SAND--90-0301

DE91 004987

SAND90-0301
Unlimited Release
Printed May 1990

Distribution
Category UC-~~630~~ 702

1989 ENVIRONMENTAL MONITORING REPORT SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NEW MEXICO

S. Hwang, G. Chavez, J. Phelan, A. Parsons
G. Yeager, D. Dionne, B. Schwartz, T. Wolff
J. Fish, C. Gray, D. Thompson

ES&H Directorate 3200
Sandia National Laboratories
Albuquerque, New Mexico 87185

ABSTRACT

This 1989 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 documentation, environmental permits, environmental restoration, and various waste management programs for Sandia National Laboratories in Albuquerque (SNL, Albuquerque) are included. The maximum offsite dose impact was calculated to be 8.8 x 10^{-4} mrem. The total Albuquerque population received a collective dose of 0.097 person-rem during 1989 from SNL, Albuquerque, operations. As in the previous year, SNL, Albuquerque, operations in 1989 had no adverse impact on the general public or on the environment. This report is prepared for the U.S. Department of Energy in compliance with DOE Order 5400.1.

ACKNOWLEDGMENTS

This report was compiled by the staff of the Environment, Safety and Health Directorate (3200) of Sandia National Laboratories, Albuquerque. R. Gomez and R. Hamilton of the Radioactive and Mixed Waste Division (3222) assisted in the environmental sample collection. C. Massey, A. Solow, and T. Roybal of Division 3222, R. Helgese, L. Marlman, and K. Molley of Division 3221, and M. Irwin of Division 3223 assisted in providing information for waste management activities and compliance assessments. K. Gruelich of the Industrial Hygiene Division (3211) assisted with the radiological sample analyses. W. Booker of IT Corporation provided the Quality Assurance results for non-radiological analyses. J. Fish of Division 3222 assisted in the editorial review, and J. Meloche of Division 7537 provided photography for use in this report. G. J. Smith, Manager of Environmental Programs Department (3220), performed the technical review of this report.

CONTENTS

CONTENTS
(Continued)

CONTENTS
(Concluded)

FIGURES

TABLES

TABLES
(Continued)

TABLES
(Continued)

TABLES
(Concluded)

ABBREVIATIONS

System International Prefixes

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

Units

cm	centimeter	kg	kilogram
°C	degree Celsius	L	liter
ft	feet	lps	liters per second
gpd	gallons per day	m	meter
gpm	gallons per min	mi	mile
g	gram	min	minutes
h	hour	ml	milliliter
ha	10,000 square meters	% moisture	weight percent of water
in.	inch	s	seconds
J	Joule	yr	year

Symbols

σ	statistical variance	>	greater than
s	standard deviation	<	less than
$\bar{x}$	mean value	β	beta particle
s_x	standard error of the mean	α	alpha particle
P	statistic probability		

Nuclide Symbols for Frequently Referenced Nuclides and Components

Ar	argon	S	sulphur
Cs	cesium	U	uranium
Co	cobalt	^{238}U	principal component of depleted uranium
K	potassium		
Kr	krypton	U_{tot}	total uranium
PCB	polychlorinated biphenyl	U_{nat}	natural uranium
HTO	tritiated water vapor	Xe	xenon
^3H	tritium		

Radioactivity measurements

Ci	curie (unit of radioactivity)
person-rem	radiation dose to population
mR	milliroentgen (unit of radiation exposure)
mrem	millirem (unit of radiation dose)

ABBREVIATIONS (Continued)

Water Quality Measurements and Abbreviations

Cl	chloride ion
CN	cyanide
CN_T	cyanide - total
CNamenable	cyanide amenable to chlorination
CWL	chemical waste landfill
F	filtered water
MCL	maximum contaminant level
MWL	mixed waste landfill
NTU	nephelometric turbidity unit
pH	hydrogen ion concentration, a measure of acidity
S	suspended solids
SP.Cond	specific conductivity (mhos/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
TTO	total toxic organics
WLEL	water level elevation above mean sea level

Acronyms

ACRR	Annular Core Research Reactor
ADM	Action Description Memorandum
ALARA	as low as reasonably achievable
AMO	Albuquerque Microelectronics Operations
AQCR	Air Quality Control Regulations
CAA	Clean Air Act
CAM	continous air monitor
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CWA	Clean Water Act
CWL	chemical waste landfill
DCP	direct current plasma
DCG	derived concentration guide
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
ECF	Explosive Components Facility
EIS	environmental impact statement
EIS/ODIS	Effluent Information System/On-site Discharge Information System
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ES&H	Environment, Safety and Health

ABBREVIATIONS (Continued)

Acronyms

FONSI	Finding of No Significant Impact
GFAA	graphite furnace atomic adsorption
GPP	General Plant Projects
HEPA	high efficiency particulate air
HWMF	Hazardous Waste Management Facility
ICP	inductive coupled plasma
KAFB	Kirtland Air Force Base
LANL	Los Alamos National Laboratory
LDR	Land Disposal Restriction
LLW	low-level radioactive waste
MCA	multi-channel analyzer
MDL	minimum detectable level
MW	mixed waste
NAAQS	National Ambient Air Quality Standards
NAPL	nonaqueous phase liquid
NBS	National Bureau of Standards
NCC	National Climatic Center
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NMEID	New Mexico Environmental Improvement Division
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	National Response Center
NSPS	New Source Performance Standards
NTS	Nevada Test Site
OSHA	Occupational Safety and Health Administration
PBFA	Particle Beam Fusion Accelerator-II
PCB	polychlorinated biphenyl
POTW	publicly-owned treatment works
QA	quality assurance
QC	quality control
R&D	research and development
RAM	Radiological Air Monitor
RCRA	Resource Conservation and Recovery Act
RMWMF	Radioactive and Mixed Waste Management Facility
RPD	relative percent difference
RQ	reportable quantity
SARA	Superfund Amendment and Reauthorization Act
SC	Special-Case
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 incident (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
SNL	Sandia National Laboratories

ABBREVIATIONS (Concluded)

Acronyms

SPCC	Spill Prevention Control and Countermeasure
SPR	Sandia Pulsed Reactor
STL	Simulation Technology Laboratory
SWMU	Solid Waste Management Unit
TLD	thermoluminescent dosimeter
TRU	transuranic
TSCA	Toxic Substances Control Act
TSDF	Treatment Storage and Disposal Facility
UST	underground storage tank
VOC	volatile organic compound
WIPP	Waste Isolation Pilot Plant
WIPPWAC	Waste Isolation Pilot Program Waste Acceptance Criteria
XRF	x-ray fluorescence

CHAPTER 1

EXECUTIVE SUMMARY

1.1 Assessment of Environmental Compliance Activities

Background

Sandia National Laboratories, Albuquerque (SNL, Albuquerque), operates in compliance with environmental requirements established by Federal and State statutes and regulations, Executive Orders, the U.S. Department of Energy (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 the U.S. Environmental Protection Agency (EPA), the State of New Mexico Environmental Improvement Division (NMEID), Bernalillo County, and the City of Albuquerque (Section 3.2). The following summarizes the compliance status of SNL, Albuquerque, with the major environmental statutes.

Comprehensive Environmental Response Compensation and Liability Act (CERCLA)--SNL, Albuquerque, has negotiated with the other potentially responsible part involved in an offsite National Priorities List (NPL) location to reimburse the EPA for completed remedial actions. SNL, Albuquerque, has not been nominated for the NPL and does not expect to be in the future. Thus, all Environmental Restoration (ER) Program activities will be directed by a Resource Conservation and Recovery Act (RCRA) Corrective Action permit provision.

Clean Air Act (CAA)--From the Albuquerque/Bernalillo County Air Quality Control Board, SNL, Albuquerque, periodically receives open-burning permits as well as top soil 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 air emissions (subpart C), and asbestos emissions (subpart M). In April 1989, SNL, Albuquerque, obtained an NESHAP permit for radionuclides during the modification of the Particle Beam Fusion Accelerator (PBFA) II in Area IV.

Clean Water Act (CWA)--SNL, Albuquerque, has five wastewater discharge permits from the City of Albuquerque for sanitary sewer discharges and has resolved past minor violations of the permits with the City of Albuquerque. Two surface impoundments are permitted and 65 septic tanks are registered with the NMEID. The NMEID has ruled that several categories of low volume and/or clean wastewater surface discharges require no discharge plans.

National Environmental Policy Act of 1969 (NEPA)--SNL, Albuquerque, is committed to the principles and practices underlying the National Environmental Policy Act of 1969 (NEPA); in 1989, there was a major increase in NEPA compliance. New guidance procedures were initiated. The number of Action Description Memorandums (ADMs) increased by 100 percent, and five environmental assessments (EAs) are under preparation for submittal to the DOE.

Resource Conservation and Recovery Act (RCRA)--SNL, Albuquerque, has inactive chemical waste landfills (CWL), mixed waste landfills (MWL), a storage facility, and a thermal treatment facility which are all permitted under interim status. Minor RCRA violations have been resolved with the State. The RCRA Part B Hazardous Waste Permit Application was deemed administratively complete by the State, and an informal public hearing was held on the application. Review of the permit application for technical adequacy is underway. A revised Part A permit application for hazardous waste and mixed waste was prepared for submission to the NMEID. An interim status permit was prepared for mixed waste storage and submitted to the DOE on February 9, 1990. At present, fifty-two underground storage tanks (USTs) are registered with the NMEID.

A groundwater monitoring compliance order was issued by the State. Corrective actions have been implemented. An agreement with the State concerning remaining corrective actions was completed on December 29, 1989, and signed on January 11, 1990.

The potential release sites identified by the ER Program will be evaluated and corrected as required by the RCRA 3004(u), Corrective Action for Releases from Solid Waste Management Units. A schedule for this corrective action will be a part of the final RCRA Part B permit.

Current Issues and Actions

Mixed Waste Authority (RCRA)--SNL, Albuquerque, recently submitted a Part A permit application for mixed waste (MW) storage and treatment to the DOE. The DOE will submit the Part A application to the NMEID in calendar year 1990. As a matter of policy, SNL, Albuquerque, will comply with RCRA requirements for all storage and treatment activities.

Groundwater Monitoring (RCRA)--The State issued a Notice of Violation for groundwater monitoring violations in 1989, and since 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 NMEID was signed on January 11, 1990, to close the Compliance Order. The Compliance Agreement included revising the Sandia Sampling and Analysis Plan, installing a fourth downgradient monitoring well, and characterizing the uppermost aquifer at the CWL. SNL, Albuquerque, is currently working toward fulfilling the compliance agreement requirements.

Low-Level Radioactive Waste (LLW) and Mixed Waste (MW) Disposal--SNL, Albuquerque, will submit an application to the Nevada Test Site (NTS) for disposal of both Low-Level Radioactive Waste (LLW) and MW in 1990. 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 (LDR)--In 1984, Congress amended the 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 will be implemented, forbidding the land disposal of hazardous waste that does not meet prescribed treatment standards. The DOE has submitted a 2-yr national capacity variance for MW.

1.2 Assessment of Radiological Impact for the Public

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 for ^{3}H, gross alpha (α) and beta (β), total uranium, and gamma isotopic in surface water, groundwater, soil, and vegetation. These samplings and analyses are performed around Albuquerque at SNL, perimeter, and community locations. All levels measured in 1989 in public areas were consistent with the average local radiation background levels measured in previous years.

A total of 8.8 Ci of ^{41}Ar, 0.6 Ci of ^{133}Xe, 0.2 Ci each of ^{13}N and ^{15}O and μCi amounts of ^{3}H and depleted uranium were released as a result of SNL, Albuquerque, operations in 1989. The maximum whole-body dose calculated for an offsite residence is 8.8×10^{-4} mrem, less than 0.004 percent of the 25 mrem/yr dose limit specified in NESHAP standards and DOE Orders (Appendix G, Table G-1). The total Albuquerque population received a collective dose of 0.097 person-rem during 1989 from SNL, Albuquerque, operations, whereas it received greater than 40,000 person-rem from natural background radiation (Chapter 5).

1.3 Overview of 1989 Monitoring Results

Radiological Monitoring

All of the 1989 radiological 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.

Background levels of ^{137}Cs from worldwide fallout were detected in vegetation and soil samples. Values in vegetation ranged from less than the minimum detectable level (MDL) to 0.18 pCi/g. Values in soil ranged from 0.01 to 0.88 pCi/g. Total uranium in soil ranged from 2.0 to 2.9 μg/g of dry soil. There was no statistical difference in results from SNL, perimeter, and community locations. They were consistent with naturally occurring uranium concentrations reported for soils in this area (LANL, 1981; Masada, 1964).

Concentrations of ^{3}H and ^{137}Cs in regional surface and well waters were less than the MDL and are therefore well below DOE DCGs. Gross α and β concentrations are used for screening purposes since no DCG values are available for them. The levels in well waters were below the screening levels of EPA primary drinking water standards (40 CFR 141) and required no investigation actions.

In 1989, external penetrating radiation doses for the Albuquerque community area averaged 93 mrem/yr as measured by the SNL, Albuquerque, environment thermoluminescent dosimeter (TLD) monitoring system. This is the natural background radiation dose rate for the region attributable to terrestrial and cosmic radiation. There was no statistically significant difference between the three Albuquerque locations (SNL, Albuquerque, perimeter, and community) in the 1989 TLD results (Chapter 5).

Nonradiological Monitoring

Wastewater--Discharges by SNL, Albuquerque, to publicly-owned treatment works (POTW) are regulated by the City of Albuquerque. During 1989, SNL, Albuquerque, operated under five wastewater discharge permits issued by the City. A sixth permit was obtained in August 1989. Detailed results are listed in Appendix F.

The 1989 wastewater monitoring results were within the permit conditions except for a few cases of pH, fluoride, and copper exceedances (Chapter 6). Some of the pH excursions were due to equipment malfunction. The corrective actions were taken after the problems were identified.

The annual 24-hr composite sampling for all parameters specified in the City permits was conducted during June 1989. The results were all less than the concentration limits established by the permits. The results are summarized in Appendix G, Table G-3.

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 Area IV was approved in March 1988 and amended in December 1989 by the State. Monthly water level measurements and quarterly analysis were all within the parameters and concentration limits specified in DP-530. Quarterly reports that include the surface water sampling and analyses were submitted to the NMEID Ground Water Bureau.

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 onsite. Airborne emissions sampling was performed according to permit specifications. During 1989, a beryllium air emission test was performed for the Building 869, Toxic Machine Shop. The results were all within the regulatory limits specified in 40 CFR 61 Subpart C for beryllium emission. A SNL-wide inventory of air emissions was started in October 1989. This inventory will survey estimated quantities of potentially hazardous air pollutants and associated control and stack information. The inventory is expected to be completed in 1990.

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, Inc., provides service to the U.S. Government on a nonprofit, no-fee 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 and uranium; 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 KAFB East, with co-use agreements on some Air Force 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 a low of 1,500 m at the Rio Grande River to a high of 3,255 m at Sandia Crest, which is in the Sandia Mountains adjacent to Albuquerque. KAFB is at a mean elevation of 1,630 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 1980 census figures show an Albuquerque population of 331,767 (U.S. Department of Commerce, Bureau of the Census, 1981). The Isleta Indian Pueblo, which borders KAFB on the south, is the next nearest population center with a 1980 census of 1,872. An estimated total population of 450,000 people lives within an 80-km radius of KAFB (U.S. Department of Commerce, Bureau of the Census, 1981). This includes permanent residents of KAFB living in the KAFB housing areas.

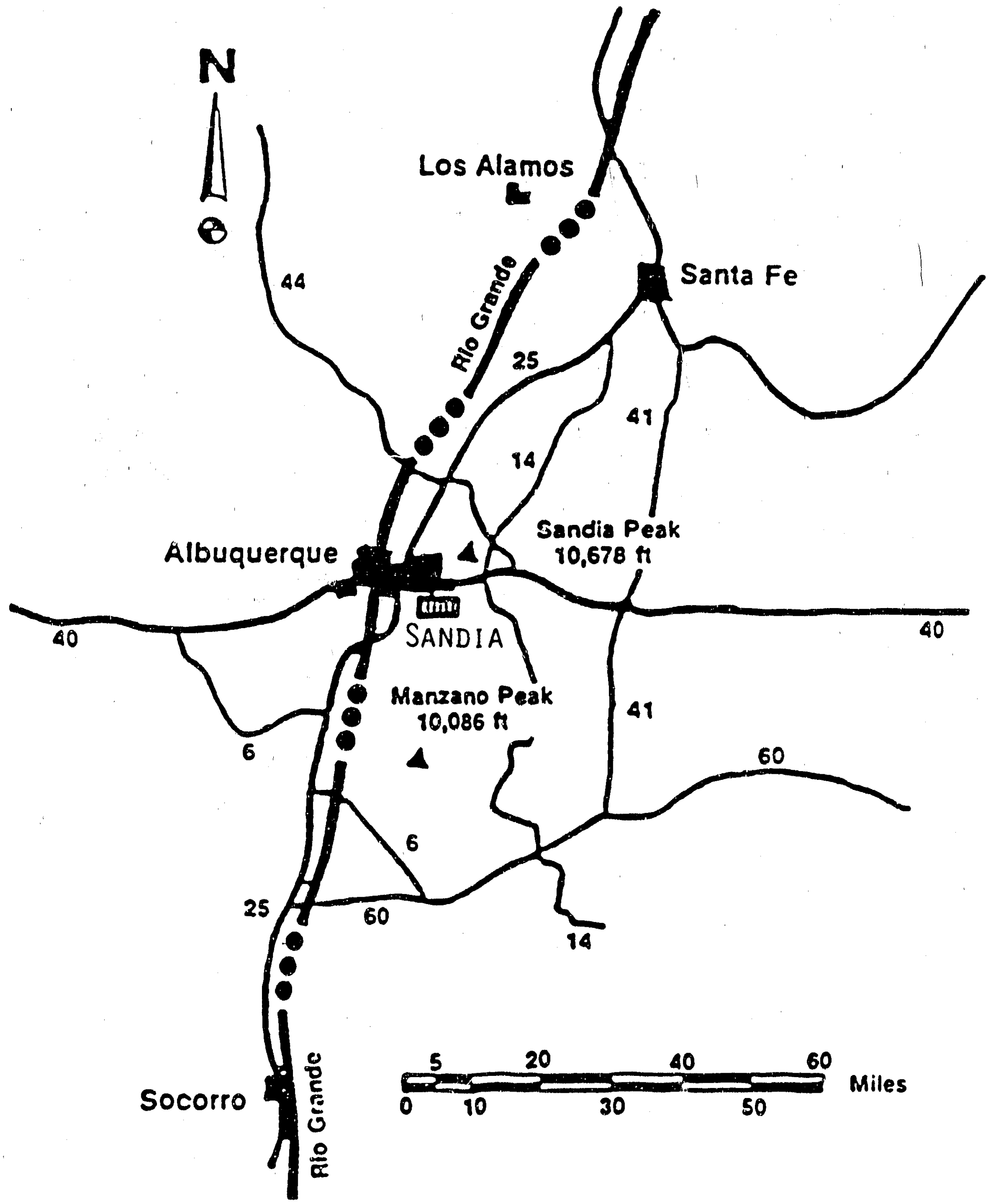

Figure 2-1. Albuquerque Site Regional Setting

2.3 Climate and Meteorology

Albuquerque temperatures are characteristic of high altitude, dry, continental climates (Appendix A). Daily temperatures are wide-ranging, although temperature extremes such as -18°C and 38°C occur infrequently (Table A-1). Daytime temperatures during the winter average near 10°C. Maximum summer daytime temperatures average less than 32°C except in July, when the maximum reaches 34°C. 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 less than 5 cm of precipitation normally recorded. The average annual relative humidity is about 43 percent (Table A-2), although the humidity drops to less than 20 percent in April, May, and June. Strong winds, often accompanied by blowing dust, occur mostly in late winter and early spring (NOAA, 1983; 1968). 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). Rapid nighttime ground cooling produces strong temperature inversions as well as strong drainage winds down Tijeras Canyon.

Table 2-1 summarizes meteorological data for 1989. The total annual precipitation of 12.1 cm for 1989 was 8.5 cm below the 30-yr annual average of 20.6 cm (see Appendix A, Table A-1).

2.4 Geology

The SNL, Albuquerque facilities are located within the Albuquerque Basin, which is bounded by the Sandia, Manzanita, and Manzano Mountains to the east and the Lucero and Jemez uplifts (or mesas) to the west. The Albuquerque basin consists of approximately 12,000 ft of Miocene-Pliocene-Santa Fe alluvial and colluvial sediments. The basin deposits were formed by a complex mixture of aeolian, channel, debris flow, levee, and floodplain mechanisms.

The general stratigraphy of sediments consists primarily of deposits of sands and gravels interbedded with silt and clay rich zones. The observation of sequences fining upward in the stratigraphy is important in that typically these deposits have lenticular shapes in cross section. The nature of the cross sections observed in the drilling activities confirmed the presence of sedimentary deposits and silt and clay rich zones, which were discontinuous across the site.

2.5 Hydrology and Biology

The major hydrologic surface feature in Central New Mexico is the Rio Grande River, which runs north-south through Albuquerque and is approximately 8 km west of KAFB (Albuquerque District Corps of Engineers, 1979). Rio Grande water is primarily used for irrigation of agricultural crops. There are no continuously running streams on KAFB. Tijeras Arroyo has intermittent flow during heavy thundershowers.

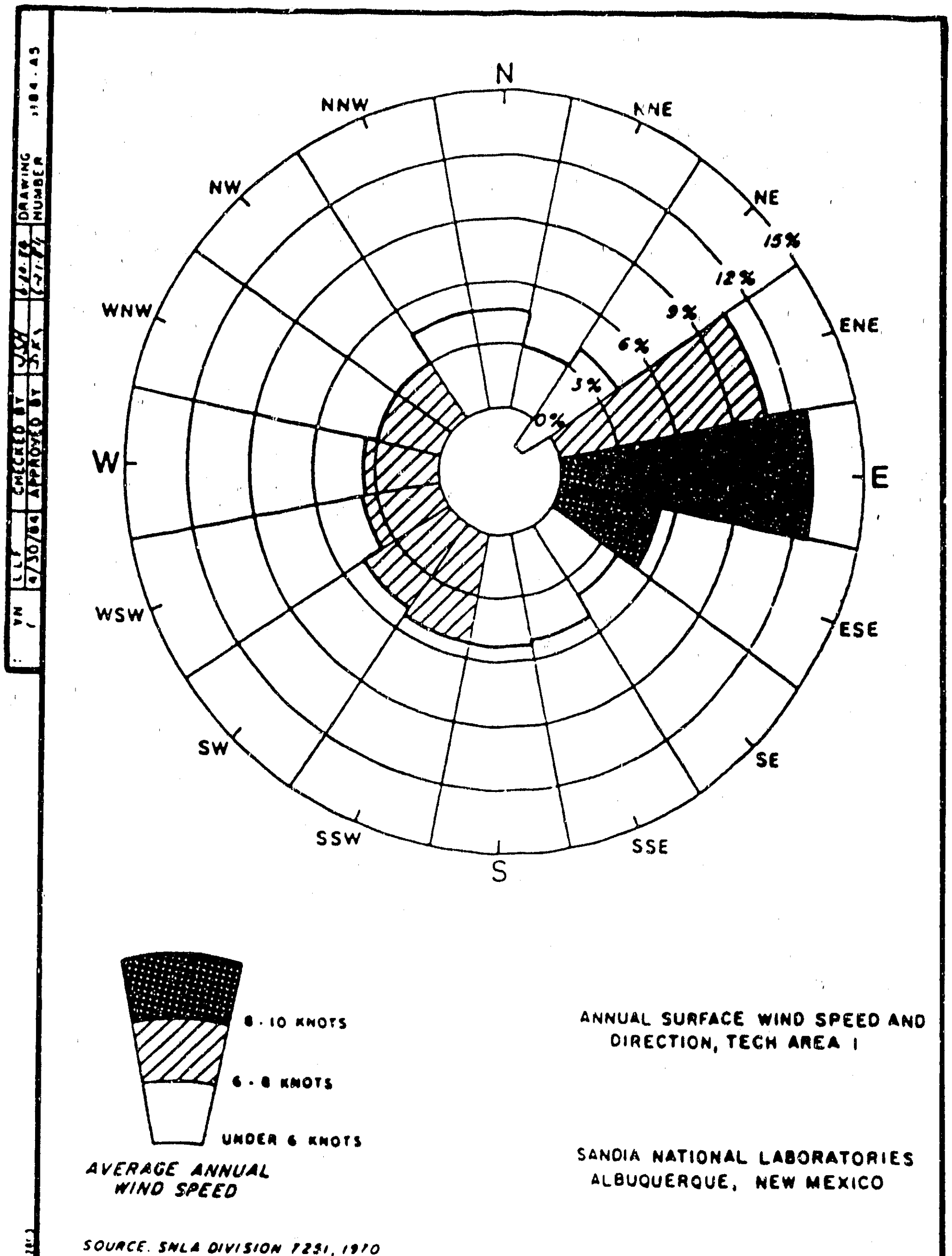

Figure 2-2. Annual Surface Wind Speed and Direction, Technical Area I

Table 2-1. Summary Meteorological Data for the Albuquerque Area in 1989

Month	Temperatures (°C) Daily Range Min	Max	Precipitation (cm) Water Equivalent	Wind Speed m/s	Direction
Jan	-5.0	8.8	0.82	3.7	N
Feb	-1.7	12.7	0.89	4.0	NW
Mar	2.6	20.4	1.22	4.0	SW
Apr	7.2	25.4	T*	5.0	W
May	11.4	29.5	0.05	5.3	S
Jun	15.9	32.5	0.05	5.2	SE
Jul	18.3	33.4	3.83	4.2	SE
Aug	16.5	30.4	1.22	4.2	SE
Sep	13.3	28.2	0.79	4.2	SE
Oct	6.5	20.8	2.46	3.6	N
Nov	0.3	15.7	T	3.8	N
Dec	-5.3	8.7	0.71	3.1	N

*T = trace.

The uppermost aquifer underlying the site is approximately 480 ft below the ground surface. Some perched aquifers have been detected in the zone between the main aquifer and the ground surface. Although no drilling has been performed, it is possible that the entire 12,000 ft of the Santa Fe formation contains groundwater.

The groundwater underlying SNL facilities is separated into two systems by major faulting. The Hubble Springs, Tijeras, and Sandia faults separate the hydrogeology into a somewhat deep region west of the fault systems and a much shallower region on the east side. The CWL and many of the SNL facilities are located west of the fault systems in the area of deeper groundwater.

West of the fault systems, the groundwater flows in a northwesterly direction. Prior to the growth of the City of Albuquerque, the flow was reported to be more westerly. Albuquerque provides all of its drinking water from the groundwater, and pumping from municipal supply wells has significantly altered the flow direction.

The hydrology east of the fault systems is poorly understood because there are a limited number of water supply wells, no monitoring wells, and the geology between the fault systems and the mountains is very complex. The SNL facilities located in this area are generally in the canyons of the Manzanita Mountains. The groundwater flow would typically be out of the canyons and toward the fault systems.

The municipal and domestic water needs of the Albuquerque vicinity are supplied by deep wells. These wells range from 148 to 365 m in depth, with an average depth of 305 m.

New Mexico has low precipitation, wide temperature extremes, frequent drying winds, heavy showers with erosive effects, and erratic seasonal distribution of precipitation. This 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 2-3. Figure 2-4 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.

2.6 Technical Areas

SNL, Albuquerque (Figure 2-5), consists of five technical areas and several additional test areas. Each area has its own distinctive operations. The following is a brief description of the activities in each area and a summary of potential sources for radioactive and nonradioactive effluent releases.

Area I

Area I has the largest employee population: approximately 5,000. 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 laboratories and shops used by administrative and technical staff. Generally, the only potential radioactive release from Area I is tritium (^3H) from two laboratory sources; however, no ^3H was released from these stacks in 1989. Potential sources for nonradioactive effluents include the paint shops, toxic machine shop, process development lab, emergency diesel generator plant, solvent spray booth, foundry, and steam plant.

Area II

Area II is a small facility used for explosive testing. Microcurie amounts of tritium may be released each year from component testing. Techniques for measuring fractures in geologic strata are developed at this facility. Also located in Area II are an inactive LLW disposal site, a small

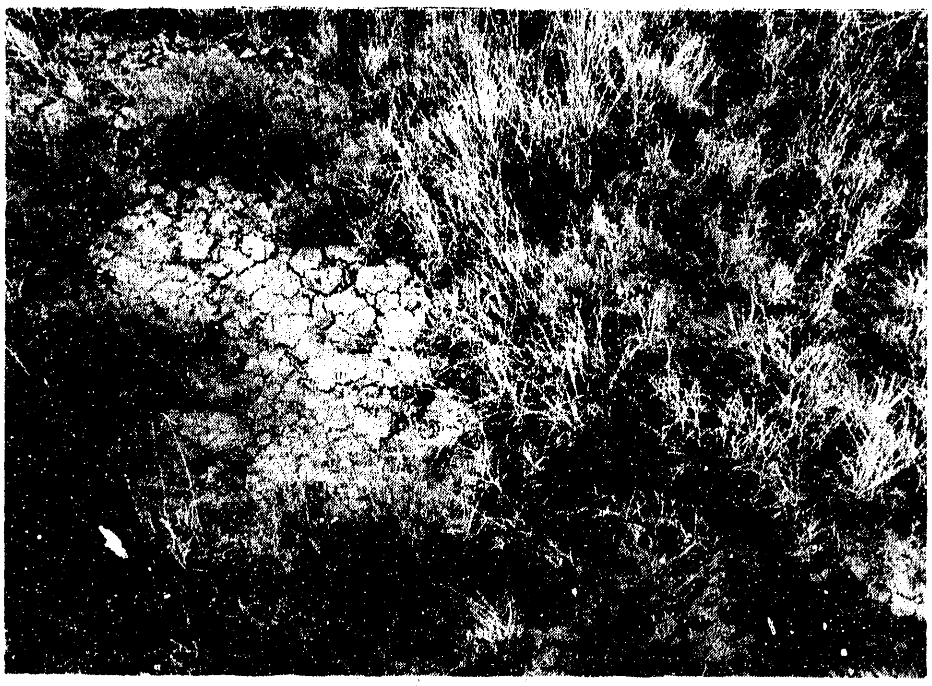

Figure 2-3. Mesa Vegetation

Figure 2-4. Manzano Foothills Vegetation

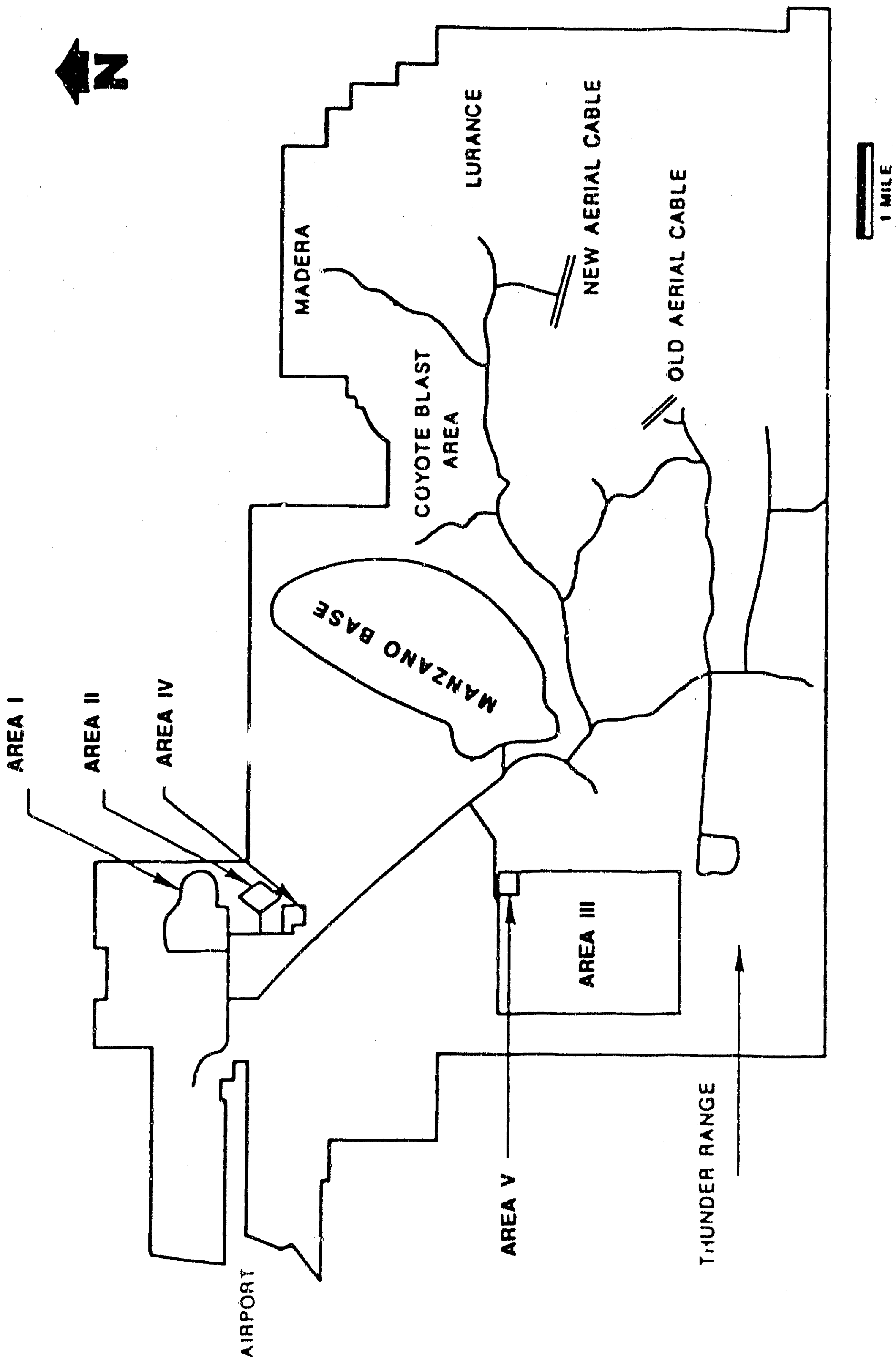

Figure 2-5. SNL, Albuquerque, Technical Areas (I-V) and Remote Areas

radioactive material decontamination and storage facility, 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 Area II. This facility will integrate many of the existing Area II activities as well as some remote testing activities currently performed in other test areas.

Area III

Area III is located 8 km south of 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 1989, there was a total of four NIKE motor tests that released 3.73 lb of lead per test at the sled-track area. Other facilities in Area III include a paper incinerator, an inactive LLW and MW disposal site, a large melt facility, and a Melting and Solidification Laboratory.

The inactive radioactive waste disposal site in Area III consists of two adjoining fenced areas that occupy approximately 0.6 ha (SNL, Albuquerque, 1989). 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 waste disposal. The site is scheduled for closure by 1991. It 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 the late fiscal year 1990. This new facility is located at the south end of Area III adjacent to the inactive chemical disposal site.

An inactive hazardous waste disposal and storage site is located near the southern boundary of Area III (SNL, Albuquerque, 1989). 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 Area I, has been in use since 1988.

Area IV

Area IV 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 HT) will be released from fusion research efforts starting 1991. A large accelerator facility, the Simulation Technology Laboratory (STL), houses seven pulsed power accelerators: HERMES III, RLA, TROLL, STF, SPEED, HYDRAMITE, and in 1989, PROTO II. Several of these accelerators have been transferred from Area V. HERMES III became operational in 1988. Another new accelerator facility, SATURN, was also completed in 1987. There were minimal radioactive releases from these facilities in 1989. A major new research facility, the Strategic Defense Facility (SDF), is under construction and will be operational by 1990. During 1989, radioactive emmissions from this facility were short-lived radionuclides, primarily ^{13}N and ^{15}O.

Area V

Area V houses large electron beam accelerators, three research reactors in two reactor facilities, an intense gamma irradiation facility (using ^{60}Co and ^{137}Cs), and a hot cell facility. The largest accelerator is HERMES II. These facilities have been transferred to Area IV except for HERMES II. No tritium was released in 1989, nor has there been for several years due to the nature of current research efforts.

The two research reactor facilities in Area V are quite dissimilar: the Sandia Pulsed Reactor (SPR) is an unreflected, unmoderated assembly of enriched uranium; 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 ^{133}Xe. The reported amount of ^{41}Ar, released from both reactor areas, was computed from reactor operating parameters. The reported releases from both reactors for 1989 were very small (8.8 Ci) and were not significantly different from previous releases.

Remote Test Areas

SNL, Albuquerque, also has test areas outside of the five technical areas. These areas are located south of Area III and in canyons on the west side of the Manzano Mountains. Coyote Canyon and Thunder Range are two examples of such areas (Figure 2-5). In these remote areas, wild animals including snakes, deer, coyote, and owl are often present. Figures 2-6, 2-7, 2-8, and 2-9 show the presence of some of these wild animals near the Coyote test field, Thunder Range, and Solar Tower areas.

Depleted uranium is infrequently spread over limited areas during explosive testing in these remote test areas. The test areas are surveyed following each test, and contaminated materials are collected and disposed in accordance with DOE requirements. Environmental monitoring is done as necessary. Operations in these areas are, in addition, administratively controlled to avoid uranium contamination to public areas beyond the confines of KAFB.

Figure 2-6. A Group of Deer at the Main Burn Site in Coyote Test Field

Figure 2-7. Coyote Wandering Near Solar Tower, Technical Area III

Figure 2-8. An Owl Sitting on a Telephone Pole Near Thunder Range

Figure 2-9. Deer at Coyote Canyon

CHAPTER 3

SUMMARY OF SIGNIFICANT ENVIRONMENTAL ACTIVITIES

The environmental compliance activities at SNL, Albuquerque, are administered by the newly formed 1989 Environmental Programs Department 3220. The Department consists of three divisions: 3221, Hazardous Waste and Wastewater Division; 3222, Radioactive and Mixed Waste Division; and 3223, Environmental Impact and Restoration Division. This chapter summarizes all significant environmental compliance activities that occurred during 1989.

3.1 NEPA Compliance and Documentations

The NEPA, the nation's most comprehensive legislative and public policy statement on environmental protection, applies to all agencies of the Federal government. Executive and DOE orders apply NEPA and NEPA-related activities to SNL, Albuquerque. The Council on Environmental Quality (CEQ) was created in the Executive Office of the President under the authority of NEPA. CEQ regulations were formally adopted by the DOE in August 1979.

Environmental documents serve as vehicles for presentation and review of the environmental issues associated with projects. Division 3223 of the Environmental Programs Department consults and trains line organizations in NEPA, coordinates NEPA document preparation, maintains a corporate NEPA document file, and reviews all NEPA documents before their submittal to the DOE.

1989 Activities

In late 1989, a staff member was assigned full-time to NEPA coordination for SNL, Albuquerque. An assessment of compliance and guidance procedures was performed to improve document quality and to eliminate situations where delays could cause undue pressure to expedite work. A Sandia Compliance Strategy and NEPA Compliance Guide was prepared as a result of the assessment. The guidance was designed to improve document quality and expedite the review process.

