SANDIA REPORT

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1999 Annual Site Environmental Report Sandia National Laboratories Albuquerque, New Mexico

Dianne Duncan and Rebecca Sanchez

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

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a Lockheed Martin Company, for the United States Department of
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Sandia National Laboratories

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1999
Annual Site Environmental Report
Sandia National Laboratories, Albuquerque, New Mexico

Dianne Duncan, *Chief Editor*

Rebecca Sanchez, *Associate Editor*

Produced by
Sandia National Laboratories
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ABSTRACT

Sandia National Laboratories/New Mexico (SNL/NM) is a government-owned, contractor-operated facility. The U.S. Department of Energy (DOE) oversees the operation of SNL/NM through the Kirtland Area Office (KAO), which reports to the Albuquerque Operations Office (AL). Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, is the operating contractor for SNL/NM. Primarily, the work performed at SNL/NM is in support of DOE's mission to provide weapon component technology and hardware for the nation's security needs. Sandia Corporation also conducts fundamental research and development to advance technology in energy research, computer science, waste management, microelectronics, materials science, and transportation safety for hazardous and nuclear components. In support of Sandia Corporation's mission, the Integrated Safety and Security Center and the Environmental Restoration (ER) Project at SNL/NM have established extensive environmental programs to assist Sandia Corporation's line organizations in meeting all applicable local, state, and federal environmental regulations and DOE requirements. This annual report summarizes data and the compliance status of Sandia Corporation's environmental protection and monitoring programs through December 31, 1999. Major environmental programs include air quality, water quality, groundwater protection, terrestrial surveillance, waste management, pollution prevention, environmental remediation, oil and chemical spill prevention, and the National Environmental Policy Act (NEPA). Environmental monitoring and surveillance programs are required by DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990) and DOE Order 232.1, *Environment, Safety, and Health Reporting* (DOE 1996a).

Site Environmental Report for 1999
Sandia National Laboratories, Albuquerque, New Mexico
Final Approval date: February 2001

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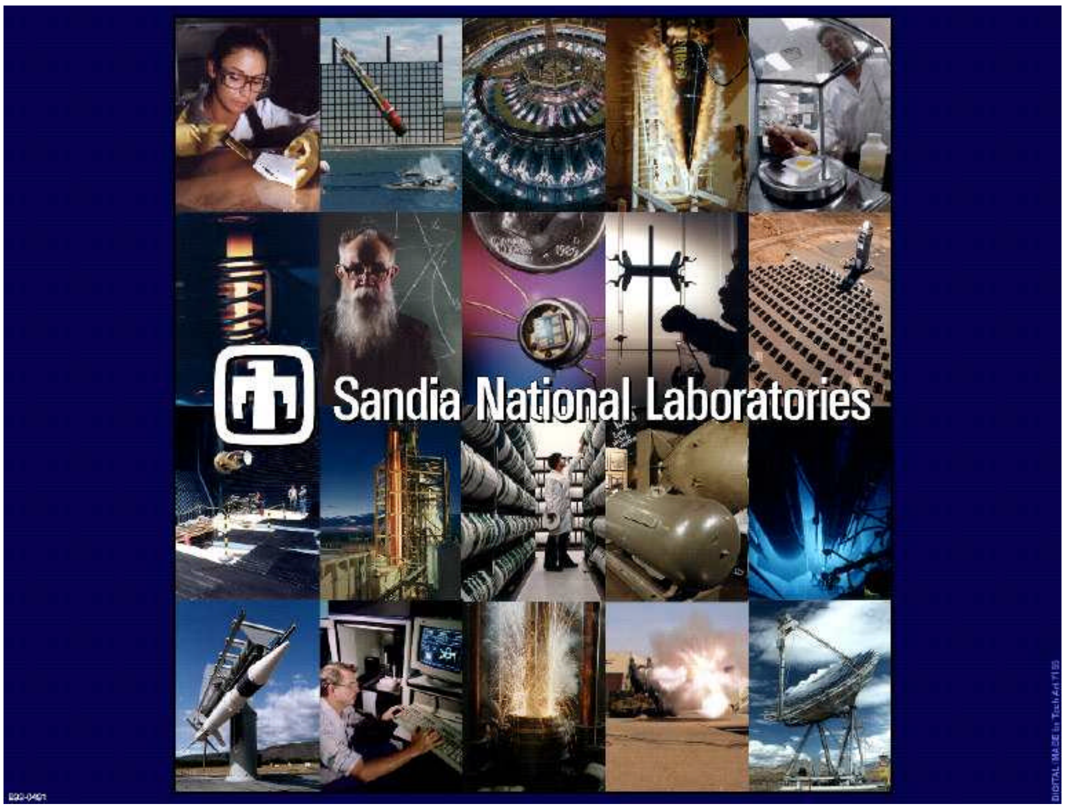

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ABBREVIATIONS

Acronyms and Abbreviations

A

ABC/AQCB	Albuquerque-Bernalillo County/Air Quality Control Board
ACRR	Annular Core Research Reactor
ACE	Army Corps of Engineers
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
AIRFA	American Indian Religious Freedom Act
AFSEC	Albuquerque Full-Scale Experimental Complex
AL	U.S. Department of Energy/Albuquerque Operations Office
ALARA	as low as reasonably achievable
AMPL	Advanced Manufacturing Process Laboratory
ARCOC	Analysis Request and Chain-of-Custody (form)
ARPA	Archaeological Resources Protection Act
ASER	Annual Site Environmental Report
AST	above-ground storage tank
AT&T	American Telephone and Telegraph Company

B

BMP	Best Management Practices

C

CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAMU	Corrective Action Management Unit
CAN	Clean Air Network
CAP88	Clean Air Act Assessment Package-1988
CAS	Chemical Abstract System
CCCL	Cleaning and Contamination Control Laboratory
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COD	chemical oxygen demand
COIL	Chemical Oxygen Iodine Laser
CPAP	Contractor Performance Assessment Program
CRA	Cultural Resources Act
CRADA	Cooperative Research and Development Agreement
CSRL	Compound Semi-Conductor Laboratory
CTF	Coyote Test Field
CWA	Clean Water Act
CWDR	Chemical Waste Disposal Request
CWL	Chemical Waste Landfill
CY	calendar year

ABBREVIATIONS (Continued)

D

D&D	demolition and decontamination
DCG	derived concentration guide
DOE	U.S. Department of Energy
DOE/NSP	U.S. Department of Energy/Nuclear Explosive Safety Program
DOT	U.S. Department of Transportation
DP	Discharge Plan
DQO	data quality objective
DU	depleted uranium

E

EA	Environmental Assessment
ECF	Explosive Components Facility
EDE	effective dose equivalent
EHS	extremely hazardous substance
EID	Environmental Information Document
EIS	Environmental Impact Statement
EMSL	Environmental Monitoring Systems Laboratory
EO	Executive Order
EOC	Emergency Operations Center
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ER	Environmental Restoration
ERDA	Energy Research and Development Administration
ER/WM	Environmental Restoration and Waste Management
ES&H	Environment, Safety, and Health
ESA	Endangered Species Act
ESEF	Engineering Sciences Experimental Facility

F

FAA	Federal Aviation Administration
FFCA	Federal Facilities Compliance Act
FFCO	Federal Facility Compliance Order
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLAME	Fire Laboratory used for the Authentication of Models and Experiments
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	fiscal year

G

GEL	General Engineering Labs
GIF	Gamma Irradiation Facility
GSA	General Services Administration
GSAF	Generator Set-Aside Fee
GWPP	Groundwater Protection Program

ABBREVIATIONS (Continued)

H

HA	hazard analyses
HAP	hazardous air pollutant
HAZMAT	hazardous materials
HCF	Hot Cell Facility
HE	high explosives
HERMES	High Energy Radiation Megavolt Electron Source
HLW	high-level radioactive waste
HPGe	High Purity Geranium (Lab)
HSWA	Hazardous and Solid Waste Amendments
HWMF	Hazardous Waste Management Facility

I

ICP	Inductively Coupled Plasma
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectrum
IMS	Ion Mobility Spectrometer
IMRL	Integrated Materials Research Laboratory
IRP	Installation Restoration Program
ISMS	Integrated Safety Management System
ISRC	Intelligent Systems and Robotics Center
ISS	Interim Storage Site
ITRI	Inhalation Toxicology Research Institute (now LRRI)

J

JIC	Joint Information Center

K

KAFB	Kirtland Air Force Base
KTF	Kauai Test Facility
KUMSC	Kirtland Underground Munitions Storage Complex
KAO	U.S. Department of Energy/Kirtland Area Office

L

LANL	Los Alamos National Laboratory
LDR	Land Disposal Restrictions
LDRD	Lab Directed Research and Development
LECS	Liquid Effluent Control System
LIHE	Light Initiated High Explosives (Facility)
LLW	low-level radioactive waste
LMF	Large Melt Facility
LRRI	Lovelace Respiratory Research Institute
LWDS	Liquid Waste Disposal System

ABBREVIATIONS (Continued)

M

MAC	maximum allowable concentration
MAPEP	Mixed Analyte Performance Evaluation Program
MCL	maximum contaminant level
MDL	minimum detection limit
MDL	Microelectronics Development Laboratory
MEI	maximally exposed individual
MEMS	Microelectromechanical Systems
MIPP	Medical Isotope Production Project
MO-99	Molybdenum-99
MSDS	Material Safety Data Sheet
MW	mixed waste
MWL	Mixed Waste Landfill

N

N/A	not available or not applicable
NAAQS	National Ambient Air Quality Standards
ND	not detected
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	No Further Action
NGF	Neutron Generator Facility
NHPA	National Historic Preservation Act
NM	New Mexico
NMAC	New Mexico Administrative Code
NMAQS	New Mexico Air Quality Standards
NMDOA	New Mexico Department of Agriculture
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	National Response Center (phone # 1-800-424-8802)
NRC	U.S. Nuclear Regulatory Commission
NSTTF	National Solar Thermal Test Facility
NTNC	Non-Transient, Non-Community
NTS	Nevada Test Site
NVOO	U.S. Department of Energy/Nevada Operations Office

O

ODS	ozone-depleting substance
ORPS	Occurrence Reporting Processing System

ABBREVIATIONS (Continued)

P

P2	Pollution Prevention
PA/SI	Preliminary Assessment/Site Inspection
PBR/SDP	Packed Bed Reactor/Silent Discharge Plasma
PBT	Persistent Bioaccumulative Toxics
PCB	polychlorinated biphenyl
PETL	Processing and Environmental Technology Laboratory
PG	Program (Sandia Corporation program overview document)
PHS	Preliminary Hazard Screening
PM	particulate matter
PM_{10}	respirable particulate matter (diameter equal to or less than 10 microns)
$PM_{2.5}$	respirable particulate matter (diameter equal to or less than 2.5 microns)
PPE	personal protective equipment
ppm	parts per million
PPOA	Pollution Prevention Opportunity Assessment

Q

QA	quality assurance
QAP	Quality Assurance Plan
QAPjP	Quality Assurance Project Plan
QC	quality control

R

RCRA	Resource Conservation and Recovery Act
RHEPP	Repetitive High Energy Pulsed Power (an accelerator facility)
RML	Radiation Metrology Laboratory
RMP	Risk Management Plan
RMSEL	Robotic Manufacturing Science and Engineering Laboratory
RMWMF	Radioactive and Mixed Waste Management Facility
ROD	Record of Decision
ROI	Return on Investment
RQ	reportable quantity
RVR	Robotic Vehicle Range
RWL	Radioactive Waste Landfill

ABBREVIATIONS (Continued)

S

SABRE	Sandia Accelerator & Beam Research Experiment
SAP	Sampling and Analysis Plan
SAR	Synthetic Aperture Radar
SARA	Superfund Amendments and Reauthorization Act
SATURN	(an accelerator facility)
SDWA	Safe Drinking Water Act
SIC	Standard Industrial Classification
SMO	Sample Management Office
SNL/CA	Sandia National Laboratories/California
SNL/NM	Sandia National Laboratories/New Mexico
SPCC	Spill Prevention Control and Countermeasures (plan)
SPHINX	Short Pulse High Intensity Nanosecond X-Radiator (an accelerator facility)
SPR	Sandia Pulsed Reactor
SS&TP	Sandia Science and Technology Park
SSWM	Storm Drain, Sanitary Sewer, and Domestic Water System Modernization
STAR	Sample Tracking Analytical Results (SMO database)
START	Sandia Tomography and Radionuclide Transport Laboratory
STEL	short-term exposure limit
SVOC	Semi Volatile Organic Compound
SWEIS	Site-Wide Environmental Impact Statement
SWISH	Small WInd SHield (facility)
SWMU	Solid Waste Management Unit
SWP3	Storm Water Pollution Prevention Plan
SWTF	Solid Waste Transfer Facility

T

TA	Technical Area
TANDEM	(an accelerator facility)
TCE	trichloroethylene or trichloroethene
TCLP	toxicity characteristic leaching procedure
TESLA	(an accelerator facility)
TLD	thermoluminescent dosimeter
TLV	threshold limit value
TNMHC	total non-methane hydrocarbon
TOC	total organic carbon
TOX	total halogenated organics
TQ	threshold quantity
TRI	Toxic Release Inventory
TRU	transuranic (radioactive waste)
TRU/MW	transuranic waste/mixed waste
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal facility
TSS	total suspended solids
TTF	Thermal Treatment Facility
TTR	Tonopah Test Range
TU	Temporary Unit
TWA	time weighted average

ABBREVIATIONS (Continued)

U

USAF	United States Air Force
USGS	United States Geological Survey
UST	underground storage tank

V

VCA	Voluntary Corrective Action
VCM	Voluntary Corrective Measure
VFD	Variable Frequency Drive
VOC	volatile organic compound

W

WA	Weapons Assembly
WIPP	Waste Isolation Pilot Plant

ABBREVIATIONS (Continued)

Units of Measure

°C	Celsius degree	m^3	cubic meter
cm	centimeter	MBtu	million British thermal unit
°F	Fahrenheit degree	mg	milligram
ft	feet	mi	mile
g	gram	ml	milliliter
gal	gallon	ppb	parts per billion
hr	hour	ppm	parts per million
in.	inch	scf	standard cubic feet
kg	kilogram	sq ft	square feet
km	kilometer	sq km	square kilometer
kW	kilowatt	sq mi	square mile
L	liter	tpy	tons per year
lb	pound	yr	year
m	meter	µg	microgram

Radioactivity Measurements

rem	roentgen equivalent man
mrem	millirem (unit of radiation dose)
person-Sv	person-Sievert (unit of radiation dosage)
person-rem	radiation dose to population (also man-rem)
mSv	millisievert (unit of radiation dosage)
Sv	Sievert
Ci	curie
pCi	picocurie
µCi	microcurie

Chemical Abbreviations

CO	carbon monoxide
HCl	hydrochloric acid
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
pH	potential of hydrogen (acidity)
SO_2	sulfur dioxide
TCE	trichloroethylene or trichloroethene
TCA	trichloroethane
U_{tot}	uranium, total
1,1,1,-TCA	1,1,1,-trichloroethane

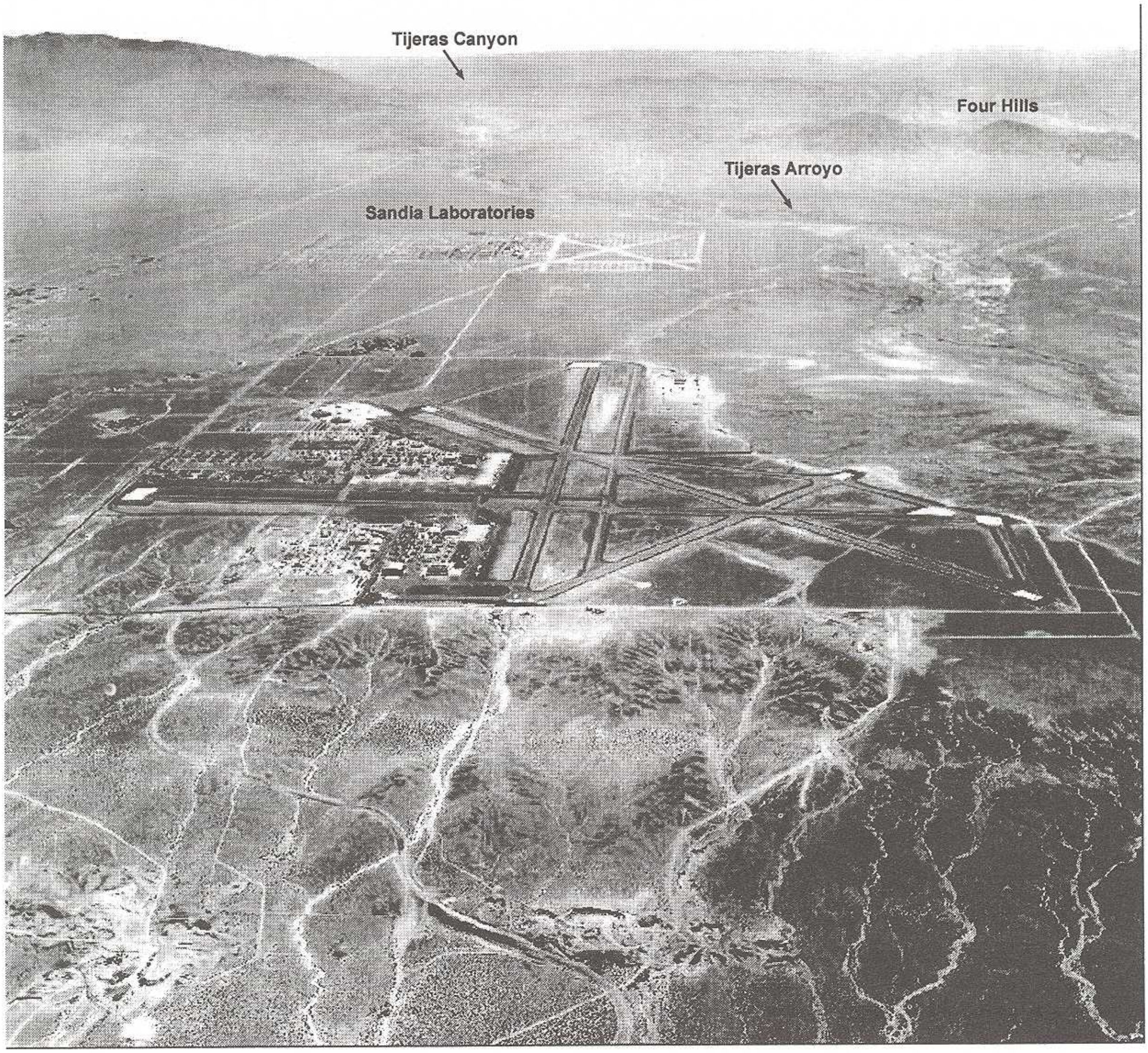
ABBREVIATIONS (Concluded)

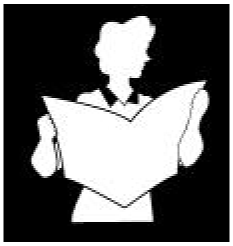
Approximate Conversion Factors for Selected SI (Metric) Units

Multiply SI (Metric) Unit	By	To Obtain U.S. Customary Unit
Cubic meters (m^3)	35	Cubic feet (ft^3)
Centimeters (cm)	0.39	Inches (in.)
Meters (m)	3.3	Feet (ft)
Kilometers (km)	0.62	Miles (mi)
Square kilometers (km^2)	0.39	Square miles (mi^2)
Hectares (ha)	2.5	Acres
Liters (L)	0.26	Gallons (gal)
Grams (g)	0.035	Ounces (oz)
Kilograms (kg)	2.2	Pounds (lb)
Micrograms per gram (µg/g)	1	Parts per million (ppm)
Milligrams per liter (mg/L)	1	Parts per million (ppm)
Celsius (°C)	°F = 9/5 °C+ 32	Fahrenheit (°F)

Early View of Sandia National Laboratories, New Mexico

This July 11, 1945 aerial view looking east indicates the isolation of Sandia Laboratories (Oxnard Field) at the time. The Four Hills of Manzano Base can be seen in the upper right backed by the Manzanita Mountains. The early development of Kirtland Airfield is shown in the foreground. Tijeras Arroyo originates out of Tijeras Canyon, which seperates the Sandia Mountains on the left and the Manzano and Manzanita Mountains on the right. Today, the City of Albuquerque is densely built up to the base of the mountains except on Kirtland Air Force Base (KAFB). The open spaces making up much of KAFB, especially near the mountains, provide a rich habitat for plants and animals.





Executive Summary

The U.S. Department of Energy (DOE) oversees operation of Sandia National Laboratories, New Mexico (SNL/NM) through the Kirtland Area Office (KAO), which reports to the Albuquerque Operations Office (AL). SNL/NM is operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation. This report was prepared in accordance with and as required by DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990) and DOE Order 231.1, *Environment, Safety, and Health Reporting* (DOE 1996a).

This report summarizes data from Sandia Corporation's environmental protection, restoration, and monitoring programs through December 31, 1999. It also discusses Sandia Corporation's compliance with environmental statutes, regulations, and permit provisions and highlights significant environmental program efforts and accomplishments. This report is a key component of the DOE's effort to keep the public informed about environmental conditions throughout the DOE Complex.

Site Characteristics

SNL/NM is located on Kirtland Air Force Base (KAFB), a 51,559-acre military installation including the 20,486 acres withdrawn from the U.S. Forest Service on the east side of KAFB (DOE 1999a). The topography within the withdrawal area generally consists of mountains and canyons vegetated with juniper, pinion, cactus, and drought-tolerant shrubs and grasses. The highest elevation within the withdrawal area is just under 8,000 ft. To the west, the area grades into rolling hills and alluvial fans cut by arroyos. Further to the west, the topography is mostly flat-lying except for the significant channel cut by the Tijeras Arroyo, which is up to 33 m (108 ft) deep and 1,300 m (4,264 ft) wide. The arroyo flows approximately 8.7 miles from its western exit point at KAFB to its discharge point at the Rio Grande.

Sandia Corporation's Mission

Sandia Corporation's operations are conducted within five technical areas and several remote test areas. The total area of DOE's property dedicated to SNL/NM facilities and operational areas is 8,800 acres (DOE 1999a). SNL/NM is one of the nation's premier national laboratories within DOE's Nuclear Weapons Complex. The primary mission of Sandia Corporation is to conduct research and development for nuclear weapon system components and to ensure the integrity and reliability of the nation's nuclear defense systems. This mission has greatly expanded in recent years to include non-military applications for microelectronics, micro-machines, computer technology, accelerator and pulsed power energy research, robotics, and material sciences.

Environmental Programs

The primary environmental programs in place at SNL/NM are as follows:

- Waste management programs and the Pollution Prevention (P2) Program
- Environmental Restoration (ER) Project
- Terrestrial Surveillance Program
- Water quality programs
- Groundwater Protection Program (GWPP)
- Air quality programs
- National Environmental Policy Act (NEPA) Program

WASTE MANAGEMENT AND P2

Waste management at SNL/NM is conducted at three primary waste handling facilities: the Hazardous Waste Management Facility (HWMF), the Radioactive and Mixed Waste Management Facility (RMWMF), and the Solid Waste Transfer Facility (SWTF). In addition, representatives from Sandia Corporation's waste minimization and Pollution Prevention (P2) programs confer with Sandia Corporation line organizations to implement waste minimization technologies and recycling, wherever feasible.

- **HWMF** – The HWMF operates under a Resource Conservation and Recovery Act (RCRA) Part B Permit. All nonradioactive, non-explosive, hazardous chemical wastes, including RCRA-hazardous waste, asbestos, polychlorinated biphenyls (PCBs), and biohazardous waste, are handled at this facility. A total of 18,566 individual chemical waste items (such as bottles, small bags, and lamp bulbs) were collected and cataloged at the HWMF in 1999. The HWMF shipped out the following waste categories:

Weight (kg)	*Category*
104,614	RCRA waste
202,162	Asbestos
4,344	PCBs (recycled & waste)
1,872	Biohazardous waste
173,877	Other recycled and chemical waste
486,869	Total shipped

- **RMWMF** – The RMWMF currently handles low-level radioactive waste (LLW), mixed waste (MW), transuranic waste (TRU), and TRU/MW. In 1999, the RMWMF managed the following quantities of radioactive waste:

Quantity	*Category*
181,580 kg	LLW
4,234 ft^3	MW
2,924 kg	TRU

- **SWTF** – The SWTF accepts non-hazardous solid waste generated from SNL/NM's offices and laboratories. The waste is screened, compacted, baled, and stored for shipment to disposal at local area landfills. Recyclable material handling makes up a large portion of the facility's activities. The SWTF recycles paper and cardboard contributed from SNL/NM, KAFB, DOE field offices, and Los Alamos National Laboratory (LANL). In 1999, a total of 1,328,997 kg of solid waste was handled at the facility and an additional 604,275 kg of paper and cardboard were recycled.

ENVIRONMENTAL RESTORATION (ER)

The assessment and remediation of past and potential release sites due to Sandia Corporation's activities is being addressed by the ER Project. At the close of fiscal year 1999 (FY99), there were 146 sites remaining to be addressed. Although this is the same number of sites as there were at the close of FY98, considerable progress was made in preparing many of these sites for No Further Action (NFA) status. NFA status is granted by the New Mexico Environment Department (NMED) once a site has been cleaned up or it has been demonstrated that contamination levels are below regulatory concern. Almost all of the ER sites at SNL/NM are listed on the Hazardous and Solid Waste Amendments (HSWA) permit. The state must approve the release of a site through the NFA process before it is removed from the permit. Additionally, DOE approves the release of any site with radiological contamination issues once it has been determined that contamination levels are non-existent or negligible. These sites are then proposed for NFA and must be approved by NMED to be removed from the permit. In 1999, 12 sites with radiological issues were proposed for NFA.

Remediation activities continued at the Chemical Waste Landfill (CWL) and the Classified Waste

Landfill in 1999. Remediation of all SNL/NM ER sites is expected to be completed by 2005.

TERRESTRIAL SURVEILLANCE

Sandia Corporation conducts an annual terrestrial surveillance at various sites near SNL/NM facilities and activities or in areas where contaminants could be expected to accumulate. Currently, soil, sediment, and vegetation are collected from onsite, perimeter, and offsite locations. Additionally, water from the Rio Grande is sampled at two offsite locations—upgradient and downgradient from the point where Tijeras Arroyo discharges to the river. The surveillance sampling objectives are to detect any potential releases or migration of contaminated material to offsite locations as well as to determine if pollutants are migrating from offsite to onsite areas. 1999 results were consistent with past year's sampling results. There were some sites that showed statistically increasing trends but all of these sites had contamination levels below offsite averages. Other sites in areas of known contamination (ER sites) were above offsite values but none of these sites showed an increasing trend.

WATER QUALITY

Sandia Corporation's water quality programs address wastewater, surface discharges, and storm water runoff.

- **Wastewater** – Wastewater from SNL/NM is discharged from five permitted outfall stations. Four of these connect directly to the public sewer at the Tijeras Arroyo Intercept and one directly monitors discharges from the Microelectronics Development Laboratory (MDL). Wastewater monitoring is conducted to ensure that all discharges meet the standards set by the City of Albuquerque's sewer treatment plant. In December 1999, there was one instance of a wastewater permit violation. The City of Albuquerque issued a Notice of Violation (NOV) to Sandia Corporation and KAO after a split sample showed fluoride levels at 68.6 mg/L, compared to the permit limit of 36 mg/L. There were no penalties assessed for the one-day violation.

- **Surface Discharges** – All water to be discharged to the ground surface, either directly or to lined containments, must meet state surface discharge standards. There were 28 requests made for individual discharges to the ground surface. All requests met standards and were approved. Additionally, routine surface discharges are made to two evaporation lagoons servicing the Pulsed Power Facility under an existing discharge permit. All permit requirements for both lagoons were met in 1999.

  Two minor releases of petroleum products (several gallons) were reported to the Surface Discharge Program in 1999. The spills were cleaned up and there was no impact to the environment.

- **Storm Water Runoff** – In 1999 there were five storm events of sufficient intensity to meet storm water sampling criteria. Analysis results showed several parameters (stable metals) above benchmark values, as given in the National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Storm Water Permit. However, it is likely that these values are a result of the natural elements in the native soils that derive from the granitic/metamorphic complex of the Manzanita Mountains. In the previous two years, there has only been one sample per year. Therefore, more data is necessary to draw conclusions from the analysis results. Sandia Corporation is in the process of expanding the storm water sampling locations from the current two stations to up to eight stations.

GROUNDWATER PROTECTION

Groundwater monitoring activities reported are those associated with Sandia Corporation's Environmental Restoration (ER) Project and the Groundwater Protection Program (GWPP).

- **Groundwater Protection Program (GWPP)** – The GWPP conducts general surveillance of water quality from a network of wells not associated with the ER Project. In May 1999, 11 wells and one spring were sampled. Samples were analyzed at an offsite lab that uses U.S. Environmental Protection Agency (EPA) analysis methods. Nickel, iron, and manganese were elevated in samples from several wells. These particular metals do not pose a health risk, but are listed for aesthetic water quality characteristics, such as taste and smell. The presence of nickel is associated with corrosion of the well screen in groundwater wells.

- **Environmental Restoration (ER)** – The ER Project samples at five general areas: the Chemical Waste Landfill (CWL), the Mixed Waste Landfill (MWL), Tech Area V, Sandia North (near Tech Area I and Tech Area II), and the Canyons Area. Water quality results reported by the ER Project were consistent with past years results. In areas of known contamination, levels remained consistent except for the CWL, which has shown a decreasing trend in detected trichloroethylene (TCE) since completion of the Vapor Extraction Project. This project successfully removed up to 5,000 lb of volatile organic compounds (VOCs) from the vadose zone (unsaturated soil above the water table). Tech Area V wells continue to show elevated TCE up to 23 μg/L as compared to the maximum contaminant level (MCL) of 5 μg/L. There have been no contaminants detected in groundwater at the MWL with the exception of nickel (attributed to well screen corrosion). Nitrates are a contaminant of concern at Sandia North, Tech Area V, and the Canyons Area near the Burn Site. Nitrate levels are highest in Sandia North wells (up to two times the established MCL of 10 mg/L). There is no indication that contaminants are migrating from any ER sites at SNL/NM.

AIR QUALITY

- **Ambient Air Monitoring –** Sandia Corporation measures ambient air quality at six stations throughout the site and compares results with National Ambient Air Quality Standards (NAAQS) and local ambient air standards. The network monitors criteria pollutants, VOCs, and particulate matter (PM). There were no exceedences in ambient air quality at any of SNL/NM's stations in 1999.

- **Air Quality Compliance –** Sandia Corporation has yet to be issued a Title V Air Permit as required under the Clean Air Act Amendments of 1990 (CAAA). However, in anticipation of the permit, Sandia Corporation tracks all fuel throughput for its generators and the Steam Plant and pays an air emission fee based on fuel usage.

- **National Emission Standards for Hazardous Air Pollutants (NESHAP) Compliance –** Subpart H of NESHAP regulates radionuclide air emissions from DOE facilities with the exception of naturally-occurring radon. In 1999, there were 20 SNL/NM facilities reporting NESHAP-regulated emissions. The primary radionuclides released were tritium, nitrogen-13, oxygen-15, and argon-41. The results of the dose assessment showed that the maximally exposed individual (MEI) onsite received an effective dose equivalent (EDE) of 0.00085 mrem/yr. The offsite MEI received 0.00021 mrem/yr. These doses are approximately 10,000 times less than the

EPA standard of 10 mrem/yr. By comparison, the average person in the Albuquerque area receives 330 to 530 mrem/yr resulting primarily from radon emanating from earth materials, medical procedures, consumer products, and cosmic radiation (Brookins 1992).

National Environmental Policy Act (NEPA) ACTIVITIES

Sandia Corporation's NEPA activities are coordinated with KAO. In November 1999, DOE's Albuquerque Operations Office (AL) issued the final Site-Wide Environmental Impact Statement (SWEIS) for SNL/NM (DOE 1999a). The Record of Decision (ROD) was issued one month later in December. The SWEIS covers many activities at SNL/NM, which must be given NEPA review and consideration. Additional NEPA documentation must be prepared for any activities not clearly covered in the SWEIS. In 1999, Sandia Corporation prepared 50 NEPA Checklists for proposed projects at SNL/NM. KAO is responsible for making all NEPA determinations.

Chapter 1

Introduction

Sandia National Laboratories, New Mexico (SNL/NM) is managed by Sandia Corporation, a wholly owned subsidiary of the Lockheed Martin Corporation. The operations at SNL/NM are overseen by the U.S. Department of Energy (DOE) through the Kirtland Area Office (KAO), which reports to the Albuquerque Operations Office (AL). SNL/NM is one of the nation's premier multi-program national security laboratories within DOE's Nuclear Weapons Complex.

This Annual Site Environmental Report (ASER) describes the environmental protection programs in place at SNL/NM. Environmental programs are in place to protect the public and the environment and to ensure compliance with relevant and applicable local, state, and federal regulations. SNL/NM's compliance status with major environmental laws and regulations are summarized through December 31, 1999. The production of a site environmental report is a requirement for all large DOE facilities and represents a key component of DOE's effort to keep the public informed about environmental conditions at DOE sites.

General Site Location and Characteristics

SNL/NM is located on the east side of Kirtland Air Force Base (KAFB) a 51,559-acre military installation including the 20,486 acres withdrawn from the Cibola National Forest through agreement with the U.S. Forest Service (Figure 1-1). The total area of DOE's property that is dedicated to SNL/NM facilities and operations is 8,800 acres. Sandia Corporation conducts its operations within five technical areas (2,842 acres) and several remote test areas. An additional 15,003 acres in remote areas are provided to DOE through land use agreements with the Air Force (approximately 5,910 acres) and Isleta Pueblo (approximately 6,346 acres). KAFB land is owned primarily by the United States Air Force (USAF), DOE, Bureau of Land Management (BLM), and the U.S. Forest Service. The USAF owns the majority of acreage comprising the western half of KAFB. The DOE also owns land on KAFB comprising the compound area for AL.

KAFB is located at the foot of the Manzanita and Manzano Mountains and encompasses parts of these ranges within the land withdrawal area. The topography within the withdrawal area consists mostly of mountains and canyons vegetated with juniper, piñon, cactus, and drought-tolerant shrubs and grasses. The highest elevation within the withdrawal area is just under 8,000 ft. To the west, the area grades into rolling hills and alluvial slopes cut by arroyos. The topography on the western section of KAFB is mostly flat lying except for the significant channel cut by the Tijeras Arroyo, which dissects KAFB east to west. The arroyo has cut a channel up to 33 m (108 ft) deep and 1,300 m (4,264 ft) wide. From its western exit point at KAFB, the arroyo flows approximately 14 km (8.7 mi) to its discharge point at the Rio Grande. KAFB and SNL/NM are located adjacent to the City of Albuquerque, which surrounds KAFB on the north, northeast, west, and southwest boundaries. Isleta Pueblo borders KAFB on the south.

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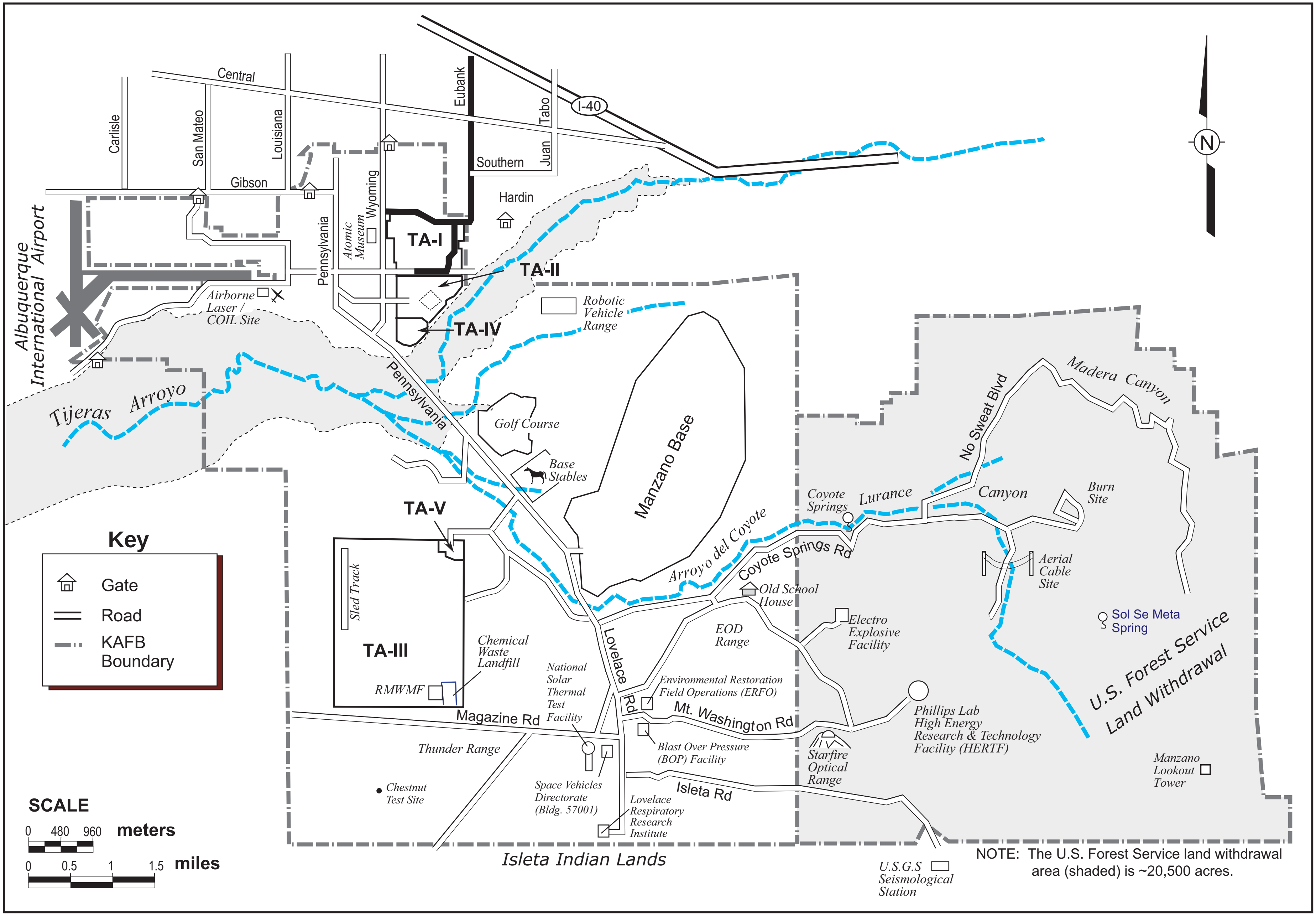

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FIGURE 1-1. Facilities Located on KAFB Military Complex Showing SNL/NM Technical Areas and the U.S. Forest Service Land Withdrawal

The Albuquerque area is a high altitude desert environment and the eastern most expression of the Basin and Range province. The Rio Grande basin upon which most of KAFB and the City of Albuquerque is situated is defined by steeply dipping north-south faults that have created a series of down-dropped basins. There is up to 5 miles of structural relief in vertical displacement between rock units at the bottom of the basin with the equivalent units at the top of the Sandia and Manzano Mountains. These basins have been filled with thousands of feet of unconsolidated sediments making up the Santa Fe Group. The regional aquifer that occurs within the basin sediments is encountered at approximately 400 to 500 ft below the surface. A more thorough discussion of the local geology, hydrology, and ecology is presented at the end of this chapter.

ASER Scope

This chapter describes Sandia Corporation's history, mission, major SNL/NM facilities, and the site characteristics of the surrounding region. Subsequent chapters in this ASER describe Sandia Corporation's specific environmental programs related to effluent monitoring, environmental surveillance, Environmental Restoration (ER), waste management, pollution prevention, chemical inventory management, oil spill prevention, and quality assurance. All activities conducted at SNL/NM that have the potential to impact the environment are reviewed against the requirements of the National Environmental Policy Act (NEPA). In 1999, DOE's Albuquerque Operations Office (AL) completed the Site-wide Environmental Impact Statement (SWIES) describing the activities and current conditions at SNL/NM (DOE 1999a).

The ASER represents a collective effort by many Sandia Corporation organizations responsible for the implementation of the various environmental programs in place at Sandia. The specific contributors are named in the front section of this document. The annual performance for each environmental program is described, noting ongoing and new activities, changes in program direction, corrective actions, and special awards and commendations, where applicable.

Sandia Corporation, like all regulated industries, complies with specific environmental regulations promulgated by local, state, and federal agencies. However, as a prime contractor to DOE, Sandia Corporation must additionally comply with DOE Orders that establish specific requirements for environmental programs. There are three primary DOE Orders related to environmental management and safeguards that are implemented at DOE facilities:

- DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990);
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993); and
- DOE Order 231.1, *Environment, Safety, and Health Reporting* (DOE 1996a).

1.1 SANDIA CORPORATION'S HISTORY AND MISSION

Mission

The primary mission of Sandia Corporation is focused on national security programs and defense-related technology programs for DOE. This core mission makes up approximately 65 percent of work conducted at SNL/NM. Sandia Corporation is responsible for the engineering development of all U.S. nuclear weapons and for systems integration of the nuclear weapons with their delivery vehicles. Specifically, Sandia Corporation's work at SNL/NM is to design all non-nuclear components for the nation's nuclear weapons stockpile, conduct energy research projects, and respond to national security threats—both military and economic. Current defense work conducted at SNL/NM includes the weaponization of nuclear explosives (for example, the design of arming, fusing, and firing systems); safe transport and storage of radioactive materials; pulsed power and accelerator research; and arms control and non-proliferation.

Sandia Corporation also performs work for other government agencies, particularly the Department of Defense (DoD) and, over the past several years, SNL/NM has become a valuable resource for U.S. industry as well. Working with industry and universities has provided great advancements for both the Labs and its partners. Sandia Corporation conducts work under two primary categories: Lab Directed Research and Development (LDRD) and Cooperative Research and Development Agreements (CRADA). Recent technologies developed at SNL/NM are described on page 1-6 and 1-7, "Recent Developments From Sandia Labs."

Although Sandia Corporation's primary mission remains defense oriented, many non-military technologies developed at SNL/NM have made great strides in the commercial sector. Sandia Corporation's integrated technological capabilities specific to the SNL/NM site include:

- Advanced manufacturing technology,
- Advanced information technology,
- Computing,
- Pulsed power technology,
- Biochemical and medical research,
- Energy sciences,
- Electronics and microelectronics,
- Robotics, and
- Environmental remediation technologies.

SNL/NM Facilities and Locations

Sandia Corporation operates two National Laboratories in two states: the main Lab in Albuquerque, New Mexico (SNL/NM) and the Lab in Livermore, California (SNL/CA). Sandia Corporation also has offices where it conducts operations at the Tonopah Test Range (TTR) in Nevada, the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, Vandenberg Air Force Base in California, and the Kauai Test Facility (KTF) in Hawaii. Additional information about SNL/NM can be found at Sandia Corporation's external website:

http://www.sandia.gov

Sandia National Laboratories

CORPORATE MISSION STATEMENT

As a DOE national laboratory, Sandia works in partnership with universities and industry to enhance the security, prosperity, and well-being of the nation. We provide scientific and engineering solutions to meet national needs in nuclear weapons and related defense systems, energy security, and environmental integrity, and to address emerging national challenges for both government and industry.

Remaining Vigilant

Although the Cold War has ended, the threat posed by weapons of mass destruction remains. Work conducted at SNL/NM continues to play a vital role in developing the technology to verify international treaties and agreements that prevent the spread of nuclear, biological, and chemical weapons. Emerging national security threats include politically and financially unstable nations from the former Soviet Union. Sandia Labs scientists are actively involved in helping these new countries to improve nuclear safeguards and security. Other major threats exist with aggressive states and terrorist factions that are actively pursuing nuclear weapons technology. Therefore, in the current political environment, the U.S. continues to rely on nuclear weapons as a vital military deterrent. The primary mission of Sandia Corporation is to ensure the integrity, reliability, and security of the nation's nuclear weapons.

Managing a Legacy of Contamination

DOE's Environmental Management (EM) Program faces formidable challenges to address the widespread waste legacy that has resulted from activities within the Nuclear Weapons Complex. In 1989, DOE established the Office of Environmental Restoration and Waste Management (ER/WM) to remediate areas of past contamination and establish sound waste management practices for the future. Innovative technologies continue to be developed to address environmental restoration sites throughout the Complex. In a ranking of DOE sites, however, SNL/NM was one of the least contaminated facilities in the DOE Complex. The cleanup and remediation of all SNL/NM sites is expected to be complete by 2005. Some sites will require long-term monitoring to ensure that any remaining contamination does not migrate from the site. DOE's website for ER/EM contains detailed information about DOE's cleanup efforts throughout the Complex:

http://www.em.doe.gov/index4.html

377th Air Base Wing Host

SNL/NM is located on KAFB, which is currently hosted by the 377th Air Base Wing. There are over 150 tenant groups on KAFB including the Air Force Research Laboratory (Phillips Laboratory), Air Force Operations Wing, Defense Nuclear Agency's Field Command, KAO, AL, and SNL/NM.

SNL/NM's History

In 1945, an extension of Los Alamos National Laboratory (LANL) was set up at Sandia Base in Albuquerque, New Mexico to support the Manhattan Project. The small operation, which was tasked to design and test non-nuclear components for nuclear weapons, was called the "Z Division." In 1948, the name was changed to "Sandia Laboratories." In 1949, President Harry Truman wrote a letter to American Telephone and Telegraph Company (AT&T) President Leroy Wilson, offering the company "an opportunity to render an exceptional service in the national interest" by managing Sandia Labs. AT&T accepted and began management on Nov. 1, 1949, thus formally separating Sandia Laboratories from LANL. AT&T managed the Labs for nearly 44 years. In 1993, Martin Marietta took over management and in 1995, Martin Marietta joined with Lockheed to become Lockheed Martin. Today, Truman's words remain Sandia Corporation's creed:

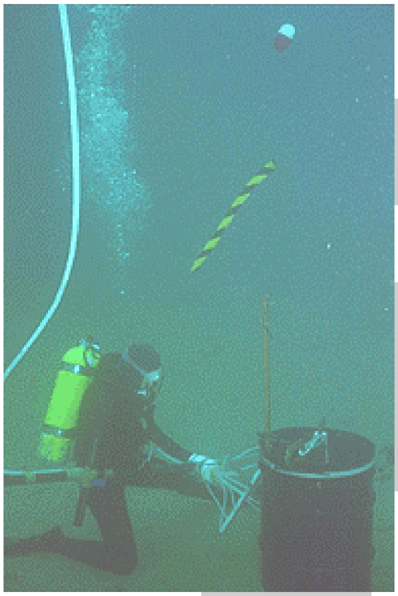
"Exceptional Service in the National Interest."

The Manhattan Project

The Manhattan Project was a Top Secret effort to develop an atomic bomb during World War II. The project was started in the remote hills of Los Alamos and headed by notable physicist, Robert Oppenheimer. The site became Los Alamos National Laboratory. Part of the operation was moved to Sandia Base in Albuquerque, which later became "Sandia Laboratories," and then Sandia National Laboratories.

The first successful test of a nuclear weapon was conducted at the Trinity Site in southern New Mexico on July 16, 1945. This was 3 1/2 years after the U.S. was catapulted into World II with the bombing of Pearl Harbor on December 7, 1941. World War II was brought to an end with the surrender of Japan on August 14, 1945.

Recent Developments From Sandia Labs



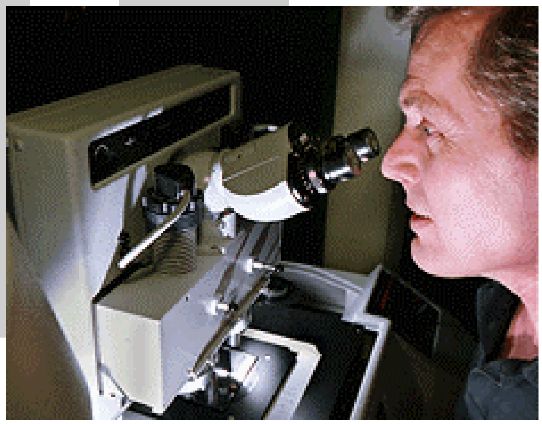
Chemical Sensor system – A prototype of a portable chemical sensor system the size of a soccer ball is being developed by scientists at SNL/NM. This device would be capable of detecting and identifying even the smallest traces of explosives under water—whether in a rice paddy or deep in the ocean.

The chemical sensor system draws water surrounding submerged objects containing explosives and extracts the molecules of interest on a fiber, desorbs the molecules from the fiber and scans them in an Ion Mobility Spectrometer (IMS). Explosive materials are identified based on chemical signatures.

A diver collects water samples during an experiment. Sandia researchers prepared simulated explosive devices using oil drums doped with trace amounts of explosives.

Smart Scalpel – Sandia Labs have developed a prototype biocavity microlaser called a "Smart Scalpel" intended to detect the presence of cancer cells during surgery. This dime-sized device should assist surgeons in more accurately cutting away malignant growths while minimizing the amount of healthy tissue removed.

Paul Gourley examines the photomask used to microfabricate the biocavity microlaser flow device.



Sandia Labs' team of mini robots demonstrate the use of "Swarm" to locate a skier buried under an avalanche.

Robotic "Swarm" – Buried skiers and snowboarders in an avalanche will have a greater chance of survival with Sandia Labs' new mini-robots and computer program called "Swarm." The program provides group intelligence feedback allowing a "swarm" of robots to quickly pinpoint a buried victim. Computer simulations show that the robots can find victims four times faster than any other search scheme presently in use. The program can also be used by a group of people (instead of robots) carrying minicomputers, global positioning receivers, and simple radio equipment to find buried victims. In more complicated situations, where the depth of snow burial, or rocks and trees create complications, the "Swarm" system works comparatively even faster.

Remote Gas Sensor – Hazardous gases can be detected up to two miles away with Sandia Labs' new remote sensor device called a "Polychromator." The device will use a combination of optics and micro-electromechanical systems (MEMS) to determine gas types. The Polychromator uses a variation on conventional gas analysis techniques with correlation spectroscopy. Infrared radiation is passed through a sample gas imparting a spectral pattern. Each gas species has a unique spectral pattern that is compared to a reference gas for identification.

Mike Sinclair (left) and Mike Butler prepare to put a Polychromator remote sensor chip into a testing unit.

Explosives and Narcotics "Sniffers" – Sandia Labs have developed a hand-carried device that can sniff out drugs and bombs at airports, border crossings, military installations, and schools. This device works by drawing in a large volume of air through a filter and sampling for heavy organic compounds. This portable device is a miniaturized version of an explosive-detecting walk-through portal developed by Sandia Labs for the Federal Aviation Administration (FAA).

Kevin Linker looks through the air-intake/valve assembly of a chemical preconcentrator.

Lynx Synthetic Aperture Radar (SAR) – Designed to be mounted on both manned aircraft and unmanned aerial vehicles, the 115 pound SAR is a sophisticated all-weather sensor, which is capable of providing real time photographic-like images through various weather conditions such as clouds, fog, rain, or day and night.

The sensor produces high-resolution images and can operate at a range of up to 85 kilometers. The radar sensor forms an image covering an area larger than that displayed, storing it in cache memory. This allows the operator to pan around within the total scene in order to concentrate on a particular area of interest. The radar's fine resolution allows it to detect small surface penetrations, even footprints in soft terrain.

Bill Hensley checks the Lynx Synthetic Aperture Radar (SAR) installed on a General Atomics 1-GNAT unmanned aerial vehicle.

Evolution of Environment, Safety, and Health (ES&H) Programs at SNL/NM

During the crunch of the war years when the primary concern was to manufacture components for the nation's defense, very little consideration was given to environmental impacts resulting from weapons research and development. Even after the war ended, mission driven tasks took priority over environmental concerns, and waste management practices and environmental management programs were poor throughout the DOE Complex.

In 1984, DOE began assessing its sites of past releases nationwide, spurring major changes in improving the management of the environment around DOE sites. The initial assessment of sites at SNL/NM was completed in 1987. Significant environmental problems were identified at the Labs that included diesel fuel leaks, contaminated landfills, and various chemical discharge sites.

In 1989, DOE created the Office of Environmental Restoration and Waste Management (ER/WM). As ES&H became a priority with new DOE Orders and U.S. Environmental Protection Agency (EPA) regulations, Sandia Corporation infused environmental management into its corporate culture on a site-wide basis to ensure that environmental compliance was met. By 1990, ES&H programs at SNL/NM were raised to the highest administrative levels (Johnson 1997).

DOE's Tiger Teams

An initiative by the Secretary of Energy in 1989 to conduct rigorous ES&H appraisals at DOE facilities formulated what became known as "Tiger Teams." From April 15 to May 24, 1991, a DOE Tiger Team conducted an appraisal at SNL/NM and identified 382 findings. Sandia Corporation has since completed all corrective actions resulting from this appraisal and continues to improve its ES&H programs through routine self-assessments and ongoing external audits.

A History of Progress

Over the last nine years, Sandia Corporation has made tremendous progress in building a comprehensive ES&H Program. The ES&H Manual, a dynamic online resource available to all workers at SNL/NM, clearly describes ES&H requirements for all levels of work conducted at the Labs. Better waste management practices have been implemented and state-of-the-art waste handling facilities have been constructed to handle and properly dispose of hazardous, radioactive, and solid wastes. Pollution Prevention (P2) programs and waste minimization practices have been very successful at SNL/NM. Audits conducted over recent years by the EPA, various DOE field offices, the City of Albuquerque, and the State of New Mexico have been testimony to Sandia Corporation's significant ES&H progress.

KAO and Sandia Corporation have worked to formulate extensive public outreach programs to keep the public informed about environmental management at SNL/NM and to involve the public in Environmental Restoration (ER) efforts. This Annual Site Environmental Report (ASER) is a part of that effort.

1.2 SNL/NM OPERATIONAL AREAS

Technical Area I

Tech Area I is SNL/NM's center for administration and site support activities and the main area for research, design, manufacturing, and production of weapon system components. The following bullets highlight some notable facilities.

- ***Microelectronics Development Laboratory (MDL)*** – The MDL provides state-of-the-art research and development in microelectronic technology. Work conducted here includes scanning electron

Mark Tucker studies the effects of a non-hazardous foam that neutralizes biological poisons such as anthrax.

microscopy, integrated circuit fabrication, silicon wafer testing, photolithography, etching, computer modeling and simulations, and device inspection.

- ***Advanced Manufacturing Process Laboratory (AMPL)*** – The primary capabilities of the AMPL include specialized production of weapon hardware, development of new manufacturing processes, and design and manufacturing of unique parts and equipment using innovative materials.

- ***Photovoltaic Device Fabrication Laboratory*** – Photovoltaic cells concentrate and store solar energy. The mission of this lab is to increase the cost effectiveness of solar cell technology.

- ***Energy and Environment Facility*** – This complex comprises a multitude of labs located in Bldg. 823. Research areas include material sciences, geophysics, chemical engineering, wind turbine testing, and instrument analysis.

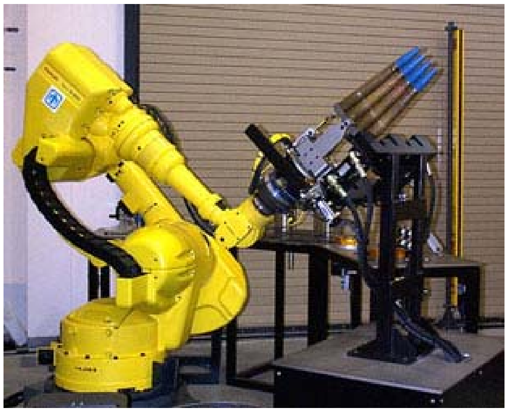
- ***Neutron Generator Facility (NGF)*** – War reserve neutron generators are fabricated at the NGF. Neutron generators produce a pulse of neutrons that initiate nuclear fission in nuclear weapons or physics tests. Previously, neutron generators were manufactured at the Pinellas Plant in Florida; in 1992, DOE formally decided to consolidate production at SNL/NM in accordance with the Arms Agreement between Russia and the United States.

- ***Lightning Simulation Facility*** – Simulated lightning is generated at this facility to test weapon components, communication equipment, and other materials and structures.

- ***Teraflops Computer*** – Teraflops, which stands for one trillion floating point operations per second, is made up of 76 computer cabinets with 9,072 Pentium Pro processors and nearly 600 billion bytes of memory. The computer, which was built in partnership with Intel Corporation, covers about 1,600 sq ft.

- ***Integrated Materials Research Laboratory (IMRL)*** – IMRL research focuses on studying the relationship between the atomic structure of materials and their physical and mechanical properties. The IMRL has developed innovative and superior materials such as alloys, ceramics, adhesives, organic polymers, and optical and dielectric materials.

- ***Ion Beam Materials Research Lab*** – This facility researches and establishes theories and models in the areas of material science, solid state physics, and accelerator physics. The 6 MeV TANDEM Van de Graaff Generator located here can be used for producing and accelerating ion beams of most elements.



Robotic prototype developed by the RMSEL for demilitarizing munitions. Here, the robot arm is disassembling 40 mm fixed-rounds.

- ***Steam Plant*** – The Steam Plant was built in 1949 and has operated non-stop since then. The plant produces hot water and steam to heat Tech Area I facilities and buildings on the east side of KAFB. A vast underground system of piping delivers steam and returns condensate to and from the plant. The plant operates five boilers using primarily natural gas, although the boilers can also burn diesel.

- ***Rock Mechanics Lab*** – This lab performs geomechanical studies to characterize natural fracture systems, identify and model rock deformation and failure processes, and determine thermomechanical and transport properties of competent rock and natural fractures. Research in geomechanics can be directly applied to underground construction, mining, and oil and gas production and reservoir management.

- ***Robotic Manufacturing Science and Engineering Lab (RMSEL)*** – This facility is home to the Intelligent Systems and Robotics Center (ISRC). The center encourages industry and academic partners in developing a wide range of robotic and intelligent system applications. Robots are developed for surveillance and reconnaissance, accident response, environmental sensing, weapons delivery, security monitoring and testing, and hazardous material handling. Advanced robots are self-learning and self-directed.

- ***Center for Security Systems*** – This center conducts research and development of systems and technologies to understand, identify, and solve the nation's security problems. Physical security systems developed and tested include sensors, video, image processing, alarm communications and display, and entry control contraband detection. Developments are being applied to improve security at our nation's schools.

- ***Engineering Sciences Experimental Facility (ESEF)*** – Various labs within this complex include large-scale experimental facilities for aerosciences, including the Hypersonic and Trisonic Wind Tunnels, the High Altitude Chamber, and the Parachute Fabrication/ Development Facility.

Technical Area II

Tech Area II is located adjacent to and south of Tech Area I. The following bullets describe the primary facilities:

- ***Explosive Components Facility (ECF)*** – Activities conducted at this facility are related to handling, testing, and evaluating energetic components, such as explosives research, and neutron generator assembly and testing.

- ***Hazardous Waste Management Facility (HWMF)*** – The HWMF is the centralized location for the collection, packaging, shipping, and recycling (as applicable) of regulated and non-regulated chemical waste.

- ***Solid Waste Transfer Facility (SWTF)*** – The SWTF is the centralized receiving center for most non-hazardous solid waste produced at SNL/NM. A major effort at the SWTF includes recycling paper and cardboard.

Technical Area III

Tech Area III is the location of many large-scale test facilities conducted under the Albuquerque

Full-Scale Experimental Complex (AFSEC). Components and very large objects are subjected to extreme physical stresses, such as heat, acceleration, and impacts. By experimental observation, engineers are able to develop and validate models and determine the limits of component survivability. Major AFSEC facilities in Tech Area III are described below. (Two other AFSEC facilities, the Aerial Cable Facility and the Lurance Canyon Burn Site, are described under Coyote Test Field [CTF]).

- ***Large Centrifuge Facility*** ***(AFSEC)*** – There are two centrifuges in the complex: a 29-ft indoor (underground) centrifuge and a 35-ft outdoor centrifuge. The smaller radius centrifuge is the most powerful with the capability of accelerating up to 16,000 lb at a force of 100 g's and lighter loads to 300 g's. Objects tested include weapon components, satellite systems, re-entry vehicles, and rocket motors. Tests may be conducted under extreme temperatures, if needed.

- ***Water Impact Facility*** ***(AFSEC)*** – A 300-ft drop tower stands next to a 120 by 188-ft, 50-ft deep pool. At the center of the pool is a 6-ft diameter 30-ft long pipe that extends to a total depth of 80 ft for underwater testing. Objects weighing up to 3,000 lb can be subjected to free-fall drops or rocket-assisted pulldowns into the pool.

- ***Drop Tower Facility*** ***(AFSEC)*** – Routine tests conducted at the Drop Tower include shipping container certification, simulated transportation accidents, and moderate velocity impacts. Crush tests are also routinely conducted by dropping a spike or other object onto a test item.

Rocket Sled Track Facility workers at SNL/NM prepare the sled prior to a test run.

- ***Rocket Sled Track Facility*** ***(AFSEC)*** – The 10,000-ft sled track is used to test extremely high-speed impacts of various objects such as weapon components and full-scale objects, including aircraft. The facility is equipped with high-speed photometrics.

- ***Mobile Laser Tracker*** ***(AFSEC)*** – SNL/NM has two mobile, self-contained, computer-controlled, laser tracking systems. The laser trackers routinely track missiles, rocket sleds, smart munitions, parachute systems, aircraft, an other test items. The test range is up to 25,000 ft and tracking velocities are up to 20,000 ft/sec. The trackers are capable of high-speed photometric coverage to 5,000 frames per second.

- ***Vibration and Acoustic Testing Facility*** ***(AFSEC)*** – Controlled vibrations can be conducted on small to very large components to determine system integrity and validation of models. Common tests performed are acoustic, random vibration, shock on shakers, seismic simulation, sinusoidal vibration, and mixed-mode vibration.

- ***Mechanical Shock Facility*** ***(AFSEC)*** – Simulation of impact environments and other dynamic structural loading are conducted on weapon components and assemblies. Typical tests involve the simulation of mechanical shock environments produced by transportation, flight, impact, explosive, and other dynamic events.

- ***Photometrics* (AFSEC)** – Cameras at multiple positions allow experimenters to capture high-speed events or processes with a slow motion effect. Prism cameras have frame rates of 500 to 10,000 frames per second. High-speed video cameras have frame rates up to 1,000 frames per second.

- ***Radiant Heat Facility* (AFSEC)** – Intense heat testing up to 2,000 °C is performed on various components in a controlled environment using an array of electrically powered heat lamps that can "dial-a-fire."

- ***Terminal Ballistic Facility*** – Various ballistic studies using many types of firearms are tested as well as solid fuel rocket motor tests.

- ***Classified Destruction Facility*** – A hammermill paper pulverizer and plastics shredder is used to destroy classified documents, computer tapes, and microfilms by turning these materials into an unreadable residue.

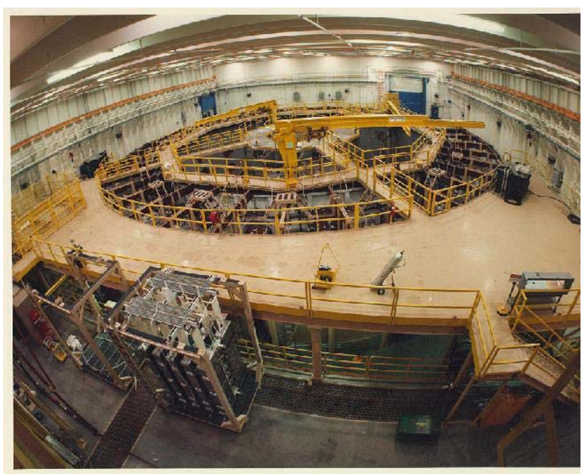
- ***Radioactive and Mixed Waste Management Facility (RMWMF)*** – Most radioactive waste produced at SNL/NM is handled at this facility. Waste is characterized, packaged, stored, and shipped to offsite approved disposal facilities. Some mixed waste (MW) is treated at the RMWMF before shipment.

Technical Area IV

Tech Area IV is SNL/NM's center for pulsed power accelerator research. A pulsed power accelerator is a device that electromagnetically accelerates atomic sized particles, such as ions, protons, and electrons, into energetic beams that can be directed at a target. Tech Area IV accelerators are used to test nuclear weapon component survivability by subjecting components to extreme magnetic fields and x-ray sources. This technology is also used for radiation hardening of materials, sterilization of medical waste, and food purification. Other activities conducted at Tech Area IV include research in computer science, flight dynamics, radiation transport, satellite processing, and robotics.

The following bullets highlight the primary accelerator facilities in TA-IV:

- ***Z Accelerator*** – The Z Accelerator, formally the Particle Beam Fusion Accelerator (PBFA-II), is the most powerful pulsed power x-ray source in the world producing as much as 290 trillion watts (terawatts) of x-ray power and an x-ray energy of 1.9 million joules. The pulse that drives the Z Accelerator lasts less than ten billionths of a second. The pulse is 20,000 times faster and delivers 1,000 times the electrical current of the average lightning bolt.



The Z Accelerator is the most powerful x-ray source in the world.

- ***High Energy Radiation Megavolt Electron Source (HERMES III***) – HERMES III is housed in the Simulation Technology Laboratory. It is a third generation gamma ray accelerator used to simulate the gamma rays produced by nuclear weapons. Testing is conducted on various systems such as electronic and other components.

- ***SATURN*** – This accelerator produces x-rays to simulate radiation bursts on electronic subsystems and material components.

- ***Short Pulse High Intensity Nanosecond X-Radiator (SPHINX)*** – The SPHINX is an x-ray source for small area exposures primarily used for thermostructural response testing.

- ***Sandia Accelerator and Beam Research Experiment (SABRE)*** – This accelerator produces electron beams or x-rays for moderate exposures that support the Inertial Confinement Fusion Program.

- ***Repetitive High Energy Pulsed Power (RHEPP) I and RHEPP II*** – These repetitive pulsed power accelerators produce pulses of ions to create x-rays (RHEPP I) and an electron beam and x-rays (RHEPP II).

- ***TESLA*** – Short x-ray bursts produced by this accelerator are used to test plasma-opening switches.

- ***High Power Microwave Lab*** – Several accelerators in this lab are capable of producing high-energy electron beams used to drive microwave-generating devices.

Technical Area V

Tech Area V is located adjacent to and on the northeast end of Tech Area III. This facility primarily conducts reactor operations used in testing weapon components and reactor safety studies. The reactors are used for irradiating various targets and testing survivability of materials, electronic subsystems, and components in a hostile environment. Notable facilities in Tech Area V are highlighted in the following bullets.

- ***Annular Core Research Reactor (ACRR)*** – The ACRR consists of a deep water-filled tank with cylindrical fuel elements around a central experimental cavity. This reactor provides neutron and sustained gamma pulsed environments. The ACRR is used to test the survivability of weapon components and perform in-pile experiments for reactor safety research (simulating reactor accident scenarios).

- ***Sandia Pulse Reactor III (SPR III)*** – This is a fast burst reactor used to create intense neutron bursts. It produces a near-fission spectrum radiation environment and is used for effects testing on material components and electronic subsystems.

- ***Gamma Irradiation Facility (GIF)*** – This facility provides cobalt-60 gamma ray sources for simulating irradiation environments. A new GIF is expected to be operational by December 2000.

- ***Hot Cell Facility (HCF)*** – The HCF has full capability to remotely handle and analyze radioactive materials. It is primarily an isotope production facility where isotopes produced in the ACRR are extracted in the cell.

- ***Radiation Metrology Laboratory (RML)*** – This lab provides radiation measurement services for SNL/NM's reactors, isotopic sources, and accelerator facilities.

Remote Test Areas and Storage Facilities

Operations in remote test areas include large-scale testing within the Coyote Test Field (CTF) and waste storage handling at the Manzano Storage Complex.

- ***Manzano Storage Complex*** – Manzano Base is an Air Force-owned area encompassing the four prominent hills just west of the withdrawal boundary (Figure 1-1). Previously this was a high-security storage facility for munitions and explosives. The Kirtland Underground Munitions Storage Complex (KUMSC) has since been built for this purpose. Sandia Corporation leases several bunkers at the Manzano Storage Complex to store radioactive waste and archived records.

Coyote Test Field (CTF)

The CTF collectively describes several remote test areas on KAFB including test areas within the canyons of the Manzanita Mountains and areas south and east of Tech Area III. DOE holds lease agreements with the Air Force to conduct activities in these areas such as large-scale experiments on weapon system components, transport containers, and other assemblies. The following bullets highlight the major facilities:

- ***Aerial Cable Facility*** ***(AFSEC)*** – This facility has several cables spanning 5,000 ft across Sol Se Mete Canyon. Objects such as transportation packages are subjected to drop and high-velocity impact testing. The cables are also used to guide full scale, air-deliverable weapon systems to simulate free flight for realistic target engagement scenarios. Rocket sled assisted pull downs can be used to increase the impact.

- ***Lurance Canyon Burn Site*** ***(AFSEC)*** – This 220-acre complex has three open burn pools and three burn facility structures: (1) SWISH (Small WInd SHield) is an enclosed facility that reduces smoke and improves combustion, (2) FLAME is a Fire Laboratory used for the Authentication of Models and Experiments, and (3) Igloo is a small bunker facility used to simulate building fires.

- ***Thunder Range Complex*** – This range originated in 1963 as an explosive testing area. Sandia Corporation no longer conducts explosive testing on the range. It is primarily used for disassembly and evaluation of special items.

- ***Robotic Vehicle Range (RVR)*** – The 226-acre RVR is an outdoor test used to test robots over varied terrain. The Mobile Robotics Department operates the range as a branch of the ISRC.

- ***Containment Technology Test Facility*** – There are two scale models (1:4 and 1:10) of reactor containment buildings at this facility. The models are used to support reactor containment research and development (simulating reactor accident scenarios).

- ***National Solar Thermal Test Facility (NSTTF)*** – This 115-acre test facility is devoted to the development of solar energy. The NSTTF includes solar furnaces, parabolic dishes and troughs, and a field of 222 computer controlled heliostats that reflect concentrated sunlight onto a 200-ft receiving tower. The Solar Tower can concentrate the sun's energy up to 5,000 times its normal intensity.

1.3 SITE SETTING AND DEMOGRAPHICS

Regional Topography and Layout

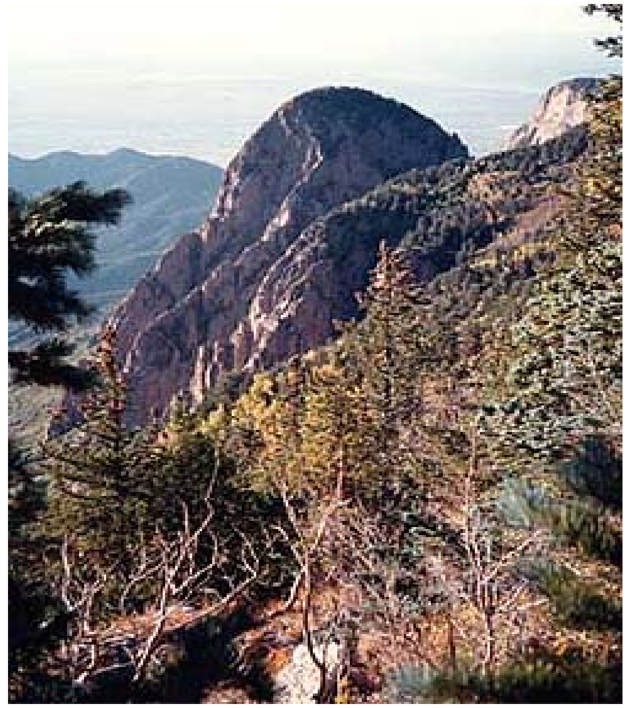
KAFB has widely varied topography from rugged mountains on the east to nearly flat plains on the west. As shown in Figure 1-1, the land withdrawal backs up to and encompasses a portion of the Manzanita Mountains within the Cibola National Forest. The remainder of KAFB, with the exception of Manzano Base, is situated on gently west sloping foothill terrain that grades to widespread flat areas where the majority of Air

Force and SNL/NM facilities are built. The Albuquerque International Sunport on the far west side of KAFB shares the runway with KAFB.

The Mountains
The most prominent topographic feature in the Albuquerque area is the impressive west face of the Sandia Mountains east of the City of Albuquerque. The Sandias form a 21-kilometer (13-mile) long escarpment distinguished by steep cliffs, pinnacles, and narrow canyons. Sandia Crest at 3,254 m (10,678 ft) is the highest point in the region. Tijeras Canyon divides the Sandia Mountains to the north from the Manzanita and Manzano Mountains to the south. Sediments transported from the canyons and draws of these mountains have formed coalescing alluvial fans called bajadas. These broad alluvial plains slope west across KAFB and are dissected by the Tijeras Arroyo and smaller arroyos and washes.

Tijeras Arroyo
Tijeras Arroyo is up to 1,300 m (4,264 ft) wide and 33 m (108 ft) deep forming a significant topographic feature across KAFB. The watershed drained by Tijeras Arroyo includes the southern Sandia Mountains, the Manzanita Mountains, and the north end of the Manzano Mountains. The arroyo is dry except during heavy downpours, which can cause significant flash flooding. The arroyo originates out of Tijeras Canyon and runs coincident with the Tijeras fault for several miles before deviating to the southwest where it discharges to the Rio Grande.

The Rio Grande
The Rio Grande, meaning “Great River,” is 2,896 km (1,800 mi) long, extending from Stony Pass in the San Juan Mountains of Colorado to the Gulf of Mexico. In North America, it is second only in length to the Mississippi/Missouri River combination. It is flanked by a narrow riparian forest ecosystem (bosque). The Middle Rio Grande bosque has the largest stands of cottonwoods in the world. The cottonwoods depend on the natural flood cycles of the river for seedling propagation. However, flooding of the river has since been managed and contained by the construction of the Cochiti Dam and an extensive system of flood control ditches built by the U.S. Army Corps of Engineers. As a result, the cottonwoods have been declining. A Bosque Ecosystem Monitoring Program in conjunction with the University of New Mexico is studying the problem and working to preserve the bosque.



A view of the Sandia Needle in the Sandia Mountains overlooking Albuquerque.

Today, water from the Rio Grande is primarily used for agricultural irrigation, however, plans are underway to build a water treatment plant that will use river water to supplement Albuquerque’s drinking water supply.

Regional Elevations

Elevations in the Albuquerque metropolitan area range from 1,493 m (4,900 ft) at the Rio Grande, near the intersection of Interstate-40 (I-40) and Interstate-25 (I-25) to approximately 1,767 m (5,800 ft) at the base of the Sandia Mountains. Albuquerque's average elevation of 1,619 m (5,311 ft) makes it the highest large metropolitan city in America (AED 1999). The KAFB military reservation has a mean elevation of 1,641 m (5,384 ft). The maximum elevation at KAFB is 2,434 m (7,988 ft) within the land withdrawal.

Counties and Population

New Mexico is the fifth largest state in the U.S. with 121,666 sq mi and a total population of approximately 1.5 million. A recent count of the population within an 80-kilometer (50-mile) radius of SNL/NM was 695,406 residents (DOC 1998). The Albuquerque metropolitan area alone has approximately 678,820 residents (U.S. Bureau of Census). There are nine counties contained in all or part of this radius (Figure 1-2 and Table 1-1).

Regional Economics

The City of Albuquerque and its neighboring communities are the main economic center for the state. The top 10 employers are shown below:

Employer	Employees
Albuquerque Public Schools	17,500
University of New Mexico	15,475
KAFB (civilian)	12,830
City of Albuquerque	9,000
Sandia National Laboratories	8,500
Presbyterian Healthcare Services	5,800
KAFB (military)	5,650
Intel Corporation	5,200
State of New Mexico	4,870
Lovelace Medical Center	3,225

NOTE: Source: AED 1999

TABLE 1-1. Counties Within an 80 km (50-mile) Radius of SNL/NM

County	Primary Population Centers
Bernalillo	Albuquerque, KAFB, and east mountain residents (Sandia, Manzanita, and Manzano Mountains
Sandoval	Corrales, Rio Rancho, Bernalillo, and several Indian Pueblos
Valencia	Bosque Farms, Los Lunas, and Belen
Santa Fe	Edgewood and suburbs of Santa Fe
Torrance	Moriarty and small villages east of the Manzano Mountains
McKinley	Sparsely populated northwest edge of the county
San Miguel	Sparsely populated southwest edge of the county
Cibola	Laguna Pueblo
Socorro	Several small villages on the north edge of county

1.4 GEOLOGY

1.4.1 Regional Setting

The regional geologic setting in which SNL/NM and KAFB are situated is an area that has been subjected to relatively recent episodes of basaltic volcanism and ongoing intercontinental rifting (crustal extension). The Rio Grande rift has formed a series of connected down-dropped basins in which vast amounts of sediments have been deposited. The rift extends for about 450 miles from Leadville, Colorado to southern New Mexico, and is one of the greatest troughs on Earth. In recent geologic times, basaltic lavas rising from deep fissures along the rift have been extruded in vast sheets.

It is thought that the Rio Grande rift is the eastern most expression of the Basin and Range Province of the west and southwest regions of the U.S. (NMGS 1984). The Basin and Range is characterized by large crustal blocks uplifted along steeply dipping normal faults and separated by long thin alluvial-filled valleys.

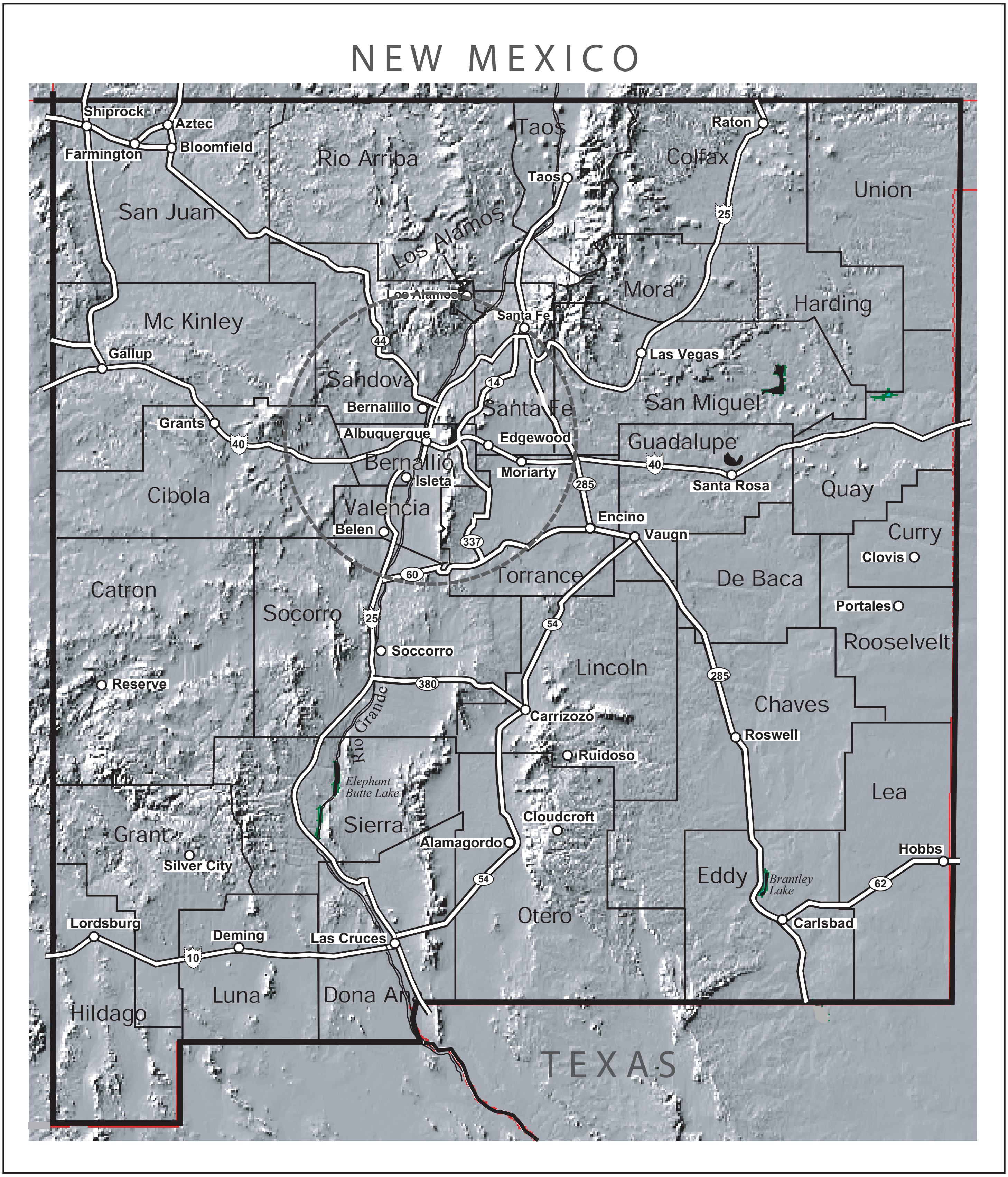


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FIGURE 1-2. New Mexico Satellite Map

The overlay shows major roads, cities, county lines, and the 80 km (50-mile) radius from SNL/NM facilities (dashed circle).

