessment (PA) of the KTF to identify sites where past spills or releases might have caused environmental degradation. Two sites were identified: the Drum Rock Area and Photo Laboratory Discharges area.

J.4 Other Compliance Activities

Spill Prevention and Control Countermeasure (SPCC) Plan

SNL at KTF is part of the PMRF Spill Prevention and Control Countermeasure (SPCC) Plan which provides support in the event of a diesel fuel spill from the 10,000-gal aboveground fuel tank just outside the compound.

Underground Storage Tanks

Underground storage tanks (USTs) at SNL, Kauai Test Facility (KTF), are managed in accordance with the State of Hawaii interim UST regulations and the Federal UST Regulations 40 CFR 280/281.

The KTF has only one UST in its inventory (666C). This state of the art UST system was placed in service in August 1991 and is registered with the State of Hawaii as a DOE owned, SNL UST system.

Toxic Substances Control Act

Under the Toxic Substances Control Act (TSCA), oil-containing electrical and mechanical equipment and hydraulic-fluid-containing systems must be assumed to be polychlorinated biphenyl (PCB)-containing systems unless sampling and analysis show otherwise. The transformers on the KTF site have been tested and shown to be free of PCBs.

REFERENCES

Gonzalez, T., and J. Berryman, 1990. "Archaeological Survey and Testing, Department of Energy, Kauai Test Facility," prepared for Sandia National Laboratories, Albuquerque, NM.

Helgesen, R. F., 1990. "Safety Assessment for the Kauai Test Facility at Barking Sands, Kauai," SAND89-2548, Sandia National Laboratories, NM.

International Technology Corporation (IT), 1990a. "A Survey of the Green Sea Turtle Population Fronting the Kauai Test Facility, Pacific Missile Range, Barking Sands, Kauai: An Analysis of Potential Impacts with Implementation of the Strategic Defense Initiative."

International Technology Corporation (IT), 1990b. "Botanical Survey of the Kauai Test Facility Site, Barking Sands, Kauai, Hawaii," prepared for Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1990c. "Ornithological Survey Report of the Kauai Test Facility Site, Barking Sands, Kauai, Hawaii," prepared for Sandia National Laboratories, Albuquerque, NM.

International Technology Corporation (IT), 1990d. "Soil Sampling Program for Sandia National Laboratories, Kauai Test Facility, Kauai, Hawaii," prepared for Sandia National Laboratories, Albuquerque, NM.

Sandia National Laboratories, 1986. "Environmental Report, Proposed IRBS Facilities, Kauai Test Facility," prepared by Sandia National Laboratories, Albuquerque, NM, for the DOE.

U.S. Department of Energy (DOE), 1992. "Kauai Test Facility Two Experiment Rocket Campaign," DOE/EA-0492, DE91 008894, DOE Albuquerque Operations, Albuquerque, NM.

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