At the DOE's request, a standard operating procedure was written in November 1989 for the preparation of ADMs and permitting procedures for burn tests. The documents outlined procedures to streamline the process for approving ADMs and open burning permits.

The status of NEPA documentation at SNL, Albuquerque, from January 1, 1985, through August 1989 was reviewed at the direction of the DOE. Active General Plant Projects (GPP) were reviewed for NEPA compliance in December 1989.

Consistent with a U.S. Department of Energy, Albuquerque Office (DOE/AL) memorandum of April 17, 1989, archaeological surveys for all construction projects were prepared through Facilities Engineering. The survey reports have been integrated into NEPA documentation.

In 1989, SNL, Albuquerque, initiated a program to increase employee awareness of NEPA responsibilities. The training initiative culminated in a day-long workshop held on November 30, 1989, titled "Compliance With the National Environmental Policy Act."

Environmental Assessments (EAs)

The primary role of an Environmental Assessment (EA) is to determine the potential impact of a proposed action on the human environment. An EA is a "concise public document" that is intended to provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a Finding of No Significant Impact (FONSI). EAs are being written for a number of facilities at SNL, Albuquerque. These documents are designed to (1) reduce the number of ADMs needed, and (2) facilitate the application of appropriate categorical exclusions. EAs are currently being prepared for these facilities:

- The Kauai Test Facility; this EA is expected to be sent to the DOE in June 1990.
- The Lurance Canyon Burn Site; the draft EA was sent to the DOE in May 1990.
- The ECF; this EA is expected to be completed by August 1990.
- The Integrated Materials Research Laboratory; the EA was submitted to the DOE in April 1990.
- The Radioactive and Mixed Waste Management Facility (RMWMF); the EA was submitted to the DOE in February 1990.

Action Description Memoranda (ADMs)

ADMs are used by the DOE to the determine the appropriate level of NEPA documentation for proposed actions and to support memo-to-file reviews. The number of ADMs written in 1989 increased and the quality of the documents written improved as a result of activities to increase NEPA awareness. The 26 ADMs written or approved in 1989 and their approval status are listed in Appendix I, Table I-1. Between 1988 and 1989, there was a 100 percent increase in the number of ADMs submitted to the DOE for approval.

3.2 Environmental Permits

The following are the laws and regulations under which environmental permits are held by SNL, Albuquerque, as part of its commitment to full compliance with all applicable environmental laws and regulations.

A. Air

The Clean Air Act (CAA) is enforced by the NMEID and the joint Albuquerque/Bernalillo County Air Quality Control Board. They regulate the following:

1. National Ambient Air Quality Standards (NAAQS);
2. NESHAP, except for the radionuclide NESHAP, which is administrated 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; and
6. Top soil disturbance permits.

B. Water

1. The Clean Water Act (CWA) 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 point sources; and
   c. Spill Prevention Control and Countermeasure (SPCC) Plan.
2. Sanitary Sewer Regulations are based on Federal pretreatment standards and promulgated by the City of Albuquerque.
3. Wastewater discharge regulations are administered by the NMEID.
4. Groundwater monitoring regulations of RCRA are also administered by the NMEID.

C. Solid Waste

1. The Federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 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 and nonhazardous solid waste.

   a. Chemical hazardous waste is regulated by the RCRA.

   b. USTs for hazardous substances are regulated by the RCRA.

   c. Documented waste minimization programs are required by the RCRA.

   d. Land disposal restrictions are applied by the RCRA for an increasing number of chemical wastes.

   e. Radioactive MW is dually regulated by the Atomic Energy Act and RCRA.

3. The New Mexico Hazardous Waste Act allows the NMEID to promulgate regulations equivalent to or more stringent than Federal regulations to manage RCRA hazardous waste. While SNL and DOE disagrees, the NMEID is expected to receive authority to regulate MW from the EPA in 1990.

4. The New Mexico Solid 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, including PCBs.

Summary of the Status of Current Permits and Other Notifications

Table 3-1 lists the current environmental permits issued to SNL, Albuquerque, and those that are in the process of being reviewed by various agencies. Besides these environmental permits, notifications were made to the City of Albuquerque regarding asbestos removal (NESHAP - Subpart M) and beryllium emission/relocation (NESHAP - Subpart C). Also, several projects were evaluated for applicability of NESHAP - Subpart H to facilities in Area V. Sixty-five septic tanks were registered with the NMEID, as required by the State discharge regulations, on May 9, 1989.

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	06/30/90
2069 C-2	Wastewater	WW003	City of Albuquerque	06/30/90
2069 D-2	Wastewater	WW004	City of Albuquerque	06/30/90
2069 E-2	Wastewater	Albuquerque Microelectronics Operation	City of Albuquerque	06/30/93
2069 F	Wastewater	WW006	City of Albuquerque	06/30/90
2069 G	Wastewater	Microelectronics Development Laboratory	City of Albuquerque	07/31/91
2069 H	Wastewater	Process Development Laboratory	City of Albuquerque	In process
2069 I	Wastewater	14th Street Sewer	City of Albuquerque	In process
DP-530	Wastewater	Area 4 Lagoons	State of New Mexico	03/08/93
NM5890110518	HW	958, 959	NMEID (USEPA)	In process
4/7/89	NESHAP-Subpart H	PBFA II (Area IV)	USEPA	No expiration date
Various	Open burning	Various	City of Albuquerque	Specific for each burn
Various	Top soil disturbance	Various	City of Albuquerque	Specific for each construction

3.3 Environmental Monitoring Programs

The Environmental Monitoring and Compliance Program at SNL, Albuquerque, is administered by the Environmental Programs Department 3220 to ensure compliance with pertinent environmental regulations. The environmental monitoring program at SNL, Albuquerque, was begun in 1959. Its principal objective is to monitor radioactive effluents and associated environmental impacts resulting from SNL, Albuquerque, operations. The program has

expanded greatly to encompass nonradioactive effluents as well as hazardous and radioactive waste management and other environmental compliance activities. The growth of the program is 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 last three years 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).

The radiological monitoring programs which consist of environmental surveillance on soil, vegetation, surface water, and well water and external radiation measurements by TLDs are summarized in Chapter 5. The sampling locations are reviewed and modified, if necessary, each year to reflect any operational changes.

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

3.4 Summary of 1989 Release Reporting

Reporting Requirements

There are three types of release reporting requirements: (1) Reportable Quantity (RQ) release reporting, (2) the Radioactive Effluent Information System/Onsite Discharge Information System (EIS/ODIS) Annual Report, and (3) the NESHAP for Radionuclides (Subpart H) Annual Report.

RQ Reporting

RQ reporting is regulated by CERCLA and Superfund Amendment and Reauthorization Act (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 in any 24-hr period must be reported to the NRC immediately. 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 SARA Title III.

The Annual Summary of 1989 RQ Release Reporting for SNL, Albuquerque, is listed in Table 3-2. Most of the release was caused by the use of a NIKE rocket motor, which contains lead acetate as part of the propellant in sled track tests. These tests were conducted under the approval of an ADM dated June 5, 1986.

EIS/ODIS Reporting

DOE Order 5400.1 requires that the radioactive effluent and onsite discharge data covering 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.

The EIS/ODIS report for 1989 was submitted to the Waste Information System Branch, EG&G Idaho, Inc., on March 30, 1990. It covered all the routine effluent releases (gas and liquid) from SNL, Albuquerque, operations. The

Table 3-2. Annual Summary of 1989 Reportable Quality (RQ) Release Reporting

Date	Location	Material	Quantity	RQ	Release To	NRC Number	Report Date
12/13/88	TA-III	Lead[1]	3.73 lb	1 lb	Air	00248	01/06/89
02/01/89	TA-III	Lead[1]	3.73 lb	1 lb	Air	01570	02/02/89
02/02/89	TA-III	Lead[1]	3.73 lb	1 lb	Air	01571	02/02/89
03/23/89	TA-III	Lead[1]	3.73 lb	1 lb	Air	04167	03/23/89
07/28/89	TA-III	Lead[1]	3.73 lb	1 lb	Air	13046	07/31/89
08/28/89	TA-II	Asbestos[2]	1 lb	1 lb	Ground	15214	08/28/89

[1]Lead release from NIKE rocket motor-sled track test.
[2]Asbestos was found from the insulation material stripped off from a pipe by a contractor.

major radioactive air releases were from the Area V reactors (ACRR and SPR). For 1989, SNL, Albuquerque, released a total of 8.8 Ci of ^{41}Ar, 0.6 Ci of ^{133}Xe with some ^{85}Kr, approximately 0.2 Ci each of ^{13}N and ^{15}O, and a μCi range of ^{3}H and depleted uranium. The limited liquid waste discharges from ACRR were in micro-Ci ranges of ^{24}Na, ^{51}Cr, ^{58}Co, and other fission products. All of these releases were within regulatory recommended limits.

NESHAP Reporting

NESHAP in 40 CFR Part 61 Subpart H for radionuclides requires that an Annual Report from each DOE site must be submitted to EPA by June 1 each year. The report should include the calculated maximum offsite dose impacts (whole-body dose equivalent and critical organ dose) to the public and the associated input data for this calculation (40 CFR 61.94(c)).

Although the NESHAP for radionuclides have been revised and the new standards promulgated on December 15, 1989, the report required under 40 CFR 61.94 for calendar year 1989 was still to be made in accordance with the old standards. The new requirements under the revised section of 40 CFR 61.94 for the more extended annual reporting will take effect calendar year 1990.

The dose assessment for the public due to SNL, Albuquerque, operations in 1989 is discussed in detail in Section 5.3.

Environmental Incident Form

A Sandia Environmental Incident Form (Appendix H, Table H-4) was designed to gather information regarding any unplanned releases of hazardous or radioactive material. The implementation of this internal reporting will be initiated in calendar year 1990. This form consists of Part I (seven items) and Part II (seven items) that describe detailed release information and corrective actions. All reportable and nonreportable releases will be included to ensure proper follow-up actions were taken and to prevent their recurrences.

CHAPTER 4

OTHER ENVIRONMENTAL COMPLIANCE PROGRAMS

4.1 Environmental Restoration (ER) Program

The ER Program is a phased DOE program to identify, assess, and correct past spill, release, or disposal sites at all DOE/AL 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 (DOE/AL, 1987). After completion of the Installation Assessment, additional sites have been identified, and the total number of potential release sites at Albuquerque now totals 135. The majority of the new sites identified were septic tanks and drainfields that may have received nondomestic wastes. It is anticipated that a few additional sites may be identified in the future.

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 "tasks" for budget development and program tracking purposes. Table B-1 identifies the specific potential release sites that are assigned within an individual task. Figure 4-1 shows a map with the approximate locations of the groups of sites assigned within each task.

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 will be monitored by the NMEID as a requirement of the RCRA waste management operating permit. The authority for this permit provision is from the RCRA 3004(u) requirement for the corrective action of all releases from all Solid Waste Management Units (SWMUs) located at the facility that are seeking a RCRA waste management operating permit. Since the permit is expected to be issued in 1991, the ER Program began utilizing the guidance for RCRA Corrective Action evaluations in 1989. During 1989, assessment efforts continued on one task: MWL AL-SA-RC-2. Three groundwater monitoring wells were installed to supplement one that was installed in 1988. The locations of the wells are shown in Chapter 7. In addition, a stage one assessment investigation into the potential releases from the MWL was initiated.

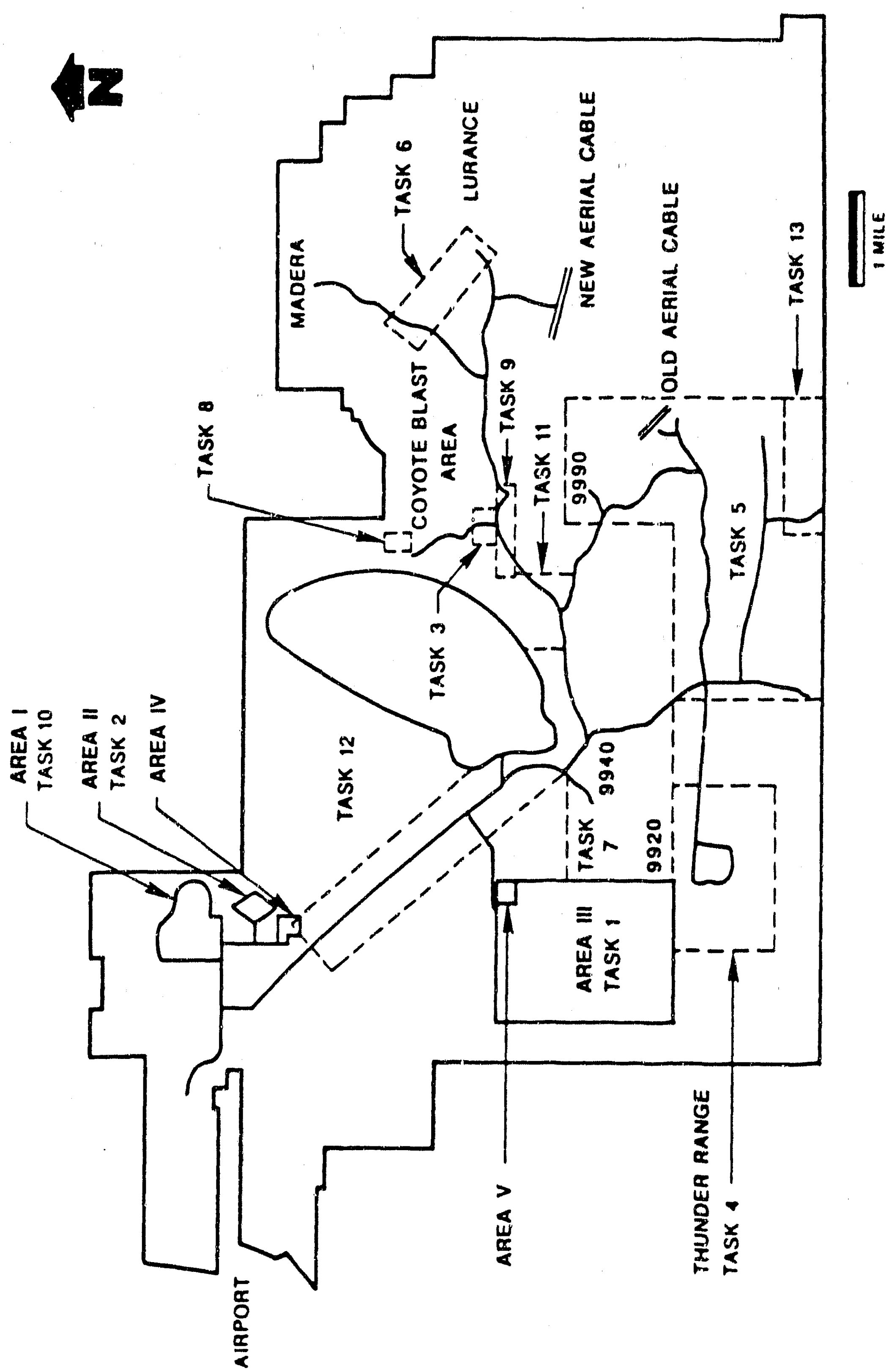

Figure 4-1. Task Map for Sandia National Laboratories, Albuquerque

4.2 Underground Storage Tanks (UST) Management and Spill Prevention Control Plan

4.2.1 Underground Storage Tanks (USTs)

USTs at SNL, Albuquerque, are managed in accordance with the State of New Mexico UST Regulations. The New Mexico UST Regulations have been written to comply with the requirements of 40 CFR Part 281 - Approval of State UST Programs.

Eight USTs were permanently closed by removal in 1989. The NMEID was notified in writing at least 30 days in advance of each removal. The NMEID was also notified by telephone 24 to 48 hr in advance of each removal. The removed USTs are listed in Appendix H, Table H-1. Every UST and excavation was inspected for evidence of release. No releases were determined to have occurred, and the NMEID was notified of this in writing for each UST closure.

Fifty-two USTs were registered at the end of 1989, including four that were previously unregistered. The registered USTs are listed in Appendix H, Table H-2. A draft Tank Management Plan was also developed in 1989. The plan will be finalized in 1990. The elements of the plan include a tank inventory; a UST upgrade prioritization schedule; and more detailed procedures for inventory control, leak detection, removal, and installation.

4.2.2 Spill Prevention Control Plan (SPCC)

Oil spill control activities at SNL, Albuquerque, are coordinated by the SPCC Plan. This plan was prepared in accordance with 40 CFR 112. According to these regulations, the plan must be reviewed and evaluated every three years. The current plan was approved in July 1987. The review and evaluation activity began in December 1989 and is scheduled for completion in June 1990. Construction activities for 1989 include the construction of secondary containment at the tank truck loading and unloading area in Technical Area I, the purchase and distribution of spill control pallets, the construction of secondary containment for drum storage at the motorpool, and the design of the secondary containment for the fuel storage tanks at the Burn Site.

4.3 Waste Management Programs

4.3.1 Mixed Waste Compliance Programs

SNL, Albuquerque, has recently submitted a Part A Permit Application for MW storage and treatment to DOE/AL for signature and submittal by DOE/AL to the State of New Mexico. Also, programs are currently being developed to meet the characterization requirements of the following regulations: RCRA Part 261 and Part 265 for MW storage, RCRA Part 268 restrictions on land disposal, DOE Order 5820.2A, and NVO-325 waste acceptance criteria for proper disposition of defense LLW and MW at the NTS. Transuranic (TRU) (including mixed TRU) waste packaging and certification procedures are being developed to meet the Waste Isolation Pilot Program Waste Acceptance Criteria (WIPP WAC).

4.3.2 Radioactive Waste

Onsite disposal of LLW was terminated in December 1988 at SNL, Albuquerque, by order of the DOE. Presently, all LLW and MW are being temporarily stored at generator sites or above ground in transport containers at the inactive Area III Disposal Site. Approximately 2,000 ft^3 of waste were accepted at the Area III storage location in 1989. The waste consisted primarily of fission product and uranium contaminated waste.

Construction of the RMWMF was begun in 1989. This 6,000-sq ft facility will serve as a centralized storage facility for generated LLW and MW at SNL, Albuquerque. Draft applications were prepared in 1989 for the offsite disposal of LLW and MW at the NTS.

Ultimately, the TRU waste generated at SNL, Albuquerque, will be disposed of at the WIPP. Currently, all generated TRU waste is packaged and stored at generator-controlled locations.

4.3.3 Special Case Waste

SNL, Albuquerque, will perform 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 waste (SC-HLI)
- Commercially held, DOE-owned materials (SC-COM)

The scope of this identification and characterization effort is significantly larger than 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 six SC waste categories above 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.

4.3.4 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 NMEID in May 1988. Negotiations with the NMEID on the closure continued during 1989. 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 Department of Transportation (DOT) hazard class, and transported to the Hazardous Waste Management Facility (HWMF) for storage. Packaged wastes are transported by EPA-permitted carriers to EPA-permitted TSDFs for disposal.

The EPA-permitted commercial transporters used to transport SNL hazardous waste during 1989 are listed in Table 4-1. The permitted TSDFs used for disposal of SNL hazardous wastes are listed in Table 4-2 along with the waste treatment methods employed at each facility.

During calendar year 1989, 179,098 kg of chemical wastes were managed by SNL's hazardous waste management program, including 127,946 kg of RCRA regulated hazardous waste and 51,152 kg of nonregulated industrial wastes. A total of 48,899 packages were collected from SNL generators in calendar year 1989, put into 4,664 containers, and sent to TSDFs in 43 shipments. The increase of approximately 20,000 kg over the volume of chemical waste managed in calendar year 1988 was partially the result of a laboratory-wide Environment, Safety and Health (ES&H) initiative conducted at SNL, Albuquerque, during the last five months of calendar year 1989. As part of the ES&H initiative, an "Orphan Chemical" Program was conducted to identify any improperly stored and labeled chemicals stored outside at SNL, Albuquerque.

In calendar year 1989, a covered waste oil storage area was built on the HWMF grounds to provide covered, bermed storage of waste oil and storage for HWMF supplies. A containment pond to hold runoff and fire-fighting water from the HWMF was completed in late 1989.

<u>Permitting Activities</u>

In 1989, NMEID conducted an informal hearing on the RCRA Permit B application by SNL, Albuquerque, with staff from EPA Region VI participating. The informal hearing was an opportunity for interested Albuquerque citizens to ask questions about and make comments on the permit application.

4.3.5 Waste Minimization and Pollution Prevention Awareness

A waste minimization and pollution prevention awareness program was initiated in 1989 to comply with both EPA regulations and DOE Order 5820.2A. It will address hazardous, mixed, and radioactive wastes.

Table 4-1. SNL, Albuquerque, Hazardous Waste Transporters* Used in CY89

1. ENSCO, INC.
2. Hazmat Environmental Group, Inc.
3. Rinchem Company, Inc.
4. Safety-Kleen Corp.
5. Star Motor Freight Lines, Inc.
6. Delta Environmental
7. Custom Environmental Transport

*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 CY89

Disposal Facility	Treatment
1. BDT, Inc.	- Hydrolysis of Reactive Metals
2. Chemical Waste Management, Inc.	- Encapsulation, Landfill
3. Conservation Services, Inc.	- Non-RCRA Waste Landfill
4. ENSCO, Inc.	- Incineration
5. Hydrocarbon Recyclers, Inc.	- Recycling
6. Rollins Env Svcs, Inc. (TX)	- Incineration
7. Rollins Env Svcs, Inc. (LA)	- Incineration
8. Safety-Kleen Corp.	- Recycling
9. USPCI (Grassy Mt., VT)	- Treatment, Encapsulation, Landfill

*Identification of these companies is not necessarily an endorsement of their services by SNL.

The diversity of the wastes and the large number of small amounts of different chemical types make source reduction difficult in many situations. Waste reduction efforts to date, therefore, have focused primarily on finding means to reclaim or reuse generated wastes using offsite technology.

Recycling and reapplication efforts will continue, with an increased emphasis on source reduction via process modifications, substitution of nonhazardous and nonradioactive materials for hazardous and radioactive materials, and segregation of hazardous and radioactive materials to avoid generation of MW.

In 1989, an analysis was commissioned to study minimizing onsite recycling of used oil and solvents. The analysis indicated that a 41 percent reduction of hazardous waste and an annual savings of greater than $50,000 could be accomplished, if implemented. The implementation will require a detailed evaluation of specific waste streams. Pending on the budget and staffing level, this evaluation will be carried out as soon as possible.

In addition, several specific HW minimization activities were carried out in 1989:

A. 166,800 kg of potassium nitrate used in solar heat-transfer experiments were shipped to a metal finishing plant for reuse. These salts would otherwise have been disposed of as RCRA-regulated waste.

B. 3,000 kg of (glycol containing) aqueous foam were donated to Albuquerque Fire Fighter Academy for use in training firefighters.

C. 450 kg of n-butyl acetate were reused as a paint thinner.

D. 250 kg of sodium were converted into sodium hydroxide and used as a neutralizer of acids.

E. 250 kg of Hg-containing switches were reapplied.

F. 250 kg of mercury were recycled.

G. A Chemical Exchange Program was initiated at SNL, Albuquerque, during the latter part of calendar year 1989. The program resulted in the reuse of 729 containers of unused, unexpired excess chemicals which would otherwise have been disposed of as hazardous waste. This reuse resulted in an estimated savings to SNL, Albuquerque, of $11,161.

H. An aqueous processing line is being installed in the new printed circuit facility to eliminate the use of chlorinated solvents.

I. An acid and base neutralization unit was installed in the HWMF. Approximately 22 percent of the hazardous wastes at SNL, Albuquerque, are acids and bases.

J. Solvent recycling/reuse during calendar year 1989 resulted in the recycling of 49,330 kg of solvents that would otherwise have been disposed of at a higher cost.

K. Other recycling/reuse initiatives resulted in a minimization of approximately 9,500 kg of chemical waste.

Radioactive waste minimization practices have included reviews of experiment and facility design to avoid generating radioactive waste or MW whenever possible. Generators are provided with guidance to prevent generating MW by materials substitution and segregation of radiation from hazardous materials. Examples of radioactive waste and MW minimization include the following:

A. Use of a nonhazardous liquid scintillation cocktail solution helped minimize radioactive waste production.

B. A review of the SDF, ECF, and RMWMF design prevented commingling of radioactive and nonradioactive waste streams and minimized the generation of liquid waste streams.

C. Separate LLW and MW compactors have been purchased for the RMWMF.

D. Disposable articles in the contaminated areas in Area IV have been replaced with anticontamination clothing consisting of rubber gloves and boots that are monitored and released after use.

E. Paper floor coverings in the same areas as above have been replaced with an extremely durable material produced by Herculite Products, Inc. This material is fire retardant, tear resistant, long lasting, and easy to decontaminate.

F. A Radioactive Materials Area has been established in Area IV to allow personnel to work on radioactive material after removing loose contamination without the use of protective clothing.

G. Refurbishment of the PBFA II stacks has been coordinated to survey and release components after wipe down prior to subsequent oiling to preclude the production of radioactive oily wastes.

H. A HEPA-filtered glove box and tent has been purchased to facilitate grinding and machining of radioactive parts in Area IV, eliminating the need for transport of material to Area II.

The previously used scintillation cocktails were considered MW. The current one can be disposed of in the sanitary sewer. The substitution has reduced MW generation by over 15 kg/yr.

4.3.6 Polychlorinated Biphenyl (PCB) Waste

SNL, Albuquerque, is in the process of phasing out PCB and PCB-contaminated equipment to the greatest extent possible. For example, all electrical distribution equipment at the laboratory is either being replaced or retrofitted. It is expected that all such equipment will contain less than a 50-ppm PCB concentration by January 1991. For non-distribution electrical devices and other equipment, an expanded PCB survey is currently being conducted to identify PCB-containing items. In 1989, over 400 items, including research electrical devices, vacuum pumps, and hydraulic equipment, were sampled for PCB content. Most contained no detectable amounts of PCBs.

All items containing any concentration of PCBs are documented and controlled by SNL, Albuquerque, and will be replaced and disposed of as soon as practical.

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). The objectives of this surveillance program are to detect the release and/or migration of radioactive material from SNL, Albuquerque, operations and to determine the resulting population exposures above normal background radiation levels. The radiological monitoring program also provides a check on the effectiveness of reactor radiological safety systems that are in effect at Area V. Radioactive effluent discharges to the environment will be kept at ALARA levels and in accordance with DOE Order 5400.5 for environmental protection. Soil, vegetation, and water are monitored for radionuclides, primarily ^{137}Cs and ^{3}H. Gross α and β screening analysis are performed on water samples. Soil samples are analyzed for uranium.

In addition to the above elements of the radiological surveillance, a program was begun in 1981 which uses TLDs to measure ambient levels of external penetrating radiation around each major facility. Before a facility's contribution to a population dose can be calculated (in the event of an unplanned release), a good estimate of ambient background with its inherent variability must be available. Natural background radiation levels are affected by many environmental factors, including ground cover and seasonal variations in precipitation and temperature.

5.1 Radioactive Effluent Monitoring

There are few facilities within SNL, Albuquerque, that routinely generate radioactive effluents or emissions. These facilities include the accelerators in Technical Area IV (e.g., HERMES-III and PBFA-II), the reactors in Technical Area V (e.g., ACRR and SPR), and the Neutron Generator Test Facility in Technical Area II. Most of these are air emissions. A small quantity of radioactivity is released as liquid effluent from the ACRR Reactor cooling tank.

Small quantities of ^{3}H, ^{41}Ar, ^{85}Kr and ^{133}Xe emissions have been released to the atmosphere as a result of SNL, Albuquerque, operations. Because SNL's 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's) and the conversion factor for the activation products (in uCi/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 1975 to 1989.

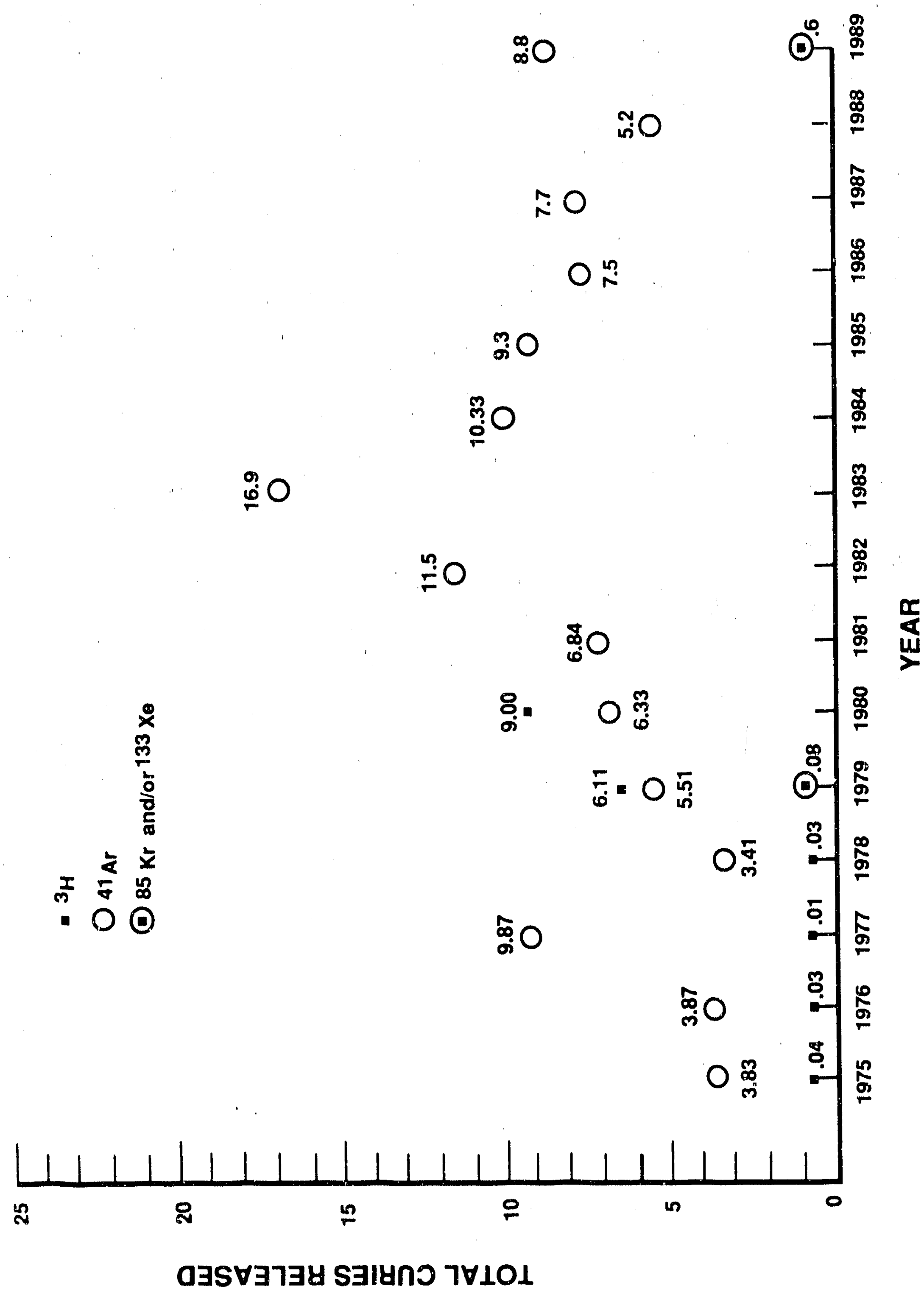

Figure 5-1. Summary of Atmospheric Release of ^{41}Ar, ^{3}H, ^{85}Kr, and ^{133}Xe From Sandia-Albuquerque Facilities Since 1975

Technical Area V Reactors

Only noble gases are released from Area V reactor stacks. HEPA filters are used to filter out particulates from SPR, ACRR, and Hot Cell exhaust air. Charcoal filters are used to collect noble gases from the SPR and ACRR stack exhaust air. Gamma scans are performed on the filters to check for activity. 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 by theory.

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 for gamma-emitting particulates using a multi-channel analyzer (MCA).

The ACRR reactor filter banks also consist of a prefilter, HEPA filter, and charcoal filter. ACRR has two exhaust stacks. The main room stack in the high bay is equipped with two continous air monitors (CAMs), a particulate and a gaseous air monitor, as well as a RAM which is located on the HEPA filter housing. Gamma-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 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 MCA analysis can also be collected.

The Area V Hot Cell Facility filter banks are equipped with a prefilter and HEPA filter. 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.

In 1989, two sets of isokinetic sampling equipment were purchased. One was installed within the main stack of the Hot Cell Facility to collect air samples; the other one will be installed in the ACRR stack. Both of these air samplers will become operational in 1990. Therefore, routine effluent sampling and analyses will be performed and reported in future environmental monitoring reports.

5.2 Environmental Sampling and Surveillance

Monitoring Locations

The SNL, Albuquerque, environmental surveillance locations (Figures 5-2 and 5-3) remain essentially the same from year to year. The selection of these sampling locations was based on all potential releases, past contamination areas, and other potential impacts to the offsite residents and the surrounding environment. Monitoring locations are changed as necessary to

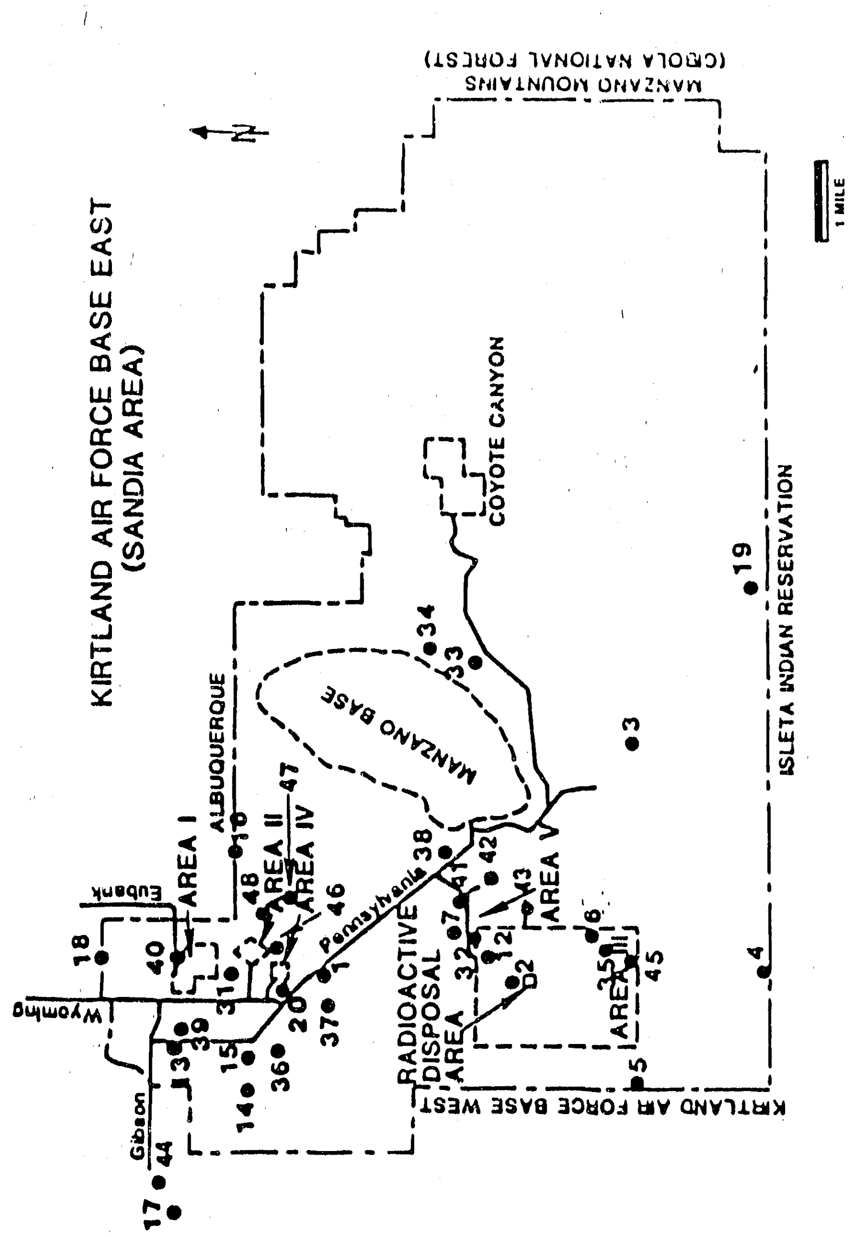

Figure 5-2. Environmental Monitoring Locations in Technical Area I-V and KAFB

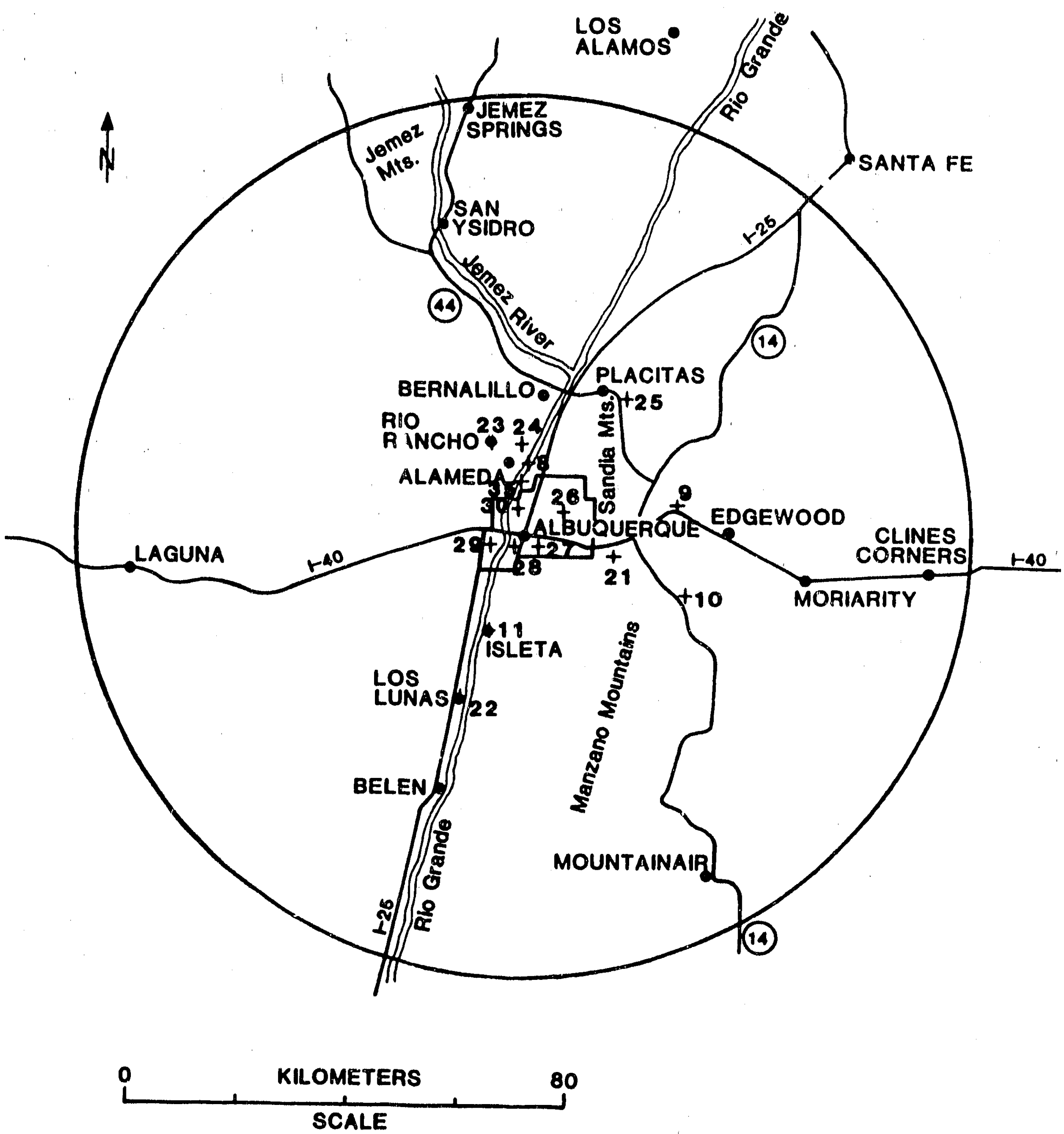

Figure 5-3. Community Monitoring Locations in the Albuquerque Area

accommodate facility changes. Three new TLD locations were added in 1987. They were located at the north, east, and south radiation control fence lines surrounding Area V. Additional TLD stations were placed in Area IV in 1988 to monitor radiation levels at new facilities. Groundwater samples for radiological analysis are collected from base wells in use at the time of sample collection, and the sampled wells may differ from one year to the next.