The Rio Grande rift is also characterized by steeply dipping faults, although the valleys are much broader.

1.4.2 Albuquerque Basin

The Albuquerque Basin is one of several north-south trending sediment-filled basins formed by the Rio Grande rift. This major structural feature is approximately 48 km (30 mi) wide and 161 km (100 mi) long and 3,000 sq mi in area (Grant 1982) (Figure 1-3). On the east, the basin is bounded by uplifted fault blocks, reflected by the Sandia, Manzanita, and Manzano Mountains. The western side of the basin is bounded by the Lucero uplift to the south, the Rio Puerco fault belt, and the Nacimiento uplift at the northern end. There is relatively little topographic relief along the Rio Puerco fault belt on the northwestern side of the basin. The basin is drained by two south-flowing rivers: the Rio Puerco to the west and the Rio Grande to the east.

During the Miocene and Pliocene epochs, the basin filled with as much as 4,560 m (15,000 ft) of sediments derived from the erosion of the surrounding highlands and material transported into the basin by the ancestral Rio Grande. This sequence of unconsolidated sediments (primarily the Santa Fe Group) thins toward the edge of the basin and is truncated by normal faults at the bounding uplifts. The Santa Fe Group is overlain in places by Pliocene Ortiz gravel and Rio Grande fluvial deposits, which are interbedded with Tertiary and Quaternary basaltic and pyroclastic materials. The Santa Fe Group consists of channel, debris flow, and floodplain deposits, and includes eolian and playa deposits towards the center of the basin (in the lower units). Most of the bedding is thought to be lenticular with limited lateral extent, although buried channels or debris flows can extend for miles. These subsurface features are of major importance in controlling the movement of groundwater within the basin.

Regional Fault Systems

As shown in Figure 1-4, several major faults are located on KAFB. Tijeras fault, which has been traced as far north as Madrid, New Mexico, trends southwesterly through Tijeras Canyon, and across KAFB. Tijeras Canyon was formed by preferential erosion along the fault. The Tijeras fault is a strike-slip fault of Paleozoic (and younger) age expressed by southwesterly movement of the northern block (left lateral). The system of faults connecting with the Tijeras fault on KAFB is collectively referred to as the Tijeras fault complex. The fault complex marks a distinct geologic boundary between the uplifted blocks on the east and the sediment-filled basin to the west. This geologic boundary also forms a boundary between the two groundwater regimes at KAFB.

The Sandia fault is thought to be the primary boundary between the Sandia Mountains and the Albuquerque Basin and shows evidence of Quaternary motion (Kelley 1977). The Sandia fault converges with the Tijeras fault and the Hubble Springs fault. The Hubble Springs fault has created the Hubbell Bench (south of KAFB) with offsets of 5 to 30 m (15 to 100 ft) and is one of the most clearly visible fault scarps on the edge of the basin (Machette et al. 1982). Both the Sandia and Hubble Springs faults are north-south trending, down-to-the-west, en-echelon normal faults, Tertiary in age (Lozinsky et al. 1991; Woodward 1982; Kelley and Northrop 1975).

1.4.3 Regional Geologic History

The Precambrian granite, gneiss, schist, quartzite, and greenstone exposed in the Sandia Mountains today represent the mountain roots of an ancient system formed 1.5 billion years ago (Kelly 1977). Over the eons, this ancestral Sandia range was eroded to a broad level peneplain forming the “Great Unconformity” that marks the stratigraphic bottom of all sedimentary rocks in the region.

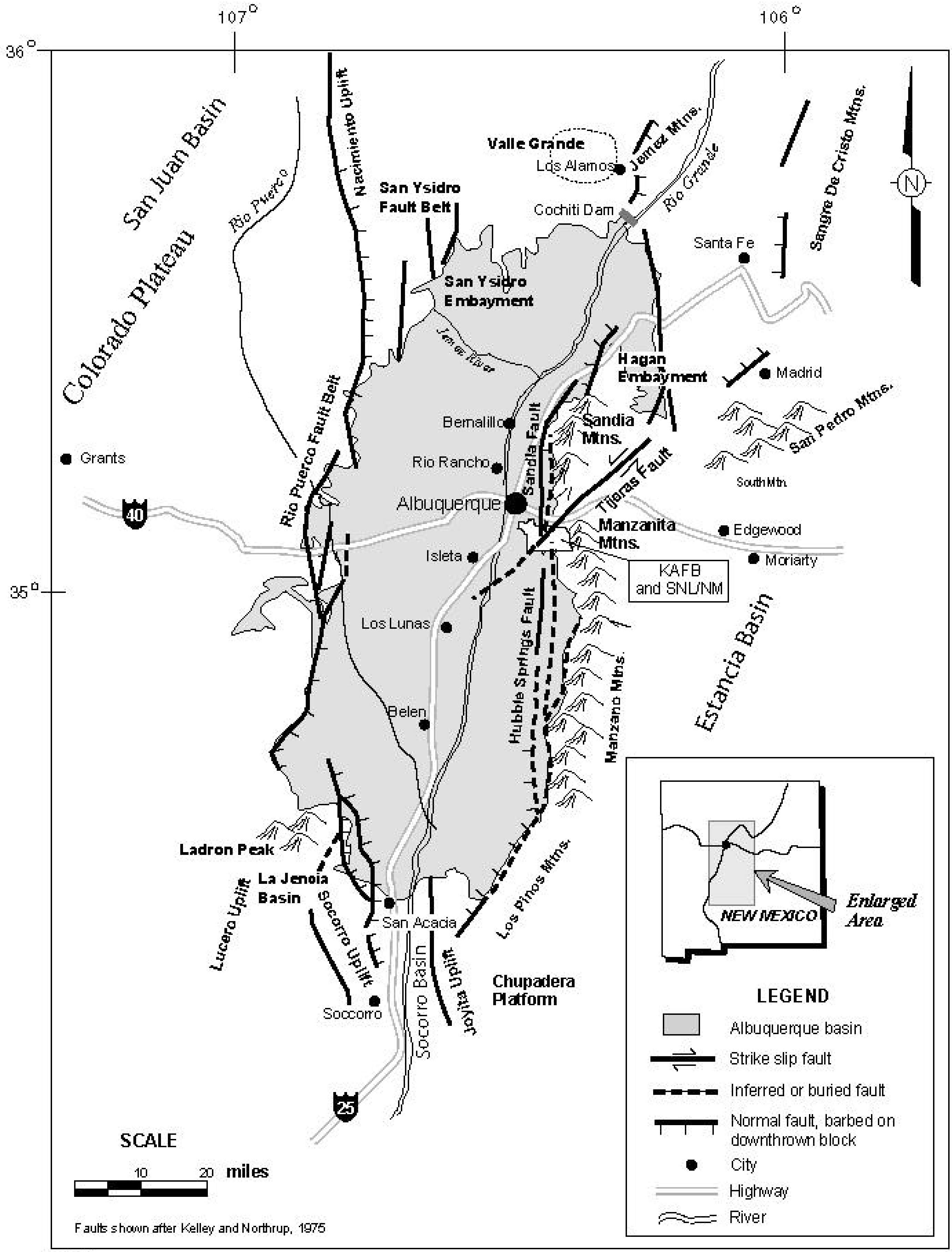

FIGURE 1-3. The Albuquerque Basin, North Central New Mexico, Showing Bounding Faults and Uplifts

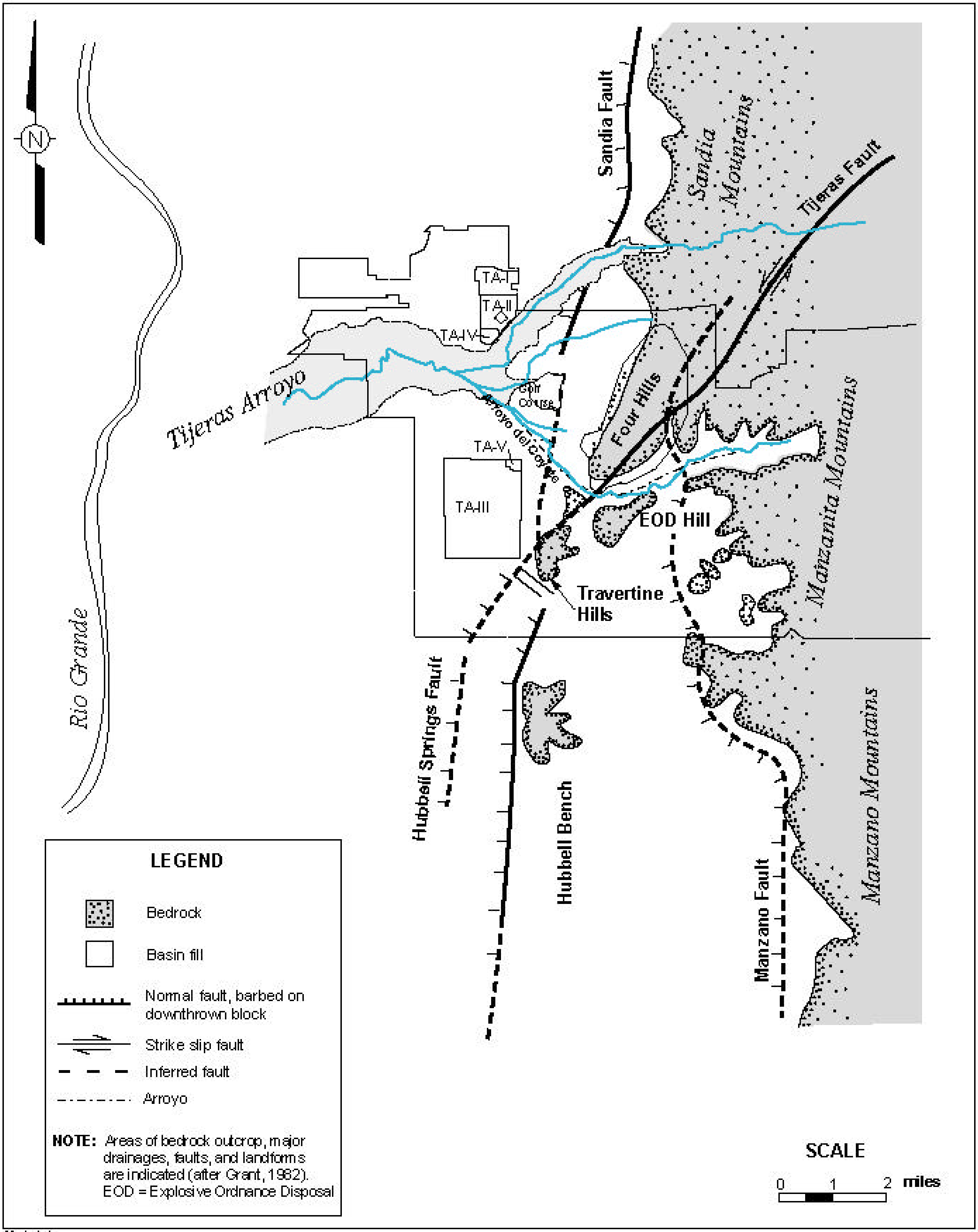

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FIGURE 1-4. Generalized Geology in the Vicinity of SNL/NM and KAFB

Marine Transgressions

Beginning about 500 million years ago (mya) in the Ordovician and continuing through the Cretaceous, the entire regional area (most of New Mexico and west Texas) was inundated by episodic shallow marine transgressions, which laid down great thicknesses of marine limestone, sandstone, and shale. In the Albuquerque region, most of the earlier Paleozoic section is missing, most likely because previously deposited beds were eroded and removed from the geologic record. During the Pennsylvanian period (300 mya), a shallow sea advanced across most of New Mexico along great seaways separated by narrow mountainous islands. Corals, brachiopods, crinoids, and bryozoans inhabited the near-shore waters and accumulated on the sea floor. The Pennsylvanian age Sandia Formation and Madera Group limestone, capping the Sandia granite, are rich with fossils of these animals.

At the close of the Paleozoic, terrestrial "red beds" were deposited in a vast flood-plain valley (Abo Formation). By the mid to late Permian, seas transgressed again across New Mexico resulting in primarily marine deposits (Yeso, Glorieta, and San Andreas Formations). By Triassic times, New Mexico remained above sea level for about 40 my. Widespread floodplain and fluvial sediments were deposited across much of New Mexico and the southwest (Moenkopi and Chinle Formations). In mid-Jurassic times, vast sand dunes covered the regional southwest (Entrada Sandstone). The climate became wetter in late-Jurassic times with huge lakes and floodplains supporting a wide variety of life including abundant dinosaurs (Morrison Formation). By Cretaceous times, the seas returned again and regional subsidence accelerated resulting in a huge thickness of marine sandstone and shale, forming a deposit nearly as great as the combined thickness of all the sedimentary rocks below it.

Dinosaurs in New Mexico

Dinosaur fossils abound throughout the State of New Mexico including Pentocerotops (a horned dinosaur unique to New Mexico) and Seismosaurus, which was a huge vegetarian dinosaur similar to Apatosaurus (formerly known as Brontosaurus). Coelophysis (a small carnivorous dinosaur) is the state's official fossil.

In the late Cretaceous (100 to 65 mya), swamps and lagoons along the coasts formed great volumes of decaying vegetation that later formed rich coal beds. The Tijeras Coal Basin is one such deposit. At the close of Mesozoic era (65 mya) the seas retreated from the state for the last time.

New Mexico Earthquake Activity

The Albuquerque-Socorro area is considered an area of moderate seismic risk. New Mexico's seismic activity shows little correlation with the faults in the Albuquerque area. Most seismic activity in New Mexico is concentrated over a huge magma body about 12 miles below the surface near Soccorro, approximately 120 km (75 mi) south of KAFB.

In 1906, an earthquake in the Socorro area was estimated to be greater than magnitude 6.0 on the Richter scale. The largest *recorded* earthquakes have been about 4.7 in magnitude. Three earthquakes of this magnitude occurred in 1970, 1971, and 1990. The geophysics group at New Mexico Tech operates the New Mexico Tech Seismic Observatory and tracks recent earthquake activity in New Mexico at the following website:

http://www.ees.nmt.edu/Geop/recentquakes.html

Volcanic Activity

By the mid-Tertiary (25 to 40 mya), much of the southwest including the Albuquerque regional area became tectonically active. Valley Grande, a 22-mile wide caldera near Los Alamos, is the centerpiece of the Jemez volcanic field. Approximately 2,000 km^3 of material were ejected from this volcano over several million years of activity (Wood and Kienle 1990). Much later in the Pliocene (4 mya), Mt. Taylor, west of Albuquerque, began erupting producing successive lava and ash flows over a period of two million years. The earliest flows were andesite and dacite and the most recent flows were basaltic. The mountain, which today stands at 3,444 m (11,301 ft), has been quiescent for the last two million years.

Mountain Building and Rift Formation

Volcanic activity was followed by tremendous faulting and uplift, and marked the beginning of the Rio Grande rift, basin formation, and mountain building that formed the current Sandia, Manzanita, and Manzano Mountains. The majority of the uplift has occurred during the last five to 10 million years. The ancient precambrian granite and metamorphics, which are capped by marine limestone, are exposed in the Sandia and Manzano Mountains. The equivalent stratigraphic sequence that is exposed on the crest of the Sandia Mountains today is located at the bottom of the Albuquerque Basin underlying the Santa Fe Group sediments. The total offset is approximately 6 miles in the deepest part of the basin (SNL 1994).

Holocene Volcanism

In very recent geologic time (the last one million years), a small string of 18 volcanoes, known as the Albuquerque Volcanoes, formed along the western fissure of the Rio Grande rift. Basaltic lava, extruded from deep within the earth's crust, spread in large sheets over the western Rio Grande valley. These volcanic rocks are exposed in the low profile cliffs along the west mesa.

1.5 HYDROLOGICAL SETTING

Understanding the groundwater hydrology at KAFB is complicated by the structurally complex terrain. In general, hydrogeological characterization is divided into two areas separated by the Tijeras fault complex, which marks a distinct geological boundary. To the east of the Tijeras fault complex, the geology is characterized by fractured and faulted bedrock covered by a thin layer of alluvium, and shallow groundwater 15 to 30 m (50 to 100 ft) deep. On the west side of the fault complex within the basin, groundwater levels occur from 90 to 150 m (300 to 500 ft) below the surface.

Natural Springs

Two perennial springs, Coyote Springs and Sol se Mete Spring, are present on KAFB. Hubbell Spring, also perennial, is located immediately south of the KAFB boundary on Isleta Pueblo.

Groundwater Yields

The primary regional aquifer in the basin is within the upper unit and, to a lesser degree, the middle unit of the Santa Fe Group. Most of the City of Albuquerque's water supply wells are located on the east side of the Rio Grande. The highest yield wells are screened in the sediments associated with the ancestral river channel. Prior to extensive urban development in the Albuquerque area beginning in the 1950s, the direction of regional groundwater flow was primarily to the southwest. As a result of groundwater withdrawal, the water table has dropped by as much as 43 m (140 ft) (Thorn et al. 1993). Groundwater withdrawal from KAFB and City of Albuquerque wells at the north end of KAFB has created a trough-like depression in the water table causing flow to be diverted northeast in the direction of the well fields.

1.6 REGIONAL CLIMATE

The climate of the Albuquerque Basin is characterized by wide diurnal temperature extremes, monsoons, and frequent drying winds.

Air temperatures are characteristic of high-altitude, dry continental climates. Temperature averages are as follows:

Season	Daytime High (avg.)	Nighttime Low (avg.)
Summer	32.7 °C 90.8 °F	16.6 °C 61.8 °F
Winter	9.6 °C 49.2 °F	-4.6 °C 23.7 °F

Source: NOAA 1995

The monthly average relative humidity varies from a low of 30 percent in early summer to 56 percent in early winter.

Annual precipitation, most of which occurs between July and October, averages approximately 21 cm (8.2 in.) on KAFB. In the higher elevations of the Sandia and Manzano Mountains, annual precipitation is between 12 to 35 in. The winter season is typically dry with less than 4.0 cm (1.6 in.) of precipitation recorded.

While the regional climate is described by the atmospheric state variables of temperature and humidity, site-specific meteorology at SNL/NM is influenced by the proximity to topographic features such as mountains, canyons, and arroyos. These features influence local wind patterns across the site; canyons and arroyos tend to channel or funnel wind, whereas mountains create upslope-downslope diurnal (day/night) wind flows. Winds tend to blow toward the mountains during the day and blow down the mountain towards the Rio Grande Valley during the night. These topographically induced wind flows can be enhanced or negated by synoptic (regional) weather systems that move across the southwest part of the United States. The strongest winds occur in the spring when monthly wind speeds average 4.6 meters per second (m/s) (10.3 miles per hour [mph]). Wind gusts can commonly reach up to 50 mph.

1.7 REGIONAL ECOLOGY

The regional area within an 80 km (50 mi) radius of SNL/NM facilities is situated at the junction of four major physiographic provinces:

- **Great Plains Grassland Prairie** (east of the Rocky Mountains);
- **Great Basin Desert** (west of the Rocky Mountains);
- **Chihuahuan Desert** (south of Albuquerque); and
- **Rocky Mountains** (the Sandia and Manzano Mountains form the southern extension of the Rockies).

Each province has an influence on the typical landforms, flora, and fauna predominant within the region. The Albuquerque area is perhaps most influenced by the Great Basin Desert ecosystem. With the topography at KAFB ranging from mountainous to flat grasslands, and much of the reservation open and undeveloped, there is much diversity in plants and animal communities living on KAFB. At least 267 plant species and 195 animal species occur on KAFB (DOE 1999a). Table 1-2 lists some of the birds, mammals, reptiles, and amphibians that have been identified onsite. Table 1-3 lists some of the plants occurring onsite.

1.7.1 Regional Life Zones

The Canadian Life Zone occurs from 8,000 to 11,500 ft; the highest elevations in the Sandia and Manzano Mountains are just over 10,000 ft. This zone is marked by mixed coniferous forests of

TABLE 1-2. A Partial List of Animals Identified at KAFB

BIRDS			
American robin	*Turdus migratorius*	European starling	*Sturnus vulgaris*
American kestrel	*Falco sparverius*	Greater roadrunner	*Geococcyx californianus*
Ash-throated flycatcher	*Myiarchus cinerascens*	Gray vireo	*Vireo vicinior*
Brown towhee	*Pipil fuscus*	Golden eagle	*Aquila chrysaetos*
Barn owl	*Tyto alba*	Great horned owl	*Bubo virginianus*
Bushtit	*Psaltriparus minimus*	Great-tailed grackle	*Quiscalus mexicanus*
Black-chinned hummingbird	*Archilochus alexandris*	Grace's warbler	*Dendroica graciae*
Black-throated sparrow	*Ampohispiza bilineata*	Gambel's quail	*Callipepla gambelii*
Black-headed grosbeak	*Pheucticus melanocephalus*	Hairy woodpecker	*Picoides villosus*
Brown-headed cowbird	*Molothrus ater*	Horned lark	*Eremophila alpestris*
Broad-tailed hummingbird	*Selasphorus platycercus*	Dark-eyed junco	*Junco hyemalis*
Bank swallow	*Riparia riparia*	Killdeer	*Charadrius vociferus*
Barn swallow	*Hirundo rustica*	Lark bunting	*Caramopiza melanocorys*
Black-throated gray warbler	*Dendroica nigrescens*	Loggerhead shrike	*Lanius ludovicianus*
Bewick's wren	*Thryomanes bewickii*	Mountain bluebird	*Sialia currucoides*
Cooper's hawk	*Accipter cooperi*	Northern flicker	*Colaptes auratus*
Common raven	*Corvus corax*	Piñon jay	*Gymnorhinus cyanocephalus*
Chirping sparrow	*Spizella passerina*	Red-tailed hawk	*Buteo jamaicensis*
Cassin's kingbird	*Tyrannus vociferans*	Rufous-sided towhee	*Pipiloerythro melanocephalus*
Common nighthawk	*Chordeiles minor*	Scrub jay	*Aphelocoma coerulescens*
Crissal thrasher	*Toxostoma dorsale*	Turkey vulture	*Cathartes aura*
Dark-eyed junco	*Junco hyemalis*	Western burrowing owl	*Athena cunicularia*
		Western meadowlark	*Sturnella neglecta*
MAMMALS		**REPTILES AND AMPHIBIANS**	
Black bear	*Ursus americanus*	Collared lizard	*Crotaphytus collaris*
Bobcat	*Felis rufus*	Chihuahuan spotted whiptail	*Cnemidophorus exsanguis*
Big brown bat	*Eptesicus fuscus*	Desert horned lizard	*Phrynosoma platyrhinos*
Banner-tailed kangaroo rat	*Dipodomys spectabilis*	Desert-horned lizard	*Phrynosoma platyrhinos*
Brush mouse	*Peromyscus boylii*	Eastern fence lizard	*Sceloporus undulatus*
Black-tailed jackrabbit	*Lepus californicus*	Gopher snake	*Pituophis melanoleucus*
Common porcupine	*Erethizon dorsatum*	Great plains skink	*Eumeces obsoletus*
Common raccoon	*Procyon lotor*	Great plains toad	*Bufo cognatus*
Coyote	*Canis latrans*	Leopard lizard	*Gambelia wislizenii*
Desert cottontail	*Sylvilagus audubonii*	Tiger salamander	*Ambystoma tigrinum*
Deer mouse	*Peromyscus maniculatus*	Western diamondback rattlesnake	*Crotalus atrox*
Gunnison's prairie dog	*Cynomys gunnisoni*	Side-blotched lizard	*Uta stansburiana*
Gray fox	*Urocyon cinereoargenteus*	Striped whip snake	*Masticophus taeniatus*
Mountain lion	*Felis concolor*	Short-horned lizard	*Phrynosoma douglassi*
Mule deer	*Odocoileus hemionus*		
Rock squirrel	*Spermophilus variegatus*		
Striped skunk	*Mephitis mephitis*		

The Greater Roadrunner (Geococcyx californianus) is New Mexico's state bird.

spruces, Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), gambel oak (*Quercus gambeli*), and quaking aspen (*Populus tremuloides*). Animals living here include black bear (*Ursus americanus)*, mountain lion (*Felis concolor)*, bobcat (*Felis rufus)*, mule deer (*Odocoileus hemionus)*, rabbits, and squirrels. Numerous raptor species, such as hawks and owls, inhabit this zone.

The Ponderosa Pine or Transition Zone occurs in the higher elevations of the withdrawal land on KAFB. In the Albuquerque region, ponderosas generally occur between 7,000 and 8,000 ft. In addition to Ponderosa Pine (*Pinus ponderosa*), there is shrub live oak (*Quercus turbinella)*, Colorado piñon (*Pinus edulis)*, and many grassy meadows. Mule deer, mountain lion, black bear, porcupine (*Erethizon dorsatum)*, and squirrels are found within this zone. Common birds seen at this elevation include the rufous-sided towhee (*Pipiloerythro melanocephalus)*, northern flicker (*Colaptes auratus*), scrub jay (*Aphelocoma coerulescens*), black-chinned hummingbird (*Archilochus alexandris)*, and various raptors.

The Piñon Juniper Zone generally occurs from 6,000 to 7,000 ft within canyons, foothills, and mesas. This zone makes up much of the rolling terrain located on the KAFB land withdrawal. The hillsides are dotted with Colorado piñon, one seed juniper (*Juniperus monosperma)*, shrub live oak (*Quercus turbinella)*, tree cholla (*Opuntia imbricata),* and red-flowered prickly pear (*Opuntia erinacea*) amongst large open areas of drought tolerant grasses. The canyon areas may support riparian habitat along ephemeral creeks and arroyos. Animals characteristic of this zone include the piñon mouse (*Peromyscus truei*) and the piñon jay (*Gymnorhinus cyanocephalus*). Mule deer and a large variety of rodents and reptiles are common in this area. Typical birds include the Western meadowlark (*Sturnella neglecta)*, common raven (*Corvus corax)*, and European starling (*Sturnus vulgaris)*.

The Upper Sonoran Life Zone (below 6,000 ft) supports scrubby semi-desert vegetation. The primary vegetation is grama grasses, tumble weed (*Salsola kali*), goathead (*Tribulus terrestris*), snakeweed (*Gutierrezia sarothrae*), sages, and numerous cacti species. This type of terrain is abundant with coyote (*Canis latrans*), desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus)*, Gunnison's prairie dogs (*Cynomys gunnisoni)*, and a wide variety of rodents and reptiles including the Western diamondback rattlesnake (*Crotalus atrox)*. Common birds in this zone include the Western Meadowlark *(Sturnella neglecta),* dark-eyed junco *(Junco hyemalis),* Gambel's quail *(Callipepla gambelii), and* Cassin's kingbird *(Tyrannus vociferans).* The Western burrowing owl (*Athena cunicularia*), a species of concern, co-habitats in prairie dog towns.

The Rio Grande and Bosque in the Albuquerque area occurs below 6,000 ft. The river is approximately 14 km (8.7 mi) to the west of KAFB. Tijeras Arroyo, which discharges to the river, drains much of KAFB and the Tijeras Canyon area watershed. In the Albuquerque area, the Rio Grande is wide, shallow, and meandering. Some portions of the river may be completely dry and run underground, especially when irrigation use is high. The riparian forest, or bosque, along the river's edge are heavily vegetated with valley cottonwood *(Populus deltoides*), salt cedar (*Tamarix chinensis*), and Russian olive (*Elaeagnus angustifolia*). The banks of the river are characterized by marshes, sandbars, and dunes. Common animals that live in this lush life zone include common raccoon (*Procyon lotor*), common beaver (*Castor canadensis*), common muskrat (*Ondatra zibethicus*), coyote, striped skunk (*Mephitis mephitis*), rabbits, and many rodents, reptiles, and amphibians. Red-winged blackbird (*Agelaius phoeniceus*), crows, owls, and woodpeckers are characteristic birds.

Like the mountains, the river provides an important flyway and habitat for migrating birds. Geese, ducks, and cranes, potentially including the rare whooping crane (*Grus americana*), winter along the Rio Grande. Other birds present are turkeys, pheasants, quail, songbirds, and hummingbirds.

TABLE 1-3. A Partial List of Plants Identified at KAFB

PLANTS			
Apache plume	*Fallugia paradoxa*	Goathead	*Tribulus terrestris*
One-seed juniper	*Juniperus monosperma*	India ricegrass	*Oryzopsis hymenoides*
New Mexico porcupine grass	*Stipa neomexicana*	Ring muhly	*Muhlenbergia torreyi*
Purple three-awn	*Aristida purpurea*	Bush muhly	*Muhlenbergia porteri*
Shrub live oak	*Quercus turbinella*	Soapweed yucca	*Yucca glauca*
Spectacle pod	*Ditheryrea wislizenii*	Blue locoweed	*Astragalus lentiginosus*
Annual goldenweed	*Machaeranthera gracilis*	Globemallow	*Sphaeralcea incana*
Western blue flax	*Linum lewisii*	Beakpod milkvetch	*Astragalus lentigenous*
Four-wing saltbush	*Atriplex canescens*	Paperdaisy	*Psilostrophe tagetina*
Colorado piñon	*Pinus edulis*	Prickly pear cactus	*Opuntia polyacantha*
Desert marigold	*Baileya multiradiata*		

RAPTOR MIGRATION IN THE MANZANOS

Raptors—or birds of prey—include eagles, hawks, owls, falcons, and vultures. During fall migration, raptors in New Mexico tend to funnel down from the Jemez and Sangre de Cristo Mountain ranges toward the Manzano Mountains. The crest of these mountains serve as an important flyway for migrating birds, including numerous raptor species. Birds use updrafts from the mountain ridges to gain lift and conserve energy.

HawkWatch International Inc., a raptor research and conservation organization, has an observation station located in the Manzanos just south of KAFB (fall migration). The station counts an average of 150 raptors per day during the fall migration.

Cooper's Hawk (Accipter cooperi)

Update 10-6-00

Chapter 2

Compliance Summary

Sandia Corporation strives to meet 100 percent regulatory compliance standards—both in letter and spirit—with all applicable environmental regulations, statutes, and U.S. Department of Energy (DOE) Orders. As a prime contractor to DOE, Sandia Corporation conducts its operations and develops its own internal rules under the guidance contained in DOE Orders. Environmental compliance specifically falls under the guidance of three DOE Orders:

- DOE Order 231.1, *Environment, Safety, and Health (ES&H) Reporting* (DOE 1996a);
- DOE 5400.1, *General Environmental Protection* (DOE 1990); and
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993).

This chapter provides a concise summary of Sandia Corporation's compliance status with major environmental regulations and statutes promulgated by the U.S. Environmental Protection Agency (EPA), which are applicable to operations at Sandia National Laboratories (SNL/NM) (see shaded box on page 2-3). The specific environmental programs responsible for meeting compliance with these regulations are discussed in subsequent chapters of this report.

Ongoing compliance issues and corrective actions, environmental occurrences, and environmental audits and appraisals are also discussed. Current permits held by Sandia Corporation for air, water, and waste are listed in a Table 2-7 at the end of the chapter. Permit violations that occurred in 1999 are listed in Table 2-8.

2.1 COMPLIANCE STATUS WITH FEDERAL REGULATIONS

This section summarizes Sandia Corporation's compliance status with major environmental regulations and statutes and Executive Orders (EOs) and DOE Orders that pertain to the environment.

2.1.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

CERCLA, commonly known as "Superfund," provides cleanup funds and/or assessment requirements for inactive waste sites at all federal facilities. CERCLA requirements are implemented under 40 CFR 302, "Designation, Reportable Quantities, and Notification." CERCLA was amended by SARA in 1986 to address significant hazardous waste sites.

A Preliminary Assessment/Site Inspection (PA/SI), as required by SARA Section 120(c), was performed at SNL/NM in 1988. This inspection confirmed that Sandia Corporation does not own any sites that would qualify for listing on the National Priorities List (NPL). The NPL lists the nation's high priority cleanup sites or "Superfund sites." Therefore, with respect to inactive hazardous waste sites, Sandia Corporation has no CERCLA reporting requirements. Other CERCLA reporting requirements are invoked in the case of a reportable quantity (RQ) release. CERCLA requires that any release to the environment (in any 24-hour period) of any pollutant or hazardous substance in a quantity greater than or equal to the RQ, must be reported immediately to the National Response Center (NRC) at 800-424-8802. If the release is "federally permitted" under CERCLA Section 101(10)H, it is exempted from CERCLA reporting. This reporting exemption also applies to any "federally permitted" release under SARA Title III. Sandia Corporation was in full compliance with CERCLA and SARA in 1999.

Other CERCLA reporting requirements defined under SARA Title III are discussed in the following section.

2.1.2 Emergency Planning and Community Right-to-Know Act (EPCRA)

SARA Title III, also known as the EPCRA, establishes emergency planning requirements for federal, state, and local governments and industry. The act, passed in 1986, is implemented by:

- 40 CFR 355, "Emergency Planning and Notification" (EPCRA, Section 302-304);
- 40 CFR 370, "Hazardous Chemical Reporting: Community Right-to-Know" (EPCRA, Section 311-312); and
- 40 CFR 372, "Toxic Chemical Release Reporting: Community Right-to-Know" (EPCRA, Section 313).

EPCRA applies to all facilities in which there is present a threshold quantity of extremely hazardous substances (EHSs) equal to or greater than the threshold planning quantities, or in specifically designated amounts as determined by the local community. Additionally, Executive Order (EO) 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements,* signed by President Clinton on August 3, 1993, directed all federal agencies to comply with EPCRA.

EPCRA requires the community to be informed of potential hazards such as the type and location of large quantities of toxic chemicals used and stored by facilities in the community. EPCRA specifically mandates that chemical information be made available to local emergency response organizations such as fire departments and hospitals. Any inadvertent release must be reported to appropriate state and local authorities and all subsequent reports must be made accessible to the public. The four major reporting requirements designated by specific sections of SARA Title III are shown in Table 2-1.

There were no reportable releases at SNL/NM under EPCRA or CERCLA in 1999. The EPA website for EPCRA is:

http://www.epa.gov/swercepp/crtk.html

Toxic Release Inventory (TRI) Reporting

EPCRA, Section 313, (40 CFR 372) requires that facilities with activities described in the Standard Industrial Code (SIC) 20 through 39 and which use toxic chemicals listed in SARA Title III over a threshold value, must submit a TRI report. A TRI report is also required by EO 12856. The threshold value for listed chemicals for which a TRI report is required is 10,000 lb/yr (unless otherwise specified).

Major Environmental Regulations & Statutes Applicable to SNL/NM	
✓ **CERCLA**, Comprehensive Environmental Response, Compensation, and Liability Act	*Provides federal funding for cleanup of inactive waste sites on the National Priority List (NPL) and mandates requirements for reportable releases of hazardous substances*
✓ **SARA**, Superfund Amendments and Reauthorization Act	*SARA,Title III, known as the Emergency Planning and Community-Right-to-Know Act (EPCRA), mandates communication standards for hazardous materials over a threshold amount that are stored or used in a community*
✓ **RCRA**, Resource, Conservation, and Recovery Act	*Mandates the management of listed hazardous waste and hazardous materials*
✓ **AEA**, Atomic Energy Act	*Directs DOE and the Nuclear Regulatory Commission (NRC) in the management of nuclear materials and radioactive waste*
✓ **FFCA**, Federal Facilities Compliance Act	*Directs federal agencies in the management of mixed waste*
✓ **CAA and CAAA,** Clean Air Act and CAA Amendments ✓	*Provides standards to protect the nation's air quality*
✓ **NESHAP**, National Emission Standards for Hazardous Air Pollutants	*Specifies standards for radionuclide air emissions and other hazardous air releases*
✓ **CWA**, Clean Water Act	*Provides general water quality standards to protect the nation's water sources and byways*
✓ **SDWA,** Safe Drinking Water Act	*Provides specific standards for sources used for drinking water*
✓ **TSCA**, Toxic Substance Control Act	*Specifies rules for the manufacture, distribution, and disposal of specific toxic materials such as asbestos and polychlorinated biphenyls (PCBs)*
✓ **FIFRA**, Federal Insecticide, Fungicide, and Rodenticide Act	*Controls the distribution and use of various pesticides*
✓ **NEPA**, National Environmental Policy Act	*Ensures that federal agencies review all of their proposed activities that have the potential to affect the environment and provide an opportunity for public involvement for projects potential significant impacts*
✓ **ESA**, Endangered Species Act	*Provides special protection status for federally-listed endangered and threatened species*
✓ **Cultural resources acts**	*Includes various acts that protect archeological, historical, and religious sites and resources*
✓ **Executive Orders (EOs)**	*Two EOs provide specific protection for wetlands and floodplains*

TABLE 2-1. 1999 SARA Title III (or EPCRA) Reporting Requirements Applicable to SNL/NM

Section	SARA Title III Section Title	Yes	No	N/R	Description
302 - 303	Planning Notification	✓			Sandia Corporation has submitted a planning report to state and local emergency response authorities detailing its notification procedures and other facility notification responsibilities.
304	Emergency Release Notification			✓	No reportable quantity (RQ) releases of an extremely hazardous substance (EHS), or as defined under CERCLA, occurred in 1999.
311-312	MSDSs and Chemical Inventory Report	✓			There are two "Community Right-to-Know" reporting requirements: (a) an inventory report listing all hazardous chemicals onsite (above threshold levels) must be submitted annually to state and local emergency response groups and fire departments; (b) all MSDS* information must be made available to local emergency organizations. Sandia Corporation submitted Tier 1 and 2 reports in March 1999.
313	Toxic Release Inventory (TRI) Reporting			✓	Chemicals at SNL/NM have been below the reporting threshold for TRI reporting since 1995. Sandia Corporation was not required to submit a TRI report in 1999.

NOTE: MSDS = Material Safety Data Sheets (gives relevant chemical information)
N/R = not required

Sandia Corporation began submitting TRI reports to the EPA and DOE in 1991. In 1995, chemical use at SNL/NM fell below the reporting threshold; a TRI report has not been submitted since that year. Up until 1995, the threshold for aerosol forms of sulfuric acid was 10,000 lb. Aerosol sulfuric acid in quantities exceeding this amount is routinely purchased for SNL/NM facilities. In 1995, the EPA changed the regulations to increase the threshold for aerosol forms of the acid to 25,000 lb, thus dropping SNL/NM below the reporting threshold, and eliminating the need to file a TRI report. However, Sandia Corporation continues to document its toxic chemical use in an annual chemical purchase inventory report. The 1999 report, *Supporting Documentation for the Hazardous Chemical Purchase Inventory, 1999 Reporting Year* (SNL 2000a), lists all purchases of chemicals that would otherwise be subject to TRI reporting. The report also details the facilities and processes that use these chemicals.

New Rulings Under SARA Title III

New Fertilizer Rule
On April 15, 1999, a federal district court reversed EPA's earlier denial of a petition by the fertilizer industry to remove phosphoric acid from the toxic chemical list. EPA has since proposed to delist phosphoric acid.

New Standards for Lead
On August 3, 1999, the EPA issued a proposed rule to lower the reporting thresholds for lead and lead compounds, which are subject to reporting under Section 313 of EPCRA and Section 6607 of the Pollution Prevention Act of 1990.

New Standards for Persistent Bioaccumulative Toxic (PBT) Chemicals
On October 29, 1999, a new EPA ruling was issued to address PBT chemicals, such as dioxin. The stricter standards will lower the threshold for Toxic Release Inventory (TRI) reporting.

TABLE 2-2. 1999 Summary of SARA Title III Toxic Chemical Purchases at SNL/NM

Chemical Name	CAS Number	1997 Usage (lb/yr)	1998 Usage (lb/yr)	1999 Usage (lb/yr)
Aluminum oxide (fibrous forms)	*1344-28-1*	none	2,325	**304**
Catechol (pyrocatechol)	*120-80-9*	none	1,332	**<1**
Dichloromethane (methylene chloride)	*75-09-2*	none	1,025	**571**
Ethylene glycol	*107-21-1*	2,493	2,691	**932**
Hydrochloric acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size)	*7647-01-0*	857	1,035	**343**
Isopropyl alcohol (manufacturing - strong process, no supplier notification)	*67-63-0*	4,566	4,479	**3,439**
Methanol	*67-56-1*	2,461	1,855	**2,028**
Nitric acid	*7697-37-2*	5,117	5,423	**4,186**
N-Methyl-2-pyrrolidone	*872-50-4*	3,897	2,999	**233**
Phosphoric acid	*7664-38-2*	1,542	1,600	**1,225**
Sulfuric acid (acid aerosals including mists, vapors, gas, fog, and other airborne forms of any particle size)	*7664-93-9*	38	30	**52**
TOTAL		20,971	24,794	**13,314**

NOTE: CAS = Chemical Abstract System

Hazardous Chemical Inventory

Chemical inventory tracking also supports compliance with Title V of the Clean Air Act Amendments (CAAA) of 1990. Chemical inventory reports are created from both an inventory of purchased chemicals and Material Safety Data Sheets (MSDSs). Sandia Corporation conducts its hazardous chemical purchase inventory annually to determine hazardous chemical use onsite with the assumption that chemicals purchased are equivalent to chemicals used. Of course, the actual chemical inventory at any given point may be different from the purchase inventory. Table 2-2 presents the results of the 1999 hazardous chemical inventory and compares it to 1997 and 1998 purchases. Table 2-2 lists chemicals historically purchased over 1,000 lb that are on the SARA Title III toxic chemical list.

2.1.3 Resource Conservation and Recovery Act (RCRA)

RCRA regulates the generation, treatment, storage, and disposal of hazardous chemical waste, non-hazardous solid waste, and hazardous or petroleum products stored in underground storage tanks (USTs).

The Hazardous Waste Program at SNL/NM is under the compliance authority of the New Mexico Environment Department (NMED), which regulates both hazardous waste and the hazardous component in radioactive mixed waste (MW). Applicable regulations are listed in Appendix B.

The following bullets describe the status of Sandia Corporation's compliance in 1999 with applicable RCRA requirements.

- **Hazardous Waste –** Hazardous waste is regulated under RCRA "Subtitle C." Hazardous waste generated at SNL/NM is handled by the Hazardous Waste Management Facility (HWMF), which is permitted under Sandia Corporation's RCRA Part B Operating Permit (Table 2-7). The facility also manages any non-hazardous waste that does not meet the waste acceptance criteria at the Solid Waste Transfer Facility (SWTF), or waste that is prohibited from normal landfill disposal. In 1999, the HWMF shipped a total of 104,614 kg of RCRA-regulated hazardous waste including recycled hazardous materials.

- **Solid Waste** – Non-hazardous solid waste is regulated under RCRA "Subtitle D." The SWTF screens, bales, and ships non-hazardous solid waste generated from SNL/NM labs and offices. The SWTF does not accept construction debris, liquids, food service waste, hazardous waste, or chemical waste. The SWTF also serves as SNL/NM's central recycling center (primarily paper and cardboard). In 1999, the facility handled 1,328,997 kg of solid waste and 604,275 kg of recycled paper and cardboard. About 60 percent of the total recyclables were received from outside agencies: DOE field offices, Los Alamos National Laboratory (LANL), Lovelace Respiratory Research Institute (LRRI), and Kirtland Air Force Base (KAFB). The facility was in full compliance with all New Mexico Solid Waste Regulations in 1999.

- **Environmental Restoration (ER) Sites** – ER sites are being assessed and remediated as required by the Hazardous and Solid Waste Amendments (HSWA) module to RCRA. By the end of fiscal year (FY99), 146 ER sites remained to be addressed at the SNL/NM site. ER sites are listed on Sandia Corporation's RCRA Part B Operating Permit with the exception of the Chemical Waste Landfill (CWL), which is a RCRA Interim Status site. The ER project generated 29,133 kg of RCRA-hazardous ER waste in 1999. Sandia Corporation met all RCRA permit conditions for ER sites in 1999.

- **Underground Storage Tanks (USTs)** – USTs are regulated under RCRA "Subtitle I" and state regulations, which are at least as strict as the federal standards. In 1999, Sandia Corporation operated three registered USTs and met all regulatory requirements.

- **Mixed Waste (MW)** – MW is dually regulated under RCRA and the Atomic Energy Act (AEA) of 1946. A new DOE Order has also been issued adding further requirements on radioactive and MW management: DOE Order 232.1A, *Ocurrence Reporting and Processing of Operations Information* (DOE 1997a). In 1999, a total of 4,234 ft^3 of MW was managed at SNL/NM and 173 ft^3 of MW was shipped from SNL/NM.
  NOTE: Due to the significant weight of the containers, volume is a better way to track MW.

- **Explosive Waste Disposal** – In 1999, Sandia Corporation sent a total of 4,041 kg of explosive waste to be treated at KAFB's Explosive Ordnance Disposal (EOD) site. One offsite explosive waste shipment of 3 kg was sent to Trade Waste Incineration in Illinois. The HWMF does not handle explosive waste.

- **Corrective Action Management Unit (CAMU) –** The CAMU was designed to process, store, treat, and contain contaminated soils generated from ER Project site closures. The bulk of the volume will come from the excavation of the Chemical Waste Landfill (CWL). The CAMU is located next to the CWL and the Radioactive and Mixed Waste Management Facility (RMWMF). The CAMU is permitted under RCRA as a treatment, storage, and disposal (TSD) facility (Table 2-7).

NOTE: A Temporary Unit (TU) next to the CAMU was originally permitted to store waste for up to a year during the completion of the CAMU. However, the TU option was never used.

2.1.4 Federal Facilities Compliance Act (FFCA)

The FFCA, passed on October 6, 1992, established requirements for all federal facilities with respect to treatment and storage of mixed waste (MW). The FFCA amended RCRA and the HSWA to include MW under hazardous waste requirements. Previously, federal facilities had been granted sovereign immunity from MW compliance. The FFCA requires DOE to meet RCRA's Land Disposal Restrictions (LDRs) for MW and implements a one-year maximum time limit for onsite storage. The FFCA is implemented by the state under the New Mexico Hazardous Waste Act (20 NMAC 4.1).

In 1999, two MW shipments were made from SNL/NM. A total of 2.1 ft^3 (0.06 m^3) of organic liquid was shipped to Perma-Fix/DSSI for incineration and 148.4 ft^3 (4.2 m^3) of inorganic and organic debris was shipped to Envirocare in Utah for macroencapsulation.

2.1.5 Atomic Energy Act (AEA)

The AEA was passed in 1946 to encourage the development and use of nuclear energy for general welfare, common defense, and security. The Act created the Atomic Energy Commission (AEC), which in essence put the control of atomic energy in civilian hands rather than military hands. The AEC later split into the Nuclear Regulatory Commission (NRC) and the Energy Research and Development Administration (ERDA). In 1977, ERDA became the DOE.

The purpose of the AEA is to assure the proper management of nuclear materials and radioactive waste. The AEA, as amended, delegates the control of nuclear energy and nuclear materials primarily to DOE, NRC, and EPA. Although federal regulations control radioactive emissions and the transport of nuclear materials, there are no federal regulations controlling the storage and handling of radioactive waste. At SNL/NM, this authority is retained by DOE and is governed by DOE Orders. In 1999, DOE Order 435.1, *Radioactive Waste Management* (DOE 1999b), replaced DOE Order 5820.2a.

2.1.6 Clean Air Act (CAA) and CAA Amendments (CAAA) of 1990

The objectives of the CAA and the CAAA are to protect and enhance the quality of the nation's air. The EPA is responsible for describing and regulating air pollutants from stationary and mobile sources, as well as setting ambient air quality standards. The City of Albuquerque locally administers these standards as well as specific air emission permits and registrations as shown in Table 2-7.

Ambient Air Quality

The City of Albuquerque announces air quality alerts requesting voluntary or mandatory compliance. *Yellow alerts* request voluntary cooperation to limit driving and burning. *Red alerts* are mandatory "No-Burn Periods," and request a voluntary "non-driving day." Sandia Corporation honors these notices by not performing any open burns or detonations during yellow or red alerts. The City of Albuquerque reported one exceedence in ambient air quality standards in 1999 when the federal ozone standard of 0.08 ppm was exceeded for the first time. In 1999, Sandia Corporation had 100 percent compliance with CAA and CAAA as determined by recorded monitoring at its six ambient air quality surveillance stations.

National Emission Standards for Hazardous Air Pollutants (NESHAP)

NESHAP regulates radioactive releases to the air. Subpart H of 40 CFR 61 specifically regulates radionuclide emissions, other than radon, from DOE facilities. As required by the regulation, Sandia Corporation calculates an annual dose assessment to evaluate radioactive air emissions with respect to potentially exposed members of the public. The regulation requires that Sandia Corporation determine the maximum possible dose that could be received for a hypothetical individual living at an onsite location 24 hours per day. A similar calculation is made for an individual living offsite at the point of maximum dose. The result is the effective dose equivalent (EDE) to the maximally exposed individual (MEI). The dose is compared to the EPA standard of 10 mrem/yr allowed for total radioactive air emissions from a DOE facility.

In 1999, the onsite MEI was located at the Kirtland Underground Munitions Storage Complex (KUMSC) just north of Tech Area V. The dose received at this location was 0.000850 millirem per year (mrem/yr) or 0.00000850 millisieverts per year (mSv/yr). The offsite MEI was located at the KAFB Eubank Gate. The dose at this location was 0.00021 mrem/yr or 0.0000021 mSv/yr. Both doses are a magnitude of four below the maximum standard (10,000 times less). Sandia Corporation was in full compliance with NESHAP and DOE 5400.5 air quality requirements in 1999.

2.1.7 Clean Water Act (CWA)

The CWA sets forth goals to protect U.S. surface waters by controlling the discharge of pollutants. As it pertains to SNL/NM, the CWA applies to sanitary and septic system wastewater effluents, storm water runoff, and surface water discharges. The CWA is implemented through local, state, and federal water quality standards: (1) the City of Albuquerque administers sanitary sewer discharges based on federal pretreatment standards; (2) the New Mexico Environment Department (NMED) administers regulations concerning surface discharges; and (3) the EPA retains oversight over storm water discharges and mandates requirements for oil storage and secondary containments.

City of Albuquerque Sewer Discharge Regulations

There are six wastewater monitoring stations at SNL/NM permitted by the City of Albuquerque. Four of these stations, or outfalls, discharge directly to the City of Albuquerque sewer; two other stations are located upline of the general outfalls and are categorical pretreatment stations. One categorical pretreatment station, however, was discontinued in 1999 after several years of being inactive.

In 1999, there was one instance of a discharge over the permit limits. Fluoride exceeded the permit limit in a split sample between the City of Albuquerque and Sandia Corporation in December 1999. The measured fluoride level was 68.6 mg/L as compared to the permit limit of 36 mg/L. No fines were assessed by the City of Albuquerque for the one-day violation. Table 2-8 lists permit violations that occurred in 1999.

National Pollutant Discharge Elimination System (NPDES)

NPDES implements the requirements that are specific to all discharges made to "Waters of the U.S.," as defined in the CWA. At SNL/NM, this is applicable to storm water runoff from any point that can drain to the Tijeras Arroyo. In 1999, five storm water samples were collected from the two permitted stations. Analysis results indicated several metals over the benchmark values. However, results remain inconclusive due to the small number of data points over the last several years (one storm water event in both 1997 and 1998) as well as the contribution of naturally occurring metals in the sediment (total sample). The igneous and metamorphic rocks comprising the mountains to the east of KAFB are made up of minerals that are naturally high in metals such as magnesium, iron, zinc, and aluminum. As more data becomes available, meaningful results will become more apparent. Section 6.3 discusses Sandia Corporation's 1999 storm water results.

The EPA conducted an inspection of the Storm Water Monitoring Program at SNL/NM on July 15, 1999. The recommendations generated from this inspection are also discussed in Section 6.3.

Surface Water Discharge
Surface discharges made to the ground or to containments must be first evaluated for compliance with regulations implemented through the New Mexico Water Quality Control Commission (NMWQCC). Sandia Corporation issued 28 one-time surface discharge permits in 1999. Additionally, two evaporation lagoons in Tech Area IV are permitted by the state due to the routine nature of the discharges. The lagoons are used to contain and evaporate accumulated storm water pumped from the secondary containments around seven oil tanks, which support the pulsed power accelerators. All permit conditions for the two lagoons were met in 1999.

In 1999, there were two inadvertent surface releases of petrochemicals that were reported as occurrences and reviewed by the Surface Discharge Program (Section 2.4). Both spills were less than two gallons each and there was no discernable impact to the environment.

2.1.8 Safe Drinking Water Act (SDWA)

The SDWA, passed in 1974 and amended in 1986 and 1996, sets national standards for drinking water sources. (The regulation focuses on surface water sources but includes a few provisions for groundwater.) SDWA standards are designed to protect human health by regulating the allowable amount of chemicals, metals, radionuclides, bacteria, and other potential pollutants in potable water sources. Discharges from residential, municipal, and industrial sources are closely monitored and regulated to prevent contamination of drinking water sources. All drinking water systems in the U.S. must be routinely tested to ensure that the water meets EPA's National Drinking Water Standards.

The SDWA addresses three areas:

- Threshold contaminant levels,
- Treatment techniques to remove certain contaminants, and
- Monitoring and reporting requirements.

Drinking Water Supply at SNL/NM
Potable water for most facilities on KAFB (including SNL/NM) is provided by the KAFB Water System. The system derives its water from deep groundwater wells (see Chapter 7). KAFB's water utility operates under EPA identification number NM3567701 and serves approximately 30,000 people who live and work on KAFB. KAFB routinely samples its water for trihalomethanes, coliforms, volatile organic compounds (VOCs), gross alpha and gross beta radioactivity, and various inorganic chemicals.

Information on the KAFB Water System is located at EPA's SDWA website, which details the compliance status for all drinking water systems in the U.S.:

http://www.epa.gov/enviro/html/sdwis/sdwis_query.html//geography

In August 1999, the KAFB Water System was assessed and found to contain elevated levels of coliform bacteria. Coliforms are bacteria that are naturally present in the environment and are used as an indicator for the presence of other potentially-harmful bacteria. The EPA has not set a maximum contaminant level (MCL) for coliform bacteria.

Drinking Water Wells at Remote SNL/NM Sites
There are several remote water delivery systems and wells used to supply drinking water to remote test areas used as SNL/NM facilities (e.g., Coyote Canyon and the 6000 Igloo Complex). These Non-Transient, Non-Community (NTNC) water systems are regulated by NMED. Sandia Corporation samples for coliforms, lead, and copper. Sandia Corporation was in full compliance with drinking water regulations in 1999.

2.1.9 Toxic Substances Control Act (TSCA)

TSCA addresses the import, export, use, and disposal of specifically listed toxic chemicals. As it applies to SNL/NM, compliance with TSCA primarily involves the handling and disposal of polychlorinated biphenyls (PCBs) and asbestos. TSCA waste and recyclables are handled and shipped by the Hazardous Waste Management Facility (HWMF). Sandia Corporation was in full compliance with TSCA in 1999.

PCB – In 1999, the HWMF shipped 176 kg of PCB waste for disposal and 4,168 kg of PCBs for recycling.

Asbestos – In 1999, the HWMF shipped 202,162 kg of asbestos waste for disposal. Asbestos waste was up significantly from last year with an 85 percent increase due to demolition and renovation activities.

2.1.10 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA regulates the use of pesticides and is enforced under the New Mexico State Pesticide Control Act. Sandia Corporation's Biological Control Activity includes compiling information on pesticide use at SNL/NM, including the use of herbicides for weed control, rodenticides for control of mice and other rodents, and insecticides for control of insect pests. Sandia Corporation contracts with commercial certified pesticide companies who use EPA-registered and approved products. Sandia Corporation was in full compliance with FIFRA in 1999.

2.1.11 National Environmental Policy Act (NEPA)

NEPA applies to federal government agencies and any private entities that are performing federally-sponsored projects. NEPA requires federal agencies, including DOE, to analyze potential impacts to the environment from their proposed actions. If the proposed action is potentially "significant," the agency must prepare an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) before the project proceeds. Although a major intention of NEPA is to preserve the environment for future generations, the law does not mandate environmental protection per se—it only ensures that federal agencies make informed decisions and are aware of the environmental impacts of their projects. NEPA mandates that the decision process be open for public review.

1999 NEPA Documentation
During 1999, Sandia Corporation submitted a total of 53 NEPA Checklists to the Department of Energy's Kirtland Area Office (KAO) for review and determination of whether an EA or an EIS would be required. Of these, one checklist was for the Kauai Test Facility (KTF) and two were for the Tonopah Test Range (TTR). EISs and EAs that were under development or completed in 1999 are as follows:

- DOE/EIS-0281 – *Sandia National Laboratories/New Mexico Final Site-Wide Environmental Impact Statement (SWEIS).* Final version issued November 2, 1999. Record of Decision (ROD) issued December 6, 1999 (DOE 1999a).

- DOE/EA-1264 – *Environmental Assessment Rapid Reactivation Project.* This project provided for an increase in manufacturing of neutron generators at the Neutron Generator Facility (NGF) and related activities at other SNL/NM facilities. The EA was under preparation in 1998 and completed in April 1999. A Finding of No Significant Impact (FONSI) was issued on February 11, 1999 (DOE 1999c).

SWEIS

The Site-Wide Environmental Impact Statement (SWEIS) describes SNL/NM's operations, processes, site characteristics, and potential operational impacts. The SWEIS was prepared for DOE by an external contract company in coordination with Sandia Corporation (DOE 1999a). Sandia Corporation prepared two supporting documents that have been incorporated into the SWEIS by reference that describe SNL/NM's facilities and environmental information:

- *Facility and Safety Information Document (FSID)* (SNL 1999a), and
- *Environmental Information Document (EID)* (SNL 1999b).

In addition, there were 20 U.S. Air Force Environmental Checklists (AF-813 forms) submitted for projects on KAFB property. Six of these projects required an Air Force EA as follows:

- AF 99-002 – *Request for a Five-year Land Use Permit for a High Purity Geranium (HPGe) Sensor Laboratory Located in the Manzano Storage Complex.*
- AF 99-007 – *Proposed Modification to Support SNL/NM Defense-Related Research at the Systems Research Remote Facility (9990 Complex).*
- AF 99-010 – *Addition of Administrative Office Space at the 6000 Igloo Area Complex.*
- AF 99-014 – *Environmental Assessment (EA) Sandia National Laboratories, New Mexico FY 1999-2000 Ecological Program.*
- AF 99-019 – *Advanced Laser Imaging Test Project.*
- AF 99-023 – *Construction of Laser Tracker Access Road.*

2.1.12 Endangered Species Act (ESA)

ESA applies to both private individuals and federal agencies (Section 7 of ESA specifically applies to federal agencies). At SNL/NM, ESA compliance is coordinated with National Environmental Policy Act (NEPA) compliance. The law ensures that any action authorized, funded, or carried out by a federal agency will not jeopardize the continued existence of a "threatened or endangered species," or result in adverse modifications to its habitat.

Sensitive Species

The term "sensitive species" includes federally-listed and state-listed "threatened or endangered species," "candidate species" for listing, species listed by other federal agencies, and species protected under other laws and regulations, such as the Migratory Bird Treaty Act. (See shaded box on the next page.)

Prior to Sandia Corporation beginning any proposed action that may potentially affect sensitive species or habitats, a NEPA Checklist is submitted to KAO for a determination. As it is applicable, KAO must confer with the following agencies:

- U.S. Fish and Wildlife Service,
- New Mexico Game and Fish Department,
- New Mexico Energy, Minerals, and Natural Resources Department, and
- U.S. Forest Service.

If potentially significant impacts to "sensitive" species or habitat could result from an agency's proposed action, an EA or an EIS must be prepared.

Wildlife

There are several federally-listed threatened, endangered, and sensitive species that have the *potential* to occur in Bernalillo County as shown in Table 2-3. Several threatened and endangered species occur in Bernalillo County, but are not found within KAFB. These include the whooping crane (*Grus americana*), Southwest willow flycatcher (*Empidonax traillii extimus*), and Rio Grande silvery minnow (*Hybognathus amarus*). Two threatened species, occurring in Bernalillo County, but not observed on KAFB, include the bald eagle (*Haliaeetus leucocephalus*) and Mexican spotted owl (*Strix occidentalis*). A proposed threatened species that occurs in Bernalillo County is the mountain plover *(Charadrius montanus)*; however, this bird has not been observed on KAFB. There are currently two state-listed threatened species that have the potential to occur on KAFB. These include the gray vireo *(Vireo vicinior)* and spotted bat *(Euderma maculatum)*. The spotted bat does not currently occur on KAFB, however the gray vireo has been observed on KAFB. Two state-listed threatened species have the potential of being transients through KAFB. These include the Bell's vireo *(Vireo bellii)* and Baird's sparrow *(Ammodramus bairdii)*.

Plants

There are no plant species that are currently listed as endangered by the New Mexico Forestry and Resource Conservation Division that are known to occur on KAFB. Only one sensitive (List 2) plant species, the Santa Fe milkvetch (*Astragalus feensis*), has been recorded. For more information on sensitive plants and animals in New Mexico, visit the New Mexico State Wildlife Agency website:

http://www.gmfsh.state.nm.us/

The *Environmental Information Document (EID)* (SNL 1999b), a supplementary document to the *Site-Wide Environmental Impact Statement (SWEIS)* (DOE 1999a), includes a section on biological resources. The management of sensitive species and habitat is also discussed in the *Environmental, Safety, and Health (ES&H) Manual*, "NEPA, Sensitive Species, and Historic Properties" (SNL 1999c).

Migratory Bird Treaty Act

In addition to the special consideration afforded to species listed as threatened and endangered, or sensitive, most birds are protected under the Migratory Bird Treaty Act. At SNL/NM, construction sites are surveyed prior to digging or earth movement to avoid possible impacts to nesting birds, such as the Western burrowing owl, which may cohabitate in prairies dog towns.

2.1.13 Cultural Resources Acts

The three primary cultural resources acts applicable at SNL/NM are as follows:

- National Historic Preservation Act (NHPA);
- Archaeological Resources Protection Act (ARPA); and
- American Indian Religious Freedom Act (AIRFA).

At SNL/NM, cultural resources compliance is coordinated through the NEPA Program. Actions that could adversely affect cultural resources are initially analyzed in a NEPA Checklist.

TABLE 2-3. Threatened, Endangered, and Sensitive Species Potentially Occurring in

Bernalillo County, New Mexico

Species		Federal Status	State Status
MAMMALS			
Black-footed ferret	*Mustela nigripes*	Endangered	--
FISH			
Rio Grande silvery minnow	*Hybognathus amarus*	Endangered	Threatened
BIRDS			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	--
Mountain plover	*Charadrius montanus*	Proposed Threatened	--
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Threatened
Whooping crane	*Grus americana*	Endangered	Endangered

NOTE: There are no listed endangered, threatened, or proposed plant, reptile, or amphibian species in Bernalillo County.

Historical properties, as defined by NHPA and implementing regulations, include archeological sites and historic buildings and structures. Historic buildings and structures may include those over 50 years old that are significant, or younger structures of exceptional significance associated with historical events such as the Cold War. Sandia Corporation and DOE have begun assessments of potentially historic buildings and structures from these periods. Sandia Corporation's activities are usually planned to avoid potential impacts to such sites. There are no known archeological sites located on DOE-owned property, although cultural and historic sites do exist in proximity to DOE-leased property and ER sites. These areas are located both on Air Force land and on portions of Cibola National Forest land withdrawal. It is the responsibility of the Air Force or the U.S. Forest Service to ensure that cultural resources are not adversely impacted by tenant agencies such as DOE.

The EID provides information on cultural resources at KAFB. Cultural resources compliance is discussed in the *ES&H Manual*, “NEPA, Sensitive Species, and Historic Properties” (SNL 1999c).

Historical Building Assessment

In 1999, information was prepared to assist DOE in determining whether buildings in Tech Area I are eligible for the National Register of Historic Places as required under NHPA. There are 81 buildings in Tech Area I of greater than one thousand square feet that were built or acquired before 1990. These buildings have been documented on State of New Mexico Historic Building Inventory forms. Of the 81 buildings evaluated, 21 were noted as being of historic interest, either individually or as contributing elements of a district. DOE will determine eligibility of Tech Area I buildings to the National Register in consultation with the New Mexico State Historic Preservation Officer.

2.1.14 Executive Orders (EOs)

There are two EOs related to environmental compliance that are coordinated through the NEPA Program.

Floodplain Management, EO 11988 – This Order has minimal impact for SNL/NM, since all active SNL/NM facilities are located outside the 500-year floodplain as described by the U.S. Army Corps of Engineers (ACE 1979). This applies to both the Tijeras Arroyo and Arroyo del Coyote.

Protection of Wetlands, EO 11990 – Wetlands are areas inundated by surface or groundwater with a frequency to support a prevalence of aquatic plant and/or animal life. Wetlands generally include swamps, bogs, potholes, ponds, mudflats, and areas around natural springs. There are several natural springs on KAFB with a limited wetland setting. These springs, located on Air Force land and the withdrawn area, are managed by the Air Force and the U.S. Forest Service. The springs provide an important source of drinking water for wildlife as well as create a unique biological niche in an otherwise arid habitat.

2.1.15 Department of Energy (DOE) Orders

There are three primary DOE Orders that pertain to environmental protection and management. These are:

- DOE Order 231.1, *Environment, Safety, and Health (ES&H) Reporting* (DOE 1996a);
- DOE 5400.1, *General Environmental Protection* (DOE 1990); and
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993).

In 1999, Sandia Corporation met all requirements stated in these orders.

2.2 CURRENT COMPLIANCE ISSUES AND ACTIONS

Environmental issues and actions current in 1999 relating to non-compliance or corrective actions at SNL/NM are discussed below.

- **Mixed Waste (MW) Management** – Although, Sandia Corporation is in compliance with the Federal Facilities Compliance Act (FFCA), the issue of compliance with regard to RCRA's Land Disposal Restrictions (LDRs) (RCRA 3004j) remains. The Federal Facilities Compliance Order (FFCO) acknowledges the lack of treatment capacity for MW and allows MW to be stored onsite past the normal one-year time frame mandated by RCRA. As required by the Order, Sandia Corporation has developed MW treatment technologies and has initiated shipments of MW for offsite disposal and offsite treatment (if not already treated at SNL/NM). The first offsite shipment of MW for treatment began in September 1996. Onsite treatment of MW at SNL/NM began in 1997. However, it will be several years before all of the back accumulated MW stored onsite is removed from the inventory through permanent disposal. Table B-2 in Appendix B details the history of Sandia Corporation's MW compliance.

- **Ozone (Smog) Issue** – The ozone monitoring standard for SNL/NM has not yet changed. On May 14, 1999, the U.S. Court of Appeals for the District of Columbia issued an opinion regarding the final National Ambient Air Quality Standards (NAAQS) for ozone, which EPA issued on July 16, 1997. In 1998, the City of Albuquerque requested Sandia Corporation to assist with a study to determine if local levels of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) are limiting for ozone.

- **Particulate Matter (PM) (Soot) Issue** – The EPA issued its final ruling for NAAQS for PM on July 16, 1997. The new ruling required stricter standards for PM, which would have required $PM_{2.5}$ monitoring (particles less than or equal to 2.5 µm). However, on May 14, 1999, the U.S. Court of Appeals for the District of Columbia Circuit issued an opinion regarding EPA's final ruling, overturning the stricter standards. EPA responded on June 28, 1999, by filing a petition to rehear the key aspects of the case. The U.S. Court of Appeals responded to the petition on October 29, 1999 and denied the rehearing. Sandia Corporation does not currently monitor for $PM_{2.5}$ at SNL/NM.

- **40 CFR 68, Subpart G, Risk Management Plan (RMP)** – The CAAA directs the EPA to promulgate regulations for managing highly hazardous materials and preventing accidental releases. In response, the EPA promulgated 40 CFR 68, the Risk Management Program rule, on May 24, 1996. The rule requires owners of facilities or processes that use listed substances in quantities greater than 67,000 lb, to develop and implement risk management programs that incorporate hazard assessment, release prevention, and an Emergency Response Program. This information is to be summarized in an RMP and be submitted to the EPA by June 21, 1999. On May 21, 1999, the EPA published a formal exemption for certain hydrocarbon fuels such as propane. Sandia Corporation evaluated the ruling in 1999 and determined that since it has no regulated substances above a threshold quantity (TQ), an RMP is not currently required.

2.3 1999 AUDITS AND APPRAISALS

Operations at SNL/NM are routinely subjected to audits by external regulatory agencies including DOE. Sandia Corporation also conducts its own self-assessments and appraisals. Audits identify issues that may be positive or negative in nature. A negative issue is reported as a "finding" to denote non-compliance and the need for corrective action. A positive issue is reported as a "noteworthy practice." An "observation" may be positive or negative and does not require follow-on action. Addressing negative issues resulting from audits and appraisals is the responsibility of each program area. The *ES&H Manual* provides requirements for addressing and tracking corrective actions (SNL 2000b). Audits and appraisals conducted by external agencies in 1999 are listed in Table 2-4.

2.4 1999 RELEASES AND ENVIRONMENTAL OCCURRENCES

An occurrence is a problem, concern, failure, malfunction, or a deficiency in equipment, process, procedure, or program. It is also any condition or event that adversely affects, or may adversely affect, DOE or contractor personnel, the public, property, the environment, or DOE's mission, security, or operations. This section describes environmental occurrences.

2.4.1 Occurrence Tracking

Occurrence reporting is tracked by the ES&H and Safety and Security Reporting and Feedback Department. All occurrences at SNL/NM are entered into the Occurrence Reporting Processing System (ORPS) database, which tracks corrective actions and closeouts. Final responsibility for completing corrective actions rests with each affected organization. Table 2-5 presents a five-year history of occurrence reporting status for SNL/NM.

DOE Order 232.1A, *Occurrence Reporting and Processing of Operations Information* (DOE 1997a), establishes a DOE system for identification, categorization, notification, analysis, reporting, follow-up, and close-out of occurrences. DOE notifies appropriate agencies based on the nature of each occurrence.

TABLE 2-4. Environmental Program Audits and Appraisals Conducted in 1999

Appraising Agency	Title	Date	Summary
SNL/NM**	Internal Independent ES&H and Quality Appraisal of Environmental Protection Programs	Apr-May	The Air Quality QAPjP, which is not required, was found deficient. The document was deleted and all program information is now summarized in an Air Quality Program document. Other areas audited included waste management programs. No negative issues were noted.
EPA	NPDES Compliance Inspection, Storm Water Monitoring Station Appraisal	Jul 15	Observations noted the need to include ER sites on the NPDES permit and to add additional storm water monitoring locations in industrial areas and ER sites. Noteworthy observations included excellent management at the Reapplication Yard with respect to storm water runoff. The EPA issued no fines or orders. The Storm Water Pollution Prevention Plan (SWP3) draft is being updated to include EPA's recomendations.
SNL/NM **	Internal ER Audit	Feb 99	No major findings were found or corrective actions required.
EPA and City of Albuquerque	Radionuclide NESHAP, Subpart H Training	Apr 20-22	The RMWMF was inspected; no findings were found.
City of Albuquerque	Wastewater Program, Inspection of Flow Basins*	Apr 28	No negative issues were noted.
NVOO	Radioactive Waste Program, Waste Storage Inspection (including generator sites)	Jun	There was a concern of whether americium-241 was at LLW levels or TRU levels; a follow up in January 2000 confirmed the waste was LLW. All issues were closed out.
DOE/NESP	Nuclear Surety Orders Packaging and Transportation Audit	Mar 1-5	No issues were found with the Hazardous Waste Program.

NOTE: *A "flow basin" describes the buildings that discharge to a central outfall.
**SNL/NM Department 12870, ES&H and Quality Assessments
DOE/NESP = DOE Nuclear Explosive Safety Program
EPA = Environmental Protection Agency
RMWMF = Radioactive Mixed Waste Management Facility
NPDES = National Pollutant Discharge Elimination System
NVOO = U.S. Department of Energy/Nevada Operations Office
QAPjP = Quality Assurance Project Plan
MDL = Microelectronic Development Laboratory
TRU = Transuranic waste
ER = Environmental Restoration
LLW = Low-level radioactive waste

TABLE 2-5. Summary of Environmental Occurrences at SNL/NM in the Past Five Years

Year	Waste Management-Related	Surface Discharge or Water Quality	Air Quality	Other	Total Reportable Releases to the Environment
1999	2	4	1	1	8
1998	4	0	0	0	4
1997	7 (6)	5 (3)	1	0	13 (10)
1996	0	3	0	0	3
1995	2	2	2	0	6

NOTE: The number in parentheses for 1997 represents the incidences for which an occurrence report was prepared.

New Guidance

An internal guidance agreement with KAO was added to the Occurrence Reporting Categorization Matrix to assist the line in determining thresholds in reporting for: (1) electrical shocks, (2) suspicious packages, and (3) near-miss occurrences. The *ES&H Manual,* Chapter 18, "Reporting, Investigating and Correcting ES&H Events," was updated in May 2000 to improve guidance for determining what constitutes an occurrence and the proper reporting procedures (SNL 2000c). Sandia Corporation's notification and communication procedures are given in the SNL/NM Emergency Plan (SNL 2000d). The plan also describes SNL/NM's major facilities and hazards and potential chemical releases. In addition to Sandia Corporation and DOE, the plan is distributed to City of Albuquerque emergency response officials, the State of New Mexico's Department of Public Safety, the KAFB's Fire Department, and other KAFB officials. DOE Order 151.1, *Comprehensive Emergency Management System*, provides the requirements for the SNL/NM Emergency Plan (SNL 1996b).

Emergency Preparedness at SNL/NM

Emergency planning notification, as required by EPCRA, facilitates emergency response and preparedness capabilities through better coordination and planning with state and local authorities.

Sandia Corporation conducts routine emergency drills and an annual full-scale "General Emergency" exercise to simulate a release or event with offsite impacts. These events are conducted through the Emergency Operations Center (EOC) and may involve full participation from the KAFB Fire Department, hazardous materials (HAZMAT) teams, and local hospitals.

Emergency exercises test Sandia Corporation's ability to quickly coordinate a response and function efficiently with other emergency response agencies. Of key importance is the ability to quickly characterize the level of emergency and to make proper notifications to DOE, city, state, and Indian Pueblo authorities in a timely manner. The ability to disseminate accurate and timely news reports to local media are handled by the Joint Information Center (JIC).

Occurrence Categories

Emergency Occurrence	Unusual Occurrence	Off-Normal Occurrence
An "Emergency Occurrence" describes any actual or potential release of material that would put communities or the environment in great harm. There are three levels of emergency occurrences—Alert, Site Area, and General Emergency. A General Emergency would describe a release going beyond Sandia Corporation property or a very significant onsite event. All state and federal agencies would be immediately contacted after the occurrence was categorized. There has never been an "Emergency Occurrence" of any level at SNL/NM.	An "Unusual Occurrence" includes CERCLA reportable quantity (RQ) releases and other more significant events based on quantities released or damage incurred. All releases in this category are reported to outside state or federal agencies and DOE. DOE must be notified as soon as practical, but within two hours of occurrence categorization.	An "Off-Normal Occurrence" is an unplanned release that adversely affects the environment. An occurrence in this category does not exceed federal limits, involve personal injury, or result from the violation of safety and operational rules. Almost all historical occurrences at SNL/NM fall into this category.

Occurrence Categories

There are three types of environmental occurrences, each of which is determined by the severity of the event as described in the shaded box on the previous page. All significant releases in the first two categories are reportable to outside state and federal agencies and DOE immediately upon occurrence categorization. An occurrence can also be incurred as the result of an audit finding or other break in permit compliance and/or official agreement.

2.4.2 1999 Occurrences

There were eight environmental occurrences in 1999.

1. **Hazardous Waste Audit** – On April 6, 1999, Sandia Corporation received a letter of violation from NMED as a result of findings in the 1998 audit of the Hazardous Waste Program (May 5 to June 3). Because the letter was received in 1999, it resulted in a 1999 occurrence report. Three violations were identified including a failure to perform a hazardous waste determination, a failure to add an accumulation start date, and improper storage or treatment of a hazardous waste. All violations were immediately corrected.

2. **Sanitary Sewer Line Break** – On May 27, 1999, a contract construction worker broke through an 8-inch sanitary sewer line while excavating an area for the installation of a new sanitary sewer manhole. Approximately 65 gal of sewage were discharged into the hole. The sewer line was repaired and the area was cleaned up.

3. **Acid Leak into Secondary Containment** – On June 14, 1999, during a routine equipment and facility check at the Microelectronics Development Laboratory (MDL), a worker discovered acid leaking from the bulk hydrochloric acid (HCl) tank. Approximately 1,200 gal of a 37 percent HCl solution collected in the tank's secondary containment (6,000 gal capacity). The acid was removed and disposed of as hazardous waste. The direct cause of the leak was found to be a valve failure; however, after a thorough inspection of the entire system, it was determined that all piping and valves needed to be replaced with an upgraded material (polypropylene-lined cast steel) to prevent a similar reoccurrence. The components were replaced and the system was returned to normal operation within six weeks.

4. **NEPA Violation** – On June 18, 1999, during the replacement of a high-voltage utility pole on Coyote Springs Road, two unauthorized soil disturbance activities were reported by the U.S. Forest Service. The project area was located within 200 ft of a designated archeological site on the Air Force land withdrawal leased from the U.S. Forest Service. Project personnel had obtained prior NEPA approval for the soil disturbance activity (drilling a new hole), but exceeded the scope of the approval by also grading a road and constructing a 30 by 70 ft work pad. A subsequent inspection by DOE, Sandia Corporation, the Air Force, and the U.S. Forest Service found pottery shards in the area of disturbance. As a consequence, the Air Force agreed to perform a thorough cultural survey of the area. Sandia Corporation has since implemented more effective project planning procedures to include reviewing historical site maps and conducting site visits prior to work authorization. Additionally, Sandia Corporation agreed to provide more NEPA awareness training to both personnel preparing NEPA Checklists and to personnel working in environmentally sensitive areas.

5. ***Gamma Irradiation Facility (GIF) Pool Leak*** – On June 28, 1999, KAO notified Sandia Corporation that they had submitted a Release/Discharge Notification to NMED regarding water loss at the Gamma Irradiation Facility (GIF) pool. The 13,000-gallon pool is used to store fuel elements from the Annular Core Research Reactor (ACRR) and for gamma sources used in two irradiation cells at the facility. The pool water is tested weekly for radioactive contamination and has shown no radiation above background levels. The only radionuclide detected in the water is tritium, which is at very low levels (a factor of 10 below EPA drinking water standards). Typically, 10 to 15 gal of water are lost daily from the pool due to evaporation. However, facility personnel found that the makeup water needed to retain the level of the tank was greater than the expected loss through evaporation (0.5 gal/hr, 12 gal/day). No impact to the environment from the water loss was noted but surveillance of the pool's water level remains a high priority at the facility.