Table 5-1 lists the SNL, Albuquerque, environmental monitoring locations and specifies the type of sample collected (vegetation, water, soil) or the presence of a TLD station for each location. There are a total of 52 sampling locations (Table 5-1). Thirty-one locations (labelled as S) are onsite at SNL, Albuquerque; seven are on KAFB boundaries (labelled as P), and 14 are community or background sites (labelled as C) distributed in and around Albuquerque within an 80-km radius of SNL, Albuquerque. Water monitoring locations include nine KAFB wells and three surface water locations.

Location 8 is a surface water sampling location on the Rio Grande River upstream of the SNL, Albuquerque, facilities. It provides control data for comparison with Location 11, a downstream Rio Grande sampling location. Location 49, near the proposed ECF is a new sampling site designed to monitor the background before the operation of the ECF site. TLD Station 32 was eliminated in October 1989, because it was inside the Area V radiation control fence (at the east corner of the SPR security fence) and does not serve the purpose of environmental monitoring for that area.

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 (SNL, Albuquerque, 1986). Native vegetation (mostly grasses), soil, and water samples are collected annually at the end of the growing season. These procedures are described in Appendix C. Detection Limits for each type of radio-chemical analysis are included in Appendix D.

A total of 82 samples was submitted for tritium and gamma spectrometry analysis in 1989. Fifty-two samples were analyzed for uranium. Seventy-six water and filter samples were screened for gross α and β. Sampling frequencies are summarized in Table C-1.

Monitoring Results

Appendix F lists the monitoring results for all sample locations. Calculated summary data tables are included and discussed in the following paragraphs. MDL values were set equal to the MDL in the calculation of mean ($\bar{x}$) values.

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

Location Number	Location	Sample Description*	Type**
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	Area III, SE	S	V,S,T
*** 7	Arroyo, N Area III	S	V,S,T
8	Corrales Bridge	C	V,S,W
9	Sedillo Hill, I-40 E of Albuquerque	C	V,S
10	Oak Flats	C	V,S,T
11	Isleta Pueblo, Rio Grande	C	V,S,T,W
12	Area III Well	S	W
13	Base Well 1	S	W
14	Base Well 2	S	W
15	Base Well 7 (Not running)	S	W
***16	Four Hills	P	V,S,T
17	Base Well 14	S	W
18	North Perimeter Road	P	T
19	Seismic Center Gate	P	V,S,T
20	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 Street	C	T
24	Corrales Fire Station	C	T
25	Placitas Fire Station	C	V,S,T
26	Alb. Fire Station 9, Menaul NE	C	T
27	Alb. Fire Station 11, Southern SE	C	T
28	Alb. Fire Station 2, High SE	C	T
29	Alb. Fire Station 7, 47th NW	C	T
30	Alb. Fire Station 6, Griegos NW	C	T
31	Area II Guard Gate	S	T
***33	Coyote Springs	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	Area I NE by 852	P	T
41	Area V, NE fence	S	T
42	Area V, E fence	S	T
43	Area V, SE fence	S	T
44	Base Well 12	S	W
45	RMWMF Site	S	V,S
46	AII 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

*S = Sandia, P = Perimeter of Sandia, C = Community.
**V = Vegetation, S = Soil, W = Water, T = TLD (Thermoluminescent Dosimeters).
***Triplicate sampling sites:
5, 6, 7, 16 for V and S.
33 for W only

Vegetation

Table F-1 gives concentrations of ^{3}H, ^{137}Cs, and ^{40}K in vegetation (primarily grass species) for 18 SNL, eight perimeter, and five community samples. Table 5-2 compares the mean concentrations and respective standard deviations, as well as ranges, for ^{3}H and ^{137}Cs in vegetation for the three types of sampling locations. The ^{137}Cs concentrations ranged from <MDL values to 0.18 pCi/g. Eighteen samples had above MDL ^{137}Cs. Tritium concentrations, reported as pCi per ml of extracted water, ranged from <MDL to 16.5 pCi/ml. The reported ^{137}Cs concentrations (Table 5-2) are consistent with fallout levels. The ^{137}Cs concentrations at the three locations were not significantly different. The reported ^{3}H concentrations fall within the range of background ^{3}H levels for this area, except Station 2 (NE) at the inactive radioactive waste disposal site and Station 33 at Coyote Spring. These two locations have historically shown higher than background values.

Table 5-2. Mean Concentrations of ^{3}H and ^{137}Cs in Vegetation

			Concentration		
Nuclide	Location	Sample Size	Mean ($\bar{x}$)*	Standard Deviation (s)	Range
^{3}H (pCi/ml)	Sandia	18	1.55	3.78	0.45 to 16.5
	Perimeter	8	0.61	0.28	0.45 to 1.1
	Community	5	≤0.45	**	≤0.45
	Total	31	1.08	2.89	<0.45 to 16.5
^{137}Cs (pCi/g)	Sandia	18	0.09	0.09	<0.03 to 0.18
	Perimeter	8	0.06	0.05	<0.02 to 0.14
	Community	5	0.03	0.01	≤0.02 to 0.03
	Total	31	0.05	0.04	<0.02 to 0.18

*^{137}Cs <MDL values were used in calculations of $\bar{x}$.
**s not calculated since most values were less than 0.45.

Soil

Concentrations of uranium and ^{137}Cs and ^{3}H in soil samples are reported in Table F-2 for 18 SNL, eight perimeter, and five community samples. Table 5-3 summarizes the mean concentrations, respective standard deviations, and

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

			Concentration		
Nuclide	Location	Sample Size	Mean ($\bar{x}$)	Standard Deviation (s)	Range
Uranium ($\mu g/g$)	Sandia	18	2.4	0.3	2.0 to 2.9
	Perimeter	8	2.5	0.2	2.0 to 2.7
	Community	5	2.5	0.2	2.3 to 2.8
	Total	31	2.45	0.3	2.0 to 2.9
^{137}Cs (pCi/g)	Sandia	18	0.50	0.15	0.10 to 0.70
	Perimeter	8	0.32	0.30	0.01 to 0.88
	Community	5	0.25	0.32	<0.02 to 0.79
	Total	31	0.41	0.22	0.01 to 0.88
^{3}H (pCi/ml)	Sandia	18	5.6	2.7	1.8 to 11.2
	Perimeter	8	7.3	0.9	6.3 to 8.6
	Community	5	7.4	1.7	5.5 to 9.4
	Total	31	6.3	2.3	1.8 to 11.2

range of values for radionuclides in each of the three types of sampling locations.

Uranium concentrations in soil ranged from 2.0 to 2.9 $\mu g/g$ and are consistent with natural background levels. Differences between locations were not statistically significant. The ^{137}Cs concentrations ranged from <0.01 to 0.88 pCi/g and appear to reflect fallout levels of ^{137}Cs. Tritium concentrations ranged from 1.8 to 11.2 pCi/ml. Concentration differences between locations were not statistically significant. The uranium and ^{137}Cs concentrations were very close to those of past years, while the ^{3}H concentrations were lower compared to the ^{3}H results in 1988.

Water

Concentrations of gross α, β, ^{137}Cs, ^{3}H, and uranium in water are reported for all sample locations in Tables F-3 and F-4 for both total (unfiltered) water (T) as well as filtered water (F) and associated suspended solids (S). Table F-3 lists concentrations in surface waters while Table F-4 lists concentrations in groundwater. Tables 5-4 and 5-5 summarize the water sampling results for both well and surface water locations.

Table 5-4. Mean* Concentrations of Gross α, Gross β, Uranium, ^{137}Cs and ^{3}H in Surface Water (Streams)

Analysis (Units)	Total Water $\bar{x} \pm s$**	Filtered Water $\bar{x} \pm s$**	Suspended Solids $\bar{x} \pm s$**
Gross α (10^{-9} μCi/ml)	<2.8	<3.2	<0.7
Gross β (10^{-9} μCi/ml)	<21	<19.6	<0.4
Uranium (10^{-3} μg/ml)	<1.5	<1.5	-
^{137}Cs (10^{-9} μCi/ml)	<0.01	<0.01	-
^{3}H (10^{-6} μCi/ml)	<0.45	<0.45	-

*Summary data for three surface water locations. Individual values are in Appendix F, Table F-3.
**Standard deviation s values were not calculated because all results are less than detection levels.

Gross alpha, β, uranium, and ^{137}Cs concentrations in water were all less than MDL values and are consistent with background levels and results of previous years.

TLD

Table 5-6 gives the summary of annual TLD dose estimates for SNL perimeter, and community locations noted in Table 5-1. Data for individual locations are in Appendix F, Table F-5. These estimates include natural background plus facility contributions (if any). The mean annual doses for 12 community and seven perimeter (SNL, Albuquerque, boundary) locations were 93 mrem and 98 mrem, respectively. The mean annual dose at locations adjacent to onsite facilities was 116 mrem/yr. The mean annual external penetrating radiation dose for all location types was 103 mrem/yr, which is not statistically different from the values of perimeter and community locations (Table 5-6).

There was no significant difference between the three location types in annual dose estimates. The onsite annual dose estimate is higher than perimeter and offsite areas primarily due to location 41. Location 41, on

Table 5-5. Mean* Concentrations of Gross α, Gross β, Uranium, ^{137}Cs and ^{3}H in Groundwater (Base Wells).

Analysis (Units)	Total Water $\bar{x} \pm s$**	Filtered Water $\bar{x} \pm s3$**	Suspended Solids $\bar{x} \pm s$**
Gross α (10^{-9} μCi/ml)	<3.5	<2.8	<0.03
Gross β (10^{-9} μCi/ml)	<18.5	<18.5	<0.4
Uranium (10^{-3} μg/ml)	<1.5	<1.5	-
^{137}Cs (10^{-9} μCi/ml)	<0.01	<0.01	-
^{3}H (10^{-6} μCi/ml)	<0.45	<0.45	-

*Summary data for five well water locations. Individual values are in Appendix F, Table F-4.
**Standard deviation, s values were not calculated because all results are less than detection levels.

Table 5-6. Summary of TLD Measurements**

Location	Sample Size	Mean Annual Dose (mrem/yr) $\bar{x}$	$s_{\bar{x}}$	Range
Sandia (S)	13	116	13	90 to 277*
Perimeter (P)	7	98	4	85 to 111
Community (C)	12	93	3	79 to 109
Total	32	103	5	79 to 277

*Location 41 - on the radiation control fence, NE of Area V.
**Detailed results are listed in Appendix F, Table F-5.

the radiation control fence northeast of Area V, was significantly higher than other SNL, Albuquerque, locations. These higher values can be attributed to controlled operations at the HERMES-II accelerator in Area V. The mean annual dose from all other 12 onsite locations averaged 102 ± 9 mrem/yr.

5.3 Potential Dose Assessment for the Public

A radiation dose assessment of the public residing near the site from routine operations at SNL, Albuquerque, was performed using the AIRDOS-EPA computer code for the calendar year 1989. All doses presented in this section are based on the RADRISK model for dose rate conversion and are calculated for the compliance purposes of NESHAP (40 CFR 61, Subpart H) regulations and DOE Order 5400.1

As indicated in Section 5.1, there are few facilities within SNL, Albuquerque, that 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 dose is the only radiological dose impact to the offsite residence from routine operations at SNL, Albuquerque.

Release Sources

The radioactive air emissions from SNL, Albuquerque, during calendar year 1989 include ^{41}Ar (8.8 Ci) and ^{133}Xe (0.6 Ci) from the reactors (ACRR, SPR) in Area V; ^{13}N (0.23 Ci) and ^{15}O (0.21 Ci) from the HERMES-III accelerator in Area IV; ^{3}H (in micro-Ci) from neutron generator testing in Area II; and very small quantities of depleted uranium from Area III and Area I. Most of these emissions are too small to measure by instruments. Therefore, they are estimated by very conservative calculations. The airborne radioactive emission sources are summarized in Table 5-7.

Meteorological Data

The meteorological data used in the dose calculations for SNL, Albuquerque, is 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 1960 to 1964 inclusive for Albuquerque, New Mexico. All of these 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 AIRDOS-EPA gridded zones (total of 80). In

Table 5-7. Summary of Airborne Radioactive Emissions

Facility	Nuclide	Half-Life	Activity Released in 1989
ACRR*	Ar-41	1.8 h	8.1 Ci
	Xe-133	5.2 d	0.6 Ci***
SPR*	Ar-41	1.8 h	0.7 Ci
HERMES III*	N-13	10.0 m	0.23 Ci
	O-15	122.0 s	0.21 Ci
935 (A-II)	H-3	12.3 y	<50 μCi**
9939 (A-III)	U-238	4.5×10^9y	<10 μCi**

*The amounts released were calculated based on theoretical parameters and conservative assumptions.
**The amounts were estimated based on previous experiences.
***The 0.6 Ci quoted is mostly Xe-133, although there may be a small portion of Kr-85.

general, demographic data is 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 1989 calculations, the 1980 Census and the 1988 agricultural data were utilized. A total of 422,711 people, 31,038 beef cattle, 6,618 dairy cattle, and 2.4×10^8 m^2 of food crops were used from the surrounding nine counties.

Results of the Dose Assessment

Doses were calculated using the AIRDOS-EPA computer code and the RADRISK model for two groups of receptors around SNL, Albuquerque. The first group is the seven historical receptors analyzed in the previous monitoring reports (Table 5-8) including NW Base Housing, Four Hills, N Base Housing, the DOE Complex, the communities of Mountain View and Tijeras, and the Isleta Gate. Excluding the Isleta Gate, the remaining six receptors have residents or offices. The highest individual dose among these six receptors is 6.0×10^{-4} mrem at the DOE/AL office complex.

The second group (Table 5-9) lists additional receptors at potential maximum public impact locations (where there is a residence, school, business, or office) as required by 40 CFR 61.94, "Compliance and Reporting" of the NESHAP regulations. The second group includes Tijeras

Table 5-8. 1989 Dose Calculations of the Seven Historic Receptors for Sandia National Laboratories, Albuquerque

Location	Distance From A-V	Direction Degrees	Whole Body Dose mrem/yr x 10^{-3}
1. NW Base Housing W. Penn. Ave. S. Gibson NW Site Boundary	5.8 km	337° NW	0.48
2. Four Hills By TLD Station NE Site Boundary	5.6 km	26° NE	0.41
3. N Base Housing N. of Gibson E. of Wyoming N Site Boundary	6.1 km	350° N	0.55
4. TLD Station NW DOE Complex NW Site Boundary	6.2 km	339° NW	0.60
5. "Mountain View" W. of KAFB Community	11.2 km	268° W	0.10
6. "Tijeras" E. of KAFB Community, near TLD (Intersection I-40/S-14)	16.0 km	54° NE	0.06
7. "Isleta Gate" S. Site Boundary By TLD Station	5.7 km	180° S	1.0

Arroyo, the City Landfill, the airport (west end), the SE corner of NW Base Housing, the Eubank Gate, NE and E residents, Isleta Mine and W residences. The locations of these receptors are shown in Figure 5-4.

The highest offsite dose impact for 1989 operations was 8.8 x 10^{-4} mrem/yr at the Tijeras Arroyo receptor, located about 200 m west of the western (SNL, Albuquerque boundary) KAFB boundary. The maximum critical organ dose was calculated to be 8.3 x 10^{-4} mrem/yr to the lungs at the Tijeras Arroyo

Table 5-9. Radiation Doses to Public Receptors Surrounding SNL, Albuquerque, for 1989

	Dose (mrem)/yr*							
Location	Whole-Body	Red Bone Marrow	Lung	Endostom	Stomach Wall	Lower Large Intestine	Thyroid	Liver
Tijeras Arroyo	$.88 \times 10^{-3}$	$.43 \times 10^{-3}$	$.83 \times 10^{-3}$	$.58 \times 10^{-3}$	$.39 \times 10^{-3}$	$.40 \times 10^{-3}$	$.51 \times 10^{-3}$	$.40 \times 10^{-3}$
City Landfill	$.36 \times 10^{-3}$	$.17 \times 10^{-3}$	$.31 \times 10^{-3}$	$.23 \times 10^{-3}$	$.16 \times 10^{-3}$	$.16 \times 10^{-3}$	$.21 \times 10^{-3}$	$.16 \times 10^{-3}$
Airport (West End)	$.82 \times 10^{-3}$	$.38 \times 10^{-3}$	$.84 \times 10^{-3}$	$.55 \times 10^{-3}$	$.35 \times 10^{-3}$	$.34 \times 10^{-3}$	$.45 \times 10^{-3}$	$.36 \times 10^{-3}$
SE Corner of NW Base Housing	$.76 \times 10^{-3}$	$.37 \times 10^{-3}$	$.70 \times 10^{-3}$	$.50 \times 10^{-3}$	$.37 \times 10^{-3}$	$.33 \times 10^{-3}$	$.44 \times 10^{-3}$	$.38 \times 10^{-3}$
Eubank Gate	$.69 \times 10^{-3}$	$.33 \times 10^{-3}$	$.67 \times 10^{-3}$	$.46 \times 10^{-3}$	$.31 \times 10^{-3}$	$.30 \times 10^{-3}$	$.40 \times 10^{-3}$	$.31 \times 10^{-3}$
NE Resident	$.22 \times 10^{-3}$	$.95 \times 10^{-4}$	$.31 \times 10^{-3}$	$.17 \times 10^{-3}$	$.87 \times 10^{-4}$	$.83 \times 10^{-4}$	$.11 \times 10^{-3}$	$.89 \times 10^{-4}$
E Resident	$.58 \times 10^{-4}$	$.23 \times 10^{-4}$	$.93 \times 10^{-4}$	$.46 \times 10^{-4}$	$.20 \times 10^{-4}$	$.19 \times 10^{-4}$	$.26 \times 10^{-4}$	$.20 \times 10^{-4}$
Isleta Mire	$.82 \times 10^{-4}$	$.30 \times 10^{-4}$	$.15 \times 10^{-3}$	$.70 \times 10^{-4}$	$.25 \times 10^{-4}$	$.25 \times 10^{-4}$	$.33 \times 10^{-4}$	$.26 \times 10^{-4}$
W Resident	$.71 \times 10^{-4}$	$.22 \times 10^{-4}$	$.16 \times 10^{-3}$	$.67 \times 10^{-4}$	$.19 \times 10^{-4}$	$.17 \times 10^{-4}$	$.23 \times 10^{-4}$	$.20 \times 10^{-4}$

*Doses are calculated from the RADRISK dose conversion model.

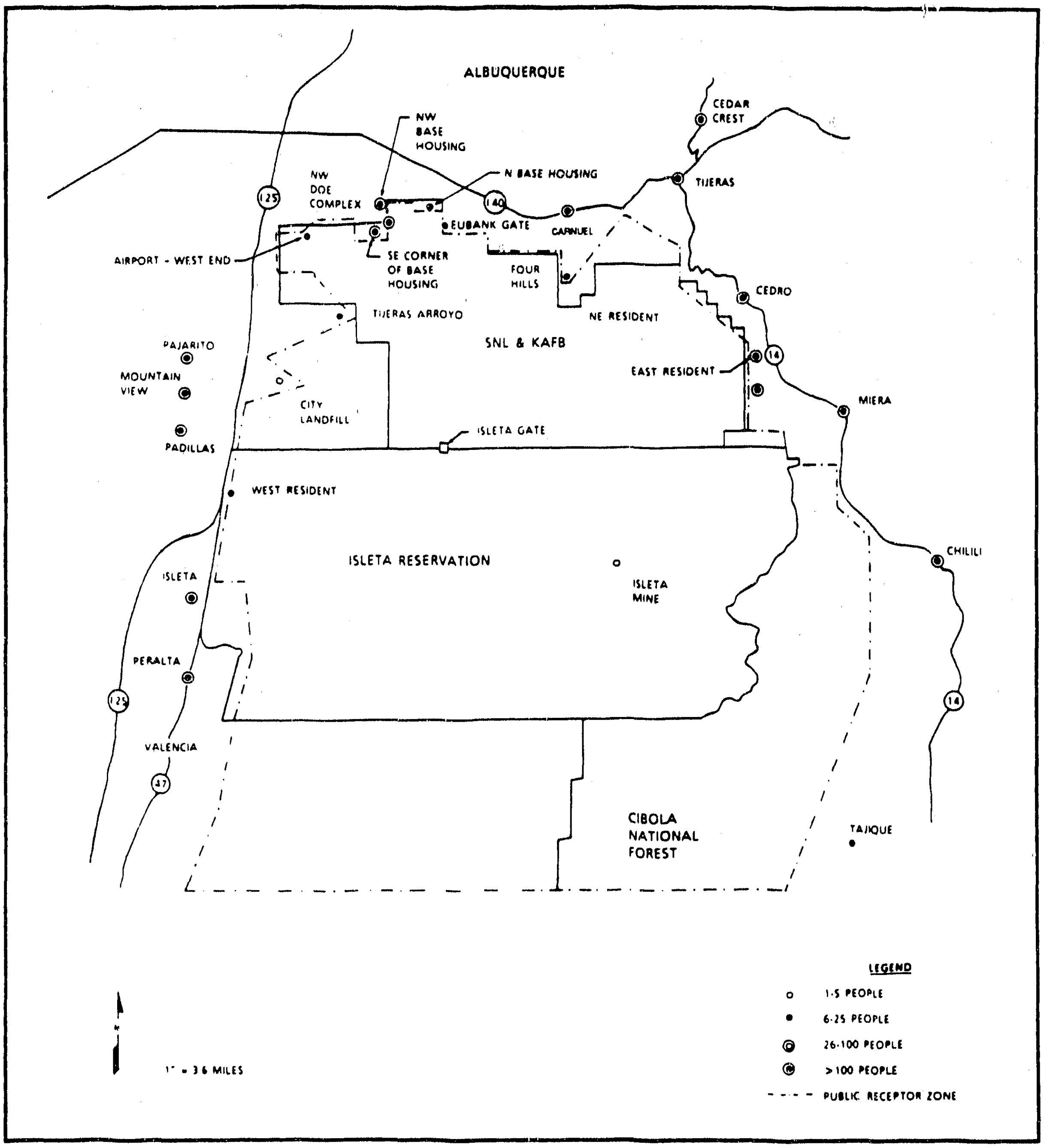

Figure 5-4. Offsite Receptor Locations of Potential Maximum Dose Impacts

receptor. The dose was primarily due to external air immersion in ^{41}Ar and secondarily due to the inhalation of ^{238}U. These doses are negligible compared to nature background radiation (99 mrem/yr) and are well below the 25 mrem/yr (whole body) and 75 mrem/yr critical organ dose limits specified in NESHAP (40 CFR 61, Subpart H) standards.

The population dose as a result of SNL, Albuquerque, operations was calculated for the 50-mi radius surrounding a single common grid analysis for all sources. Because the analysis area is so large, the relatively small distances between sources will not have any significant impact on the calculations. Demographic data based on 1980 population data and 1988 agricultural data were employed. The resulting population dose was found to be 0.097 person-rem for the 50-mi (or 80-km) population. The summary of maximum receptor whole-body dose, critical organ dose, and annual population dose in comparison to NESHAP standards and to natural background radiation is presented in Table 5-10.

Table 5-10. Summary of Offsite Dose Impacts in Comparison to NESHAP Standards and the Nature Background Radiation

Parameters	1989 SNL, Albuquerque, Calculated Dose	NESHAPs Standards	Natural Background Radiation in Albuquerque Area
Max. whole-body dose (mrem/yr)	8.8×10^{-4}	25	93*
Max. critical organ dose (mrem/yr)	8.3×10^{-4} (lung)	75	---
**Annual Population dose (person-rem)	0.097	--	>40,000

*Based on the average of community TLD values (whole-body dose from external penetrating radiation).
**Dose over the population of 80-km radius surrounding SNL, Albuquerque.

CHAPTER 6

NONRADIOLOGICAL MONITORING

6.1 Waste Water, Storm Water, and Surface Discharge Programs

6.1.1 Waste Water Programs

Discharges to POTW

SNL, Albuquerque, has about 15 mi of sewer lines which are interconnected with those of KAFB. On August 31, 1986, SNL, Albuquerque, submitted a wastewater discharge application to the City of Albuquerque. SNL, Albuquerque, received its first Wastewater Discharge Permits from the City of Albuquerque, Liquid Waste Division, on January 19, 1987. Because SNL, Albuquerque, has several connections to the City of Albuquerque sewer system and three categorical pretreatment operations, five Wastewater Discharge Permits were issued.

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

In order to remain in compliance with EPA regulations that implement the CWA, the City has implemented a pretreatment program. This program requires SNL, Albuquerque, to obtain permits for discharges to the City of Albuquerque POTW. The permits specify the required quality of discharges, the requirements for periodic monitoring of the discharges, and the frequency of reporting the results of the monitoring.

At the beginning of 1989, SNL, Albuquerque, operated under five wastewater discharge permits issued by the City of Albuquerque, Liquid Waste Division. A sixth permit was applied for on February 27, 1989, and a permit was issued that became effective on August 1, 1989. Four of the six permits contained provisions for meeting categorical limits established by the EPA. The permits in Table 6-1 that have a 40 CFR designation in the "Issuing Agency" column contain EPA categorical discharge limitations.

Further details about the wastewater sampling program are found in Appendices B, C, D, and F. Table 6-2 describes the wastewater sampling locations and brief characteristics of each. Appendix C (Tables C-2 to C-7) describes sampling procedures and permit limits for individual sampling stations. Table D-2 in Appendix D provides analytical methods, quality control (QC) acceptance criteria, and detection limits for individual parameters. Appendix E briefly describes the wastewater sampling QA data. Appendix F, Tables F-13 to F-18, provides the results of analyses on wastewater samples.

Table 6-1. Waste Water Discharge Permits, SNL, Albuquerque

Permit Number	Station Manhole	Waste Stream Process	Issuing Agency	Permit Expiration
2069A	WW001	General	City of ABQ	6-30-90
2069C-2	WW003	Electroplating/ printed circuit board	City of ABQ/ 40 CFR 413.84	6-30-90
2069D-2	WW004	Metal Finishing	City of ABQ/ 40 CFR 433.A15e	6-30-90
2069E-2	WW005	Electronics	City of ABQ/ 40 CFR Part 469.A	9-30-93
2069F	WW006	General	City of ABQ	6-30-90
2069G	WW007	Microelectronics Development Lab	City of ABQ/ 40 CFR Part 469.A	7-31-91

Compliance Summary

The discussion in this section addresses those instances in which the monitoring results were not in compliance with the permit limits described in Appendix C, Tables C-3 to C-7.

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

pH

Equipment malfunction prevented the measurement of pH at station WW 001 during the months of January and February, 1989. On April 6, 1989, pH fell below the permit limit of 5.0 for 2 hr. The pH monitoring equipment was installed December 1988 and one component malfunctioned. A replacement was not obtained until February 1989. Spares of all pH and flow monitoring equipment are now kept on hand. Source of flow pH wastewater was never determined.

Permit 2069C-2--Permit 2069C-2 is a permit that covers discharges from the categorically regulated printed circuit development activity in Building 841, SNL, Albuquerque, Technical Area I. This permit is a renewal of Permit 2069C that expired in 1988.

Table 6-2. SNL, Albuquerque, Waste Water Sample Locations

Station Number	Location	Average* Flow (gpd)
WW001	South Area IV Tijeras Arroyo	254,300
WW003	Area I Bldg. 841 SW	15,000*
WW004	Area I Bldg. 841 SE	38,300
WW005	Area I Bldg. 870 SW	227,200
WW006	E. of KAFB Lagoons	529,266
WW007	Area I Bldg. 858 Basement	56,100

*Approximate average flow rate.

Copper

Copper was detected at a concentration of 180 milligrams per liter (mg/l) in the March 14, 1989, 24-hr composite, and at 170 mg/l in the sample duplicate. These concentrations exceeded the 10.2 mg/l permitted maximum allowable concentration limit for 1-day composite samples. In addition, as a result of the excursion, the 6.0 mg/l permitted maximum allowable concentration limit for 4-day composite samples for copper was exceeded with a 4-day average concentration of 45.3 mg/l.

The cause of the copper violation was due to a set of worn rollers in a ferric chloride etching machine in Building 841. To correct the pH violation, the worn rollers were replaced and the rinse water was recirculated in the machine.

Permit 2069D-2--Permit 2069D-2 covers discharges from the categorically regulated metal-plating research and development activity in Building 841, SNL, Albuquerque, Technical Area I. This permit is a renewal of Permit 2069D that expired in 1988.

pH

Three excursions of 1-hr or more duration from the allowable pH range of 5.0 to 11.0 were detected by the continuous pH monitoring equipment at station WW004. On April 24, 1989, pH fell below 5.0 for 1 hr; on July 10, 1989, pH fell below 5.0 for 1 hr; and on July 27, 1989, pH fell below 5.0 for 1.5 hrs.

The cause of the pH violation was investigated and not found. The low pH discharge is assumed to be of low volume because no related pH deflections are evident at the downstream monitoring station WW006.

Actions to locate the source of the discharges have included the elimination of discharges from the Plating Lab in Building 841, the evaluation and elimination of discharges from a paint stripping rinse tank in Building 841, and an audit of all facilities discharging to monitoring station WW004.

Because these violations no longer occur, no further investigation is being performed.

Permit 2069E-2--Permit 2069E-2 covers the discharges from the categorically regulated semiconductor production activity conducted by Allied Signal Corporation, Albuquerque Microelectronics Operations (AMO) in Building 870, SNL, Albuquerque, Technical Area I. This permit is a renewal of Permit 2069E that expired in 1989.

pH

During 1989, at station WW005, pH excursions beyond permit limits of 5.0 to 11.0 of 1 hr or greater duration were noted on 16 days; in addition, one month experienced cumulative pH excursions amounting to greater than the 7 hr and 26 min allowed per calendar month. Specific findings are summarized in Table 6-3.

The cause of the pH violations was determined to be from the discharge of certain processes. To correct the pH violations, all acid waste processes to the Elementary Neutralization Unit (ENU) were rerouted, a manually operated chemical feed system to handle slug loads to the ENU was added, and the ENU was upgraded to provide additional and more responsive neutralization capability. The ENU upgrade modifications were completed before the end of 1989.

Permit 2069F--Permit 2069F is a general permit that covers wastewater discharges from a portion of SNL, Albuquerque, Technical Area I and some DOE and KAFB facilities.

pH

Malfunction of continuous pH monitoring equipment prevented collection of data during part of the months of February and March 1989. The pH

Table 6-3. Summary of pH Excursions for Station WW005 During 1989

Date	pH Value	Duration (hr)	Monthly Total (hr)
Jan. 2	<5.0	2.0	
4	<5.0	1.0	
17	<5.0	1.0	
24	<5.0	1.0	5.0
Feb. 28	>11.0	1.0	1.0
Mar. 2	>11.0	1.25	
23	<5.0	2.0	
28	<5.0	1.5	4.75
Apr. 4	<5.0	3.0	
5	<5.0	2.0	
6	<5.0	5.0	
11	<5.0	2.0	
17	<5.0	1.0	13.0
May 5	<5.0	1.0	
16	>11.0	1.25	2.25
June 12	<5.0	1.5	1.5

monitoring equipment is now checked daily, and spares of equipment are kept on hand.

Permit 2069G--Permit 2069G covers discharges from the categorically regulated microelectronics R&D programs conducted at the Microelectronics Development Laboratory (MDL) in Building 858, SNL, Albuquerque, Technical Area I. Permit 2069G became effective on August 1, 1989. Prior to August 1, 1989, discharges from the MDL were sampled and compared to maximum permitted concentrations set forth in Permit 2069E-2. Violations from both sampling periods are noted as follows:

Fluoride

Fluoride concentrations exceeded permit limit values twice during the period preceding the August 1, 1989, starting date for Permit 2069G and twice after August 1. In each instance, the exceedance occurred in a 24-hr composite sample, which caused exceedance of the 4-day average permit limit. The fluoride violations are summarized in Table 6-4.

Table 6-4. Summary of Fluoride Exceedances at MDL During 1989

Sample Date/Type	Concentration mg/l	Permit Limit mg/l
Compared to Permit 2069E-2:		
April 14, 24-hr	70	45
April 4-day average	32	30
June 28, 24-hr	130	45
June 4-day average	50	30
Under Permit #2069G:		
October 24, 24-hr	98	45
October 4-day average	33	30
November 17, 24-hr	230	45
November 4-day average	68	30

The cause of excess fluoride was determined to be from the discharge of certain processes. It was determined that strict administrative controls and additional pretreatment were necessary to prevent further violations. Modifications are being designed to control the fluoride content of the wastewater and upgrade the neutralization system. Installation and performance tests are expected to be complete by November 1990.

Annual Sampling

Annual sampling for all parameters is specified in wastewater discharge permits of SNL, Albuquerque, (Appendix C and Figure 6-1). Annual 24-hr composite sampling for all parameters specified in City permits was conducted during June 1989. The results were all less than the concentration limits established by the permits. The results of the annual sampling analyses are contained in Tables 6-5 and 6-6.

Discharge to Septic Systems

In New Mexico, discharge from septic systems is regulated by the Liquid Waste Disposal Regulations and the New Mexico Water Quality Control Commission Regulations. These regulations are administered by the NMEID.

On May 9, 1989, registration forms for a total of 65 septic systems were sent to the NMEID in two separate letters. The registered septic systems

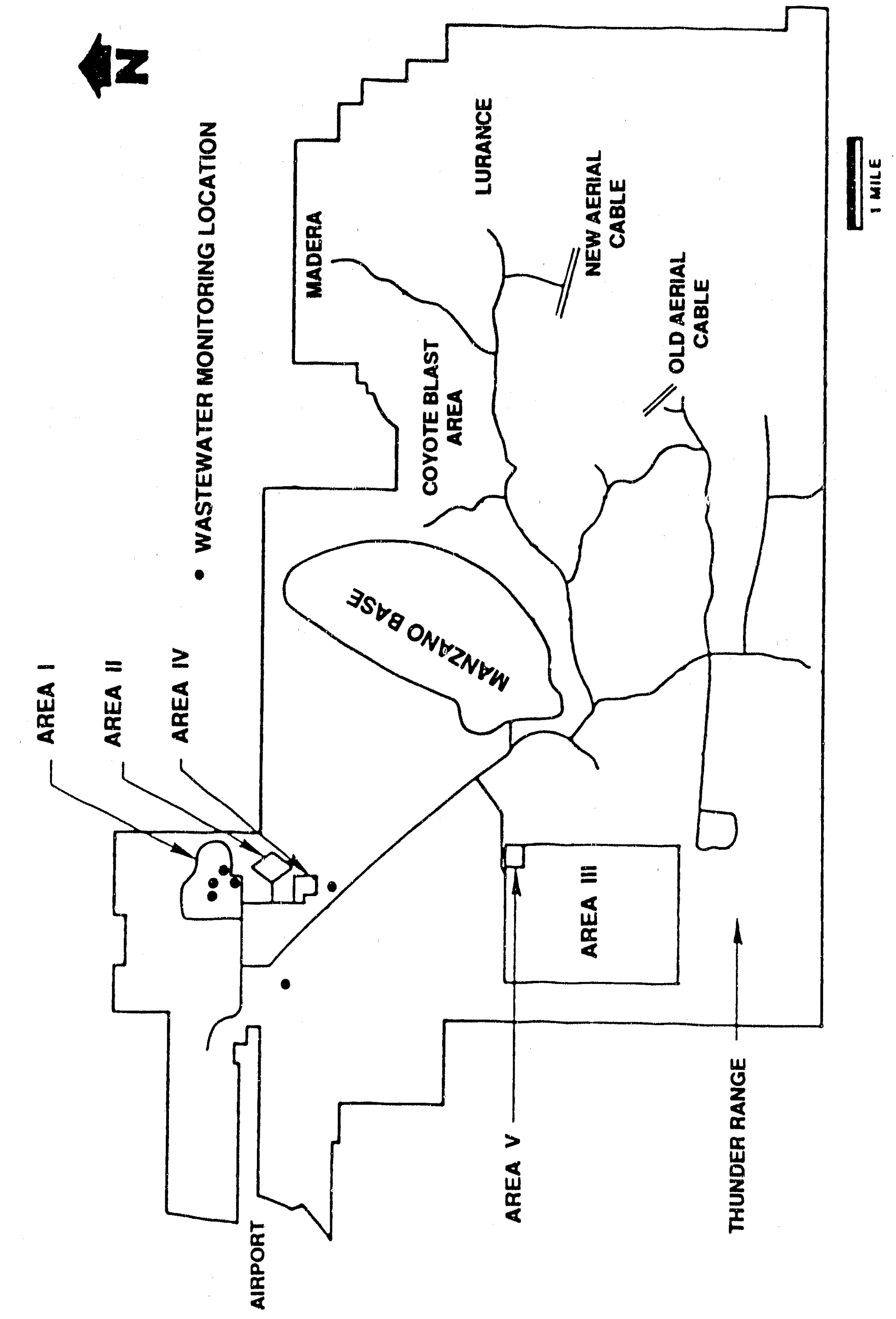

Figure 6-1. Waste Water Discharge Sampling Locations

Table 6-5. Sampling Parameters and Concentrations Limits Specified by Surface Water Discharge Plan DP-530

Parameter	Concentration Limit
Purgeable and Extractable Organics per NMWQCC regulations,	Sections 1-101
UU and 3-103.A Total Dissolved Solids	1000 mg/l
Chloride	250 mg/l
Sulfate	600 mg/l
Alkalinity	None specified
Sodium	None specified
Calcium	None specified
Magnesium	None specified
Potassium	None specified

are listed in Appendix H, Table H-2. At the end of 1989, 13 additional septic systems were being investigated for registration. These septic systems will be registered, if necessary, in 1990.

6.1.2 Storm Water Programs

The discharge of storm water from SNL, Albuquerque, facilities is regulated by the statutory authority of the CWA (as amended). To be regulated, the storm water must be discharged to a surface receiving water designated as a water of the U.S., such as the Tijeras Arroyo, which ultimately flows to the Rio Grande. For storm water, the provisions of this act are implemented by the EPA through the National Pollutant Discharge Elimination System (NPDES), described in 40 CFR 122. In New Mexico, NPDES permits are issued by the EPA with some review and concurrence responsibility assigned to the State of New Mexico. If storm water is discharged to a surface impoundment with no subsequent discharge to a receiving water, the discharges may be regulated by the NMEID Ground Water Bureau.

In the Federal Register, dated December 7, 1988, the EPA proposed changes to 40 CFR Parts 122, 123, 124, and 504. The proposed changes define NPDES permitting requirements for storm water discharges. The proposed regulations are currently being rewritten and are not final. A study was

Table 6-6. Summary of Annual One-Day Composite Parameters, SNL, Albuquerque, June 1989*

Station	WW001	WW003	WW004	WW005	WW006
Permit	2069A	2069C-2	2069D-2	2069E-2	2069F
Sample No.	SNLA000339	SNLA000299	SNLA000305	SNLA000352	SNLA000346
Date Collected	06/21/89	06/28/89	06/28/89	06/21/89	06/22/89
Parameter					
Phenols	<0.05	0.13	0.26	<0.05	0.40
Ag	<0.01	<0.01	<0.01	<0.01	0.02
As	<0.002	<0.002	<0.002	<0.002	<0.002
Ba	0.42	0.40	0.09	0.41	0.45
Cd	<0.01	<0.01	<0.01	<0.01	<0.01
CN (Total)	<0.010	0.024	<0.010	0.013	0.015
Cr (Total)	0.03	<0.02	<0.02	0.03	0.04
Cu	<0.02	0.21	0.24	<0.02	0.05
F (Soluble)	NA	NA	NA	15.0	NA
Hg	<0.0002	<0.0002	<0.0002	<0.0002	0.0004
Mn	<0.005	0.008	<0.005	0.005	0.008
Ni	<0.05	<0.05	<0.05	<0.05	<0.05
O&G	8	5	<4	10	10
Pb	<0.02	<0.02	<0.02	<0.02	<0.02
pH (pH Units)	8.02	7.46	7.56	8.45	7.57
Se	<0.002	<0.005	<0.005	<0.002	<0.005
Temp. (°C)	26	24	26	27	24
Total Metals	<0.38	<0.52	<0.33	<0.37	<0.42
TTO	0.011	0.011	0.037	0.011	0.044
Zn	0.28	0.24	<0.02	0.27	0.28

*All results in mg/l unless otherwise noted.

conducted in 1989 to identify those areas that would require a permit according to the proposed regulations. Since the regulations are being changed, the study will need to be revised after the new changes are published. Permits for storm water discharge from SNL, Albuquerque, facilities may be required within one year after finalization of the proposed regulations.

6.1.3 Surface Discharge Programs

Nonsanitary discharges to surface impoundments for SNL, Albuquerque, is under the authority of the New Mexico Water Quality Control Commission Regulations as implemented by the NMEID 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. A Discharge Plan DP-530 was approved for these discharges in March 1988 and amended in December 1989. The approved Discharge Plan, before it was amended, required monthly measurement of water levels and quarterly sampling and analysis for specified groundwater quality parameters. The amended Discharge Plan requires quarterly measurement of water levels and semiannual sampling and analysis. See Table 6-5 for a description of the parameters and sample concentration limits specified in Discharge Plan DP-530. Reports containing the results of the monitoring were submitted quarterly in 1989 to the NMEID, Ground Water Bureau. During 1989, sampling was done in January, March, May, July, September, and November. See Tables 6-7, 6-8, and 6-9, for the water level measurements and the analytical results.

Discharge Plan DP-530 does not list any limits for sample parameters. Total dissolved solids (TDS) and chloride ion (Cl) exceeded the New Mexico State Water Quality Control Commission Standard on several occasions due to ion concentration by evaporation. Organic compounds detected were investigated for possible sources. The possibility of analytical laboratory contamination is high.

6.2 Air Quality Monitoring

6.2.1 Air Quality

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

- Ambient Air Quality Standard (regulates As, Cu, Zn, Be, CO, HS, Pb, NO_2, SO_2, TSP, hydrocarbons, soiling index and total reduced sulfur)
- AQCR 3: Open Burning
- AQCR 5: Visible Air Contaminants
- AQCR 8: Airborne Particulate Matter
- AQCR 11: Volatile Organic Compounds (VOCs)
- AQCR 12 to 18: Process equipment emissions (NO_2, SO_2, and particulates)

Table 6-7. 1989 Water Level Measurements for Lagoons I and II, Technical Area IV, SNL, Albuquerque

Date	Lagoon I		Lagoon II	
	Water Level	% Full	Water Level	% Full
01/20/89	6 ft. 6 in.	61	0 ft. 0 in.	0
02/15/89	6 ft. 5 in.	60	0 ft. 6 in.	3
03/14/89	5 ft. 8 in.	54	2 ft. 0 in.	10
04/20/89	5 ft. 2 in.	48	1 ft. 6 in.	8
05/18/89	4 ft. 8 in.	41	*	*
06/27/89	4 ft. 0 in.	36	3 ft. 6 in.	20
07/19/89	3 ft. 7 in.	32	2 ft. 8 in.	13
08/11/89	4 ft. 2 in.	38	1 ft. 2 in.	6
09/21/89	4 ft. 2 in.	38	1 ft. 6 in.	8
10/13/89	4 ft. 9.5 in.	44	1 ft. 5 in.	7
11/15/89	4 ft. 8 in.	41	0 ft. 0 in.	0
12/18/89	4 ft. 9 in.	44	0 ft. 0 in.	0

*The water level in lagoon II was inadvertently not measured during the May 18 sampling.

- 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: NESHAP and others.

The Air Pollution Control Division under the Albuquerque Environmental Health Department has set up 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.

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

  Prior to any disturbance of the soil, SNL, Albuquerque, or its contractor will apply for a Topsoil Disturbance Permit and implement a plan for controlling dust emissions generated by construction activities according to the requirement of AQCR 8,

Table 6-8. 1989 Major Cations, Anions, and TDS for Lagoons I and II, Technical Area IV, SNL, Albuquerque*

	TDS	CL	SO4	Alk	Na	Ca	Mg	K
NMWQCC Std.	1,000	250	600	**	**	**	**	**
			Lagoon I					
01/89	320	28	18	160	86	54	6.1	14
03/89	460	80	14	180	100	58	7.8	15
05/89	802	260	185	140	66	63	11.0	16
07/89	840	310	<5	230	192	41	17	30
09/89	1100	440	22	150	334	35	19	31
11/89	1100	480	34	160	315	46	18	25
			Lagoon II					
01/89	***	***	***	***	***	***	***	***
03/89	370	12	46	210	66	62	12	7.3
05/89	598	170	5.8	230	160	46	14.0	7.6
07/89	570	210	87	79	144	26	11	7
09/89	700	23	270	140	50	124	21	7.4
11/89	***	***	***	***	***	***	***	***

*All results are in mg/l unless otherwised noted.
**There are no listed standards for these compounds in either Section 3-103 or I-101.UU of the NMWQCC Regulations.
***Lagoon II was dry during the indicated sampling period. No samples were taken for analysis.

Airborne Particulate Matter. These mitigation measures include watering; phasing of construction; rescheduling of construction during windy period; limitations on vehicle access and vehicle speed; and use of dust palliatives where watering is ineffective.

- Open Burning

The Thermal Test and Analysis Division (at Coyote and Lurance Canyon Burn Sites) and the Thermal Treatment Facility (in Area III) conducted several burn tests during 1989. 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).

Table 6-9. 1989 Organic Compounds Detected for Lagoons I and II, Technical Area IV, SNL, Albuquerque*

Date	Compound	Conc.	Det. Limit	NMWQCC Std.
		Lagoon I		
1/89	Di-n-butyl phthalate	.010	.010	**
1/89	Di-n-octyl phthalate	.016	.010	**
5/89	Benzyl alcohol	.080	.010	**
7/89	Methylene chloride	.034	.005	.1
		Lagoon II		
5/89	Methylene chloride	.054	.005	.1
7/89	Methylene chloride	.010	.005	.1
9/89	Acetone	.010	.010	**

*All results are in mg/l unless otherwise noted.
**There are no listed standards for these components in either Section 3-103 or I-IOI.UU of the NMWQCC Regulations.

- Beryllium Machining Operation

The Building 869-Toxic Machine Shop occasionally conducts machining of beryllium-containing materials. The operation is regulated by AQCR 31 (NESHAP) standard for beryllium. Exhaust air from the operation passes through air-pollution control equipment before exiting from a stack. The shop uses HEPA (high-efficiency particle-attenuation) filters to control emissions, with a removal efficiency of more than 99 percent. Emission tests conducted during December 1989 demonstrated that the actual beryllium emission (less than 1.8×10^{-7} lb/hr) meets AQCR 31 limits of 9.2×10^{-4} lb/hr or 10 gm/24 hr specified in 40 CFR 61.32.

- Steam Generators

SNL, Albuquerque, proposed a modernization plan of the steam producing facility in January 1989. The more efficient controls of the new plant should produce smoother plant operation and result in a decrease of average contaminant emissions. Therefore, a confirmation was obtained from the City stating that no new source permit was required.

6.2.3 Emission Inventory

At the beginning of October 1989, SNL, Albuquerque, started the ES&H compliance initiative effort. As part of the effort, the Environmental Programs Department initiated the Hazardous Air Emission Inventory effort to survey air emissions within SNL, Albuquerque. This air emission inventory is expected to finish by May 1990. The inventory will include a list of significant exhausted hazardous chemicals, estimated quantities of emissions, and stack information including associated control equipment.

CHAPTER 7

GROUNDWATER MONITORING

7.1 Review of the Groundwater Monitoring Program

The Groundwater Monitoring Program activities conducted by SNL, Albuquerque, during 1989 included measuring the water-level elevations of monitor wells to identify the groundwater flow patterns in the region and sampling the groundwater at the CWL for the purpose of establishing the background groundwater quality.

Chemical Waste Landfill (CWL)

Groundwater monitoring at the CWL (Figure 7-1a) has been an operational program since 1985. The groundwater monitoring program was developed to comply with the groundwater monitoring requirements of RCRA and DOE 5400.1. The monitor well system at the CWL consists of a network of nine groundwater monitor wells (Figure 7-1b).

Five groundwater monitoring wells (MW-1, MW-2, MW-3, BW-1, and BW-2), were installed at the CWL during the summer of 1985 using a mud rotary drilling method. These wells were completed at various vertical depths within the aquifer, with screened intervals ranging from 70 to 460 ft in length. MW-1 is presently unusable for monitoring because it was later plugged by a bailer. In 1988, four additional wells (BW-3, MW-1A, MW-2A, MW-3A) were installed at the CWL using air rotary casing hammer techniques. The 1988 wells have 20-ft screened intervals located such that approximately 15 ft of screen is below the water table.

The shallow monitor wells are currently sampled for detection monitoring requirements (MW-1A, MW-2A, MW-3A, BW-3). Four quarters of background data have been completed, and the semiannual sampling will begin in 1990. To date, contamination has not been identified in the groundwater beneath the landfill. Detection monitoring is expected to continue, with statistical evaluations of groundwater quality data utilized to assess changes in groundwater quality.

Mixed Waste Landfill (MWL)

This program was initiated in 1989 with the completion of four groundwater monitoring wells (Figure 7-2). The program will also be required to meet the groundwater monitoring requirements of RCRA. Planned activities include the development of sampling and analytical protocols and assessing the quality of the groundwater beneath the site.

7.2 Background Setting

The following section expands on the information given in Chapter 2 and provides a description of the geology, hydrology, and geographic setting of the SNL, Albuquerque, area with particular emphasis on the CWL site.

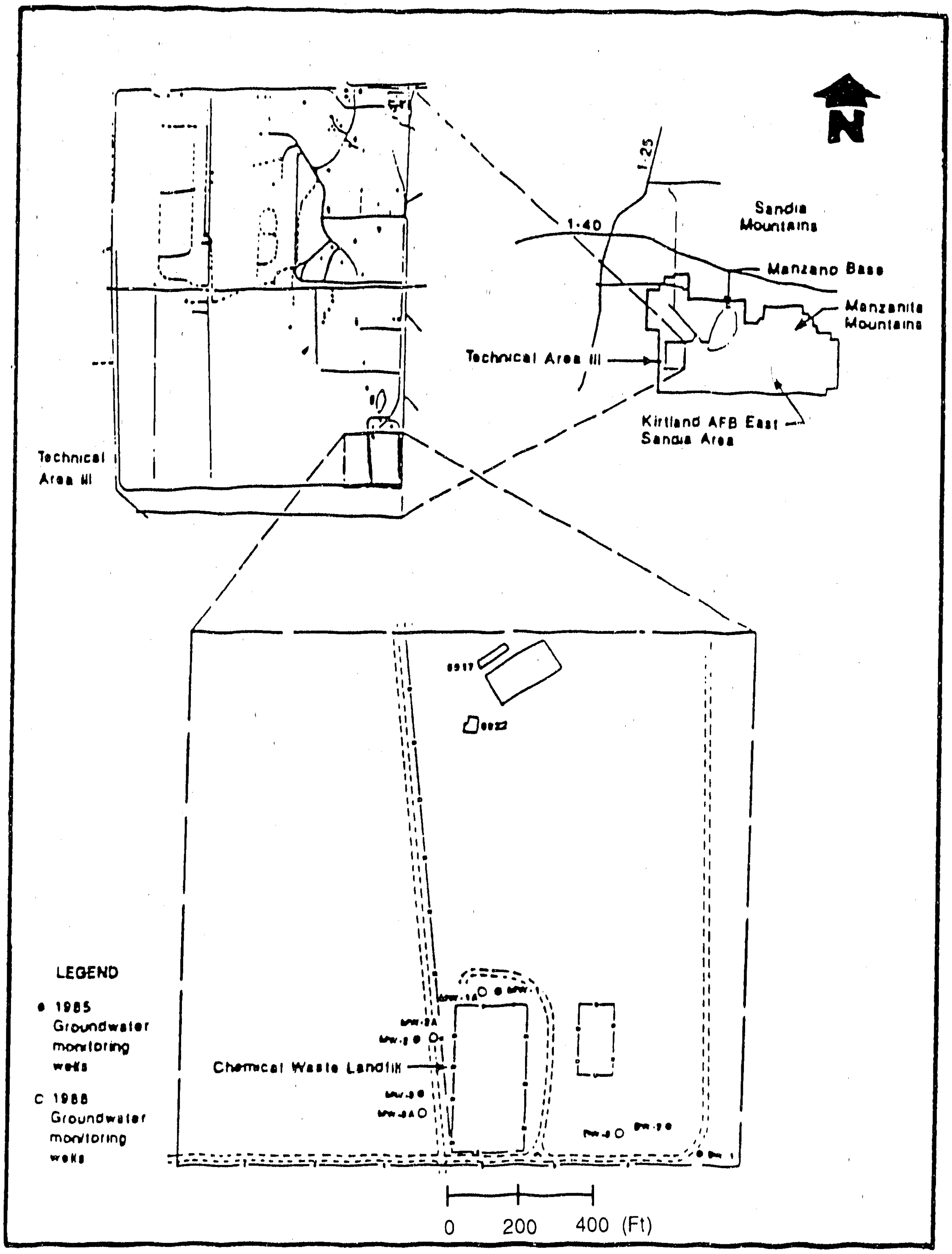

Figure 7-1a. Location of Chemical Waste Landfill (CWL), Technical Area III

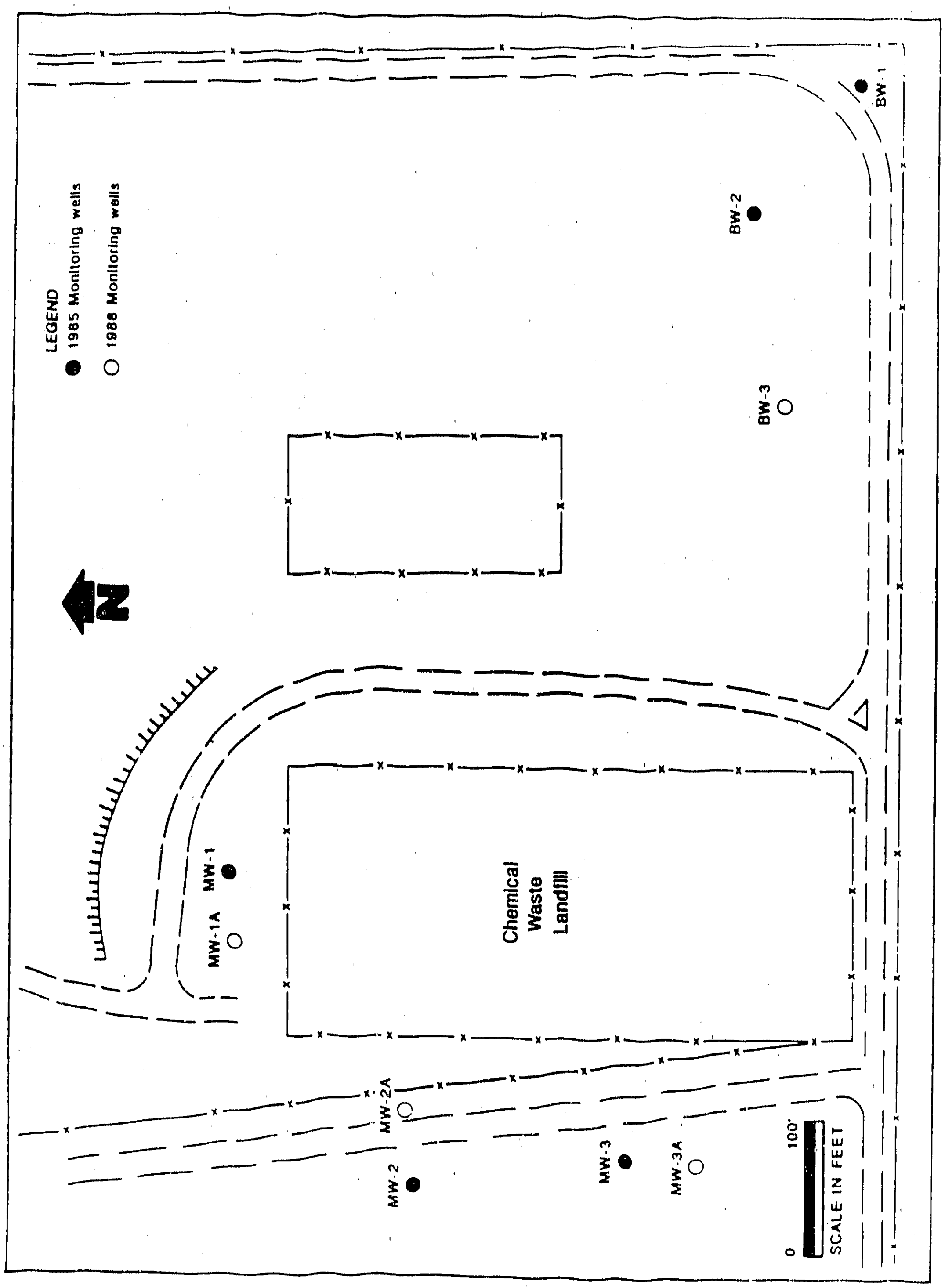

Figure 7-1b. Monitor Well Locations at the Sandia Chemical Waste Landfill (CWL)

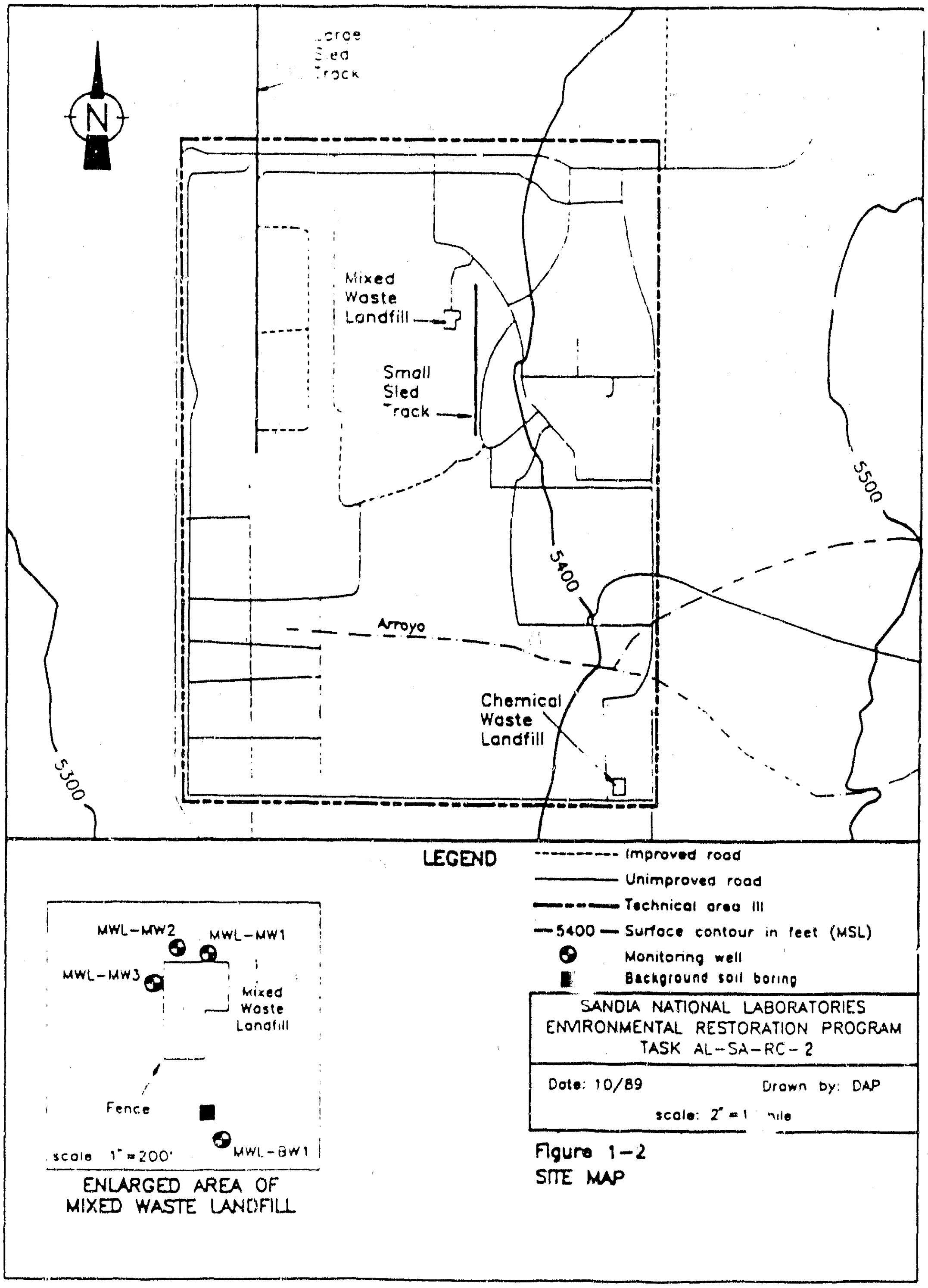

Figure 7-2. Monitoring Well Locations at the Mixed Waste Landfill (MWL)

7.2.1 Geographic Setting

SNL, Albuquerque, is located near the east-central edge of the Albuquerque-Belen Basin within the Rio Grande rift zone, on the southeast side of the City of Albuquerque, New Mexico, in Bernalillo County (Figure 7-3). The facilities of SNL, Albuquerque, are within the boundaries of KAFB. Within SNL, Albuquerque, there are five designated technical areas. The area which contains the CWL is Technical Area III. The CWL is approximately 4 mi south of the nearest drinking water supply well and at least 3 mi from any natural groundwater discharge point.

The climate of the region is semiarid. Average annual precipitation is approximately 8 in. Most of the precipitation occurs as thunderstorms during late summer to early fall. A fair amount of snowfall also occurs during the winter months. Average daytime summer temperatures are approximately 90°F, while winter daily temperatures are approximately 50°F.

7.2.2 Geology

Studies of the regional geology of the Albuquerque Basin have been presented by Kelley (1977) and Bryan (1938). The following discussion relies heavily on information from these studies.

The Albuquerque-Belen Basin, which is one of a north-south trending line of basins that make up the Rio Grande Rift zone. The Rio Grande River flows southward through the middle of the basin from White Rock Canyon on the north (5,300-ft altitude) to the Rio Salado junction on the south (4,700-ft altitude). 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 western side of the basin is bounded by the Lucero uplift with the Ladron Mountains on the south with little physiographic relief on the northwest wide of the basin (Figure 7-3). At SNL, Albuquerque, the Tijeras and Hubbel Springs Faults run roughly north-south along the west face of the Sandia Mountains. The faults create a series of stepped offsets, with general downward movement toward the west and the east (SAIC, 1985), nd therefore depth to groundwater is less to the east of the fault system han to the west.

During the Miocene and Pliocene, the Albuquerque Basin filled with a thick (up to 12,000 ft) sequence of sediments eroded from the surrounding highlands. This sequence of sediments, called the Santa Fe Group, thins toward the edges of the basin and is truncated at the bounding uplifts. Santa Fe Group sediments are overlain in places by Pliocene Ortiz gravel deposits and Rio Grande River fluvial deposits, and are interbedded with Tertiary and Quaternary basalts and pyroclastics (Bjorklund and Maxwell, 1961).

Basin fill alluvial fans of the Santa Fe Group consist of channels, debris flows, flood plain deposits, and aeolian deposits. According to Reineck and Singh (1975), these general types of sediments are composed of coarse, poorly-sorted, immature clastics ranging in size from clay to boulders.

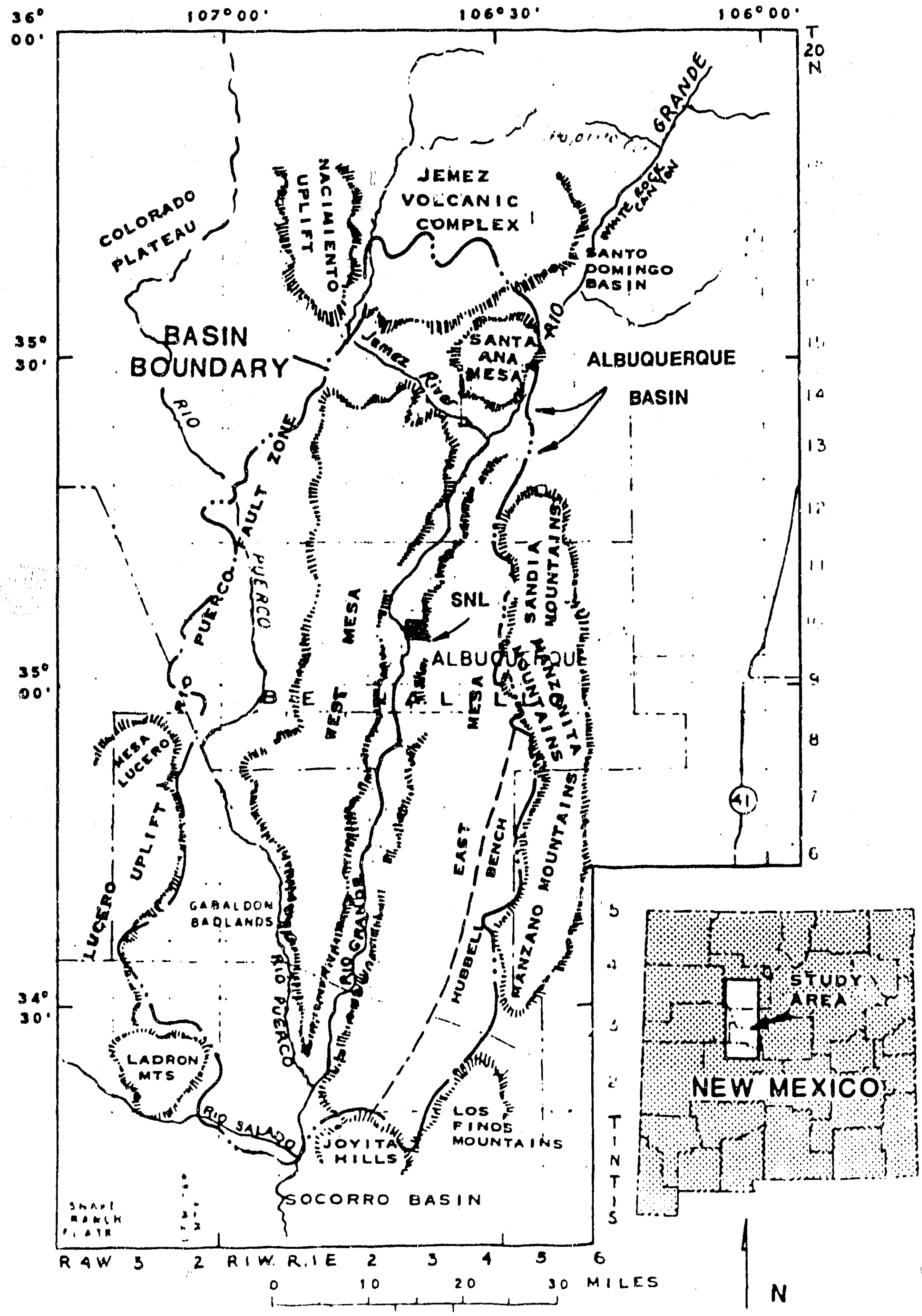

Figure 7-3. The Location of SNL in the Albuquerque-Belen Basin

Stratification can be moderately well developed, and some graded bedding may occur. Beds can vary in thickness from a few cm to several m. Much of the bedding is lenticular with limited aerial extent; however, channel beds can extend downdip for long distances, and flood deposits can lay thin sheets of fine sediments over significant areas. Caliche layers are commonly formed on subaerially exposed surfaces.

Based on the regional geologic setting of SNL, Albuquerque, any of the depositional sequences discussed above could be present. To date, analysis of sediments collected during emplacement of the SNL, Albuquerque, monitor wells has shown little correlation between wells. Sediments collected have been unconsolidated and semiconsolidated cobbles, sands, and gravels with inclusions of silt and clay lenses intermixed with sand. Lithologic logs from the installation of the nine monitoring wells at the CWL have been presented by IT Corporation (1985) and the DOE RCRA Groundwater Monitoring Plan (DOE, 1988). Lithologic logs from the installation of the monitor wells at the MWL are described by Ecology and Environment, Inc. (1989).

7.2.3 Hydrology

The regional hydrologic system of the SNL, Albuquerque, area is controlled by the processes which occur in the Albuquerque-Belen Basin. The Albuquerque-Belen Basin is approximately 100 mi long and 20 to 40 mi wide. The Rio Grande River is the main drainage in the basin flowing south, and the Jemez River, Rio Puerco, and the Rio Salado are major tributaries to the basin (Figure 7-3). The Albuquerque-Belen Basin is hydraulically connected to the Santo Domingo Basin to the north and the Socorro Basin to the south according to a report by Anderholm (1988).

In general, the Sandia and Manzano Mountains act as recharge zones for deep, regional saturated flow. Prior to extensive development in the City of Albuquerque and KAFB, the apparent groundwater flow direction in the SNL, Albuquerque, area was to the west or southwest, as presented by Bjorklund and Maxwell (1961). South of KAFB, the ambient direction of flow was to the southwest.

Municipal pumping and its subsequent effect of lowering the water table elevation in the Albuquerque area is discussed by Reeder, Bjorklund, and Dinwiddie (1967) and Kues (1987). The regional elevation of the water table in the SNL, Albuquerque, area in June 1989 is depicted in Figure 7-4. The KAFB production wells have a large effect on the hydraulic gradient in the area, creating a cone of depression in the groundwater surface elevation in the northern portion of the region. It is important to note that where there is a lack of data (i.e., west of Technical Area III) there is uncertainty in the potentiometric surface.

At the CWL, the water table is located approximately 480 ft below the land surface. According to water level contour maps, the apparent direction of groundwater flow at the CWL is to the northwest, assuming steady-state flow conditions are present and that the aquifer is homogeneous and isotropic.

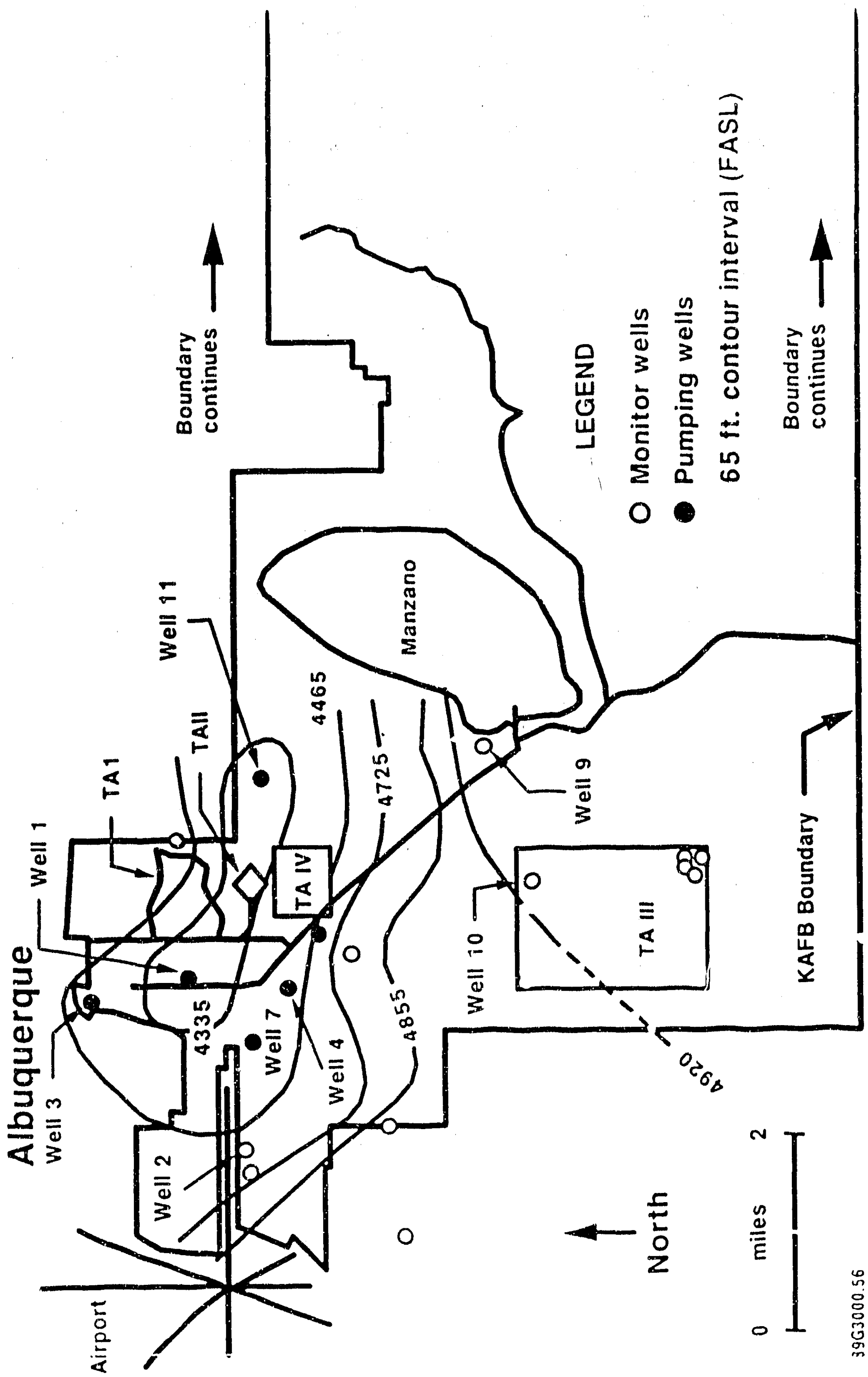

Figure 7-4. Potentiometric Contours of the SNL, Albuquerque, Area in June 1989

In addition, it appears that the KAFB production well pumping may affect the water-level fluctuations observed in the CWL monitor wells.

7.3 1989 Groundwater Monitoring Activities

Groundwater monitoring activities conducted by SNL, Albuquerque, during 1989 included measuring the water-level elevations of monitor wells in the SNL, Albuquerque, area and sampling the groundwater in the CWL monitor wells to establish the background groundwater quality. The following sections describe these activities and results for the calendar year 1989.

7.3.1 Water-Level Measurements

The elevation of the groundwater was measured in the eight currently monitored CWL wells prior to each sampling event to assure that the monitor well network continued to consist of at least one upgradient well and three downgradient wells. To supplement the local groundwater elevation data from the CWL and determine the general hydraulic gradient in the SNL, Albuquerque, area, the groundwater surface elevation was measured in all of the SNL, Albuquerque, monitor wells and several other monitor wells on a monthly basis beginning in May 1989. The additional monitor wells which were measured by SNL, Albuquerque, include the two NMEID monitor wells in Tijeras Arroyo, the two U.S. Air Force landfill monitor wells, and the KAFB wells 9 and 10 (Figure 7-5). Tables 7-1, 7-2, and 7-3 present the groundwater elevation data collected by SNL, Albuquerque, in 1989 for CWL wells, MW Landfill wells and KAFB wells, respectively.

Records of the KAFB production well static water levels were obtained from the U.S. Air Force. The U.S. Geological Survey provided data from the City of Albuquerque monitor well located east of Technical Area I (near the Eubank Gate) and KAFB well 5. These data were included in the SNL, Albuquerque, analysis.

7.3.2 Groundwater Sampling

The groundwater was sampled at the CWL to establish the background groundwater quality conditions in the monitor wells screened at the water table (BW-3, MW-1A, MW-2A, MW-3A). The first quarterly sampling took place in December 1988. During the calender year of 1989, the final three background groundwater sampling events were performed in March, June, and September. During the June 1989 sampling period, the sample holding times for total coliform bacteria, Total Organic Halogen (TOX), and nitrate were exceeded, and the equipment blank had slight traces of chromium. Resampling for these four constituents was conducted during the September 1989 quarterly sampling event. Subsequently, an additional sampling period took place in January 1990, to provide the fourth set of total chromium, total coliform bacteria, TOX, and nitrate data. The results of all four quarters of background groundwater sampling and the supplemental sampling are reported in Section 7.3.4.