Coyote Springs Road Grading

On Jun 7, 1999, a grader operator, while performing routine road maintenance along Coyote Springs Road, impacted a portion of a wetland area (approximately 18 ft^2). In the follow-up investigation, another section in the Coyote Springs area right-of-way was also found to be widened as a result of maintenance activities. However, after comparing old aerial photos of the area with the current road dimensions and conducting interviews with long-term road maintenance contractors, it was determined that the road was not graded beyond the right-of-way boundaries. The delineation of the wetland was not clear at the time of the initial occurrence report. This incident, once investigated, was not considered an occurrence.

6. ***Follow-on to GIF Pool Leak*** – On September 3, 1999, a significant increase in the amount of makeup water needed at the GIF pool was identified. The GIF pool was placed in routine shutdown mode to determine if the cause was due to the existing leak discussed above (#5) or a new leak. The apparent loss rate, as indicated by the computer controlled water addition system, showed that the GIF pool was losing 1 gal/hr above the estimated 0.5 gal/hr lost from evaporation (total of 36 gal/day). GIF operations were suspended and a long-term corrective action plan was developed. A study on September 8th showed the leakage rate to be about 0.6 gal/hr. As of September 15th, the loss through leakage had dropped to 0.5 gal/hr (total of 24 gal/day). A GIF Risk Mitigation Plan was submitted to DOE on Oct 8, 1999.

7. ***Sodium Metal Fire*** – On August 14, 1999, smoke was observed coming from a container located at ER Site 117 (near Bldg. 9939) east of Tech Area III. Sandia Corporation and KAFB emergency response personnel were notified. The content of the container was sodium metal, which had been rained on that day causing the reaction. Response personnel determined that the resultant smoke plume did not present a danger to personnel or others in the surrounding area since the plume remained isolated. The metal was removed and disposed of as hazardous waste.

8. ***Release of Hydraulic Oil*** – On October 28, 1999, a leak of approximately 1 to 2 gal of hydraulic oil was reported at the Reapplication Yard. The oil came from residual fluid left in uncapped hoses of a hydraulic lift, which had been removed from a vehicle. The oil-contaminated soil was removed and disposed of as hazardous waste. There was no discernable impact to the environment.

2.5 SUMMARY OF REPORTING REQUIREMENTS

External reporting requirements (other than to DOE) are necessary for both non-routine and routine releases of pollutants or hazardous substances. Release information may be used to evaluate facility operation compliance, waste handling programs, and emergency response programs. Table 2-6 summarizes the three primary reporting requirements for releases applicable to SNL/NM.

2.6 SUMMARY OF ENVIRONMENTAL PERMITS

Table 2-7 lists all environmental permits and registrations that were in effect in 1999. This includes permit applications that are pending and are under review by various agencies. Table 2-8 list permits for which standards were exceeded or otherwise violated in 1999.

TABLE 2-6. Summary of Sandia Corporation's Reporting Requirements to Outside Agencies Other than DOE

Report Title	Description	Agency
Annual NESHAP Dose Assessment Report	A dose assessment of the calculated effective dose equivalent (EDE) to the maximally exposed individual (MEI) is based on the assumption that an exposed individual resides 24 hours per day at an area of highest incident radiation. Dose assessment is discussed in Section 5.4 of this report.	EPA 40 CFR 61, Subpart H
Reportable Quantity (RQ) Accidental Release Reporting	RQ release reporting is required by CERCLA and SARA Title III, or EPCRA. CERCLA and EPCRA are discussed in Section 2.1.1 and 2.1.2 of this report. There were no RQ releases at SNL/NM in 1999.	NRC
Toxic Release Inventory (TRI) Report	EPCRA, Section 313, (40 CFR 372) requires a TRI report to be filed by facilities conducting specifically listed industrial activities and using listed toxic chemicals. As discussed in Section 2.1.2, Sandia Corporation is not currently required to submit a TRI report because its chemical use it below the reporting threshold.	EPA

NOTE: NESHAP = National Emission Standards for Hazardous Air Pollutants
NRC = National Response Center
EPCRA = Emergency Planning and Community Right-to-Know Act
EPA = Environmental Protection Agency

TABLE 2-7. Summary of Environmental Permits and Registrations in Effect During 1999

Permit Type and/or Facility Name	Location/Building	Permit Number	Issue Date	Expiration Date	Regulatory Agency
SEWER WASTEWATER					
General	WW001 Station Manhole, south of Tech Area IV at Tijeras Arroyo	2069 A-5	1/3/00	6/30/03	City of Albuquerque
General	WW006 Station Manhole, at Pennsylvania Ave.	2069 F-5	1/3/00	6/30/03	City of Albuquerque
Microelectronics Development Laboratory (MDL)	WW007 Station Manhole, Bldg. 858 in Tech Area I	2069 G-4	7/1/98	5/31/02	City of Albuquerque
General	WW008 Station Manhole, south of Tech Area II at Tijeras Arroyo	2069 I-4	1/24/00	1/31/04	City of Albuquerque
General	WW011 Station Manhole, north of Tech Area III (includes Tech Areas III and V, and Coyote Test Field sewer lines)	2069 K-3	7/1/98	2/28/02	City of Albuquerque
SURFACE DISCHARGE					
Pulsed Power Development Facilities (Discharge Plan) (first issue -1988)	Tech Area IV, Lagoons I and II	DP-530 (revised in 1999)	11/16/99	2/24/00	NMED
UNDERGROUND STORAGE TANKS					
9,730 gal emergency generator fuel	Bldg. 862	06383	7/1/99	6/30/00	NMED, UST Bur.
20,000 gal oil storage tank	Bldg. 888	06384	7/1/99	6/30/00	NMED, UST Bur.
20,000 gal oil storage tank	Bldg. 888	06385	7/1/99	6/30/00	NMED, UST Bur.
STORM WATER					
National Pollution Discharge Elimination System (NPDES) "Multi-sector General" Permit	Storm water discharges from Stations 4 and 5	NMR05A181	8/97	9/30/00	EPA
Storm Drain, Sanitary Sewer, and Domestic Water System Modernization (SSWM)	9th and 20th Street realignment area	NMR10B507	6/29/99	6/31/03 (estimated date)	EPA
NPDES Construction Permit	Tech Area I, Processing and Environmental Technology Laboratory (PETL)	NMR10B434	5/14/98 (Notice of Intent)	4/30/00 (estimated date)	EPA
ECOLOGICAL					
Permit to take or band birds Bird banding is conducted under a permit granted to Los Alamos National Laboratory (LANL)	Site-Wide Ecological Monitoring Activity	22783 (LANL permit)	4-30-98	6-30-2000	New Mexico Department of Game and Fish
New Mexico Department of Game and Fish for Scientific/Educational Purposes Authorization for Taking of Protected Wildlife	Site-Wide Ecological Monitoring Activity	2931	1/1/99	12/31/99	New Mexico Department of Game and Fish

NOTE: NMED = New Mexico Environment Department
EPA = U.S. Environmental Protection Agency

TABLE 2-7. Summary of Environmental Permits and Registrations in Effect During 1999 (Continued)

Permit Type and/or Facility Name	Location/Building	Permit Number	Issue Date	Expiration Date	Regulatory Agency
RCRA					
RCRA Part B Operating Permit for the Hazardous Waste Management Facility (HWMF) Module I - General Permit Conditions Module II - General Facility Conditions Module III - Containers	HWMF , Tech Area II, Bldgs. 958 and 959 (No treatment performed at the HWMF)	NM5890110518-1	8/6/92	08/06/02	NMED
RCRA Part B Operating Permit Module IV - Hazardous and Solid Waste Amendments (HSWA) Portion for Solid Waste Management Units (SWMUs)	ER Sites	NM5890110518-1	8/26/93	9/20/02	NMED
Thermal Treatment Facility (TTF) Module I - General Permit Conditions Module II - General Facility Conditions Module III - Containers	TTF, Tech Area III, Bldg. 6715 (Treatment of explosive waste)	NM5890110518-2	12/4/94	12/4/04	NMED
Class III Permit Modification for the Management of Hazardous Remediation Waste in the Corrective Action Management Unit (CAMU), Tech Area III Modification to Part B Operating Permit	CAMU, Tech Area III Treatment will start after excavation of Chemical Waste Landfill (CWL)	NM5890110518	9/97	6/03	NMED
RCRA Part A and B Permit Applications for Hazardous Waste Management Units for the hazardous component in mixed waste (MW) stored at three radioactive waste storage areas. (Interim status in effect; state has not yet requested Part B for submittal due to time constraints reviewing other site applications.)	RMWMF (Bldgs. 6920, 6921, and 6925) (MW treatment performed at RMWMF) 7 Manzano Bunkers High Bay Tech Area V, Bldg. 6596	NM5890110518	Interim status first submitted 8/90; Rev. 3, 11/96	Pending Review* (No expiration date; permit will be revised in 2001)	NMED

NOTE: *Submitted and awaiting agency review.

TABLE 2-7. Summary of Environmental Permits and Registrations in Effect During 1999 (Concluded)

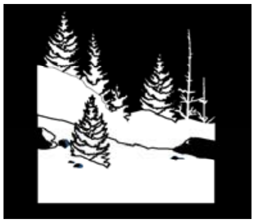
Permit Type and/or Facility Name	Location/Building	Permit Number	Issue Date	Expiration Date	Regulatory Agency
Open Burn Permits					
Thermal Treatment Facility (permit must be submitted within 30 days of receipt)	Bldg. 6715	76-OB-2-1999	12/10/98	12/30/99	City of Albuquerque
Fire Extinguisher Fire Training	Off 9th Street	76-OB-4-1999	12/11/98	12/30/99	City of Albuquerque
Burn Site (8 Open Pool Events)	Open Pool	76-OB-1-1999	12/10/98	12/30/99	City of Albuquerque
Burn Site (Bldg. 9830)	Igloo 9830	76-OB-3-1999	12/11/98	12/30/99	City of Albuquerque
Burn Site (8 Open Pool events)	Open Pool	76-OB-1-1999	12/10/98	12/30/99	City of Albuquerque
Wood Crib Fire Tests	Open Ring	76-OB-5-1999	1/12/99	12/30/99	City of Albuquerque
Sled Track – Flyer Plate Testing	800 ft south Sled Track	76-OB-6-1999	3/1/99	5/30/99	City of Albuquerque
Sled Track – Fire Training	10,000 ft Sled Track	76-OB-7-1999	3/1/99	6/30/99	City of Albuquerque
Aerial Cable	Weed maintenance (15 acres)	76-OB-8-1999	3/23/99	9/30/99	City of Albuquerque
Sled Track - Noise Calibration	South end	76-OB-9-1999	8/23/99	12/30/99	City of Albuquerque
AIR (Permits & Registrations)					
Hammermill Facility	Tech Area III, Bldg. 6583	144	08/28/85	Biennial update	City of Albuquerque
Fire Laboratory used for the Authentication of Modeling and Experiments (FLAME)	Burn Site	196	5/19/88	Registration†	City of Albuquerque
Neutron Generator Facility (NGF)	Tech Area I, Bldg. 870	374- MI	7/17/98	Biennial update	City of Albuquerque
W76 Neutron Generator Recertification	Tech Area 1, Bldg. 905	396	5/7/96	Registration†	City of Albuquerque
Standby diesel generators (four)	Tech Area I, Bldg. 862	402 (old 150)	5/07/96	Biennial update	City of Albuquerque
Radioactive & Mixed Waste Management Facility (RMWMF)	Tech Area III, Bldg. 6920	415- M1	11/24/99	Biennial update	City of Albuquerque
Isotope Production Facility (Hot Cell Facility)	Tech Area V, Bldg. 6580	428	7/08/96	Biennial update	City of Albuquerque
Title V Operating Permit	Site-Wide	515 (pending)	Submitted* 3/1/96	Pending (5 yr renewal)	City of Albuquerque
Classified Waste Landfill	Tech Area II, Landfill	560	12/17/96	Biennial update	City of Albuquerque
Classified Waste Landfill	Tech Area II, Landfill	NESHAP	06/96	Approval††	EPA, Region VI
Advanced Manufacturing Processes Laboratory (AMPL)	Tech Area I, Bldg. 878	646	1/23/97	Biennial update	City of Albuquerque
Portable Burn Pools	Burn Site	647	5/5/97	Biennial update	City of Albuquerque
Chemical Waste Landfill -Voluntary Corrective Measure (VCM)	Tech Area III, CWL	648	5/23/97	Registration†	City of Albuquerque
Soil Washing / Soil Stabilization Unit, Corrective Action Management Unit (CAMU)	Tech Area III, CAMU, next to CWL	888	4/20/98	Biennial update	City of Albuquerque
Emergency Generator	Tech Area I, Bldg. 870B	924	5/5/98	Biennial update	City of Albuquerque
Processing and Environmental Technology Laboratory (PETL)	Tech Area I, Bldg. 701	925	5/5/98	Biennial update	City of Albuquerque

NOTE: †Registration = Certificate, no permit required.
†† Approval = EPA does not issue a permit.
*Submitted and awaiting agency review.

TABLE 2-8. Permit Violations in 1999

Permit Number	Permit Type	Date	Type of Violation
2069G-4 (Station WW007)	Wastewater	December 8, 1999	Fluoride exceeded the 36 mg/L standard with a measurement of 68.6 mg/L in a split sample with the City of Albuquerque

Chapter 3



Environmental Programs Information

Environmental programs at Sandia National Laboratories, New Mexico (SNL/NM) are in place to protect the environment and health of its workers and the community. Sandia Corporation has established and implemented environmental management programs to meet or exceed the requirements of federal, state, and local environmental regulations. Executive Orders (EOs) and U.S. Department of Energy (DOE) Orders also serve to guide program criteria. In addition to meeting basic regulatory compliance requirements, Sandia Corporation conducts environmental surveillance to verify that contamination is not accumulating in the ambient environment and to identify potential concerns where they exist.

Environmental program areas covered in this chapter include:

- Environmental Restoration (ER) Project
- Hazardous and Chemical Waste Management
- Radioactive and Mixed Waste Management
- Solid Waste Management
- Biological Control Activity
- Pollution Prevention (P2) Program
- Oil Storage and Underground Storage Tank (UST) Program
- National Environmental Policy Act (NEPA) Program

Surveillance and Effluent Monitoring Programs

In general, surveillance monitoring is the sampling of ambient environmental media, such as soil, sediment, vegetation, groundwater, and air. Effluent monitoring is the direct sampling of waste streams such as wastewater and air emissions. Effluent and surveillance monitoring activities are discussed in Chapters 4, 5, 6, and 7. The specific programs covered in these chapters include: the Terrestrial Surveillance Program, the Ambient Air Quality Program, the Air Quality Compliance Program, the National Emission Standards for Hazardous Air Pollutants (NESHAP) Program, and groundwater monitoring and protection programs for both the ER Project and general site-wide groundwater surveillance monitoring on Kirtland Air Force Base (KAFB).

Commitment to Health and the Environment

It is Sandia Corporation's policy to minimize risks to the public and the environment to "as low as reasonably achievable" (ALARA) levels. For example, Sandia Corporation often exceeds regulatory requirements through Best Management Practices (BMPs) and Pollution Prevention (P2) measures implemented on a corporate-wide basis.

DOE Order 5400.1, *General Environmental Protection Program*, and DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* are the primary DOE Orders that drive Sandia Corporation's environmental programs including those that are not externally regulated (DOE 1990, DOE 1993).

Environmental Monitoring History at SNL/NM

Environmental monitoring began at SNL/NM in 1959, at which time the principal objective was to monitor radioactive effluents and determine any associated environmental impacts. Since then, environmental programs, along with other Environment, Safety, and Health (ES&H) activities, have greatly expanded at SNL/NM.

DOE's "Tiger Teams," which extensively scrutinized ES&H activities at DOE sites in 1990, provided further impetus for the continued development and expansion of ES&H programs.

Tracking Performance and Progress

Environmental progress at SNL/NM is tracked through performance measures and indicators, including annual summaries such as this report. Trends in compliance status and/or other significant program results over the past five years are given where appropriate, and awards and commendations are highlighted, where available.

The ER Project at SNL/NM was officially initiated in 1992 to implement assessment and remediation activities for sites that had been contaminated or potentially contaminated because of Sandia Corporation's past operations. In addition to the Albuquerque, New Mexico site (SNL/NM), other sites included in the original scope of Sandia Corporation's ER Project were Sandia National Laboratories, Livermore, California (SNL/CA), the Kauai Test Facility (KTF), and the Tonopah Test Range (TTR). There were also a number of miscellaneous sites located in other areas both nationwide and internationally.

3.1 ENVIRONMENTAL RESTORATION PROJECT

Sandia Corporation's Environmental Restoration (ER) Project was created under DOE's Office of Environmental Restoration and Waste Management (ER/WM) to identify, assess, and remediate sites potentially contaminated by past spill, release, and disposal activities.

The DOE Kirtland Area Office (KAO) has oversight over Sandia Corporation's ER Project, which is administered under four departments within the Geoscience and Environment Center:

- ER Project Office,
- ER for Tech Areas and Miscellaneous Sites,
- ER for Landfills and Test Areas, and
- Site Closures.

Workers sorting debris in a tent building at the Classified Waste Landfill.

Currently, the only ER sites remaining to be addressed are located at SNL/NM. All other sites have been closed out or transferred to other agencies. All ER sites at SNL/NM are on track to be completed by 2005, ahead of most other installations in the DOE complex. This date, however, may be subject to change based on available funding. Important documents for the ER Project are listed in Appendix C.

3.1.1 Regulations

The remediation and cleanup of areas of past contamination at SNL/NM are regulated by the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments Act of 1984 (HSWA). HSWA requirements apply to all ER sites, or Solid Waste Management Units (SWMUs). Specific requirements for SWMUs are described in Module IV of Sandia Corporation's RCRA Part B Operating Permit. The New Mexico Environment Department (NMED) has adopted the federal regulations by reference. For example, 40 CFR 264, "Standards for Owners and Operators of Treatment, Storage, and Disposal Facilities," (the RCRA regulation for permitted units) is enforced under New Mexico regulation 20 NMAC 4.1, Subpart V. All SWMUs are permitted on Sandia Corporation's RCRA Part B Operating Permit, with the exception of the Chemical Waste Landfill (CWL).

The CWL falls under a different set of regulations because it is a RCRA Interim Status site and is not listed on the Part B Operating Permit. Interim Status sites are regulated under 40 CFR 265, "Interim Status Standards for Owners and Operators of Treatment, Storage, and Disposal Facilities," and enforced by 20 NMAC 4.1, Subpart VI. Per the regulation, a special closure plan for the CWL has been drawn up between DOE, Sandia Corporation, and NMED to specify closure and post-closure requirements.

A SWMU is any unit "from which hazardous constituents might migrate, irrespective of whether the units were intended for the management of solid and or hazardous waste." RCRA

There are some additional sites at SNL/NM not regulated as SWMUs (primarily closed out septic systems) that are also under ER investigation. These sites were not identified at the time of issuance of Module IV of the Part B Permit; they are being investigated in the same manner they would have been addressed if they were listed on the permit.

Other regulations, in addition to RCRA requirements, may also apply during remedial activities at ER sites, such as air quality, water quality, and National Environmental Policy Act (NEPA) regulations. In 1996, the ER Project prepared an Environmental Assessment (EA) to satisfy NEPA requirements (SNL 1996c). The ER Project evaluates all proposed ER field work with the EA to ensure that the activity is covered. A NEPA Checklist is prepared for any ER sites that are not covered by the EA.

ER Project History

Formal assessment of DOE's past sites of release nationwide began in 1984. In 1989, the DOE created the Office of Environmental Restoration and Waste Management (ER/WM) to oversee and guide remediation activities at all DOE sites.

The initial identification of ER sites at SNL/NM was completed in 1987. At that time, 117 sites under Sandia Corporation's jurisdiction were identified in the initial *Comprehensive Environmental Assessment and Response Program (CEARP) Phase I: Installation Assessment* (DOE 1987). By 1992, the year Sandia Corporation's ER Project was initiated, a total of 172 sites were identified. By the end of fiscal year 1992 (FY92), the number of identified sites reached 219. These included SNL/NM-operated sites in other locations such as California, Nevada, and Hawaii.

Between 1992 and 1998, a total of 500 individual sites, potential sites, or individual historical activities had been identified for investigation. Many of these sites were confirmed to contain little or no contamination of regulatory concern. As of 1998, almost all offsite locations had been investigated or transferred to other agencies. There are 146 sites remaining on the ER Project list located at SNL/NM.

A list of the primary regulations applicable to the ER Project is given in Appendix B. Sandia Corporation remains in compliance with RCRA permit conditions and is currently ahead of schedule for assessment and cleanup activities.

3.1.2 Cleanup and Site Closures

Waste generated from SNL/NM ER sites include low-level radioactive waste (LLW), RCRA-hazardous waste, mixed waste (MW), Toxic Substances Control Act (TSCA) waste (primarily polychlorinated biphenyls [PCBs] and asbestos), and non-regulated industrial solid waste. Radioactive and MW generated by the ER Project is handled by the Radioactive and Mixed Waste Management Facility (RMWMF). RCRA-regulated hazardous waste and TSCA-regulated waste is handled by the Hazardous Waste Management Facility (HWMF). Non-regulated waste is disposed of directly to local landfills, such as the KAFB Landfill or the Rio Rancho Landfill, just west of Albuquerque.

In 1999, radioactive waste generated by ER remediation activities was primarily LLW and minor amounts of MW. The waste management section in this chapter shows the waste volumes generated by the ER Project.

No Further Action (NFA) Status

Many ER sites were proposed for NFA based on insignificant contamination present or after remediation had already been completed. At SNL/NM, remediation is accomplished through Voluntary Corrective Measures (VCMs) or Voluntary Corrective Actions (VCAs). Once NMED grants NFA status, the owner is released from further RCRA requirements. The appropriate land-use category (such as industrial use) is used as part of the input for calculating the remaining risks to human health and the ecosystem. This method is used to ensure these calculated risks are small enough to warrant NFA status, if any residual contamination remains. From 1993 to 1996, 152 sites at SNL/NM and offsite locations were investigated and proposed for NFA after assessment and/or remediation. Table 3-1 shows the ER Project status since 1992. Sandia Corporation has continued to actively pursue the closure of proposed NFA sites by working with the NMED to provide adequate and/or further verification, as requested, for a successful determination. The last step of the NFA process is removing the sites from the permit.

3.1.3 1999 Status and Activities

At the close of 1999, there were 146 regulated sites remaining on Sandia Corporation's RCRA Part B Permit. During 1999, 20 sites were being actively remediated at SNL/NM. Although 14 NFA sites were carried over from 1998, significant progress was made in preparing these sites to be removed from the permit. NMED has agreed, in writing, that many sites are appropriate for petition to the last step—removal from the permit. In 2000, the ER Project expects to remove approximately 60 sites from the permit, as well as to propose 11 more sites for NFA status.

Project Highlights

Of the 20 sites undergoing remediation in 1999, the following three sites are highlighted:

- **Classified Waste Landfill (ER Site 2)** – The Classified Waste Landfill contained waste that is classified based on its shape or components. Contaminants of concern at this landfill included radionuclides, metals, and volatile organic compounds (VOCs). Cleanup at the landfill began in March 1998; two years later, in February 2000, excavation was completed (four and a half months ahead of schedule). Approximately 50,000 yd^3 of soil were excavated, more than 600 tons of scrap objects were removed, and more than 150 tons of materials have been recycled so far. Final work to complete this project includes waste sorting/segregation, demilitarization, recycling, waste management, confirmatory soil sampling, and revegetation. Final closure is expected in fiscal year 2003 (FY03).

A survey team uses handheld radiation detectors at Site 228A.

- **Centrifuge Dump Site (ER Site 228A)** – This inactive site is located east of Tech Area II on the north rim of Tijeras Arroyo. During the 1950s, depleted uranium (DU) was used during centrifuge testing; debris from this testing was dumped at what became Site 228A. After removal of the larger fragments of DU (which are bright yellow and easily identified), the site was left undisturbed for some 40 years. (Construction and metal debris were also dumped and buried along the edge of the arroyo at this site.) In July 1997, a severe thunderstorm washed out a portion of the buried site exposing DU-contaminated soil and moving some of it into the floodplain of Tijeras Arroyo. A preliminary radioactivity survey of the site found that DU had not washed into the main arroyo channel. Fieldwork to fully characterize the site, including identifying other buried objects, began in 1998 as a VCM. Special equipment was brought in to sort radioactive particles from large volumes of soil (a computer-controlled Segmented Gate System). A total of 1,400 yd^3 were scanned and the contaminated soil volume was reduced by 95 to 99 percent. After soil surveys confirmed removal of the contaminants, the site was revegetated. Site 228A was deemed appropriate for NFA by the NMED in March 2000. An adjacent site, Site 228B, which had no radioactive contamination, was also cleaned up; an NFA proposal is being prepared.

Corrective Action Management Unit (CAMU)

The CAMU will be used to store, treat, and permanently contain hazardous wastes generated by the ER Project. The CAMU is located in Tech Area III near the Chemical Waste Landfill (CWL). Operations at the CAMU commenced in September 1998 and the first waste was accepted in January 1999. Construction of the final storage facilities, the treatment area, and the containment cell was completed in March 1999.

The CAMU consists of a bulk staging area that can hold up to 600,000 ft^3 of soils, an outdoor storage area for containerized waste, four temporary tent buildings, a treatment area, and a containment cell that can hold approximately one million cubic feet of treated soil (37,000 yd^3). Almost all of the waste to be processed at the CAMU will come from the CWL. Originally, the CAMU was designed to accept only hazardous waste. In 1999, the waste acceptance criteria were revised to accept low-concentration tritium-contaminated soils and PCB-contaminated soils.

The primary treatment processes at the CAMU will be soil washing and stabilization (cement added for solidification) and low-temperature thermal desorption, which will evaporate and destroy volatile organics. Waste treatment at the CAMU will start after remediation of the CWL is nearly complete. Treated waste that meets permit-specific treatment criteria will be placed in the containment cell, which is designed with leak detection monitors, and a leachate collection and removal system. Any treated waste that does not meet permit criteria will be disposed of at offsite permitted facilities. Once closed, the containment cell will be subject to long-term monitoring for at least 30 years.

- **Chemical Waste Landfill (CWL) (ER Site 74)** – The CWL is the most significant cleanup project remaining to be completed by the ER Project. Excavation at the CWL began in September 1998 and is ongoing. In August 1999, the Vapor Extraction Project at the CWL was completed. This system was emplaced in three existing monitoring wells and several boreholes to remove VOCs from the vadose zone. Approximately 5,000 lb of VOCs were removed from the soil over the course of the project. Prior to vapor extraction, groundwater results showed trichloroethene (TCE) in groundwater samples at about four times the regulatory standard of 5 µg/L in some wells. Based on six quarterly sampling events after vapor extraction, no VOCs have been detected in the groundwater above the drinking water standards in any CWL monitoring well, demonstrating the success of the program. (1999 groundwater results for the CWL are presented in Section 7.2.2 of this report.)

ER Project Awards and Commendations
All performance measures were completed on or ahead of schedule and received the highest rating of "Outstanding" by the DOE and Sandia Corporation appraisal system. This is the fifth year in a row that the ER Project has received this rating, a very noteworthy achievement for Sandia Corporation.

A landfill worker inspects a large aluminum object excavated from the Chemical Waste Landfill (CWL).

TABLE 3-1. Summary of ER Project Status

Year	Total ER Sites at Start of FY*	ER Sites Proposed for NFA in FY*	Sites Approved for NFA in FY*	Corrective Actions Completed by End of FY*	New ER Sites Identified During FY*	Total ER Sites at End of FY*
1999	**146**	**4**	**0**	**20**	**0**	**146**
1998	146	16	0	0	0	146
1997	153	30	7	4	0	146
1996	155	35	2	29	0	153
1995	191	61	36	34	0	155
1994	219	48	28	3	0	191
1993	219	0	0	0	0	219
1992	172	0	0	0	47	219

NOTE: *FY = October 1 to September 30
NFA = No Further Action
** Some of the original 219 sites included TTR, KTF, and other offsite areas in New Mexico and internationally. The ER Project began in 1992.

3.2 WASTE MANAGEMENT

Waste management at SNL/NM is conducted under two departments: the Hazardous and Solid Waste Department and the Radioactive Waste and Nuclear Material Disposition Department. Documents relevant to Sandia Corporation's waste management programs are listed in Appendix C.

The SNL/NM site, with hundreds of individual research laboratories, generates over 14,000 different waste streams. Spent solvents and waste oils make up the largest quantities of waste. In addition to site-generated waste, Sandia Corporation may also process waste and recyclable materials received from offsite sources such as SNL/CA, LANL, and other DOE sites, as well as KAFB. Waste at SNL/NM is processed at three facilities: The Hazardous Waste Management Facility (HWMF), the Radioactive and Mixed Waste Management Facility (RMWMF), and the Solid Waste Transfer Facility (SWTF). The primary waste types handled by these facilities are shown below. Waste management at SNL/NM is described in this section by waste management facility.

HWMF	RMWMF	SWTF
Hazardous & Chemical Waste	**Radioactive & Mixed Waste**	**Non-hazardous Solid Waste**
Hazardous	Low-level Waste (LLW)	Sanitary
Biohazardous	Mixed Waste (MW)	Industrial Debris
Chemical	Transuranic Waste (TRU)	Construction Debris
Asbestos	TRU/MW	Recycled Paper
PCB	Special Case Waste	Other Recycled
Recyclables		

A worker scans the bar codes on chemical containers at the Hazardous Waste Management Facility (HWMF).

Hazardous and Chemical Waste Management

3.2.1 Hazardous Waste Management Facility (HWMF)

The HWMF, located in Tech Area II, packages, segregates, stores, and ships hazardous and chemical wastes. The facility consists of a Waste Packaging Facility (Bldg. 959), a Waste Storage Facility (Bldg. 958), covered outdoor pads for containerized waste, transportainers for waste storage, and three office trailers. A concrete-lined catchment pond within the facility perimeter is used to contain all storm water runoff.

The HWMF handles hazardous waste, asbestos, polychlorinated biphenyls (PCBs), non-regulated chemical waste, non-facilities biohazardous waste, used oil, batteries of all types, and recyclable lead. All used oil (most is recycled), is regarded as hazardous waste until it has been characterized. Additionally, waste normally received as solid waste at the SWTF may be sent to the HWMF if it has hazardous characteristics and does not meet SWTF waste acceptance criteria (such as light bulbs and pressurized cans).

HWMF Operations

Hazardous waste is tracked from the point of generation to final disposal through meticulous documentation at each waste-handling step. Each generator at SNL/NM initiates the "cradle to grave" tracking process by preparing a Chemical Waste Disposal Request (CWDR) describing the quantity and type of waste requested for pickup. Generators characterize their own waste by either process knowledge or, if necessary, sampling and analysis. Each waste item received at the HWMF is labeled with a unique bar code, linking the item to the original CWDR. The item is also labeled with the Department of Transportation (DOT) hazard class and RCRA waste code, if applicable. An individually coded waste item typically is a bottle, plastic bag, or other small item that contains chemical materials.

RCRA hazardous waste is waste that has the characteristics of ignitability, corrosivity, reactivity, or toxicity—or is otherwise listed as hazardous.

All waste is verified at the HWMF before being placed in isolated bays according to DOT waste categories. These categories ensure that incompatible wastes remains segregated. The bays are designed with secondary containments to contain any spills and are equipped with earthquake shelving to withstand minor tremors. After a sufficient quantity of items have accumulated in the bays, the items are packed into a larger container, which is also bar coded. These packages are moved to an adjacent building to await shipment to a permitted treatment, storage, and disposal (TSD) facility or recycling center. Waste is usually processed and shipped offsite within several weeks of receipt.

Regulations

The HWMF operates under Sandia Corporation's RCRA Part B Operating Permit, which is administered by NMED. SNL/NM is classified as a "large-quantity generator" under RCRA (generating greater than 1,000 kg of hazardous waste per month). All waste processed at the facility is sorted and recycled, where feasible. Asbestos and PCB waste are regulated under the Toxic Substances Control Act (TSCA). Asbestos, is also regulated as a hazardous air pollutant under the National Emission Standards for Hazardous Air Pollutants (NESHAP). Biohazardous (infectious) waste is regulated by the State of New Mexico. All applicable regulations for hazardous and chemical waste handled by the HWMF are listed in Appendix B.

1999 Activities at the HWMF

In 1999, 18,566 individual items were handled by the HWMF. The HWMF shipped a total of 104,614 kg of RCRA-regulated hazardous (including recyclable waste). The bulk volume of waste normally handled by the HWMF is waste regulated by RCRA. However in 1999, a larger than usual volume of TSCA-regulated asbestos waste was handled as a result of demolition and renovation projects. Table 3-2 summarizes waste handling operations at the HWMF over the last five years. Specific waste categories managed in 1999 are shown in Table 3-3 (1998 figures are shown for comparison).

Recycling

The HWMF recycles all categories of hazardous and chemical waste where feasible. RCRA recycled waste includes various batteries, silver compounds, mercury compounds, lamps, capacitors and toxic metals. A total of 19,271 kg of RCRA hazardous waste were recycled. A total of 26,172 gal of used oil were recycled. "Other recyclable waste" includes miscellaneous recycled categories not regulated under RCRA or TSCA. This category includes various batteries, fluorescent lamps, various oils, and non-PCB ballasts and capacitors. There were 78,984 kg of materials recycled in this category.

TABLE 3-2. Five-Year Summary of Waste Handling at the Hazardous Waste Management Facility (HWMF)

Year	ER Wastes (Soils etc.) (kg)	Recycled (kg)	RCRA Non-ER (kg)	Other Hazardous (kg)	Total Waste & Recyclables (kg)
1999	31,477	127,383	56,210	270,583	485,653
1998	19,572	141,905	59,290	78,576	299,343
1997	344,334	88,348	50,153	231,011	713,846
1996	5,517	95,109	51,549	181,405	333,580
1995	303,966	114,290	91,876	287,729	797,861

NOTE: *Routinely recycled materials include nickel-cadmium batteries and lead acid batteries.
RCRA = Resource Conservation and Recovery Act
ER = Environmental Restoration

TABLE 3-3. Waste Handled by the Hazardous Waste Management Facility (HWMF) in 1999
1998 figures are shown for comparison.

Waste Categories Handled at the HWMF	1998 Waste Shipped (kg)	1999 Waste Shipped (kg)
RCRA Waste		
Hazardous Waste	59,290	56,210
Hazardous Waste (Generated by ER Project)	11,293	29,133
Recycled Hazardous Waste	14,156	19,271
Total	**84,739**	**104,614**
TSCA		
Asbestos	31,523	202,162
PCB	968	176
PCB (recycled)	1,173	4,168
Total	**33,664**	**206,506**
BIOHAZARDOUS		
Infectious Waste Total	**2,574**	**1,872**
OTHER		
Chemical Waste	37,212	64,506
Non-hazardous Solid Waste (RCRA Subtitle D) *	6,299	1,871
Non-RCRA (Generated by ER Project)	8,279	2,344
Used Oil (recycled)	80,700	26,172
Lead (recycled)	11,767	0**
Recycled (Other) – various batteries, fluorescent lamps, other oil, and non-PCB (ballasts, capacitors, and oils)	34,109	78,984
Total	**178,366**	**173,877**
Total Waste and Recyclables Handled	**299,343**	**486,869**

NOTE: *Non-hazardous solid waste manifested from the Solid Waste Transfer Facility (SWTF)
**There was no lead handled by the HWMF, but reapplied lead materials are discussed in Section 3.3.4.
RCRA = Resource Conservation and Recovery Act
TSCA = Toxic Substances Control Act (primarily regulates asbestos and PCBs)

Asbestos Waste Handling

Asbestos waste is tracked through Sandia Corporation's Asbestos Program working in tandem with the Facilities Asbestos Program. Facilities is responsible for asbestos removal from building demolitions or renovations and the proper packaging of all asbestos waste generated. Facilities-generated asbestos waste is stored in a building adjacent to the main HWMF compound.

At SNL/NM, the abatement of asbestos-containing equipment and building materials is ongoing. Asbestos materials removal is only done if the material presents an inhalation hazard, or if the building is to be torn down or renovated. Typical building materials containing asbestos include floor, ceiling, and roofing tiles, certain types of insulation, and other fire retardant construction materials.

Similarly, in instances where laboratory equipment has asbestos-containing material in a non-friable form (and it poses no inhalation risk), the item is allowed to remain in service or is redistributed through the property reapplication program. Typical asbestos waste generated from equipment abatement consists of fume hoods, cable insulation, and ovens. Asbestos waste from SNL/NM is disposed at a New Mexico landfill permitted to accept friable asbestos waste. In 1999, 202,162 kg of asbestos waste were generated and disposed.

Polychlorinated Biphenyls (PCB) Handling

The EPA banned the production of PCBs in 1977. PCBs were widely used in many industrial and commercial applications—most notably electrical equipment and dielectric fluids due to their non-flammability, chemical stability, high boiling point, high heat capacity, and electrical insulating properties. PCBs were also used in pigments, plastics, and rubber products. The widespread use of PCBs and their stability in the environment has resulted in their persistence in the environment.

PCB Mega rule

New PCB rulings became effective on August 28, 1998, with sweeping amendments to 40 CFR 761, also known as the "PCB Mega Rule." Among the many changes were new rules for decontamination and cleanup procedures.

In 1999, efforts to decontaminate an existing PCB spill on concrete met with limited success. Despite repeated decontamination attempts, PCBs were still present above regulatory levels. Sandia Corporation decided to employ a "use authorization" for porous surfaces provided for by the PCB Mega rule. The Rule allows existing PCB spill sites to be double washed and rinsed and completely covered with two solvent resistant and water repellant coatings. The area is then marked as containing PCB. When the PCB-contaminated surface is no longer needed, (such as a concrete pad) the regulations require that the contaminated materials be removed for disposal.

PCBs are defined as any material having a PCB concentration equal to or greater than 500 ppm. "PCB-contaminated" materials are those items with a PCB concentration less than 500 ppm but greater than or equal to 50 ppm. PCBs are regulated under TSCA as implemented by 40 CFR 761.

Sandia Corporation has replaced almost all PCB-containing equipment through the Power System Modernization project completed in mid-1999. Most of the remaining regulated PCBs at SNL/NM are capacitors contained inside fluorescent light ballasts manufactured before January 1, 1978. Light ballasts represent the largest single source of PCB waste at SNL/NM and are recycled to the extent possible. Other items may include transformers, switches, dielectric fluids, contaminated solvents, hydraulic oils, waste oils, heat transfer liquids, lubricants, paints, and casting wax. Items that are suspected to contain PCBs but remain sealed and would otherwise have to be destructively tested, are allowed to remain in service.

Removal of all PCB and "PCB-contaminated" equipment was completed in 1999, as required by 40 CFR 761. All that remains in Sandia Corporation's inventory is one PCB-contaminated transformer, light ballasts, and some unidentified miscellaneous equipment. All remaining PCB equipment will be removed as time and resources permit.

Like other TSCA waste, PCB waste is handled by the HWMF and stored within an adjoining fenced compound. In 1999, 176 kg of PCB waste were shipped offsite for disposal; 4,168 kg of PCB materials were shipped for recycling.

Explosive Waste

The HWMF does not accept explosive waste. Most explosive waste is treated at KAFB's Explosive Ordnance Disposal (EOD) site. In 1999, 4,041 kg were sent to the EOD. A minor amount of explosive waste (generally contaminated rags) is treated at the SNL/NM Thermal Treatment Facility (TTF), however, this facility was not used in 1999. Additionally there was one offsite shipment of 3 kg of explosive waste.

Radioactive Waste Management

3.2.2 Radioactive and Mixed Waste Management Facility (RMWMF)

The RMWMF, located in the southeast corner of Tech Area III, manages low-level radioactive waste (LLW), mixed waste (MW), transuranic waste (TRU), and TRU/MW. No high-level waste (HLW) is generated at SNL/NM. Although Sandia Corporation operates several nuclear reactors, no spent fuel has ever been produced since the original fuel rods are still viable. Furthermore, because SNL/NM is not a power-producing utility, any spent fuel that would eventually be removed from the research reactors would not be classified as HLW.

Most radioactive and MW generated on site is processed through the RMWMF. Some waste however, which is already sealed and characterized is put directly into temporary storage areas onsite. The waste processing functions at the RMWMF include waste characterization, segregation, treatment, packaging, storage, and shipment to permitted offsite facilities. Waste management includes the handling and processing of incoming new waste as well as the management of the existing inventory in storage.

SNL/NM's Radioactive Waste

Low-Level Radioactive Waste (LLW) – Most LLW in Sandia Corporation's inventory is radioactively-contaminated soils excavated from ER sites. Other LLW is demolition and decontamination (D&D) debris, personal protective equipment (PPE), and laboratory waste. LLW is primarily contaminated with isotopes of strontium, plutonium, cobalt, americium, thorium, cesium, tritium, and uranium. (Plutonium and americium in LLW are below the activity level designated for TRU waste.)

Mixed Waste (MW) – MW generally consists of the same materials as LLW, with the addition of RCRA-hazardous contaminants such as metals and solvents. The radioactive component in MW results primarily from tritium, cesium, strontium, plutonium, americium, and uranium.

Transuranic Waste (TRU) – TRU may derive from sealed instrument sources, D&D waste, PPE, and laboratory waste. The radioactive component in TRU is generally americium, plutonium, neptunium, and curium.

Transuranic/Mixed Waste (TRU/MW) – TRU/MW is a combination of radioactive and hazardous waste as described above.

Facilities at the RMWMF include Bldg. 6925 where incoming MW is verified and stored. LLW is verified and stored at Bldg. 6926. The primary waste handling facility, Bldg. 6920, is equipped with a main control room for monitoring activities and controlling air flow throughout the facility. Handling bays, sorting rooms, and various waste storage areas operate under negative airflow to ensure that all emissions are channeled through the facility's stack. Waste treatment is conducted in Bldgs. 6920 and 6921.

Regulations
DOE Order 435.1, *Radioactive Waste Management* (DOE 1999b) and DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993) are the primary drivers for radioactive waste management. RCRA regulations (40 CFR 260–282) regulate the hazardous component in MW. Applicable DOE Orders and regulations for radioactive waste and MW management are listed in Appendix B.

DOE Order 435.1 replaced DOE Order 5820.2a in July 1999. The new Order will significantly change the way radioactive waste is managed at SNL/NM. First, it will require Sandia Corporation to develop a comprehensive plan for all radioactive waste disposal. Second, it will require all radioactive and MW generators to contact the Radioactive Waste Program before generating waste to obtain prior approval. This will ensure that a proper waste pathway is in place *before* any waste is generated. Third, the order will require radioactive waste to be shipped offsite after a maximum storage period of one year, similar to the RCRA mandates for hazardous waste and MW. This change will require the RMWMF to characterize waste for shipment within one year, increasing the work load at the facility. The impact of the new Order will be felt in 2000.

Sorting at the RMWMF

RMWMF personnel sort all radioactive and mixed waste (MW) that has not been fully characterized. There are four sorting levels, which depend on the known hazards present or the level of prior characterization:

- **Level 1** – Radioactive waste that is well characterized, in a sealed container, and contains very low radiation levels. Personnel may open the container to verify the contents, but are not required to contact the waste. At this level, only coveralls, glasses, and work gloves are required for handling.
- **Level 2** – Radioactive waste that has been previously characterized and has very low radiation levels and minor chemical hazards associated with it. Extra precautions are taken as the waste may require handling to take samples or to be repackaged. Waste may be physically segregated to remove known hazardous chemical components, which would otherwise classify the waste as MW.
- **Level 3** – Radioactive waste that has not been fully characterized and therefore has a higher associated risk. Workers handling this waste category wear fully contained personal protective equipment (PPE) including respirators.
- **Level 4** – Radioactive waste with a high hazard level. The waste is either totally uncharacterized, such as legacy waste, or is know to contain high radiation levels. All waste is contacted through a glove box; workers wear full-containment PPE.

Radioactive Waste Storage
Presently, radioactive waste generated from SNL/NM is temporarily stored at the RMWMF, the Manzano Storage Complex, and the High Bay Storage Facility (Bldg. 6596) in Tech Area V. Most MW and LLW stored onsite remains at the RMWMF. TRU and TRU/MW is stored only at the Manzano Storage Complex. Eventually, TRU and TRU/MW will be routed through Los Alamos National Laboratory

(LANL) for final disposal at the Waste Isolation Pilot Plant (WIPP).

Sandia Corporation is currently working on the RCRA Part B Operating Permit renewal process for submittal to the NMED in late 2000 or early 2001. The plan is to combine all RCRA permits held by Sandia Corporation into one permit. The Interim Storage Site (ISS) in Tech Area III is no longer used for waste storage and will be taken off the permit. The ISS closure plan has been submitted to NMED but has not yet been approved.

1999 Activities at the RMWMF

In 1999, the RMWMF managed all four waste types (LLW, MW, TRU, and TRU/MW). LLW was shipped to Envirocare in Utah and the Nevada Test Site (NTS). Two small shipments of MW were shipped to Perma Fix and Envirocare. Section 3.2.2 discusses MW management in detail. Table 3-4 shows the quantities of waste managed and shipped by the RMWMF over the last five years. Both mass and volume are shown since mass alone can be misleading due to the weight of the containers. For example, a 2,000 lb container may hold less than 100 lb of waste. As shown in the shaded box below, ER waste makes up the bulk of radioactive waste managed by the RMWMF.

Waste Generated by the ER Project -1999

LLW - Managed = 161,936 kg (3,515 ft^3)
Shipped = 128,491 kg (2,467 ft^3)

MW - Managed = 116,334 kg (2,320 ft^3)
Shipped = 3,053 kg (80 ft^3)

TRU - None generated in 1999

Low Level Waste (LLW)

Year	Managed (kg)	Shipped (kg)
1999	181,580 *(11,690 ft^3)*	90,947 *(10,403 ft^3)*
1998	861,590 *(41,454 ft^3)*	749,487 *(30,066 ft^3)*
1997	332,731 *(12,582 ft^3)*	322,736 *(10,520 ft^3)*
1996	511,298 *(22,730 ft^3)*	469,165 *(14,510 ft^3)*
1995	12,431 *(1,924 ft^3)*	3,327 *(688 ft^3)*

Mixed Waste (MW)

Year	Managed (kg)	Shipped (kg)
1999	-- *(4,234 ft^3)*	-- *(173 ft^3)*
1998	10,143 *(436 ft^3)*	5,518 *(1,137 ft^3)*
1997	-- *(284 ft^3)*	0
1996	-- *(4,880 ft^3)*	267 *(7 ft^3)*
1995	-- *(682 ft^3)*	0

Transuranic Waste (TRU)

Year	Managed (kg)	Shipped (kg)
1999	2,924 *(41 ft^3)*	0
1998	22,089 *(625 ft^3)*	0
1997	0.45 *(0.12 ft^3)*	0
1996	390 *(155 ft^3)*	0
1995*	3,789* *(170 ft^3)*	0

NOTE: The "Managed" column includes waste that was in inventory and waste that was generated as of the close of 1999.
*In 1995, all TRU waste originated from the Inhalation Toxicology Research Institute (ITRI).

TABLE 3-4. Five-Year Summary of the Total Radioactive Waste Managed at SNL/NM

Mixed

Mixed Waste Management

3.2.3 Mixed Waste Management

Regulatory Status

As discussed in Section 2.1.4, the Federal Facilities Compliance Act (FFCA) amended RCRA and HSWA in 1984 to address the lack of treatment capacity for MW at federal facilities. The Federal Facility Compliance Order (FFCO) sets specific milestones for treatment and the reduction of Sandia Corporation's MW inventory. Sandia Corporation expects to meet the deadline set by the Order to have all back-stored MW at SNL/NM shipped offsite by September 1, 2002. The Order also requires Sandia Corporation to update its Site Treatment Plan annually. Sandia Corporation submitted a proposed Site Treatment Plan (Revision 4) to the state in August 1999 (SNL 2000d). The final plan was approved in June 2000.

Sandia Corporation remains in compliance with the FFCA, which allows for storage of MW onsite past the one-year time frame set by RCRA. SNL/NM continues to operate under RCRA Interim Status with regard to MW management. The specific RCRA permit applicable to MW management is "RCRA Part A and B Permit Applications for Hazardous Waste Management Units" (Table 2-7). A summary of the compliance history from 1984 to the present with regard to MW management is shown in Table B-2 of Appendix B.

Mixed Waste (MW) Treatment

Treatment of MW began at SNL/NM in 1997 and the first offsite shipment was made in 1998. Table 3-5 lists the current MW categories (TG-1 to TG-19 plus TRU/MW) and the currently preferred treatment options for each category.

There are 11 onsite treatment processes described in the current RCRA Part B Operating Permit Application. Deactivation, neutralization, and stabilization/solidification are the three most important treatments being used at SNL/NM at this time. The first five on the list are the treatments that have been performed onsite:

- **Deactivation**
- **pH Neutralization**
- **Solidification/Stabilization**
- **Macroencapsulation**
- **Mechanical Processing**
- Amalgamation
- Chemical Oxidation
- Flocculation/Centrifugation
- Packed Bed Reactor/ Silent Discharge Plasma (PBR/SDP) *(not funded by DOE)*
- Reverse Osmosis
- Thermal Desorption *(not funded by DOE)*

MW may be removed from SNL/NM's inventory by shipment to offsite commercial or DOE facilities for treatment and disposal, onsite treatment that removes the hazardous component, or re-characterization (identifying it as just radioactive or hazardous waste and not mixed waste [MW]).

Status of MW Management in 1999

The majority of MW now being stored onsite consists of very low-level radioactive sludges from septic tank system close-outs (ER Project), oils and absorbed oils, and radioactive metallic objects with RCRA metals. No offsite MW was received from other DOE sites in 1999. Two MW shipments were made in 1999:

- June 3, 1999 – Sandia Corporation shipped 0.06 m^3 of MW organic liquids to Perma-Fix/DSSI for incineration. (LLW liquid scintillation fluid was also included in this shipment.)

- September 23, 1999 – Sandia Corporation shipped 4.2 m^3 of inorganic (metal) and organic debris to Envirocare in Utah for macroencapsulation treatment.

TABLE 3-5. Mixed Waste Treatment Status

Waste Category	Volume (m^3)	Preferred Treatment Technology	Constituents	Treatment Status
TG-1	0	Deactivation	Inorganic Debris with Explosive Component	Disassembly of all TG-1 neutron generators completed
TG-2	0	Deactivation	Inorganic Debris with Water Reactive Component	Treatment of TG-2 wastes completed
TG-3	0.03	Deactivation	Reactive Metals	Treatment of TG-3 waste completed (FY99 milestone)
TG-4	0.15	Macroencapsulation	Elemental Lead	Onsite and offsite treatment pursued through Envirocare
TG-5	0. 27	Neutralization / Stabilization	Aqueous Liquids (Corrosive)	Onsite treatment began in FY99
TG-6	0	Amalgamation	Elemental Mercury	Treatment exists but no TG-6 waste currently exist
TG-7	0.006	Incineration	Organic Liquids I	Offsite incineration
TG-8	3.9	Thermal Desorption	Organic Debris with Organic Contaminants	Offsite incineration
TG-9	29.05	Macroencapsulation	Inorganic Debris with TCLP Metals	
TG-10	0.37	Sorting / Reclassification	Heterogeneous Debris	
TG-11	3.2	Hydrothermal Processing	Organic Liquids II	Offsite treatment at Perma-Fix (FY99)
TG-12	2.19	Macroencapsulation	Organic Debris with TCLP Metals	Offsite treatment and disposal at Envirocare
TG-13	0.01	Deactivation / Stabilization	Oxidizers	Treated onsite
TG-14	0.003	Evaporative Oxidation	Aqueous Liquids with Organic Contaminants	Offsite incineration
TG-15	16.03	Stabilization	Soils <50% Debris and Particulates (w/TCLP Metals)	Treated onsite
TG-16	0.0001	Oxidation	Cyanide Waste	Onsite and offsite treatment is being pursued
TG-17	37.46	Incineration / Stabilization	Liquid/Solid with Organic and/or Metal Contaminants	Offsite incineration and chemical oxidation pursued (Some onsite treatment in FY99)
TG-18	0.24	Incineration	Particulates with Organic Contaminants	Offsite incineration and chemical oxidation pursued
TG-19	0.06	Stabilization	Liquids with Metals	Onsite and offsite treatment is being pursued
TRU/MW	0.63	To Be Determined	TRU with Hazardous Components	Offsite options pursued

NOTE: Treatments are detailed in the *Mixed Waste Site Treatment Plan, Compliance Plan Volume Background Volume* (SNL 1999a) and the *Site Treatment Plan for MW FY99 Update* (SNL 2000d).
TCLP = toxicity characteristic leaching procedure

Five milestones listed in the Site Treatment Plan were met in 1999 including a waste shipment for incineration, waste treatment performed onsite, waste sorting, and development of a treatment pathway and permit activity for TRU/MW.

Solid Non-Hazardous Waste Management

3.2.4 Solid Waste Transfer Facility (SWTF)

The SWTF handles non-hazardous sanitary solid waste consisting primarily of office trash and recyclable paper and cardboard. The purpose of this facility is to screen all solid waste streams to ensure compliance with solid waste regulations and to increase the quantity of materials being recycled at SNL/NM. The primary waste handling building houses a multi-story industrial compactor/baler. The disposal process at the facility begins with initial waste screening; all waste or recyclable material is dumped directly onto the bay floor for inspection and sorting (screening). After segregation, the material is put onto the conveyer belt to be compacted into 4 by 4 by 6 ft bales weighing up to 1 ton each.

Regulations

Sanitary waste disposal is regulated under RCRA "Subtitle D" and New Mexico's Solid Waste Management Regulations administered by the Solid Waste Bureau. Additionally, Executive Order (EO) 12780, *Federal Agency Recycling*, and EO 12873, *Federal Acquisition, Recycling and Waste Prevention* mandates the level of recycling expected from government agencies. Monthly reports are sent to Sandia Corporation's Pollution Prevention (P2) Group, KAFB, and LANL. Regulations are listed in Appendix B.

SWTF Operations

All solid waste accepted at this facility must be sanitary non-hazardous waste. Any waste with hazardous characteristics is re-manifested to the HWMF for handling. The SWTF does not accept food service waste, construction debris, liquids, pressurized cans, light bulbs, and liquids. Construction debris and food service waste is collected and transported directly to local landfills.

Recyclables

The SWTF is the central processing point for recyclable paper and cardboard generated from SNL/NM and several outside cooperating agencies including LANL, KAFB, DOE field offices, and the Lovelace Respiratory Research Institute (LRRI). LRRI joined in 1999. KAFB, which joined Sandia Corporation's recycling program in 1997, has increased its contribution by 87 percent in the last two years.

Recycled paper is sorted by "Mixed," "Office," and "White" paper categories. "Mixed" paper contains mostly colored paper, newsprint, and magazines. "Office" paper may contain up to 30 percent mixed paper, and "White" paper contains less than one percent mixed paper. Profits from the sale of recyclables are split among the cooperating agencies.

Table 3-6 presents a summary of solid waste management in 1999. Table 3-7 details the amounts of recycled materials from all cooperating agencies in 1999.

1999 Activities at the SWTF

A total of 1,328,997 kg of solid waste was compacted into 1,810 bales in 1999. An additional 604,275 kg of recyclables were recovered and compacted into 931 bales. The SWTF works closely with P2 and Waste Minimization Program staff to implement existing and new recycling activities. In 1999, Sandia Corporation expanded the recycling program to include residential recycling for KAFB housing residents (newspapers and recyclable paper).

TABLE 3-6. Solid Waste Transfer Facility (SWTF) Activity Summary for 1999 *"Total Solid Waste" and 'Total Recyclables" are two separate totals.*

Category	Weight lb (kg)	Volume (yd^3)	Bales (each)
Total Solid Waste	**2,929,936 lb (1, 328,997 kg)**	**3,439**	**1,810**
Recyclables			
White Paper	805,998 lb (365,595 kg)	1,051	553
Office Paper	N/A	N/A	N/A
Mixed Paper	51,600 lb (23,405 kg)	51	27
Cardboard	438,616 lb (198,953 kg)	648	341
Newsprint	14,984 lb 6,797 kg)	19	10
Phone Books	21,000 lb (9,525 kg)	40	N/A
Total Recyclables	**1,332,198 lb (604,275 kg)**	**1,809**	**931**

NOTE: The SWTF reports weight in pounds. Conversions have been made to kilograms. N/A = not available

TABLE 3-7. Recyclable Materials Received from Participating Agencies in 1999

Location	Weight (lb)	Weight (kg)	Bales (each)
White Paper (up to 1% mixed)			
SNL/NM	256,747	116,458	173
DOE	7,756	3,518	5
LANL	335,950	152,834	231
KAFB	205,818	93,357	144
Newsprint			
KAFB	14,984	6,797	10
Mixed Paper (mostly newspaper/ magazines)			
SNL/NM	51,600	23,405	27
Cardboard			
SNL/NM	278,962	126,535	218
LRRI	10,800	4,899	8
KAFB	148,854	67,519	115
Total	**1,311,471**	**595,322**	**931**

3.3 WASTE MINIMIZATION AND POLLUTION PREVENTION (P2) PROGRAMS

3.3.1 Program Scope

The Pollution Prevention (P2) Program was developed to infuse P2 practices into Sandia Corporation's corporate culture. The program focuses on reducing all waste streams—hazardous, radioactive, and solid. In addition, the program includes efforts associated with energy and water conservation. P2 goals are to encourage and create practices that:

- Reduce or eliminate waste sources;
- Improve process efficiency;
- Conserve energy, water, and resource use;
- Recycle potential waste items; and
- Procure products with recycled content, wherever feasible.

The P2 Program works in concert with other environmental programs at SNL/NM, ES&H coordinators, and P2 Line support personnel. When requested, the P2 team provides background research on waste reduction technologies and products, performs cost-benefit analyses, and locates and obtains P2 funding for new waste reduction processes. The P2 Program focuses on four functional areas:

- Generator Set-Aside Fee (GSAF) Program,
- Pollution Prevention Opportunity Assessments (PPOAs),
- Recycling implementation, and
- Return on Investment (ROI) Projects. *(Funding was not available in 1999 for ROI Projects.)*

Some artifacts excavated at the Classified Waste Landfill in Tech Area II will be melted down to recover precious metals through a GSAF Project.

P2 Awards

In 1999, Sandia Corporation received three awards for P2 accomplishments:

- Steam Plant Optimization - Sandia Recognition Award for significantly reducing air emissions through process improvement.
- Soy Oil Alternative - DOE P2 Pollution Prevention Award for the replacement of petroleum-based hydraulic fluids with soybean-based oil.
- Large Industry Air Quality - New Mexico Managers Network, Joint Industry and Government P2 Award.

3.3.2 Generator Set-Aside Fee (GSAF) Program

The Generator Set-Aside Fee (GSAF) Program was created to provide a direct incentive for waste generating organizations to minimize their waste. The program is part of a DOE program to set aside funds for P2 activities by collecting a minimal fee from waste generators. The money is used to fund P2 projects at SNL/NM. In 1999, $320,000 in GSAF funds were used to implement nine P2 projects (Table 3-8).

3.3.3 Pollution Prevention Opportunity Assessments (PPOAs)

Pollution Prevention Opportunity Assessments (PPOAs) suggest P2 objectives for specific facilities. As requested by the facility owner, the P2 team will scrutinize a facility's operations to identify opportunities that can reduce waste and save energy. Suggestions may include substituting less toxic materials, improving preventative maintenance, and cutting back on overall energy use by replacing inefficient equipment. The final decision to implement any identified P2 opportunities lies with the facility owner.

In 1999, two PPOAs were conducted at the Cafeteria in Tech Area I and the Coronado Club. The recommendations for both facilities included purchasing reusable serving ware to reduce solid waste generation, and

TABLE 3-8. Generator Set-Aside Fee (GSAF) Projects in 1999

Project	Description	Cost Saving Benefit	~ Savings per year
Coolant Systems Replaced at Machine Shop	Two coolant recycling systems were purchased and installed in the machine shop. The new systems will reduce the coolant waste stream by 75 to 90 percent.	Avoided waste stream	$24,000
Purchase of Electronic X-ray System	An electronic x-ray system was installed for the Engineering Sciences and Technologies Center to replace the existing photochemical x-ray system.	Avoided waste stream	$10,000
Recovery of Precious Metals from Classified Waste Landfill Artifacts	Demilitarization and sanitization operations over the next two years will support the recovery and processing of many old weapon components excavated from the Classified Waste Landfill. Many of the artifact materials, which are still classified, will be dismantled, shredded, and melted down to recover precious metals. A shredder and hammermill will be installed in Bldg. 841.	Avoided waste management costs	$38,000
New Energy Efficient Lighting	Old incandescent lighting fixtures in Bldg. 6526 were replaced with energy efficient fixtures, which will result in a reduction of approximately 39 metric tons of carbon dioxide air emissions per year.	Reduced energy costs	$3,500
Cooling Tower Optimization	The cooling tower system for Bldg. 858 was upgraded, which will result in the reduction of approximately 678 metric tons of carbon dioxide per year.	Reduced energy costs	$36,000
Variable Frequency Drive (VFD) for Chilled Water System	A VFD was installed in the chilled water system for Bldg. The variable speed pump will result in a reduction of approximately 296 metric tons of carbon dioxide air emissions per year.	Reduced energy costs	$17,300
Variable Frequency Drive (VFD) for Chilled Water System	Another VFD was installed for Bldg. 870, which will result in a reduction of approximately 103 metric tons of carbon dioxide emissions per year.	Reduced energy costs	$6,000
Water Efficient Fixtures	Water efficient fixtures (urinals, toilets, and faucets) were installed in the Facilities area as part of a water conservation demonstration.	Water conservation	N/A
Waste Hopper for Metal Collection	A new hopper was purchased to collect metal waste at the Liquid Melt Processing Laboratory resulting in approximately 1 metric ton less of sanitary waste per year.	Avoided waste costs	$2,000

installing an energy efficient dish washing machine at the Tech Area I Cafeteria.

3.3.4 Recycling and Waste Minimization

Sandia Corporation continues to work on improving recycling programs. As described under the Waste Management sections of this chapter, Sandia Corporation routinely recycles paper products, oil, metals, and office products. Additionally, other items not handled by the waste management facilities that are recycled include tires, construction materials, landscaping refuse, and various other categories. Table 3-9 summarizes the quantities of materials that Sandia Corporation recycled in all categories during 1999. Other recycling and waste minimization efforts at SNL/NM include:

- **Lead Bank** – Various lead materials are recycled, decontaminated, and reapplied as needed, including lead sheets, bricks, and BBs. Lead may be recast or reapplied. In 1999, a total of 9,318 kg were reapplied. Additionally, 15,454 kg of lead bricks were decontaminated for redistribution.

- **"Green" Landscaping Practices** – Sandia Corporation reduces water, pesticide, and herbicide use by landscaping its facilities with southwest drought-tolerant plants, rocks, and gravel.

- **Affirmative Procurement** – Sandia Corporation purchases items with recycled content where feasible and cost effective. Common items include construction materials, vehicle products, landscape products, park and recreation products, paper products, and non-paper office products.

- **Interagency Recycling** – Sandia Corporation cooperatively recycles paper products with DOE field offices, KAFB, and LANL. Profits are shared between the agencies.

TABLE 3-9. Categories of Waste Recycled at SNL/NM in 1999

Recycled Categories	Weight (kg)
Stainless steel	3,098
Carbon steel	1,224,328
Copper	413
Aluminum metal	13,241
Lead	4,536
Capacitors, PC boards	13,115
Engine oils	18,250
Toner cartridges	9,245
Batteries	5,376
Tires	2.395
Newsprint	6,797
Wood	25,500
Mercury items	100
Transformers	953
Fluorescent light bulbs	15,141
Non-PCB light ballasts	10,715
Office paper	237,496
Cardboard	198,956
Phone books	9,734
Aluminum cans	1,460
Other chemicals	54
Total	**1,798,510**

NOTE: PC = printed circuit

3.4 BIOLOGICAL CONTROL ACTIVITY

The Biological Control Activity provides customer support related to animal control issues and compiling information on pesticide use at SNL/NM. Animal control support includes providing general information and resolving issues related to removing nuisance animals. This effort may entail interfacing, as necessary, with Air Force and State of New Mexico agencies to resolve animal control issues. No animals were captured and/or relocated in 1999.

Pesticide use at SNL/NM includes the use of herbicides for weed control, rodenticides for controlling mice, and insecticides for the control of insects in food service and work areas. Sandia Corporation uses EPA-registered pesticides that are primarily applied by certified applicators. Material Safety Data Sheets (MSDS) and product label information for pesticides used at SNL/NM are maintained under the program. Pesticide use (product names and amounts applied) is documented in quarterly reports. Documents related to the program are listed in Appendix C.

3.5 OIL STORAGE AND SPILL CONTROL

SNL/NM has an oil storage capacity of 5.46 million gallons. In 1999, Sandia Corporation owned 89 regulated containers, including oil-containing equipment, transformers, underground storage tanks (USTs), and above-ground storage tanks (ASTs). All oil containment sites with regulated volumes must be equipped with secondary spill containments, although Sandia Corporation provides spill containments for smaller volumes as well. Secondary containment structures include concrete lined basins, retaining walls, containment reservoirs, earthen berms, sloped pads, and trenches.

The preparation of a Spill Prevention Control and Countermeasures (SPCC) Plan is required by 40 CFR 112, "Oil Pollution Prevention" and 40 CFR 110, "Discharge of Oil," which are promulgated under the Clean Water Act (CWA). The focus of the regulations is to protect specifically defined waterways, or "navigable waters of the United States" from potential oil contamination. "Navigable waters," is a broad term that includes, not only rivers, lakes, and oceans, but water channels such as streambeds and arroyos that connect to a river. On KAFB, this applies to the Tijeras Arroyo, which discharges to the Rio Grande.

Sandia Corporation's SPCC Plan describes oil storage facilities and the mitigation controls in place to prevent inadvertent discharges of oil (SNL 1999i). Regulated facilities are those that contain 660 gal of oil or more in one container or 1,320 gal of oil in multiple containers at one location. Facilities at SNL/NM subject to the regulations include:

- Oil storage tanks (USTs and ASTs),
- Bulk storage areas (multiple containers)
- Electrical transformers,
- Temporary or portable tanks, and
- Other oil-containing equipment.

Underground Storage Tanks (USTs)
In 1990, the State of New Mexico adopted federal standards contained in RCRA Subpart I for USTs. There are three USTs in inventory at SNL/NM: two 20,000 gal tanks at Bldg. 888 and one 9,730 gal tank at Bldg. 862. Applicable regulations are listed in Appendix B. Program documents are listed in Appendix C.

3.6 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE

ACTIVITIES

NEPA, signed into law in January 1970, is one of the nation's most comprehensive legislative and public policy statements on protection of the environment. It requires federal agencies to consider environmental impacts of their proposed activities and to prepare documentation on potential environmental impacts. Where these impacts may be significant, the process of assessing the impacts and determine subsequent agency action must provide for public review of the decision-making process.

NEPA Program
Sandia Corporation's NEPA Program, is coordinated with the DOE Kirtland Area Office (KAO). Sandia Corporation provides KAO with technical assistance on NEPA and resource protection laws, such as the Endangered Species Act (ESA) and the National Historic Preservation Act (NHPA). Sandia Corporation prepares NEPA Checklists on proposed actions or projects and sends them to KAO for review. KAO determines if the proposed action:

(1) Falls under a Categorical Exclusion,
(2) Has already been analyzed in an existing NEPA document, or
(3) Requires further NEPA documentation, such as an Environmental Assessment (EA) or Environmental Impact Statement (EIS).

NEPA program documents are listed in Appendix C.

DOE's NEPA Regulations
In 1996, DOE amended 10 CFR 1021, "National Environmental Policy Act," to incorporate changes to its regulations designed to increase DOE's efficiency and cost effectiveness in implementing NEPA requirements. DOE Order

451.1a, *National Environmental Policy Act Compliance Program* (DOE 1997b), establishes responsibilities and requirements to implement NEPA in conformance with DOE NEPA regulations. NEPA regulations are listed in Appendix B.

SNL/NM Site-Wide Environmental Impact Statement (SWEIS)

In 1997, the Department of Energy Albuquerque Operations Office (AL) announced its intention to prepare a SWEIS for SNL/NM. As a matter of policy, the DOE prepares such NEPA documents for its large, multi-facility installations.

The SWEIS allows DOE to "tier" its NEPA documents and reduce the need to revisit the same discussions for each new project proposed. In this way, DOE can focus on project-specific issues in its NEPA determinations. In November 1999, DOE issued the final SWEIS, and in December 1999, issued the Record of Decision (ROD). The ROD selected the "Expanded Operations" alternative as the preferred alternative. In accordance with 10 CFR 1021, DOE will examine the SWEIS in five years to decide if the analysis remains valid, or if a supplemental EIS should be prepared.

REFERENCES

(NMED 199__ SW) EIB/SWMR-4—Solid Waste Management Regulations

TC updates in this chapter done - 10/5/00

Chapter 4

Terrestrial Surveillance Program

There are two major activities conducted under the general term environmental monitoring. These are "environmental surveillance" and "effluent monitoring." Environmental surveillance is the collection of samples from the ambient environment such as from the atmosphere, groundwater, and earth materials. Effluent monitoring is the direct measurement or collection of samples from a specific source, such as a stack, catchment pond, or sewer outfall. The ultimate purpose of all environmental monitoring is to determine if there are any perceivable impacts to the environment and to ensure that applicable regulatory requirements are being met.

Terrestrial surveillance is the collection of natural materials at or near the earth's surface to characterize and measure the level of pollutants that have accumulated in the environment from air deposition, surface water runoff, and possible releases from past activities. Listed pollutants may also be derived from natural sources such as metallic elements present in rocks and soils. Sandia Corporation's Terrestrial Surveillance Program currently collects soil, sediment (from arroyos and rivers), vegetation, and surface water samples. Additionally, ambient levels of gamma radiation are measured with thermoluminescent dosimeters (TLDs). The Environmental Management Department at SNL/NM performs terrestrial surveillance sampling annually.

4.1 PROGRAM

BACKGROUND

Terrestrial Surveillance sampling began at SNL/NM in 1959 with the collection of soil samples for radiological analysis. In 1983, external gamma radiation measurements began. In 1993, the program was expanded to include nonradiological constituents by adding 21 metals to the parameter list. Sediments were also added under terrestrial media that year. Later in 1996, vegetation sampling began in conjunction with the expansion of the Ecological Program.

The major functions within the Terrestrial Surveillance Program include sample site selection, sample collection and direct field measurements, sample preservation and shipment, analytical procedures, statistical analysis (including trend analysis), and annual data reporting.

4.1.1 Program Objectives

The objective of the Terrestrial Surveillance Program can be summarized by the following excerpts based on requirements given in DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990):

- Collect and analyze samples so as to characterize environmental conditions, and define increasing or decreasing trends.
- Establish background levels of pollutants to define baseline conditions (offsite sampling).

- Provide continuing assessment of pollution abatement programs.
- Identify and quantify new or existing environmental quality problems and their potential impacts, if any.
- Verify compliance with applicable environmental laws and regulations and commitments made in National Environmental Policy Act (NEPA) documents, such as Environmental Impact Statements (EISs), as well as other official documents.

4.1.2 Regulatory Standards and Comparisons

The Terrestrial Surveillance Program is primarily interested in comparing samples collected from onsite and perimeter locations with samples from areas that represent background conditions. Background samples are taken at community locations in areas where "natural" conditions are present (i.e., not in areas of industry or heavy traffic). In addition to comparisons with offsite values, onsite and perimeter results are compared to Resource Conservation and Recovery Act (RCRA) Subpart S action levels, where established. These action levels define the contaminant threshold at which remediation actions may be triggered. Results are also compared to U.S. Surface Soil averages (for nonradiological metals) published in *Trace Elements in Soils and Plants* (CRC 1992). This gives a broad range of normal values for metals present in soils. The range of "normal" values for metal constituents in soil is affected by local mineralogy.

Concentration limits for radionuclides in soils are not well established. Although radiological standards exist for air and water, there are, as of yet, no state or federal regulatory standards for radiological contaminants in soil. Sandia Corporation follows the standards and requirements for deriving radionuclide levels in soils given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993).

The DOE Oversight Bureau of the New Mexico Environment Department (NMED) periodically splits samples with Sandia Corporation for an added measure of verification. Interested parties can obtain these comparison results from the Bureau upon request.

Jennifer Payne collects soil samples during the yearly terrestrial sampling event.

Statistical Analyses

The collection of samples in the field are, for the most part, taken from fixed locations to effectively make statistical comparisons with results from previous years. Statistical analysis is the method used to determine if a result is significantly different when compared to some determined standard. In this case, onsite and perimeter results are compared statistically to offsite results. Since multiple data points are necessary to provide an accurate view of a system (sample size), Sandia Corporation does not rely on the terrestrial results from any single year's sampling event to characterize environmental conditions onsite. Results of each year's sampling event are averaged with past sampling results to more effectively gauge the true level of contaminants present. Furthermore, results from a single sampling point can be variable from year to year based on fluctuating factors, such as slight changes in sampling locations, differences in climatic conditions, and laboratory variations or errors. Therefore, as the amount of data increases, the accuracy of the characterization increases.

Statistical trending is an important element in Sandia Corporation's analysis of onsite and perimeter conditions. Trending allows Sandia Corporation to assess an additional level of characterization by determining if specific contaminants are increasing, decreasing, or remaining at stable levels. Trends can vary from year to year; an increasing trend may be apparent one year and not the next. An increasing trend does not necessarily present a concern since the detected contaminant is often below offsite values and several magnitudes below regulatory action levels.

Consistent sampling and analysis procedures allows Sandia Corporation to identify statistically significant indicators.

Statistical analysis can also detect patterns of migration, which may point to movement of contaminants either onto or off of SNL/NM property. Early detection allows Sandia Corporation to assess, well in advance, any potential areas of concern and, if possible, to determine if elevated levels are derived from SNL/NM sources.

Any investigation is based on the risk present and is determined on a site-by-site basis. A site showing significantly elevated contaminants and/or increasing trends could trigger an investigation and mitigation actions. To date, there have been no terrestrial results that have indicated a significant level of concern that would trigger mitigation in areas that are not already being addressed by the ER Project.

4.2 SAMPLING LOCATIONS, PARAMETERS, AND TERRESTRIAL MEDIA

4.2.1 Sampling Locations

Annual sampling was performed in July 1999 at 72 fixed locations in three distinct areas:

- **Onsite** – 39 locations
- **Perimeter** – 17 locations
- **Offsite** – 16 locations
  (Nine of these locations are TLD stations.)

Tables 4-1 and 4-2 list the onsite and perimeter sampling locations and the terrestrial media sampled at each site. Table 4-3 provides similar information for offsite sampling locations.

Terrestrial surveillance activities begin with the selection and periodic review and assessment of sampling sites to determine which sites can best indicate potential environmental impacts from Sandia Corporation's operational activities. The criteria for selecting sampling sites is discussed below.

Criteria for Choosing Onsite and Perimeter Sampling Locations
New onsite and perimeter sampling sites are added as necessary (and as resources allow) to monitor changes in Sandia Corporation's activities, such as new facility start-ups (new effluent sources), initiation of environmental remediation activities (disturbed soil areas), and any new sites of contaminant discovery. A new sampling site may also be added to better characterize an area if elevated values or increasing trends are present. Conversely, some locations may be dropped from the survey if historical data continues to show that there is no concern at a particular site. This allows resources to be allocated in higher priority areas that are potentially more relevant. No new sites

TABLE 4-1. Onsite Terrestrial Surveillance Locations and Sample Types
There are 39 onsite sampling locations.

Location Number	Sampling Location	Vegetation	Soil	Sediment	TLD
1	Pennsylvania Ave.		⌖		▯
2NW	Mixed Waste Landfill (northwest)	❖	⌖		▯
2NE *	Mixed Waste Landfill (northeast)	❖	⌖		
2SE	Mixed Waste Landfill (southeast)		⌖		
2SW	Mixed Waste Landfill (southwest)		⌖		
3	Coyote Canyon Control		⌖		▯
6	TA-III (east of water tower)	❖	⌖		▯
7 *	Unnamed Arroyo (north of TA-V)		⌖		▯
20 *	TA-IV (southwest) (KAFB Skeet Range)	❖	⌖		▯
31	TA-II Guard Gate				▯
32S	TA-II, Bldg. 935 (south bay door)		⌖		
32E	TA-II, Bldg. 935 (east personnel door)		⌖		
33	Coyote Springs	❖	⌖		
34	Lurance Canyon Burn Site	❖	⌖		
35	Chemical Waste Landfill (CWL)	❖	⌖		
41	TA-V (northeast fence)		⌖		▯
42	TA-V (east fence)	❖	⌖		▯
43	TA-V (southeast fence)	❖	⌖		▯
45	RMWMF, TA-III (northwest corner)	❖	⌖		▯
45E	RMWMF, TA-III (east fence)				▯
46	TA-II (south corner)	❖	⌖		▯
47	Tijeras Arroyo (east of TA-IV)				▯
48	Tijeras Arroyo (east of TA-II)				▯
49	Near the Explosive Component Facility (ECF)	❖	⌖		
51	TA-V (north of culvert)	❖	⌖		
52	TA-III, northeast of Bldgs. 6716 and 6717	❖	⌖		
53 *	TA-III south of long sled track		⌖		
54	TA-III, Bldg. 6630		⌖		
55	Large Melt Facility (LMF), Bldg. 9939	❖	⌖		
56	TA-V, Bldg. 6588 (west corner)		⌖		
57	TA-IV, Bldg. 970 (northeast corner)		⌖		
66	KAFB Facility	❖	⌖		
72	Arroyo del Coyote (midstream)			⊗	
74N**	TA-IV, Tijeras Arroyo (midstream)			⊗	
75	Arroyo del Coyote (downgradient)			⊗	
76	Thunder Range (north)		⌖		
77	Thunder Range (south)		⌖		
78	School House Mesa		⌖		
79	Arroyo del Coyote (upgradient)			⊗	

NOTE: *Replicate sampling locations: In addition to single samples taken for each media, two replicate samples are collected for internal checks on consistency of laboratory results.
**Location 74 was moved slightly north and is now called 74N.
RMWMF = Radioactive and Mixed Waste Management Facility
TA = Tech Area
TLD = thermoluminescent dosimeter

TABLE 4-2. Perimeter Terrestrial Surveillance Locations and Sample Types
There are 17 perimeter sampling locations.

Location Number	Sampling Location	Vegetation	Soil	Sediment	TLD
4	Isleta Reservation Gate	❖	⌖		▯
5	McCormick Gate	❖	⌖		▯
12	Northeast Perimeter	❖	⌖		
16	Four Hills		⌖		▯
18	North Perimeter Road				▯
19	USGS Seismic Center Gate		⌖		▯
39	Northwest DOE Complex				▯
40	Tech Area I, northeast (by Bldg. 852)				▯
58	North KAFB Housing	❖	⌖		
59	Zia Park (southeast)		⌖		
60	Tijeras Arroyo (downgradient)	❖	⌖	⊗	
61	Albuquerque International Sunport (west)		⌖		
63	No Sweat Boulevard		⌖		
64 *	North Manzano Base	❖	⌖		
65E	Tijeras Arroyo, east (upgradient)		⌖	⊗	
73 *	Tijeras Arroyo (upgradient)			⊗	
80	Madera Canyon		⌖		

NOTE: *Replicate sampling locations: In addition to single samples taken for each media, two replicate samples are collected for internal checks on consistency of laboratory results.
TLD = thermoluminescent dosimeter

TABLE 4-3. Offsite (Community) Terrestrial Surveillance Locations and Sample Types
There are 16 offsite sampling locations within a 25-mile radius of SNL/NM.