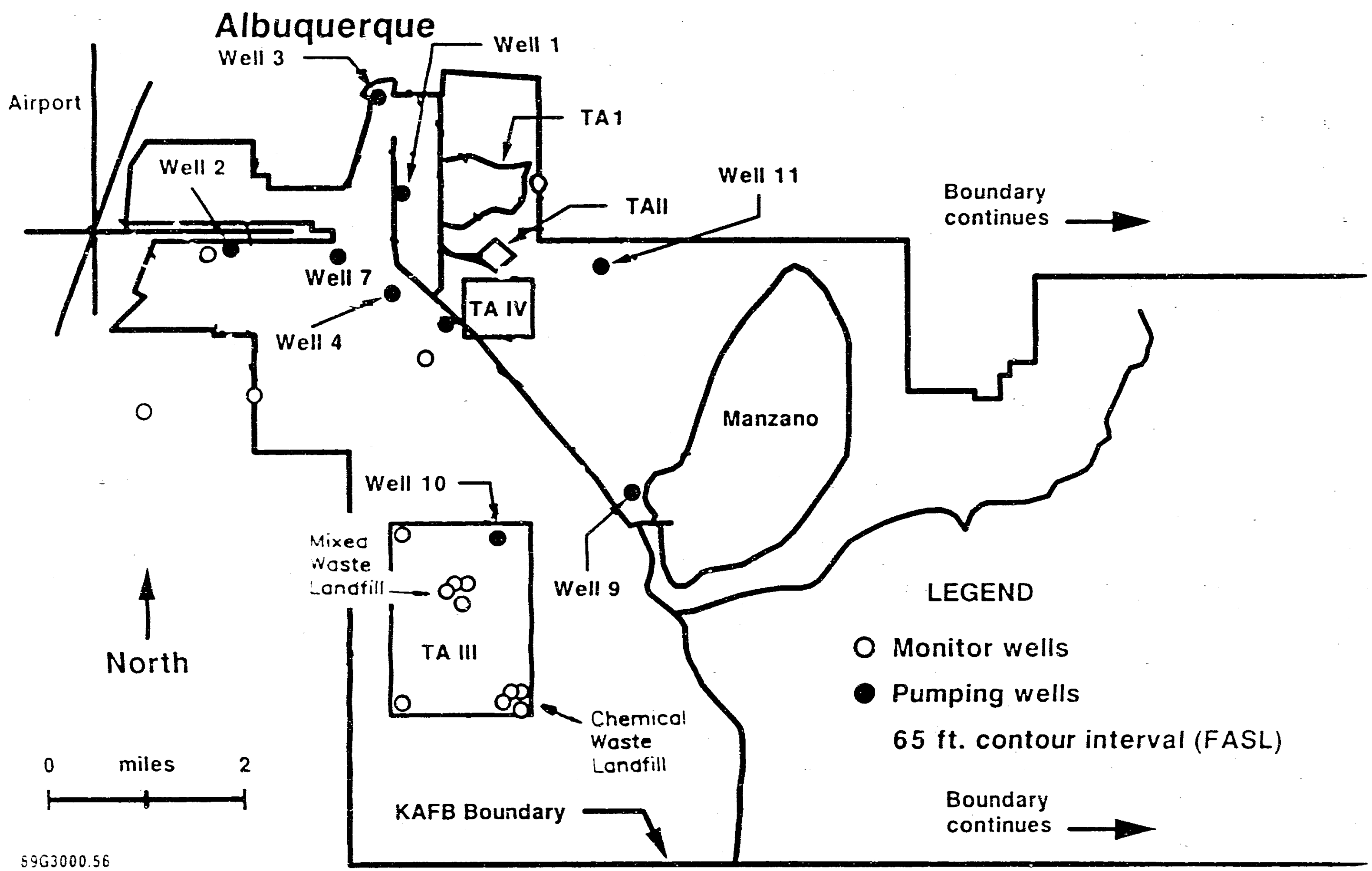

Figure 7-5. Location of the Monitor Wells and Kirtland Air Force Base (KAFB) Production Wells in the SNL, Albuquerque, Area (modified from SAIC, 1985)

Table 7-1. Water Level Elevations Measured for Chemical Waste Landfill (CWL) Well*

Date	Chemical Waste Landfill Wells								
	BW-1	BW-2	BW-3	MW-1	MW-1A	MW-2	MW-2A	MW-3	MW-3A
Jan 89	4957.73	4938.99	4942.02	--	4939.51	4937.21	4940.24	4937.64	4940.35
Feb 89	4957.54	4938.74	4941.70	--	4939.04	4936.66	4939.65	4937.10	4939.88
Mar 89	4957.68	4939.12	4942.11	--	4939.59	4937.48	4940.63	4937.60	--
Apr 89	4958.28	4939.33	4942.34	--	4939.79	4937.48	4940.51	4937.85	4940.67
May 89	4957.63	4938.80	4941.35	--	4939.09	4936.62	4939.68	4937.02	4939.89
Jun 89	4957.77	4938.94	4941.75	--	4939.26	4936.84	4940.05	4937.23	4940.23
Jun 89	4958.00	4938.92	4941.92	--	4939.76	4937.05	4940.17	4937.36	4940.24
Jul 89	4957.58	4938.70	4941.44	--	4938.80	4936.34	4939.40	4936.72	4939.59
Aug 89	4957.65	4938.73	4941.39	--	4938.82	4936.25	4939.36	4936.67	4939.58
Sep 89	4957.63	4938.72	4940.81	--	4938.81	4936.26	4939.36	4936.66	4939.56
Oct 89	4957.46	4938.40	4941.05	--	4938.35	4935.84	4938.85	4936.26	4939.12
Nov 89	4957.43	4938.49	4941.15	--	4938.43	4935.93	4938.97	4936.35	4939.21
Dec 89	4957.58	4938.60	4941.19	--	4938.50	4935.98	4939.08	4936.41	4939.31

*Water Level Elevation in Feet Above Mean Sea Level.

Table 7-2. Water Level Elevations Measured for Mixed Waste Landfill (MWL) Wells*

	MWL Wells			
Date	MWL-MW1	MWL-MW2	MWL-MW3	MWL-BW1
Jan 89	4924.59	--	--	--
Feb 89	--	--	--	--
Mar 89	4927.46	--	--	--
Apr 89	4925.13	--	--	--
May 89	4924.56	--	--	--
Jun 89	4924.70	--	--	--
Jun 89	--	--	--	--
Jul 89	4924.12	--	--	--
Aug 89	4924.13	--	--	--
Sep 89	4924.11	--	--	--
Oct 89	4923.62	--	--	--
Nov 89	4923.78	4923.86	4920.14	4923.62
Dec 89	4923.89	4924.01	--	4923.72

*Water Level Elevation in Feet Above Mean Sea Level
--Not measured. Note that MWL-MW2, MWL-MW3, and MW1-BW1 were not installed until late summer 1989.

7.3.3 Sampling Procedures and Methods

The specific sampling and analysis protocols for each constituent of interest are specified in the Sampling and Analysis Plan (SNL, 1988). The procedure for the collection of groundwater samples includes (1) monitoring the well head atmosphere for the presence of organic vapors which may indicate the presence of nonaqueous phase liquids (NAPL), (2) measuring the groundwater elevation and total depth of each well, (3) purging the well of three well volumes, (4) collecting the desired groundwater sample in specified containers provided by the analytical laboratory, and (5) sending the samples to the analytical laboratory for analysis.

Specific details pertaining to each quarterly background groundwater sampling event are described in the quarterly groundwater sampling reports and the supplemental groundwater sampling report (IT Corporation, 1989a; 1989b; 1989c). These reports contain summary tables, raw field and laboratory data, QA-QC results, and descriptions of the analytical methods employed by the laboratories.

Table 7-3. Water Level Elevations Measured for Monitoring and Production Wells*

Date	Other Monitoring Wells							Production Wells	
	NWTA3	SWTA3	EUBANK	LF-01	LF-02	MVMWJ	MVMWK	K-09	K-10
Jan 89	--	--	--	--	--	--	--	--	4926.39
Feb 89	--	--	--	--	--	--	--	--	4926.78
Mar 89	--	--	--	--	--	--	--	--	4926.62
Apr 89	--	--	--	--	--	--	--	--	4926.43
May 89	--	--	--	--	--	--	--	--	4925.81
Jun 89	--	--	--	4899.27	4901.43	4914.68	4911.99	4961.16	4926.11
Jun 89	--	--	--	--	--	--	--	5504	--
Jul 89	--	--	--	4895.95	4900.28	4910.41	4904.35	4960.55	4925.36
Aug 89	--	--	--	4900.45	4899.98	4910.29	4904.08	4960.52	4925.23
Sep 89	--	--	--	4895.39	4899.91	4910.27	4904.03	4960.57	4925.18
Oct 89	--	--	--	4894.65	4899.54	4909.61	4903.4	--	4924.98
Nov 89	4895.34	4903.52	--	4894.89	4900.26	4909.67	4903.52	--	--
Dec 89	4895.26	4896.64	--	4895.34	4900.56	4909.62	4903.57	4954.77	4924.91

*Water Level Elevation in Feet Above Mean Sea Level
=Not measured.

7.3.4 Water Quality Background Monitoring Data

The background concentrations of groundwater contamination indicator parameters (pH, specific conductance, TOX, Total Organic Carbon (TOC) are presented in Appendix F, F-7a to F-7d. Both the field and laboratory results are included for pH and specific conductance. If the parameter was not detected, the reported value is equal to half of the detection limit as recommended by the EPA (1986). The arithmetic mean and variance of all replicate samples have been calculated (Appendix F, Tables F-7a to F-7d). The TOX data from January 1990 was used in place of the June 1989 TOX data, which was not valid because the sample holding time was exceeded.

Results of background concentrations of the groundwater quality indicator parameters (chloride, iron, manganese, phenols, sodium, and sulfate) are presented in Appendix F, Tables F-8a to F-8d. Both total (unfiltered) and dissolved (filtered) metal concentrations were measured.

Tables F-9a through F-9d in Appendix F show the metal constituents of the background concentrations of the Appendix III EPA interim primary drinking water supply parameters. Both total (unfiltered) and dissolved (filtered) metal concentrations were measured. All of the measured constituents were below the drinking water standard (MCL) with the exception of total chromium in the unfiltered samples.

None of the dissolved chromium samples had concentrations above the MCL of 0.05 mg/l; however, analysis of BW-3, MW-1A, and MW-2A indicated total chromium concentrations above the MCL during three separate sampling events (Appendix F, Tables F-9a to F-9d). In December 1988, the total chromium concentration in MW-2A was determined to be 0.06 mg/l. The turbidity was high in MW-2A during this time relative to the other monitor wells, and perhaps the high total chromium was due to the high sample turbidity.

In June 1989, the total chromium analysis indicated a concentration of 0.06 mg/l in MW-1A. This may have been due to the equipment blank concentration of 0.03 mg/l. The inductively-coupled plasma mass spectrometry (ICP) analytical method (detection limit of 0.01 mg/l) was used for the first three quarters of sampling.

In September 1989, the ICP method and a more sensitive graphite furnace atomic adsorption (GFAA) technique (detection limit of 0.001 mg/l) were used. The results of two methods were consistent, with the exception of BW-3 where the ICP indicated no detection and the GFAA results showed a concentration of 0.068 mg/l. These results supported the decision to analyze chromium by using the GFAA method for future sampling events.

The high total chromium concentrations detected in BW-3 may be due to particulate larger than 0.45 microns present in the alluvial material at the CWL. None of the dissolved chromium concentrations are above the detection limit of 0.001 mg/l. Particulate (greater than 45 microns) obtained from filtering selected CWL groundwater samples were examined by scanning electron microscopy. The electron microscopy results indicate that chromium is present in the form of small particulate matter (less than 1 micron) as discrete particles randomly dispersed throughout the sample. Additionally, X-ray fluorescence (XRF) and direct current plasma (DCP) emission spectroscopy analysis results of alluvial core samples collected near the CWL indicate the natural background concentrations of the sediments ranges from approximately 10 to 30 ppm/kg-bulk material.

Tables F-10a to F-10d in Appendix F contain the other Appendix C constituents. The concentrations of these constituents were consistently below the MCL except gross alpha, total coliform bacteria, and turbidity.

Gross alpha activity equalled or exceeded the drinking water standard of 15 pCi/l in all four wells during the background sampling (Appendix F, Tables F-10a to F-10d). During June 1989, additional samples were collected to investigate the source of the gross alpha activity at the CWL. As shown in Appendix F, Table F-11, 72 to 95 percent of the alpha activity is attributable to uranium isotopes. The mass distribution of uranium isotopes compared with natural (i.e., equilibrium) mass distributions are shown in Appendix F, Table F-12. The mass distribution of uranium in the groundwater samples approaches the natural occurrence, suggesting that uranium, and the associated alpha activity in groundwater samples at the CWL are naturally occurring.

The concentration of total coliform bacteria was unknown in at least one of the four wells during each quarterly sampling event (Appendix F, Tables F-10a to F-10d). This is because the total coliform analysis could not be performed for some of the samples due to a high noncoliform bacteria population (i.e., too numerous to count). There is no particular pattern to the occurrence of high noncoliform bacteria concentrations. In December 1988, the field blank had high noncoliform concentrations, and in March 1989, the field blank and the equipment blank had high noncoliform bacteria concentrations. Thus, it appears that the high noncoliform bacteria concentrations detected in the monitor wells may actually be due to the field sampling method, a contaminated container, or the laboratory analysis procedures.

The turbidity exceeded the drinking water standard of 1 Nephelometric Turbidity Unit (NTU) for about half of the samples collected in each of the wells at some time (Appendix F, Tables F-10a to F-10d). However, the standard for monitor well analysis of 5 NTU (EPA, September 1986) was only exceeded in BW-3 during the first quarter of sampling in December 1988. Subsequent sampling events show turbidity values mainly between 0.5 and 2.5 NTU.

7.4 Summary

This chapter described the groundwater monitoring activities conducted at SNL, Albuquerque, during the calender year 1989. The groundwater at the CWL was sampled to determine the background groundwater quality conditions. The groundwater surface elevation was evaluated by measuring the water level at monitor wells in the SNL, Albuquerque, area. Additionally, new monitor wells were installed for the purpose of better determining the water table elevation contours in the area.

The apparent groundwater flow direction at the CWL is to the northwest. Potentiometric surface contour maps of the CWL indicate that the groundwater monitor network satisfies the requirements of 40 CFR 265.91; i.e., the monitor wells are located such that there is one upgradient well (BW-3) and three downgradient wells (MW-1A, MW-2A, MW-3A).

The specific sampling and analysis protocols used for the collection of groundwater samples are specified in the Sampling and Analysis Plan (SNL, Albuquerque 1988). Background groundwater quality conditions were established at the CWL for the Appendix C drinking water supply parameters, contamination indicator parameters, and groundwater quality parameters. Although the drinking water standards were exceeded for total chromium, gross α, and turbidity, there is no indication that the groundwater has been contaminated due to a release from the CWL. The high total chromium concentrations may be due to high sample turbidity or particulate matter present in the groundwater. The high gross α activity has been attributed to uranium content, of which the distribution approaches naturally occurring conditions in groundwater. Only one of the turbidity measurements was above the EPA recommendation of 5 NTU, and that was during the first sampling period. In addition, for some of the samples, it was not possible to measure the concentration of total coliform bacteria due to high levels of noncoliform bacteria. The presence of high noncoliform bacteria concentrations is not consistent and may be due to the field sampling method or the laboratory analysis procedures.

CHAPTER 8

QUALITY ASSURANCE PROGRAMS

8.1 Quality Assurance (QA) for Environmental Programs

Policies and Responsibilities

The ES&H Directorate (3200) has the overall responsibility for ensuring the quality of all activities related to environmental protection and compliance. A QA Program Plan was issued in June 1989 to address the policy, activities, and responsibilities of this Directorate for the promotion of quality throughout its operations.

The Environmental Programs Department (3220, formerly 3202), under the direction of the ES&H Directorate (3200), has developed its own QA Plan. This QA Plan defines an approach to ensure that 3220's work (items and services) meet or exceed SNL, Albuquerque; DOE (DOE/AL 5700.6B); and applicable regulatory (EPA, Occupational Safety and Health Administration (OSHA), state, and local) requirements. The 3220 QA Plan supplements the SNL, Quality Plan (corporate) and the SNL ES&H Directorate Quality Plan.

It is the responsibility of each employee in 3220 to ensure that all activities performed by or for 3220 are in accordance with the policies and guidelines set in the 3200 ES&H Quality Plan and the 3220 QA Plan.

New Programs

The 3220 QA Plan was issued in November 1989. It is written in accordance with the guidelines set in DOE/AL 5700.6B (General Operations Quality Assurance), the SNL (corporate) Quality Plan, and the 3200 ES&H Directorate Quality Plan.

This comprehensive QA Plan describes QA guidelines and standards for all activities and functions conducted by or for 3220. It stresses prevention of problems by ensuring that requirements are defined in documents such as plans and procedures, and that the requirements are understood (through familiarization and training) to enable 3220 staff to "get it right the first time" where the "it" is the requirements. There is an ongoing effort to include applicable quality elements from the 3220 QA Plan into implementation plans and procedures within 3220 for all hazardous, radioactive, MW operations, environmental protection, remediation, and compliance activities.

The 3220 QA Plan includes 18 quality elements. These elements are listed in Appendix E, Table E-5.

8.2 Quality Assurance (QA) of Environmental Sampling and Analysis

There were various types of informal (unwritten) and formal (written) QA Plans that covered the activities of Environmental Protection Program in the past. All QA related activities and results have been summarized and published every year in the Annual Site Environment Report, although there was no formal QA Plan written for Department 3220 (formerly Division 3202) until 1989.

The existing environmental monitoring activities that are under the auspices of the 3220 QA Plan are listed as follows:

A. Environmental Sampling

Sample collection and chain-of-custody procedures were developed. To help ensure compliance with EPA SW-846, environmental samples are collected by trained personnel only in accordance with Section 8.0 of the 3220 QA Plan.

B. Radioactive Analysis

Samples are analyzed using standard procedures. Instruments are calibrated using approved procedures that ensure traceability to the SNL Standards Laboratory and/or directly to the National Institute of Standards (NIST) (formerly National Bureau of Standards (NBS)) or other nationally recognized standards.

Laboratory QA is achieved through successful participation in EPA (Environmental Monitoring Systems Laboratory) and DOE (Environmental Measurements Laboratory) intercomparison programs. Table 8-1 provides results for 1989 gross α, gross β, ^{137}Cs, ^{3}H, and uranium determinations in water, soil and vegetation. Ratios comparing SNL, Albuquerque, values to reference values provided by EPA and DOE laboratories for QA programs are included. All results are acceptable in comparison to program values except that ^{137}Cs, ^{40}K, and total u values in soil and vegetation are bias high. The problems are being investigated. Corrective actions will be performed once the problems are identified. Table 8-2 lists the results of samples collected at the same location to determine sample variability. This approach is part of the routine sampling program.

Three sets of replicate samples of soil and vegetation were collected in order to get an estimate of the variability associated with each location. Table 8-2 lists $\bar{x}$ and standard error of the mean (s_x) for the replicate samples. This estimate of variability includes both the sampling error and the analytical and counting errors. The reported ^{137}Cs levels reflect background fallout concentrations. Potassium-40 (^{40}K) is a naturally occurring background radionuclide, as are uranium and tritium.

Table 8-1. 1989 Quality Assurance Results for Selected Radiochemical Analysis

Analysis	Units	Sample Type	Date	QA Program	Program Value	SNL, Albuquerque Value*	Ratio**
Gross α	pCi/l	Water	01/20	EPA	8 ± 5	8.67 ± 1.53	1.08
		Water	09/22	EPA	4 ± 5	4.00 ± 1.00	1.00
Gross β	pCi/l	Water	01/20	EPA	4 ± 5	6.67 ± 0.58	1.67
		Water	09/22	EPA	6 ± 5	11.00 ± 1.00	1.83
^{3}H	pCi/l	Water	02/24	EPA	2754 ± 356	2769 ± 1000	1.01
		Water	10/20	EPA	3496 ± 364	3510 ± 1000	1.00
	Bq/l	Water	12/04	DOE	3950	2540 ± 10	
^{137}Cs	pCi/l	Water	02/10	EPA	10 ± 5	10 ± 0.5	1.00
	pCi/l	Water	10/06	EPA	59 ± 5	60 ± 1	1.02
	Bq/l	Water	12/04	DOE	68.3	69.2 ± 0.4	1.01
	pCi/ml	Water	04/03	DOE	2.55	2.60 ± 0.02	1.02
	Bq/kg	Soil	12/04	DOE	6420	8330 ± 7	1.30
	Bq/kg	Soil	04/03	DOE	20.8	29.0 ± 0.24	1.39
	Bq/kg	Vegetation	12/04	DOE	47.9	58.8 ± 0.8	1.23
	pCi/g	Vegetation	04/03	DOE	1.6	2.04 ± 0.03	1.28
^{40}K	pCi/g	Soil	04/03	DOE	24.1	34.0 ± 0.91	1.41
	Bq/kg	Soil	12/04	DOE	561	722 ± 26	1.29
	pCi/g	Vegetation	04/03	DOE	26.1	34.5 ± 0.42	1.32
	Bq/kg	Vegetation	12/04	DOE	1290	1680 ± 16.5	1.30
Total U	pCi/l	Water	03/17	EPA	5 ± 6	9.67 ± 0.58	1.93
	pCi/g	Vegetation	04/03	DOE	0.012	0.020 ± 0.010	1.67

*1σ Counting Errors.
**Ratio of SNL, Albuquerque, to Program value.

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

Sample Type	Location	U (ug/g) $\bar{x} \pm s\bar{x}$ (%v)**	^{137}Cs (pCi/g) $\bar{x} \pm s\bar{x}$ (%v)**	^{40}K (pCi/g) $\bar{x} \pm s\bar{x}$ (%v)**	^{3}H (pCi/g) $\bar{x} \pm s\bar{x}$ (%v)**
Vegetation	5	No analysis	0.11 ± 0.05 (45)	1.91 ± 0.32 (17)	0.65 ± 0.30 (46)
	6	No analysis	0.06 ± 0.02 (33)	2.00 ± 0.60 (30)	<0.45
	7	No analysis	0.04 ± 0.02 (50)	1.63 ± 0.66 (40)	<0.45
	16	No analysis	<0.03	1.90 ± 0.98 (52)	<0.45
Soil	5	2.6 ± 0.1 (2)	0.36 ± 0.30 (85)***	10.8 ± 9.1 (84)***	[illegible].6 ± 1.1 (15)
	6	2.8 ± 0.1 (4)	0.46 ± 0.03 (7)	17.0 ± 0.1 (1)	3.8 ± 0.6 (15)
	7	2.1 ± 0.1 (5)	0.63 ± 0.06 (9)	18.6 ± 0.6 (3)	3.1 ± 1.7 (54)
	16	2.6 ± 0.0 (0)	0.11 ± 0.01 (5)	25.3 ± 0.6 (3)	7.3 ± 1.2 (16)
Water	33	$<1.5 \times 10^{-3}$	<0.01	0.18 ± 0.01 (5)	<0.45

*All results are listed under F-1, F-2, and F-3 in Appendix F.
**(%v): Standard deviation in terms of percent.
***Gamma analysis of 5A (refer to Table F-2) is an obvious outlier; 5B and 5C agree with each other well.

C. Nonradioactive Analysis

Ninety percent of the nonradioactive analyses are performed by outside contractors. The contracts stipulate that the laboratories implement and report QC data with the analytical results.

- Groundwater Samples

  A Groundwater Sampling Plan is currently documented and in place. QC includes the analytical laboratory's routine QC procedure, which is audited by SNL, Albuquerque. Also, blanks and replicate samples are submitted with all field samples.

- Wastewater Samples

  A Wastewater Sampling Plan for SNL, Albuquerque, is in draft form and will be finalized by May 1990. The Plan describes or references procedures for sample handling (e.g., preservation) equipment maintenance, sample logs, sample-collection frequencies, chain-of-custody, analytical methods, data storage and reporting, and laboratory QC samples. The Plan will be written and issued in accordance with applicable Sections of the 3220 QA Plan.

- PCB and Asbestos Analysis

  The quality of PCB and asbestos analysis are evaluated through check samples, blanks, and replicate sampling programs. Analyses are performed by various laboratories and the results evaluated for their conformance to quality requirements.

8.3 Quality Assurance (QA) of Data Management

All data received from test laboratories were reviewed by a SNL staff or consultant independent of the test laboratories. The staff or consultant then submitted the reports to the responsible 3220 project leader. The project leaders maintained all of the reports. According to Section 17 of the 3220 QA Plan, these records are being formally accepted by 3220 staff and submitted to specific files in the 3220 Records Center. The Records Center maintains all data files related to this report.

8.4 Quality Assurance (QA) of Outside Analytical Laboratories

Appraisals of contractor laboratories (pre-award audits) are conducted in accordance with Section 4 of the 3220 QA Plan before an analysis laboratory is selected. Annual appraisals (e.g., inspections or audits) are subsequently conducted at the contractor laboratories in accordance with Sections 10 and/or 18 of the 3220 QA Plan. Trip blanks, check samples, and replicates are submitted with the wastewater samples for analyses.

Current contractors were selected, in part, because of their strong QA/QC programs.

Contractor QA Overview

The Environmental Programs Department (3220) 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 3220 QA 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 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 with two commercial laboratories to provide analytical services to SNL, Albuquerque, in conjunction with environmental and hazardous waste programs. The laboratories that provided the majority of analytical support to SNL environmentally-related sampling activities during 1989 were Encotec (Environmental Control Technology Corporation) located in Ann Arbor, Michigan, and Enseco, located in Arvada, Colorado. Other commercial laboratories providing analytical support during 1989 were International Technology Analytical Services Laboratories, Assagai, and TMA-Eberline. Quantities and types of analyses performed during 1989 are presented in Table E-1.

The primary 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 quality of data generated by the contractor laboratories, SNL, Albuquerque, has implemented its own laboratory performance program to monitor the laboratories overall analytical precision and accuracy for analyses routinely performed on SNL, Albuquerque, samples. During 1989, a total of 171 environmental duplicate samples and 219 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 on monthly or quarterly basis to monitor and document analytical precision. Check samples were submitted to the laboratories on a quarterly or semiannual basis based on the frequency and type of samples submitted to assess and document laboratory precision and accuracy.

Environmental samples collected in conjunction with the Sandia Wastewater Monitoring program were submitted to the Encotec laboratory for analysis on a monthly basis during 1989. Duplicate samples were submitted to Encotec on a monthly basis and check samples on a quarterly basis. Samples were collected in conjunction with the SNL, Albuquerque, Groundwater Monitoring program on a quarterly basis and submitted to Enseco for analysis. Environmental duplicate samples were submitted to Enseco on a quarterly basis and check samples submitted on a semiannual basis. Precision was assessed by calculating relative percent difference (RPD) for replicate analyses performed. Results of duplicate analyses performed during 1989, and statistical data are summarized in Tables 8-3 and 8-4. As indicated in the tables, the majority of analytical data are below method detection limits and, thus, RPD could not be calculated. Ninety-three percent and 86 percent of reported duplicate environmental sample analyses data with calculable results were within the control limit of 20 percent for the Encotec and Enseco laboratories, respectively. When calculated RPDs for analyzed constituents analytes were outside the acceptance range, the analytes in question were carefully reviewed by SNL, Albuquerque, staff to determine if reanalysis was necessary.

Check samples submitted to the laboratories were prepared by an outside laboratory or the EPA and submitted to the contractor laboratories at the frequencies indicated above. 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 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 and cations. In addition to aqueous samples, oil samples prepared by the EPA containing known concentrations of polychlorinated biphenyls were submitted to both laboratories for analysis.

Results of each set of check sample analyses are summarized in Appendix E, Tables E-3 and E-4 for the Enseco and Encotec laboratories, respectively. 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

Table 8-3. Summary of Relative Percent Difference Measurements for Environmental Duplicate Sample Analyses Performed During 1989 at ENSECO

PARAMETER	DEC 88	MAR 89	JUN 89	SEP 89
Arsenic	NC	NC	NC	NC
Barium	0	0	0	0
Cadmium	NC	NC	NC	NC
Chloride	2	2	6	4
Chromium	NC	NC	22	40
Fluoride	0	6	7	0
Iron	NC	0	0	NC
Lead	NC	NC	NC	NC
Manganese	9.5	0	50	NC
Mercury	NC	NC	NC	NC
Nitrate (as N)	20	0	0	0
pH	0	4		
Phenols	NC	NC	NC	NC
Selenium	NC	NC	NC	NC
Silver	NC	NC	NC	NC
Sodium	1	0	3	1
Specific Conductance	6	2	4	0.4
Sulfate	1	2	7	5
Total Organic Carbon	114	29	NC	NC
Total Organic Halogen as Cl	85	NC	10	2

NC = Not Calculable

Table 8-4. Summary of Relative Percent Difference Measurements for Environmental Duplicate Sample Analyses Performed During 1989 at ENCOTEC

MONTH	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DEC*
Parameter											
Cd	3.8	NC	12	NC	NC	NC	NC	NC	NC	NC	NC
Cr (total)	1.9	NC	NC	NC	12	NC	NC	NA	NC	NC	NC
Cu	5.7	22	0	0	11	0	0	0	0	NC	0
CN (total)	NC	12	NC	10	NA	NC	NC	NC	NC	NC	NC
Pb	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Ni	NC	NC	NC	NC	NC	NC	NC	NA	NC	NC	NC
Ag	NC	NC	NC	NC	0	NC	NC	NA	NC	NA	NC
Zn	1.6	0	NC	3.5	6	NC	NC	183	NC	NC	NC
F	1.8	26.4	0	NA	NA	NA	3	1.4	2.7	0	11.8

NC = Not Calculable
NA = Not Applicable
*Duplicate samples for December 1989.

percent recovery for respective indicators of precision and accuracy. As indicated in the tables, the majority of reported values were within the acceptance limits identified.

Review of QC data suggests difficulties may exist with silver, cyanide, and mercury analyses performed at Encotec and with phenolics, sulfate, conductivity, and TOC analyses at Enseco. A concerted effort to identify deficiencies in the laboratory systems and resolve these issues will be undertaken when sufficient data exist to pinpoint these areas. During 1990, SNL, Albuquerque, is planning to increase the volume of QC samples sent to the contractor laboratories and continue to monitor overall laboratory performance.

REFERENCES

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

Anderholm, S. K., 1988. "Ground-water Geochemistry of the Albuquerque-Belen basin, Central New Mexico," Report 86-4094, United States 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," Report 21, New Mexico State Engineer.

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

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

Bryan, K., 1938. "Geology and Groundwater Conditions of the Rio Grande Depression in Colorado and New Mexico," *U.S. Natural Resources Planning Board, the Rio Grande Joint Investigations in the Upper Rio Grande Basin*, Vol. 1, Part 2, U.S. Government Printing Office, Washington, D.C.

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, May 1961.

Ecology and Environment, Inc., 1989. "Statement of Work: Installation of Groundwater Monitoring Wells for RCRA Compliance Closure of the Mixed Waste Landfill," prepared for Sandia National Laboratories, Albuquerque, NM, May 1989.

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

Environmental Surveillance Group, Los Alamos National Laboratory, 1982. "Environmental Surveillance at Los Alamos During 1981," LA-9349-Env, Los Alamos National Laboratory, Los Alamos, NM, April 1982.

Fish, J., 1990. "Waste Management Site Plan FY 1989," Plan 90-07, Sandia National Laboratories, Albuquerque, NM, March 1990.

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

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

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

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

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

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

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

Kues, G. E., 1987. "Ground-Water-Level Data for the Albuquerque-Belen Basin, New Mexico, Through Water Level Year 1985," Open File Report 87-116, U.S. Geological Survey.

Masuda, A., 1964. *Distribution of Thorium, Uranium, and Potassium and Radioactive Heat Production as a Function of Depth of Earth*, Rep. INSJ-65, Institute of Nuclear Studies, Japan.

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

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

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

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

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, April 1983.

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, April 1985.

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, April 1986.

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, April 1987.

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, April 1988.

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, May 1989.

National Oceanographic and Atmospheric Administration (NOAA), 1968. in "Summary of Hourly Observations, Albuquerque, New Mexico, Municipal Airport 1951-1960," "Climatography of the United States No. 82-89," NOAA, Washington, D.C.

National Oceanographic and Atmospheric Administration (NOAA), 1983. "Local Climatological Data, Annual Summary with Comparative Data," Albuquerque, NM.

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, May 1970.

Parsons, A. M., 1990. "Calendar Year 1989 Groundwater Monitoring Program Annual Report," Sandia National Laboratories, Albuquerque, NM, February 1990.

Reeder, H. O., L. J. Bjorklund, and G. A. Dinwiddie, 1967. "Quantitative Analysis of the Water Resources in the Albuquerque Area, New Mexico," Technical Report 33, New Mexico State Engineer Report.

Reineck, H. E. and I. B. Singh, 1975. *Depositional Sedimentary Environments*, New York: Springer-Verlag.

Sandia National Laboratories (SNL), Albuquerque, 1988. "Chemical Waste Landfill Sampling and Analysis Plan," Draft Report, Sandia National Laboratories, NM, Albuquerque, April 1988.

Science Applications International Corporation (SAIC), 1985. "Installation Restoration Program Phase II - Confirmation/Quantification Stage I," Report 2-827-06-351-33, SAIC.

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

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

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

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

U.S. Bureau of the Census, 1981. "1980 Census of Population and Housing," PHC80-V-33, U.S. Government Printing Office, March 1981.

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

U.S. Department of Energy (DOE), 1988. "RCRA Groundwater Monitoring Plan, Sandia National Laboratories, Albuquerque," U.S. Department of Energy, December 1988.

U.S. Environmental Protection Agency (EPA), 1986. *RCRA Ground Water Monitoring Technical Enforcement Guidance Document*, EPA, Washington, D.C.

APPENDIX A

METEOROLOGICAL DATA

Table A-1. Long-Term Historical Data (1951 to 1980) for the Albuquerque Area*

Month	Temperatures (°C) Daily Range Min	Max	Precipitation (cm) Water Equivalent	Wind Speed m/s	Wind Direction
Jan	-5.4	8.4	1.04	3.6	N
Feb	-3.4	11.6	1.02	4.0	N
Mar	-0.2	15.9	1.32	4.6	SE
Apr	4.2	21.4	1.02	5.0	S
May	9.2	26.6	1.17	4.7	S
Jun	14.7	32.6	1.30	4.5	S
Jul	18.2	33.8	3.30	4.1	SE
Aug	17.1	31.9	3.84	3.7	SE
Sep	12.7	28.3	2.16	3.9	SE
Oct	6.2	22.1	2.18	3.7	SE
Nov	-0.7	14.0	0.97	3.5	N
Dec	-4.9	8.9	1.32	3.5	N

*NOAA, Local Climatological Data, Annual Summary with Comparative Data, Albuquerque, New Mexico, 1983. Values are in parenthesis. Temperature and precipitation values are normals recorded for the 1951 to 1980 period. Wind direction is prevailing direction through 1963. Average wind speeds are reported. The data were collected at the International Albuquerque Airport-Kirtland AFB, elevation 1.62 km. The original measurements have been converted to metric units.

Table A-2. Normals, Means, and Extremes, Albuquerque New Mexico for 1951 to 1980 (NOAA, 1985)

NORMALS, MEANS, AND EXTREMES

ALBUQUERQUE, NEW MEXICO

LATITUDE: 35°03'N LONGITUDE: 106°37'W ELEVATION: FT. GRND 5311 BARO 05313 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	55.0	64.3	74.5	78.8	76.1	69.0	57.4	44.0	35.6	56.2
Extremes														
-Record Highest	46	69	75	85	89	98	105	105	101	100	91	77	72	105
-Year		1971	1972	1971	1965	1951	1980	1980	1979	1979	1979	1975	1958	JUN 1980
-Record Lowest	46	-17	-5	8	19	28	40	52	52	37	25	-7	3	-17
-Year		1971	1951	1948	1980	1975	1980	1985	1968	1971	1980	1976	1974	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	46	72	73	73	77	80	83	76	76	79	79	77	72	76
MEAN SKY COVER (tenths)														
Sunrise - Sunset	46	4.8	4.9	5.1	4.5	4.1	3.3	4.5	4.3	3.6	3.5	4.0	4.6	4.3
MEAN NUMBER OF DAYS:														
Sunrise to Sunset														
-Clear	46	12.9	11.3	11.2	12.8	14.7	17.9	12.0	13.8	16.8	17.5	15.1	13.9	170.0
-Partly Cloudy	46	7.8	7.8	10.0	9.4	10.2	8.6	14.3	12.4	7.7	7.6	7.7	7.5	111.2
-Cloudy	46	10.3	9.2	9.7	7.7	6.1	3.6	4.7	4.8	5.5	5.9	7.2	9.5	84.1
Precipitation .01 inches or more	46	3	4.0	4.5	3.3	4.3	3.7	8.8	9.3	5.7	4.8	3.3	4.0	59.8
Snow, Ice pellets 1.0 inches or more	46	1.0	0.8	0.7	0.2	0.*	0.0	0.0	0.0	0.0	0.0	0.4	0.9	4.1
Thunderstorms	46	0.1	0.3	0.9	1.5	3.8	4.9	11.2	11.0	4.7	2.4	0.6	0.2	41.7
Heavy Fog Visibility 1/4 mile or less	46	1.2	1.0	0.6	0.2	0.*	0.*	0.1	0.*	0.1	0.3	0.6	1.4	5.6
Temperature °F														
-Maximum														
90° and above	25	0.0	0.0	0.0	0.0	2.6	17.4	24.0	16.9	4.3	0.2	0.0	0.0	65.3
32° and below	25	2.5	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.5	5.0
-Minimum														
32° and below	25	28.9	23.5	16.8	5.0	0.3	0.0	0.0	0.0	0.0	2.2	16.3	28.5	121.6
0° and below	25	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.6
AVG. STATION PRESS. (mb)	13	838.5	837.9	834.6	835.5	836.0	837.9	840.4	840.8	840.2	839.8	838.8	839.2	838.3
RELATIVE HUMIDITY (%)														
Hour 05	25	71	65	56	48	48	45	60	65	62	62	65	70	60
Hour 11 (Local Time)	25	51	44	34	26	25	23	34	39	40	38	42	50	37
Hour 17	25	41	32	25	18	18	17	27	30	31	30	36	43	29
Hour 23	25	62	52	44	35	34	32	47	52	52	50	55	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	46	1.32	1.42	2.18	1.97	3.07	1.71	3.33	3.30	1.99	3.08	1.45	1.85	3.33
-Year		1978	1948	1973	1942	1941	1967	1968	1967	1940	1972	1940	1959	JUL 1968
-Minimum Monthly	46	T	T	T	T	T	T	0.08	T	T	0.00	0.00	0.00	0.00
-Year		1970	1984	1966	1972	1945	1975	1980	1962	1957	1952	1949	1981	DEC 1981
-Maximum in 24 hrs	46	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	46	9.5	8.2	13.9	8.1	1.0				T	0.9	9.3	14.7	14.7
-Year		1973	1964	1973	1973	1979				1971	1979	1940	1959	DEC 1959
-Maximum in 24 hrs	46	5.1	4.2	10.7	6.6	1.0				T	0.9	5.5	14.2	14.2
-Year		1973	1946	1973	1973	1979				1971	1979	1946	1958	DEC 1958
WIND:														
Mean Speed (mph)	46	8.1	8.6	10.2	11.1	10.5	10.0	9.1	8.2	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 Mile														
-Direction (!!)	44	E	NW	NW	S	W	SE	E	SE	SE	N	NW	SE	SE
-Speed (MPH)	44	61	68	80	72	72	82	68	61	62	66	57	90	90
-Year		1949	1944	1943	1946	1950	1946	1945	1951	1945	1959	1948	1943	DEC 1943
Peak Gust														
-Direction (!!)	2	E	W	SW	SW	S	E	S	E	W	W	SW	E	SW
-Speed (mph)	2	41	63	58	64	54	48	58	47	61	51	52	46	64
-Date		1985	1984	1984	1984	1985	1985	1984	1984	1985	1984	1985	1984	APR 1984

REFERENCES

National Oceanographic and Atmospheric Administration (NOAA), 1985. "Local Climatological Data, Annual Summary with Comparitive Data," Albuquerque, NM.

APPENDIX B

SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, ENVIRONMENTAL RESTORATION PROGRAM SITES

Table B-1. Sandia National Laboratories, Albuquerque, Environmental Restoration Program Sites

ER Program Task	ER Program Site No.	Site Name
I. HIGH PRIORITY TASKS		
AL-SA-RC-1	74.	Chemical Waste Landfill
AL-SA-RC-2	76.	Mixed Waste Landfill
AL-SA-1 (TA 3 and 5)	4.	Radioactive Surface Impoundment
	5.	Radioactive Seepage Basin
	18.	Storage and Salvage Yards
	26.	Burial Site (west fence of TA 3)
	31.	Elect. Transformer Oil Spill (Phase 5)
	34.	Centrifuge Oil Spill (Phase 5)
	35.	Vibration Facility Oil Spill (Phase 5)
	36.	Oil Spill - HERMES
	37.	PROTO Oil Spill
	51.	Bldg 6924 (pad, tank, pit)
	52.	Sandia Engineering Reactor
	78.	Gas Cylinder Disposal Pit
	83.	Sled Tracks
	84.	Gun Facilities (Area III)
	100.	Bldg. 6620 HE Sump/Drain
	102.	Rad Disposal Site (E of TA 3)
	105.	Mercury (Bldg. 6536)
	107.	Explosive Test Area (SE TA 3)
	111.	Bldg. 6715 Sump/Drains
AL-SA-2 (TA 2)	1.	Radioactive Burial Site
	2.	Classified Waste Disposal Trenches
	3.	Chemical Disposal Pit
	43.	Radioactive Storage Yard
	44.	Decontamination Site
	50.	Old Centrifuge Site
	113.	Area II Firing Sites
	114.	Explosive Burn Pit
	159.	Bldg. 935 Floor Drains and Septic System
AL-SA-19 (Septic Tanks and Drainfields)	48.	Bldg. 904
	135.	Bldg. 906
	136.	Bldg. 907
	137.	Bldg. 6540/6542 Septic Tanks and Leach Field
	138.	Bldg. 6630 Septic Tank and Leach Field
	139.	Bldg. 9964 Septic Tank Systems

Table B-1. Sandia National Laboratories, Albuquerque, Environmental Restoration Program Sites (Continued)

ER Program Task	ER Program Site No.	Site Name
	140.	Bldg. 9965 Septic Tank and Seepage Pit
	141.	Bldg. 9967 Septic Tank and Seepage Pit
	142.	Bldg. 9970 Septic Tank and Seepage Pit
	143.	Bldg. 9972 Septic Tank and Leach Field
	144.	Bldg. 9980 Septic Tank Systems
	145.	Bldg. 9981/9982 Septic Tank and Leach Field
	49.	Bldg. 9820 Drains
	116.	Bldg. 9990 Septic Tank and Drain Fields
	101.	Explosive Contaminated Sumps, Drains
	146.	Drain Fields (Bldg. 9920)
	147.	Bldg. 9925 Septic Tanks and Leach Field
	148.	Bldg. 9927 Septic Tank and Seepage Pit
	149.	Bldg. 9930 Septic Tank and Seepage Pit
	150.	Bldg. 9939/9939A Septic Tank and Seepage Pit
	151.	Bldg. 9940 Septic Tank and Seepage Pit
	152.	Bldg. 9950 Septic Tank and Leach Field
	153.	Bldg. 9956 Septic Tank and Leach Field
	154.	Bldg. 9960 Septic Tank and Seepage Pit
	161.	Bldg. 6636 Septic Tank and Leach Field
AL-SA-20 (Underground Storage Tanks)	155.	Bldg. 6597 25,000 Gallon UST
II. MEDIUM PRIORITY TASKS		
AL-SA-3 (Coyote Cyn Blast Area)	8.	Open Dump
	58.	Coyote Canyon Blast Area
AL-SA-4 (Thunder Range)	6.	Gas Cylinder Disposal Pit
	17.	Scrap Yards/Open Dump
	39.	Oil Spill - Solar Facility
	54.	Pickax Site
	55.	Red Towers Site
	56.	Old Thunderwells
	79.	Gas Cylinder Disposal
	89.	Shock Tube Site
	90.	Beryllium Firing Site
	91.	Lead Firing Site
	110.	Thunder Range - Miscellaneous

Table B-1. Sandia National Laboratories, Albuquerque, Environmental Restoration Program Sites (Continued)

ER Program Task	ER Program Site No.	Site Name
AL-SA-5 (Central Coyote Test Field)	11.	Radioactive/Explosive Burial Mounds
	19.	Scrap Yard (NW of old Aerial Cable)
	22.	Storage/Burn Area (W of DEER)
	57.	Workman Site (Phase 5)
	66.	Boxcar Site
	68.	Old Burn Site (Phase 5)
	70.	Explosive Test Pit (water towers)
	71.	Moonlight Shot Area
	87.	Bldg. 9990
	82.	Old Aerial Cable Site (scrap yard/dump/test area)
AL-SA-6 (Pendulum Area)	10.	Burial Mounds
	59.	Pendulum Site
	60.	Bunker Area
	92.	Pressure Vessel Test Site (Coyote Canyon)
AL-SA-7 (Coyote Springs Area)	21.	Metal Scrap (Coyote Springs)
	27.	Bldg. 9820 - Animal Disposal Pit
	62.	Graystone Manor Site
	88.	Firing Site (SW of Coyote Springs)
III. LOW PRIORITY TASKS		
AL-SA-8 (SW Coyote Test Field)	14.	Burial Site (Bldg. 9920)
	38.	Oil Spill (Bldg. 9920)
	53.	Bldg. 9923
	85.	Firing Site (Bldg. 9920)
	86.	Firing Site (Bldg. 9927)
	103.	Scrap Yard (Bldg. 9939)
	106.	Building Drains (Bldgs. 9939, 9960, 9967)
	108.	Firing Site (Bldg. 9940)
	109.	Firing Site (Bldg. 9956)
	112.	Explosive Contaminated Sump (Bldg. 9956)
	115.	Firing Site (Bldg. 9930)
	117.	Trenches (Bldg. 9939)
	162.	Bldg. 9932 Seepage Pit

Table B-1. Sandia National Laboratories, Albuquerque, Environmental Restoration Program Sites (Concluded)

ER Program Task	ER Program Site No.	Site Name
AL-SA-9 (TA 1)	25.	Burial Site (S of TA 1)
	30.	PCB Spill (Reclamation Yard)
	32.	Steam Plant Oil Spill (Phase 5)
	33.	Motor Pool Oil Spill (Phase 5)
	41.	Bldg. 838 Mercury Spill
	42.	Acid Spill-Water Treatment Facility
	73.	Hazardous Waste Repackaging/Storage
	77.	Oil Surface Impoundment (Area IV)
	96.	Storm Drain System
	104.	PCB Spill (Computer Facility)
AL-SA-10 (Lurance Canyon)	12.	Burial Site/Open Dump
	13.	Oil Surface Impoundment (Lurance Canyon)
	63.	Balloon Test Area
	64.	Gun Site (Madera Canyon)
	65.	Lurance Canyon Explosive Test Site
	94.	Lurance Canyon Burn Site
	81.	New Aerial Cable Site (burial site/dump/test area)
	93.	Madera Canyon Rocket Launcher Pads
AL-SA-11 (Schoolhouse Mesa)	9.	Burial Site/Open Dump
	20.	Uranium Burn Site
	61.	Schoolhouse Mesa Test Site
AL-SA-12 (Tijeras Arroyo)	23.	Disposal Treches
	24.	Landfill/Open Dump
	45.	Liquid Discharge (behind TA 4)
	7.	Gas Cylinder Disposal (Arroyo del Coyote)
	16.	Open Dumps (Arroyo Del Coyote)
	40.	Oil Spill (6000 Igloo Area) (Phase 5)
	46.	Old Acid Waste Line Outfall
AL-SA-13 (South Coyote Test Field)	15.	Trash Pits (Frustration Site)
	28.	Mine Shafts
	47.	Doomed Bunker Outfall
	67.	Frustration Site
	69.	Firing Pits (near USGS)
	72.	Operation Beaver Site

APPENDIX C

SAMPLE COLLECTION AND ANALYSIS

C.1 SAMPLE COLLECTION FOR RADIOACTIVE EFFLUENTS

Samples are gathered 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. TLDs are exchanged quarterly (Table C-1).

Vegetation. Native vegetation samples are collected in late summer from a 9-m^2 area at each sample location. Since 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 include variability 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 were collected at each of three adjacent sample plots in order to estimate variability due to location. Each vegetation sample is cut and blended prior to 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_3 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 α, gross β, gamma spectrum analysis, uranium, and tritium are then performed on the water and filter samples.

Soil. Soil samples are randomly collected from the same 9-m^2 quadrat 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 ^{137}Cs and uranium analysis. A separate aliquot is used for tritium analysis following EPA-recommended procedures. Replicate (three) samples are collected at three or more locations to determine sample variability.

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 3H 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_3/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_3. 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 in one of two ways. A moisture balance is used which provides a direct readout of percent moisture in 10 g of soil. An 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, 862 g of soil, or 70 g of vegetation 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 multi-channel analyzers. The 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 Bureau of Standards (NBS) or by using a standard for specific radionuclides traceable to NBS. The data are analyzed by computer software developed by Canberra Industries.

Water. Water samples are further analyzed for gross alpha-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 NBS.

C.3 EXTERNAL PENETRATING RADIATION

Thermoluminescent Dosimeters (TLDs) are placed at 33 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 in order 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 prior to 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 expcsed at each level.

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

C.4 SAMPLE COLLECTION AND ANALYSIS FOR GROUNDWATER SAMPLES

Sampling protocol is as follows. Water level measurements are taken using a chalked tape. After four to 10 well volumes have been evacuated from each well, pumping is continued 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 erronecus 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 U.S. Environmental Protection Agency (EPA) is reviewing the significance of headspace in samples containing organics.

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

SOURCES OF ERROR

The purpose of the 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. The identification of 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

Since 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.

Since it is not practical to make in-situ measurements of the groundwater pH, the sample must be brought to the surface. Two methods have been used to evacuate and sample the wells: pumping with a small diameter piston pump and bailing. The potential for having gas exchange occurring starts when the groundwater flows into the well bore 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 bailing in the well bore is generally surged and mixed with the atmosphere existing in the wellbore above the water. The water within the bailer is then removed and placed into a bucket. Both wells MW1 and BW1 are two inch wells that do not allow a pump to pass restricted zones within the casing. Thus, these two wells must be bailed 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 prior to bailing. The loss or gain of certain volatile constituents that participate in controlling the solution pH, such as carbon dioxide and hydrogen sulfide, will alter the pH as a time-dependent phenomenon. The absorption of CO_2 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_2 is about five (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 will also be an important source of error. Carbonate minerals such as calcite (limestone) and arragonite (caliche) will hydrolyze in solution releasing carbonate. The carbonate will remove hydrogen ions from the solution using the same carbonate-bicarbonate reaction noted above and act 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 will also be capable of removing hydrogen ions from solutions and increasing the pH. A small laboratory experiment was performed to determine the effect a clay found near the water table during the drilling of in well MW1A, just 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 NTU for MW1 and 3,100 for BW1.

Specific Conductivity

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.

Statistical Assumptions

The statistical procedure used to test for significant change in this report was 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. There has been much criticism of this method due to the inherently high false positive rate 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 Part 264. The EPA felt that most land disposal facilities would have permits by November 1988, and did not feel the need to modify the interim status regulations of 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 does not adequately consider the number of comparisons that must be made under the regulations, and (3) the CABF does not 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 post-closure monitoring, the statistical tests must remain t-tests as specified in 40 CFR Part 265 for interim status facilities or by the New Mexico Environmental Improvement Division (NMEID).

C.5 SAMPLE COLLECTION AND ANALYSIS FOR WASTEWATER SAMPLING

The sampling methods and procedures are detailed in the SNL, Albuquerque Wastewater Sampling Plan Table C-3. Samples were collected at five locations (Table 6-2). Methods used for sampling grab and composite samples are listed in Tables C-4 and C-5, respectively. Analytical methods and detection limits are listed in Table D-2 for each parameter. Monitoring requirements for each of the permitted stations may be separated into daily, monthly and yearly requirements. These requirements are summarized in Table C-3 to C-8. Details about the parameters to be analyzed and the permit limits for each parameter are contained in Tables C-4 to C-8. Pollutants noted with an asterisk (*) an Tables C-4 to C-8 are analyzed for in samples collected each month.

The City of Albuquerque permits require that all parameters listed in Tables C-4 to C-8 be analyzed once each year. Stations WW001, WW004, WW005, WW006, and WW007 are monitored continuously for pH and flow. Station WW003 is monitored for pH in each of two grab samples taken during the four sampling days every month. Table C-9 describes the analytical methods used for each SNL permitted wastewater sampling station.

C.6 SAMPLE COLLECTION AND ANALYSIS FOR AREA IV LAGOONS

Approved Discharge Plan DP-530 requires quarterly measurement of water level in each of the lagoons and semi-annual sampling for the water-quality parameters listed in Table 6-5. The limits for these parameters are also shown in Table 6-5.

Samples from the lagoons are collected and preserved in accordance with guidance provided in the Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA-600/4-82-029). Organic and inorganic fractions are collected as surface grab samples using a wide-mouthed borosilicate glass jar. Purgeable and extractable organic fractions are aliquotted first. Metal and wet-chemistry fractions are passed through a 0.45-micron cellulose acetate membrane filter before placement into prepreserved sample containers. All samples are iced after collection and during shipment.

Analyses conducted on all samples include (1) priority pollutant analysis for purgeable and base neutrals, (2) major cations and anions, and (3) total dissolved solids (TDS). Analyses are performed in accordance with U.S. Environmental Protection Agency (EPA) recommended analytical procedures for aqueous samples.

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

Parameter	Sample Media: Vegetation	Soil	Water: Total	Water: Filters* Filtrate	TLDs
Number of Locations	23	23	10	10	32
Number of Samples	31	31	10	10	128
Sample Frequency	Annual	Annual	Annual	Annual	Quarterly
Analysis Performed					
Gross α			X	X**	
Gross β^-			X	X**	
U_{tot}		X	X	X	
Gamma Spec.	X	X	X	X	
Tritium	X	X	X	X	
% H_2O	X	X			
TLD					X
Number of Analysis	93	93	50	106	125

*These filter samples are for analysis of suspended solids as well as water for selected analysis.
**Analysis performed on suspended solids in addition to filtered water (filtrate).

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

Parameter	Method No. (SW-846)(1)	Estimated Method Detection Limit(2)	Container Type(3)	Minimum Volume	Preservation(4)	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 H_2SO_4 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, H_2SO_4 to pH <2	28 days
Groundwater Quality Parameters						
Chloride	9250/9251 color EPA 300.0(5) 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, H_2SO_4 to pH <4	28 days
Sulfate	9035 color 9036 color 9038 color EPA 300.0(5) 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(6)	HNO_3 to pH <2	6 months
Manganese	6010 ICP	0.01 mg/l	P	1000 ml(6)	HNO_3 to pH <2	6 months
Sodium	6010 ICP	5.0 mg/l	P	1000 ml(6)	HNO_3 to pH <2	6 months

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

Parameter	Method No. (SW-846)(1)	Estimated Method Detection Limit(2)	Container Type(3)	Minimum Volume	Preservation(4)	Maximum Holding Time
EPA Interim Drinking Water Parameters						
Arsenic	7060 GFAA	0.005 mg/l	P	1000 ml(6)	HNO_3 to pH <2	6 months
Barium	6010 ICP	0.01 mg/l	P	1000 ml(6)	HNO_3 to pH <2	6 months
Cadmium	7131 GFAA 6010 ICP	0.0005 mg/l 0.005 mg/l	P	1000 ml(6)	HNO_3 to pH <2	6 months
Total Chromium	7191 GFAA 6010 ICP	0.001 mg/l 0.01 mg/l	P	1000 ml(6)	HNO_3 to pH <2	6 months
Lead	7421 GFAA	0.005 mg/l	P	1000 ml(6)	HNO_3 to pH <2	6 months
Mercury	7470 CVAA	0.0002 mg/l	P,G	1000 ml(6)	HNO_3 to pH <2	13 days in plastic 38 days in glass
Selenium	7740 GFAA	0.002 mg/l	P	1000 ml(6)	HNO_3 to pH <2	6 months
Silver	EPA 272.2(5) GFAA 6010 ICP	0.0005 mg/l 0.01 mg/l	P Dark, AG	1000 ml(6)	HNO_3 to pH <2	6 months
Gross Alpha	9310	3 pCi/l	P	1 gallon(7)	HNO_3 to pH <2	6 months
Gross Beta	9310	4 pCi/l	P	1 gallon(7)	HNO_3 to pH <2	6 months

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

Parameter	Method No. (SW-846)[1]	Estimated Method Detection Limit[2]	Container Type[3]	Minimum Volume	Preservation[4]	Maximum Holding Time
Total Radium	9315	3 pCi/l	P,G	1 gallon[7]	HNO_3 to pH <2	6 months
Endrin	8080 GC	0.10 μg/l	AG, Teflon-lined cap	2 x 1000 ml[8]	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[8]	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[8]	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[8]	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[8]	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[8]	Cool to 4°C, pH 5-9	7 days to extraction, 40 days after extraction
Fluoride	EPA 300.0[5] IC EPA 340.2[5] IS	0.005 mg/l 0.1 mg/l	P	300 ml	None required	28 days
Turbidity	EPA 180.1[5]	<1 NTU	P,G	200 ml	Cool to 4°C	48 hours
Nitrate (as Nitrogen)	EPA 300.0[5] IC EPA 353.2[5] 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, H_2SO_4 to pH <2	48 hours 28 days

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

Parameter	Method No. (SW-846)(1)	Estimated Method Detection Limit(2)	Container Type(3)	Minimum Volume	Preservation(4)	Maximum Holding Time
Total Coliform Bacteria	9132	<2 colony/100 ml	P/G (sterilized)	200 ml	Cool to 4°C	6 hours
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 gallon, or 1 x 1 gallon	Cool to 4°C	7 days to extraction 40 days after extraction

(1)U.S. EPA, 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical MEthods, Third Edition, U.S. Environmental Protection Agency, 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; GC/MS = Gas Chromatography/Mass Spectrometry.
(2)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.
(3)P = linear polyethylene; G = glass; AG = Amber Glass.
(4)Preservatives and holding times as specified in SW-846, Third Edition.
(5)U.S. EPA, 1984, Methods for Chemical Analysis of Water and Wastewater, U.S. Environmental Protection Agency, EPA-600-84-017.
(6)All metals analytes from single sample.
(7)All radionuclide analytes from single container.
(8)All pesticide and herbicide analytes from single set of containers.

Table C-3. Summary of Characteristics for SNL, Albuquerque, Waste Water Sampling Stations

Station Number	Frequency	Flumes	Flow Meter and Sampling Equipment
WW001	4x/mo	3" Parshall	ISCO 24 Flow Meter ISCO 2700R Sampler Leeds and Northrop pH Analyzer system
WW003	4x/mo	none	ISCO 2700 Sampler
WW004	4x/mo	2" Parshall	ISCO 2400 Flow Meter ISCO 2700R Sampler Leeds and Northrop pH Analyzer
WW005	4x/mo	3" Parshall	ISCO 2400 Flow Meter ISCO 2700R Sampler Leeds and Northrop pH Analyzer system
WW006	4x/mo	6" Parshall	ISCO 2400 Flow Meter ISCO 2700R Sampler Leeds and Northrop pH Analyzer system
WW007	4x/mo	45°V-Notchweir	ISCO 2440 Flow Meter ISCO 2700R Sampler Leeds and Northrop pH Analyzer system

Table C-4. Pollutant Concentration Limits, Waste Water Discharge Permit 2069A, Sampling Station WW001

Pollutant	4-Day Average	1-Day Average	Grab Maximum
Phenols (ug/l)	1000	2000	4000
Silver (ug/l)	2000	3400	8000
Arsenic (ug/l)	500	800	2000
Barium (ug/l)	5000	7500	20000
Cadmium (ug/l)*	1000	1700	4000
Cyanide (mg/l)*	2	3.8	8
Chromium (ug/l)	5000	8800	20000
Copper (ug/l)*	6000	10200	24000
Mercury (ug/l)	20	40	100
Manganese (ug/l)	5000	7500	20000
Nickel (ug/l)	3000	4700	12000
Oil/Grease (mg/l)	50	75	150
Lead (ug/l)*	800	1200	3200
pH**			>5,<11
Selenium (ug/l)	500	800	2000
Temperature °F			<140
Total Metals (Cu, Cr)	1000	15400	40000
Total Toxic Org.	2100	3200	5000
Zinc (ug/l)*	7000	11300	28000

*Analyzed monthly.
**Monitored continuously.

Table C-5. Pollutant Concentration Limits, Waste Water Discharge Permit 2069C-2, Sampling Station WW003

Pollutant	4-Day Average	1-Day Average	Grab Maximum
Phenols (ug/l)	1000	2000	4000
Silver (ug/l)*	2000	3400	8000
Arsenic (ug/l)	500	800	2000
Barium (ug/l)	5000	7500	20000
Cadmium (ug/l)*	641.025	1098.9	4000
Cyanide (ug/l)*	641.025	1217.94	8000
Chromium (ug/l)*	5000	8800	20000
Copper (ug/l)*	5769.23	9615.38	24000
Mercury (ug/l)	20	40	100
Manganese (ug/l)	5000	7500	20000
Nickel (ug/l)*	2083.33	3285.25	12000
Oil/Grease (mg/l)	50	75	150
Lead (ug/l)*	732.6	1098.9	3200
pH**			>5,<11
Selenium (ug/l)	500	800	2000
Temperature °F			<140
Total Metals (Cu, Cr)*	1000	15400	40000
Total Toxic Org.	2100	1365.380	5000
Zinc (ug/l)*	4761.9	7692.3	28000

*Analyzed monthly.
**Measured in two grab samples, four days each month.

Table C-6. Pollutant Concentration Limits, Waste Water Discharge Permit 2069D-2, Sampling Station WW004

Pollutant	4-Day Average	1-Day Average	Grab Maximum
Phenols (ug/l)	1000	2000	4000
Silver (ug/l)*	436.3630	781.8180	8000
Arsenic (ug/l)	500	800	2000
Barium (ug/l)	5000	7500	20000
Cadmium (ug/l)*	371.428	985.714	4000
Cyanide (ug/l)*	650	860	
Chromium (ug/l)*	4275	6925	20000
Copper (ug/l)*	6000	10200	24000
Mercury (ug/l)	20	40	100
Manganese (ug/l)	5000	7500	20000
Nickel (ug/l)*	2975	4700	12000
Oil/Grease (mg/l)	50	75	150
Lead (ug/l)*	800	1200	3200
pH**			>5,<11
Selenium (ug/l)	500	800	2000
Temperature °F			<140
Total Metals (Cu, Cr)*	1000	15400	40000
Total Toxic Org.	2100	2130	5000
Zinc (ug/l)*	4228.57	7457.143	28000

*Analyzed monthly.
**Monitored continuously.

Table C-7. Pollutant Concentration Limits, Waste Water Discharge Permit 2069G, Sampling Station WW007

Pollutant	4-Day Average	1-Day Average	Grab Maximum
Phenols (ug/l)	1000	2000	4000
Silver (ug/l)	2000	3400	8000
Arsenic (ug/l)*	500	800	2000
Barium (ug/l)	5000	7500	20000
Cadmium (ug/l)*	1000	1700	4000
Cyanide (mg/l)	2	3.8	8
Chromium (ug/l)*	5000	8800	20000
Copper (ug/l)*	6000	10200	24000
Fluoride (mg/l)*	30	45	100
Mercury (ug/l)	20	40	100
Manganese (ug/l)	5000	7500	20000
Nickel (ug/l)*	3000	4700	12000
Oil/Grease (mg/l)	50	75	150
Lead (ug/l)*	800	1200	3200
pH**			>5,<11
Selenium (ug/l)	500	800	2000
Temperature °F			<140
Total Metals (ug/l)*	10000	15400	40000
Total Toxic Org. (ug/l)	2100	698	5000
Zinc (ug/l)	7000	11300	28000

*Analyzed monthly.
**Monitored continuously.

Table C-8. Pollutant Concentration Limits, Waste Water Discharge Permit 2069F, Sampling Station WW006

Pollutant	4-Day Average	1-Day Average	Grab Maximum
Phenols (ug/l)	1000	2000	4000
Silver (ug/l)	2000	3400	8000
Arsenic (ug/l)	500	800	2000
Barium (ug/l)	5000	7500	20000
Cadmium (ug/l)*	1000	1700	4000
Cyanide (mg/l)*	2	3.8	8
Chromium (ug/l)	5000	8800	20000
Copper (ug/l)*	6000	10200	24000
Mercury (ug/l)	20	40	100
Manganese (ug/l)	5000	7500	20000
Nickel (ug/l)	3000	4700	12000
Oil/Grease (mg/l)	50	75	150
Lead (ug/l)*	800	1200	3200
pH**			>5,<11
Selenium (ug/l)	500	800	2000
Temperature °F			<140
Total Metals (Cu, Cr)	10000	15400	40000
Total Toxic Org.	2100	3200	5000
Zinc (ug/l)*	7000	11300	28000

*Analyzed monthly.
**Monitored continuously.

Table C-9. Sampling and Analytical Methodology, SNL, Albuquerque, Waste Water Monitoring Stations

PARAMETER	WASTEWATER DISCHARGE PERMIT NO.	SAMPLING FREQUENCY	SAMPLE COLLECTION METHOD	EPA ANALYTICAL METHOD[a]	PRESERVATIVE	HOLDING TIME	CONTAINER TYPE
Arsenic	2069A	A	Flow-Composite[b]	206.3/200.7[c]	HNO_3 to pH<2	6 months	P,G
	2069C	A	Time-Composite[d]				
	2069D	A	Flow-Composite				
	2069E	M A	Flow-Composite				
	2069F	A	Flow-Composite				
Barium	2069A	A	Flow-Composite	208.1/200.7[c]	HNO_3 to pH<2	6 months	P,G
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite				
Cadmium	2069A	M A	Flow-Composite	213.1/200.7[c]	HNO_3 to pH<2	6 months	P,G
	2069C	M A	Time-Composite				
	2069D	M A	Flow-Composite				
	2069E	M A	Flow-Composite				
	2069F	M A	Flow-Composite				
Chromium, total	2069A	A	Flow-Composite	218.1/200.7[c]	HNO_3 to pH<2	6 months	P,G
	2069C	M A	Time-Composite				
	2069D	M A	Flow-Composite				
	2069E	M A	Flow-Composite				
	2069F	A	Flow-Composite				
Copper	2069A	M A	Flow-Composite	220.1/200.7[c]	HNO_3 to pH<2	6 months	P,G
	2069C	M A	Time-Composite				
	2069D	M A	Flow-Composite				
	2069E	M A	Flow-Composite				
	2069F	M A	Flow-Composite				
Cyanide, total	2069A	M A	Flow-Composite	335.2/335.3[c]	Cool to 4 deg. C, NaOH to pH>12, 0.6g $C_6H_8O_6$/L	14 days	P,G
	2069C	M A	Time-Composite				
	2069D	M A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	M A	Flow-Composite				

Table C-9. Sampling and Analytical Methodology, SNL, Albuquerque, Waste Water Monitoring Stations (Continued)

PARAMETER	WASTEWATER DISCHARGE PERMIT NO.	SAMPLE SAMPLING FREQUENCY	COLLECTION METHOD	EPA ANALYTICAL METHOD[a]	PRESERVATIVE	HOLDING TIME	CONTAINER TYPE
Fluoride	2069E	M A	Flow-Composite	340.2[c]	None required	28 days	G
Lead	2069A	M A	Flow-Composite	239.1/200.7[c]	HNO_3 to pH<2	6 months	P,G
	2069C	M A	Time-Composite				
	2069D	M A	Flow-Composite				
	2069E	M A	Flow-Composite				
	2069F	M A	Flow-Composite				
Manganese	2069A	A	Flow-Composite	243.1/200.7[c]	HNO_3 to pH<2	6 months	P,G
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite				
Mercury	2069A	A	Flow-Composite	245.1[c]	HNO_3 to pH<2	28 days	P,G
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite				
Nickel	2069A	A	Flow-Composite	249.1/200.7[c]	HNO_3 to pH<2	6 months	P,G
	2069C	M A	Time-Composite				
	2069D	M A	Flow-Composite				
	2069E	M A	Flow-Composite				
	2069F	A	Flow-Composite				
Oil and grease	2069A	A	Flow-Composite	413.1[c]	Cool to 4 deg. C, HCl to pH<2	28 days	P,G
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite				

Table C-9. Sampling and Analytical Methodology, SNL, Albuquerque, Waste Water Monitoring Stations (Continued)

PARAMETER	WASTEWATER DISCHARGE PERMIT NO.	SAMPLING FREQUENCY	SAMPLE COLLECTION METHOD	EPA ANALYTICAL METHOD(a)	PRESERVATIVE	HOLDING TIME	CONTAINER TYPE
pH	2069A	C		150.1/150.2(c)	None required	analyze immediately	P,G
	2069C	(e)					
	2069D	C					
	2069E	C					
	2069F	C					
Phenolics	2069A	A	Flow-Composite	420.1/420.2(c)	Cool to 4 deg. C, H_2SO_4 to pH<2	28 days	P,G
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite				
Selenium	2069A	A	Flow-Composite	270.3/200.7(c)	HNO_3 to pH<2	6 months	P,G
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite				
Silver	2069A	A	Flow-Composite	272.1/200.7(c)	HNO_3 to pH<2	6 months	P,G
	2069C	M A	Time-Composite				
	2069D	M A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite				
Temperature	2069A	A	Grab	170.1(c)	None required	NA	P,G
	2069C	M A	Grab(e)				
	2069D	A	Grab				
	2069E	A	Grab				
	2069F	A	Grab				
Zinc	2069A	M A	Flow-Composite	289.1/200.7(c)	HNO_3 to pH<2	6 months	P,G
	2069C	M A	Time-Composite				
	2069D	M A	Flow-Composite				
	2069E	M A	Flow-Composite				
	2069F	M A	Flow-Composite				

Table C-9. Sampling and Analytical Methodology, SNL, Albuquerque, Waste Water Monitoring Stations (Continued)

PARAMETER	WASTEWATER DISCHARGE PERMIT NO.	SAMPLE SAMPLING FREQUENCY	COLLECTION METHOD	EPA ANALYTICAL METHOD[a]	PRESERVATIVE	HOLDING TIME	CONTAINER TYPE
TOTAL TOXIC ORGANICS:[g]							
Volatile compounds	2069A	A	Flow-Composite[h]	624[i]	Cool to 4 deg. C, $0.008\%\ Na_2S_2O_3$	14 days	AG, Teflon-faced silicone septa, no headspace
	2069C	A	Time-Composite[h]				
	2069D	A	Flow-Composite[h]				
	2069E	A	Flow-Composite[h]				
	2069F	A	Flow-Composite[h]				
BNA Extractable compounds	2069A	A	Flow-Composite	625[l]	Cool to 4 deg. C, $0.008\%\ Na_2S_2O_3$	7 days[j]	AG, Teflon-lined cap
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-composite				
Pesticides	2069A	A	Flow-Composite	608[l]	Cool to 4 deg. C, pH 5-9	7 days[j]	AG, teflon-lined cap
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite				
Polychlorinated biphenyls	2069A	A	Flow-Composite	608[l]			AG, teflon-lined cap
	2069C	A	Time-Composite				
	2069D	A	Flow-Composite				
	2069E	A	Flow-Composite				
	2069F	A	Flow-Composite		Cool to 4 deg. C pH 5-9	7 days[j]	

Table C-9. Sampling and Analytical Methodology, SNL, Albuquerque, Waste Water Monitoring Stations (Concluded)

NOTES

[a] Alternate EPA approved analytical methods are listed in 40 CFR Part 136.3, Table 1B.

[b] 24 Hour flow proportional composite sample collected with an ISCO 2700R sampler interfaced to an ISCO 2400 flow meter. Sample maintained near 4°C during sample collection. Specific sample collection techniques are identified in the draft SNLA Wastewater Sampling Plan (Oct. 1987).

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

[d] 24-hour time-weighted composite sample collected using an ISCO 2700 portable sampler. Sample collection container iced during sample collection.

[e] Two grab samples collected and measured for pH and temperature each day of monthly sample collection.

[f] Continuous monitoring with a Leeds and Northrup 200 series pH monitoring system.

[g] Total Toxic Organic (TTO) parameters as identified in wastewater discharge permits are contained in the subset of organic analyses methods listed.

[h] Volatile organic fraction collected each 12-hour interval during annual sample collection.

[i] U.S. Environmental Protection Agency (EPA), July 1982, Methods for Organic Chemical Analysis of Municiple and Industrial Wastewater, EPA-600/4-82-057.

[j] Holding time is 40 days after extraction.

A - Annually
AG - Amber glass
C - Continuous monitoring
G - Glass
M - Monthly
NA - Not Applicable
P - Plastic, for metals polyethylene with polypropylene cap

REFERENCES

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

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

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

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

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

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

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

APPENDIX D

MINIMUM DETECTION LIMITS
AND
ANALYTICAL METHODS

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

Analysis	Method	Sample Type	Sample Size	MDL** Value	MDL** Units	Count Time Minutes
^{3}H	Liquid Scintillation	Water	1 ml	0.45	pCi/ml	100
u_{tot}	Flourescence	Water	1 ml	1.5×10^{-3}	μg/ml	
		Soil	1 g	1.2×10^{-2}	μg/g	
Gross α	Gas Proportional	Water	100 ml	2.8×10^{-3}	pci/ml	100
		Water	1000 ml	1.4×10^{-4}		
Gross β	Gas Proportional	Water	100 ml	1.8×10^{-2}	pci/ml	100
		Water	400 ml	1.8×10^{-3}		
^{137}cs	Gamma Spectral* Analysis	Water	450 ml	1.0×10^{-2}	pci/ml	1000
		Vegetable+	60 g	3.0×10^{-2}	pci/g	1000
		Soil+	800 g	2.0×10^{-2}	pci/g	100
^{40}k	Gamma Spectral* Analysis	Water	450 ml	1.0×10^{-1}	pci/ml	1000
		Vegetable+	60 g	5.0×10^{-1}	pci/g	1000
		Soil+	800 g	2.0×10^{-1}	pci/g	100

+Soil and vegetation sample size is geometry volume. Sample mass varies from sample to sample. The marinelli water standard is a 450 ml standard. The marinelli soil standard is 890 gm.
*Gamma isotopics were analyzed using a pgt intrinsic/germanium detector.
**These are typical mdl values at 95% confidence level.

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

Parameter	Analytical Methods (EPA, 1983)	Detection Limits ($\mu g/l$)	QC Acceptance Criteria Spike Recovery	Q 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.

APPENDIX E

QUALITY ASSURANCE DATA

Table E-1. List of Nonradioactive Environmental Samples Collected During CY89

Type	No. of Samples	No. of Analyses
Groundwater	230	780
Wastewater	953	2400
Oils/PCBs	467	467
Hazardous Wastes	34	168
Asbestos	2	2
Other	177	591
Total	1863	4408

Table E-2. List of Laboratories Used During CY89

Assaigai Analytical Laboratories, Inc.

Encotec

Enseco-Rocky Mountain Analytical Labs

IT Analytical Services

Sandia National Laboratories Div. 3211

TMA Eberline

Table E-3. Summary of Analytical Results for Check Samples Submitted to Encotec During 1989

Quarter	First Quarter		Second Quarter		Third Quarter		Fourth Quarter		Acceptance Range(2)	
Parameter	Percent Recovery	Relative Percent Difference	Percent Recovery	Relative Percent Difference	Percent Recovery	Relative Percent Difference	Percent Recovery	Relative Percent Difference	Percent Recovery	RPD
Arsenic	89/92	12	76/83,8	8	96,82,94	15	107/103,102	3	75-125	± 20% for values
Barium	--	--	--	--	89,89,84	0	100/92,97	9	75-125	greater than 5 x MDL,
Cadmium	68/74	7	86/85,9	1	ND,92,105	NC	917/100,96	170	75-125	± MDL for values less
Chromium	100/100	0	100/75,92	29	92,92,110	0	96/92,125	4	75-125	than 5 x MDL.
Copper	100/100	0	100/100,92	10	99,99,96	0	100/100,125	0	75-125	
Lead	100/100	0	93/100,90	18	96,102,57	7	97/93,111	3.6	75-125	
Manganese	--	--	--	--	88,88,85	0	93/86,140	8	75-125	
Mercury	--	--	--	--	90,94,94	4	38/47,36	22	75-125	
Nickel	80/80	0	100/100,85	0	100,100,96	0	93/89,100	4	75-125	
Selenium	--	--	--	--	ND,95,110	NC	100/100,106	0	75-125	
Silver	ND/ND	NC	75/100,92	29	ND,ND,ND	NC	95/91,100	5	75-125	
Zinc	114/100	13	60/60,81	0	85,90,ND	NC	93/93,100	0	75-125	
Cyanide	96/85	13	86/86,20	0	74,79,70	6	5/6	18	75-125	
Fluoride	93/91	2	100/100,102	0	98,92,96	7	108,91	12	75-125	
Oil and Grease	--	--	--	--	89,61,142	31	--	--	75-125	
Phenols	--	--	--	--	131,131,179	0	--	--	75-125	
PCBs	--	--	--	--	100	--	96/62	--	75-125	

NC = Not calculable.
ND = Not detected.
(1)First two values are results of duplicate sample analyses from which RPD values were calculated. Acceptance limits of PCBs analyses are based on 95 percent confidence intervals from round-robin analyses and are not listed.
(2)Acceptance criteria are based on limits identified in the Sandia National Laboratories Laboratory Data Quality Evaluation Plan for the Wastewater Monitoring Program, March 1988.