Location Number	Sampling Location	Vegetation	Soil	Surface water	Sediments	TLD
8	Rio Grande, Corrales Bridge (upgradient)	❖	⌖	💧	⊗	
9	Sedillo Hill, I-40 (east of Albuquerque)	❖	⌖			
10	Oak Flats	❖	⌖			▯
11 *	Rio Grande, Isleta Pueblo (downgradient)	❖	⌖	💧	⊗	▯
21	Bernalillo Fire Station 10, Tijeras					▯
22	Los Lunas Fire Station					▯
23	Rio Rancho Fire Station, 19th Ave.					▯
24	Corrales Fire Station					▯
25	Placitas Fire Station	❖	⌖			▯
26	Albuquerque Fire Station 9, Menaul NE					▯
27	Albuquerque Fire Station 11, Southern SE					▯
28	Albuquerque Fire Station 2, High SE					▯
29	Albuquerque Fire Station 7, 47th NW					▯
30	Albuquerque Fire Station 6, Griegos NW					▯
62	East resident	❖	⌖			
68	Las Huertas Creek			💧	⊗	

NOTE: *Replicate sampling locations: In addition to single samples taken for each media, two replicated samples are collected for internal checks on consistency of laboratory results.
TLD = thermoluminescent dosimeter

were added in 1999. Figure 4-1 shows the locations for onsite and perimeter sampling sites.

Onsite – Onsite sampling locations are, for the most part, sited within or near areas of past or present Sandia Corporation operations. This includes SNL/NM's five technical areas and active and inactive sites within the land withdrawal such as the Burn Facility within Lurance Canyon. Locations are primarily chosen in areas of known contamination or in areas where contamination, if present, would have the greatest potential of accumulating. Other considerations that support the determination of an optimum sampling site include topography, wind direction, and the proximity to other sampling sites. Some sites, however, are chosen in areas not associated with any particular SNL/NM facility or operation. These onsite locations are designed to provide a representative profile of the general pollutant accumulation from SNL/NM facilities as a whole.

Perimeter – Perimeter sampling locations establish if contaminants are migrating either onto or off of SNL/NM property. Perimeter locations are sited at close proximity to SNL/NM operational areas but are not on SNL/NM property. As shown in Figure 4-1, perimeter sites may be on KAFB property or just outside the KAFB boundary.

Criteria for Choosing Offsite Sampling Locations

Offsite or "community" samples are collected from within a 25-mile radius of SNL/NM facilities (Figure 4-2). Offsite sampling locations are chosen in community areas where any pollutants present (due to human activities) would be very low. Community sites are chosen far enough away from SNL/NM facilities so as to ensure that any pollutants present could not be derived from Sandia Corporation's activities.

4.2.2 Terrestrial Media Samples

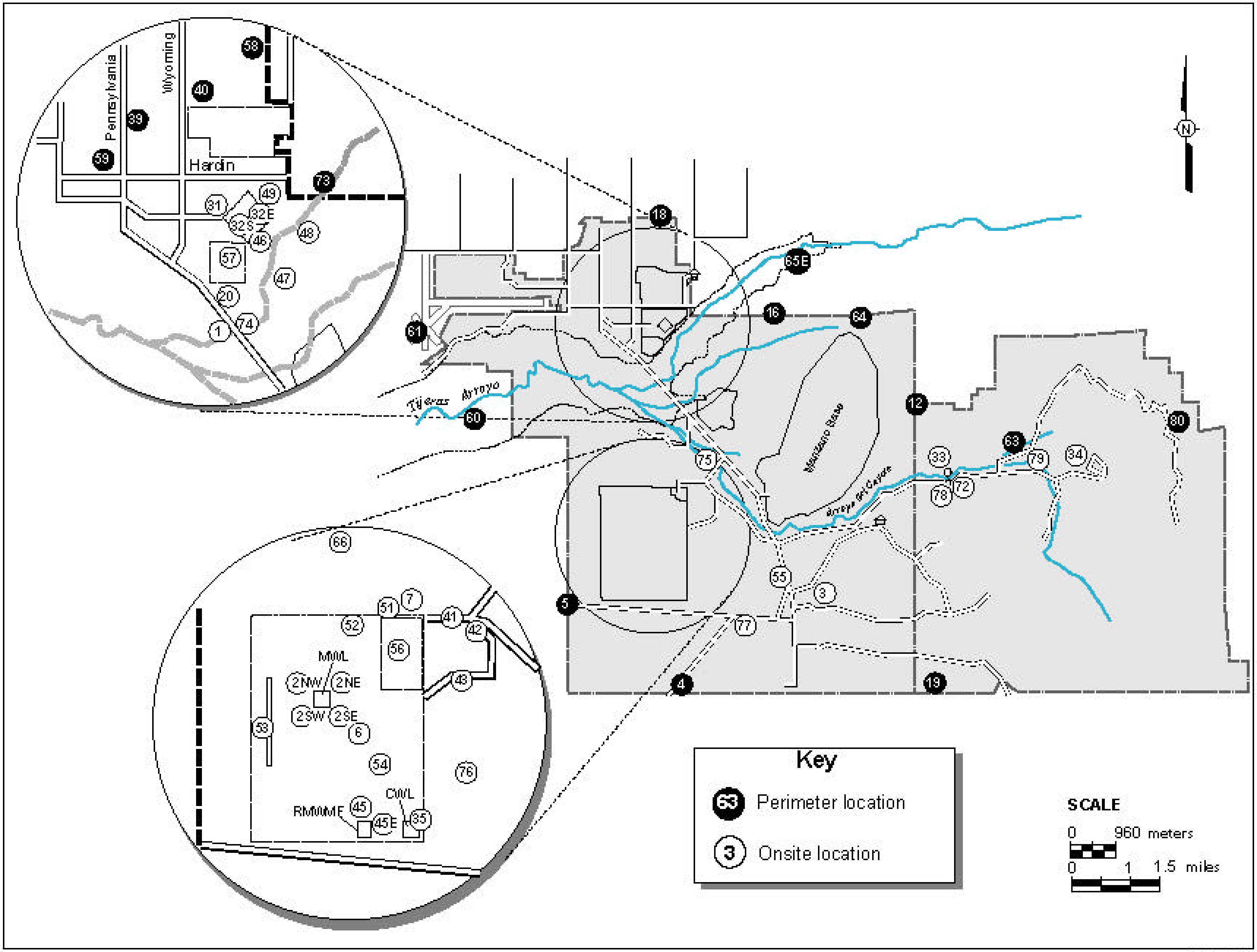
Table 4-4 shows the analytical methods performed on terrestrial media. The sample collection criteria and method are discussed below:

Soil – Soil samples are collected to ascertain the presence of air-deposited pollutants or contaminants that have been transported and deposited through surface runoff. Samples are collected by scooping off the top few inches of soil with a hand trowel. All samples are desiccated (dried) before analysis. In 1999, soil samples were collected from 50 locations (31 onsite, 13 perimeter, and six offsite locations).

TABLE 4-4. Analysis Performed on Environmental Media Sample Types

Media	Radiological Analysis					Nonradiological Analysis	
	Gross Alpha	Gross Beta	Gamma Spec	Tritium	U_{tot}	ICP-20 Metals	Percent Water
• Soil			✓	✓	✓	✓	✓
• Sediment			✓	✓	✓	✓	✓
• Vegetation			✓	✓	✓	✓	✓
• Surface Water							
- Filtered	✓	✓	✓	✓	✓	✓	
- Unfiltered	✓	✓	✓	✓	✓	✓	
- Filters (Suspended solids)	✓	✓	✓		✓	✓	

NOTE: ICP = Inductively Coupled Plasma (method)
U_{tot} = total uranium isotopes



00_4-1.ai

FIGURE 4-1. Onsite and Perimeter Sampling Locations *Onsite locations are within areas of SNL/NM operations. Perimeter locations are located both on and off KAFB property .*

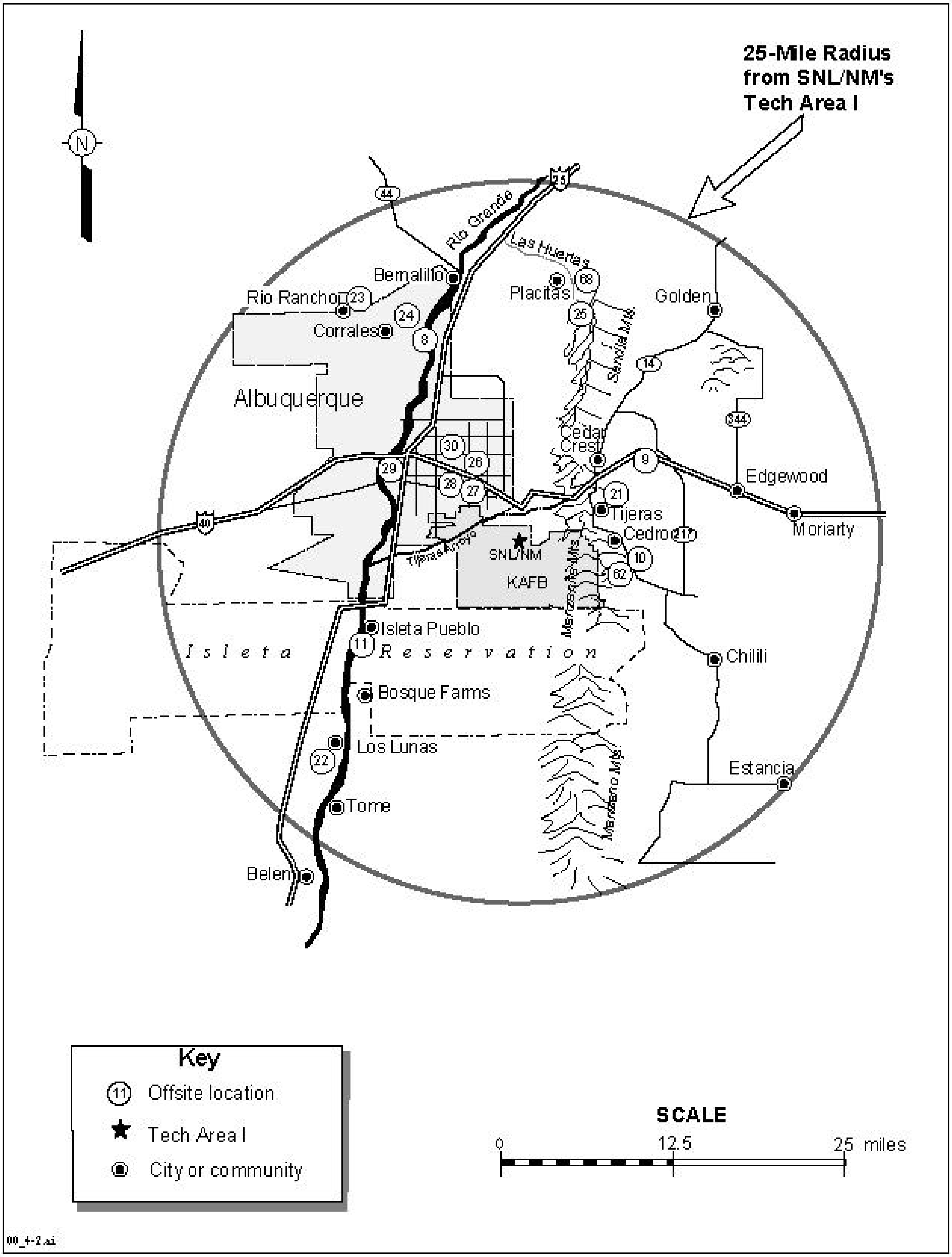


FIGURE 4-2. Offsite Sampling Locations

Sediment – Sediment samples are collected from four onsite locations within Tijeras Arroyo and Arroyo del Coyote to determine the presence of potential waterborne pollutants. Perimeter samples are collected at upgradient and downgradient locations within Tijeras Arroyo at locations a short distance off the KAFB boundary. Offsite sediment samples are collected from the banks of the Rio Grande and Las Huertas Creek. Sediment samples are collected in the same manner as soil sampling using a small trowel. All samples were desiccated before analysis. In 1999, sediment samples were collected from 10 locations (three offsite, four onsite, and three perimeter locations).

Vegetation – Vegetation is sampled to determine potential uptake of pollutants by plants, which hypothetically would be available to forage animals, thus providing a contaminant pathway to humans through the food chain. In actuality, this is unlikely since the only forage animals present on KAFB are deer and the horses at KAFB stables. No range cattle are allowed on KAFB. Samples are primarily collected from various grass species. Grass is chosen because of its abundance, but small leafy plants may be used where grass is not available. Samples are collected by cutting off the top few inches of growth from the plant. In 1999, samples were obtained from 28 locations (16 onsite, six perimeter, and six offsite locations).

Surface water – Surface water samples are not collected onsite by the Terrestrial Surveillance Program. The only perennial surface water available on KAFB is at several springs located in and near Arroyo del Coyote and one spring located in the Manzanita Mountains. Coyote Springs is sampled by Sandia Corporation's Groundwater Protection Program (GWPP); results are provided in Chapter 7 and Appendix E. Surface water samples are collected offsite at one creek and from the Rio Grande. River samples are collected at upgradient and downgradient locations relative to where Tijeras Arroyo discharges to the river. Because Tijeras Arroyo drains a large portion of KAFB, including SNL/NM operational areas, a difference between the two results could indicate potential sources contributed from facilities on KAFB. However, to date, no statistically significant differences have ever been observed between the two samples. All radionuclide contaminants detected have been within normal background levels. Samples are collected by grab sampling (dip off the surface) and are divided into three categories: unfiltered water (total water), filtered water (dissolved constituents), and suspended solids (>0.45 micron [µm]) collected off filters.

Thermoluminescent Dosimeters (TLDs)
Although TLD data have been measured since 1983, only 1991-1999 results were used in the statistical trending analysis in order to remain consistent with trend analyses performed on other terrestrial media.

4.2.3 Prioritization of Results

Terrestrial surveillance results are assigned to four categories to aid in the decision-making process that will determine the level of concern warranted to each result. The Statistical Analysis Prioritization Method (Shyr, Herrera, and Haaker 1998) is based on two "yes or no" questions resulting in a matrix of four answers labeled Category 1 to Category 4 (CAT-1 to CAT-4). The decision matrix is shown in Table 4-5. A CAT-1 result would be the most significant concern level indicating contaminants at an onsite or perimeter location that were both statistically higher than offsite values and demonstrating an increasing trend. (There has never been a CAT-1 result in the terrestrial sampling history at SNL/NM.) A CAT-2 result indicates a higher than offsite value but with no indication of an increasing trend. The level of concern for a CAT-2 site would be commensurate with the contaminant level present. A CAT-3 result indicates an increasing trend but is of low concern because the statistical averages for contaminant levels are lower than offsite averages. Finally, a CAT 4 result is equivalent to a background sample and there is no level of concern warranted.

4.3 RADIOLOGICAL PARAMETERS AND RESULTS

4.3.1 Radiological Parameters

Radiological analysis is performed on all soil, sediment, vegetation, and surface water samples as shown in Table 4-4. The complete report detailing 1999 terrestrial surveillance results is published in *1999 Data Analysis in Support of the Annual Site Environmental Report* (SNL 2000e). Radiological analyses include the following analytical procedures:

- ***Gross alpha*** analysis is a semi-quantitative technique for measuring overall radioactivity produced from alpha decay. An alpha particle is a helium nuclei (two protons and two neutrons). Alpha emitters include uranium, strontium, and plutonium. Currently, gross alpha analysis is only run on water samples. A high result may trigger an isotopic analysis to determine the specific radionuclides present.

- ***Gross beta*** analysis is a semi-quantitative technique for measuring overall radioactivity produced from beta decay. A beta particle may be negative (an electron) or positive (a positron). Beta emitters include neptunium and tritium. Currently, this test is only run on water samples. A high result may trigger an isotopic analysis to determine the specific radionuclides present.

TABLE 4-5. Decision Matrix for Determining Priority Action Levels Based on Categories Assigned at Each Sampling Location

Category	Are results higher than offsite?*	Is there an increasing trend over the last 9 years?	Priority for further investigation
1	**Yes**	**Yes**	**1st Priority** - Immediate attention needed. Specific investigation planned and/or notifications made to responsible parties.
2	**Yes**	No	**2nd Priority** - Some concern based on the level of contaminant present. This may be from a known site of contamination already being addressed under the ER Project. Investigation planned and/or notifications made to responsible parties.
3	No	**Yes**	**3rd Priority** - A minor concern since contaminants present are not higher than offsite averages. An investigation may or may not be needed.
4	No	No	**4th Priority** - No concern. No investigation required.

NOTE: Based on Prioritization Statistical Analysis Methodology (Shyr, Herrera, and Haaker 1998).
*While some sites may appear higher than offsite, there may not be a statistically significant difference.

Gamma spectroscopy detects the emission of gamma radiation from unstable atomic nuclei. Gamma radiation is a high energy photon that produces an identifiable signature (emission spectrum). This signature energy allows the specific radionuclide to be identified. Gamma emitters include cesium-137.

- ***Tritium*** is a radioactive isotope of hydrogen with a half-life of 12.5 yrs. An ordinary hydrogen atom has one proton and one electron; the tritium isotope (H^3) has an additional two neutrons. Tritium occurs naturally in the environment and is also a common contaminant related to nuclear weapons research and development.

- ***Uranium, total (U_{tot})*** analysis measures all uranium isotopes present in a sample. Uranium isotopes have 92 protons and 142 or more neutrons present. Isotopes include uranium-234, -235, -236, -238, and -239/240. A high U_{tot} measurement may trigger an isotope-specific analysis.

- ***Thermoluminescent dosimeters (TLDs)*** measure the ambient levels of gamma radiation in the environment. The dosimeters are placed on aluminum poles at a height of 1 to 1.5 m and are measured and exchanged quarterly (January, April, July, and October) at 34 stations. Gamma radiation may derive from natural sources such as cosmic radiation and geologic materials, or man-made activities and products. At SNL/NM, low levels of gamma radiation may be measured just outside high-energy test facilities at SNL/NM, such as reactor and accelerator facilities, and near the Radioactive and Mixed Waste Management Facility (RMWMF). TLD stations next to these types of facilities measure operational levels and are not considered representative of ambient gamma radiation levels.

Change in TLD Station Status

In 1996, the Radioactive and Mixed Waste Management Facility (RMWMF) opened for operation. As a result of handling low-level radioactive waste (LLW), the facility began emitting low levels of gamma radiation. The increase was detected at two nearby TLD stations. However, because the RMWMF is an operational area and DOE thresholds are higher for radioactive material areas, locations 45 and 45E are no longer considered representative for ambient onsite levels of gamma radiation. Results from these TLD stations are reported quarterly to RMWMF facility personnel.

4.3.2 Overview Discussion of Radiological Results

Seven out of 56 onsite and perimeter sampling sites showed elevated values (CAT-2) for radiological parameters in soil samples and one vegetation sample. Seven sites showed below offsite averages but with increasing trends (CAT-3). Tritium and cesium-137 were the only radiological constituents that were elevated or showed increasing trends. Locations with CAT-2 results are discussed as follows:

- **Location 2NE** is one of four locations outside the fence at each corner of the Mixed Waste Landfill (MWL). The MWL is a known site of tritium contamination being addressed by the ER Project. Location 2NE on the northeast corner was elevated for tritium in both vegetation and soil samples. Conversely, a decreasing trend in tritium values was observed at the northwest sampling site (2NW). Location 2NW did show an increasing trend for cesium-137. The two locations at the southern boundary (2SW and 2SE) showed no radiological parameters as elevated or increasing (CAT-4).

- **Location 32S and 32E** are near Bldg. 935 in Tech Area II (ER Site 159). This area was previously used for explosive testing on neutron generators. Tritium, a known contaminant at this site, was elevated in soil samples. This site is being addressed by the ER Project. In June 1995, the ER Project proposed the site for No Further Action (NFA) after contamination levels were found to be below regulatory concern.

- **Location 64** on the north end of Manzano Base is located just west of the land withdrawal and just south of the KAFB fenceline near the Four Hills subdivision. This location was elevated for cesium-137 (CAT-2) and also showed an increasing trend for tritium for the first time (CAT-3).

- **Locations 12, 34, and 80** are located on the withdrawal and were each elevated for cesium-137 in soils. Location 12 and 80 are both perimeter locations. Location 34 is located near the active Burn Site in Lurance Canyon.

Four onsite locations and two perimeter locations showed increasing trends for cesium-137 in soil or sediment. Coyote Springs (33), the RMWMF (45), and the MWL (2NE and 2NW) are the onsite locations. Increasing trends in cesium-137 were also seen at one offsite location near Corrales Bridge (8). No onsite locations showed increasing tritium values, although perimeter location 64 was CAT-3 for tritium.

Radiological results are located on the map in Figure 4-3 and summarized in Table 4-6.

4.3.3 Radiological Results

Vegetation Results

CAT-2

Tritium		Vegetation, CAT-2
Location	***1991–1999 Avg***	***Offsite Avg***
2NE	9.63 pCi/ml	0.035 pCi/ml

Tritium values at location 2NE near the Mixed Waste Landfill (MWL) over the last nine years of sampling have ranged from 0.68 to 26 pCi/ml.

Soil Results

CAT-2

Tritium		Soil, CAT-2
Location	**1991–1999 Avg**	**Offsite Avg**
32E, 32S, 2NE	176.39 pCi/ml	0.152 pCi/ml

The average value for the three onsite locations elevated for **tritium** was 176.39 pCi/ml. There was no change in the 1997 status for CAT-2 sites for tritium. Two sites are near Tech Area II (32E and 32 S) and one site is near the MWL. Both are areas of known tritium contamination being addressed by the ER Project. Results are consistent with past measurements and there is no indication of an increasing trend.

■

Cesium-137		Soil, CAT- 2
Location	**1991–1999 Avg**	**Offsite Avg**
12, 34, 64, 80	1.037 pCi/g	0.298 pCi/g

Higher than offsite results for **cesium-137** were noted at four locations on or near the land withdrawal (12, 34, 64, and 80). These sites were also elevated last year.

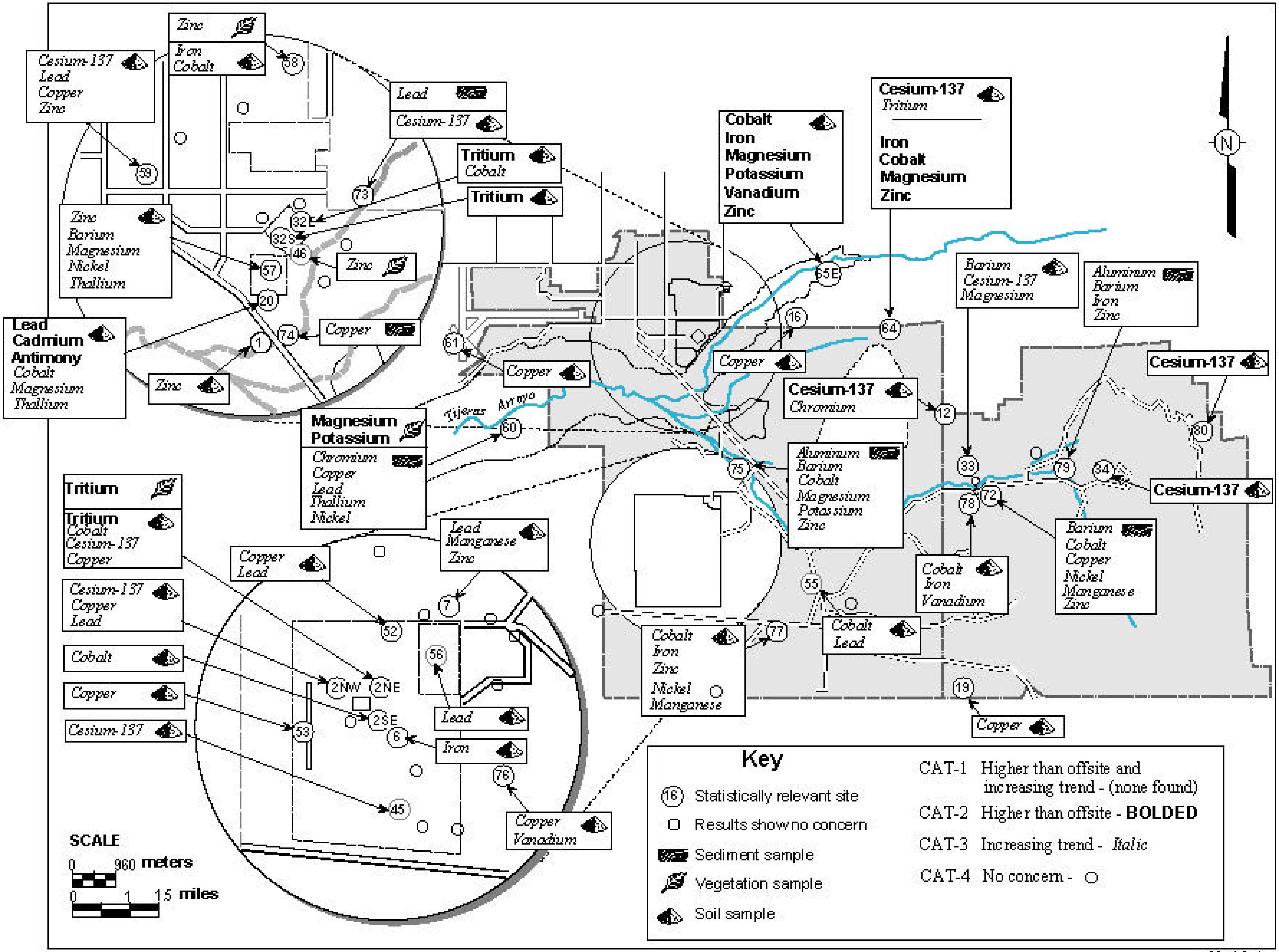


FIGURE 4-3. Statistically Relevant Results for Terrestrial Media for Onsite and Perimeter Locations in 1999
The icons show the media type for which CAT-2 or CAT-3 results were reported.

TABLE 4-6. Radiological Parameters Listed by Category 2 and 3 for Each Media Type

Media	Priority/ Media	Location	Parameter	Units	Onsite Average	Offsite Average	U.S. Surface Soil
Vegetation	CAT-2	2NE	Tritium	pCi/ml	9.63	0.035	not avail
Soil	CAT-2	2NE, 32E, 32S	Tritium	pCi/ml	176.4	0.152	not avail
		12, 34, 64, 80	Cesium-137	pCi/g	1.037	0.298	0.3 – 25 ppm*
Soil	CAT-3	64	Tritium	pCi/ml	0.598	0.037	not avail
		2NE, 2NW, 33, 45, 59	Cesium-137	pCi/g	0.304	0.298	not avail
		73	Cesium-137	pCi/g	0.038	0.102	not avail

NOTE: * Value from *Elements in North American Soils* (Dragun & Chiasson 1991).
RCRA Subpart S action levels are not established for radionuclides.

(Soil Results Continued)

CAT-3

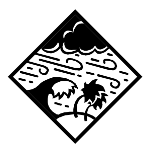
Tritium		Soil, CAT- 3
Location	**1991–1999 Avg**	**Offsite Avg**
64	0.598 pCi/g	0.037 pCi/g

Tritium results for location 64 over nine years have ranged from – 0.12 to 3.20 pCi/ml (a negative value essentially indicates a zero reading, and four of the 13 results were below the detection limit). Although there is an apparent elevation of onsite results, there is no significant statistical difference between onsite and offsite averages.

■

Cesium-137		Soil, CAT - 3
Location	**1991–1999 Avg**	**Offsite Avg**
2NE, 2NW, 59, 33, 45	0.304 pCi/g	0.298 pCi/g

Three sites continue to show an increasing trend for **cesium-137**: 2NE and 2NW near the MWL, and 59, west of Tech Area I. Two new locations, Coyote Springs (33) and the northwest corner of the RMWMF (45), also showed an increasing trend for cesium-137 for the first time this year. Onsite and perimeter sample results over the last nine years have ranged from 0 to 0.78 pCi/g. These values are within the range of background cesium-137 concentrations from soils in the Albuquerque vicinity (Hostak 1995).



Sediment Results

CAT-3

Cesium-137		Sed, CAT - 3
Location	**1991–1999 Avg**	**Offsite Avg**
73	0.038 pCi/g	0.102 pCi/g

An increasing trend for **cesium-137** was seen in sediments at perimeter location 73, just north of the KAFB boundary within the Tijeras Arroyo. Results over nine years have ranged from – 0.01 to 0.09 pCi/g (a negative value essentially indicates a zero value.) It should also be noted that a community location at the Corrales Bridge (8) also showed an increasing trend for cesium-137. The offsite average for the Corrales Bridge location ranged from 0.01 to 0.21 pCi/g with an average result of 0.114 pCi/g.

False Uranium Trend

Trending analysis in 1997 showed an apparent increasing trend in the level of total uranium isotopes (U_{tot}) in soil. However, it was later discovered that this was due to a laboratory error in reporting 1991 and 1992 results too low. The mistake was revealed in early 1999 during an audit at the laboratory. In an interview with lab personnel, it was found that there had been mechanical difficulties with the laboratory equipment used to measure U_{tot} during the 1991-1992 time frame. The lab had the equipment checked and serviced at least twice during this time after consistently low recovery rates for radiological parameters had been noticed. Based on this information, the data was deleted from the statistical analysis and the analysis was run again. The adjusted data set produced no evidence of an increasing trend in uranium isotopes.

Surface Water Results

Surface water samples are not collected on KAFB by the Terrestrial Surveillance Program. Two samples from the Rio Grande were collected at upgradient and downgradient locations relative to the Tijeras Arroyo discharge point to the river. There was no statistical difference in samples from both locations. Radionuclides detected were measured at normal background levels in both samples.

Thermoluminescent Dosimeter (TLD) Results

The 1999 sampling period took place from January 7, 1999 to January 18, 2000. Table 4-7 shows the average exposures over the last nine years from 1991 to 1999. Table 4-8 shows detailed results from 1999 with high and low

TABLE 4-8. TLD Results for 1999

values as well as the average. As can be seen by the nine-year average (Table 4-8), TLD average values for onsite stations (101.02 mrem/yr) are only slightly higher but still statistically indistinguishable from offsite and perimeter values (98.79 and 96.82 mrem/yr). Table 4-9, 1999 also shows reflects slightly higher onsite results as compared to perimeter and offsite results. Figure 4-4 graphically portrays TLD results from 1991 to 1999. (Operational TLD stations were not used in the analyses.)

TABLE 4-7. TLD Average Exposure by Year 1991-1999

Year	SNL/NM (mrem/yr)	Perimeter (mrem/yr)	Community (mrem/yr)
1991	92.51	88.86	90.60
1992	103.05	100.64	100.55
1993	97.91	94.80	95.35
1994	102.85	101.03	99.63
1995	99.95	98.73	97.86
1996	105.81	102.19	99.50
1997	101.40	97.48	96.12
1998	96.35	95.73	93.71
1999	109.32	109.64	98.03
Average	101.02	98.79	96.82
Std Dev	5.06	5.74	3.21
Minimum	92.51	88.86	90.60
Maximum	109.32	109.64	100.55
Range	16.81	20.78	9.95

4.4 NONRADIOLOGICAL PARAMETERS AND RESULTS

4.4.1 Nonradiological Parameters

Beginning in 1993, the scope of the Terrestrial Surveillance Program was broadened to include sample analysis of certain metals that are key indicators of contaminants in soil. The list of 21 metals has been modified over time to best

Location Class	Sample Size	Mean (mrem/yr)	Std Dev* (mrem/yr)	Minimum (mrem/yr)	Maximum (mrem/yr)
SNL/NM (Operational)	2	133.40	25.17	115.60	151.20
SNL/NM (Onsite)	14	109.32	5.91	99.50	116.50
Perimeter	7	109.64	9.71	97.90	127.20
Offsite	12	98.03	10.75	85.50	116.90

NOTE: *Standard deviation

represent a broad range of toxic pollutant indicators based on RCRA and CERCLA target list metals. With the exception of mercury, the presence and quantity of all analytes are determined by EPA's Inductively Coupled Plasma-Atomic Emission Spectrum (ICP-AES) method. When samples are super-heated to a plasma state, individual elements can be identified by the atomic emission spectrum they emit. For this reason, the list of metals is often referred to as ICP-20 metals.

ICP-20 Metals

The terrestrial surveillance team has modified the analyte list over time, selecting the most useful metals. For example, calcium, silicon, strontium, and titanium were removed from the list since they are naturally abundant in the soil and are not useful indicators of pollution. These metals were replaced with more representative indicators (antimony, arsenic, selenium, and thallium). The current list of 21 metals including mercury is as follows:

Aluminum (Al)	Antimony (Sb)
Arsenic (As)	Barium (Ba)
Beryllium (Be)	Cadmium (Cd)
Chromium (Cr)	Cobalt (Co)
Copper (Cu)	Iron (Fe)
Lead (Pb)	Manganese (Mn)
Magnesium (Mg)	Mercury (Hg)
Nickel (Ni)	Potassium (K)
Selenium (Se)	Silver (Ag)
Thallium (Tl)	Vanadium (V)
Zinc (Zn)	

As was done for radiological results, locations were categorized from CAT-1 to CAT-4 based on the contamination present and the results of the trend analysis. There were no sites designated as CAT-1. CAT-4 locations are not discussed because they are of no environmental concern. Figure 4-3 shows locations where nonradionuclide contaminants are elevated or show an increasing trend. A complete report detailing terrestrial surveillance data results can be found in the *1999 Data Analysis in Support of the Annual Site Environmental Report* (SNL 2000e).

4.4.2 Overview Discussion of Nonradionuclide Results

A summary of all nonradionuclide results is presented in Table 4-9. Soil results were averaged over seven years and vegetation results were averaged over four years. Average values were compared with average offsite values over the same time period. Soil results were also compared to RCRA Subpart S action levels and U.S. Surface Soil averages, where established (CRC 1992).

Soil Results

Over half of the soil sites sampled (33 of the 56) at onsite and perimeter locations were designated as CAT-4 for nonradionuclides (all media). Many of these sites showed values significantly below community levels and/or demonstrated decreasing trends.

Sediment Results

Similar to last year's analysis, there was no *statistical* difference between onsite and perimeter location results as compared to offsite

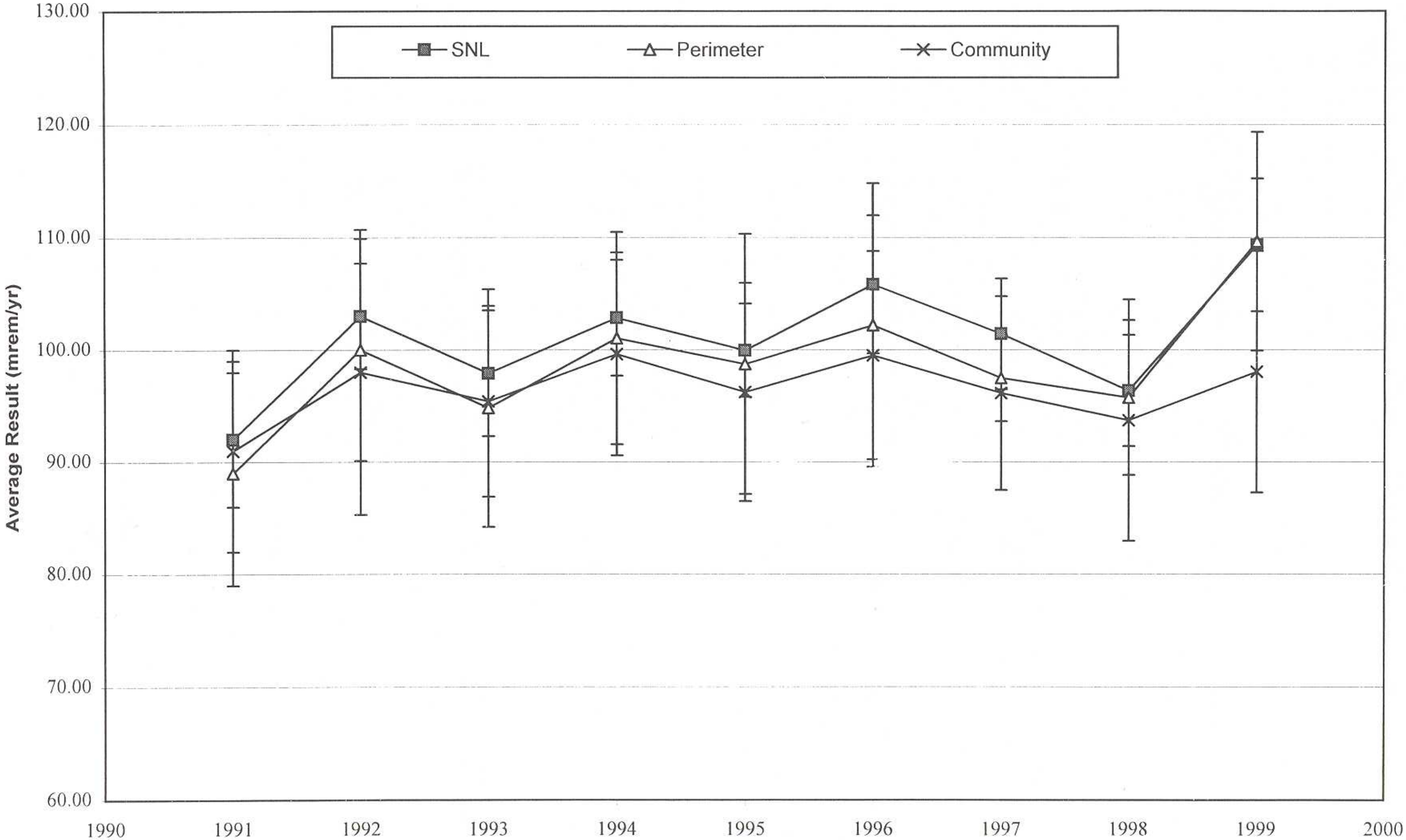


FIGURE 4-4. TLD Results Summarized Over the Past Nine Years (1991-1999)

TABLE 4-9. Nonradiological Parameters Listed by Category 2 and 3 for Each Media Type

Category Media	Location	Parameter	Units	Onsite/ Perimeter Avg	Offsite Avg	RCRA Subpart S Level	U.S. Surface Soil
CAT-2 Vegetation	60	Magnesium	mg/kg	5,325	1,275	N/A	N/A
	60	Potassium	mg/kg	57,250	14,820	N/A	N/A
CAT-3 Vegetation	20	Magnesium	mg/kg	1,158	1,275	N/A	N/A
	46, 58	Zinc	mg/kg	30.63	20.67	N/A	N/A
CAT-2 Soil	20	Antimony	mg/kg	106.3	5.00	none	0.25–.6
	20	Cadmium	mg/kg	1.72	0.52	40	0.41–0.57
	64	Cobalt	mg/kg	8.40	5.35	4,800	3–50
	65E	Cobalt	mg/kg	9.50	5.35	4,800	3–50
	64	Iron	mg/kg	20,800	12,570	21,000	1,000–100,000
	65E	Iron	mg/kg	22,500	12,570	21,000	1,000–100,000
	20	Lead	mg/kg	6,161	19.06	none	10–70
	64	Magnesium	mg/kg	6,480	3,565	460,000	300–100,000
	65E	Magnesium	mg/kg	8,233	3,565	460,000	300–100,000
	65E	Potassium	mg/kg	4,583	2,485	100,000	1,900–63,000 *
	65E	Vanadium	mg/kg	37.83	24.25	560	0.7–98
	64	Zinc	mg/kg	77.70	43.48	23,000	13–300
	65E	Zinc	mg/kg	80.33	43.48	23,000	13–300
CAT-3 Soil	33, 57	Barium	mg/kg	151.2	163.10	5,600	20–1,500
	2NE, 2SE, 32E, 55, 58, 77, 78	Cobalt	mg/kg	3.73	5.35	4,800	3–50
	20	Cobalt	mg/kg	5.32	5.35	4,800	3–50
	2NE, 2NW, 52, 53, 76, 16, 19, 59, 61	Copper	mg/kg	9.34	13.24	2,960	3–300
	6, 77, 78, 58	Iron	mg/kg	10,931	12,570	21,000	1,000–100,000
	2NW, 7, 52, 55, 56, 59, 60	Lead	mg/kg	11.00	19.07	none	10–70
	33, 57	Magnesium	mg/kg	4,235	3,565	460,000	300–100,000
	7, 77	Manganese	mg/kg	201.3	361.5	400	20–3,000
	57, 77	Nickel	mg/kg	7.27	10.7	1,600	< 5–150
	65E	Thallium	mg/kg	26.75	15.17	none	none
	57, 60	Thallium	mg/kg	16.37	15.17	none	none
	76, 78	Vanadium	mg/kg	15.75	24.25	560	0.7–98
	1, 7, 57, 77, 59	Zinc	mg/kg	35.50	43.48	23,000	13–300
CAT-3 Sediment	72, 75	Aluminum	mg/kg	6,555	8,140	80,000	none
	72, 75, 79	Barium	mg/kg	92.95	190.6	5,600	20–1,500
	60	Chromium	mg/kg	27.56	29.63	400	7–1,500
	72, 75	Cobalt	mg/kg	4.46	4.30	4,800	3–50
	72, 74, 60	Copper	mg/kg	10.10	9.90	3,000	3–300
	79	Iron	mg/kg	8,633	10,390	21,000	1,000–100,000
	73	Lead	mg/kg	5.65	13.30	none	10–70
	75	Magnesium	mg/kg	3,120	3,722	460,000	300–100,000
	72	Manganese	mg/kg	246	283	400	20–3,000
	72, 60	Nickel	mg/kg	7.65	8.70	1,600	< 5–150
	75	Potassium	mg/kg	1,116	1,811	100,000	none
	72, 75, 79	Zinc	mg/kg	31.24	39.00	23,000	13–300

NOTE: All values have been rounded to four significant figures or less.
*U.S. soil average not available. Value is New Mexico soil average.
N/A = not applicable.

results. All four onsite sediment locations showed an increasing trend for at least one metal. Two of the three perimeter locations also showed increasing trends for various metals. It should be noted that the offsite sediment samples near the Corrales Bridge (8) also showed increasing trends for metals, specifically, aluminum, barium, copper, magnesium, manganese, nickel, vanadium, and zinc.

Vegetation Results

Because vegetation sampling did not begin until 1996, the sample size has been too small until this year to perform a trend analysis. Four years of data indicated increasing trends in metals for vegetation at three locations. One perimeter location (60) showed higher than offsite results for magnesium and potassium. Three soil samples and one vegetation sample were elevated for several metals (CAT-2). These four sites are discussed below:

- ***Soil* – Location 20** is located near the Air Force Skeet Range, which is now closed and undergoing remediation. Since the skeet range is Air Force property, Sandia Corporation is not involved in the cleanup. This location was again elevated for lead and cadmium in soil, as was seen last year, which can be expected given the lead shot in the soil. Antimony, which is associated with lead, was elevated for the first time this year. Increasing trends for cobalt, magnesium, and thallium were also noted (CAT-3), although average values for these metals remained below offsite averages. Lead values are expected to remain above normal. To determine whether or not lead is leaching into the soil, a toxicity characteristic leaching procedure (TCLP) for lead was conducted in 1996, 1997, and 1998. Results indicated that lead was not leaching into the soil. This area will continue to be monitored.

- ***Soil* – Location 64**, located at the north end of Manzano Base, was elevated for iron, cobalt, magnesium, and zinc in soil. This is the same result as last year with the exception of manganese, which was elevated for the last two years, but was not statistically above offsite values this year. Last year, an increasing trend for chromium was observed, but this year no metals showed increasing trends.

- ***Soil* – Location 65E**, a new perimeter site added in 1995, is located within the upgradient portion of Tijeras Arroyo near the Four Hills Subdivision area. This location was elevated for cobalt, iron, magnesium, potassium, vanadium, and zinc. This is the first year that vanadium was reported as statistically higher than community values. Previously, manganese was reported higher than community values, but did not appear to be statistically significant in 1999. Thallium was observed to have an increasing trend in this location.

- ***Vegetation* – Location 60**, a perimeter site, is located within the downgradient portion of Tijeras Arroyo just off KAFB. This site was elevated for magnesium and potassium in vegetation samples and showed increasing trends for chromium and copper in sediments similar to what was observed last year. (Additionally, three new metals showed increasing trends in the sediments at this location: lead, thallium, and nickel. Zinc, which showed increasing trends last year, was not statistically significant this year.)

Trends

Multiple locations showed increasing trends in metal constituents for soils and sediment, although average values remain below statistical offsite averages (CAT-3). These locations are shown on the map in Figure 4-3. It should be noted that statistical trends vary from year to year. For example, there were 12 sites that showed increasing trends for metals in 1999, which were not observed the year before. There were also 10 sites that showed increasing trends in 1998 that did not show increasing trends in 1999.

4.4.3 Nonradiological Results

Vegetation Results

CAT-2

Magnesium	Vegetation, CAT-2	
Location	**1996–1999 Avg**	**Offsite Avg**
60	5,325 mg/kg	1,275 mg/kg

Potassium	Vegetation, CAT-2	
Location	**1996–1999 Avg**	**Offsite Avg**
60	57,250 mg/kg	14,820 mg/kg

Location 60 continued to show elevated **magnesium** and **potassium** values. The average value for both potassium and magnesium over four years is approximately four times higher than offsite values. Monitoring will continue at this location.

CAT-3

Magnesium	Vegetation, CAT-3	
Location	**1996–1999 Avg**	**Offsite Avg**
20	1,157 mg/kg	1,275 mg/kg

An increasing trend for **magnesium** was observed at the Air Force Skeet Range (20). Results over the past four years have ranged from 730 to 1,400 mg/kg.

■

Zinc	Vegetation, CAT-3	
Location	**1996–1999 Avg**	**Offsite Avg**
46, 58	30.63 mg/kg	20.67 mg/kg

Two locations, 46 and 58, showed an increasing trend for **zinc** for the first time this year. Location 46, south end of Tech Area II, showed values of 21 to 34 mg/kg. Location 58, located within the North KAFB Housing, showed a range of 27 to 44 mg/kg in the last four years. Since this is the first year that an increasing trend was noted, all three of these locations will continue to be monitored.

Soil Results

CAT-2

Antimony	Soil, CAT-2	
Location	**1996–1999 Avg**	**Offsite Avg**
20	106.3 mg/kg	5 mg/kg

Antimony was added to the parameter list in 1996. This is the first year that antimony values were statistically significant in elevated values. All other sampling locations including community sites showed antimony values at the detection limit of 5 mg/kg. The average value for antimony measured over four years was 106.3 mg/kg. The result for antimony in 1996, 320 mg/kg, was almost four times higher than the next highest value of 81 mg/kg recorded in 1997. Results for antimony in 1998 and 1999 were 9 mg/kg and 15 mg/kg, respectively. The highest value of antimony corresponds to the highest value of lead during this same four-year time period. Conversely, lower values of antimony correspond to lower values of lead.

■

Cadmium	Soil, CAT-2	
Location	**1993–1999 Avg**	**Offsite Avg**
20	1.72 mg/kg	0.52 mg/kg

Cadmium values ranged from 0.5 to 2.8 mg/kg at location 20. The majority of offsite values for cadmium were 0.5 mg/kg, which is the method detection limit. Recorded values are considerably below the proposed RCRA Subpart S action level of 40 mg/kg.

■

Cobalt		Soil, CAT-2
Location	**1993–1999 Avg**	**Offsite Avg**
64	8.40 mg/kg	5.35 mg/kg

Cobalt		Soil, CAT-2
Location	**1995–1999 Avg**	**Offsite Avg**
65E	9.50 mg/kg	5.35 mg/kg

The maximum **cobalt** concentration at location 64 was 14 mg/kg recorded in August 1993. This is well below the proposed RCRA Subpart S action level of 4,800 mg/kg and also within the range of U.S. Surface Soil background cobalt concentrations, 3 to 50 mg/kg (CRC 1992).

Location 65E, added in 1995, was averaged separately. The maximum cobalt result at 65E was 12 mg/kg reported in 1996. This is significantly below the proposed RCRA action limit of 4,800 mg/kg, and well within the average U.S. Surface Soil background levels of 3 to 50 mg/kg (CRC 1992).

■

Iron		Soil, CAT-2
Location	**1993–1999 Avg**	**Offsite Avg**
64	20,800 mg/kg	12,570 mg/kg

Iron		Soil, CAT-2
Location	**1995–1999 Avg**	**Offsite Avg**
65E	22,500 mg/kg	12,570 mg/kg

The average concentration of **iron** at location 64 was 20,800 mg/kg. The maximum concentration of 29,000 mg/kg was recorded in August 1993; the minimum concentration of 17,000 mg/kg was recorded in August 1994 and July 1997.

Location 65E (added in 1995) was averaged separately. The average concentration at this site was 22,500 mg/kg. The maximum iron concentration at location 65E was 28,000 mg/kg, reported in 1996 and again in 1998.

The proposed RCRA Subpart S action level for iron is 21,000 mg/kg, which is close to the averages reported at both locations. However, the iron concentration falls well within the U.S. Surface Soil background levels of 1,000 to 100,000 mg/kg (CRC 1992). EPA considers iron only a moderately hazardous metal. Monitoring will continue at both of these locations.

■

Lead		Soil CAT-2
Location	**1993–1999 Avg**	**Offsite Avg**
20	6,161 mg/kg	19.06 mg/kg

The value for **lead** at location 20 averaged over the last seven years, was 6,161 mg/kg (1993-1999), as compared to average offsite lead values of 19.1 mg/kg over the same time frame. The high values (240 to 16,000 mg/kg) are not surprising considering the large amount of lead shot in the soil.

■

Magnesium		Soil, CAT-2
Location	**1993–1999 Avg**	**Offsite Avg**
64	6,480 mg/kg	3,565 mg/kg

Magnesium		Soil, CAT-2
Location	**1995–1999 Avg**	**Offsite Avg**
65E	8,233 mg/kg	3,565 mg/kg

The maximum **magnesium** concentration at location 64 was recorded in August 1993 at 9,400 mg/kg. The maximum magnesium concentration at location 65E was 11,000 mg/kg reported in 1996 and again in 1998. Both of these values are well below the proposed RCRA Subpart S action level of 460,000 mg/kg and also within the range of U.S. Surface Soil background magnesium concentrations of 300 to 100,000 mg/kg (CRC 1992). Magnesium is considered a low hazardous metal. Monitoring will continue at both of these locations.

■

Potassium		Soil, CAT-2
Location	**1995–1999 Avg**	**Offsite Avg**
65E	4,583 mg/kg	2,485 mg/kg

Potassium concentrations at location 65E ranged from 2,200 to 6,800 mg/kg. The average potassium concentration was 4,583 mg/kg. This is significantly below the proposed RCRA action limit of 100,000 mg/kg. U.S. Surface Soil background concentrations are not available, but the surface soil concentrations for New Mexico are 1,900 to 63,000 mg/kg (CRC 1992).

■

Vanadium		Soil, CAT-2
Location	1995–1999 Avg	Offsite Avg
65E	37.83 mg/kg	24.25 mg/kg

Vanadium concentrations at location 65E were noted higher than community for the first time this year. The average vanadium concentration at location 65E is 37.83 mg/kg. This is significantly below the proposed RCRA Subpart S action level of 560 mg/kg. Concentrations are also within the U.S. Surface Soil background concentration of 0.7 to 98 mg/kg (CRC 1992). Monitoring at this location will continue and any developing trends noted.

■

Zinc		Soil, CAT-2
Location	1995–1999 Avg	Offsite Avg
65E	80.33 mg/kg	43.48 mg/kg

Zinc		Soil, CAT-2
Location	1993–1999 Avg	Offsite Avg
64	77.70 mg/kg	43.48 mg/kg

Zinc concentrations at location 65E ranged from 41 to 100 mg/kg with an average value of 80.33 mg/kg. The maximum value for zinc at location 64 was reported in August 1993 at 110 mg/kg. Since then, values have ranged from 64 to 78 mg/kg with an average of 77.70 mg/kg. Both results are below the proposed RCRA action limit of 23,000 mg/kg. Concentrations are also well within the U.S. Surface Soil background concentration of 13 to 300 mg/kg (CRC 1992). Monitoring at these locations will continue and any developing trends noted.

CAT-3

Barium		Soil, CAT-3
Location	1993–1999 Avg	Offsite Avg
33, 57	151.2 mg/kg	163.13 mg/kg

Location 33, Coyote Springs, showed an increasing trend for **barium** in soil similar to last year. Values ranged from 86 to 150 mg/kg. Location 57 showed an increasing trend for barium for the first time this year. Concentrations ranged from 140 to 240 mg/kg. The average value for both locations is well below the proposed RCRA Subpart S action level of 5,600 mg/kg and falls within the range of 20 to 1,500 mg/kg for U.S. Surface Soils (CRC 1992). Monitoring will continue at both of these locations.

■

Cobalt		Soil, CAT-3
Location	1993–1999 Avg	Offsite Avg
2NE, 2SE, 32E, 55, 58, 77, 78	3.73 mg/kg	5.35 mg/kg

Cobalt		Soil, CAT-3
Location	1993–1999 Avg	Offsite Avg
20	5.32 mg/kg	5.35 mg/kg

Multiple onsite locations showed an increasing trend for **cobalt**: 2NE, 2SE at the Mixed Waste Landfill (MWL), and various onsite and perimeter locations (32E, 55, 58, 77, and 78). Values from all locations combined ranged from 2.5 to 6.2 mg/kg. All results were much lower than the RCRA Subpart S action level of 4,800 mg/kg.

Location 20, near the Air Force Skeet Range was averaged separately. Cobalt again showed an increasing trend this year. Values ranged from 4.5 to 5.7 mg/kg. The proposed RCRA Subpart S action level for cobalt is 4,800 mg/kg.

■

Copper		Soil, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
2NE, 2NW, 52, 53, 76, 16, 19, 59, 61	9.34 mg/kg	13.24 mg/kg

Multiple onsite and perimeter locations showed an increasing trend for **copper**: five onsite locations (2NE, 2NW, 52, 53, and 76) and four perimeter locations (16, 19, 59, and 61). Combined averaged values for all locations ranged from 4 to 24 mg/kg, which is well below the proposed RCRA Subpart S action level of 2,960 mg/kg.

■

Iron		Soil, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
6, 77, 78, 58	10,930 mg/kg	12,570 mg/kg

Three onsite locations (6, 77, and 78) and one perimeter location (58) were noted with an increasing trend for **iron** again this year. Combined values for all locations ranged from 7,100 to 17,000 mg/kg. The RCRA Subpart S action level is 21,000 mg/kg. Monitoring will continue at these locations. Iron is considered a moderate hazard concern.

■

Lead		Soil, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
2NW, 7, 52, 55, 56, 59, 60	11.00 mg/kg	19.07 mg/kg

Five onsite locations (2NW, 7, 52, 55, and 56) and two perimeter locations (59 and 60) showed an increasing trend for **lead**. Locations 55, 56, and 60 were not noted in last year's report. Combined values for all locations ranged from 5 to 26 mg/kg. There is no RCRA Subpart S action level for lead. The U.S. Surface Soil concentration for lead is 10 to 70 mg/kg (CRC 1992). Monitoring will continue at these locations.

■

Magnesium		Soil, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
33, 57	4,235 mg/kg	3,565 mg/kg

Two onsite locations (33 and 57) showed an increasing trend for **magnesium** again this year with values ranging from 3,400 to 5,400 mg/kg. (Although the average value is above the average offsite value, the difference is not statistically significant and does not constitute a CAT-2 result.) The result is well below the RCRA Subpart S action level of 460,000 mg/kg. Monitoring will continue at these locations.

■

Manganese		Soil, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
7, 77	201.3 mg/kg	361.50 mg/kg

Two onsite locations (7 and 77) showed an increasing trend for **manganese** for the first time this year. Values for this location ranged from 120 to 240 mg/kg. The RCRA Subpart S action level is 400 mg/kg. Monitoring will continue at these locations.

■

Nickel		Soil, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
57, 77	7.27 mg/kg	10.7 mg/kg

Two onsite locations (57 and 77) showed an increasing trend for **nickel** with values ranging from 6 to 10 mg/kg. The RCRA Subpart S action level for nickel is 1,600 mg/kg. Monitoring will continue at these locations.

■

Thallium		Soil, CAT-3
Location	**1996–1999 Avg**	**Offsite Avg**
57, 60	16.37 mg/kg	15.17 mg/kg

Thallium		Soil, CAT-3
Location	**1996–1999 Avg**	**Offsite Avg**
65E	26.75 mg/kg	15.17 mg/kg

Thallium (Skeet Range)		Soil, CAT-3
Location	**1996–1999 Avg**	**Offsite Avg**
20	17.00 mg/kg	15.17 mg/kg

Since analysis for **thallium** began in 1996, this is the first year a trend analysis could be done. Onsite location 57 and perimeter location 60 showed increasing trends for thallium with values ranging from 10 to 29 mg/kg. There is no RCRA Subpart S action level for thallium. Values for these two locations were within the range of community results (10 to 38 mg/kg). Location 65E showed an increasing trend for thallium for the first time this year. Values ranged from 10 to 52 mg/kg. It should also be noted that community location 10, Oak Flats, noted an increasing trend for thallium with concentrations ranging from 10 to 24 mg/kg.

Location 20, near the Skeet Range was averaged separately. Values have ranged from 10 to 26 mg/kg. The average value is 17.00 mg/kg, which is only marginally above offsite value. Monitoring will continue at all these locations.

Vanadium		Soil, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
76, 78	15.75 mg/kg	24.25 mg/kg

Two onsite locations (76 and 78) were noted with an increasing trend for **vanadium** with values ranging from 11 to 20 mg/kg, well below the RCRA Subpart S action level of 560 mg/kg. Monitoring will continue at these locations. Location 76 was noted as increasing for the first time.

Zinc		Soil, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
1, 7, 57, 77, 59	35.50 mg/kg	43.48 mg/kg

Four onsite locations (1, 7, 57, and 77) and one perimeter location (59) showed an increasing trend for **zinc**. Combined values ranged from 24 to 57 mg/kg, with an average value of 35.5 mg/kg, well below the RCRA Subpart S action level of 23,000 mg/kg. Monitoring will continue at these locations.

Sediment Results

CAT-3

Aluminum		Sediment, CAT-3
Location	**1995–1999 Avg**	**Offsite Avg**
75, 79	6,555 mg/kg	8,140 mg/kg

Two Arroyo del Coyote locations (75 and 79) showed an increasing trend for **aluminum** in sediments with combined values ranging from 4,600 to 9,400 mg/kg. The RCRA Subpart S action level is 80,000 mg/kg. Locations 75 and 79 were added in 1995.

Barium		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
72, 75, 79	92.95 mg/kg	190.63 mg/kg

All three Arroyo del Coyote locations (72, 75, and 79) showed an increasing trend for **barium.** Values ranged from 38 to 220 mg/kg, which is well below the RCRA Subpart S action level of 5,600 mg/kg. This was the first year that location 79 showed an increasing trend for barium.

Chromium		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
60	27.56 mg/kg	29.63 mg/kg

The downgradient Tijeras Arroyo location (60) showed an increasing trend for **chromium** with values ranging from 18 to 42 mg/kg. The RCRA Subpart S action level is 400 mg/kg.

Cobalt		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
72, 75	4.46 mg/kg	4.30 mg/kg

Two Arroyo del Coyote locations (72 and 75) continued to show an increasing trend for **cobalt** with combined values ranging from 3.1 to 6.3 mg/kg, well below the RCRA Subpart S action level of 4,800 mg/kg.

■

Copper		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
72, 74, 60	10.10 mg/kg	9.90 mg/kg

Two onsite locations (72 and 74) and one perimeter location (60) showed an increasing trend for **copper** with combined values ranging from 6.3 to 25 mg/kg, well below the RCRA Subpart S action level of 3,000 mg/kg. Locations 74 (Tijeras Arroyo, mid-stream) was added in 1995.

■

Iron		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
79	8,633 mg/kg	10,390 mg/kg

Onsite location 79 showed an increasing trend for **iron** with values ranging from 7,300 to 12,000 mg/kg for the first time. The RCRA Subpart S action level for iron is 21,000 mg/kg.

■

Lead		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
73	5.65 mg/kg	13.30 mg/kg

Onsite location 73 showed an increasing trend for **lead** with values ranging from 0.5 to 7 mg/kg. There is no RCRA Subpart S action level defined for lead. The U.S. Surface Soil concentration is between 10 and 70 mg/kg (CRC 1992). The usual detection limit for lead is 5 mg/kg.

■

Magnesium		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
75	3,120 mg/kg	3,722 mg/kg

Onsite location 75 was observed to have an increasing trend for **magnesium**. Values ranged from 2,800 to 3,600 mg/kg, well below the RCRA Subpart S action level of 460,000 mg/kg.

■

Manganese		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
72	246 mg/kg	283 mg/kg

Onsite location 72 was observed to have an increasing trend for **manganese**. Values ranged from 190 to 340 mg/kg, below the RCRA Subpart S action level of 400 mg/kg.

■

Nickel		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
72, 60	7.65 mg/kg	8.70 mg/kg

Onsite location 72 and perimeter location 60 showed an increasing trend for **nickel**. Values ranged from 5 to 13 mg/kg, well below the RCRA Subpart S action level of 1,600 mg/kg. This is the first year that location 60 was increasing for nickel.

■

Potassium		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**
75	1,116 mg/kg	1,810.67 mg/kg

Onsite location 75 showed an increasing trend for **potassium**. Combined values ranged from 980 to 1,300 mg/kg, well below the RCRA Subpart S action level of 1,000,000 mg/kg.

■

Zinc		Sediment, CAT-3
Location	**1993–1999 Avg**	**Offsite Avg**

72, 75, 79	31.24 mg/kg	39.00 mg/kg

Onsite locations 72, 75, and 79 showed an increasing trend for **zinc**. Combined values ranged from 21 to 58 mg/kg, well below the RCRA Subpart S action level of 23,000 mg/kg.

Surface Water Results

In 1999, surface water grab samples were taken offsite at the Rio Grande and Las Huertas Creek. Samples taken at upgradient and downgradient locations on the Rio Grande, relative to the discharge point of Tijeras Arroyo, showed no statistical difference between the two points. Samples from Las Huertas Creek are not compared to any other location but are compared from year to year.

4.5 ECOLOGICAL STUDIES

Tech Area II Monitoring Study

Ecological monitoring was conducted at SNL/NM over a period of four months from June through September 1999. The study collected baseline information on small mammals, birds, and vegetation. Various data sets were compiled including visual population counts, mark-and-release trapping, and contamination data. Contamination data was obtained from the tissue samples of several rodents.

The purpose of the study is to compare animal and plant populations inhabiting or frequenting Tech Area II (an area of known contamination) with similar species found in an uncontaminated control site. Tech Area II is the site of several Environmental Restoration (ER) areas including the Classified Waste Landfill. The control site was located at the southeastern end of KAFB near the perimeter fence between KAFB and Isleta Pueblo.

Baseline Monitoring

Baseline monitoring is performed to record basic environmental conditions at both the control site and Tech Area II, such as population estimates, and plant and animal species identification. (In 1999, however, population data were not taken at the control site due to budget restraints.) The mark-and-release portion of the study recorded individual data on each captured animal, such as species, sex, various body dimensions, and the number of recaptures. Small mammals captured and released at Tech Area II included:

- White-throated woodrat *(Neotoma albigula)*
- Silky pocket mouse (*Perognathus flavus*)
- Deer mouse (*Peromyscus maniculatus*)
- Brush mouse (*Peromyscus boylii*)

Prairie dogs (Cynomys gunnisoni) are abundant on KAFB.

Eleven bird species were identified. The most common included the western meadowlark

(Sturnella neglecta) and the mourning dove *(Zenaida macroura).*

Contaminant Monitoring
Contamination data were collected using mice for whole body tissue analysis at both the study site and the control site. This was necessary to determine what internal contaminant loads were present. Tissue samples were analyzed for radiological parameters—tritium, strontium-90, U_{tot}, and by gamma spectroscopy.

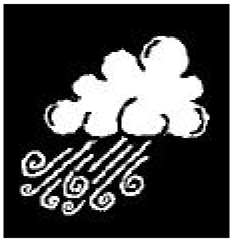
Nonradiological parameters included all metals as listed in Section 4.4. Results were compared to determine statistical differences in the contaminant loads of animals located near Tech Area II and those from the control site.

Small mammals collected for tissue analysis at the control site included:

- Silky pocket mouse (*Perognathus flavus)*
- Deer mouse (*Peromyscus maniculatus*)
- White-footed mouse *(Peromyscus leucopus)*
- Ord's kangaroo rat (*Dipodmys ordii*)

Results showed no statistical differences in contaminant loads between the two groups.

Chapter 5



Air Quality Compliance and Meteorological Monitoring

Air quality monitoring, surveillance, and compliance are conducted under three programs at Sandia National Laboratories, New Mexico (SNL/NM):

- The **Clean Air Network (CAN) Program** conducts meteorological monitoring and ambient air surveillance.
- The **National Emission Standards for Hazardous Air Pollutants (NESHAP) Program** coordinates with facility owners to meet radiological air emission regulations.
- The **Air Quality Compliance Program** ensures that all nonradiological air emission sources at SNL/NM, such as generators, boilers, and vehicles, meet applicable air quality standards.

5.1 METEOROLOGICAL MONITORING PROGRAM

The Meteorological Monitoring Program at SNL/NM commenced operations in January 1994 with the initiation of the Clean Air Network (CAN) Program. Both meteorological monitoring and ambient air monitoring (Section 5.2) are conducted under the CAN Program, which resides within the Environmental Management Department. Regulations applicable to the Meteorological Monitoring Program are listed in Appendix B.

Tower Instrumentation

Sandia Corporation conducts meteorological monitoring through a network of eight fully instrumented meteorological towers located throughout KAFB on or near SNL/NM property:

- Six 10-meter towers,
- One 50-meter tower, and
- One 60-meter tower.

All instrumentation at meteorological towers is checked weekly and calibrated on a routine basis. Figure 5-1 shows the extent of the CAN network of meteorological towers and ambient air monitoring stations.

Meteorological Monitoring Towers

All meteorological towers are instrumented to measure **temperature**, and **wind velocity*** at 3- and 10-meter levels (with the exception of the A15 tower, which has no 3-meter level). Temperature and wind velocity* are also measured at the top of the two tallest towers (50- and 60-meters).

Additionally, **relative humidity** is measured at all towers with 3-meter instrumented levels. **Rainfall** is measured at the 1-meter levels of the A36, A21, and SC1 towers. **Barometric pressure** is measured at the 2-meter levels of the A36 and A21 towers.

**Including the standard deviation of horizontal wind speed (sigma theta).*

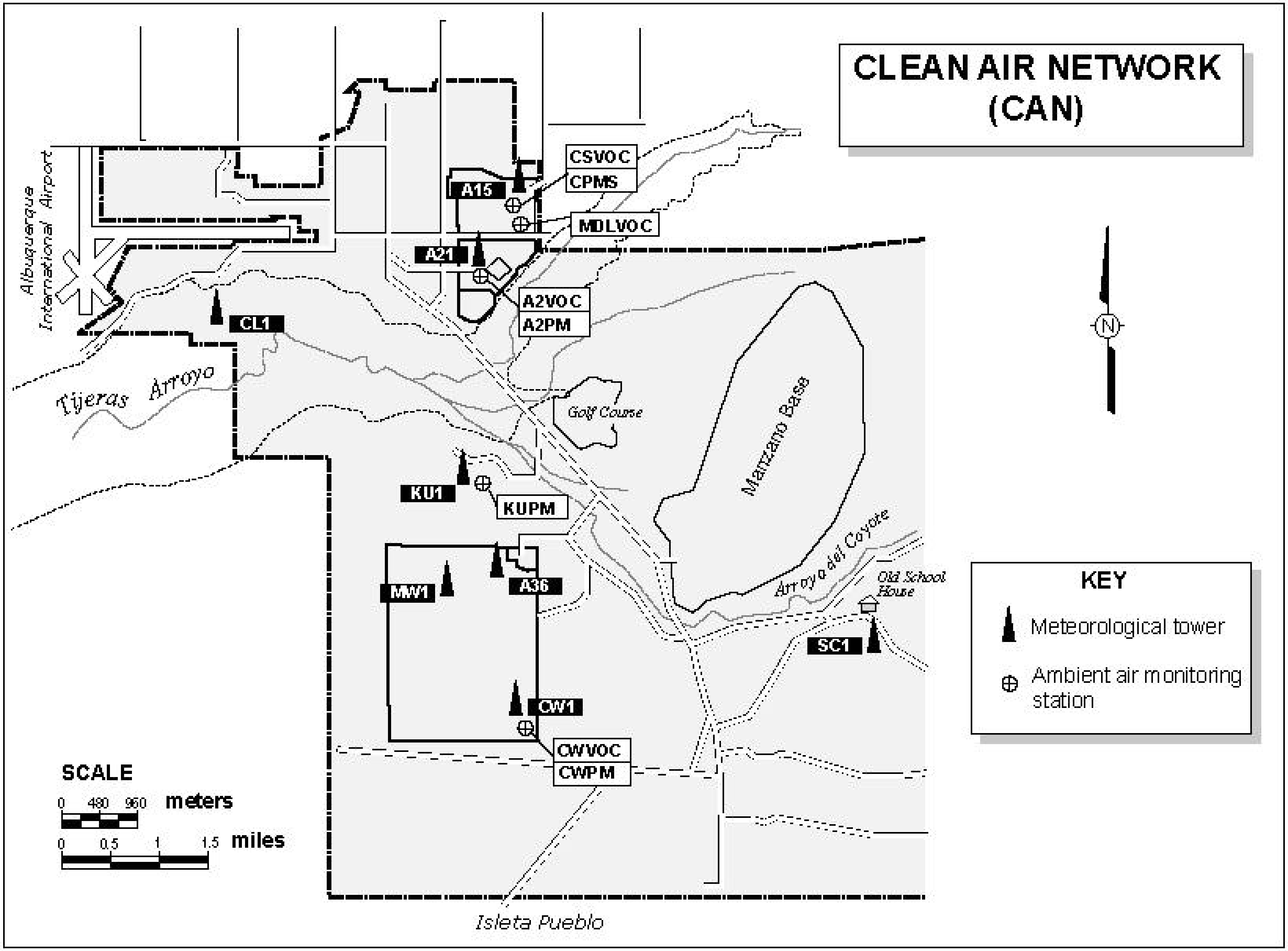


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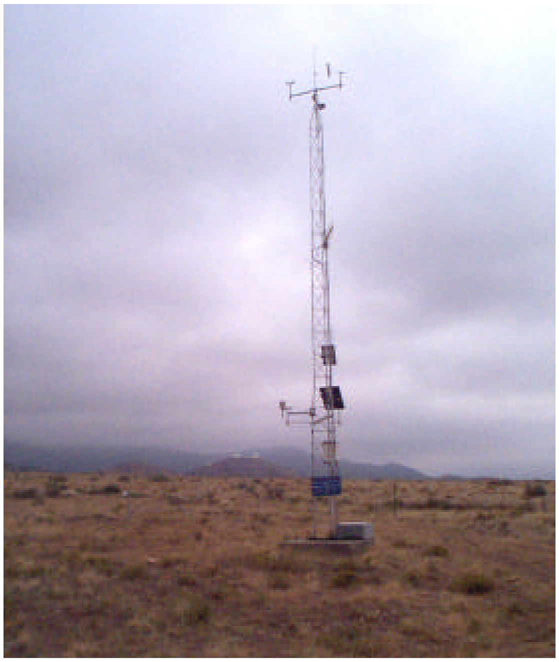
FIGURE 5-1. The Clean Air Network (CAN) of Meteorological Towers and Ambient Air Monitoring Stations

Uses for Meteorological Data

The primary objective of the Meteorological Monitoring Program is to provide representative local meteorological data for input to air dispersion and transport models and for supporting the regulatory permitting process. All data are consistent with program guidelines required for regulatory modeling applications. Other uses for meteorological data include: (1) providing meteorological information to emergency response personnel in the event of a hazardous or other unplanned release, (2) determining optimum air monitoring station locations, and (3) providing meteorological data to Sandia Corporation's research and development projects.



The SC1 meteorological tower is located near the foothills of the Manzanita Mountains on the east side of KAFB.

5.1.1 Meteorological Monitoring Results

The A36 60-meter tower is used to describe general meteorology at SNL/NM because of its central geographic position and availability of data at all instrument levels. The A15 50-meter tower, while closer to the most populous part of SNL/NM in Tech Area I, shows micro-scale urbanization effects not seen within the rest of the network. The 1999 annual climatic summary, which was developed using information from the A36 tower, is shown in Table 5-1.

In general, the annual statistics for each of the towers are similar. However, daily meteorology at each site varies considerably across the network. This has implications on transport and dispersion of pollutants, which is particularly important in atmospheric emergency release scenarios and air dispersion modeling. Figure 5-2 shows some of the extremes and variations found in meteorological measurements across SNL/NM.

5.1.2 Wind Analysis

Figure 5-3 portrays annual wind roses for three locations across SNL/NM. A wind rose is a graphical presentation of wind speed and direction frequency distribution. Wind direction is the true bearing when facing the wind (the direction from which the wind is blowing). As seen in the figure, wind direction and speed can vary significantly across SNL/NM. Although not shown, the annual wind frequency distribution for Tech Area I shows a different pattern with the greatest direction frequency from the east and east-northeast, as winds blow from Tijeras Canyon. The annual predominant direction at most towers is produced by the topographic influences that also create nocturnal drainage flows.

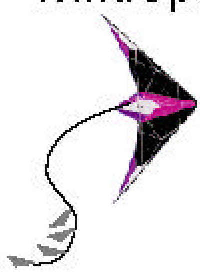
TABLE 5-1. The 1999 Annual Climatic Summary from Tower A36

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Totals
Temperature (°C)													
Daily Max	12.50	11.04	15.57	19.36	22.51	28.84	29.87	25.26	22.76	21.88	14.50	9.40	**19.5**
Daily Min	-1.22	-2.85	0.77	2.37	8.12	15.92	19.87	18.81	11.81	1.88	1.31	-2.86	**6.2**
Average	5.63	7.23	10.13	11.51	17.03	22.61	23.53	22.75	19.46	15.19	10.63	2.55	**14.0**
Temperature Extremes (°C)													
High	17.50	20.47	22.32	27.16	30.24	36.77	37.15	31.60	30.44	27.67	22.26	13.56	**37.2**
Low	-7.63	-8.72	-6.69	-4.25	3.08	6.33	13.31	13.82	4.15	-3.32	-4.23	-8.12	**-8.7**
Relative Humidity (%)													
	39.35	27.98	37.91	32.46	30.96	28.12	46.82	53.00	47.31	30.99	28.90	46.89	**37.6**
Precipitation (cm)													
Monthly	0.61	0.00	2.82	1.93	1.19	0.89	4.17	5.51	2.18	0.76	0.03	0.25	**20.3**
24 Hour Max	0.61	0.00	1.02	1.22	0.51	0.30	1.75	1.98	1.73	0.64	0.03	0.13	**2.0**
Wind (m/s)													
Monthly	3.16	3.63	4.12	5.61	4.61	4.54	3.69	3.24	3.39	3.25	2.54	2.83	**3.7**
24 Hour Max	6.52	7.69	8.26	12.43	7.92	8.44	9.02	5.80	5.95	6.85	5.01	6.65	**12.4**
Max Gust	19.65	23.65	26.05	27.65	26.05	24.45	23.65	22.85	21.25	24.45	20.45	20.45	**27.7**
Barometric Pressure (mb)													
	834.60	835.63	832.37	830.78	832.38	834.12	837.45	838.58	836.32	838.39	839.13	836.77	**835.5**

NOTE: Conversions to English Units: Temperature …. °F = (1.8 °C) + 32
Wind Speed …. mph = (2.2369)(m/s)
Rainfall ……… in. = (2.54)(cm)

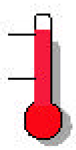
A comparison of the A15 tower wind speed data with the rest of the network reveals building affects (urbanization) on wind speed; the large percentage of calms and very low wind speeds produces the slowest average annual wind speed as shown in Figure 5-2. In addition to the lower wind speeds, stability class frequency (not shown in the table) is also affected by the variations in wind direction by flow around and over buildings. Completely lost in the annual frequency distribution, is the diurnal pattern of wind flow common through many areas of KAFB. Figure 5-4 shows the day and night wind frequency distributions, respectively, for tower A36. In general, the closer to the mountains or canyons the greater the frequency of winds coming from the easterly directions at night. Daytime wind patterns are not quite as pronounced, but winds generally flow toward the mountains or channel into the canyons.