Table E-4. Summary of Analytical Results for Check Samples Submitted to Encotec During 1989

Quarter	Second Quarter		Fourth Quarter		Total	Acceptance Range(1)	
Parameter	Average Percent Recovery	Relative Percent Difference	Average Percent Recovery	Relative Percent Difference	Number of Check Samples Analyzed	Percent Recovery	RPD
Arsenic	80/96	18	98/101	3	5	75-125	± 20% for
Barium	96/96	0	104/104	0	5	75-125	values greater
Cadmium	100/100	0	100/100	0	5	75-125	than 5 x MDL,
Chromium	132/132	0	98/98	0	5	75-125	± MDL for
Iron	ND/ND	--	100/100	0	5	75-125	values less
Lead	80/95	17	108/108	0	5	75-125	than 5 x MDL.
Manganese	82/82	0	100/100	0	5	75-125	
Mercury	88/88	0	106/106	0	5	75-125	
Selenium	101/110	8	106/118	11	5	75-125	
Silver	136/191	40	100/100	0	5	75-125	
Chloride	97/97	0	101/76	28	5	75-125	
Nitrate-N	126/126	0	100/ND	NC	5	75-125	
pH	98/94	4			2	75-125	
Phenols	ND/15	NA	ND/83	NC	5	75-125	
Sulfate	93/93	0	105/305	98	5	75-125	
Conductivity	85/15	138	93/84	10	5	75-125	
TOC	NA/104	NA	7.3/ND	NA	5	75-125	
TOX	147/147	0	91/86	5	5	75-125	
PCBs	54	--	19/48/15/70/10/58/104		NA	75-125	

NA = Not Applicable.
NC = Not calculable.
ND = Not detected.
(1)Acceptance criteria are based on limits identified in the Sandia National Laboratories Laboratory Data Quality Evaluation plan for the Wastewater Monitoring Program, March 1988. Acceptance limits of PCBs analyses are based on 95 percent confidence intervals from round-robin analyses and are not listed.

Table E-5. Department 3220 QA Plan Contents of 18 Quality Elements

1.0 ORGANIZATION
- 1.1 Authority and Responsibilities
- 1.2 Scope of Work

2.0 QUALITY ASSURANCE PROGRAM
- 2.1 Plans
- 2.2 Management Assessment
- 2.3 Familiarization, Training, and Qualification

3.0 DESIGN CONTROL AND ANALYSIS
- 3.1 Design Input
- 3.2 Design-Related Drawings
- 3.3 Analysis
- 3.4 Verification of Computer Programs Supporting Design Control and Analyses

4.0 CONTROL OF PROCUREMENT
- 4.1 Purchase Requests
- 4.2 Statements of Work
- 4.3 Procurement Source Evaluation
- 4.4 Bid Evaluation

5.0 INSTRUCTIONS, PROCEDURES, AND DRAWINGS
- 5.1 Procedure Content
- 5.2 Logbooks
- 5.3 Documentation of Photographs
- 5.4 Method of Logbook Entry
- 5.5 Corrections to Logbook Entries
- 5.6 Environment Safety & Health
- 5.7 Security
- 5.8 Distribution

6.0 DOCUMENT CONTROL
- 6.1 Documents Issued By or For Division 3202
- 6.2 Documents Not Issued By or For Division 3202
- 6.3 SAND Reports

7.0 CONTROL OF PURCHASED ITEMS AND SERVICES
- 7.1 Review and Approval of Contractor Plans and Procedures
- 7.2 Performance Verification
- 7.3 Receiving Inspection
- 7.4 Deviation From Requirements

Table E-5. Department 3220 QA Plan Contents of 18 Quality Elements (Continued)

8.0 IDENTIFICATION AND CONTROL OF MATERIALS AND SAMPLES
- 8.1 Sample Collection
- 8.2 Sample Identification
- 8.3 Sample Preservation and Handling
- 8.4 Chain of Custody
- 8.5 Sample Delivery

9.0 CONTROL OF PROCESSES

10.0 INSPECTIONS
- 10.1 General Criteria
- 10.2 Inspection Planning

11.0 TEST CONTROL
- 11.1 Test Procedures
- 11.2 Data Acquisition and Reduction
- 11.3 Test Results and Records
- 11.4 Quality Control Samples
- 11.5 Data Verification

12.0 CONTROL OF MEASURING AND TEST EQUIPMENT
- 12.1 Frequency of Calibration
- 12.2 Calibration Labels
- 12.3 Calibration Certificates
- 12.4 Preventive Maintenance
- 12.5 Corrective Action
- 12.6 Exemptions

13.0 HANDLING, PACKAGING, STORAGE, AND SHIPPING
- 13.1 Special Equipment
- 13.2 Special Tools
- 13.3 Specific Instructions

14.0 INSPECTION, TEST, AND OPERATING STATUS
- 14.1 Methods of Indicating Status
- 14.2 Application and Removal of Status Indicators

15.0 CONTROL OF NONCONFORMANCES

16.0 CORRECTIVE ACTIONS

Table E-5. Department 3220 QA Plan Contents of 18 Quality Elements (Concluded)

17.0 RECORDS MANAGEMENT
- 17.1 Generation of QA Records
- 17.2 Acceptance of Records
- 17.3 Receipt of Records by the Records Manager
- 17.4 Records Identification
- 17.5 Storage
- 17.6 Critical Records
- 17.7 Preservation
- 17.8 Safekeeping
- 17.9 Corrections
- 17.10 Retrieval and Retention Times

18.0 AUDITS
- 18.1 Scope of Audits
- 18.2 Scheduling of Audits
- 18.3 Preparation of Audits
- 18.4 Reporting Audit Results
- 18.5 Response to Audits
- 18.6 Follow-Up Action

REFERENCES

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

APPENDIX F

ENVIRONMENTAL MONITORING DATA

Table F-1. 1989 Vegetation Sample Analysis

Report No.	Loc. Type	^{3}H pCi/ml	^{3}H SDEV	% H_2O	^{137}Cs pCi/g	^{137}Cs SDEV	^{40}K pCi/g	^{40}K SDEV
1	S	<0.45	-	64.1	<0.03	-	32.0	0.44
2 NW	S	<0.45	-	21.0	<0.03	0.006	3.92	0.21
2 SE	S	<0.45	-	4.1	0.12	0.01	3.23	0.22
2 NE	S	16.5	0.5	6.6	0.04	0.007	3.49	0.2
2 SW	S	<0.45	-	7.6	0.04	0.007	1.98	0.15
3	S	0.5	0.5	5.9	0.18	0.01	3.98	0.2
4	P	<0.45	-	19.5	<0.02	-	7.2	0.23
5 A	P	<0.45	-	6.0	0.14	0.009	1.99	0.18
5 B	P	1.0	0.5	6.3	0.13	0.01	1.56	0.19
5 C	P	0.5	0.5	8.1	0.05	0.008	2.19	0.18
6 A	S	<0.45	-	3.4	0.04	0.008	1.34	0.32
6 B	S	<0.45	-	2.9	0.07	0.01	2.15	0.21
6 C	S	<0.45	-	5.4	0.06	0.009	2.5	0.22
7 A	S	<0.45	-	5.2	0.06	0.008	1.36	0.16
7 B	S	<0.45	-	4.9	<0.03	-	1.15	0.17
7 C	S	<0.45	-	6.1	0.03	0.007	2.39	0.21
8	C	<0.45	-	54.8	<0.03	-	7.24	0.27
9	C	<0.45	-	49.7	<0.03	-	10.3	0.29
10	C	<0.45	-	49.7	<0.03	-	7.21	0.26
11	C	<0.45	-	48.5	0.02	0.006	9.34	0.27
16 A	P	<0.45	-	8.5	<0.03	-	3.03	0.21
16 B	P	<0.45	-	7.5	<0.03	-	1.29	0.17
16 C	P	1.1	0.5	5.2	<0.03	-	1.37	0.18
19	P	<0.45	-	18.3	0.09	0.008	6.01	0.22
20	S	<0.45	-	3.2	0.11	0.009	3.92	0.19
25	C	<0.45	-	27.5	<0.02	-	14.9	0.28
33	S	2.6	0.5	14.1	<0.03	-	3.17	0.19
34	S	<0.45	-	15.9	0.03	0.008	3.25	0.21
35	S	<0.45	-	6.3	0.05	0.01	4.95	0.24
45	S	<0.45	-	30.6	<0.03	-	8.42	0.26
49	S	<0.45	-	2.0	0.30	0.01	3.98	0.22

Table F-2. 1989 Soil Sample Analysis

Report No.	Loc. Type	U-Tot ug/g	U-Tot SDEV	^3H pCi/ml	^3H SDEV	% H_2O	^{137}Cs pCi/g	^{137}Cs SDEV	^{40}K pCi/g	^{40}K SDEV
1	S	2.6	0.2	10.3	1.0	1.3	0.43	0.02	17.7	0.39
2 NW	S	2.9	0.2	8.1	1.0	0.01	0.35	0.01	15.6	0.29
2 SE	S	2.0	0.2	4.7	1.0	0.06	0.7	0.02	16.1	0.29
2 NE	S	2.1	0.2	6.7	1.0	0.04	0.42	0.01	16.0	0.3
2 SW	S	2.0	0.2	7.0	1.0	0.02	0.57	0.02	16.5	0.3
3	S	2.7	0.2	11.2	1.0	0.44	0.44	0.01	19.2	0.32
4	P	2.7	0.2	6.9	1.0	0.37	0.3	0.01	18.4	0.3
5 A	P	2.5	0.2	8.1	1.0	0.29	<0.008	-	0.29	0.04
5 B	P	2.6	0.2	6.3	1.0	0.27	0.57	0.02	16.3	0.3
5 C	P	2.6	0.2	8.4	1.0	0.28	0.5	0.01	15.7	0.29
6 A	S	2.7	0.2	4.4	1.0	0.17	0.49	0.01	16.9	0.3
6 B	S	2.9	0.2	3.5	1.0	0.15	0.45	0.01	17.1	0.3
6 C	S	2.9	0.2	3.4	1.0	0.12	0.43	0.01	17.1	0.3
7 A	S	2.1	0.2	5.0	1.0	0.53	0.61	0.02	19.2	0.33
7 B	S	2.0	0.2	2.5	1.0	0.52	0.7	0.02	18.0	0.31
7 C	S	2.2	0.2	1.8	1.0	0.48	0.59	0.01	18.5	0.31
8	C	2.3	0.2	9.4	1.0	0.25	<0.02	-	17.5	0.3
9	C	2.6	0.2	7.6	1.0	3.8	0.3	0.01	14.8	0.3
10	C	2.5	0.2	5.7	1.0	2.5	0.79	0.02	15.2	0.31
11	C	2.5	0.2	8.7	1.0	0.5	0.08	0.007	17.7	0.3
16 A	P	2.6	0.2	6.4	1.0	0.53	0.11	0.008	26.0	0.35
16 B	P	2.6	0.2	8.6	1.0	0.5	0.11	0.01	25.2	0.36
16 C	P	2.6	0.2	6.8	1.0	0.56	0.1	0.009	24.7	0.34
19	P	2.0	0.2	6.7	1.0	0.61	0.88	0.02	19.6	0.32
20	S	2.1	0.2	3.1	1.0	0.15	0.59	0.02	15.8	0.3
25	C	2.8	0.2	5.5	1.0	0.32	0.06	0.006	18.8	0.31
33	S	2.5	0.2	8.1	1.0	0.65	0.1	0.008	17.3	0.32
34	S	2.3	0.2	6.1	1.0	1.5	0.34	0.01	16.3	0.3
35	S	2.2	0.2	2.4	1.0	0.09	0.4	0.01	18.2	0.32
45	S	2.7	0.2	6.0	1.0	0.32	0.7	0.02	19.7	0.32
49	S	2.2	0.2	7.2	1.0	0.04	0.6	0.02	19.7	0.33

Table F-3. 1989 Water Sample Analysis - Surface Water

Sample Type	Gross Alpha x 10^{-3} pCi/ml	Alpha SDEV x 10^{-3}	Gross Beta x 10^{-3} pCi/ml	Beta SDEV x 10^{-3}	U-Tot ug/ml	U-Tot SDEV	^3H pCi/ml	^3H SDEV	^{137}Cs pCi/ml x 10^{-3}	^{137}Cs SDEV x 10^{-3}
Number: 8										
F	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
S	1.5	0.9	<0.4	-	<0.012	-	-	-	-	-
T	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
Number: 11										
F	5.3	3.2	19.9	17.4	<0.012	-	<0.45	-	<0.01	-
S	1.9	1.1	<0.4	-	<0.012	-	-	-	-	-
T	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
Number: 33A										
F	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
S	<0.2	-	<0.4	-	<0.012	-	-	-	-	-
T	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
Number: 33B										
F	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
S	<0.03	-	<0.4	-	<0.012	-	-	-	-	-
T	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
Number: 33C										
F	<2.8	-	22.6	17.4	<0.012	-	<0.45	-	<0.01	-
S	<0.03	-	<0.4	-	<0.012	-	-	-	-	-
T	<2.8	-	32.8	17.5	<0.012	-	<0.45	-	<0.01	-

Table F-4. 1989 Water Sample Analysis - Well Water

Sample Type	Gross Alpha $\times 10^{-3}$ pCi/ml	Alpha SDEV $\times 10^{-3}$	Gross Beta $\times 10^{-3}$ pCi/ml	Beta SDEV $\times 10^{-3}$	U-Tot ug/ml	U-Tot SDEV	^{3}H pCi/ml	^{3}H SDEV	^{137}Cs pCi/ml $\times 10^{-3}$	^{137}Cs SDEV $\times 10^{-3}$
Number: 14										
F	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
S	<0.03	-	<0.4	-	-	-	-	-	-	-
T	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
Number: 17										
F	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
S	<0.03	-	<0.4	-	-	-	-	-	-	-
T	4.0	3.1	<18.5	-	<0.012	-	<0.45	-	<0.01	-
Number: 37										
F	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.02	-
S	<0.03	-	<0.4	-	-	-	-	-	-	-
T	3.9	3.1	<18.5	-	<0.012	-	<0.45	-	<0.01	-
Number: 38										
F	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
S	<0.03	-	<0.4	-	-	-	-	-	-	-
T	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
Number: 50										
F	<2.8	-	<18.5	-	<0.012	-	<0.45	-	<0.01	-
S	0.04	0.04	<0.4	-	-	-	-	-	-	-
T	4.1	3.1	<18.5	-	<0.012	-	<0.45	-	<0.01	-

Table F-5. 1989 Thermoluminescent Dosimeter (TLD) Summary Radiation Exposure Data

Report No.	1st Field Days	Qtr. Exposure mR	2nd Field Days	Qtr. Exposure mR	3rd Field Days	Qtr. Exposure mR	4th Field Days	Qtr. Exposure mR	Dose mR/365d (error)[a]
Location Type: C									
10	84	21.5	78	21.7	104	31.5	94	27.2	103 (5)
11	84	20.0	78	13.7	104	22.6	94	21.7	79 (8)
21	84	21.4	78	19.2	104	26.8	94	21.5	90 (17)
22	84	19.5	78	17.6	104	22.9	94	22.0	83 (6)
23	84	19.5	78	16.3	104	24.7	94	NA[b]	83 (8)
24	84	22.5	78	18.9	104	26.8	94	26.1	96 (9)
25	84	25.5	78	20.8	104	32.6	94	29.0	109 (11)
26	84	26.7	78	22.2	104	31.1	94	25.0	106 (15)
27	84	22.8	78	15.9	104	26.9	94	23.8	91 (11)
28	84	22.5	78	16.8	104	26.9	94	25.0	92 (9)
29	84	20.1	78	17.6	104	24.3	94	22.8	86 (9)
30	84	24.2	78	17.7	104	28.6	94	27.3	99 (10)
Location Type: P									
4	84	23.1	78	19.6	104	29.3	92	23.1	97 (5)
5	84	22.2	78	16.5	104	24.3	92	20.7	85 (10)
16	84	24.1	78	21.9	104	34.0	92	28.8	111 (8)
18	84	23.9	78	17.4	104	27.3	92	20.8	91 (9)
19	84	25.7	78	20.7	104	30.3	92	24.1	104 (6)
39	84	20.8	78	18.4	104	25.0	92	21.2	87 (8)
40	84	22.9	78	37.2	104	25.3	92	22.9	110 (12)
Location Type: S									
1	84	21.4	78	17.8	104	29.2	92	31.7	102 (12)
2	84	24.9	78	20.4	104	NA[b]	92	25.7	102 (6)
3	84	NA[b]	78	17.9	104	28.5	92	25.3	96 (12)
6	84	24.2	78	18.4	104	28.6	92	23.5	96 (8)
7	84	31.2	78	23.8	104	34.1	92	29.6	121 (9)
20	84	21.9	78	20.3	104	29.6	92	25.9	100 (9)
31	84	23.2	78	15.4	104	29.1	92	24.6	94 (12)
41	84	55.9	78	82.1	104	65.5	92	68.0	277 (31)
42	84	25.6	78	21.7	104	27.7	92	24.5	101 (9)
43	84	21.5	78	18.5	104	25.9	92	22.4	90 (7)
46	84	24.8	78	20.0	104	35.3	92	28.6	111 (10)
47	84	25.0	78	23.3	104	34.1	92	27.4	112 (11)
48	84	25.1	78	20.0	104	31.0	92	27.1	105 (9)

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

[b]NA = data was not available.

Table F-6. 1989 Calculated Effluent Release Data

Parameter	^{41}Ar***
Release Point	Area V
χ/Q at 3 km*	3.06×10^{-13} s/ml
χ/Q at 80 km	2.27×10^{-16} s/ml
Activity Released	8.8 Ci
Released Rate (Q)	0.28 μCi/s
Boundary Concentration	8.51×10^{-14} μCi/ml
DCG for Average Population**	1.0×10^{-8} μCi/ml
Boundary Concentration/DCG	8.51×10^{-6}

*Release point to site boundary distance is 3 km.
**"Radiation Protection of the Public and the Environment," DOE order 5400.5.
***Only ^{41}Ar data are presented here, since it is the largest dose contributor of all 1989 effluent releases from Sandia, Albuquerque's operations.

Table F-7a. Background Concentrations of Groundwater Contamination Indicator Parameters for BW-3

Sampling Date	pH(1)	Specific Conductance (umhos/cm at 25°C)(1)	Total Organic Halogen (TOX) (ug/l)	Total Organic Carbon (TOC) (mg/l)
12/88		990	38	1.3
12/88	7.66	1110	21	1.2
12/88	7.78	1100	24	1.2
12/88	7.90	1100	36	1.4
3/89	7.34	1170	2.5(2)	0.2
3/89	7.33	1170	5	0.3
3/89	7.35	1170	2.5(2)	0.3
3/89	7.36	1170	8	0.2
6/89			15(2),(3)	0.25(2)
6/89	6.98	1112	15(2),(3)	0.25(2)
6/89	7.21	1124	9(3)	0.25(2)
6/89	6.93	1227	10(3)	0.6
9/89	7.19	1207	5	0.7
9/89	7.20	1209	6	0.7
9/89	7.20	1207	2.5(2)	0.7
9/89	7.21	1198	18	0.7
Arith Mean	7.33	1151	14	0.6
Variance	0.08	3866	128	0.2
n	14	15	16	16

(1) Measurements taken in field, values listed are last four measurements of well purge water prior to sample collection.
(2) No detection, value is one-half the reported detection limit.
(3) = Collected during supplemental sampling event in January 1990.
n = number of samples.

Table F-7b. Background Concentrations of Groundwater Contamination Indicator Parameters for MW-1A

Sampling Date	pH (1)	Specific Conductance (umhos/cm at 25°C)(1)	Total Organic Halogen (TOX) (ug/l)	Total Organic Carbon (TOC) (mg/l)
12/88	7.41	790	14	0.9
12/88	7.37	800	20	1.0
12/88	7.36	810	26	1.0
12/88	7.36	820	19	1.2
3/89	7.35	1000	2.5(2)	0.5
3/89	7.29	1000	3(1)	0.4
3/89	7.28	1000	5.0	0.3
3/89	7.29	1000	8	0.3
6/89	7.05	1019	15(2),(3)	0.25(2)
6/89	7.05	1009	15(2),(3)	0.25(2)
6/89	7.05	1011	8.0(3)	0.25(2)
6/89	7.06	1002	15(2),(3)	0.3(2)
9/89	7.06	1041	2.5(2)	0.3
9/89	7.05	1038	2.5(2)	0.3
9/89	7.05	1038	2.5(2)	0.3
9/89	7.05	1039	2.5(2)	0.3
Arith Mean	7.20	--	10	0.5
Variance	0.02	9201	60	0.1
n	16	16	16	16

(1) Measurements taken in field, values listed are last four measurements of well purge water prior to sample collection.
(2) No detection, value is one-half the reported detection limit.
(3) = Collected during supplemental sampling event in January 1990.
n = number of samples.

Table F-7c. Background Concentrations of Groundwater Contamination Indicator Parameters for MW-2A

Sampling Date	pH(1)	Specific Conductance (umhos/cm at 25°C)(1)	Total Organic Halogen (TOX) (ug/l)	Total Organic Carbon (TOC) (mg/l)
12/88	7.29	970	106	0.2
12/88	7.49	970	103	0.2
12/88	7.34	970	95	0.3
12/88	7.56	980	110	1.4
3/89	7.53	1040	12	0.3(2)
3/89	7.46	1040	12	0.1
3/89	7.44	1040	7	0.1
3/89	7.42	1040	14	0.3(2)
6/89	7.56	1049	40(3)	0.25(2)
6/89	7.41	1045	27(3)	0.25(2)
6/89	7.32	1027	30(3)	0.25(2)
6/89	7.41	1023	50(3)	0.5
9/89	7.19	1027	19	0.3(2)
9/89	7.19	1027	13	0.3(2)
9/89	7.18	1027	11	0.3(2)
9/89	7.18	1027	18	0.6
Arith Mean	7.37	1019	42	0.3
Variance	0.02	827	1493	0.1
n	16	16	16	16

(1)Measurements taken in field, values listed are last four measurements of well purge water prior to sample collection.
(2)No detection, value is one-half the reported detection limit.
(3)= Collected during supplemental sampling event in January 1990.
n = number of samples.

Table F-7d. Background Concentrations of Groundwater Contamination Indicator Parameters for MW-3A

Sampling Date	pH(1)	Specific Conductance (umhos/cm at 25°C)(1)	Total Organic Halogen (TOX) (ug/l)	Total Organic Carbon (TOC) (mg/l)
12/88	7.78	990	32	0.6
12/88	7.80	990	34	0.5
12/88	7.71	990	32	0.5
12/88	7.71	920	19	0.6
3/89	7.79	1000	2.5(2)	0.4
3/89	7.79	1000	5	0.2
3/89	7.81	1000	7.0	0.4
3/89	7.8	1000	3(2)	0.3
6/89	7.27	1013	8(3)	0.25(2)
6/89	7.25	1008	6(3)	0.80
6/89	7.23	1008	5(3)	0.80
6/89	7.24	1008	5(3)	0.8
9/89	7.16	1002	55	0.3(2)
9/89	7.16	1002	58	0.3(2)
9/89	7.17	1002	58	0.3(2)
9/89	7.16	1001	58	0.4(2)
Arith Mean	7.49	996	24	0.5
Variance	0.09	453	504	0.05
n	16	16	16	16

(1)Measurements taken in field, values listed are last four measurements of well purge water prior to sample collection.
(2)No detection, value is one-half the reported detection limit.
(3)= Collected during supplemental sampling event in January 1990.
n = number of samples.

Table F-8a. Background Concentrations of Groundwater Quality Indicator Parameters for BW-3

Constituent	Units	Sampling Date 12/88	3/89	6/89	9/89
Chloride	(mg/l)	116	114	123	129
Iron - t	(mg/l)	0.39	0.36	0.5	0.4
Iron - d	(mg/l)	<0.012<0.05	ND<0.05	ND<0.1	ND<0.1
Manganese - t	(mg/l)	0.058	0.028	0.02	0.03
Manganese - d	(mg/l)	0.063	0.018	0.02	0.03
Phenols	(mg/l)	ND<0.01	ND<0.01	0.11	ND<0.01
Sodium - t	(mg/l)	141	138	113	128
Sodium - d	(mg/l)	144	142	112	137
Sulfate	(mg/l)	111	106	83	102

t = Total metal concentration.
d = Dissolved metal concentration.
ND = Not detected at the method reporting limit stated in the table above.

Table F-8b. Background Concentrations of Groundwater Quality Indicator Parameters for MW-1A

Constituent	Units	Sampling Date 12/88	3/89	6/89	9/89
Chloride	(mg/l)	105	100	104	103
Iron - t	(mg/l)	0.17	0.12	0.6	ND<0.1
Iron - d	(mg/l)	ND<0.05	ND<0.05	ND<0.1	ND<0.1
Manganese - t	(mg/l)	0.091	0.062	0.09	0.02
Manganese - d	(mg/l)	0.0469	0.063	0.04	0.01
Phenols	(mg/l)	0.01	0.03	ND<0.01	ND<0.01
Sodium - t	(mg/l)	145	72	74	74
Sodium - d	(mg/l)	75	73	74	80
Sulfate	(mg/l)	67	58	62	61

t = Total metal concentration.
d = Dissolved metal concentration.
ND = Not detected at the method reporting limit stated in the table above.

Table F-8c. Background Concentrations of Groundwater Quality Indicator Parameters for MW-2A

Constituent	Units	Sampling Date 12/88	3/89	6/89	9/89
Chloride	(mg/l)	99	99	99	104
Iron - t	(mg/l)	0.96	0.16	0.3	ND<0.1
Iron - d	(mg/l)	ND<0.05	ND<0.05	ND<0.1	ND<0.1
Manganese - t	(mg/l)	0.066	0.018	0.01	ND<0.01
Manganese - d	(mg/l)	0.069	0.006	ND<0.01	0.01
Phenols	(mg/l)	ND<0.01	ND<0.01	ND<0.01	ND<0.01
Sodium - t	(mg/l)	78	72	75	75
Sodium - d	(mg/l)	80	74	74	82
Sulfate	(mg/l)	65	59	59	61

t = Total metal concentration.
d = Dissolved metal concentration.
ND = Not detected at the method reporting limit stated in the table above.

Table F-8d. Background Concentrations of Groundwater Quality Indicator Parameters for MW-3A

Constituent	Units	Sampling Date 12/88	3/89	6/89	9/89
Chloride	(mg/l)	97	94	97	99
Iron - t	(mg/l)	ND<0.05	0.06	ND<0.1	ND<0.1
Iron - d	(mg/l)	ND<0.05	ND<0.05	ND<0.1	ND<0.1
Manganese - t	(mg/l)	0.022	0.018	ND<0.01	ND<0.01
Manganese - d	(mg/l)	0.017	0.014	ND<0.01	ND<0.01
Phenols	(mg/l)	ND<0.01	ND<0.01	ND<0.01	0.27
Sodium - t	(mg/l)	101	92	86	79
Sodium - d	(mg/l)	106	87	79	81
Sulfate	(mg/l)	68	63	62	63

t = Total metal concentration.
d = Dissolved metal concentration.
ND = Not detected at the method reporting limit stated in the table above.

Table F-9a. Background Concentrations (Metals) of EPA Interim Primary Drinking Water Supply Parameters for BW-3

Constituent	Units	MCL	Sampling Date 12/88	3/89	6/89	9/89	1/90
Arsenic - t	(mg/l)	0.05	ND<0.006	ND<0.003	ND<0.005	ND<0.005	
Arsenic - d	(mg/l)	0.05	ND<0.003	ND<0.006	ND<0.005	ND<0.005	
Barium - t	(mg/l)	1.0	0.044	0.049	0.06	0.05	
Barium - d	(mg/l)	1.0	0.043	0.047	0.05	0.05	
Cadmium - t	(mg/l)	0.01	ND<0.005	ND<0.005	ND<0.005	ND<0.005	
Cadmium - d	(mg/l)	0.01	ND<0.005	ND<0.005	ND<0.005	ND<0.005	
Chromium - t	(mg/l)	0.05	0.03	0.03	0.04	0.68	0.046
Chromium - d	(mg/l)	0.05	ND<0.01	ND<0.01	ND<0.01	0.001	0.001
Fluoride	(mg/l)	1.4-2.4	1.8	1.9	1.5	1.6	
Lead - t	(mg/l)	0.05	ND<0.004	ND<0.002	ND<0.005	ND<0.005	
Lead - d	(mg/l)	0.05	ND<0.002	ND<0.002	ND<0.005	ND<0.005	
Mercury - t	(mg/l)	0.002	ND<0.0001	ND<0.0001	ND<0.0002	ND<0.0002	
Mercury - d	(mg/l)	0.002	ND<0.0001	ND<0.0001	ND<0.0002	ND<0.0002	
Selenium - t	(mg/l)	0.01	0.006	ND<0.004	ND<0.01	ND<0.01	
Selenium - d	(mg/l)	0.01	ND<0.002	0.007	ND<0.005	ND<0.005	
Silver - t	(mg/l)	0.05	ND<0.005	ND<0.005	ND<0.01	ND<0.01	
Silver - d	(mg/l)	0.05	ND<0.005	ND<0.005	ND<0.01	ND<0.01	
Turbidity*	(NTU)	1	4.34	2.49	4.30	1.90	3.90

t = Total metal concentration.
d = Dissolved metal concentration.
ND = Not detected at the method reporting limit stated in the table above.
MCL = Maximum contaminant level.
* = Field measurement.

Table F-9b. *Background Concentrations (Metals) of EPA Interim Primary Drinking Water Supply Parameters for MW-1A*

Constituent	Units	MCL	Sampling Date 12/88	3/89	6/89	9/89	1/90
Arsenic - t	(mg/l)	0.05	ND<0.02	ND<0.006	ND<0.005	ND<0.005	
Arsenic - d	(mg/l)	0.05	ND<0.003	ND<0.006	ND<0.005	ND<0.005	
Barium - t	(mg/l)	1.0	0.150	0.077	0.07	0.07	
Barium - d	(mg/l)	1.0	0.078	0.080	0.08	0.07	
Cadmium - t	(mg/l)	0.01	ND<0.005	ND<0.005	ND<0.005	ND<0.005	
Cadmium - d	(mg/l)	0.01	ND<0.005	ND<0.005	ND<0.005	ND<0.005	
Chromium - t	(mg/l)	0.05	ND<0.01	ND<0.01	0.06	0.002	0.004
Chromium - d	(mg/l)	0.05	ND<0.01	ND<0.01	ND<0.01	ND<0.001	ND<0.001
Fluoride	(mg/l)	1.4-2.4	1.5	1.6	1.6	1.6	
Lead - t	(mg/l)	0.05	ND<0.002	ND<0.002	ND<0.005	ND<0.005	
Lead - d	(mg/l)	0.05	ND<0.002	ND<0.002	ND<0.01	ND<0.005	
Mercury - t	(mg/l)	0.002	ND<0.0001	ND<0.0001	ND<0.0002	ND<0.0002	
Mercury - d	(mg/l)	0.002	ND<0.0001	ND<0.0001	ND<0.0002	ND<0.0002	
Selenium - t	(mg/l)	0.01	0.003	0.002	ND<0.005	ND<0.005	
Selenium - d	(mg/l)	0.01	ND<0.002	ND<0.002	ND<0.005	ND<0.005	
Silver - t	(mg/l)	0.05	ND<0.005	ND<0.005	ND<0.01	ND<0.01	
Silvery - d	(mg/l)	0.05	ND<0.005	ND<0.005	ND<0.01	ND<0.01	
Turbidity*	(NTU)	1	2.40	0.89	0.96	0.79	1.20

t = Total metal concentration.
d = Dissolved metal concentration.
ND = Not detected at the method reporting limit stated in the table above.
MCL = Maximum contaminant level.
* = Field measurement.

Table F-9c. Background Concentrations (Metals) of EPA Interim Primary Drinking Water Supply Parameters for MW-2A

Constituent	Units	MCL	Sampling Date				
			12/88	3/89	6/89	9/89	1/90
Arsenic - t	(mg/l)	0.05	ND<0.006	ND<0.003	ND<0.005	ND<0.005	
Arsenic - d	(mg/l)	0.05	ND<0.006	ND<0.006	ND<0.005	ND<0.005	
Barium - t	(mg/l)	1.0	0.070	0.070	0.07	0.07	
Barium - d	(mg/l)	1.0	0.062	0.070	0.07	0.07	
Cadmium - t	(mg/l)	0.01	ND<0.005	ND<0.005	ND<0.005	ND<0.005	
Cadmium - d	(mg/l)	0.01	ND<0.005	ND<0.005	ND<0.005	ND<0.005	
Chromium - t	(mg/l)	0.05	0.06	0.02	0.04	0.014	ND<0.002
Chromium - d	(mg/l)	0.05	ND<0.01	ND<0.01	ND<0.01	ND<0.001	ND<0.001
Fluoride	(mg/l)	1.4-2.4	1.5	1.6	1.4	1.4	
Lead - t	(mg/l)	0.05	ND<0.002	ND<0.002	ND<0.005	ND<0.005	
Lead - d	(mg/l)	0.05	ND<0.002	ND<0.002	ND<0.005	ND<0.005	
Mercury - t	(mg/l)	0.002	ND<0.0001	ND<0.0001	ND<0.0002	<0.0003	
Mercury - d	(mg/l)	0.002	ND<0.0001	ND<0.0001	ND<0.0002	ND<0.0002	
Selenium - t	(mg/l)	0.01	ND<0.002	ND<0.004	ND<0.005	ND<0.005	
Selenium - d	(mg/l)	0.01	0.003	0.003	ND<0.005	ND<0.005	
Silver - t	(mg/l)	0.05	ND<0.005	ND<0.005	ND<0.01	ND<0.01	
Silvery - d	(mg/l)	0.05	ND<0.005	ND<0.005	ND<0.01	ND<0.01	
Turbidity*	(NTU)	1	16.20	2.06	4.48	0.89	2.20

t = Total metal concentration.
d = Dissolved metal concentration.
ND = Not detected at the method reporting limit stated in the table above.
MCL = Maximum contaminant level.
* = Field measurement.

Table F-9d. Background Concentrations (Metals) of EPA Interim Primary Drinking Water Supply Parameters for MW-3A

Constituent	Units	MCL	Sampling Date 12/88	3/89	6/89	9/89	1/90
Arsenic - t	(mg/l)	0.05	ND<0.003	ND<0.003	ND<0.005	ND<0.005	
Arsenic - d	(mg/l)	0.05	ND<0.06	ND<0.006	ND<0.005	ND<0.005	
Barium - t	(mg/l)	1.0	0.048	0.051	0.05	0.06	
Barium - d	(mg/l)	1.0	0.049	0.054	0.05	0.06	
Cadmium - t	(mg/l)	0.01	ND<0.005	ND<0.005	ND<0.005	ND<0.005	
Cadmium - d	(mg/l)	0.01	ND<0.005	ND<0.005	ND<0.005	ND<0.005	
Chromium - t	(mg/l)	0.05	ND<0.01	ND<0.01	ND<0.01	0.003	0.004
Chromium - d	(mg/l)	0.05	ND<0.01	ND<0.01	ND<0.01	ND<0.001	ND<0.001
Fluoride	(mg/l)	1.4-2.4	1.4	1.6	1.5	1.5	
Lead - t	(mg/l)	0.05	ND<0.002	ND<0.002	ND<0.01	ND<0.005	
Lead - d	(mg/l)	0.05	ND<0.002	ND<0.002	ND<0.01	ND<0.005	
Mercury - t	(mg/l)	0.002	ND<0.0001	ND<0.0001	ND<0.0002	ND<0.0002	
Mercury - d	(mg/l)	0.002	ND<0.0001	ND<0.0001	ND<0.0002	ND<0.0002	
Selenium - t	(mg/l)	0.01	ND<0.002	0.003	ND<0.01	ND<0.005	
Selenium - d	(mg/l)	0.01	ND<0.002	ND<0.002	ND<0.005	ND<0.005	
Silver - t	(mg/l)	0.05	ND<0.005	ND<0.005	ND<0.01	ND<0.01	
Silvery - d	(mg/l)	0.05	ND<0.005	ND<0.005	ND<0.01	ND<0.01	
Turbidity*	(NTU)	1	0.51	0.80	0.17	1.44	2.80

t = Total metal concentration.
d = Dissolved metal concentration.
ND = Not detected at the method reporting limit stated in the table above.

Table F-10a. Background Concentrations (Others) of EPA Interim Primary Drinking Water Supply Parameters for BW-3

Constituent	Units	MCL	Sampling Date 12/88	3/89	6/89	9/89	1/90
Nitrate (as N)	(mg/l)	10	2.2	1.6	1.4	1.6	1.6
Endrin	(mg/l)	0.0002	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Lindane	(mg/l)	0.004	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Methoxychlor	(mg/l)	0.1	ND<0.0005	ND<0.0005	ND<0.0005	ND<0.0005	
Toxaphene	(mg/l)	0.005	ND<0.001	ND<0.001	ND<0.001	ND<0.001	
2,4-D	(mg/l)	0.1	ND<0.0002	ND<0.0002	ND<0.0002	ND<0.0002	
2,4,5-TP (Silvex)	(mg/l)	0.01	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Radium (Ra-226 + Ra-228)	(pCi/l)	5	0.0	3.0	0.2	1.1	
Gross Alpha	(pCi/l)	15	30	15	5.7	15	
Gross Beta	(pCi/l)	4 mrem/yr	8.4	0.9	5.4	0.6	
Total Coliform Bacteria	(col/100 ml)	1	TNC	TNC	4	TNC	<1
Turbidity*	(NTU)	1	4.34	2.49	4.30	1.90	3.90

ND = Not detected at the method reporting limit stated in the table above.
MCL = Maximum contaminant level.
TNC = Too numerous to count non-coliform bacteria present.
* = Field measurement.

Table F-10b. Background Concentrations (Others) of EPA Interim Primary Drinking Water Supply Parameters for MW-1A

Constituent	Units	MCL	Sampling Date 12/88	3/89	6/89	9/89	1/90
Nitrate (as N)	(mg/l)	10	0.9	0.9	0.9	1.2	0.8
Endrin	(mg/l)	0.0002	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Lindane	(mg/l)	0.004	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Methoxychlor	(mg/l)	0.1	ND<0.0005	ND<0.0005	ND<0.0005	ND<0.0005	
Toxaphene	(mg/l)	0.005	ND<0.001	ND<0.001	ND<0.001	ND<0.001	
2,4-D	(mg/l)	0.1	ND<0.0002	ND<0.0002	ND<0.0002	ND<0.0002	
2,4,5-TP (Silvex)	(mg/l)	0.01	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Radium (Ra-226 + Ra-228)	(pCi/l)	5	1.0	0.2	2.3	2.4	
Gross Alpha	(pCi/l)	15	17/22	16	15.2	16	
Gross Beta	(pCi/l)	4 mrem/yr	7.7	0.4	2.4	6.2	
Total Coliform Bacteria	(col/100 ml)	1	TNC	ND<1	<1	<1	<1
Turbidity*	(NTU)	1	2.40	0.89	0.96	0.79	1.20

ND = Not detected at the method reporting limit stated in the table above.
MCL = Maximum contaminant level.
TNC = Too numerous to count non-coliform bacteria present.
* = Field measurement.

Table F-10c. Background Concentrations (Others) of EPA Interim Primary Drinking Water Supply Parameters for MW-2A

Constituent	Units	MCL	Sampling Date 12/88	3/89	6/89	9/89	1/90
Nitrate (as N)	(mg/l)	10	1.0	1.1	1.0	1.3	1.0
Endrin	(mg/l)	0.0002	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Lindane	(mg/l)	0.004	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Methoxychlor	(mg/l)	0.1	ND<0.0005	ND<0.0005	ND<0.0005	ND<0.0005	
Toxaphene	(mg/l)	0.005	ND<0.001	ND<0.001	ND<0.001	ND<0.001	
2,4-D	(mg/l)	0.1	ND<0.0002	ND<0.0002	ND<0.0002	ND<0.0002	
2,4,5-TP (Silvex)	(mg/l)	0.01	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Radium (Ra-226 + Ra-228)	(pCi/l)	5	0.2	0.4	0.3	1.6	
Gross Alpha	(pCi/l)	15	19	12	7.0	16	
Gross Beta	(pCi/l)	4 mrem/yr	11	0.0	3.8	0.0	
Total Coliform Bacteria	(col/100 ml)	1	TNC	ND<1	TNC	<1	<1
Turbidity*	(NTU)	1	16.20	2.06	4.48	0.89	2.20

ND = Not detected at the method reporting limit stated in the table above.
MCL = Maximum contaminant level.
TNC = Too numerous to count noncoliform bacteria present.
* = Field measurement.