Wind Speed



	Minimum (m/sec)	Maximum (m/sec)	Spread (m/sec)
Average Annual Wind Speed	2.89 *tower A15*	3.98 *tower CW1*	1.09
Greatest Difference in Wind Speed over 24 hours	5.66 *tower A15*	9.15 *tower KU1*	3.49
Greatest Difference in Daily Maximum Wind Speed	14.85 *tower CW1*	27.65 *tower A15*	12.8
Average Difference in Daily Wind Speed	1.37 *(all towers)*		

Temperature



	Minimum (°C)	Maximum (°C)	Spread (°C)
Average Annual Temperature	13.66 *tower SC1*	14.18 *tower KU1*	0.52
Network Annual Temperature Extremes	-11.26 *tower SC1*	37.71 *tower KU1*	48.97
Greatest Variation in Daily Minimum Temperature	-2.425 *tower A21*	3.764 *tower SC1*	6.189
Greatest Difference in Average Daily Temperature	12.62 *tower A15*	15.41 *tower SC1*	2.79
Greatest Variation in Daily Maximum Temperature	14.62 *tower CL1*	18.45 *tower CW1*	3.83

Precipitation

	Minimum (cm)	Maximum (cm)	Spread (cm)
Annual Precipitation (Extremes)*	20.03 *tower A36*	24.38 *tower SC1*	4.35
Daily Rainfall Variation	0 *tower A36*	2.03 *tower SC1*	2.03
Greatest Monthly Precipitation Difference	5.36 *tower A21*	9.09 *tower SC1*	3.731
Greatest in Daily Rainfall		2.03 *tower A21*	

Note: Winter precipitation that falls as snow is underestimated (mostly at the SC1 tower).
* Excludes Annual A21 precipitation

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FIGURE 5-2. Variations and Extremes in Meteorological Measurements Across the Meteorological Tower Network

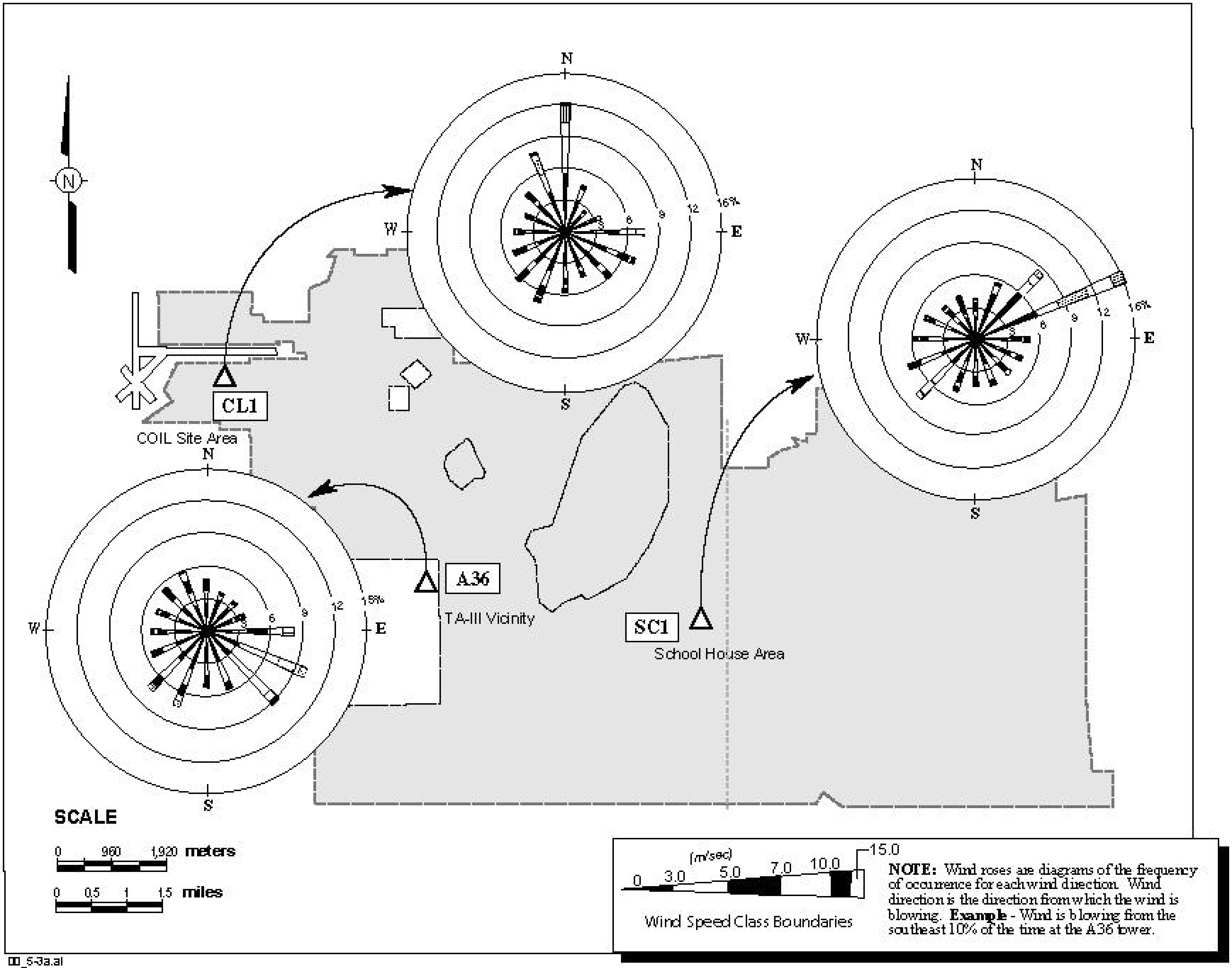


FIGURE 5-3. 1999 Annual Wind Roses for Towers CL1, A36, and SC1

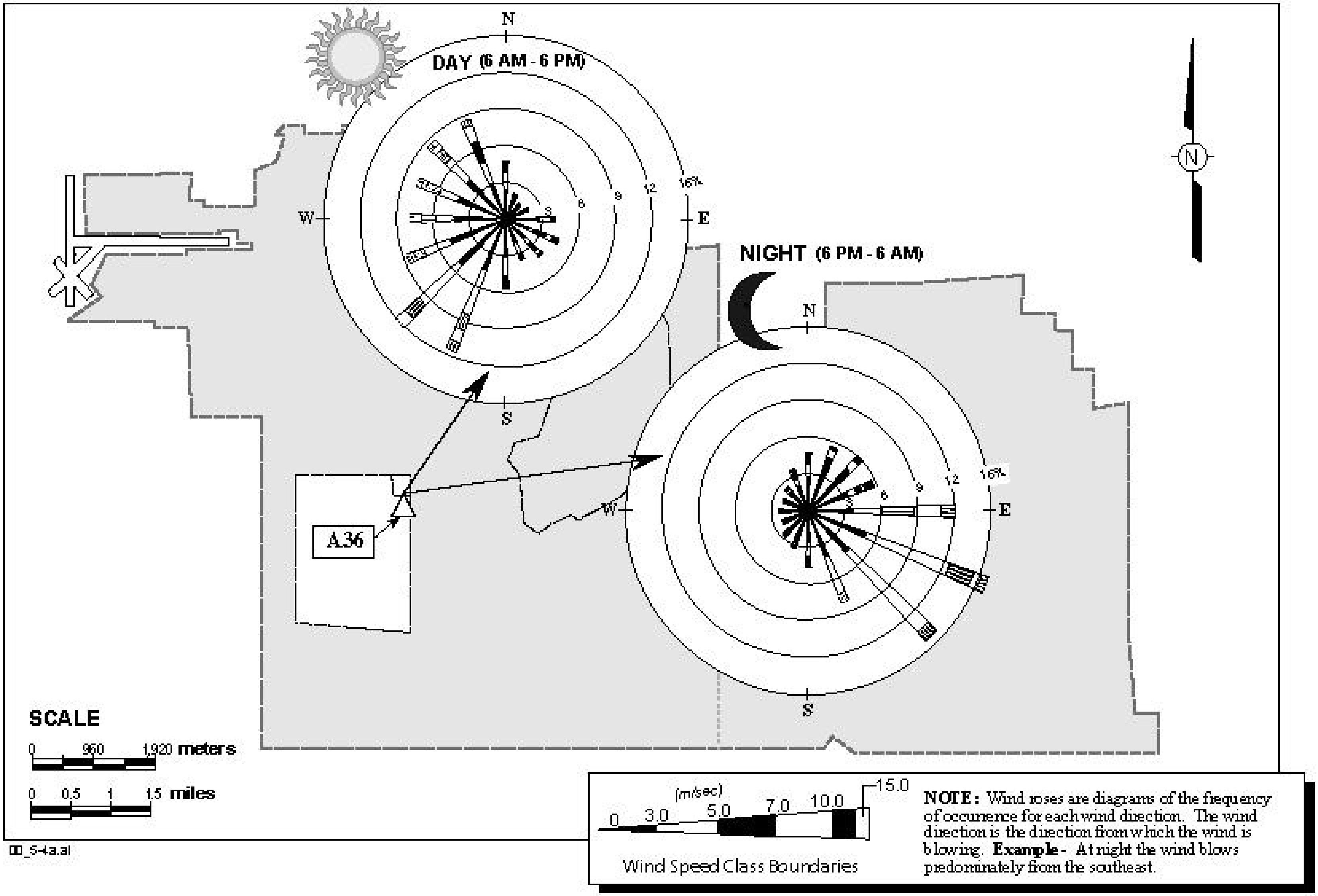


FIGURE 5-4. 1999 Annual Wind Roses for Daytime and Nighttime Wind Frequency at the A36 Tower

5.2 AMBIENT AIR SURVEILLANCE PROGRAM

Ambient air surveillance is conducted under the CAN Program through a network of air monitoring stations located throughout KAFB on or near SNL/NM property. The primary objectives of ambient air surveillance is to show compliance with the National Ambient Air Quality Standards (NAAQS) (40 CFR 50) and local ambient air quality standards. Applicable regulations are listed in Appendix B. Surveillance is also important to establish background concentration levels for pollutants of concern and evaluate the affects, if any, on the public and the environment as a result of SNL/NM's operations.

Ambient air surveillance is performed at five locations with nine monitors described briefly below and illustrated in Figure 5-1.

- ***Criteria Pollutant Monitoring Station (CPMS)*** – There is one criteria pollutant monitoring station (CPMS) in the network, which is located in the most populated area of SNL/NM on the northeast corner of Tech Area I. The CPMS performs continuous monitoring for sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x), and ozone (O_3). Data are then compiled into hourly averages. A particulate monitor is a part of the CPMS. Lead, a criteria pollutant, is one of the 20 metals analyzed from PM samples at this station.

Criteria Pollutants

The EPA has listed the following as criteria pollutants:

Sulfur dioxide (SO_2) is a primary contributor to acid rain and lower visibility resulting largely from coal and oil combustion, steel mills, refineries, pulp and paper mills, and nonferrous smelters.

Nitrogen dioxide (NO_2) is a reddish brown, highly reactive gas. Nitrogen oxides (NO_X) are important precursors for both ozone (O_3) and acid rain. The two major emissions sources for NO_X are transportation and stationary fuel combustion sources such as electric utility and industrial boilers.

Carbon monoxide (CO) is a colorless, odorless, and poisonous gas produced by incomplete burning of carbon fuels. Most CO emissions nationwide come from motor vehicles. Other major CO sources include wood-burning stoves, incinerators, and industrial sources.

Ozone (O_3) is a photochemical oxidant and a primary ingredient in smog. Although O_3 is an important component of the upper atmosphere to shield the earth from harmful ultraviolet light, it is an air quality concern at ground level. O_3 is formed with sunlight through a complex chemical reaction involving volatile organic compound (VOC) and NO_X precursors.

Particulate matter (PM) is dust, dirt, soot, smoke, and liquid droplets directly emitted into the air by sources such as factories, power plants, cars, construction activities, fires, and natural windblown dust. PM with a diameter equal to or less than 10 µm (PM_{10}) is considered a criteria pollutant, because it is an inhalation hazard.

Lead emissions derive primarily from gasoline additives, tobacco smoke, non-ferrous smelters, and battery plants.

- ***Particulate Matter (PM) Stations*** – There are four PM monitoring stations distributed throughout the site (CPMS, A2PM, KUPM, and CWPM). Samples are collected over a 24-hour period starting and ending at midnight, every sixth day. This schedule is consistent with the National Air Sampling Program. Samples are analyzed for 20 metals and four radionuclides. (Monitoring at the MWPM station was discontinued in August 1998.)

- ***Volatile Organic Compound (VOC) Stations*** – There are four VOC monitoring stations (CSVOC, MDLVOC, CWVOC, and A2VOC). VOC samples are collected once a month over a 24-hour period.

5.2.1 Ambient Air Monitoring Results

Criteria Pollutants

The automated data recovery for criteria pollutants in 1999 was 87.5 percent. Table 5-2 lists the results from the CPMS and compares them to state and federal ambient air quality standards for criteria pollutants.

Annual federal standards for criteria pollutants cannot be violated; however, exceedences of the short-term standards are allowable once a year. State standards also allow short-term exceedences due to meteorological conditions such as in the case of an atmospheric inversion where air mixing may be extremely restricted. In 1997, the EPA reviewed the ozone standard and decided to change from an hourly standard of 0.120 ppm to an 8-hour standard of 0.080 ppm. The fourth highest daily maximum may not exceed this value. There were no violations or short-term exceedences for criteria pollutants in 1999.

Particulate Matter (PM_{10})

Data recovery for PM_{10} (particles with a diameter less than or equal to 10 µm) was 91 percent complete based on an every sixth day sampling schedule. In general, 24-hour (daily) PM_{10} concentrations were low except for the last quarter of the year. The highest daily particulate loading (66 µg/m^3) occurred at the KUPM site (Table 5-2). This station also had the highest annual loading for 1999. Table 5-3 lists the quarterly PM_{10} averages and the annual average at each location. There were no exceedences of federal or state standards for PM_{10} during 1999.

> ***1999 Ambient Air Monitoring Results***
>
> **Criteria Pollutants** – There were no violations or short-term exceedences in 1999. Measured criteria pollutants were significantly below maximum EPA standards.
>
> **Particulate Matter (PM) –** There were no exceedences of federal or state standards for PM_{10} during 1999.
>
> **Volatile Organic Compounds (VOC)** – All measured VOCs were significantly below threshold limit values (TLVs).

Table 5-4 shows the radiological and nonradiological analyses conducted on samples collected at each PM_{10} station (20 metals plus gross alpha, gross beta, gamma spectroscopy, and uranium). Filters, collected every six days, are consolidated into monthly composites for the analyses. Monthly composites varied from three to five filters per month throughout 1999 depending on the sampling schedule and some missed samples (for example, monthly composites for two months contained four instead of five filters due to missed samples). Analyses are conducted by an EPA-approved offsite laboratory. The laboratory results for the samples are subtracted from the monthly blank analysis. The final analytical results are averaged over the year (Table 5-5) and compared to threshold limit values (TLVs), where established. TLVs are used as a reference using time weighted averages these values (TWAs). Although TLVs are not legal limits,

TABLE 5-2. 1999 Criteria Pollutant Results as Compared to Regulatory Standards

Criteria Pollutant	Averaging Time	Unit	NMAQS Standard	NAAQS Standard	Yearly Summary of Measured Concentrations
Carbon Monoxide	1 hour 8 hours	ppm ppm	13.1 8.7	35 9	6.40 2.55
Nitrogen Dioxide	24 hours Annual	ppm ppm	0.10 0.05	 0.053	0.039 0.016
Sulfur Dioxide§	3 hours 24 hours Annual	ppm ppm ppm	 0.10 0.02	0.50 0.14 0.03	0.010 0.002
Ozone	1 hour 8 hour	ppm ppm	0.12 	0.12 0.080	0.089 0.075
PM_{10}	24 hours Annual	$\mu g/m^3$ $\mu g/m^3$	150 	150 50	66* 16.58**
Total Suspended Particulates	7 days 30 days	$\mu g/m^3$ $\mu g/m^3$	110 90	N/A	N/A N/A
Lead	30 days Any quarter	$\mu g/m^3$ $\mu g/m^3$	N/A	1.5	0.0021 < 0.0010

NOTE: ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter
N/A = not applicable or not available
NMAQS = New Mexico Air Quality Standards
NAAQS = National Ambient Air Quality Standards
§Standards are defined in $\mu g/m^3$ and have been converted to ppm.
*Highest 24-hour particulate loading was measured at the KUPM site in November.
**Highest annual particulate loading was measured at the KUPM site.

TABLE 5-3. Quarterly and Annual Averages of PM_{10} at SNL/NM for 1999

Station	Jan-Mar ($\mu g/m^3$)	Apr-Jun ($\mu g/m^3$)	Jul-Sep ($\mu g/m^3$)	Oct-Dec ($\mu g/m^3$)	Annual ($\mu g/m^3$)
CPMS	11.43	11.67	9.86	15.36	12.08
A2PM	11.42	12.98	9.75	17.60	12.94
CWPM	9.23	11.68	11.89	11.83	11.16
KUPM	13.30	12.50	11.20	29.33	16.58

NOTE: $\mu g/m^3$ = micrograms per cubic meter

TABLE 5-4. Nonradiological and Radionuclide Analysis of PM_{10} Filters

Station	ICP-20 Metals	Total Uranium	Gamma Spectroscopy	Gross Alpha	Gross Beta
CPMS	✓	--	--	--	--
A2PM	✓		✓	✓	✓
CWPM	✓		✓	✓	✓
KUPM	✓	✓	✓	✓	✓

NOTE: PM_{10} = particulate matter (diameter equal to or less than 10 µm)

ICP = Inductively Coupled Plasma (method)

TABLE 5-5. PM_{10} Average Annual Concentration by Station Location

Analyte	Units	A2PM	CPMS	CWPM	KUPM	TLV*
Metals						
Aluminum	µg/m^3	0.0971	N/A	0.0741	0.1698	2,000
Arsenic	µg/m^3	0.0000	N/A	0.0000	0.0000	10
Barium	µg/m^3	0.0049	N/A	0.0021	0.0023	50
Beryllium	µg/m^3	0.0000	N/A	0.0000	0.0000	2
Cadmium	µg/m^3	0.0000	N/A	0.0000	0.0000	10
Calcium	µg/m^3	0.2950	N/A	0.1657	0.3522	2,000
Chromium	µg/m^3	0.0002	N/A	0.0002	0.0002	10
Cobalt	µg/m^3	0.0000	N/A	0.0000	0.0000	20
Copper	µg/m^3	0.0106	N/A	0.0078	0.0066	1,000
Iron	µg/m^3	0.1007	N/A	0.0740	0.1494	5,000
Lead	µg/m^3	0.0003	0.0001	0.0002	0.0004	150
Magnesium	µg/m^3	0.0510	N/A	0.0358	0.0616	10,000
Manganese	µg/m^3	0.0028	N/A	0.0023	0.0041	200
Molybdenum	µg/m^3	0.0000	N/A	0.0000	0.0000	5,000
Nickel	µg/m^3	0.0000	N/A	0.0001	0.0001	50
Potassium	µg/m^3	0.0716	N/A	0.0463	0.0853	N/A
Selenium	µg/m^3	0.0000	N/A	0.0000	0.0000	200
Silicon	µg/m^3	0.0273	N/A	0.0243	0.0374	10,000
Silver	µg/m^3	0.0000	N/A	0.0000	0.0000	10
Sodium	µg/m^3	0.6970	N/A	0.5015	0.6658	5,000
Thallium	µg/m^3	0.0000	N/A	0.0000	0.0001	100
Vanadium	µg/m^3	0.0002	N/A	0.0002	0.0003	50
Zinc	µg/m^3	0.0038	N/A	0.0033	0.0018	10
Radionuclides						
Gross Beta	pCi/m^3	0.0105	N/A	0.0111	0.0115	N/A
Gross Alpha	pCi/m^3	0.0042	N/A	0.0043	0.0039	N/A
Beryllium-7	pCi/m^3	0.1147	N/A	0.1297	0.1210	N/A
Potassium-40	pCi/m^3	0.0379	N/A	0.0406	0.0358	N/A
Uranium-total	µg/m^3	N/A	N/A	N/A	0.0025	200

NOTE: TLV = threshold limit value
TLVs are guidelines and not legal standards. TLVs guidelines assist in the control of health hazards.
N/A = not applicable or not measured
*Values listed are time-weighted averages (TWAs). TWA is the concentration for a normal 8-hour work day and 40-hour week, to which nearly all workers may be exposed without adverse affect.

serve as a guide for determining potential health hazards.

The PM_{10} analytical results are generally consistent with metals found in local soil analyses at SNL/NM. As can be seen from Table 5-5, beryllium, as a total metal, was not found above the detection limit—but it was found in the gamma analysis. All radiochemistry data are used in the averaging routine for reporting, regardless of the detection limit for that specific sample. This generally produces more conservative (higher total) concentrations.

Due to the low averages, a relatively small variation between the sites may be mis-interpreted as a significant difference. An analysis of variance was performed to determine if concentrations of any analyte were statistically and significantly different at any site. Results of this variance test showed that aluminum and iron were statistically less at the CWPM station. These results are most likely an artifact produced by the higher loadings found at KUPM and A2PM.

Volatile Organic Compounds (VOCs)
Data recovery for VOC monitoring was 58 percent. The poor data recovery percentage is due to both problems with the analytical laboratory and problems in the field with procedures and hardware. The problems were corrected in early 2000. Monthly VOC samples (for seven months) were analyzed for 33 VOC species plus total non-methane hydrocarbon (TNMHC). Monthly results for compounds detected are reported as averaged concentrations as shown in Table 5-6. These averages are not annual averages due to the method of including the sample only if the compound is detected. This type of averaging is done to prevent diluting the reported average.

The VOCs generally observed at SNL/NM are products or by-products of fossil fuels or solvents. An analysis of variance was not performed on the monthly results due to the poor recovery rate. VOC results were significantly below TLVs, where established. TLVs are not legal limits, but serve as a guide for determining potential health hazards.

Volatile Organic Compounds (VOCs)

VOCs are highly evaporative chemicals that off-gas into the air from various sources derived from petrochemical and synthetic materials. These include fossil fuels, solvents, glues, plastics, paints, dry cleaning fluids, and cleaning chemicals.

5.3 RADIOLOGICAL AIR EMISSIONS

National Emission Standards Hazardous Air Pollutants (NESHAP) compliance support is provided to all SNL/NM facilities and operations. The NESHAP Program resides within the Environmental Management Department. The EPA regulates radionuclide air emissions in accordance with 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." The EPA has set a maximum individual radiological dose limit of 10 mrem/yr resulting from the combined radiological air emissions produced from a DOE facility. EPA's radiation protection programs can be viewed at the following website:

V http://www.epa.gov/radiation/

TABLE 5-6. VOC Average Concentrations Compiled from Monthly Results at Four Stations
These averages are not true annual averages due to the method of including the sample only if the compound is detected.

Analyte	CSVOC (ppbv)	CWVOC (ppbv)	MDLVOC (ppbv)	A2VOC (ppbv)	TLV (ppbv)
1,1,1-Trichloroethane	0.07	1.74	5.40	5.04	350,000
1,1,2-Trichlorotrifluoroethane	0.07	0.09	0.09	0.08	1,000,000
1,2-Dichloroethane	0.08	0.02	0.03	0.02	10,000
1-Butene/Isobutene	0.53	0.53	0.79	0.37	N/A
2,2,4-Trimethylpentane	0.21	0.06	0.20	0.09	N/A
2-Butanone	1.00	0.82	1.38	0.52	200,000
2-Methylbutane	1.46	2.12	2.23	1.38	120,000
3-Methylpentane	0.28	0.10	0.16	0.15	N/A
Acetone	5.87	16.06	42.42	24.70	750,000
Benzene	0.42	0.17	0.32	0.29	300
Carbon tetrachloride	0.07	0.08	0.07	0.06	5,000
Chlorobenzene	0.03	0.02	0.04	0.01	10,000
Chloromethane	0.50	0.57	0.55	0.56	5,000
Dichlorodifluoromethane	0.47	0.51	0.53	0.54	1,000,000
Ethylbenzene	0.11	0.06	0.10	0.07	100,000
Halocarbon-113	0.08	0.08	0.08	0.08	N/A
Isohexane	0.50	0.20	0.30	0.24	N/A
Isopentane	1.81	0.65	2.74	0.82	600,000
m/p-Xylene	0.30	0.14	0.28	0.17	100,000
Methyl tert-butyl ether	0.02	0.03	0.04	0.01	40,000
Methylene chloride	0.59	0.23	0.86	0.13	50,000
Methylisobutylketone	0.13	0.10	0.16	0.04	50,000
n-Butane	1.13	0.57	0.95	0.75	800,000
n-Hexane	0.36	0.15	0.33	0.16	50,000
n-Pentane	0.88	0.39	1.38	0.54	600,000
n-Undecane	0.11	0.11	0.10	0.02	500,000
o-Dichlorobenzene	0.10	0.03	0.02	0.01	25,000
o-Xylene	0.12	0.08	0.11	0.08	100,000
Tetrachloroethene	0.14	0.11	1.32	0.08	25,000
Toluene	1.07	0.57	0.93	0.44	50,000
Trichloroethene	0.09	0.07	0.09	0.11	50,000
Trichlorofluoromethane	0.28	0.31	0.35	0.28	1,000,000**
TNMHC (total non-methane hydrocarbons)	22.38	18.47	39.33	26.08	N/A

NOTE: VOCs may be shown of as separate species as well as in combination with another analyte.
ppbv = parts per billion by volume
N/A = not applicable or not measured
TLV= threshold limit value. (TLVs are guidelines and not legal standards. TLV guidelines assist in the control of health hazards.)
*Values listed are time weighted averages (TWAs) except where marked. TWA is the concentration for a normal 8-hour work day and 40-hour week, to which nearly all workers may be exposed without adverse affect.
**Short-term exposure limit (STEL) is a 15-minute TWA not to be exceeded at any time during the work day.

Average Annual Radiation Dose

The *national average* annual dose a person receives from all radioactive sources—natural and man-made—is about 250 mrem/yr (Brookins 1992). The major contributing sources are shown in Figure 5-5. As seen in the figure, the primary source comes from radon in soils and rocks. Other contributors to the total dose are radioactive elements within the body, medical x-rays, cosmic radiation, and consumer products such as smoke detectors, cigarettes, and illuminated dials. Residents living at higher elevations, such as within the Albuquerque area, receive a higher annual dose due to the thinner atmosphere, which provides less protection from cosmic radiation. The local average dose for individuals in the Albuquerque area has been estimated between 330 to 530 mrem/yr. This higher than average dose is also attributed to the indoor radon levels in the Albuquerque area due to the local granitic rocks and soils (Brookins 1992).

5.3.1 Compliance Reporting

Sandia Corporation prepares an annual NESHAP report that summarizes radionuclide air emission releases from SNL/NM facilities and presents the results of the annual dose assessment. The EPA requires this report to be submitted by June 30th following the reporting year. DOE and NMED also receive a copy of the report. The NESHAP summary report is complimented by a more comprehensive report detailing facility emission factors, demographic data, and dose assessment calculations and is available to EPA, DOE, and NMED upon request. The NESHAP reports prepared in 1999 are as follows:

- *NESHAP Annual Report for CY 1999, Sandia National Laboratories, New Mexico* (SNL 2000f [1]), and

- *Radiological Dose Calculations and Supplemental Dose Assessment Data for NESHAP Compliance for Sandia National Laboratories, New Mexico 1999* (SNL 2000f [2]).

All NESHAP program documents are listed in Appendix C.

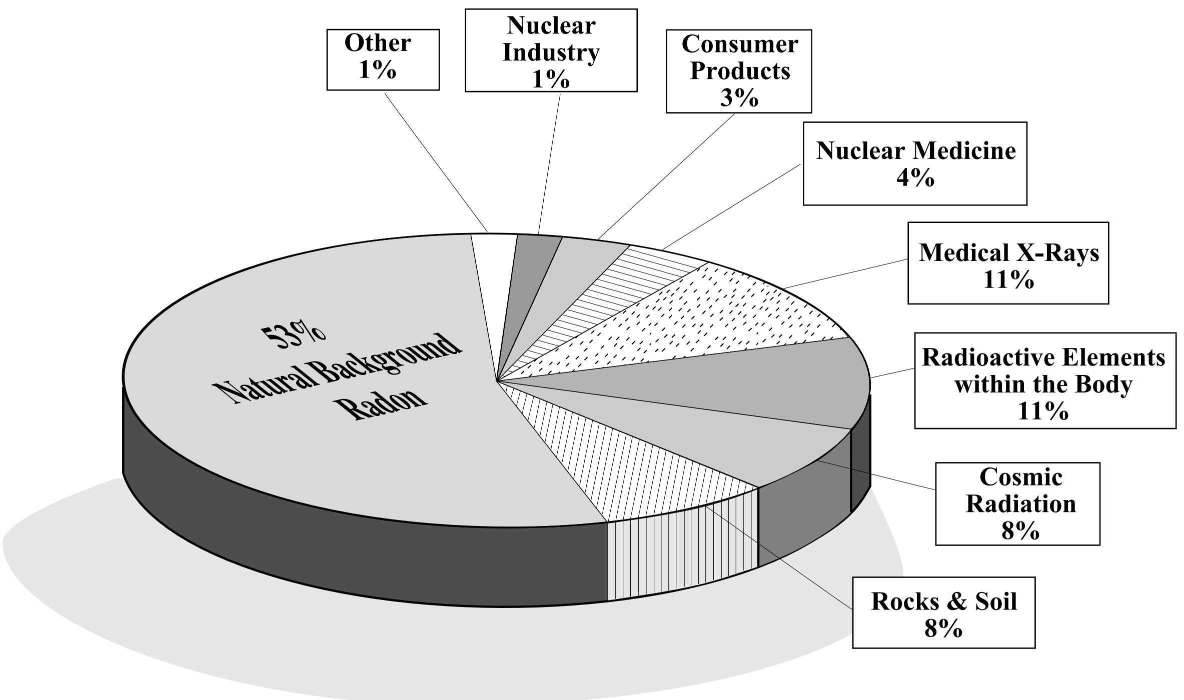
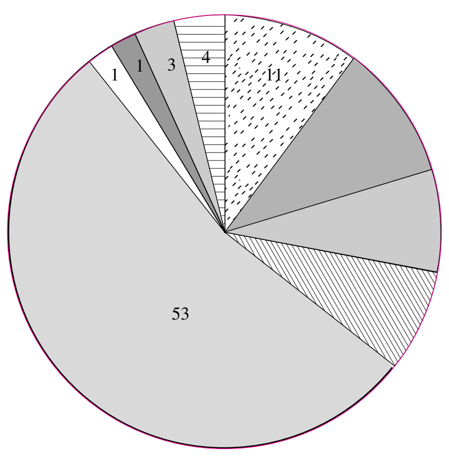


FIGURE 5-5. Dose Contributions from Man-Made and Natural Radiological Sources



Point and Diffuse Sources
Radionuclide emissions are described as either point or diffuse sources. Point sources are produced from an exhaust stack or vent, while diffuse sources emanate from broad areas of contamination, such as radionuclide-contaminated soils present at some Environmental Restoration (ER) sites.

Releases are calculated from measured facility parameters (such as known radionuclide production) in relation to periodic monitoring, and/or continuous monitoring. Doses are determined by performing a dose assessment using EPA's Clean Air Assessment Package-1988 (CAP88) computer model, which is discussed in Section 5.4 (EPA 1997).

In 1999, the highest activities found reported in SNL/NM air emissions were associated with argon and tritium. Historically, these radionuclides have contributed the most to the cumulative effective dose equivalent (EDE) of the maximally exposed individual (MEI). Figure 5-6 shows the annual reported release in curies from argon-41, tritium, xenon-135, and krypton-85 over the past 11 years.

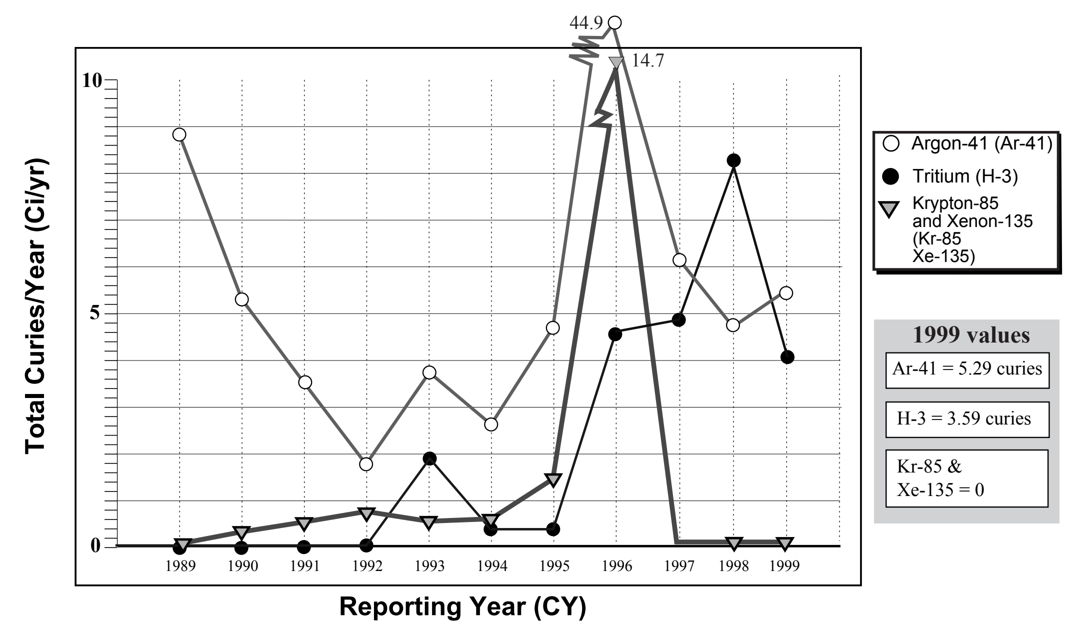
Table 5-7 lists the radionuclides and total curies released from each SNL/NM NESHAP source in 1999. Of the 20 sources, 17 were point sources and three were diffuse sources (landfills). Four of the 20 facilities reported zero emissions in 1999. The Classified Waste Landfill, which is not a routine NESHAP source, was evaluated through continuous air monitoring. Likewise, the Chemical Waste Landfill (CWL), another nonroutine NESHAP source, was evaluated for its potential release via modeling to ensure that any releases were as low as expected.

5.3.2 SNL/NM NESHAP Facilities

The following paragraphs describe the 20 NESHAP facilities at SNL/NM located in four Tech Areas (Figure 5-7). The facility processes that produce radioactive air emissions are briefly described.

Tech Area I Sources

Neutron Generator Facility (NGF) – The NGF is the nation's principal production facility of neutron generators used in nuclear weapons. This facility currently emits only tritium. The facility has two stacks: the Principal Production Facility



NOTE: The atmosphere contains 72% nitrogen, 21% oxygen, 0.93% argon, 0.03% carbon dioxide, and minor concentrations of neon, methane, hydrogen, helium, and kyrpton. Some of these constituents are susceptible to isotope transformations during high energy processes, which result in air activation products such as Ar-41.

00_5-6.ai

FIGURE 5-6. Summary of Atmospheric Releases of the Most Prevalent Airborne Radionuclides from SNL/NM Facilities Since 1989

Data

7.7 Ar	5.2 Ar	8.8 Ar	5.3 Ar	3.55 Ar	1.8 Ar	3.18 Ar	2.6 Ar	4.7 Ar	__ A
0 Tr	0 Tr	0 Tr	0.02Tr	0.02Tr	0.06Tr	1.9Tr	0.29Tr	0.29Tr	__T
0 Kr	0 Kr	0.6 Kr	0.4 Kr	0.5 Kr	0.7 Kr	0.4 Kr	0.41 Kr	1.4 Kr	__

TABLE 5-7. Summary of Radionuclide Releases from the 20 NESHAP Sources in 1999 (continued)

Tech Area	Facility Name	Location	Monitoring Method *	CAP88 Input?	Radionuclide	Reported Release (Ci/yr)
I	**Neutron Generator Facility (NGF)** - East Annex, NGF - North Wing Tritium Envelope	Bldg. 870 Bldg. 870	Calculation Continuous	**yes**	Tritium Tritium	8.0×10^{-2} 2.7
I	**Metal Tritide Shelf-Life Laboratory**	Bldg. 891	Calculation	no	Tritium	5.0×10^{-9}
I	**Radiation Laboratory**	Bldg. 827	Calculation	no	Tritium Nitrogen-16 Nitrogen-13 Argon-41	1.0×10^{-5} 2.0×10^{-7} 1.0×10^{-8} 1.0×10^{-9}
I	**TANDEM Accelerator**	Bldg. 884	Calculation	no	Tritium Carbon-11 Nitrogen -13 Oxygen-14 Oxygen-15 Fluorine-18	1.0×10^{-6} 1.09×10^{-8} 1.85×10^{-5} 4.72×10^{-8} 2.81×10^{-4} 1.69×10^{-6}
I	**Weapons Assembly (WA) System Level Testing Facility**	Bldg. 809	Periodic	no	none	0
I	**Cleaning and Contamination Control Laboratory (CCCL)**	Bldg. 897	Calculation	no	Carbon-14	3.50×10^{-5}
I	**Calibration Laboratory**	Bldg. 869	Calculation	no	Tritium	2.60×10^{-5}
II	**Explosive Components Facility (ECF)**	Bldg. 905	Calculation	no	Tritium	5.05×10^{-4}
II	**Classified Waste Landfill** (Diffuse emissions)		Continuous	no	Gross Alpha Gross Beta Tritium	$-4.87 – 1.52 \times 10^{-14}$ $8.15 – 3.91 \times 10^{-14}$ $-2.34 – 3.88 \times 10^{-14}$
III	**Radioactive and Mixed Waste Management Facility (RMWMF)**	Bldg. 6920	Continuous	**yes**	Tritium	0.6
III	**Sandia Tomography and Radionuclide Transport (START) Laboratory**	Bldg. 6600	Calculation	no	Sodium-22 Americium-241 Uranium-232 Plutonium-241	2.4×10^{-12} 1.0×10^{-13} 1.0×10^{-13} 1.0×10^{-13}

NOTE: * Monitoring Method: Periodic = Based on periodic measurements
Calculation = Calculated from known parameters
Continuous = Based on continuous air monitoring results

TABLE 5-7. Summary of Radionuclide Releases from the 20 NESHAP Sources in 1999 (Concluded)

Tech Area	Facility Name	Location	Monitoring Method *	CAP88 Input?	Radionuclide	Release (Ci/yr)
III	**Mixed Waste Landfill (MWL)** (Diffuse emissions)	North end	Periodic	**yes**	Tritium	0.294
III	**Chemical Waste Landfill (CWL)** (Diffuse emissions)	South end	Calculation	**yes** (not routine)	Tritium Uranium-235 Uranium-238 Thorium-228 Thorium-231 Thorium-232 Lead-212 Lead-214 Bismuth-212 Bismuth-214 Radium-224 Radium-228 Thallium-208 Actinium-228 Potassium-40 Thallium-207	3.8×10^{-7} 1.73×10^{-8} 2.52×10^{-6} 5.29×10^{-8} 1.57×10^{-8} 6.31×10^{-8} 5.72×10^{-8} 1.67×10^{-9} 7.36×10^{-8} 3.00×10^{-10} 7.01×10^{-8} 6.81×10^{-8} 6.11×10^{-8} 6.67×10^{-8} 8.33×10^{-9} 2.66×10^{-8}
IV	**Z-Facility** (Accelerator)	Bldg. 983	Calculation	**yes**	Tritium	7.2×10^{-8}
IV	**High-Energy Radioactive Megavolt Electron Source (HERMES III)**	Bldg. 970	Periodic	**yes**	Nitrogen-13 Oxygen-15	4.08×10^{-4} 4.08×10^{-5}
IV	**Saturn Facility**	Bldg. 981	Calculation	no	none	0
IV	**Short Pulsed High Intensity Nanosecond X-Radiator Facility (SPHINX)**	Bldg. 981	Periodic	no	none	0
V	**Annular Core Research Reactor (ACRR)**	Bldg. 6588	Periodic	**yes**	Argon-41	2.99
V	**Sandia Pulsed Reactor (SPR)**	Bldg. 6590	Periodic	**yes**	Argon-41	2.30
V	**Hot Cell Facility (HCF)**	Bldg. 6580	Periodic	**no** (no releases in 1999)	none	0

NOTE: * Monitoring Method: Periodic = Based on periodic measurements
Calculation = Calculated from known parameters
Continuous = Based on continuous air monitoring results

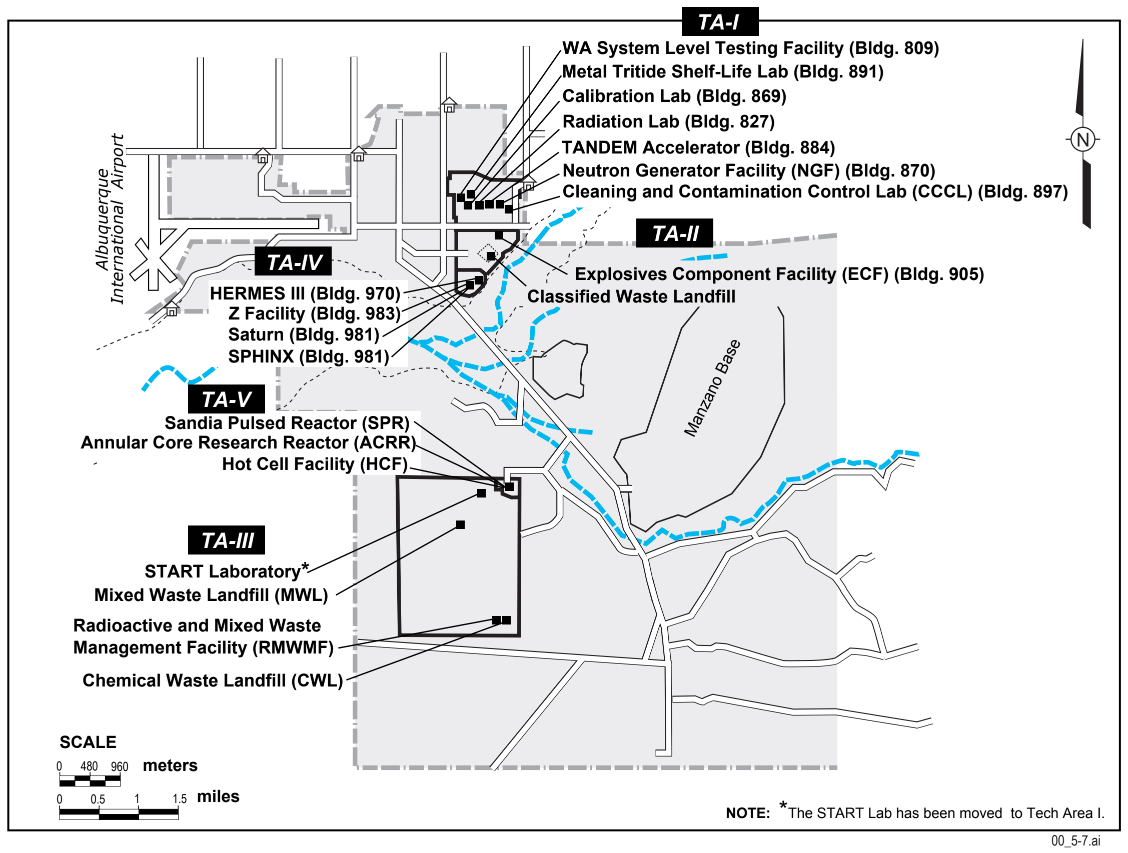


FIGURE 5-7. Locations of the 20 Facilities at SNL/NM that Provided Radionuclide Release Inventories in 1999

East Annex and the Tritium Envelope North Wing. In 1999, 2.7 Ci were released over the year from the North Wing stack. Less than 0.1 Ci was released from the East Annex.

Metal Tritide Shelf-Life Laboratory – This lab, which conducts research on tritium materials, released negligible levels of tritium (one billionth of a curie).

Radiation Laboratory – Small-scale radiation experiments resulted in the release of air-activation products and tritium.

TANDEM Accelerator – This is an ion solid interaction and defect physics accelerator facility. Reported emissions included air activation products, fluorine, carbon, and tritium.

Weapons Assembly (WA) System Level Testing – WA is a research facility that assembles weapons trainers for various tests. Zero emissions were reported in 1999.

Cleaning and Contamination Control Laboratory (CCCL) – The CCCL, formerly the Integrated Materials Research Laboratory (IMRL), is used for research and development of new and superior materials for government and industrial needs. Carbon-14 was the only emission released in 1999.

Calibration Laboratory – Calibration on radiation detection equipment resulted in minute releases of tritium.

Tech Area II Sources

Explosive Components Facility (ECF) – The ECF conducts destructive testing on neutron generators. Tritium was the only release in 1999.

Classified Waste Landfill – The landfill is primarily a diffuse source of tritium and depleted uranium (DU) contamination. Since the landfill was largely uncharacterized, continuous air monitoring has been conducted since the onset of remediation. Monitoring for gross alpha, gross beta, and tritium resulted in the detection of naturally-occurring radionuclides at minute levels. Excavation of the landfill was completed in 2000.

Tech Area III Sources

Radioactive and Mixed Waste Management Facility (RMWMF) – The RMWMF primarily handles LLW and MW and some TRU waste. In 1999, the RMWMF reported only tritium releases.

Sandia Tomography and Radionuclide Transport (START) Laboratory – This lab is used to perform small-scale experiments. In 1999, the facility reported emissions of sodium-22, plutonium-241, americium-241, and uranium-232. The lab has been moved to Tech Area I.

What is Depleted Uranium (DU)?

Natural uranium ore is almost entirely made up of two uranium isotopes: 99.3% uranium-238 and 0.7% uranium-235. Uranium processing enriches the amount of U-235 for use in weapons and as nuclear fuel. The resulting uranium by-product is depleted in uranium-235 and is made up almost entirely of uranium-238. This by-product is called "depleted uranium," or DU. The reduction of U-235 and the long half-lives of the uranium isotopes contribute to the lower specific activity associated with DU.

Mixed Waste Landfill (MWL) – The MWL was closed in 1988 and is being addressed by the ER Project. Although a diverse inventory of radionuclides is present in the landfill, tritium is the only radionuclide released to the air. In 1992 and 1993, two special studies were conducted to measure the tritium emissions (Radian 1994). As conditions at this landfill have remained unchanged, the measured concentrations are assumed to remain fairly constant.

Chemical Waste Landfill (CWL) – The CWL is not a routine NESHAP source. The primary radionuclides released from the CWL are diffuse tritium and DU. Remediation on the CWL began in 1998. Soil and debris samples were collected and analyzed for radioactive content and used to estimate the total radioactivity excavated in 1999. A worst case analysis was done, which assumed that all radioactivity present was re-suspended into the air.

Tech Area IV Sources

High-Energy Radiation Megavolt Electron Source-III (HERMES III) – The HERMES III accelerator is used to test the effects of prompt radiation from a nuclear burst on electronics and complete military systems. This facility produces air activation products, primarily nitrogen-13 and oxygen-15.

Z Facility – The Z Facility is an accelerator used for research on light ion inertial confinement fusion. Large amounts of electrical energy are stored over several minutes and then released as an intense concentrated burst (shot) at a target. In 1999, the facility produced only tritium emissions.

Saturn Accelerator – This is a modular, high power, variable spectrum, x-ray simulation source that reproduces the radiation effects of nuclear countermeasures on electronic and material components. Zero emissions were reported in 1999.

Air Activation Products

Elements such as oxygen, nitrogen, and argon in air can become radioactive in the presence of a strong radiation field such as those produced by reactors and accelerators. Neutron capture, for example, turns the normal nonradioactive argon-40 isotope into argon-41. Neutrons can also be displaced such as when oxygen-16 is transformed to oxygen-15.

Short Pulsed High Intensity Nano-second X-Radiator (SPHINX) Facility – The SPHINX is a high voltage, high shot rate bremsstrahlung accelerator used to measure the x-ray induced photo currents from short, fast rise time pulses in integrated circuits. Zero emissions were reported in 1999.

Tech Area V Sources

Annular Core Research Reactor (ACRR) – This reactor is used primarily to support defense program projects. If required in the future, the facility also has the capability to support the Medical Isotope Production Project (MIPP). Argon-41, an air activation product, was the only reported release in 1999.

Hot Cell Facility (HCF) – The HCF provides full capability to remotely handle and analyze radioactive materials such as irradiated targets. The facility is in a standby mode to support MIPP should production be required in the future. No emissions were reported in 1999.

Sandia Pulsed Reactor (SPR) – The SPR is used to produce intense neutron bursts for effects testing on materials and electronics. In 1999, only argon-41, an air activation product, was released.

5.4 ASSESSMENT OF POTENTIAL DOSE TO THE PUBLIC

In general, the dose received by a person is dependent on the distance from the source(s), various pathways in the environment (food chain, air, and water), radionuclide half-lives and activities, and meteorological conditions. Historically, radioactive releases from SNL/NM have been, and continue to be, several orders of magnitude below the EPA's maximum allowable standard of 10 mrem/yr. Radiation protection standards specific to DOE facilities are given in Appendix A.

Dose Calculation

To assess compliance, NESHAP facilities at SNL/NM submit facility emission data to the NESHAP Program Administrator. All annual doses presented in this section were obtained using EPA's CAP88 computer code (EPA 1997). Seven facilities were used in the dose calculations. The resulting calculated dose determines the effective dose equivalent (EDE) to the maximally exposed individual (MEI). The MEI is defined as a member of the public at any publicly accessible location such as a school, recreation area, place of business, or residence. A member of the public does not include persons working at or for Sandia Corporation on SNL/NM property. CAP88 conservatively assumes that the MEI abides at the receptor location 24-hours-a-day to receive the maximum potential dose.

5.4.1 NESHAP Dose Assessment Input

Emission Sources

In 1997, a programmatic review of the SNL/NM NESHAP Program found the program to be in excess of the requirements of 40 CFR 61, Subpart H. NESHAP regulation requires Sandia Corporation to monitor any radionuclide air emission source that has the *potential* to produce a dose of 0.1 mrem/yr to a MEI; however, there are no facilities at SNL/NM that have the potential to produce a dose of 0.1mrem/yr under routine operations. Therefore, according to the regulation, no stack monitoring is required at SNL/NM. However, as a Best Management Practice (BMP), Sandia Corporation does conduct periodic stack monitoring at several facilities. The results may be used for calculating total facility emissions.

As shown in Table 5-7, seven facilities were modeled using CAP88 to calculate the EDE to the MEI. (The Chemical Waste Landfill [CWL] was also modeled as a non-routine source.)

Radionuclide Activity vs. Dose

Activity is the number of nuclear transformations (or disintegrations) a radioactive material has in a unit of time. This value is measured in Curies (Ci) or disintegrations per second (dps).

1 Ci = 3.7 x 10^{10} dps

A value in Curies is useful in quantifying how much radiation is present. However, activity does not directly indicate the affects of radiation on a human body. This is measured by dose equivalent, which allows for varied biological effectiveness and different types of radiation. The dose equivalent is defined as the absorbed dose (the amount of energy deposited per gram of tissue) multiplied by a *quality factor* that is based on the type of radiation and its effectiveness in transferring energy to tissue. Dose is measured in units of rem (Roentgen equivalent man) or Sieverts (Sv).

1 rem = 1,000 millirem (mrem)
100 rem = 1 SV

Demographic Data

Demographic data includes resident population, the number of beef and dairy cattle, and the utilized food crop area fraction for the 80-km radius study area. The densities for population, cattle, and food crops are calculated as the quotient of the most recent county data and the county land area (e.g., cows per acre). For the 1999 NESHAP calculation, population was based on the state's 1994-1995 estimated urban and county population data and U.S. Census Bureau data (DOC 1998). The beef and dairy cattle numbers and the food crop area fractions were calculated using the 1995 agricultural statistics supplied by the New Mexico Department of Agriculture (NMDOA 1998). The following values were used in the 1999 CAP88 calculation:

15,790	Dairy cattle
32,696	Beef cattle
87.7	Food crops (sq mi)
695,406	Population (within 80-km radius)

Onsite and Offsite Public Receptors

Various receptor locations have been evaluated (in the vicinity of SNL/NM) as potential locations of maximum exposure to a member of the public. Offsite receptor locations extend to the Isleta Indian Reservation, the Four Hills subdivision north of KAFB, the Manzanita Mountains (east mountain residents), and areas near the airport west of KAFB. A total of 30 receptor locations (onsite and offsite) were evaluated in 1999. One receptor, the Coyote Canyon Control Center, was dropped because it is no longer considered a public facility. Three new receptor locations were added in 1999. These include the Chestnut Test Site (southwest of the RMWMF) and the East and West Capehart Housing units.

Meteorology

Data from four meteorological towers (CW1, A36, A21, and MW1) in the proximity of NESHAP emission sources were used in 1999. Data from each tower consisted of approximately 35,000 hourly observations of wind direction, wind speed, and stability class (inferred from wind and solar insulation data). The data are compiled into a normalized distribution from which all wind and stability frequency-of-occurrence data were derived.

5.4.2 Dose Assessment Results

CAP88 utilizes a gaussian plume equation that emulates both horizontal and vertical air dispersion. Individual EDE doses to offsite and onsite receptors are presented in Tables 5-8 and 5-9, respectively. Dose assessment results are summarized in Table 5-10.

TABLE 5-8. Annual Source-Specific Effective Dose Equivalent (EDE) to Offsite Receptors in 1999

Receptor	ACRR (Bldg. 6588)	SPR (Bldg. 6590)	HERMES III (Bldg. 970)	RMWMF (Bldg. 6920)	Mixed Waste Landfill	NGF (Bldg. 870)	Z Facility (Bldg. 983)	Effective Dose Equivalent (mrem/yr)
Albuquerque City Offices	6.90E-05	5.40E-05	2.20E-09	6.10E-06	7.90E-06	1.30E-04	2.90E-12	**2.67E-04**
East Resident	3.50E-06	2.60E-06	4.20E-12	4.70E-06	5.40E-06	1.10E-04	2.40E-12	**1.27E-04**
Eubank Gate Area (Bldg. 8895)	3.80E-05	2.90E-05	8.40E-09	5.30E-06	6.40E-06	2.00E-04	3.80E-12	**2.79E-04**
Four Hills	4.80E-05	3.70E-05	2.20E-09	5.30E-06	6.20E-06	1.20E-04	2.90E-12	**2.17E-04**
Isleta Bingo	9.90E-06	7.80E-06	1.90E-11	5.50E-06	5.80E-06	1.20E-04	2.60E-12	**1.49E-04**
Northeast Resident	2.20E-05	1.70E-05	2.30E-10	5.20E-06	5.70E-06	1.10E-04	2.60E-12	**1.60E-04**
Seismic Center (USGS)	1.40E-05	1.10E-05	3.80E-11	4.90E-06	5.50E-06	1.10E-04	2.50E-12	**1.46E-04**
Tijeras Arroyo (West)	1.00E-04	8.00E-05	3.20E-09	6.50E-06	9.20E-06	1.30E-04	3.20E-12	**3.25E-04**

NOTE: E Notation denotes the exponent.

TABLE 5-9. Annual Effective Dose Equivalent (EDE) to Onsite Receptors in 1999

Receptor	ACRR (Bldg. 6588)	SPR (Bldg. 6590)	HERMES III (Bldg. 970)	RMWMF (Bldg. 6920)	Mixed Waste Landfill	NGF (Bldg. 870)	Z Facility (Bldg. 983)	Effective Dose Equivalent (mrem/yr)
Airport (Bldg. 760)	7.80E-05	3.90E-05	4.50E-09	7.10E-07	1.20E-06	3.20E-05	5.90E-13	**1.51E-04**
Airport East (Bldg. 1064)	3.90E-05	3.00E-05	3.10E-09	6.10E-07	9.90E-07	3.40E-05	8.30E-13	**1.05E-04**
Bldg. 20706 (USAF)	5.40E-05	4.20E-05	2.30E-08	7.10E-07	1.20E-06	6.40E-05	2.80E-12	**1.62E-04**
Bldg. 24499 (USAF)	3.50E-05	2.60E-05	6.00E-09	6.10E-07	9.40E-07	6.60E-05	9.20E-13	**1.28E-04**
Chestnut Test Site	1.00E-04	8.60E-05	1.90E-10	1.10E-05	2.20E-06	4.40E-06	1.80E-13	**2.05E-04**
East Capehart	3.00E-05	2.30E-05	3.30E-09	5.60E-07	8.40E-07	2.40E-05	8.90E-13	**7.83E-05**
Golf Course Clubhouse	2.40E-04	1.80E-04	6.60E-09	1.40E-06	2.50E-06	1.20E-05	8.80E-13	**4.36E-04**
Golf Course Maintenance Area	1.40E-04	1.00E-04	1.20E-08	1.20E-06	2.00E-06	1.70E-05	1.80E-12	**2.60E-04**
Honeywell Instrument Support Site	7.30E-05	5.60E-05	9.90E-08	8.20E-07	1.50E-06	5.00E-05	1.40E-11	**1.81E-04**
ITRI/Lovelace	3.50E-05	2.90E-05	1.00E-10	9.90E-07	6.80E-07	2.80E-06	1.00E-13	**6.87E-05**
KAFB Fire Station #4 (Bldg. 90002)	5.00E-05	4.00E-05	7.30E-11	2.70E-06	1.60E-06	4.50E-06	1.70E-13	**9.92E-05**
KAFB Landfill	7.20E-05	5.50E-05	4.90E-08	8.80E-07	1.30E-06	3.50E-05	3.60E-12	**1.64E-04**
KUMSC	4.70E-04	3.60E-04	3.80E-09	1.70E-06	6.10E-06	1.20E-05	1.10E-12	**8.49E-04**
Loop Housing	3.30E-05	2.50E-05	6.60E-09	5.90E-07	9.30E-07	6.40E-05	1.30E-12	**1.23E-04**
Manzano Offices (Fire Station)	1.30E-04	1.00E-04	8.50E-10	1.60E-06	1.40E-06	6.70E-06	1.80E-13	**2.40E-04**
Maxwell Housing	4.10E-05	3.20E-05	8.40E-10	5.00E-07	9.50E-07	1.80E-05	3.90E-13	**9.25E-05**
Pershing Park Housing	3.30E-05	2.10E-05	3.30E-09	5.40E-07	8.20E-07	3.90E-05	8.70E-13	**9.42E-05**
Riding Club	2.60E-04	2.10E-04	1.70E-09	1.60E-06	2.60E-06	8.50E-06	4.60E-13	**4.83E-04**
Sandia Federal Credit Union	4.70E-05	3.60E-05	1.30E-08	6.50E-07	1.10E-06	1.30E-04	2.00E-12	**2.15E-04**
Space Vehicles Directorate (Bldg. 57001)	4.10E-05	3.40E-05	1.60E-10	1.00E-06	8.30E-07	3.20E-06	1.20E-13	**8.03E-05**
West Capehart	3.70E-05	2.80E-05	6.30E-10	4.70E-07	6.80E-07	9.60E-06	3.30E-13	**7.57E-05**
Zia Park Housing	4.60E-05	3.50E-05	6.70E-09	6.40E-07	1.10E-06	5.60E-05	1.30E-12	**1.39E-04**

NOTE: E Notation denotes the exponent.

TABLE 5-10. Calculated Dose Assessment Results for Onsite and Offsite Receptors and for Collective Populations in 1999

Dose to Receptor	Location	1999 Calculated Dose	NESHAP Standard
Individual Dose			
Onsite Receptor EDE to the MEI	KUMSC	0.00085 mrem/yr *(0.00000850 mSv/yr)*	10 mrem/yr *(0.1 mSv/yr)*
Offsite Receptor EDE to the MEI	Eubank Gate Area East of KAFB	0.00021 mrem/yr *(0.0000021 mSv/yr)*	10 mrem/yr *(0.1 mSv/yr)*
Collective Dose			
Collective Regional Population[2]	Residents within an 80-km radius	0.0221 person-rem/yr *(0.000221 person-Sv/yr)*	No standard available
Collective KAFB Population[1]	KAFB housing	0.00051 person-rem/yr *(0.0000051 person-Sv/yr)*	No standard available

NOTE: EDE = effective dose equivalent   MEI = maximally exposed individual
KUMSC = Kirtland Underground Munitions Storage Complex
NESHAP = National Emissions Standards for Hazardous Air Pollutants
mSv = millisievert   person-Sv = person seviert   mrem = millirem
[1]Based on a population of 4,430 people estimated to be living in permanent on-base housing.
[2]Based on a population of 695,406 people estimated to be living within an 80-km (50-mi) radius.

In 1999, the highest calculated dose for an onsite and offsite receptor resulting from SNL/NM's radiological air emissions was approximately 10,000 times less than EPA's standard of 10 mrem/yr.

The onsite MEI was again located at the Kirtland Underground Munitions Storage Complex (KUMSC), northwest of the Annular Core Research Reactor (ACRR) and Sandia Pulsed Reactor (SPR) in Tech Area V. The resultant onsite MEI dose of 0.00085 mrem/yr results primarily from argon-41.

Collective Dose

The collective population dose resulting from all SNL/NM radiological emissions was calculated for both KAFB and the regional area (Table 5-10). A population dose is not required by NESHAP regulations; however, it provides a useful numerical comparison of the public dose from year to year. The population dose is attained by multiplying a representative individual dose within a population, with the total population. Sandia Corporation calculates a population dose for both the KAFB housing areas and the general Albuquerque area population within an 80-kilometer (50-mile) radius.

Regional – The Albuquerque regional collective population dose in 1999 was 0.0221 person-rem/yr resulting primarily from argon-41 and tritium. For the purpose of calculating collective dose, all releases are assumed to occur from a location centered in Tech Area V. The population dose was calculated by multiplying 695,406 residents by doses per sector.

KAFB – A collective population dose for KAFB residents was calculated based on six main housing areas. The total population dose for KAFB was obtained by summing the six areas

CAP88 Dose Assessment Model

The Clean Air Act Assessment Package-1988 (CAP88), Windows Version 2.0 is an EPA-approved modeling code used to determine the dose from radiological air emission sources. CAP88 assesses the dose for an 80-km (50-mi) radius.

The CAP88 model calculates exposure that can occur through inhalation, ingestion, air immersion, and surface irradiation "ground-shine" pathways. Input parameters used in CAP88 include emission release factors (stack height, stack diameter, and exhaust velocity), known radionuclides, spatial data, and weather data. Site-specific data includes resident populations, agricultural food crop areas, and beef and dairy cow populations.

The resultant dose calculation identifies the location where emissions from SNL/NM's seven source facilities collectively contribute to the highest possible dose at an onsite and offsite receptor.

assuming a total residential population of 4,430. This resulted in an estimated population dose of 0.00051 person-rem/yr. Again, the dose resulted primarily from argon-41 and tritium.

5.5 AIR QUALITY REQUIREMENTS AND COMPLIANCE STRATEGIES

Air quality standards are implemented by regulations promulgated by local and federal government in accordance with the Clean Air Act (CAA) and the CAA amendments (CAAA) of 1990. Both the Albuquerque/Bernalillo County Air Quality Control Board (ABC/AQCB) and the EPA determine applicable air quality standards for nonradiological pollutants. Radionuclide air emissions are currently regulated by the EPA under NESHAP, as discussed in Section 5.4, although NESHAP regulations are in the process of being delegated to the ABC/AQCB. A complete list of air quality regulations applicable to SNL/NM is given in Appendix B.

5.5.1 SNL/NM Air Emission Sources

As discussed in Section 5.2, criteria pollutants include SO_2, NO_2, CO, ozone, particulate matter (PM), and lead. For these criteria pollutants, the EPA:

- Sets ambient air quality standards, including motor vehicle emissions;
- Requires state plans for protection and improvement of air quality;
- Institutes air quality programs to prevent the nation’s air from deteriorating; and
- Establishes hazardous air pollutant (HAPs) control programs.

EPA standards for criteria pollutants are given in 40 CFR 50, “National Ambient Air Quality Standards” and implemented in 20 NMAC 11.01 "General Provisions." Compliance with criteria

New EPA Standard for Ozone

As discussed in Section 2.3, the EPA revoked the National Ambient Air Quality Standards (NAAQSs) in 1998 for the one-hour standard of 0.12 ppm for ozone (O_3). However, on May 14, 1999, a federal appeals court blocked the EPA from imposing tougher air quality requirements for ozone and PM. The EPA said the tougher laws were needed to protect children and adults with respiratory problems.

pollutant standards for ambient air is met through ambient air surveillance, periodic direct emission sampling, and fuel throughput tracking and reporting. As discussed in the previous section, ambient air measurements taken in the vicinity of SNL/NM facilities have been well below maximum threshold values and guidelines for criteria pollutants.

The significant sources of criteria pollutants at SNL/NM are listed below.

***Steam Plant* –** The Steam Plant is used to produce steam heat for buildings in Tech Area I as well as some facilities on the eastside of KAFB. The plant has run continuously since 1949. The five boilers (Boilers 1, 2, 3, 5, and 6) run primarily on natural gas but can also burn diesel. All five boilers were used in 1999. The volume of fuel used in the boilers (throughput) is reported to the City of Albuquerque. In 1999, fuel throughput reported at the Steam Plant was as follows:

Natural Gas	Diesel
676,29,327 scf	9,402 gal

scf = standard cubic feet gal = gallon

As defined by 20 NMAC 11.67, "Equipment Emissions, Limitations," the Steam Plant falls beneath the minimum emission limits for NO_x applicability. Stack sampling is not required and because this is a "grandfathered" source, no permit has previously been required; therefore, there are no *current* regulations that apply to the Steam Plant. However, the plant's air emissions will be subject to the requirements of Title V, since it has the *potential* to emit greater than 100 tpy of criteria pollutants. As a "grandfathered" existing source, Title V does not require the Steam Plant to change or replace equipment. However, Sandia Corporation initiated the Steam Plant Optimization Project in 1997 to determine ways to improve fuel efficiency and reduce emissions.

Vehicles – The majority of government vehicles at SNL/NM are owned and operated by the General Services Administration (GSA). There are approximately 800 GSA vehicles currently in SNL/NM's fleet. These vehicles must meet the same emission standards as all personal and other vehicles that are issued KAFB vehicle passes. As required by 20 NMAC 11.100, "Motor Vehicle Inspection-Decentralized," Sandia Corporation submits a vehicle inventory update and inspection plan to the City of Albuquerque annually.

Emergency Generators – Sandia Corporation operates four main standby diesel generators for emergency power supply. These generators are located in Bldg. 862 within Tech Area 1 and are some of SNL/NM's largest generators, each with a 600-kilowatt (kW) capacity. These generators, permitted by the City of Albuquerque (Table 2-7), are exercised monthly and their electrical systems are tested quarterly. As required by Title V, all fuel used in the generators is reported to the City of Albuquerque. In 1999, the fuel throughput reported was 5,380 gal of diesel. In anticipation of Title V Permit being issued by the City of Albuquerque, Sandia Corporation has already instituted a self-imposed fuel cap upon which the Title V air emission fee is based. Sandia Corporation has assumed a maximum use of 500 hours per year for each generator, which is the same usage assumed for all other onsite generators.

Open Burns – As required by 20 NMAC 11.21, "Open Burning," Sandia Corporation obtains open burn permits for each scheduled event or test series. The regulation differentiates the permit basis into two categories: multiple-event and single-event. The single-event permit was designed to regulate individual burns having significant impact. As shown in Table 2-7, there were 10 permits issued in 1999. Open-burn permits are required for:

- **Disposal of Explosives by Burning** (avoids the hazards of transport and handling);

Steam Plant Optimization Project

The Steam Plant is SNL/NM's largest air emission source. In 1997, Sandia Corporation initiated the Steam Plant Optimization Project to determine ways to improve fuel efficiency and reduce emissions for the facility's five boilers. In 1998, design work to retrofit Boilers 5 and 6 for flue gas recirculation was completed, and actual retrofitting was accomplished in 1999. Plans were also drawn up to retrofit the remaining boilers (1, 2, and 3). This will proceed in 2000 if funding is available. Retrofitting the two boilers resulted in a reduction of the emission factor from 280 to 100 lb per million standard cubic feet of natural gas burned. NO_x emissions from the Steam Plant have therefore been reduced by 67 percent.

The success of the Steam Plant Optimization Project earned SNL/NM the ***"Industry and Government Pollution Prevention Award for 1999***" given by the New Mexico Facility Managers Network in conjunction with the City of Albuquerque. The award was in the Large Industry Air Quality Award Category.

- **Aboveground Detonation of Explosives** (over 20 lb);

- **Burning Liquid Fuel 2,000 gal or More** or solid fuel of 5,000 lb in a single-event research and development activity; and

- **Igniting Rocket Motors** with greater than 4,000 lb of fuel.

5.5.2 New Directions Under Title V

The Clean Air Act Amendments of 1990 (CAAA) contained provisions under Title V requiring all existing major air emission sources to obtain an operating permit. A *major source* is defined as the combined emissions from any facility with the potential to emit:

- 100 tons per year (tpy), or greater, of any criteria pollutant,
- 10 tpy of any hazardous air pollutant (HAP), or
- 25 tpy of any combination of HAPs.

SNL/NM is considered a major source based on its potential to emit nitrogen oxides (NO_x) and carbon monoxide (CO). Since potential emissions from the Steam Plant are greater than 100 tpy of criteria pollutants, this facility is considered a major source in itself.

The intent of Title V is not to add new requirements, but to pull together existing requirements under one umbrella regulation, thereby eliminating the need to permit individual sources. Once the Title V permit is issued by the City of Albuquerque, DOE will submit just one annual air compliance report and one annual fee to the City of Albuquerque. The Title V Operating Permit will integrate all CAAA requirements into one site-wide permit for DOE, which will be inclusive of several DOE facilities in the general KAFB area, including SNL/NM. SNL/NM sources listed on the permit application include the Steam Plant, the emergency generators, and smaller combustion sources. (Burn permits may continue to be permitted on an individual basis.)

Background

The City of Albuquerque implements Title V regulations for Albuquerque and the rest of Bernalillo County under its Operating Permit Program as described in 20 NMAC 11.42, "Operating Permits." The Permit Program received interim approval by the EPA on March 13, 1995. Title V required all existing *major sources* to apply for an Title V Operating Permit by March 13, 1996. DOE submitted Sandia Corporation's Title V Operating Permit application (No. 515, Volume 1) on March 1, 1996; the application, was deemed complete on May 1, 1996. Although the regulatory due date for the permit was March 13, 1998, the City of

Albuquerque has yet to issue the final permit.

A draft Title V Operating Permit for KAFB (but not DOE) was released during 1999 by the City of Albuquerque. The draft permit for DOE is anticipated in 2000.

Title V Fee Structure

Title V requires *major source* owners to pay air emission fees, which are implemented under 20 NMAC 11.02, "Permit Fees." Source owners may submit an inventory of their actual fuel use (throughput) for the year and pay an annual fee based on that amount. This voluntary inventory on fuel usage encourages source owners to limit their total air emissions since less emissions equals less fees. This is an improvement over the previous fee structure, which based annual fees on an assessed value of a source's maximum potential to emit regardless of actual emissions, thereby giving no incentive for owners to limit emissions. (For example, the Steam Plant would be assessed on the assumption that it operated at full capacity year-round.) Sandia Corporation meets compliance with Title V by recording fuel throughput for all significant sources. In 1999, SNL/NM's total reported emissions, based on throughput, were significantly reduced from 119 tons from the previous year to 75 tons. This resulted in a fee reduction of $1,364. This was due in large part to retrofitting two Steam Plant boilers for flue gas recirculation under the Steam Plant Optimization Project.

Risk Management Plan (RMP)

The EPA requires the submittal of a RMP by June 21, 1999 for all facility owners or operators that use regulated substances above a threshold quantity (TQ). The requirement is defined in 40 CFR 68, Subpart G, "Risk Management Plans." EPA requires the RMP to be made available to state and local governments and the public and contain the following information:

- Accidental release prevention and emergency response policies;
- The stationary source and the regulated substances handled;
- Worst-case release scenario and alternate release scenario (hazard assessment);
- General accidental release prevention program and steps;
- The five-year accident history;
- The Emergency Response Program; and
- Planned changes to improve safety.

On May 21, 1999, shortly before the required submittal date, EPA formally exempted certain hydrocarbons, such as propane, which are used as fuel. The proposed rule amendment provided a six-month stay of effectiveness for processes using listed fuels in quantities below 67,000 lb. However, if the hydrocarbon is mixed with another listed substance above a TQ, or is interconnected in any way or collated to another (non-fuel) covered process, then a RMP would still be required. Sandia Corporation does not store propane at SNL/NM in a process greater than 67,000 lb; however, there is propane stored in nine process groups greater than 10,000 lb. After review of the rule, Sandia Corporation determined that its processes did not require an RMP.

Chapter 6

Wastewater, Surface Discharge, and Storm Water Monitoring Programs

Effluent monitoring is the collection of samples or direct measurement taken from liquid or gaseous waste stream processes for the purpose of quantifying contaminants and determining regulatory compliance. Effluent monitoring in this chapter is confined to water monitoring activities that include sanitary and industrial discharges, surface discharges, and storm water runoff. Water quality monitoring at Sandia National Laboratories, New Mexico (SNL/NM) is conducted by Sandia Corporation's Environmental Management Department.

Sandia Corporation complies with water quality regulations established by local, state, and federal agencies. U.S. Environmental Protection Agency (EPA) standards are implemented at the state and local level by the New Mexico Environment Department (NMED) and the City of Albuquerque. The state and the City of Albuquerque establish water quality standards at least as strict as the federal standards. Currently, EPA Region VI implements storm water regulations under the National Pollutant Discharge Elimination System (NPDES), although this authority may eventually pass to the state. Sandia Corporation also adheres to the water quality guidelines contained in DOE Orders 5400.1, *General Environmental Protection Program,* and 5400.5, *Radiation Protection of the Public and the Environment*, (DOE 1990, DOE 1993).

6.1 WASTEWATER DISCHARGE PROGRAM

Wastewater discharged to the public sewer system from SNL/NM facilities is divided into two categories: sanitary discharges and industrial discharges. Sanitary waste streams include wastewater from restrooms and showers, food service establishments, and other domestic-type activities. Industrial discharges are produced from general laboratory research operations including electroplating, metal finishing, microelectronic development, and photographic processes.

Sandia Corporation closely monitors its liquid effluent discharges to meet regulatory compliance. Sandia Corporation further reduces its toxic discharges by implementing Toxic Organic Management Plans and general good housekeeping and engineering practices. Pollution prevention measures to reduce, substitute, or eliminate toxic chemicals are implemented where feasible, as discussed in Section 3.3.

6.1.1 SNL/NM and the City of Albuquerque Sewer System

Southside Water Reclamation Plant
SNL/NM's sewer system connects to the City of Albuquerque's sanitary sewer line at four permitted outfall stations. SNL/NM also has one additional permitted wastewater outfall

station at the Microelectronics Development Laboratory (MDL), which is upstream of the final discharge points. In 1999, the outfall station at the Advanced Manufacturing Process Laboratory (AMPL) was discontinued after several years of zero discharges. Wastewater effluent discharging from any of the five stations must meet the City of Albuquerque's wastewater standards for both physical and chemical parameters.

All wastewater flows through the Tijeras Arroyo Intercept and terminates at the Southside Water Reclamation Plant. The plant services all of the Albuquerque area and is the largest water treatment facility in New Mexico. The water treatment process begins with the removal of solids in a settling tank. The resultant sludge is tilled into the ground or sold as compost to local nurseries. Aeration tanks, rich in microorganisms, allow the sewage to be broken down further by natural biological processes. This biological treatment process is vulnerable to excess amounts of chemicals or metals that can interfere with the effectiveness of the microbes. Industrial wastes that contain an excess of heavy metals (especially cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), toxic chemicals such as cyanide, solvents, and pesticides can be very damaging to the process. For this reason, wastewater constituents must be closely monitored before being put through the treatment process.

In 1998, the plant completed a recent expansion to add a Nitrogen Removal Facility as mandated by the EPA. The new facility has immensely improved the quality of water discharged to the Rio Grande; treated water is now well within the EPA limits set for nitrogen and ammonia. All discharge standards for the City of Albuquerque are defined in its NPDES Permit.

Wastewater Compliance Awards

The City of Albuquerque's reporting requirements are defined under its Industrial Wastewater Pre-treatment Program. This program specifies the discharge quality and requirements that the City of Albuquerque will accept at its water reclamation plant. Sandia Corporation received six “Gold Pre-treatment Awards” from the City of Albuquerque for the 1998-1999 reporting year for SNL/NM. A Gold Award is given based on a facility’s 100 percent compliance to discharge limits set in permits or exceptional source reduction and pollution prevention.

6.1.2 Permitting and Reporting

The City of Albuquerque Public Works Department, Liquid Waste Division, implements EPA’s water quality standards under the authority of the “Sewer Use and Wastewater Control Ordinance.” Sandia Corporation submits semi-annual wastewater reports to the City of Albuquerque. Results from the January 1 to June 30 1999 period were submitted by July 31, 1999; results from the July 1 to December 31 1999 period were submitted by January 31, 2000. The primary regulatory drivers for the Wastewater Program are listed in Appendix B. Important program documents and reports are listed in Appendix C.

Discharge Control Program

Sandia Corporation's Water Quality Group maintains a Discharge Control Program to track expected wastewater discharges resulting from ongoing chemical, manufacturing, and industrial processes at SNL/NM’s facilities. Facility processes are reviewed for contaminants, concentrations, and discharge frequencies to determine if the effluent will meet regulatory criteria. Once approved, a facility is issued an internal SNL/NM permit, which is reviewed annually. If there are any changes in the facility’s processes and discharges prior to the annual review, the facility owner must notify the Water Quality Group. Generally, because processes are well characterized, any constituents that are detected over the limits at a wastewater monitoring station can generally be tracked back to the source facility. Corrective actions to mitigate further releases are implemented, as necessary.

One-time releases are approved on a case-by-case basis. Buildings that only produce domestic sewage, such as from lavatories, sinks, and fountains, are not required to obtain internal permitting.

6.1.3 Wastewater Monitoring Stations

SNL/NM has six onsite wastewater monitoring stations permitted by the City of Albuquerque as shown in Figure 6-1. (Wastewater permits are listed in Table 2-7.) Four of these stations discharge directly to the public sewer, which flows into the Tijeras Arroyo Intercept. Two are upstream categorical pre-treatment stations, although one of these stations became a zero discharge point in 1997 and was finally discontinued in 1999.

The EPA has established categorical pre-treatment standards for specified classes of industrial discharges. Station WW007 monitors the wastewater discharged from the acid waste neutralization system at the Microelectronics Development Laboratory (MDL) in Tech Area I. Station WW009, which closed in 1999, had monitored the wastewater generated from the operations at the Advanced Manufacturing Process Laboratory (AMPL), also in Tech Area I.

Wastewater Monitoring

All outfall stations are equipped with flow meters and pH sensors to continuously monitor wastewater 24 hours-a-day, 365 days a year. In the event that an exceedence is detected, an auto-dialer will contact SNL/NM personnel, and the City of Albuquerque will be notified within 24 hours. Station equipment parameters are listed in Table 6-1.

SNL/NM discharges approximately 800,000 gal per day to the public sewer.

Sandia Corporation splits quarterly wastewater samples taken from its outfalls with the City of Albuquerque to determine compliance with permit conditions. (As requested, splits may also be done with the NMED). All samples are taken as 24-hour flow proportional composites. Sandia Corporation sends its split samples to an EPA-approved laboratory for analysis. The results are compared with results obtained by the City of Albuquerque. Currently, the procedure is to sample randomly from a list of potential pollutants. The City of Albuquerque determines which parameters it plans to analyze. Analytes are chosen from the parameters shown in the shaded box below.

Wastewater Analyte Parameters

Metals

- Aluminum
- Chromium
- Lead
- Nickel
- Selenium
- Arsenic
- Copper
- Mercury
- Silver
- Zinc

Radiological

- Tritium
- Gross alpha
- Gross beta
- Gamma spectroscopy

General Chemistry

- Cyanide
- Soluble fluoride
- Formaldehyde
- Phenolic compounds
- Oil and grease
- Volatile organic compounds (VOCs)
- Semi-VOCs (SVOCs)
- Chemical oxygen demand (COD)

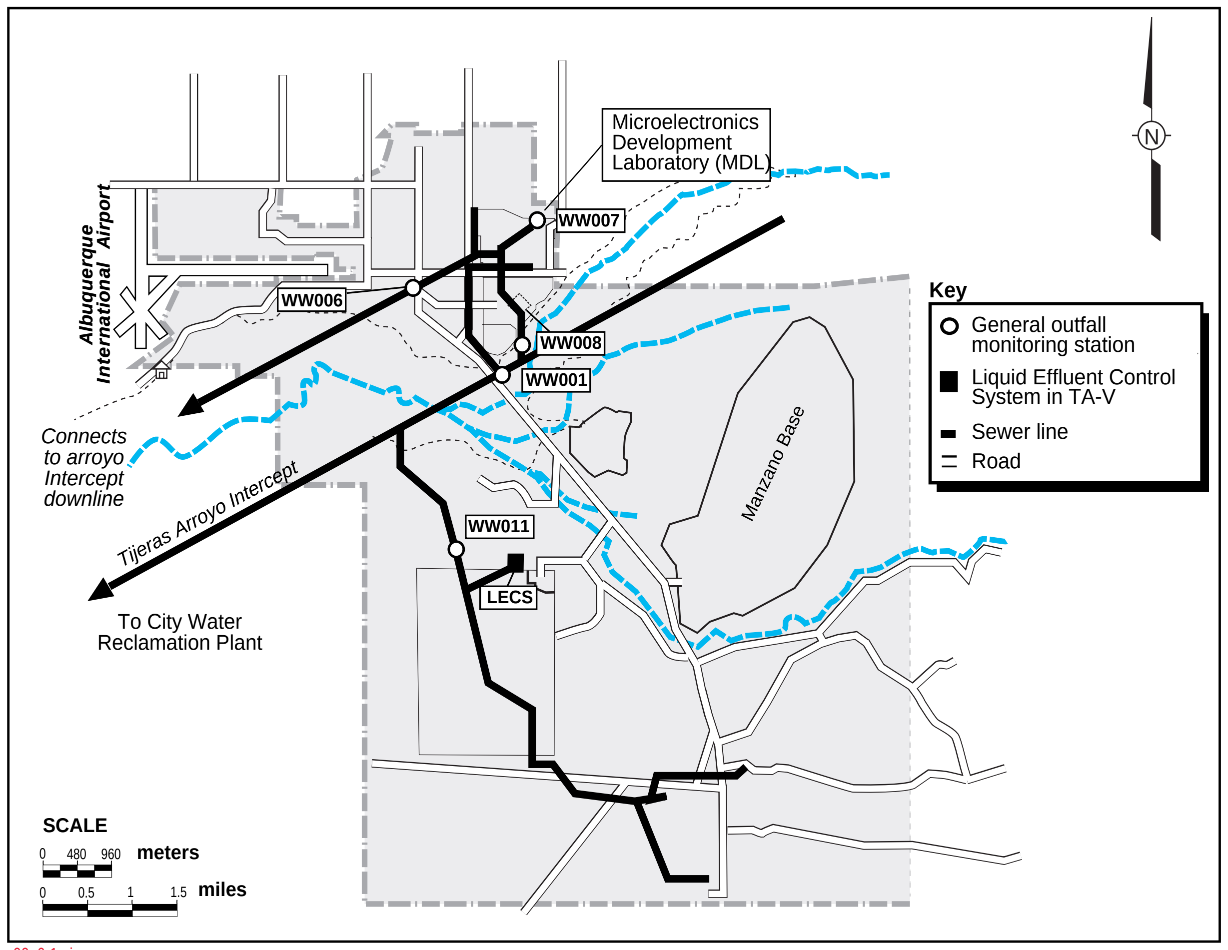


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FIGURE 6-1. Wastewater Monitoring Station Locations

TABLE 6-1. SNL/NM Wastewater Discharge Permits and Station Characteristics

	Permit	Waste Stream Process	Flume Size
GENERAL OUTFALL	WW001	All waste streams	3 in. Parshall
	WW006	All waste streams	6 in. Parshall
	WW008	All waste streams	6 in. Parshall
	WW011	All waste streams	6 in. Parshall
CATEGORICAL	WW007	Microelectronics Development Laboratory (MDL)	45° v-notch Weir
	LECS (not permitted)	Radiological screening of Tech Area V process water	N/A

NOTE: "All waste streams" include both domestic and industrial discharges.
LECS = Liquid Effluent Control System

Septic Systems
Sandia Corporation owns three active septic tanks in remote areas on KAFB, which are used only for sanitary sewage collection. Since these tanks receive only domestic sewage and not industrial discharges, they do not require sampling prior to pumping and discharge to the public sewer. However, as a Best Management practice, Sandia Corporation samples all tanks prior to pumping and discharge.

6.1.4 Tech Area V Radiological Screening

Several research reactors in Tech Area V have the potential to produce radiologically-contaminated process wastewater. To ensure that all wastewater from these facilities meets regulatory standards, liquid effluent is separated into two streams: reactor and non-reactor wastewater. Reactor process wastewater is defined as any effluent to a drain that is generated from a building or facility in Tech Area V that uses, processes, or stores radioactive materials. Reactor process wastewater is channeled to holding tanks where it can be sampled for radiological contaminants before the contents are released to the public sewer. This screening system is called the Liquid Effluent Control System (LECS).

Discharges to the sanitary sewer have not exceeded recognized standards for radionuclides at any of SNL/NM's wastewater stations, including the LECS.

The LECS system consists of three 5,000-gallon tanks and an ion exchange and filter system. The LECS is monitored 24 hours-a-day and is equipped with alarms to alert personnel to the presence of radioactive materials or high water levels. Water samples are analyzed for tritium, gross alpha, gross beta, and gamma spectroscopy to ensure radiological levels meet regulatory standards before the water is released to the public sewer system. If radioactivity levels are detected above permit limits, the water will not be released; an alternative disposal path will be found, or the radionuclides will be allowed to decay in place over a matter of days or weeks if the contamination is due to short-lived radioisotopes. Once the activity is at or below regulatory levels, the water can be safely disposed to the sewer system.

The Microelectronic Development Laboratory (MDL) uses acids for etching electronic boards and other components.

During 1998, a temporary tank (3,000 gal) was installed to handle additional tritiated water generated from core modifications at the Annual Core Research Reactor (ACRR). An alternative disposal path was necessary and the water was sent to the Radioactive and Mixed Waste Management Facility (RMWMF) in 1999 for evaporation.

6.1.5 Summary of Monitoring Results

In 1999, Sandia Corporation split quarterly wastewater samples with both the City of Albuquerque and the NMED. The City of Albuquerque staff also toured SNL/NM facilities to ensure that Sandia Corporation was in compliance with the City of Albuquerque's discharge requirements. The 1999 laboratory analysis results for wastewater samples taken at SNL/NM's monitoring stations confirmed that Sandia Corporation was in compliance with all state and local regulations. All water discharged from the LECS in 1999 also met regulatory standards for radiological levels in wastewater.

All permit conditions were met in 1999 except for one release at Station WW007. On December 16, 1999, City of Albuquerque sent a Notice of Violation (NOV) to the DOE for a one-day violation of Wastewater Discharge Permit Number 2069G-4. The NOV indicated that fluoride results obtained from a split sample dated December 8, 1999 measured at 68.6 mg/L, almost twice the permit limit of 36 mg/L. The release was traced back to the MDL. No penalties were assessed by the City of Albuquerque for the one day violation. Appendix D summarizes 1999 wastewater monitoring results.

6.2 SURFACE DISCHARGE PROGRAM

All water discharges to the ground surface are evaluated for compliance with New Mexico Water Quality Control Commission (NMWQCC) regulations as implemented by the NMED's Groundwater Bureau. The primary regulations are listed in Appendix B. Important program documents are listed in Appendix C.

6.2.1 Surface Discharge Approval and Permitting

Surface discharges are releases of water made to roads, open areas, or impoundments. Surface discharges are only made with the approval of the Surface Discharge Program within the Environmental Management Department. The Surface Discharge Program assists SNL/NM facility owners in meeting requirements set forth by the state and documents all requests and discharges. Proposed discharges are evaluated for potential contaminants and concentration levels to determine if the water quality meets strict guidelines for surface releases. Even discharges of uncontaminated water must be approved, since large volumes of water discharged in areas of prior contamination (such as ER sites) could increase infiltration rates and move contaminants deeper into the soil column. If discharges do not meet surface water quality standards, alternative methods of disposal are found.

1999 Surface Discharge Activities

Surface discharge requests are generally made when access to a sanitary sewer line is not available, such as in remote locations on KAFB where no sewer lines exists. Typical surface discharge requests include discharges made by the Groundwater Protection Program (GWPP) to dispose of well purge water from groundwater monitoring wells. Wells are purged before a representative groundwater sample can be taken. Other surface discharges are requested as a result of fire training activities, the need to flush eyewash stations, and the cleaning of building exteriors. In 1999, 28 individual requests for surface discharges were made; all met state standards and were approved.

6.2.2 Surface Discharge Releases in 1999

The Surface Discharge Program must be contacted in the event of an accidental release or spill to the ground surface. In 1999, two such spills occurred:

- ***Hydraulic Oil Spill*** – On October 28, 1999, a small release (one to two gallons) of hydraulic oil occurred at the SNL/NM Reapplication Yard in Tech Area II. The oil leaked from uncapped hydraulic lines on a hydraulic lift assembly. The lift had been removed from a vehicle and sent to the yard for storage before the oil had been properly drained. A minor amount of contaminated soil was removed and disposed of as hazardous waste. There was no impact to the environment.

- ***Benzene Spill*** – On November 15, 1999, a one liter bottle of benzene fell and broke open on a loading dock (Bldg. 897) in Tech Area I. The spill was cleaned up and there was no impact to the environment.

These events are also discussed under occurrence reporting in Section 2.4.

6.2.3 Pulsed Power Evaporation Lagoons

The Surface Discharge Program reports water quality results from samples taken routinely form two surface discharge lagoons in Tech Area IV. Both lagoons are permitted through NMED due to the ongoing nature of the discharges and the large volumes of water involved. The permit is attached to Discharge Plan DP-530.

The two lagoons, located just outside the Tech Area IV fence, are primarily used to contain and evaporate water that collects in the secondary containments around seven outdoor oil storage tanks used to store dielectric oil. The largest tank is 250,000 gal. The secondary containments are designed to hold the entire contents of a tank in the event of a spill. Significant volumes of precipitation can collect in the containments during the monsoon season. The water is visually inspected for oil contamination and any oil present is skimmed off prior to discharge. Lagoon I is a 137,500-gal capacity rectangular pond, 50 by 70 ft and 11 ft deep. Lagoon II is a 127,000-gal capacity trapezoidal-shaped pond, approximately 40 by 70 ft and 8 ft deep.

Water Level Measurements

Water levels in the lagoons are measured annually and water quality samples are taken biennially, as required by the DP-530 Discharge Plan (NMED 1999). This is a change from 1998, when water levels were measured biannually and water quality samples were taken annually. The Discharge Plan was amended on November 10, 1999 to reflect the changes. Water levels in Lagoon 1 were at 13 percent of capacity; water levels in Lagoon 2 were at 8 percent of capacity. No water quality samples were taken in 1999.

Large oil tanks in Tech Area IV are equipped with secondary containments to contain accumulated precipitation. One evaporation lagoon is shown at left.

6.3 STORM WATER PROGRAM

6.3.1 Storm Water Compliance

Storm water runoff at SNL/NM drains from paved streets, dirt roads, landscaped areas, buildings, and industrial sites and is diverted to culverts, channels, and arroyos. Depending on the surface contaminants present, the runoff may pick up vehicle exhaust residues, engine oils, air pollutant deposits, heavy metals, pesticides, and fertilizers.

Sandia Corporation limits the potential contaminants in storm water by limiting storm water contact with chemical and storage containers and carefully controlling general runoff, especially in areas where wastes, chemicals, and oil are stored or handled. Some facilities, such as the Hazardous Waste Management Facility (HWMF) and the Radioactive and Mixed Waste Management Facility (RMWMF), are also designed so that all runoff from the facility is directed to a lined catchment basin. Water that accumulates in the basin is allowed to evaporate or is pumped out for disposal. Secondary containments around outdoor oil and chemical storage areas also prevent the potential transport of pollutants in storm water.

Several environmental programs at SNL/NM work closely with the Storm Water Program to prevent storm water pollution. Primary interfaces include the Pollution Prevention (P2) Program, the Environmental Restoration (ER) Project, and the Surface Discharge Program.

NPDES Regulations

The National Pollutant Discharge Elimination System (NPDES) regulates storm water runoff from industrial facilities in order to protect "Waters of the U.S." as defined by the Clean Water Act (CWA). The EPA and NMED jointly provide regulatory oversight of the SNL/NM Storm Water Program. As it applies to SNL/NM, the Tijeras Arroyo, which discharges to the Rio Grande, is defined as a "Water of the U.S." The arroyo is generally dry, but during heavy downpours it has significant water-carrying capacity.

SNL/NM facilities are covered under the NPDES "Multi-Sector General Storm Water Permit" issued by the EPA in 1997. There are currently two SNL/NM stations on the permit (Station 4 and 5). Applicable storm water regulations are listed in Appendix B. Program documents are listed in Appendix C.

Industrial Classifications

There are four primary industrial activities at SNL/NM, as defined in 40 CFR 122, that are subject to storm water permitting. These activities and the applicable SNL/NM facilities are listed in Table 6-2.

TABLE 6-2. SNL/NM Facilities Subject to Storm Water Permitting

Description of SIC Industrial Code *	Potential Pollutants and Impacts	Applicable SNL/NM Facilities
NPDES Multi-Sector Storm Water Permit		
Scrap and Waste Recycling	- Various solid objects with potential residual surface contamination	- Reapplication and Storage Yard
Hazardous Waste Treatment, Storage, or Disposal	- Regulated hazardous chemical and radioactive waste	- Hazardous Waste Management Facility (HWMF) - Manzano Storage Area - Environmental Restoration (ER) Sites
Fabricated Metal Products	- Metal cuttings - Solvents and oils	- Machine Shop
Electronic and Electrical Equipment Manufacturing	- Raw chemical storage such as acid and sodium hydroxide - Electroplating processes	- Microelectronics Development Laboratory (MDL) - Advanced Manufacturing Process Laboratory (AMPL) - Cleaning and Contamination Control Laboratory (CCCL) - Compound Semi-Conductor Research Laboratory (CSRL) - Neutron Generator Facility (NGF)
Short-Term Construction Permits		
Construction Activities in 1999	- Building material pollutants - Disturbed soil	- Processing and Environmental Technology Laboratory (PETL) - Storm Drain Modernization Project

NOTE: *The EPA requires an NPDES Storm Water Permit for all industrial facilities that have processes defined in the Standard Industrial Classification (SIC) codes listed in Appendix A of 40 CFR 122.

**Applicable facilities include the new areas will be monitored under the expanded storm water program as documented in the revised Storm Water Pollution Prevention Plan (SWP3) (SNL 2000g).

Construction activities that disturb over five acres also require permitting under NPDES and are not listed on the Multi-Sector General Permit. The permit requires the ground to be stabilized upon completion of the project, such as reseeding and paving. In 1999, two storm water construction permits were in effect: (1) Processing and Environmental Technology Laboratory (PETL), and (2) the Storm Drain, Sanitary Sewer, Domestic Water System Modernization (SSWM) Project. Storm water permits are listed in Table 2-7.

Storm Drain System

As shown in Figure 6-2, Tijeras Arroyo enters KAFB from the northeast and flows adjacent to and just south of Tech Areas I, II, and IV. The arroyo widens significantly as it cuts into unconsolidated basin sediments, forming a significant topographic feature across KAFB. It exits KAFB just south of the Albuquerque International Sunport and continues west for approximately 14 km (8.7 mi) to its termination point at the Rio Grande. Because the arroyo discharges directly to the river, any areas at SNL/NM producing runoff that flows to the arroyo—from storm drain conduits, channels, other arroyos, ditches, or surface flow—is defined as a discharge point and is subject to NPDES Permit conditions.

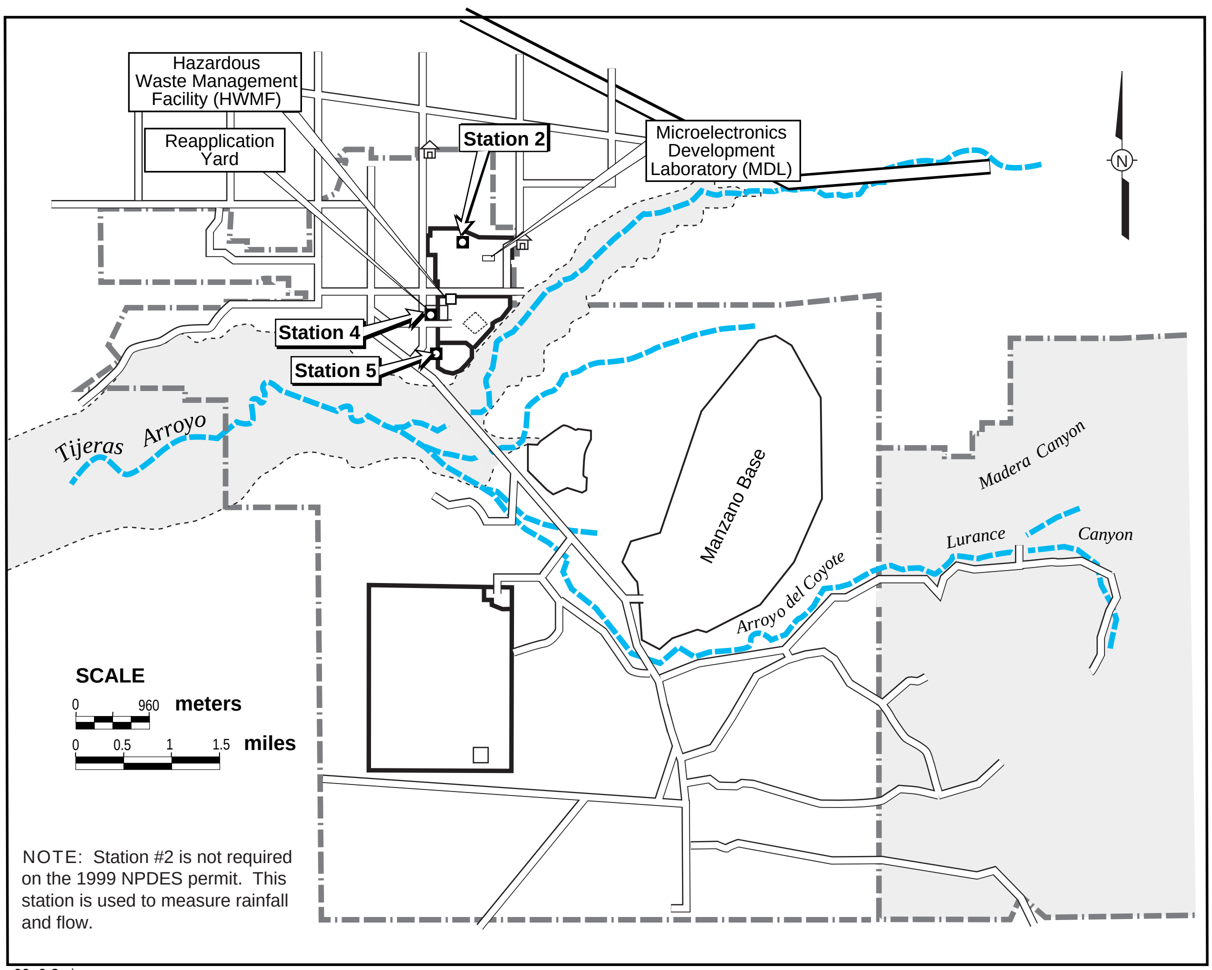

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FIGURE 6-2. Storm Water Monitoring Station Locations at Three Locations

Not all facilities at SNL/NM are subject to storm water runoff regulations and permitting. For example, storm water that falls on Tech Area III and V, and all areas south of the Arroyo del Coyote watershed do not drain into "Waters of the U.S." Runoff from these areas infiltrates to the ground due to the relatively flat terrain. Most drainages only run a short distance before terminating as the runoff quickly infiltrates into the highly permeable soil.

6.3.2 Storm Water Monitoring Stations

Sandia Corporation currently collects storm water samples from two stations (Stations 4 and 5). Station 4 monitors runoff from the Reapplication Yard. Station 5 monitors runoff from the majority of industrial activities at SNL//NM including the HWMF and the MDL. Station 2, which is not required on the permit, is used to collect rainfall data. Like all stations, it monitors rainfall and flow rates, since this is the criteria needed to define a storm event. Rainfall data is submitted to the National Weather Service.

Storm water stations are inspected monthly to ensure that equipment is working properly. Storm water samples are collected once per quarter if a storm event generates enough runoff to conduct sampling. Runoff from SNL/NM areas that are south of the Coyote Arroyo watershed either infiltrate directly into the soil, or drain away from Tijeras Arroyo and its feeder arroyos. The Multi-Sector Permit required that runoff sampling be performed once per quarter beginning in October 1998 through September 1999. Sampling results during this period are shown in Table 6-3.

Routine Inspections

Quarterly inspections of SNL/NM facilities are required by the NPDES Multi-sector Permit. These inspections include:

Construction Site Monitoring

Sandia Corporation mitigates potential storm water pollution from construction sites (or disturbed areas) by adhering to strict guidelines to prevent contaminant migration from various construction materials and processes. If the construction site is over five acres, the activity must be permitted under NPDES Construction Storm Water regulations. Construction projects affected by NPDES regulations must have individual Storm Water Pollution Prevention Plans that are specific to each site.

Once the construction project has been completed, the land must be stabilized before the permit is terminated. Stabilization may be accomplished through one or more methods such as:

(1) Constructing drainages/diversions,
(2) Reseeding open areas,
(3) Xeriscaping and other landscaping, and
(4) Asphalting to prevent the transport of residual pollutants and erosion.

✓ **Wet weather inspections** are conducted when storm water is flowing in the ditches. A sample is collected at an accessible sampling point and visually inspected for foaminess, clarity, and the presence of oil. These wet weather inspections occur between April and September during the rainy season. Wet weather inspections also provide an opportunity to check for broken levees and floating debris.

✓ **Dry weather inspections** are conducted when storm drains and ditches are dry primarily to detect illicit discharges. In general, only storm water is allowed in the storm drain system; however, with approval from the Surface Discharge Program, water that meets NPDES permit conditions can be discharged to storm drains. An example of this would be water used during fire training exercises or fire hydrant testing. Dry weather inspections are conducted on a quarterly basis. Dry weather inspections also provide an opportunity to inspect ditches for excess vegetation and accumulated sediment and debris. Storm channels are cleaned out annually or as needed.

✓ **Material storage areas** including waste handling areas, vehicle and equipment cleaning areas, and loading and unloading areas are inspected for uncovered and unprotected potential contaminant sources and spills. These inspections increase worker awareness and responsibility for storm water pollution prevention.

All inspection results are attached to the *Storm Water Pollution Prevention Plan* (SWP3) (SNL 2000g).

Sampling Protocols

The NPDES Permit requires quarterly sampling in the second and fourth year of the permit, weather permitting (preferably quarterly). Due to Albuquerque's semi-arid climate and high infiltration rates, precipitation rarely produces adequate runoff for monitoring in the months of October through March. In general, the most consistent storm water sampling occurs during the rainy season from April through September. After a rainfall of sufficient intensity and duration (as defined in the regulation), storm water runoff flowing through each station is collected by grab sample (through the automatic sampler). The discharge is collected in the first 30 minutes of the runoff event (to allow for the sampling of any residues picked up in the soil upstream of the station). Samples are sent to EPA-approved laboratories for analysis.

6.3.3 1999 Activities

Sampling Results

Sampling during 1997 and 1998 has been difficult due to dry weather and insufficient runoff to meet sampling criteria. Only one sample was collected in each year, which was not adequate to produce meaningful results. Both year's results indicated elevated values for some metals. In 1997, zinc and iron were above benchmark values. In 1998, zinc was not above the benchmark value. Elevated metals results can also be attributed to natural elements present in the sediments eroding from the igneous/metamorphic complex of the Manzanita Mountains. For example, zinc and iron are common constituents in these types of rocks.

In 1999, rainfall throughout the year was sufficient to produce five good samples: two from Station 4 and three from Station 5. Results for 1999 are shown in Table 6-3, including single sampling point results from 1998. As more data becomes available, meaningful results will become more apparent. If continued high values for specific analytes show a definite trend, an investigation will be initiated to establish the source, if possible. Storm water analytical results were reported to EPA Region VI and NMED in the *Discharge Monitoring Report for 1999.*

NMED Sampling

NMED conducted its own storm water sampling at SNL/NM in 1998 and 1999. In 1998, they installed a sampling station in Tech Area I to monitor runoff from the Old Reclamation and Salvage Yard (ER Site 30). Earlier soil analysis results indicated the presence of polychlorinated biphenyl (PCB) contamination present in surface samples at up to 87 ppm. The ER Project began cleaning up the site under a Voluntary Corrective Measure (VCM) in 1999 and the site was declared clean on the basis of the field-screening results on June 6, 2000. The state's results for both 1998 and 1999 samples did not detect PCBs in storm water samples.

Erosion Potential

Based on a new NMED protocol in 1999, all ER sites in or near a water course were evaluated for erosion potential. The ER Project conducted

TABLE 6-3. 1999 and 1998 Storm Water Sampling Results

Analytes	Units	Station 4 1st Qtr.	Station 4 2nd Qtr	5 Station 1st Qtr.	Station 5 3rd Qtr.	Station 5 4th Qtr.	1998 Station 5	Benchmark Values
TSS	mg/L	150	27	113	131	233		
pH		8.1	8.4	8.5	8.3	8.1		
Oil & Grease	mg/L	(ND)	6	(ND)	6	11		
COD	mg/L	48	22	72	413	61		
Nitrate + Nitrite	mg/L	1.60	2.05	0.58	0.45	0.65	0.75	0.68
Total Kjeldahl N	mg/L	1.4	(ND)	1.3	8.8	1.1	(ND)	--
Cyanide		(ND)	(ND)	(ND)	(ND)	(ND)	(ND)	0.0636
Ammonia	mg/L	(ND)	(ND)	(ND)	1.2	(ND)	(ND)	19
Aluminum	mg/L	13.2	1.37	7.47	1.19	18.2	9	0.75
Arsenic	mg/L	0.006	0.00201	0.0049	(ND)	0.00613	0.005	0.16854
Cadmium	mg/L	0.00796	(ND)	(ND)	(ND)	(ND)	0.007	0.05
Copper	mg/L	0.057	(ND)	0.0152	(ND)	0.0152	0.0108	0.0636
Iron	mg/L	10.8	1.07	5.45	18.5	13.4	6.05	1.0
Lead	mg/L	0.0534	(ND)	0.0239	(ND)	0.0352	0.009J	0.0816
Magnesium	mg/L	5.01	1.65	3.73	2.16	8.82	5.27	0.0636
Mercury	µg/L	(ND)	(ND)	(ND)	(ND)	(ND)	(ND)	0.0024
Selenium	mg/L	(ND)	(ND)	(ND)	(ND)	(ND)	(ND)	0.2385
Silver	mg/L	(ND)	(ND)	(ND)	(ND)	(ND)	(ND)	0.0318
Zinc	mg/L	0.210	0.0191	0.0861	0.033	0.114	0.053	0.065

NOTE: J = Detected below the reporting limit or is an estimated concentration
ND = not detected
COD = chemical oxygen demand
TSS = total suspended solids (The benchmark value is 110 mg/L.)

Source: SNL 2000i

the evaluation and is implementing Best Management Practices (BMPs) to control runoff in areas of high erosion potential. Silt fences and straw bales are the common methods employed in these areas to reduce any erosion potential.

EPA Appraisal
On July 15, 1999, an EPA officer conducted an inspection of the Storm Water Program at SNL/NM. The following points were noted in the inspection report:

(1) Since ER sites are Solid Waste Management Units (SWMUs), they should be included under the Hazardous Waste Treatment Storage or Disposal (TSD) sector of the permit.

(2) Sampling for runoff from Tech Area I should occur closer to applicable facilities such as the MDL and HWMF.

(3) Training and good housekeeping requirements need to be better defined in the Storm Water Pollution Prevention Plan (SWP3).

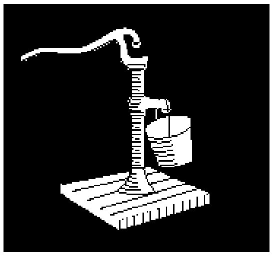
The SWP3 is undergoing extensive revision to incorporate the expanded storm water monitoring requested by EPA (SNL 2000). Other facilities that were added to the SWP3 and will be listed on the NPDES permit include the Compound Semi-Conductor Research Laboratory (CSRL) and the Neutron Generator Facility (NGF) in Tech Area I. All ER sites in areas where runoff can reach the Tijeras Arroyo have also been incorporated into the revision of the plan. This includes ER sites to the east of Manzano Base and within the Coyote Arroyo watershed. This watershed includes the Lurance and Madera Canyons and runoff from the Manzano Storage Complex.

Currently, Sandia Corporation is evaluating new storm water sampling locations, which may expand the current storm water sampling network to seven to ten stations. The new stations will be operational by October 1, 2000– in time to meet the new NPDES permit requirements.

Storm Drain Modernization Project

In 1999, construction began on the Storm Drain, Sanitary Sewer, and Domestic Water System Modernization (SSWM) Project. Most of the existing earth ditches in Tech Area I, all the way to station 5, will be replaced with concrete channels. This is occurring in tandem with the realignment of 20th street near KAFB's Eubank Gate, just east of the Robotic Manufacturing Science and Engineering Laboratory (RMSEL), and along Hardin Road.

Storm Water Station 5 (the roofline shown just to the right of this channel) Samples storm water at a discharge point to Tijeras Arroyo.



Chapter 7

Groundwater Programs

Groundwater monitoring wells are located at and around SNL/NM's operational areas and environmental remediation sites to determine potential impacts to groundwater, monitor the effectiveness of groundwater protection strategies, characterize potential contamination at ER sites, and demonstrate compliance with federal, state, and local groundwater requirements. Monitoring is conducted on an annual, biannual, quarterly, or monthly basis depending on individual project areas. Water level measurements are conducted quarterly and monthly.

Two organizations within Sandia Corporation collect groundwater data as a part of the corporate-wide Groundwater Protection Management Program at SNL/NM: the Groundwater Protection Program (GWPP) and the Environmental Restoration (ER) Project. The type of groundwater data collected includes in-field measurements taken at the well head (such as temperature, turbidity, and water levels) and collected water samples that are sent to laboratories for analysis. Specific task areas performed in FY99 under both programs are shown in Figure 7-1. As indicated in the figure, communication including data exchange with outside groundwater monitoring agencies is also a key component.

Sandia Corporation's ER Project resides under DOE's Office of Environmental Restoration and Waste Management (ER/WM). The ER Project is responsible for assessing, cleaning up, decontaminating, and decommissioning SNL/NM sites of past contamination. Some, not all, ER sites require groundwater monitoring. The ER Project at SNL/NM is tasked to perform groundwater monitoring under Resource, Conservation, and Recovery Act (RCRA) requirements for sites where actual or potential groundwater contamination is an issue. The GWPP works in concert with the ER Project to provide well registry and oversight for ER wells and other SNL/NM-owned wells.

Within the GWPP, the Groundwater Surveillance Task collects groundwater samples from a network of wells on KAFB, which are not associated with ER Project sites. The GWPP publishes an annual groundwater report to summarize data results generated from both the ER Project and the GWPP. The *Annual Groundwater Monitoring Report Fiscal Year 1999* (October 1, 1998 to September 30, 1999) is summarized in this chapter (SNL 2000h).

Figure 7-2 shows groundwater wells located on and around KAFB. Wells shown in this figure include ER monitoring wells, GWPP surveillance wells, City of Albuquerque production wells, KAFB production wells, United States Geological Survey (USGS) monitoring wells, and KAFB Installation Restoration Program (IRP) wells.

7.1 OVERVIEW OF GROUNDWATER PROGRAMS AT SNL/NM

A description of the activities and sites under the GWPP and the ER Project are described in this section.

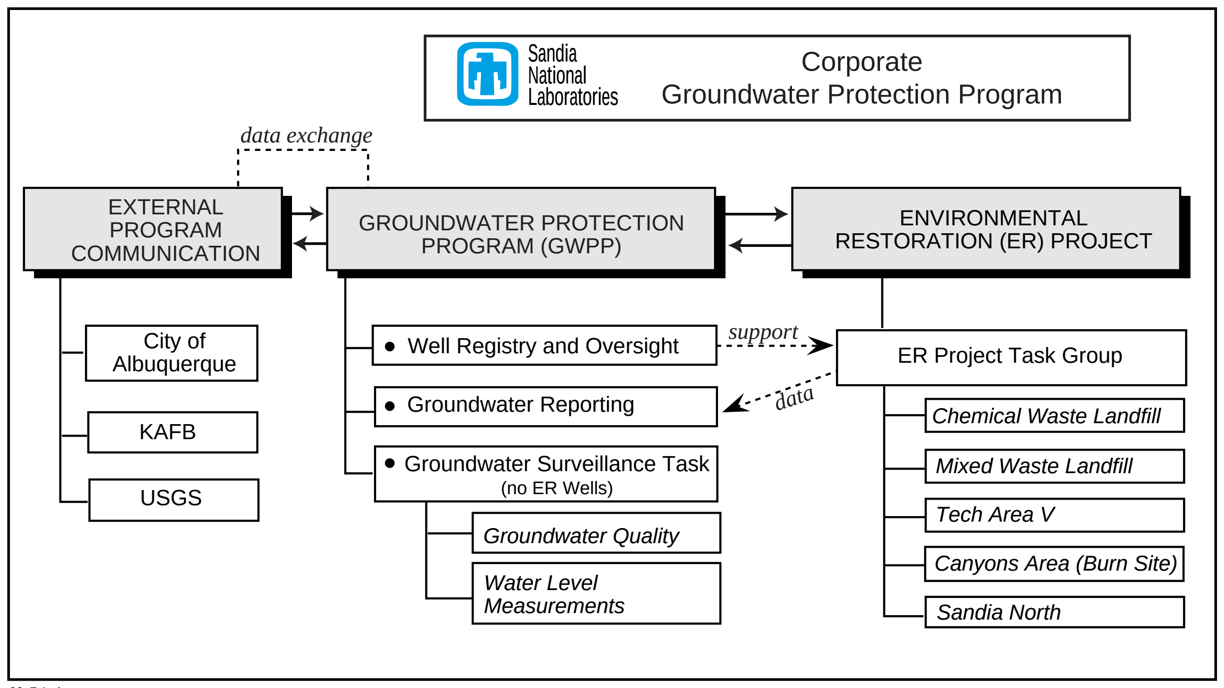


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FIGURE 7-1. SNL/NM's Groundwater Programs and Interfaces

7.1.1 Groundwater Protection Program (GWPP)

The GWPP is driven by DOE Order 5400.1, *General Environmental Protection Program*, which sets forth guidelines for groundwater protection management programs that must be implemented at DOE facilities (DOE 1990). Regulatory drivers are listed in Appendix B. Groundwater quality results are compared to federal and state standards, where established, and DOE guidelines. The GWPP has formulated its surveillance activities to conform with RCRA groundwater regulations.

The primary function of the GWPP is groundwater surveillance monitoring. The GWPP surveillance well network is shown in Figure 7-2. In 1999, 11 wells and one natural spring were sampled. The purpose of surveillance monitoring is to:

- Establish baseline water quality and groundwater flow information for the groundwater system at SNL/NM;
- Determine the impact, if any, of Sandia Corporation's operations on the quality and quantity of groundwater; and
- Demonstrate compliance with all federal, state, and local groundwater requirements.

Generally, from year to year, the GWPP samples the same wells. Occasionally, wells may be added or removed from the network based on operational changes, such as facility closures or new facility startups.

The GWPP is responsible for tracking information on all wells owned by Sandia Corporation, including its own surveillance wells, ER Project wells, and characterization boreholes. The primary purpose of the GWPP task is to ensure that all Sandia Corporation-owned wells are properly constructed and maintained to protect groundwater resources. The GWPP works with SNL/NM facility well owners to review new well design proposals, record construction information, track well ownership

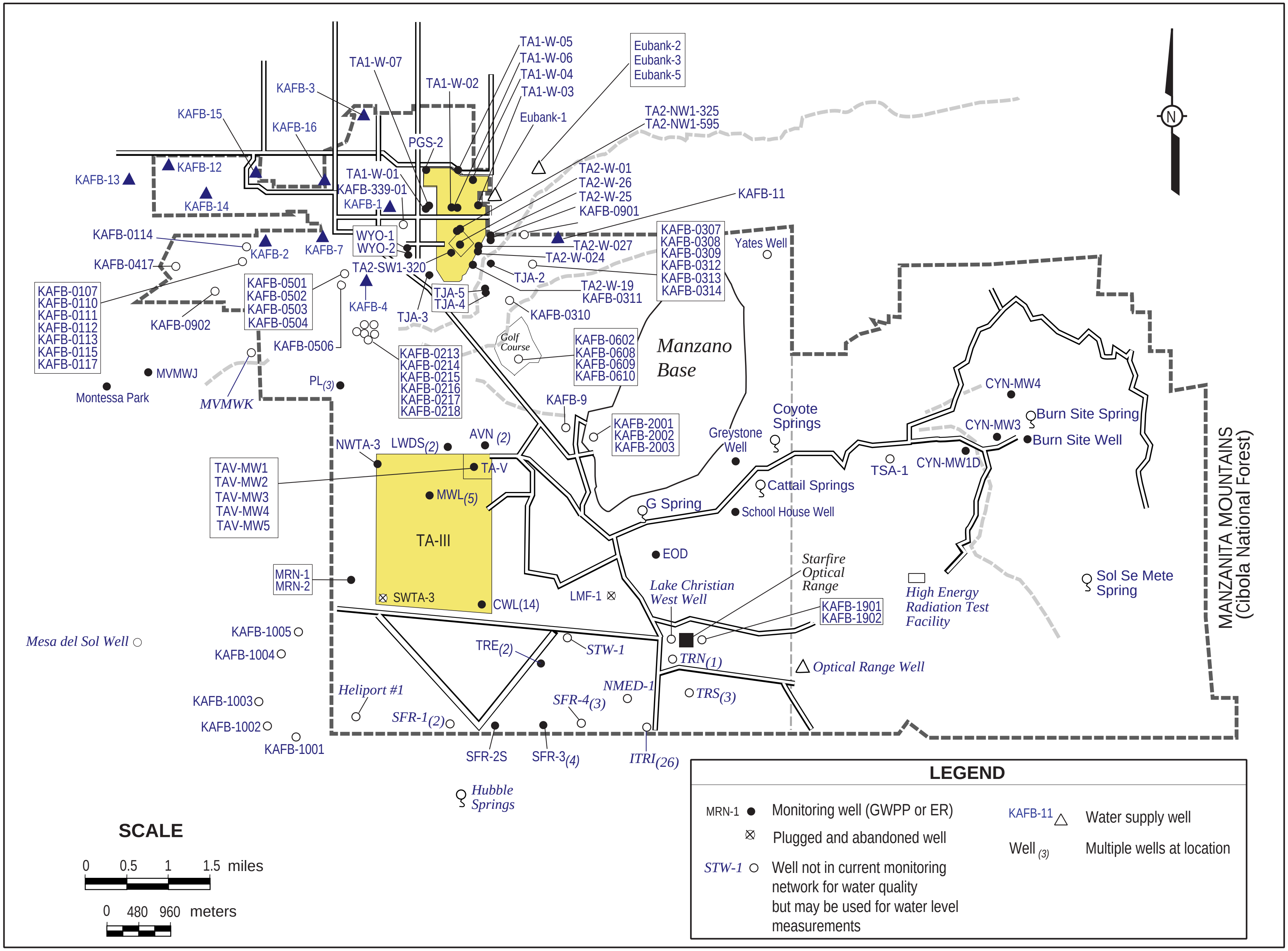


FIGURE 7-2. Wells and Springs on SNL/NM and KAFB

and maintenance records, perform annual well inspections, and consult with owners, if and when plugging and abandonment of a well or borehole is required. Any well has the potential to contaminate groundwater; therefore, proper well maintenance is critical to minimize the risk of inadvertent contamination. Wells that are no longer functional or are out of service should be either repaired or closed by plugging and abandonment.

Statistical Trending

The GWPP performs statistical trending on groundwater surveillance results by comparing past years' data with current year results. Variations are analyzed to determine if the results are within a normal range of expected values or if a significant difference is present, indicating either increasing or decreasing trends. By doing so, early detection and possible source identification can be made, even when contaminants are at levels far below regulatory concern. Conversely, unchanging baseline levels demonstrate Sandia Corporation's successful groundwater management practices and protection strategies.

7.1.2 Environmental Restoration (ER) Project Groundwater Activities

All ER Project activities fall under RCRA regulations that regulate the cleanup and management of active and inactive treatment, storage, and disposal (TSD) facilities. Applicable regulations are listed in Appendix B. Most ER sites are permitted on Sandia Corporation's RCRA Part B Hazardous and Solid Waste Amendments (HSWA) permit. A few sites, such as closed out septic systems, which were identified after the permit was issued, are being addressed in the same manner as other ER sites. Section 3.1 of this report describes the ER Project in more detail.

RCRA refers to ER sites as Solid Waste Management Units (SWMUs). Many SWMUs are scheduled for investigation based on past activities conducted at the site that had the *potential* to contaminate the surface or subsurface. Following a site investigation, the site will be placed in one of three categories:

- No contamination exists,
- Contamination is at levels below regulatory concern, or
- The site requires remediation.

Some ER sites with the potential to contaminate groundwater, have had groundwater monitoring wells installed. NMED's Hazardous and Radioactive Materials Bureau provides regulatory oversight for ER's remediation activities, including groundwater monitoring. The ER Project is concerned with the determination of the nature and extent of any contamination that has migrated within the vadose (unsaturated) zone or the regional aquifer.

There are five ER Project areas with ongoing groundwater investigations. Sampling and analysis plans and procedures have been developed specific to each ER Project area:

- Chemical Waste Landfill (CWL)
- Mixed Waste Landfill (MWL)
- Tech Area V
- Sandia North
- Canyons Area

Chemical Waste Landfill (CWL) – The CWL, which was active from 1962 to 1989, covers just over two acres and was used to dispose liquid chemical wastes into pits. The area was also used as an above-ground storage site for containerized waste. In 1985, the first monitoring wells were installed at the request of NMED. Currently, there are 13 active wells in the network, including three background (upgradient) wells and three "nested" wells. (Nested wells contain two or more wells per hole at upper and lower completions.)

The CWL is the one ER site at SNL/NM that falls under somewhat different requirements because it is a RCRA Interim Status site.

Interim Status applies to all active TSD sites or TSD sites that were still active in 1982. A separate cleanup and closure plan has been drawn up between DOE, Sandia Corporation, and NMED: *Chemical Waste Landfill Final Closure Plan and Postclosure Permit Application* (SNL 1992). The ER Project began excavation and remediation at the CWL in 1998.

Vapor Extraction Project at the CWL

The Vapor Extraction Project was a very successful cleanup initiative for removing volatile organic compounds (VOCs) from the groundwater and vadose zone at the CWL. From 1997 to 1999, the project removed approximately 5,000 lbs of VOCs from the soil.

Three CWL wells were converted for extraction of VOCs from the vadose zone as part of a Voluntary Corrective Measure (VCM). The principal groundwater contaminant of concern at the CWL is trichloroethene (TCE). As a volatile molecule, TCE is mobile within the vadose zone and migrated to the groundwater. Prior to the Vapor Extraction Project, TCE levels in groundwater were measured above regulatory levels in four wells. Last year, TCE was detected in only one well above the limits, and in 1999 TCE was not detected above the limits in any well.

Mixed Waste Landfill – The MWL was operational from 1959 to 1989. This 2.6-acre site has two distinct disposal areas: one for classified waste and one for unclassified waste. A total of 100,000 ft^3 of low-level radioactive waste (LLW) and mixed waste (MW) was buried in unlined trenches and pits. The total activity of this volume at the time of disposal was 6,300 Ci. No liquid waste was disposed of at the MWL except in 1967 when 271,000 gal of reactor coolant water with a total activity of 1 Ci was disposed of in Trench D (Peace 1995). Cesium-137 and tritium are present in surface soil samples (see Chapter 4). Tritium, slightly above detection limits, has been detected up to 120 ft below the surface (about 400 ft above the present water table). The EPA maximum contaminant level (MCL) for tritium in drinking water is 20,000 pCi/L. Tritium has not been detected above its minimum detectable activity (MDA) (~300 pCi/L) in any groundwater samples to date. Sandia Corporation plans to continue long-term monitoring of environmental media including groundwater to ensure that contaminants do not migrate from the site.

Tech Area V – Reactor facilities and a Hot Cell Facility (HCF) are located in Tech Area V. The Liquid Waste Disposal System (LWDS), an ER site just north of the Tech Area V compound, was used to dispose reactor coolant water from 1967 to 1971. Contaminants of concern at this site are primarily volatile organic compounds (VOCs) such as TCE. TCE was first detected in the groundwater in 1993. Elevated nitrate levels have also been detected in two wells. There are currently nine active monitoring wells at this site.

Sandia North – The Sandia North area includes the collective areas located in and around Tech Area I, Tech Area II, and the Tijeras Arroyo. (There are no ER sites in Tech Area IV). There are currently 23 monitoring wells in the Sandia North investigational area. Of these, 11 are regional aquifer wells and 12 are perched water zone wells. Perched zones are areas of water-bearing strata elevated above the regional groundwater system (water table). The average depth to these perched zones is 320 ft below the surface. TCE and nitrates are contaminants of concern in the Sandia North area. The discovery of TCE in several Tech Area I and Tech Area II wells led to the Sandia North Groundwater Investigation in an effort to identify the source. To date, no source has been found.

Canyons Area – The Canyons Area is the general area located around the active Burn Site Facility in Lurance Canyon. Groundwater investigations were initiated in 1997 at the request of NMED after elevated nitrate levels were discovered in the Burn Site water well. One deep groundwater monitoring well was installed in 1997 and two others were installed in 1999. Additionally, two piezometers were installed to detect any underflow in the near surface sediments. To date, both piezometers have remained dry. The Burn Site is the only SNL/NM site within the land withdrawal area that has groundwater contamination issues.

Groundwater Quality Trends at ER Sites
Trends in groundwater contaminant levels are detailed in Appendix E. Eight of SNL/NM's monitoring wells have shown contaminant levels above standards: TCE has been detected in three wells above the standard and nitrate has been detected in five wells above the standard.

7.2 GROUNDWATER QUALITY ANALYSIS RESULTS

Analytical results for groundwater quality monitoring conducted by the GWPP and the ER Project are compared with state, federal and DOE standards as shown in Table 7-1. The groundwater monitoring frequency at SNL/NM is shown in Table 7-2. All groundwater samples are analyzed by EPA-approved labs.

Appendix B.2 provides a general discussion of DOE's radiation protection standards and specific water quality standards. Water quality results for both the GWPP and the ER Project are published in the *Annual Groundwater Monitoring Report, Fiscal Year 1999* (SNL 2000h).

7.2.1 GWPP Surveillance Results

Volatile Organic Compounds (VOCs)
Field measurements taken at each well included alkalinity, turbidity, dissolved oxygen, pH, specific conductivity, oxidation reduction potential (or redox [Eh]), and temperature. Groundwater surveillance samples were analyzed for VOCs, inorganic compounds, phenolics, dissolved metals, and radionuclide activities.

No groundwater samples exceeded MCLs for VOCs. Trace concentrations of methylene chloride and toluene were detected in several samples, however, since these constituents were also present in laboratory control samples, the contaminant was introduced by the laboratory.

Inorganic Compounds and Phenolics
No groundwater samples exceeded MCLs for any of the non-metallic inorganic constituents:

- Nitrate plus nitrite (as nitrogen)
- Phenolics
- Total halogenated organics (TOX)
- Total cyanide
- Alkalinity (calcium carbonate)
- Ions (bromide, chloride, fluoride, and sulfate)

Metals
The analyses were conducted for dissolved metals (filtered samples) except for mercury, which was analyzed for the total concentration (dissolved and suspended). The following metals were analyzed:

- Aluminum
- Antimony
- Barium
- Calcium
- Cobalt
- Iron
- Magnesium
- Mercury
- Potassium
- Silver
- Thallium
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Nickel
- Selenium
- Sodium
- Zinc

NOTE: The metals list was compiled from EPA's primary drinking water standards and New Mexico Water Quality Control Commission (NMWQCC) standards.

TABLE 7-1. Guidelines Used for Groundwater Quality Sample Comparisons

Agency	Regulation/Requirements	Limits
EPA	National Primary Drinking Water Standards (this is an enforceable health standard) (40 CFR 141)	MCL
State of New Mexico	New Mexico Water Quality Control Commission Standards for Groundwater	MAC
DOE	DOE Drinking Water Guidelines for Radioisotopes	DCG

NOTE: MCL = maximum contaminant level
MAC= maximum allowable concentration
DCG = derived concentration guide

TABLE 7-2. Sampling Frequency for Groundwater Quality Monitoring at SNL/NM During FY99

			ER Project Sites				
	Sampling Period	**GWPP**	***CWL***	***MWL***	***TA-V***	***Sandia North***	***Canyons Area***
Fiscal Year 1999	**Oct 98**						
	Nov 98		✓	✓	✓		
	Dec 98					✓	✓
	Jan 99						
	Feb 99		✓ (annual)		✓		
	Mar 99					✓	
	Apr 99			✓			✓
	May 99	✓	✓		✓ (annual)		
	Jun 99					✓	
	Jul 99						
	Aug 99		✓		✓		✓
	Sep 99					✓	

Elevated levels of nickel, iron, and manganese were present at several wells. These metals do not pose an associated health risk, but are listed for aesthetic water quality characteristics (e.g. taste and smell). Nickel is associated with well screen corrosion. Iron and manganese were elevated above the respective maximum allowable concentrations (MACs) set by the state in two wells near Coyote Springs. Coyote Springs, also had elevated manganese levels. In 1998, beryllium and chromium were detected at slightly elevated levels at Coyote Springs, but were not detected above MCLs in 1999. Results that were elevated above an established standard are shown at right.

Nickel
MCL = 0.1 mg/L

Well	Concentration	Period
SFR-3P	0.27 mg/L	May 1999

Iron
MAC = 1.0 mg/L

Well	Concentration	Period
EOD	21.12 mg/L	May 1999
School House	4.82 mg/L	May 1999

Manganese
MAC = 0.2 mg/L

Well	Concentration	Period
EOD	0.83 mg/L	May 1999
School House	0.256 mg/L	May 1999
Coyote Springs	1.32 mg/L	May 1999

Radionuclides
Radioisotopic analyses were conducted on all samples as follows:

- Gross alpha

- Gross beta
- Radium-226 and -228
- Uranium-233/234
- Uranium-235 and -238

Selected gamma emitters from the following list were analyzed depending on the particular sample:

- Lead-212 and -214
- Thorium-231, -232,-233, -234, and -238
- Cobalt-60
- Pottassium-40
- Radium-226 and -228
- Actinium-228
- Uranium-235
- Cesium-137
- Yttrium-88

Activities for radium-226 plus radium-228 slightly exceeded DOE's drinking water standards at one well. Uranium-234 was almost four times the DOE guideline at the EOD Hill well. However, naturally high levels of uranium in groundwater are expected due to groundwater contacting the igneous and metamorphic basement rock, which is naturally high in uranium isotopes. All uranium results are consistent with historical data.

Radium-226 plus Radium-228 *MCL = 5.0 pCi/L*		
Well	**Concentration**	**Period**
NWTA-3	5.34 pCi/L	May 1999

Uranium-234 *DOE Guideline = 20.0 pCi/L*		
Well	**Concentration**	**Period**
EOD Hill	73 pCi/L	May 1999
TRE-1	22.1 pCi/L	May 1999

Groundwater samples from CWL wells were analyzed for VOCs, metals, tritium, and gamma spectroscopy.

Volatile Organic Compounds (VOCs)
No VOCs above MCLs were detected in any CWL well.

Metals
The following total metals (unfiltered) were analyzed:

- Arsenic
- Beryllium
- Cadmium
- Cobalt
- Iron
- Mercury
- Selenium
- Tin
- Vanadium
- Antimony
- Barium
- Chromium
- Copper
- Lead
- Nickel
- Silver
- Thallium
- Zinc

NOTE: The metals list was compiled from 40 CFR 264 Appendix IX metals, plus iron.

Nickel was the only metal detected above the MCL in any CWL well. Nickel is associated with well screen corrosion and does not reflect contamination from surface sources migrating to groundwater.

Nickel *MCL = 0.1 mg/L*		
Well	**Concentration**	**Period**
CWL-MW2A	0.78 mg/L	Aug 1999
CWL-MW4	1.13 mg/L	Nov 1998
CWL-MW4	1.29 mg/L	Feb 1999
CWL-MW4	1.10 mg/L	May 1999
CWL-MW4	1.50 mg/L	Aug 1999

7.2.2 ER Project Water Quality Results

Chemical Waste Landfill (CWL)

Radionuclides
Tritium analyses and gamma spectroscopy conducted on samples showed no radionuclides detected above MCLs, where established, or above DOE's established drinking water guidelines. Radionuclides were detected at natural background levels.

Mixed Waste Landfill (MWL)

Groundwater samples from MWL wells were analyzed for VOCs, nitrate plus nitrite, metals, and radionuclides.

Groundwater contamination has not been detected at this site with the exception of nickel, which is attributed to well screen corrosion. Since no contamination from the landfill has migrated to groundwater, NMED has agreed to reduce the sampling frequency from biannually to annually starting FY00.

Volatile Organic Compounds (VOCs)
VOCs were not detected above established MCLs. Toluene was detected in some samples but was later determined to be laboratory-introduced contamination.

Nitrate plus Nitrite
Nitrate plus nitrite (reported as nitrogen) was not detected above the MCL of 10 mg/L; levels ranged between 1.9 and 6.15 mg/L.

Metals
Dissolved metal (filtered) and total metal (unfiltered) analysis was conducted on samples in November:

- Arsenic
- Barium
- Cadmium
- Chromium
- Lead
- Mercury
- Nickel
- Selenium
- Silver

NOTE: The metals list was compiled from EPA's primary drinking water standards plus silver.

In April, a full suite of metal parameters was sampled adding the following additional metals:

- Aluminum
- Antimony
- Beryllium
- Calcium
- Cobalt
- Copper
- Iron
- Magnesium
- Manganese
- Potassium
- Sodium
- Thallium
- Vanadium
- Zinc

Nickel was the only contaminant detected in groundwater at the MWL and is attributed to well screen corrosion.

Nickel
MCL = 0.1 mg/L

Well	Concentration	Period
MWL-MW1 (total)	0.490 mg/L	Nov 1999
MWL-MW1 (dissolved)	0.467 mg/L	Nov 1999
MWL-MW1 (total)	0.313 mg/L	Apr 1999
MWL-MW1 (dissolved)	0.266 mg/L	Apr 1999

Radionuclides
The radiochemical analyses of MWL groundwater samples included:

- Gross alpha
- Gross beta
- Tritium
- Strontium-90
- Gamma spectrometry

Strontium-90 was initially detected at anomalously high levels in four samples. Resampling showed that these values were due to laboratory error. Tritium values were below minimum detectable values of 250 to 300 pCi/L. The largest value reported was 100 pCi/L. The EPA MCL for tritium is 20,000 pCi/L.

Tech Area V

Groundwater samples from Tech Area V wells were analyzed for VOCs, inorganic chemicals, and metals.

Volatile Organic Compounds (VOCs)
TCE has been consistently detected in one Tech Area V well. In FY99, the same well continued to show TCE values over the MCL of 5.0 µg/L. Values were consistent with last year's results.

Trichloroethene (TCE) *MAC = 100 µg/L* *MCL = 5.0 µg/L*		
Well	**Concentration**	**Period**
LWDS-MW1 (4 samples)	17-23 µg/L	Nov 1998
LWDS-MW1	22 µg/L	Feb 1999
LWDS-MW1	20 µg/L	May 1999
LWDS-MW1	20 µg/L	Aug 1999

Inorganic Chemicals
Inorganic chemicals analyzed included:

- Alkalinity (calcium carbonate)
- Nitrate plus nitrite (reported as nitrogen)
- Ions (bromide, chloride, fluoride, and sulfate)

Nitrate was the only parameter that exceeded MCLs. Two wells were marginally above the MCL of 10 mg/L.

Nitrate plus Nitrite (as N) *MCL = 10.0 mg/L*		
Well	**Concentration**	**Period**
LWDS-MW1	10.1 mg/L	Nov 1998
LWDS-MW1	13.1 mg/L	Feb 1999
LWDS-MW1	16.3 mg/L	May 1999
LWDS-MW1	16 mg/L	Aug 1999
TAV-MW5	13 mg/L	Aug 1999

Metals
Quarterly samples were analyzed for the following total metals (unfiltered):

- Arsenic
- Beryllium
- Calcium
- Iron
- Magnesium
- Potassium
- Silver
- Barium
- Cadmium
- Chromium
- Lead
- Mercury
- Selenium
- Sodium

NOTE: The metals list was compiled from EPA's Appendix IX parameters and from EPA's primary drinking water standards

In May 1999, a full suite analysis was conducted adding the following metals to the above list:

- Aluminum
- Cobalt
- Manganese
- Thallium
- Zinc
- Antimony
- Copper
- Nickel
- Vanadium

No metals were detected above MCLs in any Tech Area V well.

Sandia North

Groundwater samples from Sandia North wells were analyzed for VOCs, inorganic chemicals, metals, and radionuclides.

Volatile Organic Compounds (VOCs)
Three monitoring wells (one regional and two perched zone wells) showed TCE concentrations over the MCL of 5 µg/L. Results are shown on the following page.

Inorganic Chemicals
The following inorganic chemicals were analyzed:

- Alkalinity (calcium carbonate)
- Nitrate plus nitrite (reported as nitrogen)
- Ions (bromide, chloride, fluoride, and sulfate)

Trichloroethene (TCE) *MCL = 5 µg/L* *MAC = 100 µg/L*		
Well	**Concentration**	**Period**
Regional Wells		
WYO-1	6.1 µg/L	Dec 1998
WYO-1	6.1 µg/L	Mar 1999
WYO-1	5.6 µg/L	Sep 1999
WYO-1 (dup)	6.3 µg/L	Sep 1999
Perched Zone Wells		
WYO-2	7.5 µg/L	Dec 1998
WYO-2	7.2 µg/L	Mar 1999
WYO-2	5.2 µg/L	Jul 1999
WYO-2	6.9 µg/L	Sep 1999
TA2-W-26	8.6 µg/L	Dec 1998
TA2-W-26 (dup)	8.0 µg/L	Dec 1998
TA2-W-26	7.4 µg/L	Mar 1999
TA2-W-26	6.8 µg/L	Jul 1999
TA2-W-26	9.0 µg/L	Sep 1999
TA2-W-26 (dup)	8.8 µg/L	Sep 199

Nitrate was the only parameter found elevated in any samples. It has consistently been present in one perched zone well in the last several years (TA2-SW1-320). A new regional well (TJA-4) showed elevated nitrate levels at approximately twice the MCL in all sampling quarters.

Nitrate plus Nitrite (as N) *MCL = 10 mg/L*		
Well	**Concentration**	**Period**
Perched Wells		
TA2-SW1-320	20 mg/L	Dec 1998
TA2-SW1-320	26 mg/L	Mar 1999
TA2-SW1-320	27 mg/L	Sep 1999
Regional Wells		
TJA-4	20 mg/L	Dec 1998
TJA-4	25 mg/L	Mar 1999
TJA-4 (dup)	26 mg/L	Mar 1999
TJA-4	25 mg/L	Jul 1999
TJA-4 (dup)	21 mg/L	Jul 1999
TJA-4	25 mg/L	Sep 1999

Metals

The following total metals (unfiltered) were analyzed:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc
- Mercury

NOTE: The metal list was compiled from Appendix IX parameters and metals from EPA's primary drinking water standards.

Selenium and thallium were detected at slightly elevated levels in two separate wells.

Selenium *MCL = 50 µg/L*		
Well	**Concentration**	**Period**
TA1-W-03	54 µg/L	Dec 1998

Thallium *MCL = 2.0 µg/L*		
Well	**Concentration**	**Period**
PGS-2	2.4 µg/L	Mar 1999

Radionuclides

No radionuclides were above established MCLs or DOE drinking water guidelines. Samples were analyzed for

- Gross alpha
- Gross beta
- Tritium
- Uranium-233/234, -235, and -238

Canyons Area

The Burn Site within Lurance Canyon is the only ER site in the Canyons Area with groundwater issues. Groundwater samples were analyzed for organic compounds, inorganic chemicals, and metals.

Organic Compounds

The contaminants of concern at the Burn Site are petroleum products associated with the use of fuels for burn tests. Sampled parameters included:

- VOCs
- Semi-volatile organic compounds (SVOCs)
- Total extractable petroleum hydrocarbons (diesel)
- Total volatile petroleum hydrocarbons (gasoline)
- High explosives (HE)
- Total organic carbon (TOC)

Trace levels of petroleum were present in samples collected from CYN-MW1D in each quarter. Several species of VOCs were detected, although all VOCs were well below associated MCLs. Two new wells were installed in 1999 (CYN-MW3 and CYN-MW4). Trace levels of petroleum hydrocarbons were detected in CYN-MW4, a new background well; however since this well is hydraulically upgradient, the hydrocarbons are most likely due to sample contamination. Methylene chloride was detected in the new downgradient well, CYN-MW3 at levels well below the MCL.

Inorganic Chemicals
Inorganic chemical analyses included:

- Alkalinity
- Nitrate plus nitrite (reported as nitrogen)
- Ions (bromide, chloride, fluoride, and sulfate)
- Phenolics

Nitrate was elevated in one well.

Nitrate plus Nitrite (as N) *MCL = 10 mg/L*		
Well	**Concentration**	**Period**
CYN-MW1D	11.7 – 19.6 mg/L	Apr 1999
CYN-MW1D (split)	11 mg/L	Dec 1998
CYN-MW3	13.3 – 18 mg/L	Aug 1999

Metals
One well (CYN-MW1D) was sampled for the following total metals (unfiltered):

- Aluminum
- Arsenic
- Beryllium
- Calcium
- Cobalt
- Iron
- Magnesium
- Nickel
- Selenium
- Sodium
- Vanadium
- Mercury
- Antimony
- Barium
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Potassium
- Silver
- Thallium
- Zinc

No metals were detected over established MCLs.

7.3 WATER LEVELS

Sandia Corporation gathers groundwater level measurements from a large network of wells on and around KAFB. In addition to wells owned by Sandia Corporation, data is derived from the Air Force Installation Restoration Program (IRP) wells, City of Albuquerque wells, and USGS wells. In FY99, data from 138 wells were incorporated into the well level database. Water levels were measured monthly and quarterly by each agency in the following number of wells:

# Sampled	Well Owner
57	ER Project (SNL/NM)
30	GWPP (SNL/NM)
50	KAFB
2	USGS
4	City of Albuquerque

Water level data is used to characterize the groundwater regime within the regional aquifer including hydraulically distinct regimes present in perched water zones near Sandia North and the golf course.

Water level information is also used to project the useful life of existing monitor wells. Since well screens penetrate only a limited distance below the water table, the continuing decline of the water table will render some of these wells useless in the near future when the screens no longer intercept the water table.

7.3.1 Regional Hydrology

Groundwater Conceptual Model
Although water levels may fluctuate over the course of the year in response to seasonal recharge and groundwater withdrawal, the overall level of the regional aquifer within the basin continues to decline at about 1 to 2 ft/yr. Most of the City of Albuquerque and KAFB water supply wells are completed in the coarser-grained layers of the upper and middle units of the Santa Fe Group. The primary regional aquifer is located within the upper unit of the Santa Fe Group.

Water level information, with respect to the regional water table in the KAFB area, can be categorized into three general areas controlled by faults as shown in Figure 7-3. Groundwater levels east of the Tijeras fault complex are approximately 100 to 150 ft below the surface. The water table within the basin is approximately 500 ft or more below the surface. The aquifer system on the eastside of the Tijeras fault complex is not well understood due to the complex geology and the few wells available from which to characterize the system. A brief overview of the regional hydrology is given in Chapter 1.

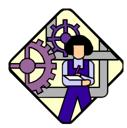
Groundwater Recharge and Loss
The dynamics of water table fluctuations, as reflected by water levels in individual wells, are a balance between groundwater inflow to the basin, recharge, water withdrawal, and basin outflow. Studies have shown that recharge to the groundwater in the Middle Rio Grande basin occurs primarily through mountain front recharge and infiltration from active arroyos, washes, and rivers.

Declining Water Levels

The U.S. Geological Survey (USGS) is currently conducting a study of the Middle Rio Grande basin to improve the understanding of the water resources of the basin.

In 1995, the USGS published the results of a two-year study on the Santa Fe Group and the hydrogeology of the Albuquerque area (Thorn, McAda, and Kernodle, 1993). The study found that the quantity of water in the aquifer was significantly less than previously estimated.

7.3.2 Groundwater Level Trends



Tech Area III and V

Wells located in and around Tech Area III and Tech Area V include ER wells and several groundwater surveillance monitoring wells located on the west boundary of Tech Area III. In general, wells in this area do not show significant seasonal fluctuations since they are further from the radius of influence surrounding the production wells on the north side of KAFB. Tech Area III wells do reflect the relatively steady declines that are consistent with basin-wide declines (0.6 ft/yr).

Chemical Waste Landfill – Eight wells were measured quarterly within the CWL network. Water level ranges recorded during the August 1999 quarterly measurement were between 483 and 496 ft below ground surface. Long-term water levels are declining at this site at approximately 0.6 ft/yr.

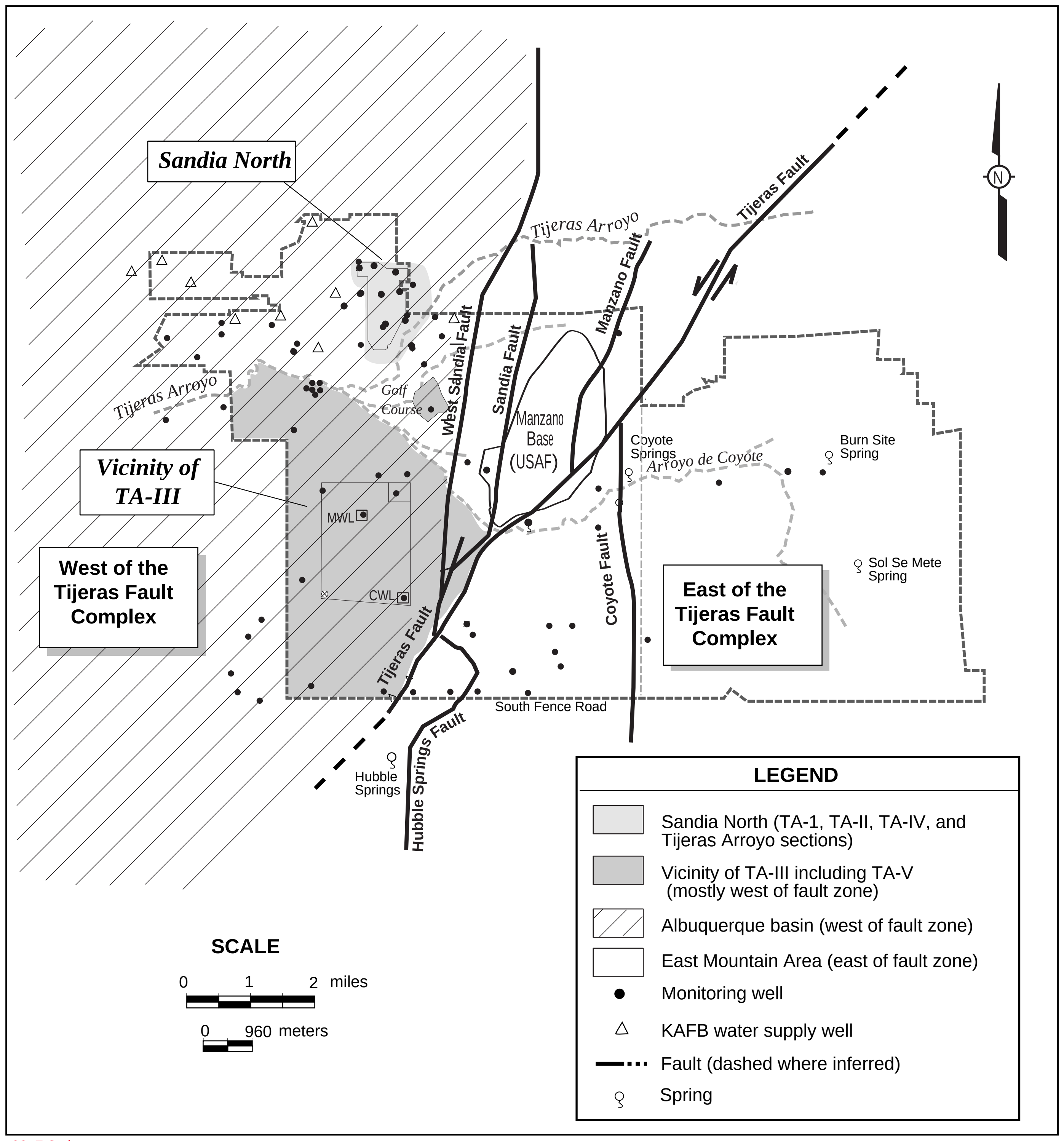


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FIGURE 7-3. Hydrogeologically Distinct Areas Primarily Controlled by Faults

Mixed Waste Landfill – Four wells were measured monthly within the MWL network for the first half of FY99. The long-term water level declines at this site are approximately 0.8 ft/yr.

Tech Area V – Monthly water level measurements were conducted at all nine monitoring wells in Tech Area V. All wells showed some variability from month to month, probably due to barometric pressure fluctuations, but average declines ranged from 0.4 to 0.7 ft/yr.

West side of Tech Area III – Five wells were measured quarterly west of Tech Area III. Three of the wells had significantly higher decline rates (double to triple) than seen at the landfill wells to the east. Decline rates ranged from 1.3 to 1.9 ft/yr.

Sandia North and Vicinity

The Sandia North area includes wells located in and around Tech Areas I, II, and IV, along Tijeras Arroyo, and near the golf course.

There are perched zones located in the Sandia North area. The lateral extent of these water bearing zones is currently under investigation. Wells in the Sandia North area are completed in either the regional aquifer or perched zones.

Sandia North – Monthly measurements were made at 23 wells in the Sandia North network. There are 12 wells completed in perched water zones where depth to water ranges from 267 to 338 ft and 11 wells completed in the regional aquifer where depth to water ranges from 429 to 574 ft below the surface. Water levels in the perched zones do not show long-term declines or seasonal response to nearby production wells, indicating that they are not hydraulically connected. (The exception is one perched well, which shows an average decline of 0.5 ft/yr.)

Long-term water levels in about half the regional aquifer wells remained stable, although they do show seasonal fluctuations (up to 3 ft/yr) associated with water withdrawal in nearby production wells. The other half of regional wells reflected steady declines in water levels consistent with basin-wide declines. Two wells showed an average increase of 0.6 ft/yr in water levels.

Tijeras Arroyo Golf Course – The golf course lies over a perched water zone approximately 300 ft below the surface. Although irrigation of the golf course may be one source of recharge to this perched zone, other geologically controlled factors may also explain this perched water zone. One Air Force well, KAFB-0310, located 2,000 ft north of the golf course (far removed from irrigation) also shows water level elevations similar to wells at the golf course. Water levels in this well are increasing at an average of 1.4 ft/yr, suggesting that the perched zone at the golf course may be connected to the perched zone in Sandia North. The overall long-term increase in golf course well levels is almost 2 ft/yr. KAFB-602, which had been showing steady increasing levels, showed a sudden decline starting in December 1998. This may have resulted from the onset of pumping by a new production well, at the north end of the golf course.

Tijeras Arroyo – Six wells near the Tijeras Arroyo were measured. Wells near the Tijeras Arroyo generally show steady water level declines ranging from no perceptible change to declines of 2 ft/yr. All wells show minor fluctuations apparently in response to seasonal water pumping.

East of Tijeras Fault Complex

Wells east of the Tijeras fault complex encounter bedrock and groundwater at relatively shallow depths. Wells in this area are located north and south of Coyote Springs Road and south of Manzano Base to the KAFB fenceline. Wells have been installed near the Starfire Optical Range, the Lovelace Respiratory Research Institute (LRRI), and Thunder Range. The aquifers on the east side of the Tijeras fault complex are not connected to the regional aquifer in the basin. Recharge sources (mountain fronts and arroyos) in the region east of the Tijeras fault complex influence water levels on a seasonal basis through precipitation and runoff.

City of Albuquerque

Four wells were measured near the Eubank Landfill, which lies approximately 0.5 miles east of Tech Area I. Several of these wells show a long-term increasing trend of up to 0.3 ft/yr.

7.3.3 Groundwater Production

Potable water for SNL/NM facilities is supplied by the Air Force water system's network of groundwater supply wells on the north side of KAFB. In addition, KAFB purchases some of its water from the City of Albuquerque. KAFB's production wells are screened over long intervals from 500 ft (approximate level of water table) to 1,500 ft.

In 1999, KAFB pumped approximately 1.2 billion gallons (1,221,523,000 gal) of groundwater from its wells.

The greatest production from KAFB wells was in July (163,504,000 gal); the lowest was in December (57,474,000 gal).

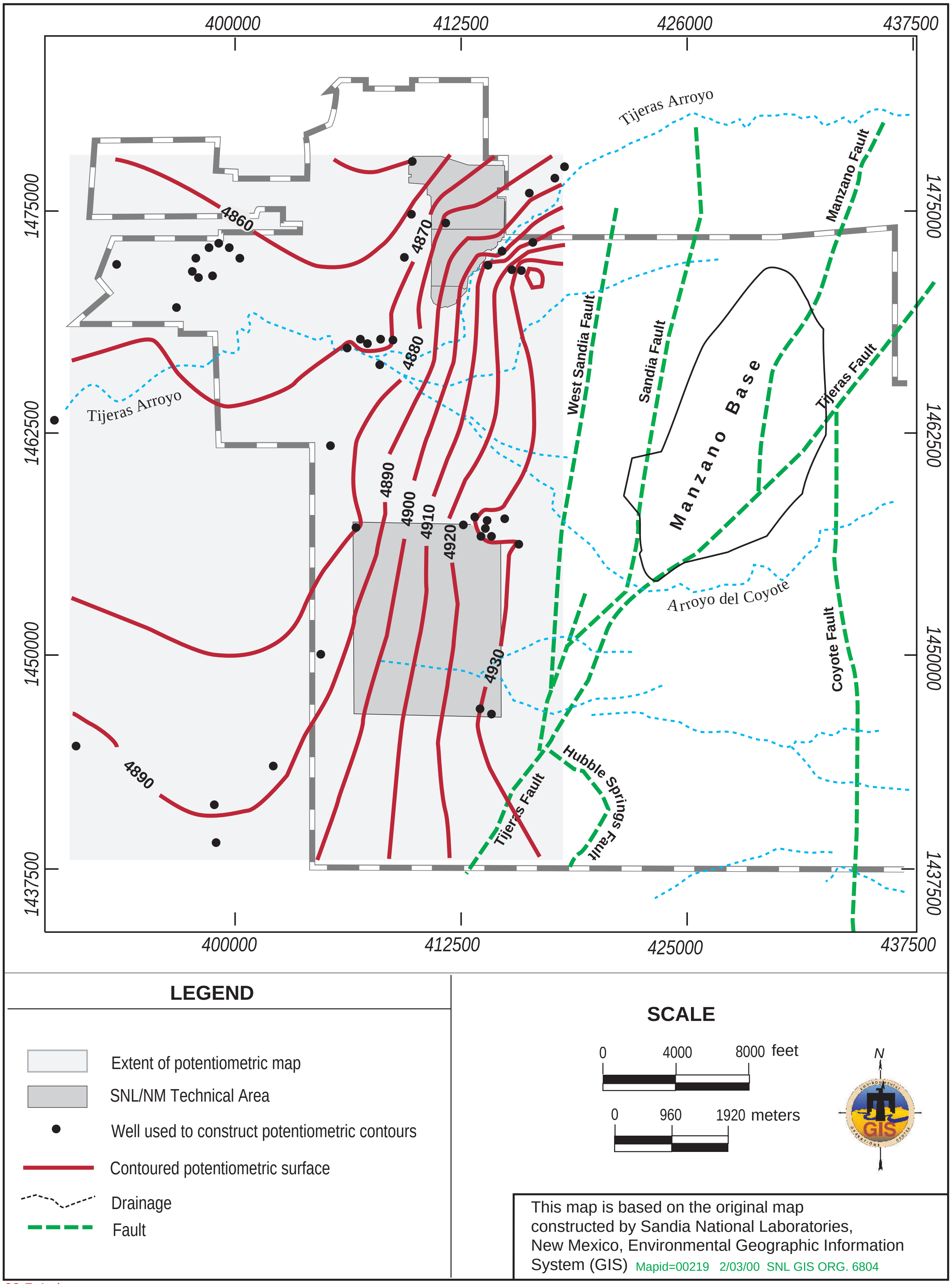
7.3.4 Potentiometric Surface

Approximately 50 wells were used to construct a potentiometric surface map (Figure 7-4). Data from September 1999 measurements were obtained from wells that penetrate the aquifer at different depths and have different screened intervals. Most of the wells represent unconfined aquifers (screened in the upper unit of the Santa Fe Group), but some wells indicate confined or semi-confined conditions.

The map represents the water table of the regional aquifer system showing the horizontal groundwater gradients. (Groundwater flow is perpendicular to equipotential contours.)

As seen in the figure, west of the Tijeras fault complex, the apparent horizontal direction of groundwater flow is west and northwest. This is in contrast to the southwesterly direction reported by Bjorklund and Maxwell (1961). This change in flow direction is a result of groundwater pumping by KAFB and nearby City of Albuquerque water supply wells. Pumping from these well fields has created a groundwater cone of depression along the western and northern boundaries of KAFB. The ellipsoidal shape of this depression, extending as far south as the Isleta Pueblo, is probably a result of preferential flow through highly conductive ancestral Rio Grande deposits, which is the primary aquifer material in this area. Potentiometric contours on the northern portion of KAFB indicate a primarily northern flow direction. Locally, pumping from water supply wells can change the groundwater flow direction and the hydraulic gradient on a seasonal basis.

The perched water zones are not shown in Figure 7-4. The extent of the perched water zone in the Sandia North and the golf course area is currently being refined. Data being collected from newly installed monitor wells will provide substantial improvement in the understanding of the perched water zone and the hydrostratigraphy and hydrology.



00-7-4.ai

FIGURE 7-4. Potentiometric Surface Map for the Regional Groundwater System at SNL/KAFB, 1999

Chapter 8

Quality Assurance

Sandia Corporation is committed to providing quality work for sampling and analysis procedures to ensure the validity and accuracy of all monitoring data as well as the general conduct of its environmental program operations. Overall quality assurance (QA) criteria for all U.S. Department of Energy (DOE) projects, including environmental programs, are enumerated in DOE Order 414.1A, *Quality Assurance* (DOE 1998). Most of the environmental programs at Sandia National Laboratories, New Mexico (SNL/NM) reside under the Integrated Safety and Security Center (7100). The Environmental Restoration (ER) Project resides under the Geoscience and Environment Center (6100).

8.1 CORPORATE LEVEL QUALITY ASSURANCE

Integrated Safety Management System (ISMS)

ISMS was developed by DOE to systematically integrate safety into management and work practices at all levels to ensure that DOE-related missions are accomplished while protecting the public, the worker, and the environment. The DOE ISMS homepage can be viewed at the following address:

http://enterprise.eh.doe.gov/ism/

DOE's ISMS principals are represented by a green star, which identifies the five critical elements of project planning, implementation, and feedback:

- **Plan Work**
- **Analyze Hazards**
- **Control Hazards**
- **Perform Work**
- **Feedback and Improve**

Before work at SNL/NM can begin, the associated hazards within each program area must be evaluated. Safety standards and requirements are established to the level of hazard protection required (graded approach) to provide adequate assurance that the public, the workers, and the environment will be protected from potentially adverse consequences. All potential hazards at a facility or for an activity where workers or the environment may be affected are documented by a Primary Hazard Screen (PHS) and a Hazard Analyses (HA).

The 7100 Center Quality Policy (ESHCP 0014) was developed in 1998 to integrate ISMS and QA. All 7100 projects and programs must contain the necessary elements of ISMS as an integral part of their programs. It is the responsibility of each department manager and project leader to ensure that their projects are carried out with the applicable ISMS and QA principles.

8.2 ENVIRONMENTAL PROGRAM QUALITY ASSURANCE

Environmental Sampling

Environmental samples are collected through various programs and analyzed for radiological and nonradiological contaminants. Some sampling is specifically required by regulations to demonstrate compliance while other sampling activities, which are not a regulatory requirement, are carried out in accordance with DOE Orders. The following sampling activities directly support regulatory compliance:

- **Wastewater** sampling is conducted at permitted outfall stations to meet City of Albuquerque discharge requirements.

- **Storm water** runoff sampling is conducted at two stations to meet U.S. Environmental Protection Agency (EPA) requirements. (The Storm Water Program plans to add up to eight stations in 2000).