Table F-10d. Background Concentrations (Others) of EPA Interim Primary Drinking Water Supply Parameters for MW-3A

Constituent	Units	MCL	Sampling Date 12/88	3/89	6/89	9/89	1/90
Nitrate (as N)	(mg/l)	10	1.1	1.0	0.9	1.3	1.0
Endrin	(mg/l)	0.0002	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Lindane	(mg/l)	0.004	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Methoxychlor	(mg/l)	0.1	ND<0.0005	ND<0.0005	ND<0.0005	ND<0.0005	
Toxaphene	(mg/l)	0.005	ND<0.001	ND<0.001	ND<0.001	ND<0.001	
2,4-D	(mg/l)	0.1	ND<0.0002	ND<0.0002	ND<0.0002	ND<0.0002	
2,4,5-TP (Silvex)	(mg/l)	0.01	ND<0.0001	ND<0.0001	ND<0.0001	ND<0.0001	
Radium (Ra-226 + Ra-228)	(pCi/l)	5	1.3	0.0	0.1	0.8	
Gross Alpha	(pCi/l)	15	23	14	5.3	12	
Gross Beta	(pCi/l)	4 mrem/yr	5.5	0.3	8.4	7.0	
Total Coliform Bacteria	(col/100 ml)	1	<1	ND<1	TNC	<1	<1
Turbidity*	(NTU)	1	0.51	0.80	0.17	1.44	2.80

ND - Not detected at the method reporting limit stated in the table above.
MCL - Maximum contaminant level.
TNC - Too numerous to count noncoliform bacteria present.
* - Field measurement.

Table F-11. Summary of Gross α and Uranium Isotope Alpha Activities at the SNL Chemical Waste Landfill (CWL), June 1989

Monitor Well No.	Gross Alpha(1) (pCi/l)	Gross Alpha(2) (pCi/l)	U234(2) (pCi/l)	U235(2) (pCi/l)	U238(2) (pCi/l)	U234 235, 238 Total (pCi/l)	Uranium Percent of Gross α
MW1A	15.2 ± 6.0	16 ± 4	11 ± 1	0.3 ± 0.2	3.4 ± 0.6	14.7 ± 1.8	92
MW2A	7.0 ± 4.4	13 ± 4	9.1 ± 0.8	0.0 ± 0.1	3.2 ± 0.5	12.3 ± 1.4	95
MW3A	5.3 ± 3.8	17 ± 4	9 ± 0.7	0.1 ± 0.1	3.1 ± 0.4	12.2 ± 1.2	72
BW3	5.7 ± 4.4	25 ± 5	14 ± 1	0.2 ± 0.1	3.7 ± 0.5	17.9 ± 1.6	72

(1) Analysis performed by RMAL.
(2) Analysis performed by TMA Eberline.

Table F-12. Summary of Uranium Isotope Mass Distribution, SNL Chemical Waste Landfill (CWL), June 1989

Well	Percent U-238	Percent U-235	Percent U-234
MW1A	98.63	1.35	0.02
MW2A	99.50	0.48	0.02
MW3A	99.50	0.49	0.01
BW3	99.14	0.84	0.02
Equilibrium(1) Distribution	99.27	0.72	0.01

(1)Chart of the Nuclides, Knolls Atomic Power Laboratory, U.S. Department of Energy, Thirteenth Edition, July 1983.

Table F-13. Summary of Four-Day Averages of Analytical Results for Waste Water Sampling Station WW001, Permit No. 2069A SNL, Albuquerque (All results in mg/l unless otherwise noted)

	Parameter				
Month	Cd	Cu	CN (Total)	Pb	Zn
January	<0.005	0.03	<0.01	<0.02	0.42
February	<0.005	0.04	<0.036	<0.02	0.19
March	<0.005	<0.02	<0.02	<0.02	0.28
April	<0.005	<0.02	<0.01	<0.02	0.24
May	<0.005	<0.02	<0.010	<0.02	0.26
June	<0.01	<0.02	<0.036	<0.02	0.29
July	<0.005	<0.02	*	<0.02	0.25
August	<0.005	0.05	<0.010	<0.02	0.34
September	<0.005	0.06	<0.01	<0.02	0.17
October	<0.005	0.06	<0.01	<0.02	0.30
November	<0.005	0.06	0.018	<0.02	0.28
December	<0.005	0.23	<0.01	<0.02	0.36

*No result due to laboratory error.

Table F-14. Summary of Four-Day Averages of Analytical Results for Wastewater Sampling Station WW003, Permit No. 2069C-2 SNL, Albuquerque (All results in mg/l unless otherwise noted)

Month	Parameter				
	Cd	Cr (Total)	Cu	CN (Total)	Pb
January	<0.005	<0.05	5.52	0.11	<0.02
February	<0.005	<0.02	0.25	<0.02	<0.02
March	<0.005	<0.15	45.3	<0.09	<0.02
April	<0.005	<0.02	0.16	0.02	<0.02
May	<0.005	<0.02	0.54	<0.013	<0.02
June	<0.01	<0.02	0.21	0.11	<0.02
July	<0.005	<0.02	1.66	*	<0.03
August	<0.005	<0.02	0.30	<0.05	<0.03
September	<0.005	<0.02	<0.09	<0.01	<0.02
October	<0.005	<0.02	0.6	<0.01	<0.05
November	<0.005	<0.02	0.34	<0.01	<0.02
December	<0.005	<0.02	0.17	<0.01	<0.02

	Ni	Ag	Zn	Total Metals (Cr+Cr+Ni+Zn)
January	<0.05	<0.02	<0.18	<6
February	<0.04	<0.02	<0.03	<0.34
March	<0.13	<0.01	<0.18	<45.8
April	<0.04	<0.01	<0.13	<0.34
May	<0.02	<0.01	<0.02	<0.6
June	<0.05	<0.01	0.27	<0.55
July	<0.02	<0.01	0.33	<2.03
August	<0.02	<0.01	0.24	<0.57
September	<0.02	<0.01	<0.02	<0.15
October	<0.02	<0.01	0.36	<0.97
November	<0.02	<0.01	0.16	<0.54
December	<0.02	<0.01	0.24	<0.45

*No result due to laboratory error.

Table F-15. Summary of Four-Day Averages of Analytical Results for Wastewater Sampling Station WW004, Permit No. 2069D-2 SNL, Albuquerque (All results in mg/l unless otherwise noted)

Month	Cd	Cr (Total)	Cu	CN (Total)	Pb
January	<0.01	<0.05	0.05	0.02	<0.02
February	<0.005	<0.02	<0.04	<0.01	<0.02
March	<0.005	<0.04	0.08	<0.02	<0.02
April	<0.011	<0.03	0.03	<0.03	<0.02
May	0.017	<0.05	0.03	<0.010	<0.02
June	<0.01	<0.05	0.09	<0.010	<0.02
July	<0.006	<0.05	<0.03	*	<0.02
August	<0.005	<0.02	0.03	<0.01	<0.02
September	<0.009	<0.02	<0.03	<0.01	<0.02
October	<0.005	<0.02	<0.03	<0.01	<0.02
November	<0.005	<0.02	0.04	<0.01	<0.02
December	<0.005	<0.05	0.16	<0.01	<0.02

Month	Ni	Ag	Zn	Total Toxic Organics (TTO)
January	<0.09	<0.02	<0.02	NR
February	<0.04	<0.02	<0.03	NR
March	<0.05	<0.01	<0.02	NR
April	<0.04	<0.01	<0.02	NR
May	<0.04	<0.01	<0.02	NR
June	<0.05	<0.01	<0.02	NR
July	<0.03	<0.01	<0.10	NR
August	<0.02	<0.01	<0.02	NR
September	<0.04	<0.01	<0.02	NR
October	<0.02	<0.01	<0.02	NR
November	<0.02	<0.01	0.02	NR
December	<0.02	<0.01	0.02	NR

*No result due to laboratory error.

Table F-16. Summary of Four-Day Averages of Analytical Results for Wastewater Sampling Station WW005, Permit No. 2069E-2 SNL, Albuquerque (All results in mg/l unless otherwise noted)

	Parameter				
Month	As	Cd	Cr (Total)	Cu	F (Soluble)
January	<0.002	<0.005	<0.02	0.02	25
February	<0.002	<0.005	<0.02	<0.02	19
March	<0.002	<0.005	0.05	<0.02	20.7
April	<0.002	<0.005	0.04	<0.02	21
May	<0.005	<0.005	<0.03	<0.02	12.5
June	<0.002	<0.01	<0.03	<0.02	16.0
July	<0.002	<0.005	<0.02	<0.02	11
August	<0.002	<0.005	<0.02	<0.02	13
September	<0.002	<0.005	<0.02	<0.03	12
October	<0.002	<0.005	<0.02	<0.02	21
November	<0.002	<0.005	<0.02	<0.02	9.7
December	<0.004	<0.005	<0.02	<0.02	13

	Pb	Ni	Zn	Total Metals (Cr+Cu+Ni+Zn)
January	<0.02	<0.02	<0.17	<0.23
February	<0.02	<0.04	0.19	<0.07
March	<0.02	<0.05	0.26	<0.38
April	<0.02	<0.02	0.22	<0.30
May	<0.02	<0.02	0.23	<0.30
June	<0.02	<0.05	0.29	<0.38
July	<0.04	<0.02	<0.22	<0.28
August	<0.02	<0.02	0.29	<0.35
September	<0.02	<0.02	<0.18	<0.25
October	<0.02	<0.02	<0.08	<0.14
November	<0.02	<0.02	<0.02	<0.08
December	<0.02	<0.02	<0.02	<0.08

Table F-17. Summary of Four-Day Averages of Analytical Results for Wastewater Sampling Station WW006, Permit No. 2069F SNL, Albuquerque (All results in mg/l unless otherwise noted)

	Parameter				
Month	Cd	Cu	CN (Total)	Pb	Zn
January	<0.005	0.06	0.02	<0.02	1.8
February	<0.005	0.07	<0.01	<0.02	0.22
March	<0.006	0.09	0.02	<0.02	0.33
April	<0.005	0.08	<0.02	<0.02	0.27
May	<0.005	0.06	<0.011	<0.02	0.27
June	<0.01	0.07	<0.020	<0.02	0.29
July	<0.005	0.12	*	<0.02	0.34
August	<0.005	0.06	<0.010	<0.02	0.34
September	<0.005	0.06	<0.011	<0.02	0.29
October	<0.005	0.07	<0.01	<0.02	2.0
November	<0.005	0.06	0.017	<0.02	0.30
December	<0.005	0.10	<0.01	<0.02	0.29

*No result due to laboratory error.

Table F-18. Summary of Four-Day Averages of Analytical Results for Wastewater Sampling Station WW007, Permit No. 2069G SNL, Albuquerque (All results in mg/l unless otherwise noted)

Month	As	Cd	Cr (Total)	Cu	F (Soluble)
January	<0.002	<0.005	<0.05	<0.02	5.6
February	<0.002	<0.005	<0.02	<0.02	4.5
March	<0.002	<0.005	<0.03	<0.05	26.6
April	<0.002	<0.005	<0.02	<0.03	32
May	<0.002	<0.005	<0.02	<0.02	21
June	<0.002	<0.01	<0.02	<0.02	50
July	<0.002	<0.005	<0.03	<0.04	<3
August	<0.002	<0.005	<0.02	<0.02	5
September	<0.002	<0.005	<0.02	<0.02	2.7
October	<0.002	<0.005	<0.02	<0.02	33
November	<0.002	<0.005	<0.02	<0.02	68
December	<0.002	<0.005	<0.02	<0.02	1.4

Month	Pb	Ni	Zn	Total Metals (Cr+Cu+Ni+Zn)
January	<0.02	<0.04	<0.02	<0.13
February	<0.02	<0.04	<0.02	<0.10
March	<0.02	<0.05	<0.12	<0.25
April	<0.02	<0.04	<0.03	<0.12
May	<0.02	<0.04	<0.02	<0.10
June	<0.02	<0.05	<0.02	<0.11
July	<0.02	<0.02	<0.03	<0.12
August	<0.02	<0.02	<0.02	<0.08
September	<0.04	<0.02	<0.02	<0.08
October	<0.02	<0.02	<0.02	<0.08
November	<0.02	<0.02	<0.02	<0.08
December	<0.02	<0.02	<0.02	<0.08

REFERENCES

U.S. Department of Energy (DOE), 1990. "Radiation Protection of the Public and the Environment," DOE Order 5400.5, DOE, February 1990.

APPENDIX G

ENVIRONMENTAL REGULATIONS AND STANDARDS

Table G-1. Radiation Standards[1] for Protection of the Public in the Vicinity of DOE Facilities for CY89

Dose Limits

All Pathways

The effective dose equivalent for any member of the public from all routine DOE operations[2] (natural background and medical exposures excluded) shall not exceed the values given below:

	Effective Dose Equivalent[3] mrem/year	(mSv/year)
Occasional annual exposures	500	(5)
Prolonged period of exposure[4]	100	(1)

No individual organ shall receive a committed effective dose equivalent of 5 rem/year (50 mSv/year) or greater.

Air Pathway

Maximum off-site residence	Dose Equivalent[5] mrem/year	(mSv/year)
Whole body dose	25	(0.25)
Critical organ	75	(0.75)

[1]DOE interim standards, Memorandum, dated August 5, 1985.
[2]Routine DOE operations means normal planned operations and do not include actual or potential accidental or unplanned releases.
[3]Effective dose equivalent will be expressed in rem (or millirem) with the corresponding value in sievert (or millisievert) in parenthesis.
[4]For the purposes of these standards, a prolonged exposure will be one that lasts, or is predicted to last, longer than 5 years.
[5]The regulation was revised on December 15, 1989. The new standard with dose limit of 10 mrem (effective dose equivalent) will be applied to all DOE operations starting CY90.

Table G-2. Derived Concentration Guides (DCG) For Selected Radionuclides[1]

Nuclide	Drinking Water DCG µCi/L	Drinking Water f, Value	Inhaled Air[4] DCG µCi/m^3	Inhaled Air[4] Solubility Class
^{3}H (Water)	2E+00	-	1E-01	-
^{137}Cs	3E-03	1E+00	4E-04	D
Gross α[2]	15E-06	-	-	-
Gross β[2]	3E-05	-	-	-
Total $U_{(nat)}$[3]	6E-04	-	6E-6	-

[1]USDOE Memorandum from Robert J. Stern, dated February 28, 1986 (Stern, 1986).
[2]USEPA National Interim Primary Drinking Water Regulations EPA-570/9-76-003)
[3]One curie of natural uranium is equivalent to 3,000 kg of natural uranium. A conversion from µg to µCi may be made by multiplying µg by 3.3 x 10^{-7}.
[4]DCG for ^{3}H in air (2E-01) is adjusted for skin absorption.

Table G-3. Groundwater Monitoring Parameters Required by 40 CFR Part 265, Subpart F

Parameter*		
Contamination Indicator	Groundwater Quality	Appendix III Drinking Water Supply
pH	Chloride (Cl)	Arsenic
Specific Conductivity	Iron (Fe)	Barium
Total Organic Halogen (TOX)	Manganese (Mn)	Cadmium
Total Organic Carbon (TOC)	Phenol	Chromium
	Sodium (Na)	Fluoride
	Sulfate (SO_4)	Lead
		Mercury
		Nitrate (as N)
		Selenium
		Silver
		Endrin
		Lindane
		Toxaphene
		2,4-D
		2,4,5-TP
		Radium
		Gross Alpha
		Gross Beta
		Coliform Bacteria
		Turbidity

*RCRA 40 CFR 265.

Table G-4. EPA Interim Primary Drinking Water Supply Parameters

Parameter	Standard**	Units
As*	0.05	mg/l
Ba*	1.0	mg/l
Cd*	0.01	mg/l
Cr*	0.05	mg/l
Pb*	0.05	mg/l
Hg*	0.002	mg/l
Se*	0.01	mg/l
Ag*	0.05	mg/l
Fl	1.4 - 2.4	mg/l
NO3	10	mg/l
Total coliform	1/100 ml	col/100 ml
Turbidity	1 TU	NTU
Ra 226	5 pCi/l	pCi/l
Ra 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	0.01	mg/l

*total metals (unfiltered sample)
**40 CFR 265, Appendix III.

REFERENCES

U.S. Department of Energy (DOE), 1990. "Derived Concentration Guide for Air and Water," Chapter 3, DOE Order 5400.5, DOE, February 1990.

U.S. Environmental Protection Agency (EPA), "USEPA National Interim Primary Drinking Water Regulations," EPA-570/9-76-003.

APPENDIX H

OTHER ENVIRONMENTAL COMPLIANCE RECORDS

Table H-1. SNL, Albuquerque, Underground Storage Tanks (USTs) Closed in 1989

Tank I.D.	Capacity	Contents	Date Closed
840-1	500 Gal	Machining Fluids	01/01/89
9970-1	500 Gal	Fuel Oil	06/15/89
6720/1-1	500 Gal	Fuel Oil	06/23/89
6581-1	500 Gal	Fuel Oil	07/03/89
6536-1	25,000 Gal	Fuel Oil	07/26/89
9832-1	650 Gal	Fuel Oil	07/28/89
6596-5	1,000 Gal	Fuel Oil	08/30/89
6018-1	500 Gal	Diesel	10/10/89

Table H-2. SNL, Albuquerque, USTs Registered as of 12/31/89

Tank I.D.	Capacity	Contents	Year Installed
605-7	1,000 Gal	Fuel Oil	1968
605-8	12,000 Gal	Fuel Oil	1956
605-9	12,000 Gal	Fuel Oil	1956
605-10	12,000 Gal	Fuel Oil	1956
605-11	12,000 Gal	Fuel Oil	1956
844-1	150 Gal	Tritiated Water	1968
862-1	9,730 Gal	Diesel	1987
867-1	4,000 Gal	Neutralization Tank	1973
876-1	1,000 Gal	Waste Oil	1950
876-2	12,000 Gal	Gasoline	1985
876-3	12,000 Gal	Diesel	1986
888-1	550 Gal	Waste Oil	1979
888-2	550 Gal	Waste Oil	1979
888-3	20,000 Gal	Transformer Oil	1982
888-4	20,000 Gal	Transformer Oil	1982
888-5	20,000 Gal	Transformer Oil	1982
888-6	20,000 Gal	Transformer Oil	1982
901-1	120 Gal	Gasoline	1951
910-1	120 Gal	Gasoline	1951
911-1	120 Gal	Gasoline	1951
912-1	120 Gal	Gasoline	1951
970-1	1,000 Gal	Fuel Oil	1987
970-3	1,000 Gal	Waste Oil	1987
983-8	60,000 Gal	Bromine Water	1986
983-9	2,000 Gal	Waste Oil	1985
6028-1	5,000 Gal	Gasoline	1987
6500-1	600 Gal	Fuel Oil	1978
6505-1	300 Gal	Fuel Oil	1956
6525-1	500 Gal	Fuel Oil	Unknown
6580-5	5,000 Gal	Fuel Oil	1958
6587-2	10,000 Gal	Gasoline	1963
6587-3	6,000 Gal	Diesel	1963
6588-1	5,000 Gal	Fuel Oil	1978
6595-1	34,120 Gal	Transformer Oil	1968
6595-2	34,120 Gal	Transformer Oil	1968
6595-3	34,120 Gal	Transformer Oil	1968
6595-4	34,120 Gal	Transformer Oil	1968
6595-5	34,120 Gal	Transformer Oil	1968
6597-2	25,000 Gal	Transformer Oil	1978
6597-3	25,000 Gal	Transformer Oil	1978
6597-4	25,000 Gal	Transformer Oil	1978
6597-5	25,000 Gal	Transformer Oil	1978
6597-6	25,000 Gal	Transformer Oil	1978

Table H-2. SNL, Albuquerque, USTs Registered as of 12/31/89 (Concluded)

Tank I.D.	Capacity	Contents	Year Installed
6597-7	25,000 Gal	Transformer Oil	1978
6597-8	25,000 Gal	Transformer Oil	1978
6630-1	560 Gal	Fuel Oil	1966
9925-1	6,000 Gal	Gasoline	1978
9925-2	6,000 Gal	Diesel	1971
9980-1	6,000 Gal	Fuel Oil	Unknown
605-12	5,264 Gal	Heat Transfer Oil	Unknown
605-13	7,897 Gal	Heat Transfer Oil	Unknown
7570-1	1,000 Gal	Fuel Oil	1965

Table H-3. Septic Tank Registration, SNL, Albuquerque

Area	Building	Location Description
Area I	898	Optical Maintenance Bldg.
Area I	8895/M0100	Sandia Guard House
Area I	M014/M015	Office/Lab
East Area II	6969, M0118, M0251, and M0252	Robotic Vehicle Range
6000 Igloo Area	6020	Explosives Receiving and Packaging
6000 Igloo Area	6030	Guard Station
Area II	901/902	Systems Analysis Facility
Area II	904	Environmental Testing Lab
Area II	906	Safety Chemicals Lab
Area II	907	Explosives Application Facility
Area II	913/913A	Component Assembly Bldg./Pressure Lab and Training Bldg.
Area II	915/922	Explosive Device Labs
Area II	914	Equipment for Building 913
Area II	919	Explosive Devices Building
Area II	935	Component Test Facility
Area II	940	Explosive Testing Lab
Area III	6584 - East end	Administration for Test Engineering
Area III	6584 - West end	Armory Facility
Area III	6589 and 6600	Guard House and Sensor Test Lab
Area III	6501	Non-Hazardous Assembly Area
Area III	6620	Hazardous Assembly Building
Area III	6505	Sodium Purification Loop
Area III	6520/6526	Hydraulic Centrifuge Facility
Area III	6523	Pump Building
Area III	6540/6542	Photometrics
Area III	6560/6562/6563	Vibration Test Facility
Area III	6570/6571	Dynamic Shock Test Facility
Area III	6587	Maintenance and Shop
Area III	6610	Complex Wave Test Facility
Area III	6640	Acoustical Test Facility
Area III	6643	Establishment type unknown

Table H-3. Septic Tank Registration, SNL, Albuquerque (Continued)

Area	Building	Location Description
Area III	6650	Vibration Data Control Center
Area III	6710	Air Gun Test Facility
Area III	6715	Explosive Test Facility
Area III	6720	Irradiated Sludge Facility
Area III	6721	Photography/Control for Bldg. 6720
Area III	6730-31/6734-35/MO128	Dynamic Shock Facility
Area III	6741	Control Bldg. for 5000 Foot Sled Track
Area III	6743	Rocket Motor Conditioning Facility
Area III	6750	Small Arms Range/Impact Test Facility
Area III	T12/T42/T43	N/A
Area III	T-52	N/A
Area III	MO231-234	Offices
Area III	MO228-230	Offices
Area III	MO242-245	Offices
Area III	6922	Explosive Test Facility
Area V	6580/6588/6590-93/6596-97	Reactor Facilities and Storage
Area V	6500	Gate House Security Operations Building
Area V	6581-82/MO32/MO57-58	Febetron Building/Emergency Evaluation Ctr/Offices/Shock Test Lab
Coyote Area	9950	Material Test Lab
Coyote Area	9956	Intermediate Velocity Gun Facility
Coyote Area	9965	Remote Control Building for Shock Facility
Coyote Area	9967	He Assembly Building
Coyote Area	9970	Antenna Measurement Facility
Coyote Area	9972	EMP Studies Facility A
Coyote Area	9980	Solar Tower Facility
Coyote Area	9981/9982	N/A
Coyote Area	Live Fire Range	Live Fire Range
Coyote Area	SFER MO127-128/MO130	Small Force Engagement Range
Coyote Area	9927	Explosive Test Facility

Table H-3. Septic Tank Registration, SNL, Albuquerque (Concluded)

Area	Building	Location Description
Coyote Area	9930	Explosive Test and Lab Building
Coyote Area	9939/9939A	Eval. Explosive Facility Control Building
Coyote Area	9940	Explosive Test Facility
Coyote Area	9925	Coyote Test Field Headquarters
Area III	6920	Mixed Waste Management Facility

Table H-4. Sandia Environmental Incident Form
(Not a Substitute for an "Unusual Occurrence Report")

Part I (Items 1 through 7)*

1. Date, time, location, and duration of incident.

2. Date and time of notification to Department 3220 and the name of the person consulted.

3. Persons, phone numbers, and organizations performing the activity that caused the incident. Include Supervisor's name, organization, and phone, and the name, organization and phone of the prime contact for this incident.

4. Names, phone numbers, and organizations of other personnel present during the incident.

5. Material and quantity involved; include chemical composition, radionuclide or trade name (attach Material Safety Data Sheet if available).

6. Describe the events leading to the incident.

7. Immediate action taken to mitigate the release.

*Contact Department 3220 for guidance in the use of this form.
Part I must be submitted to 3220 within 24 hours of incident, or on first working day after incident.
Part II must be submitted to 3220 within 2 weeks (10 calender days) of incident.

Table H-4. Sandia Environmental Incident Form (Continued)

Part II (Items 8 through 14)

8. Describe the medium (e.g., water, asphalt, soil), area, and the depth and area of contamination. Describe the method(s) used to determine this.

9. Name(s) and organization(s) (and contractors) of key personnel responding to the incident.

10. Describe remediation/cleanup activity and the method that will be used to verify completeness of remediation (e.g., monitoring, soil testing, photo-documentation). Include the names of 3220 personnel consulted about remediation.

11. Approximate labor hours and cost to perform remediation, and Organization that is funding the remediation.

12. Proposed short-term corrective action to prevent recurrence, including schedule and estimated cost, and the names of 3220 personnel consulted.

Table H-4. Sandia Environmental Incident Form (Concluded)

Part II (Items 8 through 14)

13. Proposed long-term corrective action, including schedule, estimated cost and organization funding the actions.

14. This Environmental Incident Form was completed by (Supervisor or above):

Name (Printed)	Org.	Ext.	Signature	Date

The proposed Short-Term Corrective Action(s) are accepted ____ rejected ___

The proposed Long-Term Corrective Action(s) are accepted ____ rejected ____

Name	Org.	Signature	Date
	3220		

Performance of Short-Term Corrective Action verified by (name, printed, and signed)

Org.	Date

Attachments included yes ____ no ____ If yes, how many pages ________

3220 use: Is this a reportable release? yes ____ no ____
Initials of Person Making Disposition _________

Release reported by:

Name	Org.	Date reported

Copy to:
3210 W. D. Burnett
3220 G. J. Smith
3220 File
3220 Barry M. Schwartz (QA Coordinator)
3223 J. M. Phelan (for Environmental Restoration File)

APPENDIX I

LIST OF NEPA DOCUMENTATION

Table I-1. List of NEPA Documentation

1989 ADMs and Approval Status

Title	Memo to DOE	DOE Approval Letter
Additional Trupact-II Pool Fire Tests	11/30/88	4/21/89
Closure of The Chemical Waste Landfill	1/12/89	5/12/89
Weapons Training Center Classroom and Laboratory Renovation	1/18/89	8/11/89
*Open Pool Fire Tests on the On-Site Container	3/27/89	5/01/89
Secure Test Facility for Control Systems	3/27/89	5/12/89
Star Facility Capacitor Bank Room and Security Fence	3/27/89	5/12/89
Horizontal Actuator Test CQ-3	3/30/89	5/01/89
*Wood Crib Fire Test of the W82 Recovery System	4/19/89	7/31/89
Acoustic Test Facility	4/21/89	11/03/89
Radiography Addition to Building 894	4/21/89	
**Explosive Components Facility	5/09/89	8/07/89
*Wood Crib Fire Tests of Explosive Components for Allied Signal	5/18/89	6/16/89
*Open Pool Tests of an SST Trailer Wall Section Revised	6/30/89 1/04/89	8/07/89

Table I-1. List of NEPA Documentation (Concluded)

1989 ADMs and Approval Status

Title	Memo to DOE	DOE Approval Letter
**The Integrated Materials Research Laboratory	7/21/88	10/18/89
The Water Jet Demonstration at the Robotics Vehicle Range	9/20/89	12/06/89
***Radioactive and Mixed Waste Facility	9/15/89	
*The Series of Pool Fire Tests of the "Pat-3" PNC Common Package Assembly	10/29/89	12/06/89
*Liquid Fuel Test Facilities at Test Site 9920	10/05/89	
Facility Command Center	1(/27/90	
*Performance of Four Cable Fire Tests	11/16/89	
*Rocket Motor Static Firing Test	11/29/89	
Solar Detoxification of Groundwater Experiments	11/29/89	
B61-10 Shock Test	12/13/89	
*Thermal Treatment Facility at Building 6715 Area III	12/15/89	
*12/89 Liquid Fuel Test Facilities at Test Site 9920	12/19/89	

*Open Burning permit required.
**Decision made to write EA.
***An ADM was drafted in 2/89 and sent to DOE in 9/89. An EA was requested in 12/89.

APPENDIX J

1989 ENVIRONMENTAL COMPLIANCE ACTIVITIES AT KAUAI TEST FACILITY

J.1 Introduction

Sandia National Laboratories (SNL) operates a rocket preparation and launch facility called the Kauai Test Facility (KTF) at the Navy's Pacific Missile Range Facility (PMRF) - Barking Sands, for the Department of Energy (DOE). 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, which sits on the west side of the island of Kauai, HI (Figure J-1). The majority of the facilities at the KTF were constructed in the early 1960s to support the National Readiness program. The most recent construction activity, completed in 1989, added five buildings and a new launch pad to support future DOE and Strategic Defense Initiative (SDI) launches.

KTF has been, and is being, used for testing rocket systems with science and technology payloads, advanced development of maneuvering re-entry vehicles, scientific studies of atmospheric and exoatmospheric phenomena and SDI programs. No nuclear devices have ever 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 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).

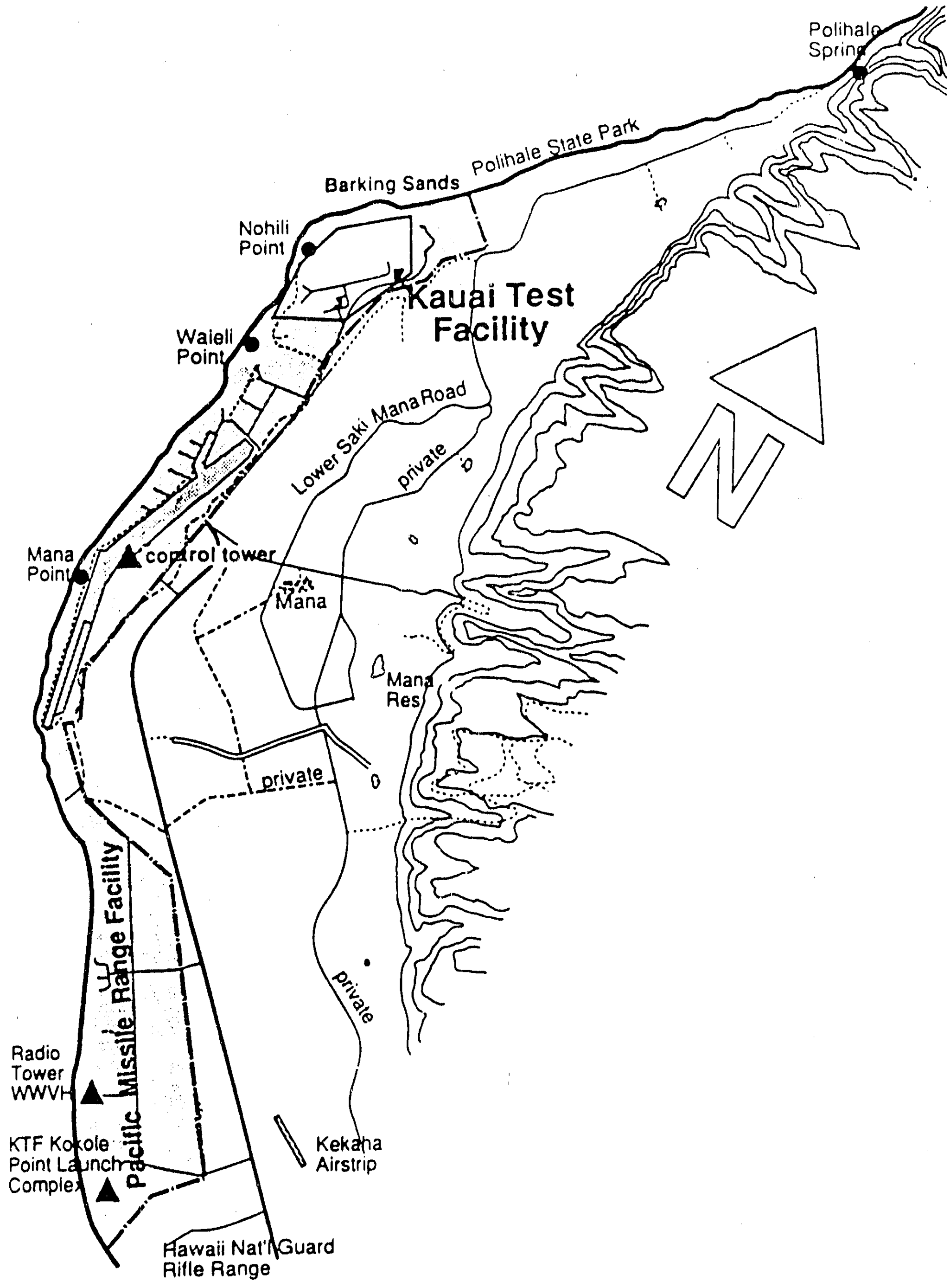

Figure J-1. Map of the Pacific Missile Range Facility (PMRF) and the adjacent area. The Kauai Test Facility (KTF) is to the north, near Nohili Point.

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 sugarcane by 1936, leaving only some small areas of wetland near Mana, about 10,000 ft from the KTF.

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 Plain is composed of a wedge of terrestrial and marine sediments overlying a volcanic basement. The basement rock outcrops 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 until at the coast 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 now are no higher than 10 ft or so except just to the north of the KTF, where they are up to 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 sea water. The overlying sediments act as a caprock 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 sea water, 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 miles south of the KTF. It was dug to a total depth of 42 ft, encountering only fine sand and coral gravel. Tested at 300 gpm, it initially yielded water having 2,800 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, Albuquerque, 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 appears barren and incapable of supporting agriculture unless improved by mixing with soil, fertilizing extensively, and irrigating it.

No mammals or signs of mammals were encountered during a 1986 field survey (SNL, Albuquerque, 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, plus three more just outside the range (SNL, Albuquerque, 1986). There are also several species of waterfowl that may be present on the range during some portion of the year, even though they were not seen during the 1986 survey. These 25 include five species native to Hawaii.

The nearest off-base community is the village of Mana, estimated population 30, 10,000 ft to the south. The population at KTF fluctuates between 10 and 70, depending on mission schedules. The majority of approximately 200 military personnel are stationed at the Pacific Missile Range Facility.

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. Most of this falls 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 southerly, westerly, or northerly directions. 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

There were no Action Description Memorandums (ADMs) prepared for KTF during 1989. The draft Environmental Assessment (EA) for KTF was prepared in 1989. It is being reviewed by SNL, Albuquerque and DOE, Albuquerque Operations Office (DOE/AL). Once the EA is finalized, a draft FONSI, if appropriate, will be prepared for approval by the DOE.

Environmental Permits

Air

There are no PSD or NESHAP sources for the facility and no air permits are held by either the DOE for KTF or the Department of Defense (DOD) for the Pacific Missile Range. However, the two electrical generators at KTF are permitted by the State of Hawaii for 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 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 onsite.

Solid Waste

The PMRF holds a RCRA Interim Status Permit for treatment and storage of hazardous waste. KTF, as a tenant on PMRF, is a small quantity hazardous waste generator. These small quantities of hazardous chemical wastes are disposed through 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 through the PMRF program.

1989 Release Reporting

All of the 1989 releases from KTF are air emissions of lead (Pb) as results of Terrier Malmute Rocket or NIKE Rocket System tests. Reportable Quantity (RQ) for lead is one pound. The release reporting was initially made by KTF staff to Environmental Programs Department (3220) at SNL, Albuquerque. The final reporting was then made by SNL, Albuquerque to National Response Center (NRC) by telephone reporting and in written reports. Table J-1 lists the Summary of 1989 Release Reporting from KTF.

Table J-1. Summary of 1989 RQ Release Reporting

Date	Location	Material	Quantity	RQ	Release to	NRC #	Report Date
9/05/89	KTF	Lead	20.4 lb	1 lb	Air	15689	9/05/89
9/11/89	KTF	Lead	20.4 lb	1 lb	Air	16195	9/12/89
9/12/89	KTF	Lead	3.7 lb	1 lb	Air	16200	9/12/89

J.3 Environmental Restoration and Monitoring Program

There is no routine environmental monitoring program for KTF due to 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: Drum Rock Area and Photo Lab Discharges.

Soil samples from two launch pads and tape samples from a transportainer were taken in October 1989. The soil samples from two launchers (12 and 14) were analyzed for lead contamination against the background soil. At launcher 12, 50 ppm were detected in each of the two samples taken. At launcher 14, 86 ppm and 415 ppm were detected respectively in two samples. No lead was detected in both background samples at a detection level of 1 ppm. The potential significance of these lead levels will be assessed in the future under the ER program.

One of the tape samples taken was found positive for chrysotile asbestos by Division 3211. A recommendation was made to treat the putty as asbestos-containing and dispose of it along with the tape in accordance with asbestos regulations.

J.4 Other Compliance Activities

Spill Prevention and Control Countermeasure (SPCC)

SNL at KTF is part of the PMRF Spill Prevention and Control Countermeasure Plan (SPCC) that provides support in the event of a diesel fuel spill from the 10,000 gal. above ground fuel tank just outside the compound.

Underground Storage Tanks (USTs)

Underground gasoline tanks in the compound are being replaced with one double wall fiberglass tank, which along with the installation, complies with the most recent Federal and State regulations.

Diesel fuel, gasoline, and oils such as mechanical oils and hydraulic fluids are stored and used in large quantities at the KTF. The underground fuel tank will be monitored for leakage as required by the Resource Conservation and Recovery Act (RCRA).

Toxic Substances and Control Act (TSCA)

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

Helgesen, R. F., 1990. "Safety Assessment for the Kauai Test Facility at Barking Sands, Kauai," SAND89-2548, Sandia National Laboraties, New Mexico, April 1990.

Sandia National Laboratories, 1986. "Environmental Report, Proposed IRBS Facilities, Kauai Test Facility," prepared by Sandia National Laboratories, Albuquerque, NM, for the DOE, August 1986.

END

DATE FILMED

01 / 24 / 91