- **Environmental Restoration (ER) Project** groundwater sampling is required by EPA under Resource Conservation and Recovery Act (RCRA) permit requirements.

- **Waste** sampling is performed, as necessary, to characterize radioactive and hazardous waste. This fulfills several regulatory requirements including the necessity to meet U.S. Department of Transportation (DOT) regulations before waste can be shipped offsite for permanent disposal.

The following sampling activities are not directly required by law but are conducted to meet DOE objectives. Data obtained may be used to support related compliance activities:

- **Terrestrial surveillance** samples include surface water, sediment, soil, and vegetation.

- **Groundwater** surveillance samples are collected on a site-wide basis to assess general groundwater quality at KAFB in the vicinity of Sandia Corporation activities. This is in addition to groundwater samples taken by the ER Project.

- **Ambient air** surveillance sampling is done to meet DOE Order 5400.1 requirements. Results are compared against Clean Air Act (CAA) standards for criteria pollutants.

- **Air emission** sampling from nonradioactive emission sources may be periodically performed on a case-by-case basis to supply data for various modeling exercises.

All samples are tracked, handled, and shipped to offsite laboratories by the Sample Management Office (SMO) as discussed in Section 8.3.

Environmental Program Description Documents

Environmental programs at SNL/NM have developed Program Documents (PGs) and Quality Assurance Project Plans (QAPjPs) that cover the following program aspects:

- Program goals outline the required scope of work;

- Program objectives describe how goals will be met;

- Project descriptions highlight important program functions;

- Roles and responsibilities identify who will meet program objectives; and

- Interfaces describe important customers and supporting agencies working with the program.

These documents are supplemented with specific procedures and other supporting documents, as necessary. All Sandia Corporation employees and contractors are individually responsible for ensuring that environmentally-related activities performed by them are carried out in accordance with applicable policies and procedures set forth in program documents. Specifically, program participants must adhere to the QA protocol within each program area by ensuring the following criteria are met before activities commence:

(1) Project requirements are defined in program plans and procedures and are adhered to by personnel doing the work;

(2) The proper level of training has been completed and project personnel fully understand and are familiar with the work processes; and

(3) The qualification of personnel has been verified through task leaders and/or management.

8.3 ENVIRONMENTAL SAMPLING AND ANALYSIS

Environmental sampling is conducted in accordance with program-specific sampling and analysis plans (SAPs) or work plans, each of which contain applicable QA elements. These documents are prepared and implemented in accordance with the *Sample Management Office (SMO) Quality Assurance Plan (QAP)* (SNL 1996b) and meet appropriate regulatory guidelines (e.g., federal, state, and local) for conducting sampling and analysis activities.

Sample Management Office (SMO) Roles and Responsibilities

SMO provides guidance and support for field activities conducted by Sandia Corporation organizations. However, the overall adherence and compliance of any sampling and analysis activity is the responsibility of each particular project.

Before field work commences, project leaders and SMO coordinators confer to ensure that the requirements of the sampling plan are established and communicated to the analytical laboratory. This step ensures that the data quality objectives (DQOs) (such as minimum detection limits) stated in the plan will be achievable by the laboratory before the project begins. An Analysis Request and a Chain-of-Custody (ARCOC) form are filled out for samples once the project begins. The SMO office assigns a unique control number for each ARCOC and sample. Samples are labeled and documented on the ARCOC and the sample collection log. SMO is responsible for QA and quality control (QC) at the point of sample relinquishment by the field team into the custody of SMO staff. Information about the quantities and types of samples processed through the SMO are available in the SMO Sample Tracking Analytical Results (STAR) database.

Project Specific Sample Analysis Plans (SAPs)
Each program involved in environmental monitoring and sampling develop and follow a relevant SAP. The specific elements present in most plans include the following:

- Descriptions of sampling procedures (mechanics of the process) applicable to each activity (such as describing the handling of samples, their preservation, labeling, and event documentation);

- A list of EPA-approved sample collection equipment, appropriate sample containers, and equipment decontamination procedures; and

- A schedule for the collection of field QC samples, at defined frequencies, to estimate sample representativeness and potential contamination acquired during the sampling and handling process.

Selection of a Contract Laboratory
All offsite contract laboratories are selected based on an appraisal (pre-award audit) as described in the QAP (SNL 1996b). All laboratories must employ EPA test procedures wherever possible; if not available, other suitable and validated test procedures are used. Laboratory instruments must be calibrated in accordance with established procedures and methods. All calibrations must be verified before instruments can be used for analysis. Once a laboratory has passed the initial appraisal and has been awarded a contract, an audit is performed annually thereafter by the SMO. Technical and QA audits are coordinated by the SMO.

Contractor laboratories are required to participate in applicable DOE and EPA programs for blind-audit check sampling to monitor the overall precision and accuracy of analyses routinely performed on SNL/NM samples.

Quality Control (QC) Measures
The QC process monitors the quality of data generated by each analytical laboratory. Various field QC sample methods are used during the sample collection process to assess the quality of the data outcome. Errors that can be introduced into the sampling process include possible sample contamination in the field or the laboratory, some of which are unavoidable. Additionally, the variability present at each sample location can also affect results.

QC samples are submitted to contractor laboratories in accordance with project-specific DQOs and SAPs. Depending on the type of investigation, one or more of the following QC sampling measures may be performed:

- ***Duplicate samples*** – Two environmental samples are collected from the same area and submitted to the laboratory to assess the overall variability of data associated with a particular sampling location.

- ***Split samples*** – A known homogeneous sample is divided and analyzed to compare precision between multiple laboratories.

- ***Field blank sampling*** – An unused (blank) sample is taken to measure conditions known to be present and associated with the field location—such as contributions which may be present in the ambient air during soil sampling. Blank samples assess the quality and unavoidable contamination present in the sampling process.

- ***Equipment blank sampling*** – Rinse water is collected off sampling equipment to determine the effectiveness of the decontamination process of field equipment (e.g., from the filter or collection vessel).

- ***Trip blank sampling*** – A sample is prepared in the lab and carried through the entire sampling process (for example, a deionized water sample) to identify baseline volatile organic compound (VOC) contaminants that may be present from routine laboratory chemicals or other potential sources of contaminants.

- ***Double blind sampling*** – A sample with known concentrations of analytes is prepared and submitted to the laboratory to assess precision and accuracy of laboratory analyses.

With each SNL/NM sample batch, lab QC samples are concurrently prepared at defined frequencies and analyzed for each method. Analytical accuracy, precision, contamination, and matrix affects associated with each analytical measurement are determined.

QC sample results are compared to statistically established control criteria for acceptance. Analytical results generated concurrent with QC sample results within established limits are considered acceptable. If QC analytical results exceed control limits, the results are qualified and corrective action is initiated. Reanalysis is then performed for samples in the analytical batch.

QC sample data results are included in analytical reports prepared by subcontract laboratories for SNL/NM.

8.4 1999 SAMPLE MANAGEMENT OFFICE (SMO) ACTIVITIES

In 1999, SMO processed a total of 8,511 samples in support of Sandia Corporation projects, which included environmental monitoring (air and water), waste characterization, demolition and decontamination (D&D), and environmental restoration samples. Of these, 2,863 were for environmental monitoring and surveillance projects. In 1999, a total of 899 QC samples were submitted to monitor overall contract laboratory performance; 324 of these were for environmental monitoring and surveillance projects.

SMO Sample Handling

SMO handled the following types of samples in 1999:

- **Radioactive waste**
- **Hazardous waste**
- **Decontamination and Demolition (D&D) materials**
- **UST sludges and liquids**
- **Soil**
- **Groundwater**
- **Environmental Restoration (ER)**
- **Wastewater effluent**
- **Surface water**
- **Storm water**
- **Soil gas**
- **Air filter swipes**

The contract labs work to both a Sandia Corporation statement of work and the *DOE/AL Model Statement of Work* (DOE 1999d).

Inter-Laboratory Comparisons
SMO contract laboratories participate in inter-laboratory comparison programs of the EPA's Environmental Monitoring Systems Laboratory (EMSL). Results in 1999 met expectations. This EPA program is being phased out and will be replaced by a yet unidentified equivalent program.

DOE Assessment Programs include the Mixed Analyte Performance Evaluation Program (MAPEP) and the inter-laboratory Quality Assurance Program. The SMO contract laboratories have a history of achieving a 90 percent or better success rate during these comparisons.

Laboratory QA

SMO initiated onsite data package assessments and validation at the EPA-approved laboratories used by Sandia Corporation. Data packages (including a wide array of analysis methods) are requested at the time of the onsite visit; the labs are not notified in advance so they do not know which data packages will be assessed. The handling history of the data package is carefully reviewed from sample receipt to data completion by retracing each step through documentation files. Specific checks for documentation completeness, proper equipment calibration, and batch QC data are made. These assessments focus on data defensibility and regulatory compliance.

In 1999, Sandia Corporation employed four contract laboratories for the analysis of SNL/NM samples:

- **ACCULABS –** Golden, Colorado;
- **General Engineering Labs (GEL) –** Charleston, South Carolina;
- **QUANTERRA –** St. Louis, Missouri; Santa Ana, California; and Richland, Washington; and
- **CORE Labs –** Denver, Colorado; Casper, Wyoming; and Houston, Texas.

QA Audits

In 1999, SMO conducted audits at all four of its contract laboratories using the centralized QA program criteria established by the Department of Energy Albuquerque Operations Office (AL) Analytical Management Program. All but five percent of the findings have been resolved.

Data Validation and Records Management

Sample collection, control documentation, and measurement data were reviewed and validated for each sample collected. Analytical data reported by test laboratories were reviewed for laboratory and field precision, accuracy, completeness, representativeness, and comparability with respect to the data quality objectives (DQOs) of the particular program. Data were reviewed and validated at a minimum of three levels:

- By the analytical laboratory, where the data were validated in accordance with the laboratory's QA plan and standard operating procedures;
- By a qualified member of the Sandia Corporation SMO staff, who reviewed the analytical reports and corresponding sample collection and control documentation for completeness and laboratory contract compliance; and
- By the Sandia Corporation Project Leader responsible for program objectives, regulatory compliance, and project-specific data quality requirements. The decision of data usability is determined by the Project Leader.

Chapter 9

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EO 12856 *Federal Agency Compliance With Right-to-Know Laws and Pollution Prevention Requirements* (Signed August 3, 1993; 58 FR 41981, August 6, 1993).

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ACTS and STATUTES

American Indian Religious Freedom Act (AIRFA) of 1978 (U.S.C., Title 42, Chapter 21)

Archaeological Resources Protection Act (ARPA) of 1979 (U.S.C., Title 16, Chapter 1b)

Atomic Energy Act (AEA) of 1954 (42 U.S.C. 2011 et sec.)

Clean Air Act (CAA) and **CAA Amendments (CAAA) of 1990** (U.S.C. Title 42, Chapter 85, §7401)

Clean Water Act (CWA) of 1977 and the **Federal Water Pollution Control Act**
(U.S.C. Title 33, Chapter 26, §1251)

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980
(U.S.C. Title 42, Chapter 103, §9601)

Emergency Planning and Community Right to Know Act (EPCRA) of 1986 (U.S.C., Title 42, Chapter 116, §11001 et seq.)

Endangered Species Act (ESA) (U.S.C., Title 16, Chapter 35, §1531 et sec.)

Federal Facility Compliance Act (FFCA) of 1992 (Public Law 102-386)

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (U.S.C., Title 7, Chapter 6, §136).

National Environmental Policy Act (NEPA) of 1969 (U.S.C., Title 42, Chapter 55, §4321)

National Emission Standards for Hazardous Air Pollutants (NESHAP)

National Historic Preservation Act of 1966 (U.S.C. Title 16, Chapter 1A, §106).

Pollution Prevention Act of 1990 (U.S.C., Title 42, Chapter 133, §13101 et seq.)

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

(RCRA Section 3004j	Land Disposal Restrictions)
(RCRA Section 6002	Federal Procurement)
(RCRA Subpart S	Action Levels)

Hazardous and Solid Waste Amendments Act (HSWA) of 1984, Module IV to RCRA Section 3004u

Superfund Amendments and Reauthorization Act (SARA) of 1986

Safe Drinking Water Act (SDWA) (U.S.C. Title 42, Chapter 6A, §300).

Toxic Substances Control Act (TSCA) of 1976 (U.S.C. Title 15, Chapter 53, §2601).

Water Quality Act of 1987 (U.S.C. Title 33, Chapter 26, §1251).

NOTE: U.S.C = United States Code

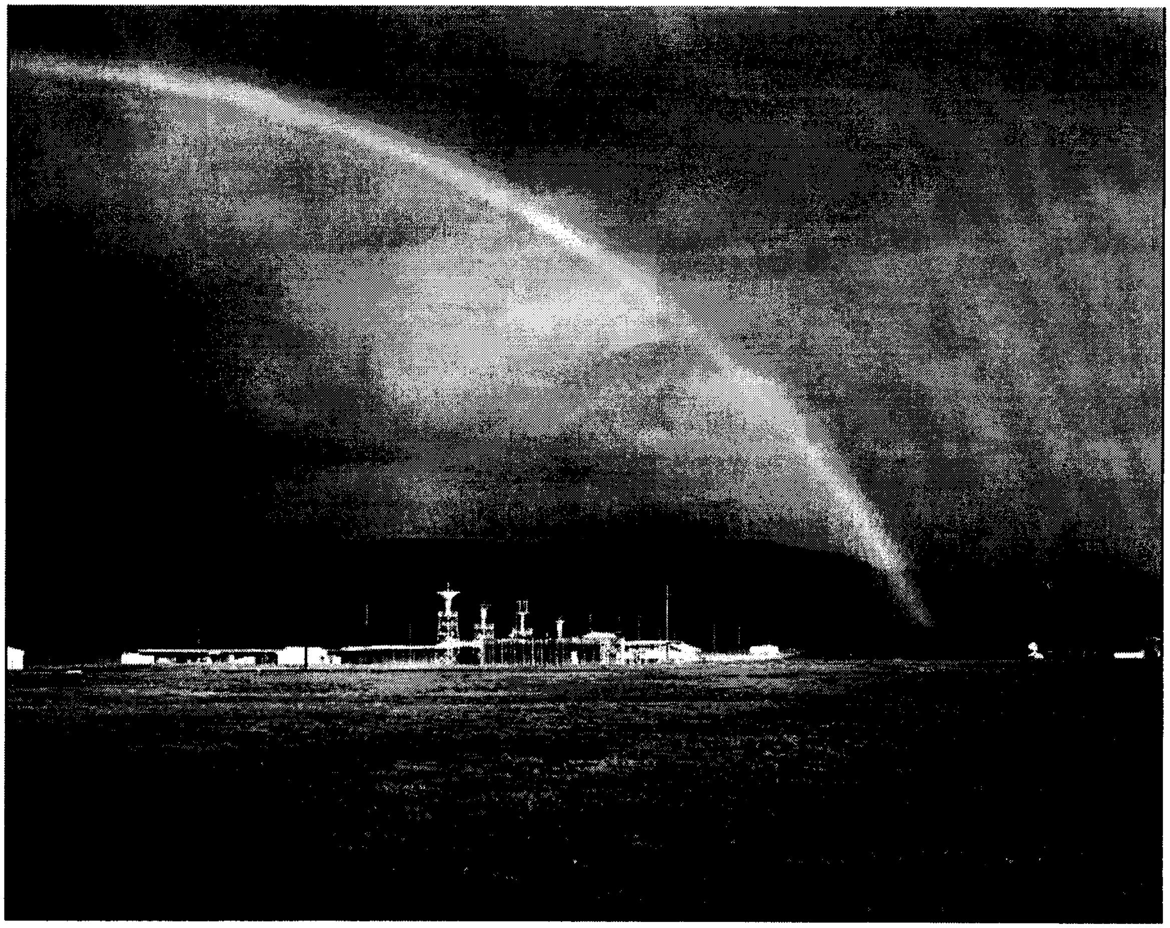
APPENDIX A

1999 Annual Site Environmental Report
for the
Kauai Test Facility (KTF)

Operated by
Sandia Corporation

ACKNOWLEDGEMENTS

This report was written with contributions from Alonzo Lopez, Joan Harris, Jennifer Payne, and Heidi Herrera.



Kauai Test Facility

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ABBREVIATIONS

Acronyms and Abbreviations

AIRF	American Indian Religious Freedoms Act
ARPA	Archeological Resources Protection Act
BMDO	Ballistic Missile Defense Organization
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/AL	U.S. Department of Energy, Albuquerque Operations Office
DOE/KAO	U.S. Department of Energy, Kirtland Area Office
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Orders
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ER	Environmental Restoration
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FFCA	Federal Facilities Compliance Act
FONSI	finding of no significant impact
FTU	Flight Test Unit
HCRR	Hawaiian Code of Rules and Regulations
HST	Hawaiian Standard Time
KTF	Kauai Test Facility
MW	mixed waste
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	No Further Action
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
NSP	Non-covered Source Permit
PCB	polychlorinated biphenyl
PMRF	Pacific Missile Range Facility
ppm	parts per million
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SDI	Strategic Defense Initiative
SDWA	Safe Drinking Water Act
SNL/NM	Sandia National Laboratories/New Mexico
SPCC	Spill Prevention Control and Countermeasures (Plan)
STARS	Strategic Targeting System
TBM	Slugger Theatre Ballistic Missile
TSCA	Toxic Substances Control Act
UST	underground storage tank

Night Launch of a STARS Rocket

The Kauai Test Facility (KTF) is operated by Sandia Corporation as a rocket preparation, launching, and tracking facility for the U.S. Department of Energy (DOE), as well as in support of other U.S. military agencies. SNL/KTF refers to the facilities at KTF under Sandia Corporation's control. The DOE oversees operation of SNL/KTF through the Kirtland Area Office (KAO), which reports to the Albuquerque Operations Office (AL). SNL/KTF exists as a facility within the boundaries of the U.S. Department of Defense (DoD) Pacific Missile Range Facility (PMRF). SNL/KTF is located on the island of Kauai at the north end of the PMRF, near Nohili Point (Figure A-1). This Annual Site Environmental Report (ASER) summarizes data and the compliance status of the environmental protection and monitoring programs at SNL/KTF through December 31, 1999. This report was prepared in accordance with DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990) and DOE Order 231.1, *Environment, Safety, and Health Reporting* (DOE 1996).

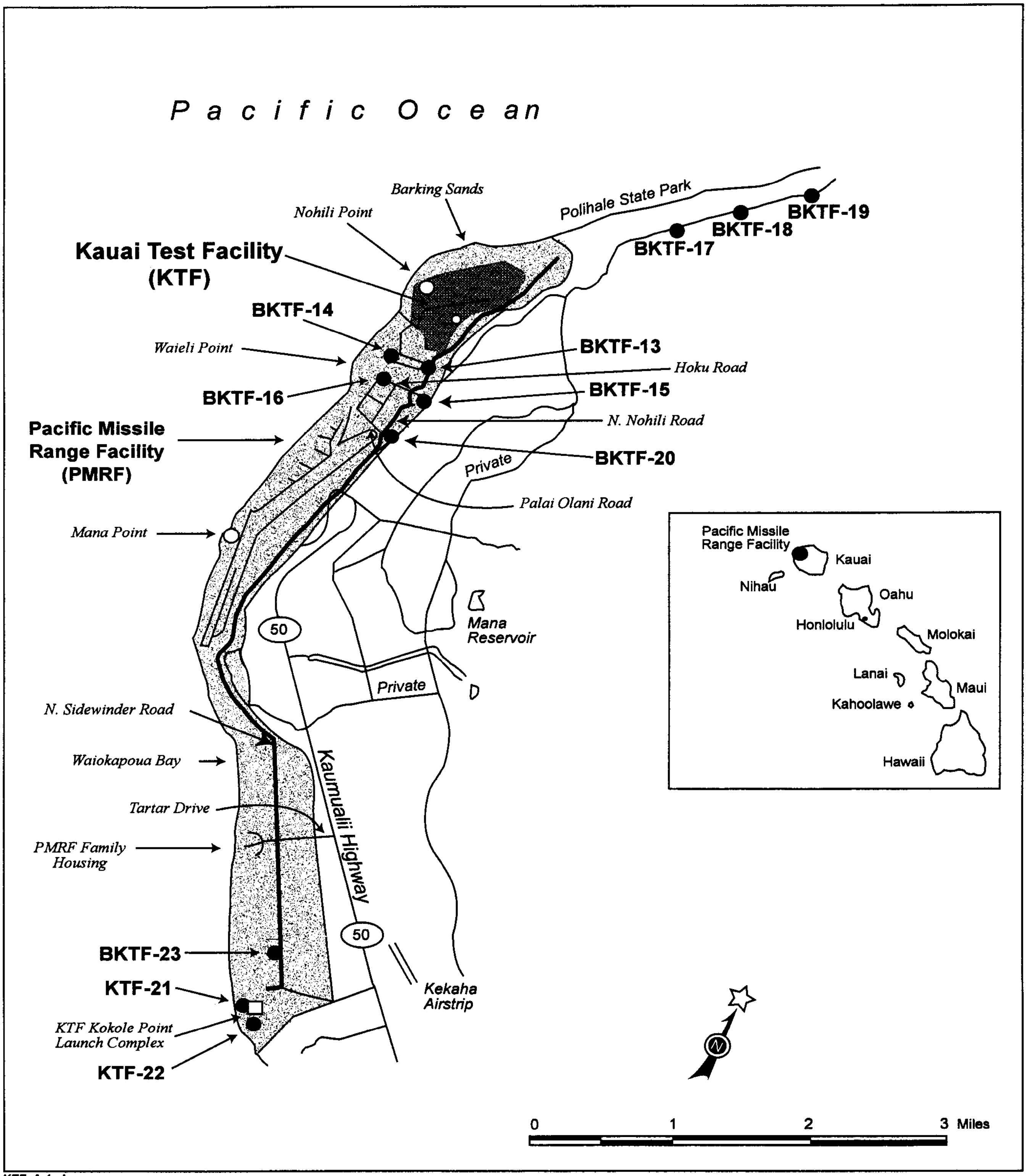
A.1 FACILITIES AND OPERATIONS

SNL/KTF has been an active rocket-launching facility since 1962. The Kauai Test Facility and Range Interfaces Department under Sandia National Laboratories in New Mexico (SNL/NM) manages and conducts the rocket-launching activities at SNL/KTF. The site is primarily used for testing rocket systems with scientific and technological payloads, advanced development of maneuvering re-entry vehicles, scientific studies of atmospheric and exoatmospheric phenomena, and Ballistic Missile Defense Organization (BMDO) programs. Nuclear devices have never been launched from SNL/KTF nor have radiological materials been used at SNL/KTF.

The first facilities at KTF were constructed in the early 1960s to support the National Readiness Program. The most recent construction, completed in 1994, added four buildings to support DOE and Strategic Defense Initiative (SDI) launches. From 1992 to 1998, there have been 12 launches.

The KTF launcher field was originally designed to accommodate 40 launch pads, but only 15 pads were constructed. Of these, 11 have had their launchers removed. Beyond the implementation of portions of the original plan, two additional launch pads were constructed: Pad 41 at Kokole Point, and Pad 42, the Strategic Targeting System (STARS) launch pad. The launcher field site has a number of permanent facilities used to support rocket operations. In addition to rocket launch pad sites, SNL/KTF facilities include missile assembly areas, data acquisition and operations facilities, a maintenance shop, and a trailer compound for administration and technical support personnel. Other features at SNL/KTF include extensive radar tracking and worldwide radio communication access to other DoD facilities.

The administrative area of SNL/KTF, known as the Main Compound, is located within a fenced area near the North Nohili access road from PMRF. Inside the fenced compound, a number of trailers and vans are connected together with a network of concrete docks and covered walkways. The majority of these temporary facilities are used during operational periods to support the field staff at SNL/KTF. During non-operational periods, general maintenance continues and dehumidifiers remain in operation (to protect equipment). Additionally, there are a number of permanent buildings, most of which are in use year-round to support and maintain SNL/KTF facilities (Helgesen 1990).



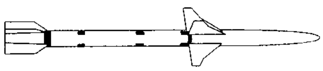
KTF_A-1.ai

FIGURE A-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

A.2 1999 ROCKET LAUNCHES

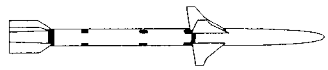
There was one rocket launched from SNL/KTF in 1999. This launch was covered by the KTF Environmental Assessment (EA) published in July 1992 (DOE 1992).

Slugger Theatre Ballistic Missile (TBM) Launch - The Slugger Theatre Ballistic Missile (TBM) Target Tracking Event was launched on June 30, 1999 at 5:00 p.m. Hawaiian Standard Time (HST). This was a single stage Malamute sounding rocket. The rocket was employed as a surrogate target in support of the Navy's Theater Ballistic Missile Defense Program.



A.3 DEMOGRAPHICS

There are 13 permanent onsite personnel at SNL/KTF. During operational periods, when rocket launches occur, an additional 15 to 130 persons from the U.S. mainland are brought to SNL/KTF (DOE 1992). The closest population center to SNL/KTF is the town of Kekaha (population 3,300), which is eight miles from the site.



A.4 COMPLIANCE SUMMARY

The list of statutes on page A-4 provides an overview of compliance status for Sandia Corporation's operations at SNL/KTF in 1999. Table A-1 lists the applicable permits in place at SNL/KTF.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) CERCLA, also known as "Superfund", addresses areas of past spills and releases. SNL/KTF has no current Environmental Restoration (ER) areas located onsite.

Background: In 1995, a site inspection was performed at SNL/KTF to determine compliance with CERCLA requirements. Three ER sites were identified at that time. Based on the site inspection report (SNL 1995a), the U.S. Environmental Protection Agency (EPA) informed the Albuquerque Operations Office (DOE/AL) on September 30, 1996 that a No Further Action (NFA) determination had been made. This confirmed that SNL/KTF met all CERCLA requirements and no additional sampling or remediation would be necessary at the three areas.

TABLE A-1. Permits in Place at SNL/KTF

Type	Permit Number	Date Issued	Expiration Date	Regulatory Agency
Non-covered Source Permit (NSP) * (two stand-by diesel generators)	0429-01-N	Sep 15, 1998	Sep 1, 2003	State of Hawaii
Resource Conservation and Recovery Act (RCRA)	HI-0000-363309	Sep 23, 1994	Not specified	EPA Region IX and Hawaii Dept. of Health
RCRA	HIP-0000-45104	Oct 20, 1998	One time only - Oct 28, 1998	EPA Region IX and Hawaii Dept. of Health
Diesel Generators (air emission)	NSP-0429-01-N	Oct 25, 1993 Re-issued Sep 15, 1998	Sep 2003	State of Hawaii

NOTE: In 1999, there was a change in reporting fuel throughput from biannual reporting to annual reporting to the State of Hawaii.

Major Environmental Regulations & Statutes Applicable to SNL/KTF	
✓ **CERCLA**, Comprehensive Environmental Response, Compensation, and Liability Act	*Provides federal funding for cleanup of inactive waste sites on the National Priority List (NPL) and mandates requirements for reportable releases of hazardous substances.*
✓ **SARA**, Superfund Amendments and Reauthorization Act	*SARA,Title III, known as the Emergency Planning and Community-Right-to-Know Act (EPCRA), mandates communication standards for hazardous materials over a threshold amount that are stored or used in a community*
✓ **RCRA**, Resource, Conservation, and Recovery Act	*Mandates the management of listed hazardous waste and hazardous materials*
✓ **FFCA**, Federal Facilities Compliance Act	*Directs federal agencies in the management of mixed waste*
✓ **CAA and CAAA,** Clean Air Act and CAA Amendments ✓	*Provides standards to protect the nation's air quality*
✓ **NESHAP**, National Emission Standards for Hazardous Air Pollutants	*Specifies standards for radionuclide air emissions and other hazardous air releases*
✓ **CWA**, Clean Water Act	*Provides general water quality standards to protect the nation's water sources and byways*
✓ **SDWA,** Safe Drinking Water Act	*Provides specific standards for sources used for drinking water*
✓ **TSCA**, Toxic Substance Control Act	*Specifies rules for the manufacture, distribution, and disposal of specific toxic materials such as asbestos and polychlorinated biphenyls (PCBs)*
✓ **FIFRA**, Federal Insecticide, Fungicide, and Rodenticide Act	*Controls the distribution and use of various pesticides*
✓ **NEPA**, National Environmental Policy Act	*Ensures that federal agencies review all of their proposed activities that have the potential to affect the environment and provide an opportunity for public involvement for projects potential significant impacts*
✓ **ESA**, Endangered Species Act	*Provides special protection status for federally-listed endangered and threatened species*
✓ **Cultural resources acts**	*Includes various acts that protect archeological, historical, and religious sites and resources*
✓ **Executive Order (EO) 11988**	*Specific protection for wetlands and floodplains*

EPA designated ongoing oversight of SNL/KTF to the Hawaii Department of Health Hazard Evaluation and Emergency Response Office. The EPA recommended continued reevaluation for environmental contamination due to the launching facility present. Rocket exhaust continues to be the main source of metals and other hazardous air emission releases.

Superfund Amendments and Reauthorization Act (SARA)
SARA Title III requires chemical inventory information and threshold quantity reporting as directed by the Emergency Planning and Community Right-to-Know Act (EPCRA), Sections 311 and 312. All required information has been submitted to the State of Hawaii. Table A-2 lists SARA Title III reporting requirements.

Resource Conservation and Recovery Act (RCRA)
In 1994, SNL/KTF reached "small quantity hazardous waste generator" status as defined by RCRA, and therefore, obtained an EPA Identification Number. However, the volume of waste generated in 1999 qualified SNL/KTF to maintain "conditionally exempt small quantity generator" status.

Federal Facilities Compliance Act (FFCA)
The FFCA addresses the disposition of mixed waste (MW) at federal facilities. No radioactive waste of any kind has been generated or stored at SNL/KTF and, therefore, this statute is not applicable to the site.

National Environmental Policy Act (NEPA)
NEPA requires that all federal facilities address environmental and cultural impacts in appropriately detailed documentation before initiating projects. Acts and Executive Orders (EOs) related to NEPA compliance include the Endangered Species Act (ESA) and Cultural resources acts, which are discussed in the following paragraphs.

The DOE Kirtland Area Office (KAO) coordinates NEPA compliance at SNL/KTF with Sandia Corporation in New Mexico.

In accordance with NEPA, a comprehensive Site-wide Environmental Assessment (EA) was completed for SNL/KTF in 1992 (DOE 1992), which resulted in a Finding of No Significant Impact (FONSI), issued on July 17, 1992. This EA is the current NEPA document covering all rocket-launching activities at SNL/KTF. Additionally, an Environmental Impact Statement (EIS) specific to the STARS Program is in place for rocket launches of this type (DoD 1992).

Prior to Sandia Corporation beginning any proposed action that may potentially affect sensitive species or habitats, a NEPA Checklist is submitted to KAO for a determination. As it is applicable, KAO must confer with the following agencies:

- U.S. Fish and Wildlife Service
- State of Hawaii Department of Land and Natural Resources

Endangered Species Act (ESA)
ESA applies to both private individuals and federal agencies (Section 7 of ESA specifically applies to federal agencies). At SNL/KTF, ESA compliance is coordinated with NEPA compliance. The law ensures that any action authorized, funded, or carried out by a federal agency will not jeopardize the continued existence of a "threatened or endangered species," or result in adverse modifications to its habitat. Table A-3 lists all threatened, endangered, and sensitive state and federal listed species occurring on the island of Kauai.

Migratory Bird Treaty Act

In addition to the special consideration afforded to species listed as threatened and endangered, or sensitive, most birds are protected under the Migratory Bird Treaty Act. At SNL/KTF, construction sites are surveyed prior to digging or earth movement to avoid possible impacts to nesting birds.

Cultural Resources Acts
The three primary cultural resources acts applicable at SNL/KTF are as follows:

- National Historic Preservation Act (NHPA);
- Archaeological Resources Protection Act (ARPA); and
- American Indian Religious Freedom Act (AIRFA).

At SNL/KTF, cultural resources compliance is coordinated through the NEPA Program. Actions that could adversely affect cultural resources are initially analyzed in a NEPA Checklist.

Executive Orders
- Executive Order 11990, *Protection of Wetlands*

- Executive Order 11988, *Floodplain Management*

One NEPA Checklist was submitted to KAO for determination on proposed actions at SNL/KTF in 1999:

- Slugger Theater Ballistic Missile (TBM) Target Tracking Event at SNL/KTF.

In 1999, Sandia continued to support the PMRF in the development of their programmatic *Pacific Missile Range Facility Enhanced Capability Environmental Impact Statement (EIS)* (DoD 1998). A Record of Decision (ROD) was signed in April 1999 by the Department Assistant Secretary of the Navy.

Clean Air Act (CAA) and Clean Air Act Amendments (CAAA) of 1990
Ambient air quality is regulated by Hawaii's Code of Rules and Regulations (HCRR), Title 11, Chapter 59 (11-59-4) under the jurisdiction of the Hawaii Department of Health, Air Pollution Control Department. Currently, there are no facilities at SNL/KTF that require air permits or compliance with the New Source Performance Standards (NSPS), "Prevention of Significant Deterioration (PSD)," or 40 CFR 161, "National Emission Standards for Hazardous Air Pollutants" (NESHAP). Within

TABLE A-2. 1999 SARA Title III (or EPCRA) Reporting Requirements Applicable to SNL/KTF

Section	SARA Title III Section Title	Yes	No	N/R	Description
302 - 303	Planning Notification	✓			Sandia Corporation submits an annual planning report detailing its onsite chemical inventories, emergency contacts and notification procedures, and other facility notification responsibilities to local emergency response authorities. Copies are also forwarded to Sandia Corporation in New Mexico.
304	Emergency Release Notification			✓	No reportable quantity (RQ) releases of an extremely hazardous substance (EHS), or as defined under CERCLA, occurred in 1999.
311-312	MSDSs and Chemical Inventory Report	✓			There are two "Community Right-to-Know" reporting requirements: (a) an inventory report listing all hazardous chemicals onsite (above threshold levels) must be submitted annually to state and local emergency response groups and fire departments; (b) all MSDS* information must be made available to local emergency organizations.
313	Toxic Release Inventory (TRI) Reporting			✓	Sandia Corporation is below the reporting threshold in 1999 for producing a TRI Report for SNL/KTF operations.

NOTE: MSDS = Material Safety Data Sheets (gives relevant chemical information)
N/R = not required

TABLE A-3. Threatened, Endangered, and Sensitive Species Potentially occurring on KTF

Species		Federal Status	State of Hawaii Status
MAMMALS			
Hawaiian hoary bat	*Lasiurus cinereus semotus*	Endangered	Endangered
Hawaiian monk seal	*Monachus schauinslandi*	Endangered	--
BIRDS			
Hawaiian Duck	*Anas wyvilliana*	Endangered	Endangered
Hawaiian coot	*Fulica americana alai*	Endangered	Endangered
Hawaiian gallinule	*Gallinula chloropus sandvicensis*	Endangered	Endangered
Kauai Nuku pu'u	*Hemignathus lucidus hanapepe*	Endangered	Endangered
Kauai 'Akia loa	*Hemignathus procerus*	Endangered	Endangered
Black-necked stilt	*Himantopus mexicanus knudseni*	Endangered	Endangered
Kauai 'O'o	*Moho braccatus*	Endangered	Endangered
Large Kauai thrush	*Myadestes myadestinus*	Endangered	Endangered
Small Kauai solitare	*Myadestes palmeri*	Endangered	Endangered
Hawaiian goose	*Nesochen sandvicensis*	Endangered	Endangered
'O'u	*Psittirostra psittacea*	Endangered	Endangered
Dark-rumped petrel	*Pterodroma phaeopygia sandwichensis*	Endangered	Endangered
Newell's shearwater	*Puffinus auricularis*	Threatened	Threatened
PLANTS			
Liliwai	*Acaena exigua*	Endangered	Endangered
No common name	*Achyranthes mutica*	Endangered	Endangered
Pendant kihi fern	*Adenophorus periens*	Endangered	Endangered
Mahoe	*Alectryon macrococcus var. macrococcus*	Endangered	Endangered
Kuawawaenohu	*Alsinidendron lychnoides*	Endangered	Endangered
No common name	*Alsinidendron viscosum*	Endangered	Endangered
No common name	*Bonamia menziesii*	Endangered	Endangered
Uhiuhi	*Caesalpinia kavaiensis*	Endangered	Endangered
'Awiwi	*Centaurium sebaeoides*	Endangered	Endangered
'Akoko	*Chamaesyce halemanui*	Endangered	Endangered
Pauoa	*Ctenitis squamigera*	Endangered	Endangered
Haha	*Cyanea asarifolia*	Endangered	Endangered
Haha	*Cyanea recta*	Threatened	Threatened
Haha	*Cyanea remyi*	Endangered	Endangered
Haha	*Cyanea undulata*	Endangered	Endangered
Pu'uka'a	*Cyperus trachysanthos*	Endangered	Endangered
Ha'iwale	*Cyrtandra limahuliensis*	Threatened	Threatened
No common name	*Delissea rhytidosperma*	Endangered	Endangered
'Oha	*Delissea rivularis*	Endangered	Endangered
No common name	*Delissea undulata ssp. kauaiensis*	Endangered	Endangered
Asplenium leaved diella	*Diellia erecta*	Endangered	Endangered
No common name	*Diellia pallida (proposed as D. laciniata)*	Endangered	Endangered
No common name	*Diplazium molokaiense*	Endangered	Endangered
Kahalapehu	*Dubautia pauciflorula*	Endangered	Endangered

TABLE A-3. Threatened, Endangered, and Sensitive Species Potentially occurring on KTF (continued)

Species		Federal Status	State of Hawaii Status
PLANTS (continued)			
'Akoko	*Euphorbia haeleeleana*	Endangered	Endangered
Heau	*Exocarpos luteolus*	Endangered	Endangered
Mehamehame	*Flueggea neowawraea*	Endangered	Endangered
No common name	*Gouania meyenii*	Endangered	Endangered
No common name	*Haplostachys haplostachya*	Endangered	Endangered
'Awiwi	*Hedyotis cookiana*	Endangered	Endangered
Na Pali beach hedyotis	*Hedyotis st.-johnii*	Endangered	Endangered
No common name	*Hesperomannia lydgatei*	Endangered	Endangered
Hau kuahiwi	*Hibiscadelphus distans*	Endangered	Endangered
Hau kuahiwi	*Hibiscadelphus woodii*	Endangered	Endangered
Ma'o hau hele	*Hibiscus brackenridgei ssp. mokuleianus*	Endangered	Endangered
Koki'o 'ula'ula; aloalo	*Hibiscus clayi*	Endangered	Endangered
Koki'o ke'oke'o	*Hibiscus waimeae ssp. hannerae*	Endangered	Endangered
Hilo ischaemum	*Ischaemum byrone*	Endangered	Endangered
Aupaka	*Isodendrion laurifolium*	Endangered	Endangered
Aupaka	*Isodendrion longifolium*	Threatened	Threatened
Koki'o	*Kokia kauaiensis*	Endangered	Endangered
Kamakahala	*Labordia lydgatei*	Endangered	Endangered
Kamakahala	*Labordia tinifolia var. wahiawaensis*	Endangered	Endangered
Nehe	*Lipochaeta fauriei*	Endangered	Endangered
Nehe	*Lipochaeta micrantha var. exigua*	Endangered	Endangered
Nehe	*Lipochaeta micrantha var. micrantha*	Endangered	Endangered
Nehe	*Lipochaeta waimeaensis*	Endangered	Endangered
No common name	*Lobelia niihauensis*	Endangered	Endangered
No common name	*Lysimachia filifolia*	Endangered	Endangered
No common name	*Mariscus pennatiformis ssp. pennatiformis*	Endangered	Endangered
Alani	*Melicope haupuensis*	Endangered	Endangered
Alani	*Melicope knudsenii*	Endangered	Endangered
Alani	*Melicope pallida*	Endangered	Endangered
Alani	*Melicope quadrangularis*	Endangered	Endangered
No common name	*Munroidendron racemosum*	Endangered	Endangered
Kolea	*Myrsine linearifolia*	Threatened	Threatened
'Aiea	*Nothocestrum peltatum*	Endangered	Endangered
Lau 'ehu	*Panicum niihauense*	Endangered	Endangered
Makou	*Peucedanum sandwicense*	Threatened	Threatened
Wawae'iole	*Phlegmariurus mannii (listed as Huperzia mannii)*	Endangered	Endangered
Wawae'iole	*Phlegmariurus nutans (listed as Lycopodium nutans)*	Endangered	Endangered
No common name	*Phyllostegia knudsenii*	Endangered	Endangered
No common name	*Phyllostegia waimeae*	Endangered	Endangered
No common name	*Phyllostegia wawrana*	Endangered	Endangered
Ale	*Plantago princeps var. anomala*	Endangered	Endangered
Ale	*Plantago princeps var. longibracteata*	Endangered	Endangered
No common name	*Platanthera holochila*	Endangered	Endangered
Mann's bluegrass	*Poa mannii*	Endangered	Endangered

TABLE A-3. Threatened, Endangered, and Sensitive Species Potentially occurring on KTF (concluded)

Species		Federal Status	State of Hawaii Status
PLANTS (concluded)			
Hawaiian bluegrass	*Poa sandvicensis*	Endangered	Endangered
No common name	*Poa siphonoglossa*	Endangered	Endangered
Loulu	*Pritchardia napaliensis*	Endangered	Endangered
Loulu	*Pritchardia viscosa*	Endangered	Endangered
Kaulu	*Pteralyxia kauaiensis*	Endangered	Endangered
No common name	*Remya kauaiensis*	Endangered	Endangered
No common name	*Remya montgomeryi*	Endangered	Endangered
Dwarf naupaka	*Scaevola coriacea*	Endangered	Endangered
Ma'oli'oli	*Schiedea apokremnos*	Endangered	Endangered
No common name	*Schiedea helleri*	Endangered	Endangered
No common name	*Schiedea kauaiensis*	Endangered	Endangered
No common name	*Schiedea membranacea*	Endangered	Endangered
No common name	*Schiedea nuttallii*	Endangered	Endangered
No common name	*Schiedea spergulina var. leiopoda*	Endangered	Endangered
No common name	*Schiedea spergulina var. spergulina*	Threatened	Threatened
Laulihilihi	*Schiedea stellarioides*	Endangered	Endangered
'Ohai	*Sesbania tomentosa*	Endangered	Endangered
No common name	*Silene lanceolata*	Endangered	Endangered
Popolo ku mai	*Solanum incompletum*	Endangered	Endangered
Popolo 'aiakeakua	*Solanum sandwicense*	Endangered	Endangered
No common name	*Spermolepis hawaiiensis*	Endangered	Endangered
No common name	*Stenogyne campanulata*	Endangered	Endangered
No common name	*Viola helenae*	Endangered	Endangered
Nani wai'ale'ale	*Viola kauaensis var. wahiawaensis*	Endangered	Endangered
Iliau	*Wilkesia hobdyi*	Endangered	Endangered
No common name	*Xylosma crenatum*	Endangered	Endangered
A'e	*Zanthoxylum hawaiiense*	Endangered	Endangered
REPTILES			
Loggerhead sea turtle (incidental in Hawaii)	*Caretta caretta*	Threatened	Threatened
Green sea turtle	*Chelonia mydas*	Threatened	Threatened
Leatherback sea turtle (incidental in Hawaii)	*Dermochelys coriaceae*	Endangered	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Endangered	Endangered
Olive ridley sea turtle (incidental in Hawaii)	*Lepidochelys olivacea*	Threatened	Threatened
SNAILS			
Newcomb's snail	*Erinna newcombi*	Proposed Endangered	Proposed Endangered
ARTHROPODS			
Kauai cave wolf spider	*Adelocosa anops*	Proposed Endangered	Proposed Endangered
Blackburn's sphinx moth	*Manduca blackburni*	Proposed Endangered	Proposed Endangered
Kauai cave amphipod	*Spelaeorchestia koloana*	Proposed Endangered	Proposed Endangered

Surveys Completed in Support of the KTF Environmental Assessment (EA)

Green Sea Turtle Survey Report – This survey found at least 32 green sea turtles (*Chelonia mydas agassizi*) in five locations at KTF. The study concluded that constructing an additional launch pad and conducting further launches, similar to those conducted at SNL/KTF since 1962, most likely will not have any quantifiable negative effects on green sea turtles inhabiting waters near SNL/KTF (IT 1990a).

Botanical Survey Report – This survey identified four major vegetation types at SNL/KTF and recommended that vehicles be kept off the beaches and dunes. The report recommended moving the entire *Ophioglossum concinnum* colony (a Category 1 proposed endangered fern) to a compatible area within PMRF because of the colony's proximity to a beach access road and its location in a frequently-mowed kiawe/koahaole vegetation zone (IT 1990b). *Note*: Category 1 is a species for which biologic vulnerability exists to the point of support of proposal to list as endangered or threatened.

Ornithological and Mammal Survey Report – This survey determined relative population densities of bird species and identified mammalian species at SNL/KTF. Based on mitigations implemented and other commitments made in the KTF EA, no adverse impacts are expected for birds or mammals as a result of Sandia Corporation's operations (IT 1990c).

Soil Sampling Report – Sampling was undertaken to delineate the extent and concentration of lead, aluminum, and beryllium in the soil at SNL/KTF and to determine whether the concentrations pose a risk to human health or the environment. The soil sampling results were used to estimate the potential for future soil contamination or human exposure from use of SNL/KTF as a launch facility (IT 1990d).

Archaeological Survey and Sampling – No significant cultural resources were found at the surface level on SNL/KTF, during this study. However, subsurface testing at one area indicated a potential for buried cultural resource materials (Gonzalez and Berryman 1990).

the boundaries of PMRF, no federal air emission permits are held either by DOE for SNL/KTF, or by DoD for PMRF. However, the two electrical generators at SNL/KTF are permitted for operation by the State of Hawaii under a "Non-covered Source Permit" (NSP) (SNL 1996a).

Rocket launches are mobile sources and do not require reporting of reportable quantity (RQ) releases.

As required by the EPA, the 1999 Annual Fee and Monitoring Report (air emissions) was submitted to the State of Hawaii on February 5, 2000. Sandia Corporation was in compliance with all air quality regulations in 1999.

Clean Water Act (CWA)
There were no compliance issues with respect to any state or federal water pollution regulations in 1999. There are three septic tanks onsite owned by SNL/KTF facilities, which currently do not require permits from the State of Hawaii.

A National Pollutant Discharge Elimination System (NPDES) permit is not required due to the lack of significant storm water runoff or wastewater discharging beyond the site boundary into "Waters of the U.S," as defined in the regulation. However, this is not to say that there is no runoff. The EPA has concern with storm water runoff washing off the launcher pads and discharging to the ocean. Some of the downstream pathways include habitat for several federally designated endangered or threatened species. The EPA has therefore recommended periodic evaluations for environmental contamination.

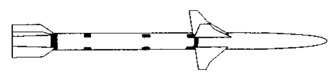
Oil Storage – There is one underground storage tank (UST) at SNL/KTF, which is owned by the Navy. There were no issues or changes in status for this tank during 1999. There is also one 10,000-gallon above ground fuel tank inside the Main Compound. Sandia Corporation cooperates with the Navy's spill control guidelines contained in the *Spill Prevention Control and Countermeasures (SPCC) Plan, Pacific Missile Range Facility* (U.S. Navy 1991).

Safe Drinking Water Act (SDWA)
The SDWA does not apply directly to Sandia Corporation activities at SNL/KTF because all drinking water is obtained through PMRF's facilities.

Toxic Substances Control Act (TSCA)
TSCA regulates the distribution of polychlorinated biphenyls (PCBs) and asbestos. The transformers on the SNL/KTF site have been tested and are free of PCBs, and there are no asbestos issues at the site.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
FIFRA controls the distribution and application of pesticides including herbicides, insecticides, and rodenticides. All pesticide use at SNL/KTF follows EPA requirements.

Releases and Occurrences
There were no accidental releases or other environmental occurrences at SNL/KTF in 1999.



A.5 ENVIRONMENTAL PROGRAM ACTIVITIES

This section describes three environmental programs: the National Environmental Policy Act (NEPA) Program, the Environmental Restoration (ER) Project, and the Spill Prevention Program.

National Environmental Policy Act (NEPA) Program Activities
In completing the KTF EA in 1992 (DOE1992), several environmental baseline surveys were conducted. These are discussed under the Endangered Species Act (ESA).

Environmental Restoration (ER) Project Activities
There are no ER sites at SNL/KTF. The three previous sites were taken off the list after the EPA made the determination of No Further Action (NFA) on September 30, 1996. The

status was granted after a site inspection and a follow up report (SNL 1995a). No additional assessment or sampling is required at SNL/KTF relative to these ER sites. This, however, does not preclude that other environmental sampling activities will take place at SNL/KTF.

A.6 ENVIRONMENTAL SURVEILLANCE AND MONITORING ACTIVITIES

Environmental Surveillance 1999 Results

Terrestrial surveillance monitoring of soils at SNL/KTF was conducted in 1999. This is the third soil sampling event that has been conducted by Sandia Corporation at the site. The last sampling event occurred in 1994. Samples are analyzed for both radiological and nonradiological (stable metals) parameters. As it currently stands, soil sampling is only done on a periodic "as needed" basis due to the limited activities at SNL/KTF. The historical data, though limited, shows that contaminated areas onsite are minimal and any contamination present is not migrating. Sample results are compared to known values, such as RCRA Subpart S Action Levels and U.S. surface soil averages, where applicable. Radiological results are reviewed qualitatively. As a result of limited data, no statistical analysis or trending has been done on any of the data.

Terrestrial sampling was performed in January 1999. Samples were collected at:

- 9 offsite (background) locations,
- 14 onsite SNL/KTF locations, and
- 5 locations in the main SNL/KTF compound.

Soil – Nonradiological Results

All nonradiological sample results were both within the range of U.S. surface soil averages and below the EPA's proposed RCRA Subpart S Action Levels except for iron. Iron exceeded both the U.S. average concentration and the proposed RCRA Subpart S standards in all background samples and onsite locations. Iron occurs in high quantities in the volcanic soils present throughout the island and the results reflect the natural background levels for the site. In fact, the maximum and average iron values were actually slightly higher in the offsite background samples than the onsite samples. The high values for iron are not considered a cause for concern with regards to stable metals. Table A-4 summarizes the iron results for the background and onsite SNL/KTF locations.

Terrestrial Sampling at SNL/KTF

Terrestrial samples taken at SNL/KTF are limited to soil and vegetation samples. (No vegetation sampling was done in 1999.) Surface water runoff quickly infiltrates into the sandy dunes upon which SNL/KTF is situated resulting in very few drainage channels at the site. Since there are no perennial surface waters onsite, surface water and water-deposited sediment samples are not being collected.

Routine groundwater sampling is not performed because the groundwater is unacceptable for consumption or irrigation of any kind (DOE 1992). SNL/KTF is located only slightly above sea level: the water table consists of a brackish non-potable water layer lying above seawater. Groundwater samples were taken at several previous ER sites in 1994 using temporary wells; no contamination was detected. Future sampling will be dependent on resource availability and demonstrated need.

Other results for stable metals showed either elevated results compared to either U.S. surface soil averages or RCRA Subpart S Action Levels. These results are shown in Tables A-5, A-6, and A-7 for background locations, onsite SNL/KTF locations, and the Main Compound, respectively.

TABLE A-4. Summary Statistics for Iron Concentrations *(all values are reported in mg/kg).*

Location	Average	Std Dev	Minimum	Maximum	US Surface Soil Average	RCRA Subpart S Action Level
BKTF (background)	16,000	13,000	2,900	42,000	N/A	21,000
KTF*	14,000	8,300	3,500	27,000	N/A	21,000

NOTE: *KTF refers to onsite sampling areas excluding the Main Compound.

TABLE A-5. Summary Statistics for Background Locations *(all values are reported in mg/kg).*

Metal	Average	Std Dev	Minimum	Maximum	US Surface Soil Avg	RCRA Subpart S Action Level
Antimony	5.8	0.7	5	7	0.25 – 0.6	N/A
Manganese	300	210	77	590	20 – 30,000	400
Selenium	7.1	3	5	12	<0.1 – 4	N/A

TABLE A-6. Summary Statistics for SNL/KTF Locations *(all values are reported in mg/kg).*

Metal	Average	Std Dev	Minimum	Maximum	US Surface Soil Avg	RCRA Subpart S Action Level
Antimony	5.9	0.8	5	7	0.25 – 0.6	N/A
Copper	39	90	5.1	350	3 – 300	3,000
Manganese	260	140	90	460	20 – 30,000	400
Nickel	190	160	24	430	<5 – 150	1,600
Selenium	5.6	1	5	8	<0.1 – 4	N/A
Zinc	100	160	6.7	560	13 – 300	23,000

TABLE A-7. Summary Statistics for SNL/KTF Main Compound Locations *(all values are reported in mg/kg).*

Metal	Average	Std Dev	Minimum	Maximum	US Surface Soil Avg	RCRA Subpart S Action Level
Antimony	5.4	0.9	5	7	0.25 – 0.6	N/A
Cadmium	0.8	0.4	0.5	1.4	0.41 – 0.57	40
Selenium	5.0	0	5	5	<0.1 – 4	N/A
Zinc	240	130	71	380	13 – 300	23,000

NOTE: The analytical laboratory's Minimum Detectable Limit (MDL) for Selenium was 5 mg/kg. This is the value that the laboratory could accurately provide a result. The values for selenium could be below 5 mg/kg.

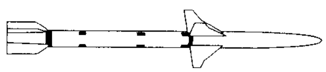
Soil – Radiological Results
Gamma spectroscopy and total uranium results for soils were well within expected levels for naturally-occurring radionuclides in soil. However, the average and maximum tritium results were significantly higher than expected as compared to the Sandia National Laboratories New Mexico (SNL/NM) tritium results. These higher values for tritium are currently being investigated, but it should be noted that these concentrations do not appear to be significant from a human risk standpoint. This is the first year that tritium analyses was performed on soil samples at SNL/KTF. Further data will clarify these results.

Wastewater Monitoring
Sandia Corporation's activities at SNL/KTF produce only sanitary sewage, which is directed into five wastewater systems—three septic tanks and two French drains—in accordance with Hawaii Underground Injection Control regulations. The septic systems are periodically pumped by licensed state-certified contractors and inspected by state officials. The limited quantity of sewage released does not impact any protected waters and, as noted earlier, there are no drinking water wells in the area of SNL/KTF. Currently, septic tanks do not require permitting or sampling. Wastewater sampling is performed as a "Best Management Practice" on an "as needed" basis. The last sampling occurred in June 1993 (IT 1994).

Air Emission Monitoring
Based on effluent air monitoring results of the STARS Flight Test Unit 1 (FTU-1) in February 1993 (EPA 1993) and the CDX rocket launch in the summer of 1992 (SNL 1992), it was determined that rocket launches at SNL/KTF were not a significant source of air pollutants. Launches are infrequent and emissions recorded did not exceed federal and state standards (DOD 1994). Because the STARS type rocket produces the greatest air emissions and remained within acceptable limits, it can be assumed that future launches of this type will also be within acceptable limits. Therefore, no further air emission monitoring is planned at this time. If a new rocket type is launched from SNL/KTF that differs in emission substance from the STARS rocket, or air emission requirements change, funding for future monitoring will be requested.

Meteorological Monitoring
Onsite meteorological instruments are used during test periods to characterize atmospheric transport, diffusion conditions, and stability classes. Due to the infrequency of launches, no formal meteorological monitoring plan is in place for SNL/KTF. Climatic information representative of SNL/KTF is obtained from the PMRF.

Noise Monitoring
In accordance with the Quiet Communities Act of 1978 (42 U.S.C. 4901 et seq.), noise monitoring was conducted in February 1993 during the STARS FTU-1 launch to confirm the determination made in the STARS EIS that noise produced from the largest launch would be below maximum acceptable levels (SNL 1993). Data collected in the nearest town of Kekaha indicated that levels were no louder than noise generated from passing vehicles on a nearby highway.



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IT 1990b IT Corporation, *Botanical Survey of the Kauai Test Facility Site, Barking Sands, Kauai, Hawaii.* IT Corporation, prepared for Sandia National Laboratories, Albuquerque, NM (1990).

IT 1990c IT Corporation, *Ornithological Survey Report of the Kauai Test Facility Site, Barking Sands, Kauai, Hawaii.* IT Corporation, prepared for Sandia National Laboratories, Albuquerque, NM (1990).

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REGULATIONS AND EXECUTIVE ORDERS

- **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980** (U.S.C. Title 42, Chapter 103, §9601)

- **Superfund Amendments and Reauthorization Act (SARA) of 1986**

- **Clean Air Act (CAA)** and **CAA Amendments (CAAA) of 1990** (U.S.C. Title 42, Chapter 85, §7401)

- **Clean Water Act (CWA) of 1977** and the **Federal Water Pollution Control Act** (U.S.C. Title 33, Chapter 26, §1251)

- **Endangered Species Act (ESA)** (U.S.C., Title 16, Chapter 35, §1531 et sec.)

- **Federal Facility Compliance Act (FFCA) of 1992** (Public Law 102-386)

- **Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)** (U.S.C., Title 7, Chapter 6, §136).

- **National Environmental Policy Act (NEPA) of 1969** (U.S.C., Title 42, Chapter 55, §4321)

- **National Emission Standards for Hazardous Air Pollutants (NESHAP)**

- **Resource Conservation and Recovery Act (RCRA) of 1976** (Public Law 94-580, 1976, 90 Statute 2795)
  (RCRA Section 3004j Land Disposal Restrictions)
  (RCRA Section 6002 Federal Procurement)
  (RCRA Subpart S Action Levels)

- **Safe Drinking Water Act (SDWA)** (U.S.C. Title 42, Chapter 6A, §300).

- **Toxic Substances Control Act (TSCA) of 1976** (U.S.C. Title 15, Chapter 53, §2601).

- Quiet Communities Act of 1978, Public Law 95-609, 92 stat. 3079, U.S.C. §4901 et seq. November 9, 1978

- HCRR, Title II, Chapter 59, Hawaiian Code of Rules and Regulations for Air Quality.

- Executive Order (EO) 11988, *Floodplain Management* (Signed May 24, 1977; 42 FR 26951, 3 CFR, 1977 Comp., p. 117; Amended by Executive Order 12148, July 20, 1979; 44 FR 43239, 3 CFR, 1979 Comp., p. 412).

- Executive Order (EO) 11990, *Protection of Wetlands* (Signed May 24, 1977; 42 FR 26961, 3 CFR, 1977 Comp., p. 121).

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APPENDIX B

Laws, Regulations, and Standards
for
Environmental Programs

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CONTENTS

TABLES

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B.1 Applicable Regulations for Environmental Programs

Air Quality Programs

All Air Quality Programs

Clean Air Act (CAA) of 1955

Clean Air Act Amendments (CAAA) of 1990

Meteorological Monitoring Program

40 CFR 51, "Guidelines for Onsite Meteorological Measurements"

Ambient Air Surveillance Program

40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards," (20 NMAC 11.01)

40 CFR 58, "Ambient Air Quality Surveillance"

NESHAP Program

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants (NESHAP)"
Subpart H, *National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities*

Air Quality Compliance Program

(See Table B-1)

TABLE B-1. Federal and State Air Regulations Applicable to SNL/NM

CAA Title	Section	Federal Regulation	Local Regulation	Subject
I	176 (c)	40 CFR 51 W 40 CFR 93 B	20 NMAC 11.04	Conformity of Federal Actions (State and Federal Plans)
	110	40 CFR 58	N/A	Ambient Air Quality Surveillance
	109	40 CFR 50	20 NMAC 11.01	National Primary and Secondary Ambient Air Quality Standards (NAAQS)
	165-166	40 CFR 52	20 NMAC 11.02	Permit Fees
		40 CFR 52	20 NMAC 11.05	Visible Air Contaminants
		40 CFR 52	20 NMAC 11.06	Emergency Action Plan
		40 CFR 52	20 NMAC 11.07	Variance Procedure
		40 CFR 52	20 NMAC 11.20	Airborne Particulate Matter (PM)
		40 CFR 52	20 NMAC 11.21	Open Burning
		40 CFR 51–52	20 NMAC 11.40	Source Registration
		40 CFR 51–52	20 NMAC 11.41	Authority-to-Construct
		40 CFR 51.100	20 NMAC 11.43	Stack Height Requirements
		40 CFR 51	20 NMAC 11.44	Emissions Trading
	171-193	40 CFR 51–52	20 NMAC 11.60	Permitting in Nonattainment Areas
	160-169 B	40 CFR 52	20 NMAC 11.61	Prevention of Significant Deterioration
I	165-166	40 CFR 60 40 CFR 63	20 NMAC 11.65	Volatile Organic Compounds (VOC)
		40 CFR 60	20 NMAC 11.66	Process Equipment
		40 CFR 60	20 NMAC 11.22	Wood Burning
		40 CFR 60	20 NMAC 11.63	New Source Performance Standards (NSPS)
		40 CFR 60	20 NMAC 11.67	Equipment, Emissions and Limitations (stationary combustion sources)
		40 CFR 60	20 NMAC 11.68	Incinerators
		40 CFR 60	20 NMAC 11.69	Pathological Waste Destructors
II	202-210 212-219 211	40 CFR 85-86	20 NMAC 11.100	Motor Vehicle Inspection
			20 NMAC 11.101	- Decentralized and Centralized (respectively)
		40 CFR 80	20 NMAC 11.102	Oxygenated Fuels
			20 NMAC 11.103	Motor Vehicle Visible Emissions
III	112	40 CFR 61 40 CFR 63	20 NMAC 11.64	NESHAP Subpart H – Radionuclides Subpart M – Asbestos
IV	401-416	40 CFR 72-78	20 NMAC 11.62	Acid Rain
V	501-507	40 CFR 70-71	20 NMAC 11.42	Operating Permit (not yet issued)
VI	601-618	40 CFR 82	20 NMAC 11.23	Ozone Protection
VII	113-114	40 CFR 64	20 NMAC 11.90	Administration, Enforcement, Inspection

NOTE: ODS = ozone depleting substances PM = particulate matter HAP = Hazardous Air Pollutant
AEHD = Albuquerque Environmental Health Department
SWISH = Small WInd SHielded Facility
SLAMS = Standards for state and local air monitoring stations
FLAME - Fire Laboratory ued for the Authentication of Models and Experiments

Water Quality Programs

All Water Quality Programs

Clean Water Act (CWA)

Federal Water Pollution Control Act

Water Quality Act of 1987

20 NMAC 6.2, "New Mexico Water Quality Control Commission Regulations"

20 NMAC 6.2, "Ground and Surface Water Protection"

Drinking Water

Safe Drinking Water Act (SDWA)

40 CFR 125, "Criteria and Standards for the National Pollutant Discharge Elimination System (NPDES)"

40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants"

40 CFR 141, "National Primary Drinking Water Regulations"

20 NMAC 7.1, "Drinking Water"

40 CFR 143.3, "Secondary Maximum Contaminant Levels"

Wastewater Program

City Sewer Regulations, "Sewer Use and Wastewater Control Ordinance" (Section 8-9-44.H)

40 CFR 400, "Categorical Pretreatment"

10 CFR 20, "Standards for Protection Against Radiation" (addresses radiological levels in wastewater) (*U.S. Nuclear Regulatory Commission)

20 NMAC 7.3, "Liquid Waste Disposal" (includes effluents to sewer and septic tanks)

Surface Discharge Program

40 CFR 112, "Oil Pollution Prevention"

Storm Water Program

40 CFR 122-125 (National Pollutant Discharge Elimination System [NPDES] Regulations)

40 CFR 123, "State Program Requirements"

40 CFR 124, "Procedures for Decision Making"

40 CFR 125, "Criteria and Standards for the National Pollutant Discharge Elimination System"

40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants"

Groundwater Protection Program (GWPP)

40 CFR 141, "National Primary Drinking Water Regulations"

20 NMAC 7.1, "Drinking Water"

Groundwater Monitoring at ER Project Sites

40 CFR 265, Subpart F, "Groundwater monitoring at Interim Sites" Chemical Waste Landfill (CWL)

40 CFR 264, Subpart F, "Corrective Action for Solid Waste Management Units (SWMU)"
(applies to all permitted ER sites, except the CWL)

Environmental Restoration (ER) Project

40 CFR 261, "Identification and Listing of Hazardous Waste" (20 NMAC 4.1, Subpart II)

40 CFR 262, "Standards Applicable to the Generators of Hazardous Wastes" (20 NMAC 4.1, Subpart III)

40 CFR 264, "Standards for Owners and Operators of TSD Facilities"

(20 NMAC 4.1, Subpart V)
Subpart F, *Releases from Solid Waste Management Units*
Subpart G, *Closure and Post Closure*

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste TSD Facilities"

(20 NMAC 4.1, Subpart VI)
Subpart F, *Groundwater Monitoring*
Subpart G, *Closure and Post-Closure*

40 CFR 268, "Land Disposal Restrictions" (20 NMAC 4.1, Subpart VIII)

40 CFR 270, "The Hazardous Waste Permit Program" (20 NMAC 4.1, Subpart IX)

40 CFR 761, "PCBs, Manufacturing, Processing, Distribution in Commerce, and Use Prohibition"

Waste Management Programs

Hazardous Waste Management Program

Resource Conservation and Recovery Act (RCRA) of 1976

RCRA Section 3004j	Land Disposal Restrictions
RCRA Section 6002	Federal Procurement
RCRA Subpart S	Action Levels

Hazardous and Solid Waste Amendments Act (HSWA) of 1984
(Module IV to RCRA Section 3004u)

Toxic Substances Control Act (TSCA) of 1976

Pollution Prevention Act of 1990

40 CFR 61, Subpart M, "NESHAP, Asbestos"

20 NMAC 4.1, "Hazardous Waste Management" (40 CFR 260-270)

20 NMAC 4.3, "Annual Hazardous Waste Fees"

20 NMAC 9.1, "Biohazardous waste"

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions"

40 CFR 763, "Asbestos"

49 CFR 171 – 180 (Department of Transportation Regulations for hazardous and radioactive waste shipments)

RCRA Regulations - 40 CFR 260-279

40 CFR 260, "Hazardous Waste Management System: General"

40 CFR 261, "Identification and Listing of Hazardous Waste"

40 CFR 262, "Standards Applicable to Generators of Hazardous Waste"

40 CFR 263, "Standards Applicable to Transporters of Hazardous Waste"

40 CFR 264 , "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, including Subpart F, "Releases for Solid Waste Management Units," Section 264.101, *Corrective Action for Solid Waste Management Units*

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities"

40 CFR 266, "Standards for Materials Being Recycled/Revised"

40 CFR 268, "Land Disposal Restrictions"

40 CFR 270, "EPA Administered Permit Programs: The Hazardous Waste Permit Program"

40 CFR 271, "Requirements for Authorization of State Hazardous Waste Programs"

40 CFR 272, "Approved State Hazardous Waste Management Programs"

40 CFR 279, "Standards for the Management of Used Oil"

Solid Waste Program

20 NMAC 9.1, "Solid Waste Management"

Radioactive Waste Management Program

Atomic Energy Act of 1946

Federal Facility Compliance Act (FFCA) of 1992

10 CFR 835, "Occupational Radiation Protection" (Implements Price Anderson Act)

49 CFR 100-199 (Department of Transportation requirements)

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants (NESHAP)"
Subpart H, *National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities*

40 CFR 260-279, RCRA regulations for hazardous waste (as it pertains to mixed waste)

TABLE B-2. Summary of Compliance History with Regard to Mixed Waste (MW) at SNL/NM

Date	Milestone	Comment
1984	Amendments to RCRA and HSWA in 1984	MW became an issue after amendments to RCRA and HSWA enforced Land Disposal Restrictions (LDRs).
Aug 1990	RCRA Part A Interim Status Permit Application	Submitted RCRA Part A Interim Status Permit application for MW storage. Later revisions to the permit added proposed MW treatment processes.
Oct 6, 1992	FFCAct Passed	The FFCAct allows storage of MW over one-year RCRA time limit. Requires DOE to submit a site treatment plan for MW.
Dec 30, 1992	NON Issued	EPA issued a Notification of Non-compliance (NON) for storage of RCRA-regulated waste (MW) over the one-year maximum period.
Oct 1993	Conceptual Site Treatment Plan Submitted	DOE submitted *Conceptual Site Treatment Plan for Mixed Waste* to NMED; other drafts followed.
Mar 31, 1995	Final Site Treatment Plan submitted	DOE submitted final *Site Treatment Plan for Mixed Waste* to NMED
Jun 1995	HDRV Project Initiated	The Historical Disposal Requests Validation (HDRV) Project was initiated to characterize and sort legacy MW. Project continued into 1997 but was replaced with new sorting procedures
Oct 4, 1995	FFCO Agreement Signed	The Federal Facility Compliance Order (FFCO), an agreement between State, DOE, and SNL, details specific actions required with regard to MW management, including the requirement to develop of a Site Treatment Plan, to be updated annually
Oct 6, 1995	Compliance Order Issued	NMED issued a Compliance Order enforcing SNL/NM's Site Treatment Plan
Sep 1996	First MW Shipment	First MW shipment made to Perma-Fix/DSSI
Oct 1996	FFCO 1st Amendment	FFCO amended
Nov 1996	Revisions to Proposed Treatment Methods	Re-submitted Part A and B permit application, to reflect revisions to its proposed treatment methods
May 1997	FFCO 2nd Amendment	FFCO amended
Dec 1997	Onsite MW Treatment	Onsite treatment of MW began at the RMWMF in Bldg. 6920. Additionally, Bldg. 6921 was converted to a laboratory for the treatment of certain types of MW
Jan 1998	Site Treatment Plan Updated	The *Mixed Waste Site Treatment Plan, Compliance Plan Volume Background Volume* was updated to include the current treatment technologies and proposed schedules
Feb 1998	Second MW Shipment	18.5 m^3 of MW shipped to the Idaho National Engineering and Environmental Laboratories (INEEL) for incineration at their Waste Experimental Reduction Facility (WERF)
Sep 1998	Third MW Shipment	1.1 m^3 of MW incineration at Perma-Fix/DSSI
1999	Site Treatment Plan Milestones Met	Five milestones listed in the Site Treatment Plan met in 1999 including a waste shipment, onsite waste treatment, waste sorting, and development of a treatment pathway and permit activity for TRU/MW
1999	Proposed Revisions to Site Treatment Plan	Submitted revised plan to state
1999	Site Treatment Plan FY98 Update	Submitted annual update
2000	Proposal for FFCO Amendment 3	Submitted a proposal to amend FFCO

NEPA Program

National Environmental Policy Act (NEPA) of 1969

American Indian Religious Freedom Act (AIRFA) of 1978

Archaeological Resources Protection Act (ARPA) of 1979

Endangered Species Act (ESA)

National Historic Preservation Act of 1966

10 CFR 1021, "National Environmental Policy Act Implementing Procedures" (General Provisions for DOE)

40 CFR 1500-1508, "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act"

Various Other Environmental Programs

Biological Control Activity

Federal Insecticide Fungicide and Rodenticide Act (FIFRA)

New Mexico Pesticide Control Act

21 NMAC 17.50, "Pesticides"

Pollution Prevention Program

Pollution Prevention Act of 1990

RCRA Section 6002, "Federal Procurement"

Oil Storage Programs

40 CFR 110, "Discharge of Oil"

40 CFR 112, "Oil Pollution Prevention"

40 CFR 122, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES)"

40 CFR 123, "State Program Requirements, (NPDES)"

40 CFR 280, "Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks"

40 CFR 281, "Approval of State Underground Storage Tank Programs"

20 NMAC 5, "Underground Storage Tanks (USTs)"

Chemical Inventory and Emergency Mangement Programs

Superfund Amendments and Reauthorization Act (SARA) of 1986

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980

Emergency Planning and Community Right to Know Act (EPCRA) of 1986

40 CFR 302, "Designation, Reportable Quantities, and Notification" (CERCLA Implementing)

40 CFR 355, "Emergency Planning and Notification (EPCRA)"

40 CFR 370, "Hazardous Chemical Reporting: Community Right-to-Know (EPCRA)"

40 CFR 372, "Toxic Chemical Release Reporting: Community Right-to-Know (EPCRA)"

B.2 Radiological Dose

Radiation Protection

The U.S. Department of Energy (DOE) has established radiation protection standards for the public to control and limit radiation doses resulting from activities at DOE facilities. Sandia National Laboratories/New Mexico (SNL/NM) is the DOE facility specific to this discussion. Public areas are defined as any location that is accessible to non-DOE facility employees (e.g., excluding Sandia Corporation employees and contractors), such as Kirtland Air Force Base (KAFB) personnel and the surrounding community. Radiation protection standards are provided in DOE Order 5400.5, *General Radiation Protection of the Public and the Environment* (DOE 1993). Environmental monitoring requirements for DOE operations are given in DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990). In addition to these quantitative standards, the overriding DOE policy is that exposures to the public shall be maintained "as low as reasonably achievable" (ALARA).

DOE Order 5400.5 limits the total annual effective dose equivalent (EDE) of all potential exposure pathways to the public (including air, water, and the food chain) to 100 millirem per year (mrem/yr). The Order lists the Derived Concentration Guides (DCGs) for radionuclides in water and air that could be continuously consumed or inhaled (365 days/year). This is a conservative approach that assumes that a member of the public resides at the location continuously. Table B-3 lists theDCGs pertinent to activities at SNL/NM and to this report.

- ***Water Pathways*** – DOE drinking water guidelines are based on an annual EDE not to exceed 4 mrem/yr. Guideline values for drinking water are calculated at 4 percent of ingested water using DCG values for specific nuclides.

- ***Air Pathways*** – DOE facilities are required to comply with U.S. Environmental Protection Agency (EPA) standards for radiation protection as given in National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H, specific to radionuclides emitted from DOE facilities (with the exception of radon). This rule mandates that air emissions from DOE facilities shall not cause any individual of the public to receive an EDE of greater than 10 mrem/yr from air pathways. Table B-4 summarizes the public radiation protection standards that are applicable to DOE facilities.

TABLE B-3. Derived Concentration Guides (DCGs) for Selected Radionuclides*

	Ingested Water		Inhaled Air†	
Radionuclide	**DCG (μCi/ml)**	**f_1 Value****	**DCG (μCi/ml)**	**Solubility Class**
Tritium (water)	2×10^{-3}	--	1×10^{-7}	W
Cesium-137	3×10^{-6}	1	4×10^{-10}	D
Uranium, total (U_{tot}) §	5×10^{-6}	--	1×10^{-13}	Y

NOTE: μCi/ml = microcuries per milliliter

*DOE Order 5400.5, Change 2, January 7, 1993 (DOE 1993).

†DCG for tritium in air is adjusted for skin absorption.

** F_1 value is the gastrointestinal absorption factor.

§A conversion from microcuries per milliliter (μCi/ml) to micrograms per liter (μg/L) may be made using:

$$\mu g / L = X\, \mu Ci / ml \frac{[1.49 \, x \, 10^9 \, \mu g / L]}{[1 \, \mu Ci / ml]}$$

TABLE B-4. General Dose Limits to the Public from DOE Facilities

Pathway	Effective Dose Equivalent (EDE) Limit	Comments
All Pathways*	100 mrem/yr 1 mSv/yr	The effective dose equivalent (EDE) for any member of the public from all routine DOE operations (normal planned activities including remedial actions). Radiation dose occurring from natural background and medical exposures are not included in the total allowed dose from all pathways.
Air Pathway **	10 mrem/yr 0.10 mSv/yr	Sandia Corporation calculates doses resulting from all potential air depositions and direct inhalation (e.g., emissions, ground shine, food crops)

NOTE: *DOE Order 5400.5, Chapters I and II (DOE 1993)

**40 CFR 61, Subpart H for radionuclides, National Emission Standards for Hazardous Air Pollutants (NESHAP).

B.3 Water Quality Monitoring Parameters

Resource Conservation and Recovery Act (RCRA)

Table B-5 lists the 40 CFR 265, Subpart F, parameters required for groundwater monitoring analysis, implemented under RCRA. Table B-6 gives the EPA interim primary drinking water standards (40 CFR 265, Appendix III) for the groundwater monitoring parameters. Table B-7 gives EPA secondary drinking water standards. At SNL/NM, this regulation applies to Environmental Restoration (ER) sites.

TABLE B-5. Groundwater Monitoring Parameters Required by 40 CFR 265, Subpart F*

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

NOTE: *Resource Conservation and Recovery Act (RCRA)
†40 CFR 265, Appendix III.

TABLE B-6. U.S. Environmental Protection Agency Primary Drinking-Water Supply Standards

Inorganic Parameter	MCL	Units
Antimony	0.006	mg/L
Arsenic†	0.05	mg/L
Barium†	2.0	mg/L
Beryllium	0.004	mg/L
Cadmium†	0.005	mg/L
Chromium†	0.1	mg/L
Cyanide	0.2	mg/L
Fluoride	4.0	mg/L
Mercury†	0.002	mg/L
Nickel	0.1	mg/L
Nitrate (as N)	10	mg/L
Nitrite (as N)	1	mg/L
Total Nitrate and Nitrate (as N)	10	mg/L
Selenium†	0.05	mg/L
Thallium	0.002	mg/L
Alachlor	0.002	mg/L
Atrazine	0.003	mg/L
Benzene**	0.005	mg/L
Carbofuran	0.04	mg/L
Carbon tetrachloride**	0.005	mg/L
Chlordane	0.0002	mg/L
1,1-Dichloroethylene**	0.007	mg/L
1,1,1-Trichloroethan	0.2	mg/L
1,2-Dichloroehane**	0.005	mg/L
Cis-1,2-Dichloroethylene**	0.005	mg/L
1,2-Dichloropropane**	0.005	mg/L
Ethylbenzene**	0.7	mg/L
Ethylene Dibromide	0.00005	mg/L
Hepatachlor	0.0004	mg/L
Heptachlor epoxide	0.0002	mg/L
Lindane	0.0002	mg/L
Methoxychlor	0.04	mg/L
Polychlorinated biphenyls	0.0005	mg/L
Pentachlorophenol	0.001	mg/L
Toxaphene	0.003	mg/L
2,4,5-TP	0.005	mg/L
Benzo[a]pryene	0.002	mg/L
Dalapon	0.2	mg/L
Di(2-ethylhexyl)adipate	0.4	mg/L
Di(2-ethylexyl)phthalate	0.006	mg/L
Dinoseb	0.007	mg/L
Diquat	0.02	mg/L
Endothall	0.1	mg/L
Endrin	0.002	mg/L
Glyphosate	0.7	mg/L
Hexachlorobenzene	0.001	mg/L
Hexachlorocyclopentadiene	0.05	mg/L

TABLE B-6. EPA Primary Drinking Water Supply Standards (Concluded)

Organic Parameter	MCL*	Units
Oxamyl (Vydate)	0.2	mg/L
Para-Dichlorobenzene**	0.075	mg/L
Picloram	0.5	mg/L
Simazine	0.004	mg/L
Trichloroethylene**	0.005	mg/L
Monochlorobenzene**	0.1	mg/L
O-Dichlorobenzene**	0.6	mg/L
Styrene**	0.1	mg/L
Tetrachloroethylene**	0.005	mg/L
Toluene**	1	mg/L
Trans-1,2-Dichloroethylene**	0.1	mg/L
Xylenes (total)**	10	mg/L
Dichloromethane**	0.005	mg/L
1,2,4-Trichlorobenzene**	0.07	mg/L
1,1,2-Trichloroethane**	0.005	mg/L
2,3,7,8-TCDD (Dioxin)	3×10^{-8}	mg/L
Vinyl chloride	0.002	mg/L

NOTE: *MCL = Maximum Contaminant Level (40 CFR 265, Appendix III) † Total metals (unfiltered sample)
mg/L = milligrams per liter; ml = milliliters;
*40 CFR 265, Appendix III.
**MCL standard only applies to community water systems for populations of 10,000 or more, which add chemicals (i.e., disinfectant) to the water in any part of the drinking water treatment process.

TABLE B-7. EPA Secondary Drinking Water Supply Standards

Contaminant	Level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/ L
Color	15 color units
Copper	1.0 mg/ L
Corrosivity	Non-corrosive
Fluoride	2.0 mg/ L
Foaming agents	0.5 mg/ L
Iron	0.3 mg/ L
Manganese	0.05 mg/ L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.1 mg/ L
Sulfate	250 mg/ L
Total dissolved solids (TDS)	500 mg/ L
Zinc	5 mg/ L

References

DOE 1990: U.S. Department of Energy, *General Environmental Protection Program*, DOE Order 5400.1. DOE, Washington, DC (1988; change 1, June 21, 1990).

DOE 1993: U.S. Department of Energy, Chapter I, *General Radiological Protection of the Public and the Environment*; Chapter II, *Requirements for Radiation Protection of the Public and the Environment*; and Chapter III, *Derived Concentration Guides for Air and Water*. DOE Order 5400.5. DOE, Washington, DC (February 8, 1990, change 2, January 7, 1993).

EPA 1998: CFR Part 141 - National Primary Drinking Water Regulations (July 1, 1998).

Regulations

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

40 CFR 61, Subpart H for radionuclides. *National Emission Standards for Hazardous Air Pollutants (NESHAP).*

40 CFR 141. *National Primary Drinking Water Regulations*, as amended.

40 CFR 265. *Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, as amended.

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APPENDIX C

Documents Important to Sandia Corporations Environmental Programs at SNL/NM

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Environmental Restoration (ER) Project

- *Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico* (DOE 1996c)
- *Proposals for No Further Action: Environmental Restoration Project, SNL/NM* (Available to the public at UNM Reading Room in Zimmerman Library)
- *Chemical Waste Landfill Final Closure Plan and Postclosure Permit Application*, Volume 2C Appendices include the "Sampling and Analysis Plan (SAP) for Groundwater Assessment Monitoring at the Chemical Waste Landfill," (SNL 1992)

Waste Management

All Waste Management Programs

- *Pollution Prevention Plan* (SNL 1997c)
- *Programmatic Waste Acceptance Criteria (*SNL 1996c)
- *Waste Management Program Document* (SNL 1999d)
- *Waste Characterization Overview (*SNL 1999f)

Hazardous Waste

- *Hazardous Waste Management Facility (HWMF) Annual Report*
- *Hazardous Waste Management Facility Biennial Hazardous Waste Report*
- Section 19A, "Hazardous Waste Management," *ES&H Manual* (SNL 1999e)
- Section 10E, "Chemical Spills," *ES&H Manual* SNL 1997a (SNL 1997a)

Radioactive Waste

- *Site Treatment Plan for Mixed Waste FY99 Update*, Rev. 4. (SNL 2000d)
- Section 19B, "Low-Level Radioactive Waste Management," *ES&H Manual* (SNL 2000j)
- *Conceptual Site Treatment Plan for Mixed Waste* (SNL 1993)
- *Sandia National Laboratories, Radioactive and Mixed Waste Program* (SNL 1999g)

- *Mixed Waste Site Treatment Plan, Compliance Plan Volume (CPV) Background Volume,* Rev. 2 (SNL 1998a)
- Manzano Nuclear Waste Facilities and Manzano Waste Storage Facilities Maintenance Support Program (SNL 1997l)
- Section 19D, "Radioactive Material Management Areas (RMMAs)," *ES&H Manual* (SNL 1998b)
- Section 19C, "Mixed Waste Management," *ES&H Manual* (SNL 1998c)
- Section 19E, "Treatability Studies for Hazardous and Mixed Waste," *ES&H Manual* (SNL 1997b)

TSCA Waste

- *PCB Inventory and Waste Disposal Program Program Document* (SNL 1995a)
- Section 6S, "Toxic Substances Control Act (TSCA)," *ES&H Manual* (SNL 1997n)

Solid Sanitary Waste and Recycling

- Section 19F, "Other Waste," *ES&H Manual* (SNL 1999h)

Air Quality

Ambient Air Surveillance and Meteorological Monitoring

- *Quality Assurance Project Plan (QAPjP) Meteorological and Ambient Air Monitoring Program* (SNL 1997k)

Air Quality Compliance

- Title V Permit Application # 515 (7 volume document)
- *Air Quality Program Document* (SNL 1999j)
- *Supporting Documentation for the Hazardous Chemical Purchase Inventory 1999 Reporting Year* (SNL 2000a)
- *Corporate Ozone-Depleting Substances Management Program* (SNL 1997h)

- Section 17B, "Air Permits in Bernalillo County," *ES&H Manual* (SNL 1997o)
- Section 17C, "Air Emission Control Measures," *ES&H Manual* (SNL 1997p)
- Section 17D, "Ozone Depleting Substances," *ES&H Manual* (SNL 1997q)

NESHAP

- *(1) NESHAP Annual Report for CY99*
  (2) *Radiological Dose Calculations and Supplemental Dose Assessment Data for NESHAP Compliance SNL/NM, 1999* (SNL 2000f)
- *Radiological NESHAP Quality Assurance Project Plan (QAPjP)* (SNL 1997g)

Water Quality

All

- *Water Quality Program Document* (SNL 1997m)
- Section 10E, "Chemical Spills," *ES&H Manual* (SNL 1997a)

Wastewater Program

- Section H, "Discharges to the Sanitary Sewer System," *ES&H Manual* (SNL 1998e)
- *SNL/NM Wastewater Sampling and Analysis Plan (*SNL 1996a)

Storm Water Program

- *Storm Water Pollution Prevention Plan (SWP3)* (SNL 2000g)
- *Results of 1999 Storm Water Sampling* (SNL 2000I)
- Section T, "Surface and Storm Water Discharges," *ES&H Manual* (SNL 1997j)
- *Storm Water and Non-storm Water Discharge Sampling and Analysis Project Plan for SNL/NM* (SNL 1996f)

Surface Discharges

- *New Mexico State Environment Department Discharge Plan Modification and Renewal* (NMED 1999)
- Section T, "Surface and Storm Water Discharges," *ES&H Manual* (SNL 1997j)
- Section 10F, "Oils, Greases, and Fuels," *ES&H Manual* (SNL 1997d)
- *Sampling and Analysis Plan (SAP) for the Pulsed Power Development Facilities, Building 981, 983, and 970 for Lagoons 1 and 2* (SNL 1996e)

Groundwater

- *Groundwater Protection Program (FY99) Annual Groundwater Monitoring Report for SNL/NM* (SNL 2000h)

Biological Control Activity

- Section 6K, "Miscellaneous Industrial Hygiene Topics," *ES&H Manual* (SNL 1998f)
- Section 6D, "Hazard Communication Standard," *ES&H Manual* (SNL 1998g)

Terrestrial Surveillance

- *The Role of Data Analysis in Sampling Design of Environmental Monitoring* (Shyr, Herrera, Haaker 1998)
- *Environmental Monitoring and Surveillance Program* (Program Document) (SNL 1997f)
- *Environmental ALARA Program* (SNL 1996d)
- *Quality Assurance Project Plan (QAPjP) for Terrestrial Surveillance at SNL/NM* (SNL 1998d)
- *1999 Data Analysis in Support of the Annual Site Environmental Report* (SNL 2000e)
- *Environmental Monitoring Plan* (SNL 2000k)
- *Ecological Monitoring for 1999: Small Mammals, Birds, and Vegetation* (SNL 1999k)

Oil Storage and Spill Containment

- *Sandia National Laboratories Spill Prevention Control and Countermeasures (SPCC) Plan* (SNL 1999i)
- Section 10K, "Underground Storage Tanks," *ES&H Manual* (SNL 1997e)
- Section 10F, "Oils, Greases, and Fuels," *ES&H Manual* (SNL 1997d)

NEPA Program

- *NEPA Program Document* (SNL 2000m)
- *Sandia National Laboratories Final Site-Wide Environmental Impact Statement (SWEIS)* (DOE 1999a)
- *Environmental Assessment(EA) Rapid Reactivation Project* (DOE 1999c)
- *Sandia National Laboratories Facility and Safety Information Document (FSID)* (SNL 1999a)
- *Sandia National Laboratories Environmental Information Document (EID)* (SNL 1999b)
- Section 10B, "NEPA, Sensitive Species, and Historic Properties," *ES&H Manual* (SNL 1999c)

Quality Assurance

Sample Management Office (SMO)

- *DOE/AL Model Statement of Work* (DOE 1999d)
- *Sample Management Office (SMO) Quality Assurance Plan* (SNL 1996b)

References

See Chapter 9, "References," for all references listed in this appendix.

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APPENDIX D

1999 Wastewater Monitoring Results

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CONTENTS

TABLES

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TABLE D-1. Permitted Sanitary Outfalls, March 1999
(All results in milligrams per liter [mg/L] unless otherwise noted.)

Permit Number:	2069A	2069F	2069G	2069I	2069K	Regulatory Limit COA [a] (mg/L)
Station:	WW001	WW006	WW007	WW008	WW011	
Date Collected:	03/10/99	03/11/99	03/10/99	03/10/99	03/10/99	
Sample ID:	044683	044684	044685	044686	044687	
Analyte						
Aluminum	0.2	0.649	0.0121	0.0468	0.166	900
Arsenic	0.0165	0.0419	0.00451	0.015	0.0125	0.051
Cadmium	0.00044	0.000794	0.00044	0.00044	0.00044	0.50
Chromium	0.00165	0.00297	0.00056	0.000788	0.00164	4.1
Copper	0.032	0.0565	0.00122	0.0091	0.0296	5.3
Lead	0.00159	0.00531	0.00159	0.00159	0.00211	1.0
Molybdenum	0.049	0.159	0.00145	0.0154	0.00748	2.0
Nickel	0.00162	0.00191	0.00129	0.00129	0.00223	2.0
Selenium	0.00271	0.00271	0.00271	0.00271	0.00271	0.46
Silver	0.00073	0.00216	0.00073	0.00073	0.00236	5.0
Zinc	0.112	0.0853	0.00912	0.0241	0.158	2.2
Cyanide	0.00596	0.0024	0.0024	Not Sampled	Not Sampled	0.45
Fluoride	0.507	0.694	1.88	1.68	0.397	36

[a] City of Albuquerque

TABLE D-2. Summary of Radiological Analyses, March 1999
(All results are in picocuries per liter [pCi/L] unless otherwise noted.)

Permit Number:	2069A		2069F		2069I		2069K		Regulatory Limit 10 CFR 20
Station:	WW001		WW006		WW008		WW011		
Date Collected:	3/10/99		3/11/99		3/10/99		3/10/99		
Sample ID:	044683		044684		044686		044687		
Analyte									
Actinium-228	5.31 ± 12.8	U	2.28 ± 6.35	U	8.15 ± 10.2	U	3.83 ± 6.72	U	300,000
Americium-241	-6.93 ± 9.69	U	-1.56 ± 3.15	U	3.62 ± 12	U	2.42 ± 15	U	200
Cerium-144	5.07 ± 13	U	-2.67 ± 9.63	U	-2.02 ± 10.8	U	13.2 ± 11.5	U	30,000
Cesium-134	-0.618 ± 1.64	U	0.65 ± 1.62	U	-0.568 ± 1.29	U	-0.831 ± 1.64	U	9,000
Cesium-137	-1.21 ± 1.62	U	3.13 ± 3.66	U	0 ± 2.45	U	-2.3 ± 2.05	U	10,000
Chromium-51	0 ± 32.6	U	-10.1 ± 18.7	U	-3.02 ± 17.6	U	7.96 ± 17.4	U	5,000,000
Cobalt-60	-2.26 ± 2.02	U	2.86 ± 2.85	U	0.249 ± 1.32	U	0 ± 2.4	U	30,000
Gross Alpha	1.26 ± 0.862		6.49 ± 1.59		1.94 ± 1.2		0.664 ± 0.857		NE
Iron-59	-0.895 ± 3.68	U	0.66 ± 3.8	U	-0.0407 ± 3.42	U	2.2 ± 3.79	U	100,000
Lead-212	6.23 ± 3.55	U	3.91 ± 4.77	U	1.05 ± 5.01	U	0 ± 4.02	U	20,000
Lead-214	7.22 ± 3.93	U	-0.146 ± 3.5	U	4.7 ± 3.55	U	5.42 ± 5.71	U	1,000,000
Potassium-40	27.6 ± 23.2	U	48 ± 49.1	U	8.16 ± 30.5	U	1.84 ± 33.7	U	40,000
Radium-226	4.82 ± 3.98	U	1.79 ± 5.24	U	0 ± 3.21	U	3.02 ± 3.46	U	600
Radium-228	5.31 ± 12.8	U	2.28 ± 6.35	U	8.15 ± 10.2	U	3.83 ± 6.72	U	600
Ruthenium-103	-2.04 ± 2.11	U	0.276 ± 1.9	U	-0.258 ± 1.93	U	-0.402 ± 2.04	U	300,000
Ruthenium-106	9.06 ± 15.8	U	-10.8 ± 14.1	U	-5.25 ± 13.2	U	0.0492 ± 14.8	U	30,000
Thorium-231	4.81 ± 10.8	U	3.7 ± 8.47	U	9.21 ± 9	U	-6.81 ± 9.06	U	300
Thorium-232	6.06 ± 3.5	U	3.86 ± 4.71	U	1.03 ± 4.94	U	0 ± 3.97	U	500,000
Thorium-234	41.5 ± 139	U	23.6 ± 54.8	U	92.4 ± 152	U	10.5 ± 195	U	50,000
Tritium	-183 ± 123	U	-207 ± 124	U	-121 ± 125	U	25.7 ± 129	U	10,000,000
Uranium-235	12.3 ± 18.3	U	3.99 ± 11.7	U	0.584 ± 10.7	U	0.111 ± 11.3	U	3,000
Uranium-238	41.5 ± 139	U	23.6 ± 54.8	U	92.4 ± 152	U	10.5 ± 195	U	3,000
Yttrium-88	-0.0292 ± 2.12	U	0.889 ± 1.56	U	0.544 ± 1.68	U	0.608 ± 2.04	U	100,000
Zirconium-95	3.23 ± 3.41	U	2.1 ± 3.1	U	-0.769 ± 2.55	U	0.899 ± 2.96	U	200,000

U = Radionuclide was not detected in the sample at or below the minimum detectable activity (MDA).
NE = Not Established

TABLE D-3. Permitted Sanitary Outfalls, June 1999
(All results in milligrams per liter [mg/L] unless otherwise noted.)

Permit Number:	**2069A**	**2069F**	**2069G**	**2069I**	**2069K**	**Regulatory**
Station:	**WW001**	**WW006**	**WW007**	**WW008**	**WW011**	**Limit**
Date Collected:	**06/09/99**	**06/09/99**	**06/09/99**	**06/09/99**	**06/10/99**	**COA [a]**
Sample ID:	**045588**	**045589**	**045590**	**045591**	**045592**	**(mg/L)**
Analyte						
Aluminum	0.342	0.202	0.0189	0.142	0.109	900
Arsenic	0.0137	0.0374	0.00451	0.00934	0.00989	0.051
Cadmium	0.00044	0.00044	0.00044	0.00044	0.00044	0.50
Chromium	0.00596	0.00278	0.00105	0.00329	0.00145	4.1
Copper	0.0501	0.0238	0.00242	0.0196	0.0341	5.3
Lead	0.00279	0.0037	0.00159	0.0148	0.00181	1.0
Molybdenum	0.0219	0.0147	0.00825	0.00952	0.0576	2.0
Nickel	0.00625	0.00311	0.00233	0.00597	0.0041	2.0
Selenium	0.00462	0.00271	0.00271	0.00271	0.00271	0.46
Silver	0.00073	0.00073	0.00073	0.00073	0.000776	5.0
Zinc	0.192	0.0445	0.0264	0.0575	0.122	2.2
Fluoride	0.693	0.59	11.2	8.67	0.437	36

[a] City of Albuquerque

TABLE D-4. Summary of Radiological Analyses, June 1999
(All results are in picocuries per liter [pCi/L] unless otherwise noted.)

Permit Number:	2069A		2069F		2069G		2069I		2069K		
Station:	**WW001**		**WW006**		**WW007**		**WW008**		**WW011**		**Regulatory**
Date Collected:	**06/09/99**		**06/09/99**		**06/09/99**		**06/09/99**		**06/10/99Y**		**Limit**
Sample ID:	**045588**		**045589**		**045590**		**045591**		**045592**		**10 CFR 20**
Analyte											
Actinium-228	6.9 ± 4.95		6.51± 4.93		6.67 ± 4.24		12.2 ± 6.85		2.04 ± 10.9	U	300,000
Americium-241	9.13 ± 13		0.714± 2.09	U	-6.09 ± 12.8	U	-0.386 ± 2.4	U	-20.2 ± 11.9	U	200
Cerium-144	1.52 ± 9.26	U	-6.54± 7.02	U	-0.662 ± 7.78	U	6.44 ± 7.87	U	-0.0741 ± 12.8	U	30,000
Cesium-134	-0.987 ± 1.3	U	-0.383± 1.3	U	-0.662 ± 1.24	U	0.0855 ± 1.45	U	-2.11 ± 2.07	U	9,000
Cesium-137	0.255 ± 3.37	U	0± 1.89	U	0 ± 1.84	U	0.989 ± 1.6	U	-0.111 ± 2.08	U	10,000
Chromium-51	-7.69 ± 12.9	U	0.5± 10.6	U	-5.79 ± 11	U	-6.83 ± 12.1	U	0.383 ± 17.9	U	5,000,000
Cobalt-60	-0.0701± 1.29	U	1.03± 1.22		-0.113 ± 1.12	U	-0.222 ± 1.63	U	-0.244 ± 1.88	U	30,000
Gross Alpha	3.6 ± 1.37		0.533± 1.43	U	1.08 ± 0.55		3.26 ± 0.971		2.05 ± 0.877		NE
Iron-59	-0.181 ± 2.68	U	1.07± 2.55	U	-0.52 ± 2.31	U	-1.8 ± 3.42	U	1.06 ± 2.86	U	100,000
Lead-212	0 ± 5.3	U	0± 2.26	U	3.91 ± 2.25		0 ± 2.43	U	0 ± 3.96	U	20,000
Lead-214	2.33 ± 5.77	U	1.44± 2.56	U	0 ± 2.88	U	0.766 ± 4.99	U	1.04 ± 6.69	U	1,000,000
Nonvolatile Beta	11.1 ± 2.67		6.27± 1.58		1.05 ± 0.68		5.27 ± 1.36		8.2 ± 1.46		NE
Potassium-40	14.3 ± 32	U	19.7± 29		8.16 ± 28.7	U	7.99 ± 37.5	U	41.6 ± 22.8		40,000
Radium-226	5.82 ± 5.15		0.538± 4.53	U	4.78 ± 6.05		0 ± 3.85	U	5.45 ± 4.4		600
Radium-228	6.9 ± 4.95		6.51± 4.93		6.67 ± 4.24		12.2 ± 6.85		2.04 ± 10.9	U	600
Ruthenium-103	-0.864 ± 1.48	U	-0.604± 1.18	U	-0.631 ± 1.17	U	1.19 ± 1.63		-1.39 ± 2.2	U	300,000
Ruthenium-106	0.0851 ± 10.5	U	-3.12± 11.2	U	-1.21 ± 10.2	U	-7.36 ± 14.1	U	8.65 ± 17.7	U	30,000
Thorium-231	1.74 ± 7.65	U	-0.518± 6.18	U	2.06 ± 6.62	U	3.56 ± 6.8	U	-1.03 ± 10.7	U	300
Thorium-232	0 ± 5.27	U	0± 2.25	U	3.88 ± 2.23		0 ± 2.41	U	0 ± 3.94	U	500,000
Thorium-234	93.1 ± 93.2		0± 29.7	U	118 ± 182		50.2 ± 46.5		0 ± 116	U	50,000
Tritium	-52.1± 122	U	-42.4± 120	U	42.9 ± 119	U	-72.1 ± 123	U	-36.4 ± 117	U	10,000,000
Uranium-235	2.97 ± 9.45	U	8.22± 7.44		0.492 ± 11.2	U	10.8 ± 12.6		2.3 ± 15.6	U	3,000
Uranium-238	93.1		0± 27.7	U	118 ± 182		50.2 ± 46.5		0 ± 116	U	3,000
Yttrium-88	-0.097	U	-0.311± 1.55	U	0.437 ± 1.35	U	0.397 ± 1.85	U	0.821 ± 2.19	U	100,000
Zirconium-95	-0.483	U	-0.622± 1.84	U	1.3 ± 2.07	U	0.831 ± 2.86	U	-2.28 ± 3.57	U	100,000

U = Radionuclide was not detected in the sample at or below the minimum detectable activity (MDA).
NE = Not Established

TABLE D-5. Permitted Sanitary Outfalls, September 1999
(All results in milligrams per liter [mg/L] unless otherwise noted.)

Permit Number:	**2069A**	**2069F**	**2069G**	**2069I**	**2069K**	**Regulatory**
Station:	**WW001**	**WW006**	**WW007**	**WW008**	**WW011**	**Limit**
Date Collected:	**09/29/99**	**09/30/99**	**09/29/99**	**09/29/99**	**09/29/99**	**COA [a]**
Sample ID:	**048233**	**048234**	**048235**	**048236**	**048237**	**(mg/L)**
Analyte						
Aluminum	0.0683	0.314	0.0962	0.0173	0.04015	900
Arsenic	0.0212	0.0187	0.00451	0.0161	0.0136	0.051
Cadmium	0.00044	0.00044	0.00044	0.00044	0.00044	0.50
Chromium	0.00173	0.00298	0.000691	0.000644	0.00117	4.1
Copper	0.0655	0.0416	0.00399	0.0294	0.0255	5.3
Lead	0.00505	0.00611	0.00159	0.0119	0.00404	1.0
Molybdenum	0.00948	0.0368	0.00377	0.00735	0.79	2.0
Nickel	0.00185	0.00221	0.00131	0.00293	0.00356	2.0
Selenium	0.00345	0.00271	0.00271	0.00271	0.00271	0.46
Silver	0.00207	0.00127	0.00073	0.00073	0.002025	5.0
Zinc	0.0913	0.063	0.00486	0.121	0.0688	2.2
Cyanide, Total	Not Sampled	0.00845	0.00197	0.00197	Not Sampled	0.45
Fluoride	0.724	0.621	2.87	2.91	0.485	36

[a] City of Albuquerque

TABLE D-6. Summary of Radiological Analyses, September 1999
(All results are in picocuries per liter [pCi/L] unless otherwise noted.)

Permit Number:	2069A		2069F		2069I		2069K		
Station:	WW001		WW006		WW008		WW011		Regulatory
Date Collected:	9/29/99		9/30/99		9/29/99		9/29/99		Limit
Sample ID:	048233		048234		048236		048237		10 CFR 20
Analyte									
Actinium-228	16.5 ± 10.2		12.8 ± 10.2		8.84 ± 11.1		0.614 ± 11.875	U	300,000
Americium-241	-5.84 ± 12.4	U	-1.26 ± 11.7	U	-1.45 ± 12.7	U	12.6 ± 14.1		200
Cerium-144	-0.444 ± 14.9	U	5.6 ± 14.7	U	7.22 ± 14.7	U	4.3819 ± 13.3	U	30,000
Cesium-134	-2.15 ± 2.86	U	0.166 ± 2.48	U	-1.51 ± 2.51	U	-1.665 ± 2.395	U	9,000
Cesium-137	-1.63 ± 2.59	U	-1.91 ± 2.58	U	0.0153 ± 2.59	U	-0.387 ± 2.265	U	10,000
Chromium-51	-3.85 ± 25	U	-14.7 ± 24.8	U	6.1 ± 23.8	U	-3.15 ± 22.9	U	5,000,000
Cobalt-60	-1.52 ± 2.37	U	1.91 ± 2.72	U	0.614 ± 2.68	U	-0.852 ± 2.475	U	30,000
Gross Alpha	1.79 ± 0.783		1.45 ± 1.06		1.51 ± 0.819		1.905 ± 0.9775		NE
Iron-59	0.499 ± 5.1	U	1.82 ± 5.26	U	-3.39 ± 5.81	U	0.575 ± 5.57	U	100,000
Lead-212	1.57 ± 8.64 U	U	0 ± 4.85	U	0 ± 4.45	U	0 ± 4.43	U	20,000
Lead-214	9.91 ± 5.52		5.71 ± 9.21		6.7 ± 5.59		5.345 ± 10.66		1,000,000
Nonvolatile Beta	12.7 ± 0.985		16.1 ± 1.78		6.21 ± 0.831		12.45 ± 1.29		NE
Potassium-40	44.8 ± 31.6		0 ± 37.8	U	28 ± 52.5	U	11.755 ± 51.6	U	40,000
Radium-226	2.43 ± 10.8	U	8.94 ± 5.31		7.02 ± 5.2		4.525 ± 6.78	U	600
Radium-228	16.5 ± 10.2		12.8 ± 10.2		8.84 ± 11.1		0.614 ± 11.875	U	600
Ruthenium-103	0.107 ± 2.66	U	-0.235 ± 2.63	U	-1.42 ± 2.74	U	-0.645 ± 2.33	U	300,000
Ruthenium-106	3.03 ± 23.5	U	25.3 ± 23		-4.7 ± 20.5	U	4.32 ± 20.75	U	30,000
Thorium-231	12.1 ± 13	U	13.1 ± 13.6		0.891 ± 12.3	U	5.995 ± 12.1	U	300
Thorium-232	1.56 ± 8.55	U	0 ± 4.8	U	0 ± 4.4	U	0 ± 4.38	U	500,000
Thorium-234	195 ± 120		78.1 ± 149	U	4.78 ± 149	U	66 ± 180.5	U	50,000
Tritium	-77.1 ± 134	U	-22.9 ± 138	U	-39 ± 140	U	-71.66 ± 139	U	10,000
Uranium-235	4.45 ± 20.4	U	-1.21 ± 14.8	U	-5.2 ± 14.6	U	13.425 ± 14.4	U	3,000
Uranium-238	195 ± 120		78.1 ± 149	U	4.78 ± 149	U	66 ± 180.5	U	3,000
Yttrium-88	0.299 ± 2.81	U	1.03 ± 2.95	U	-2.99 ± 2.64	U	1.334 ± 2.98	U	100,000
Zirconium-95	1.88 ± 4.45	U	2.61 ± 4.72	U	1.4 ± 4.27	U	0.6785 ± 4.15	U	200,000

U = Radionuclide was not detected in the sample at or below the minimum detectable activity (MDA).
NE = Not Established

TABLE D-7. Permitted Sanitary Outfalls, December 1999
(All results in milligrams per liter [mg/L] unless otherwise noted.)

Permit Number:	2069A	2069F	2069G	2069I	2069K	Regulatory
Station:	WW001	WW006	WW007	WW008	WW011	Limit
Date Collected:	12/9/99	12/9/99	12/9/99	12/9/99	12/9/99	COA [a]
Sample ID:	050415	050416	050417	050418	050419	(mg/L)
Analyte						
Aluminum	0.0638	0.0867	0.544	0.198	0.334	900
Arsenic	0.0167	0.0154	0.00257	0.016	0.0093	0.051
Cadmium	0.000631	0.000631	0.000631	0.000631	0.000701	0.50
Chromium	0.00209	0.00106	0.00237	0.00259	0.00468	4.1
Copper	0.0419	0.0126	0.00219	0.00985	0.1	5.3
Lead	0.00241	0.00229	0.00183	0.00579	0.00705	1.0
Molybdenum	0.0131	0.00948	0.00129	0.00994	0.026	2.0
Nickel	0.00309	0.00496	0.00309	0.00309	0.0103	2.0
Selenium	0.00236	0.00236	0.00236	0.00236	0.00269	0.46
Silver	0.00108	0.00147	0.000529	0.000529	0.00574	5.0
Zinc	0.112	0.0286	0.00578	0.0276	0.307	2.2
Cyanide, Total	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	0.45
Fluoride	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	36

[a] City of Albuquerque

TABLE D-8. Summary of Radiological Analyses, December 1999
(All results are in picocuries per liter [pCi/L] unless otherwise noted.)

Permit Number:	2069A		2069F-4		2069I-3		2069K		
Station:	WW001		WW006		WW008		WW011		Regulatory
Date Collected:	12/9/99		12/9/99		12/9/99		12/9/99		Limit
Sample ID:	050415		050416		050418		050419		10 CFR 20
Analyte									
Actinium-228	7.62 ± 18	U	9.27 ± 12	U	15.55 ± 11.5	U	1.24 ± 14	U	300,000
Americium-241	2.4 ± 15	U	16 ± 8	U	-17.62 ± 11	U	3.35 ± 15	U	200
Cerium-144	-6.61 ± 18	U	2.47 ± 20	U	2.47 ± 20	U	0.423 ± 17	U	30,000
Cesium-134	-2.25 ± 3	U	-1.8 ± 3	U	0.67 ± 3	U	-2.3 ± 3	U	9,000
Cesium-137	1.57 ± 3	U	-1.25 ± 3	U	-0.129 ± 3.5	U	0.0215 ± 3	U	10,000
Chromium-51	-8.3 ± 35	U	-23.3 ± 35	U	33.305 ± 40	U	9.19 ± 36	U	5,000,000
Cobalt-60	0.0291 ± 2	U	0.315 ± 3	U	1.835 ± 3.5	U	1.52 ± 3	U	30,000
Iron-59	-4.82 ± 7	U	-0.621 ± 8	U	0.2785 ± 7	U	1.97 ± 6	U	100,000
Lead-212	0.612 ± 8	U	6.8 ± 5	U	4.845 ± 6.5	U	2.18 ± 7	U	20,000
Lead-214	0.588 ± 6	U	7.68 ± 12	U	6.015 ± 8.5	U	1.62 ± 9	U	1,000,000
Potassium-40	11.4 ± 62	U	46.6 ± 43	U	56.6 ± 39	U	39 ± 48	U	40,000
Radium-226	7.76 ± 6	U	6.76 ± 7	U	7.825 ± 8.5	U	13.3 ± 13		600
Radium-228	7.62 ± 18	U	9.27 ± 12	U	15.555 ± 11.5	U	1.24 ± 14	U	600
Ruthenium-103	0.67 ± 4	U	-1.09 ± 4	U	-0.291 ± 3.5	U	-1.38 ± 4	U	300,000
Ruthenium-106	-4.02 ± 24	U	-23.4 ± 35	U	3.205 ± 24	U	-0.434 ± 28	U	30,000
Thorium-231	1.05 ± 15	U	17.8 ± 21	U	5.425 ± 13.5	U	4.9 ± 16	U	300
Thorium-232	0.602 ± 8	U	6.07 ± 5	U	4.69 ± 6.5	U	2.14 ± 7	U	500,000
Thorium-234	142 ± 127	U	0 ± 149	U	0 ± 104.5	U	386 ± 188		50,000
Tritium	-25.2 ± 133	U	-88 ± 126	U	-17.9 ± 130.5	U	-54.3 ± 127	U	10,000,000
Uranium-235	9.56 ± 18	U	11.1 ± 20	U	9.755 ± 23.5	U	1.53 ± 20	U	3,000
Uranium-238	142 ± 127	U	0 ± 149	U	0 ± 104.5	U	386 ± 188		3,000
Yttrium-88	0.897 ± 3	U	-5.05 ± 3	U	-0.637 ± 3.5	U	1.25 ± 4	U	100,000
Zirconium-95	-0.129 ± 5	U	-0.058 ± 6	U	-2.24 ± 6	U	-1.36 ± 6	U	200,000

U = Radionuclide was not detected in the sample at or below the minimum detectable activity (MDA).

TABLE D-9. Summary Statistics for Sanitary Outfalls, 1999
(All results in milligrams per liter [mg/L] unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Mean	Std Dev	Minimum	Maximum	Regulatory Limit COA[a]
2069A	**WW001**	Aluminum	4	0.17	0.13	0.0638	0.342	900
		Arsenic	4	0.02	0.00	0.0137	0.0212	0.051
		Cadmium	4	0.00	0.00	0.00044	0.000631	0.5
		Chromium	4	0.00	0.00	0.00165	0.00596	4.1
		Copper	4	0.05	0.01	0.032	0.0655	5.3
		Lead	4	0.00	0.00	0.00159	0.00505	1
		Molybdenum	4	0.02	0.02	0.00948	0.049	2
		Nickel	4	0.00	0.00	0.00162	0.00625	2
		Selenium	4	0.00	0.00	0.00236	0.00462	0.46
		Silver	4	0.00	0.00	0.00073	0.00207	5
		Zinc	4	0.13	0.04	0.0913	0.192	2.2
		Fluoride	4	0.63	0.10	0.507	0.724	36
2069F	**WW006**	Aluminum	4	0.31	0.24	0.0867	0.649	900
		Arsenic	4	0.03	0.01	0.0154	0.0419	0.051
		Cadmium	4	0.00	0.00	0.00044	0.000794	0.5
		Chromium	4	0.00	0.00	0.00106	0.00298	4.1
		Copper	4	0.03	0.02	0.0126	0.0565	5.3
		Lead	4	0.00	0.00	0.00229	0.00611	1
		Molybdenum	4	0.05	0.07	0.00948	0.159	2
		Nickel	4	0.00	0.00	0.00191	0.00496	2
		Selenium	4	0.00	0.00	0.00236	0.00271	0.46
		Silver	4	0.00	0.00	0.00073	0.00216	5
		Zinc	4	0.06	0.02	0.0286	0.0853	2.2
		Cyanide, Total	2	0.01	0.00	0.00596	0.00845	0.45
		Fluoride	4	0.64	0.04	0.59	0.694	36
2069G	**WW007**	Aluminum	4	0.17	0.25	0.0121	0.544	900
		Arsenic	4	0.00	0.00	0.00257	0.00451	0.051
		Cadmium	4	0.00	0.00	0.00044	0.000631	0.5
		Chromium	4	0.00	0.00	0.00056	0.00237	4.1
		Copper	4	0.00	0.00	0.00122	0.00399	5.3
		Lead	4	0.00	0.00	0.00159	0.00183	1
		Molybdenum	4	0.00	0.00	0.00129	0.00825	2
		Nickel	4	0.00	0.00	0.00129	0.00309	2
		Selenium	4	0.00	0.00	0.00236	0.00271	0.46
		Silver	4	0.00	0.00	0.000529	0.00073	5
		Zinc	4	0.01	0.01	0.00486	0.0264	2.2
		Cyanide, Total	2	0.00	0.00	0.00197	0.0024	0.45
		Fluoride	6	9.32	8.04	1.88	24.1	36

[a] City of Albuquerque

TABLE D-9. Summary Statistics for Sanitary Outfalls, 1999 *(concluded)*
(All results in milligrams per liter [mg/L] unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Mean	Std Dev	Minimum	Maximum	Regulatory Limit COA[a]
2069I	**WW008**	Aluminum	5	0.12	0.09	0.0173	0.217	900
		Arsenic	5	0.01	0.00	0.00934	0.0161	0.051
		Cadmium	5	0.00	0.00	0.00044	0.000631	0.5
		Chromium	5	0.00	0.00	0.000644	0.00329	4.1
		Copper	5	0.02	0.01	0.0091	0.0294	5.3
		Lead	5	0.01	0.01	0.00159	0.0148	1
		Molybdenum	5	0.01	0.00	0.00735	0.0154	2
		Nickel	5	0.00	0.00	0.00129	0.00597	2
		Selenium	5	0.00	0.00	0.00236	0.00271	0.46
		Silver	5	0.00	0.00	0.000529	0.00073	5
		Zinc	5	0.05	0.04	0.0241	0.121	2.2
		Cyanide, Total	2	0.00	0.00	0.00197	0.0024	0.45
		Fluoride	5	8.47	6.16	1.68	15.2	36
2069K	**WW011**	Aluminum	5	0.14	0.12	0.0247	0.334	900
		Arsenic	5	0.01	0.00	0.0093	0.0147	0.051
		Cadmium	5	0.00	0.00	0.00044	0.000701	0.5
		Chromium	5	0.00	0.00	0.00105	0.00468	4.1
		Copper	5	0.04	0.03	0.018	0.1	5.3
		Lead	5	0.00	0.00	0.00181	0.00705	1
		Molybdenum	5	0.33	0.42	0.00748	0.793	2
		Nickel	5	0.00	0.00	0.00223	0.0103	2
		Selenium	5	0.00	0.00	0.00269	0.00271	0.46
		Silver	5	0.00	0.00	0.000776	0.00574	5
		Zinc	5	0.14	0.10	0.0618	0.307	2.2
		Fluoride	5	0.41	0.10	0.249	0.489	36

[a] City of Albuquerque

TABLE D-10. Summary Statistics for Sanitary Outfalls, 1999
(All results are in picocuries per liter [pCi/L] unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Mean	Std Dev	Minimum	Maximum	Regulatory Limit (10 CFR 20)
2069A	WW001	Actinium-228	4	9.08	5.04	5.31	16.5	300000
		Americium-241	4	-0.31	7.55	-6.93	9.13	200
		Cerium-144	4	-0.12	4.89	-6.61	5.07	30000
		Cesium-134	4	-1.50	0.82	-2.25	-0.618	9000
		Cesium-137	4	-0.25	1.46	-1.63	1.57	10000
		Chromium-51	4	-4.96	3.85	-8.3	0	5000000
		Cobalt-60	4	-0.96	1.12	-2.26	0.0291	30000
		Gross Alpha	3	2.22	1.23	1.26	3.6	NE
		Iron-59	4	-1.35	2.38	-4.82	0.499	100000
		Lead-212	4	2.10	2.83	0	6.23	20000
		Lead-214	4	5.01	4.31	0.588	9.91	1000000
		Nonvolatile Beta	3	12.27	1.02	11.1	13	NE
		Potassium-40	4	24.53	15.25	11.4	44.8	40000
		Radium-226	4	5.21	2.22	2.43	7.76	600
		Radium-228	4	9.08	5.04	5.31	16.5	600
		Ruthenium-103	4	-0.53	1.19	-2.04	0.67	300000
		Ruthenium-106	4	2.04	5.50	-4.02	9.06	30000
		Thorium-231	4	4.92	5.05	1.05	12.1	300
		Thorium-232	4	2.06	2.75	0	6.06	500000
		Thorium-234	4	117.90	65.77	41.5	195	50000
		Tritium	4	-84.35	69.10	-183	-25.2	10000000
		Uranium-235	4	7.32	4.36	2.97	12.3	3000
		Uranium-238	4	117.90	65.77	41.5	195	3000
		Yttrium-88	4	0.27	0.45	-0.097	0.897	100000
		Zirconium-95	4	1.12	1.75	-0.483	3.23	200000
2069F	WW006	Actinium-228	4	7.71	4.44	2.28	12.8	300000
		Americium-241	4	3.47	8.41	-1.56	16	200
		Cerium-144	4	-0.28	5.39	-6.54	5.6	30000
		Cesium-134	4	-0.34	1.06	-1.8	0.65	9000
		Cesium-137	4	-0.01	2.24	-1.91	3.13	10000
		Chromium-51	4	-11.90	9.91	-23.3	0.5	5000000
		Cobalt-60	4	1.53	1.10	0.315	2.86	30000
		Gross Alpha	3	2.82	3.21	0.533	6.49	NE
		Iron-59	4	0.73	1.02	-0.621	1.82	100000
		Lead-212	4	2.68	3.31	0	6.8	20000
		Lead-214	4	3.67	3.64	-0.146	7.68	1000000
		Nonvolatile Beta	3	14.76	7.90	6.27	21.9	NE
		Potassium-40	4	28.58	23.08	0	48	40000
		Radium-226	4	4.51	3.99	0.538	8.94	600
		Radium-228	4	7.71	4.44	2.28	12.8	600
		Ruthenium-103	4	-0.41	0.58	-1.09	0.276	300000
		Ruthenium-106	4	-3.01	20.64	-23.4	25.3	30000
		Thorium-231	4	8.52	8.41	-0.518	17.8	300
		Thorium-232	4	2.48	3.01	0	6.07	500000
		Thorium-234	4	25.43	36.84	0	78.1	50000
		Tritium	4	-90.07	82.59	-207	-22.9	10000000
		Uranium-235	4	5.53	5.36	-1.21	11.1	3000
		Uranium-238	4	25.43	36.84	0	78.1	3000
		Yttrium-88	4	-0.86	2.86	-5.05	1.03	100000
		Zirconium-95	4	1.01	1.59	-0.622	2.61	200000

NE = Not Established

TABLE D-10. Summary Statistics for Sanitary Outfalls, 1999*(continued)*
(All results are in picocuries per liter [pCi/L] unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Mean	Std Dev	Minimum	Maximum	Regulatory Limit (10 CFR 20
2069G	WW007	Actinium-228	2	4.22	3.46	1.78	6.67	300000
		Americium-241	2	-1.93	5.88	-6.09	2.22	200
		Cerium-144	2	0.80	2.07	-0.662	2.26	30000
		Cesium-134	2	0.04	0.99	-0.662	0.738	9000
		Cesium-137	2	-0.45	0.64	-0.908	0	10000
		Chromium-51	2	-6.12	0.47	-6.45	-5.79	5000000
		Cobalt-60	2	-0.09	0.03	-0.113	-0.0695	30000
		Gross Alpha	2	0.48	0.84	-0.111	1.08	NE
		Iron-59	2	-1.94	2.00	-3.35	-0.52	100000
		Lead-212	2	4.62	1.00	3.91	5.33	20000
		Lead-214	2	1.96	2.77	0	3.92	1000000
		Nonvolatile Beta	2	0.36	0.98	-0.333	1.05	NE
		Potassium-40	2	24.98	23.79	8.16	41.8	40000
		Radium-226	2	5.51	1.03	4.78	6.23	600
		Radium-228	2	4.22	3.46	1.78	6.67	600
		Ruthenium-103	2	-0.24	0.55	-0.631	0.148	300000
		Ruthenium-106	2	-2.66	2.05	-4.11	-1.21	30000
		Thorium-231	2	-2.59	6.58	-7.25	2.06	300
		Thorium-232	2	4.55	0.95	3.88	5.22	500000
		Thorium-234	2	84.15	47.87	50.3	118	50000
		Tritium	2	-53.55	136.40	-150	42.9	10000000
		Uranium-235	2	4.92	6.26	0.492	9.35	3000
		Uranium-238	2	84.15	47.87	50.3	118	3000
		Yttrium-88	2	0.20	0.33	-0.0276	0.437	100000
		Zirconium-95	2	1.41	0.16	1.3	1.52	200000
2069I	WW008	Actinium-228	5	12.06	5.55	8.15	21.6	300000
		Americium-241	5	-6.69	15.56	-34.3	3.62	200
		Cerium-144	5	3.11	3.79	-2.02	7.22	30000
		Cesium-134	5	-0.13	2.02	-1.87	3.21	9000
		Cesium-137	5	0.15	0.48	-0.258	0.989	10000
		Chromium-51	5	12.57	26.27	-6.83	58.2	5000000
		Cobalt-60	5	0.86	1.04	-0.222	2.47	30000
		Gross Alpha	3	2.24	0.91	1.51	3.26	NE
		Iron-59	5	-0.93	1.74	-3.39	1.17	100000
		Lead-212	5	2.15	2.98	0	7.14	20000
		Lead-214	5	4.84	2.60	0.766	7.45	1000000
		Nonvolatile Beta	3	5.95	0.60	5.27	6.38	NE
		Potassium-40	5	31.47	26.66	7.99	72	40000
		Radium-226	5	4.53	4.16	0	8.22	600
		Radium-228	5	12.06	5.55	8.15	21.6	600
		Ruthenium-103	5	-0.21	1.09	-1.42	1.19	300000

NE = Not Established

TABLE D-10. Summary Statistics for Sanitary Outfalls, 1999*(concluded)*
(All results are in picocuries per liter [pCi/L] unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Mean	Std Dev	Minimum	Maximum	Regulatory Limit (10 CFR 20
		Ruthenium-106	5	-2.18	6.10	-7.36	8.12	30000
		Thorium-231	5	4.90	4.16	0.891	9.44	300
		Thorium-232	5	2.08	2.87	0	6.88	500000
		Thorium-234	5	29.48	41.04	0	92.4	50000
		Tritium	5	-53.58	47.30	-121	7.6	10000000
		Uranium-235	5	5.14	9.20	-5.2	18	3000
		Uranium-238	5	29.48	41.04	0	92.4	3000
		Yttrium-88	5	-0.66	1.66	-2.99	0.606	100000
		Zirconium-95	5	-0.60	2.12	-4.05	1.4	200000
2069K	**WW011**	Actinium-228	5	1.67	1.35	0.482	3.83	300000
		Americium-241	5	2.15	13.41	-20.2	12.7	200
		Cerium-144	5	4.46	6.19	-0.0961	13.2	30000
		Cesium-134	5	-1.71	0.63	-2.3	-0.831	9000
		Cesium-137	5	-0.63	0.98	-2.3	0.0215	10000
		Chromium-51	5	2.25	6.03	-4.31	9.19	5000000
		Cobalt-60	5	-0.09	0.98	-1.03	1.52	30000
		Gross Alpha	4	1.63	0.81	0.664	2.5	NE
		Iron-59	5	1.28	2.53	-2.84	3.99	100000
		Lead-212	5	0.44	0.97	0	2.18	20000
		Lead-214	5	3.75	2.76	1.04	7.67	1000000
		Nonvolatile Beta	4	10.69	2.17	8.2	13	NE
		Potassium-40	5	21.19	18.61	1.84	41.6	40000
		Radium-226	5	6.16	4.14	3.02	13.3	600
		Radium-228	5	1.67	1.35	0.482	3.83	600
		Ruthenium-103	5	-0.89	0.47	-1.39	-0.402	300000
		Ruthenium-106	5	3.38	6.06	-2.46	11.1	30000
		Thorium-231	5	1.81	5.64	-6.81	6.2	300
		Thorium-232	5	0.43	0.96	0	2.14	500000
		Thorium-234	5	105.70	160.64	0	386	50000
		Tritium	5	-41.66	69.13	-151	25.7	10000000
		Uranium-235	5	6.16	8.79	0.111	21.5	3000
		Uranium-238	5	105.70	160.64	0	386	3000
		Yttrium-88	5	1.07	0.99	0.018	2.65	100000
		Zirconium-95	5	-0.28	1.45	-2.28	0.899	200000

NE = Not Established

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APPENDIX E

1999 Groundwater Concentrations

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CONTENTS

TABLES

FIGURES

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Trichloroethene (TCE)

Three wells contained TCE average concentrations above the MCL of 5 µg/L. The table below indicates the summary statistics of the TCE concentrations for all three wells which were located in the Sandia North sampling region.

TABLE E-1. Summary Statistics of wells with TCE concentrations greater than MCL of 5
(All wells were located in Sandia North.)

Well ID	Sample Size	Average (Mean)	Std Dev.	Minimum	Maximum	Range
			Units in µg/L			
TA2-W-26	7	8.26	1.05	6.8	9.6	2.8
WYO-1	11	5.55	1.11	2.9	6.8	3.9
WYO-2	11	6.43	0.70	5.2	7.5	2.3

Figures E-1 through E-3 show TCE concentrations by sampling period. Each well has fairly consistent concentrations (the majority of data points being within one standard deviation of the mean). Standard deviation is a measure of the variability of all data points and is shown by the error bars. The average concentrations are indicated by the dashed lines.

Nitrate

Five wells contained nitrate average concentrations above the maximum contaminant level (MCL) of 10 mg/L. The table below indicates the summary statistics of the nitrate concentrations for all wells. Three different sampling regions were effected: Canyons (CYN-MW1-D), Sandia North (TJA-4 and TA2-SW1-320) and TAV (LWDS-MW1 and TAV-MW5).

TABLE E-2. Summary Statistics of wells with nitrate concentrations greater than MCL of 10

Sampling Region	Well ID	Sample Size	Average (Mean)	Std Dev.	Minimum	Maximum	Range
			Units in mg/L				
Canyons	CYN-MW1-D	4	11.18	0.89	10	12	2
Sandia North	TJA-4	4	23.75	2.50	20	25	5
	TA2-SW1-320	14	24.53	2.83	20	29	9
TAV	LWDS-MW1	13	11.35	2.22	8.4	16.3	7.9
	TAV-MW5	5	7.68	3.21	5.4	13	7.6

Figures E-4 through E-8 show Nitrate concentrations by sampling period. Each well has fairly consistent concentrations (the majority of data points being within one standard deviation of the mean). Standard deviation is a measure of the variability of all data points and is shown by the error bars. The average concentrations are indicated by the dashed lines.

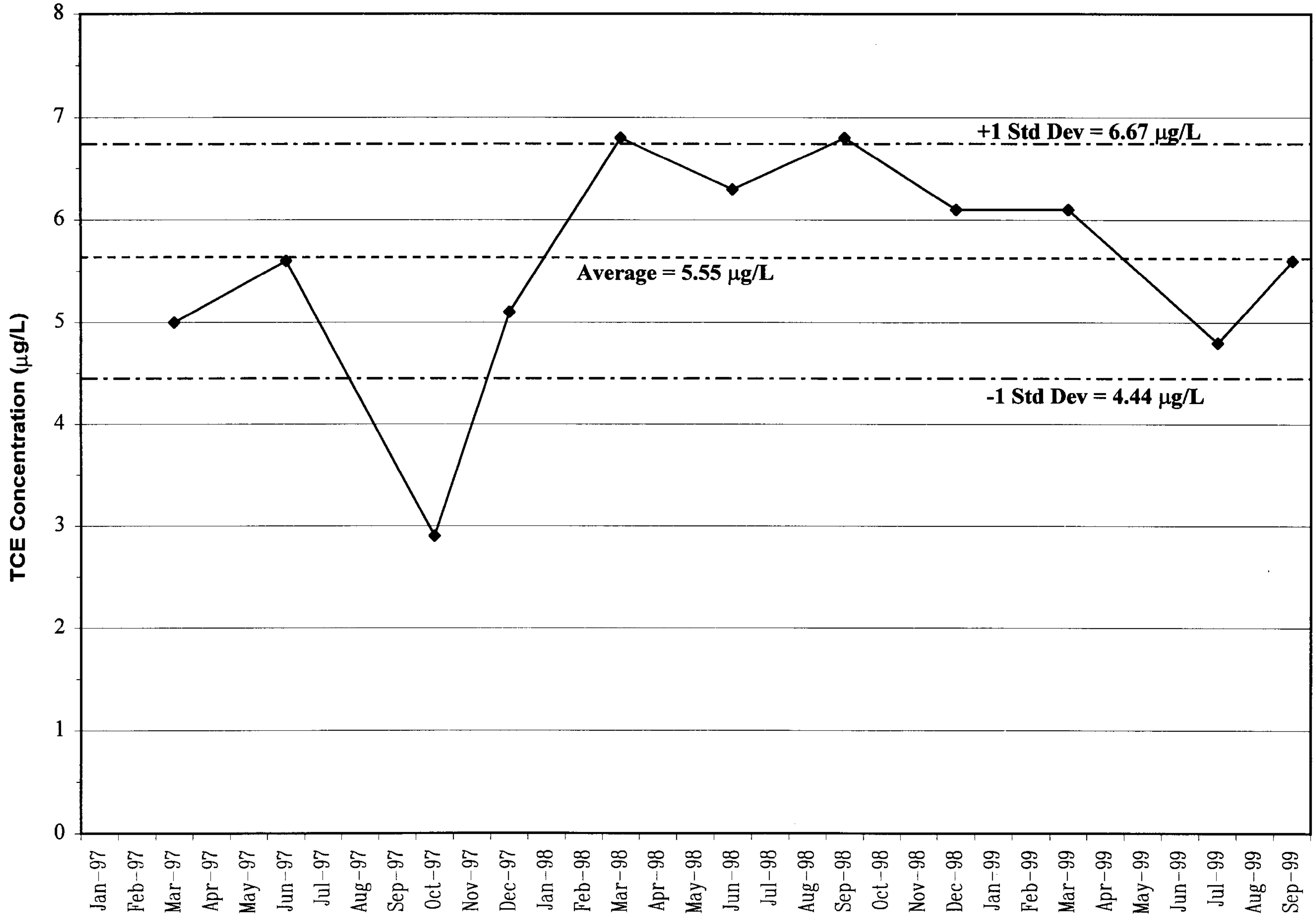

FIGURE E-1. Sandia North Well (WYO-1) TCE Concentrations (Jan 1997 - Sep 1999)

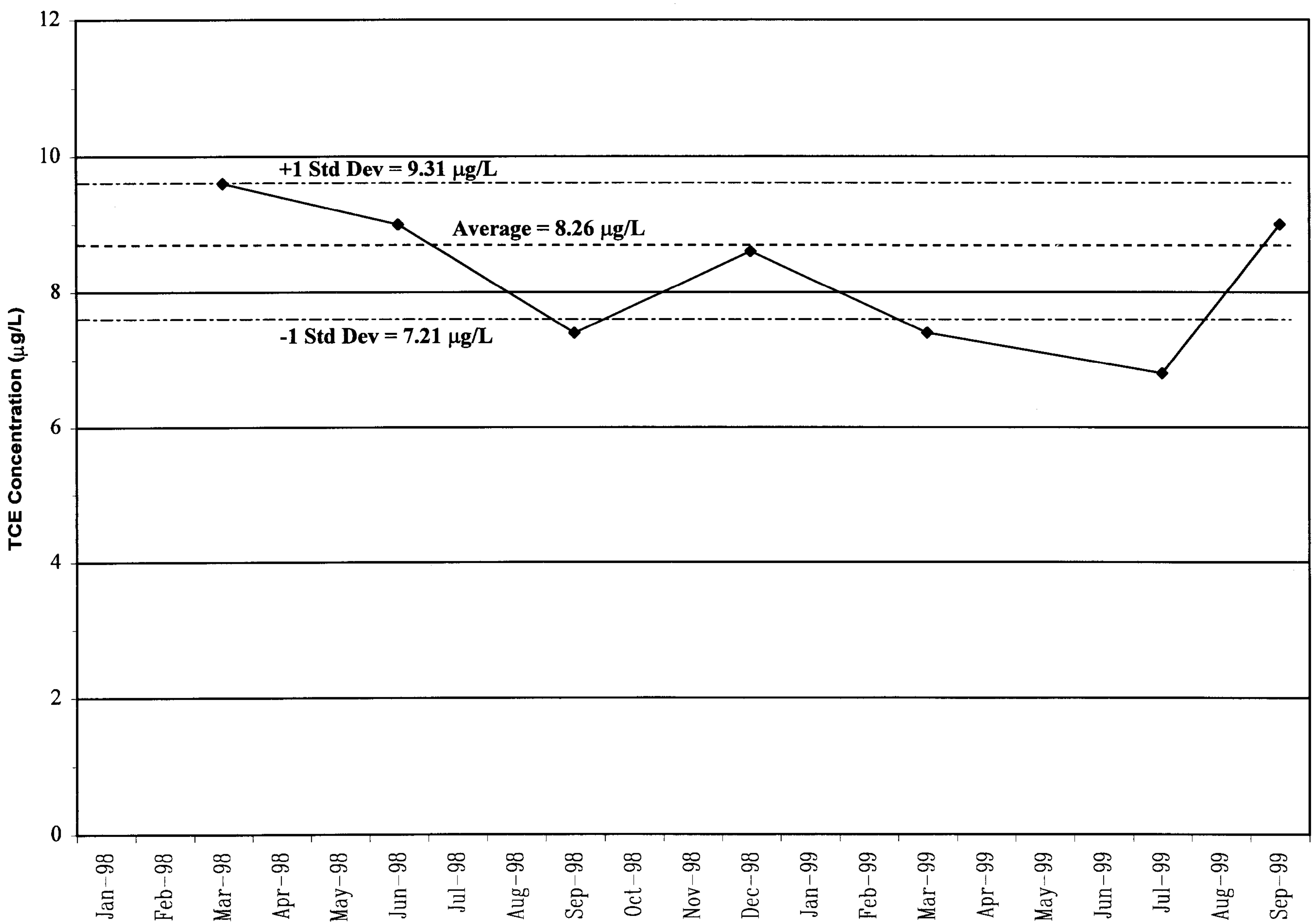

FIGURE E-2. Sandia North Well (TA2-W-26) TCE Concentrations (Jan 1998 - Sep 1999)

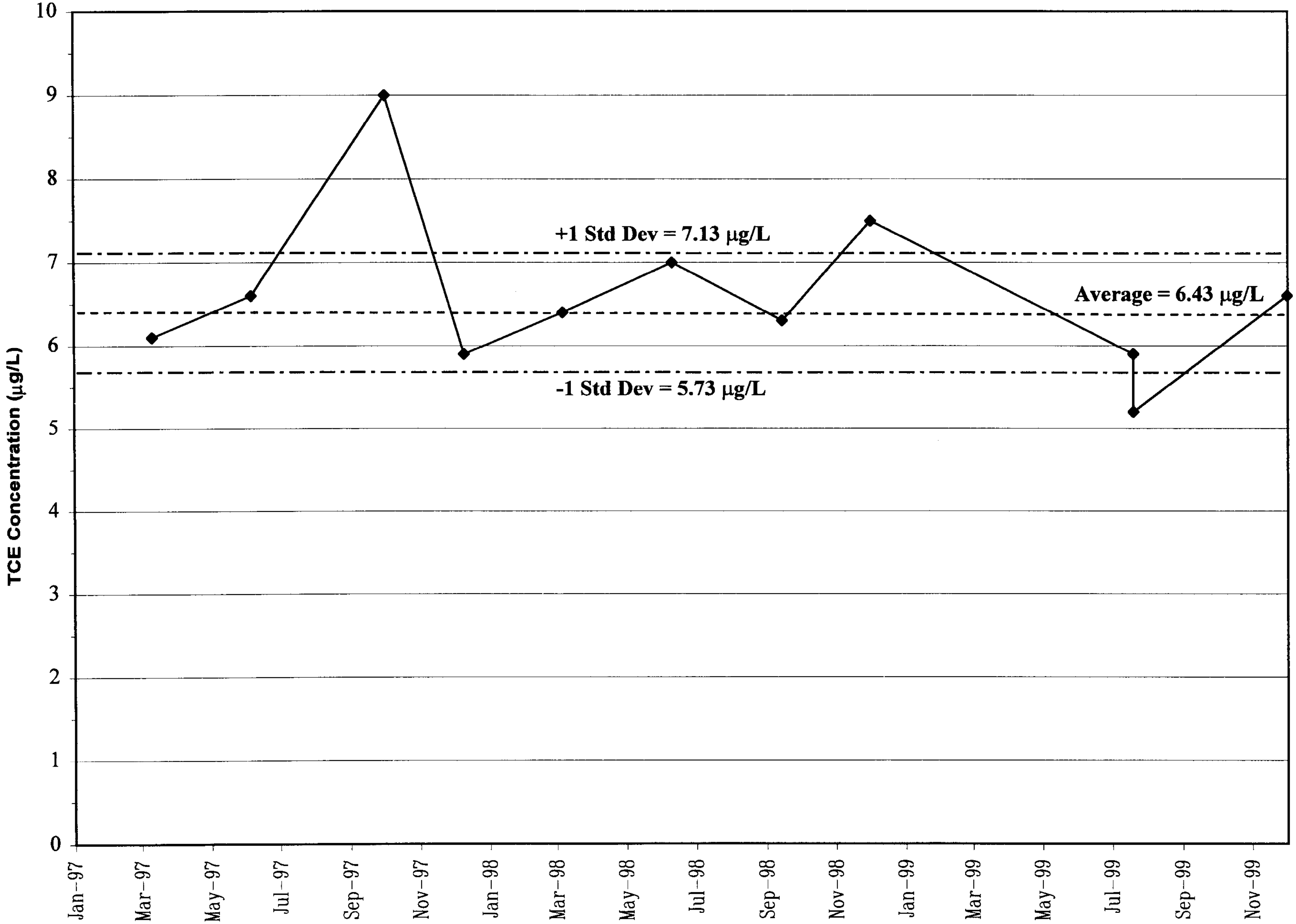

FIGURE E-3. Sandia North Well (WYO-2) TCE Concentrations (Jan 1997 - Nov 1999)

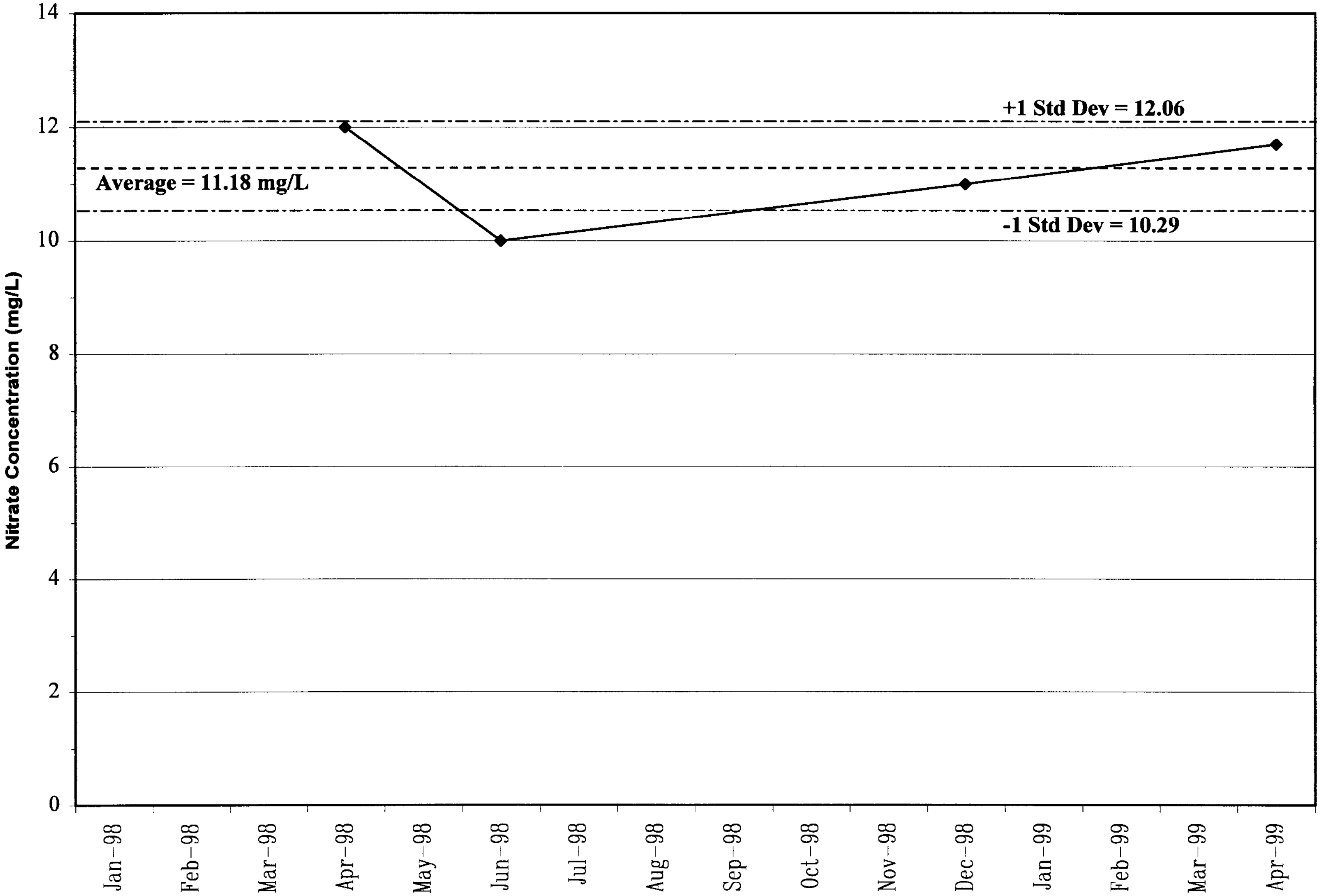

FIGURE E-4. Canyons Well (CYN-MW1-D) Nitrate Concentrations (Jan 1998 - Apr 1999)

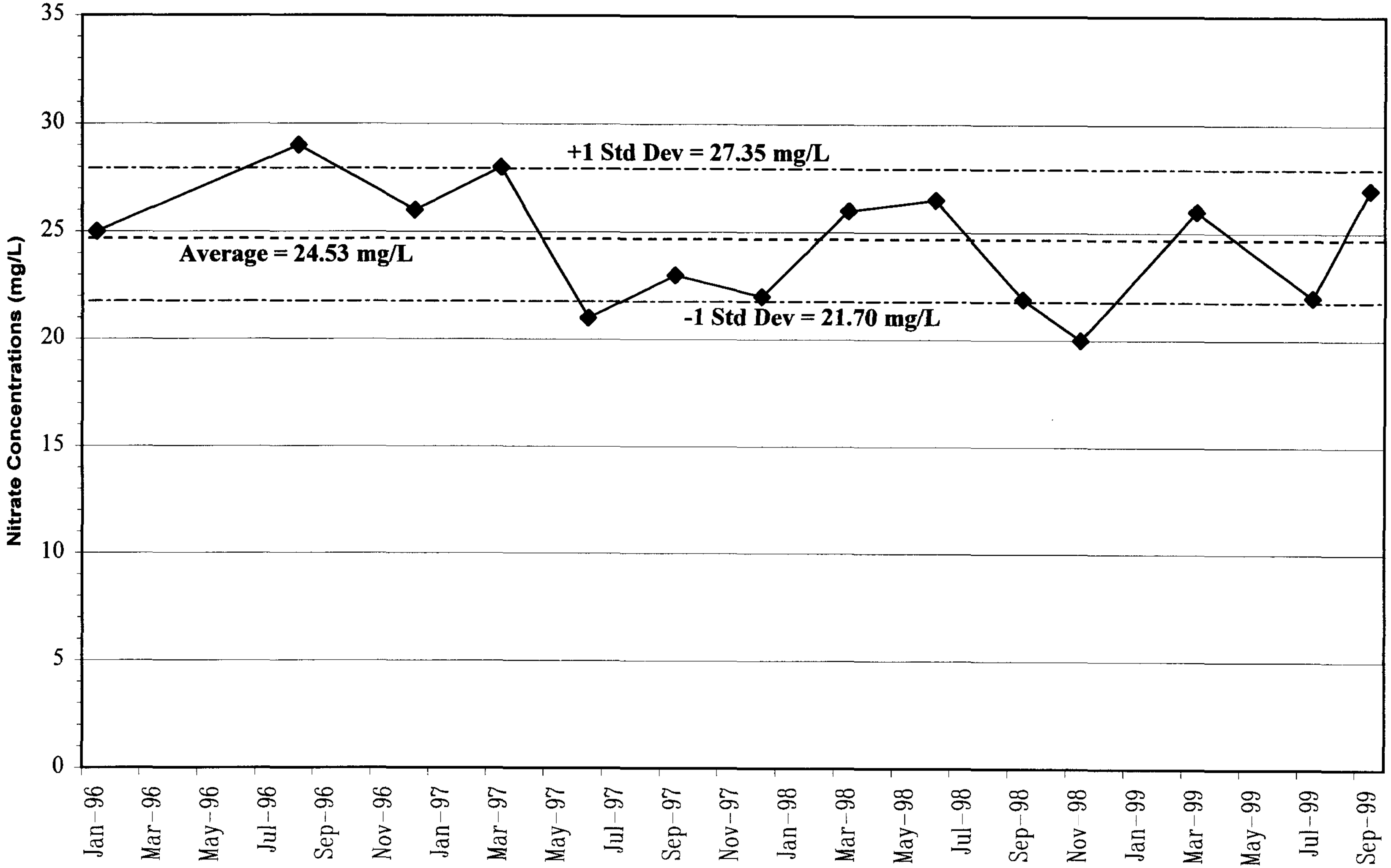

FIGURE E-5. Sandia North Well (TA2-SW1-320) Nitrate Concentrations (Jan 1996 - Sep 1999)

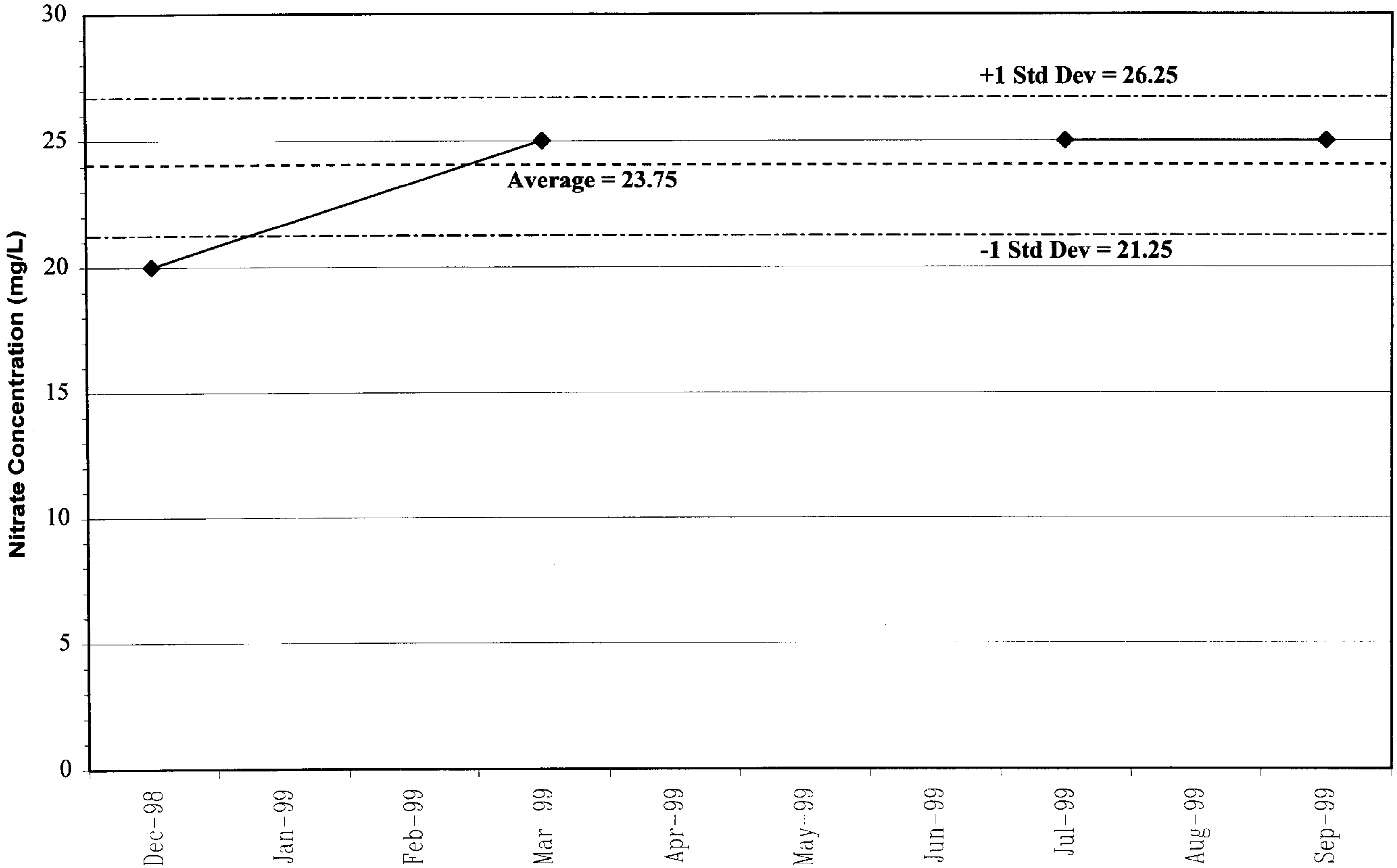

FIGURE E-6. Sandia North Well (TJA-4) Nitrate Concentrations (Dec 1998 - Sep 1999)

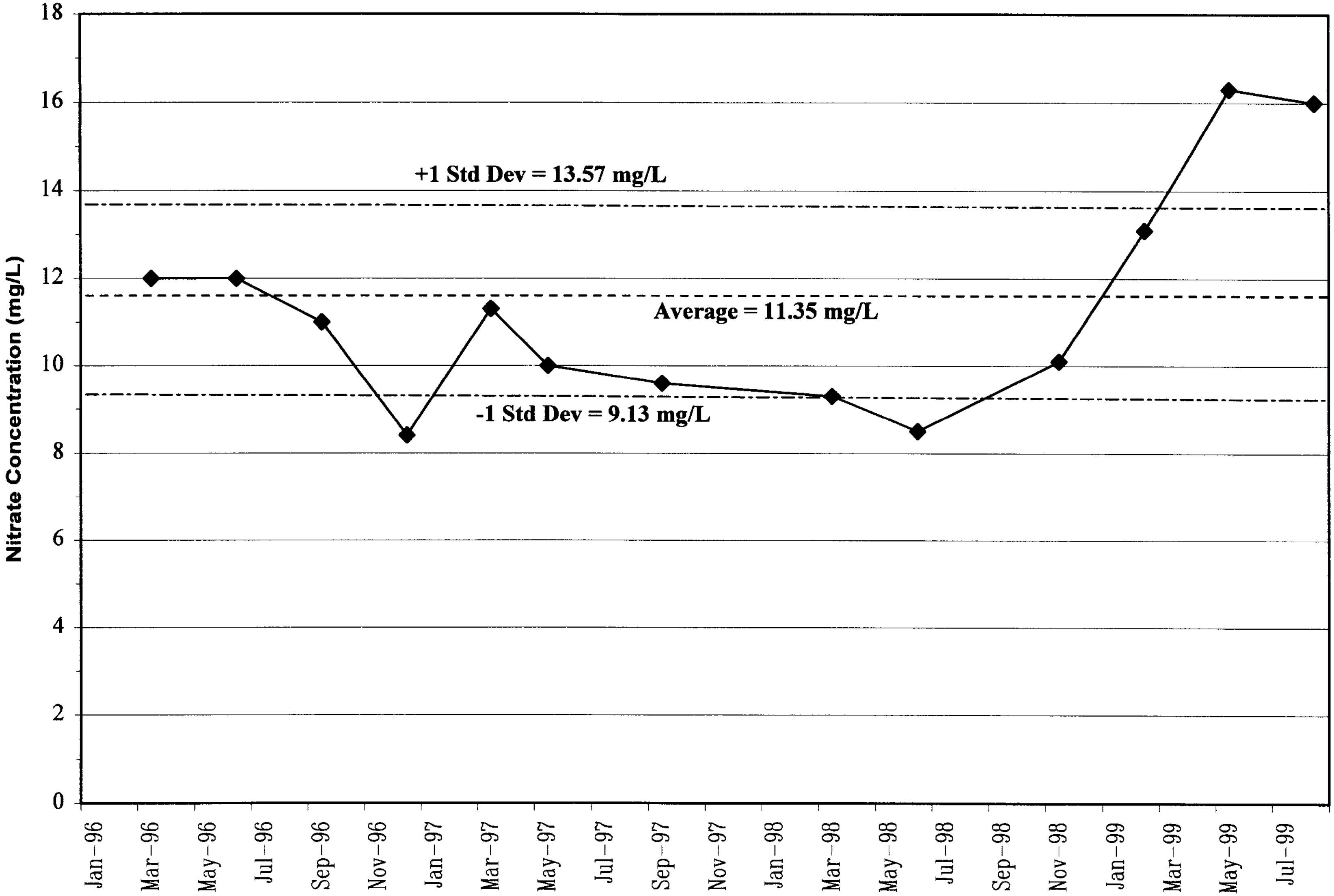

FIGURE E-7. TA-V Well (LWDS-MW1) Nitrate Concentrations (Jan 1996 - Jul 1999)

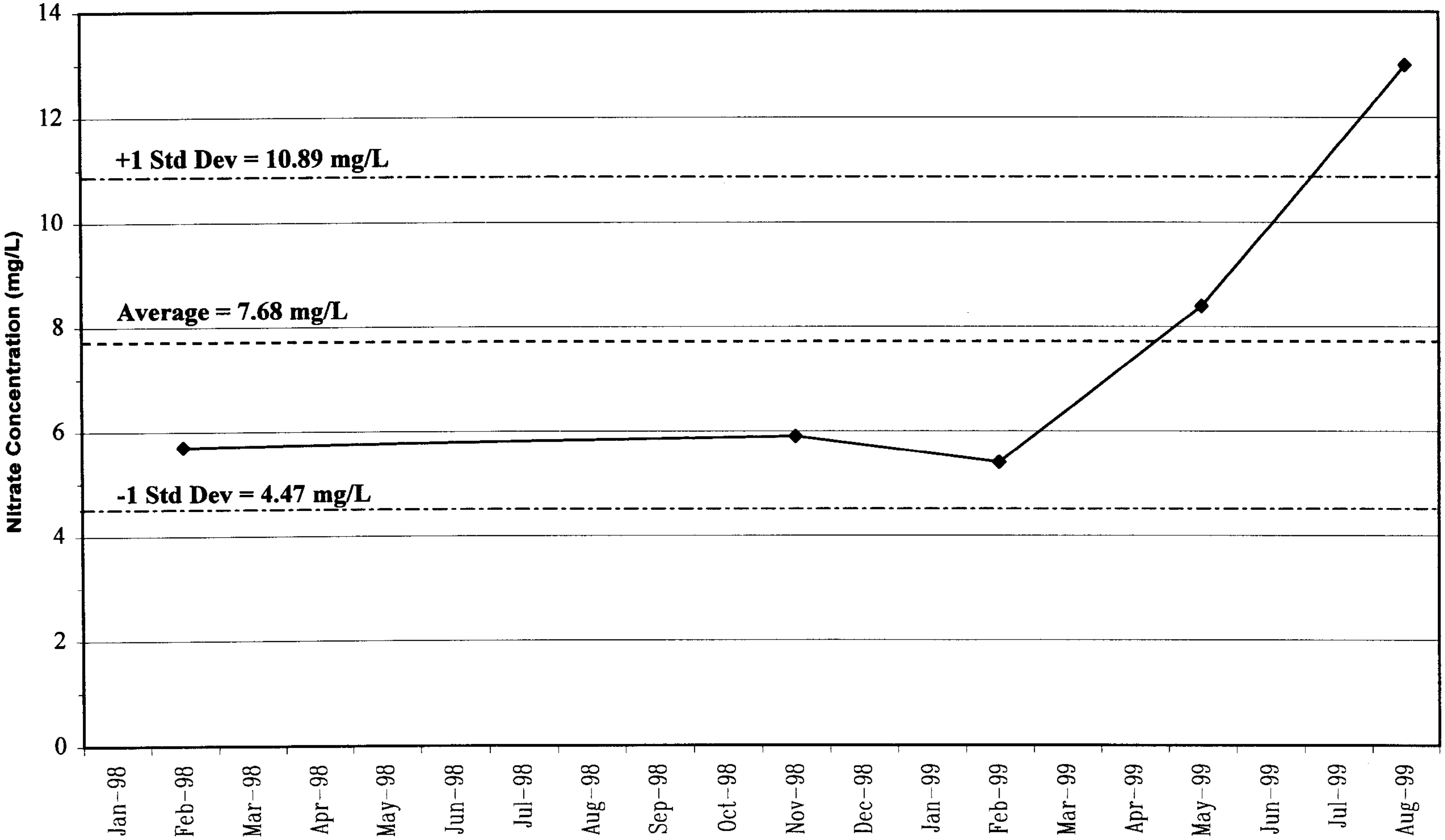

FIGURE E-8. TA-V Well (TAV-MW5) Nitrate Concentrations (Jan 1998 - Aug 1999)

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