SANDIA REPORT

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Calendar Year 2000
Annual Site Environmental Report
Sandia National Laboratories
Albuquerque, New Mexico

Rebecca Sanchez, Katrina Hamilton, and Lucie Mayeux

Prepared by
Sandia National Laboratories
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a Lockheed Martin Company, for the United States Department of
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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 the 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 (ISS) 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, 2000. 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 231.1, *Environment, Safety, and Health Reporting* (DOE 1996a).

Site Environmental Report for Calendar Year 2000
Sandia National Laboratories, Albuquerque, New Mexico
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Prepared by:
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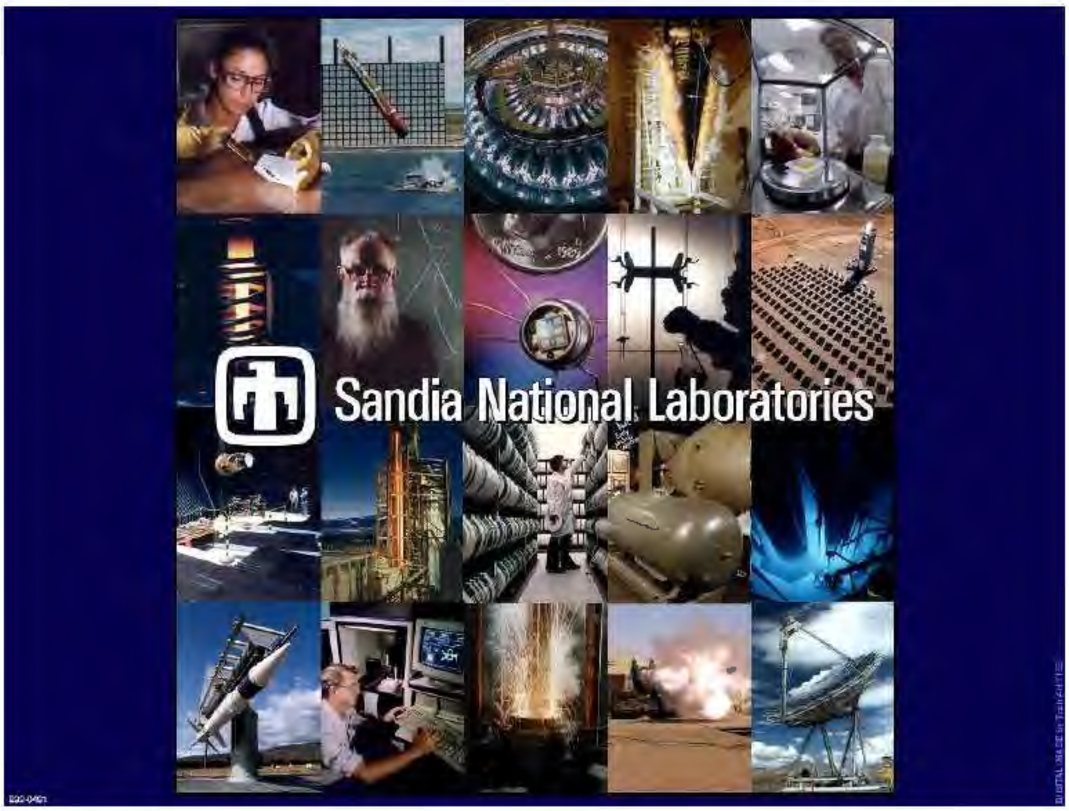

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Acronyms and Abbreviations

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
AEHD	Albuquerque Environmental Health Department
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
AMP	Analytical Management Program
AMPL	Advanced Manufacturing Process Laboratory
AQC	Air Quality Compliance
ARCOC	Analysis Request and Chain-of-Custody
ARPA	Archaeological Resources Protection Act
ASER	Annual Site Environmental Report
AST	above-ground storage tank
AT&T	American Telephone and Telegraph Company
AWN	Acid Waste Neutralization

B

BLM	Bureau of Land Management
BMP	Best Management Practice
BSC	Broad Spectrum Contrast

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 Service
CAT-1	Category 1 (higher than offsite values with an increasing trend)
CAT-2	Category 2 (higher than offsite values with no increasing trend)
CAT-3	Category 3 (not higher than offsite values with an increasing trend)
CAT-4	Category 4 (equivalent to community values with no increasing trend)
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
CIWL	Classified Waste Landfill
COD	chemical oxygen demand
CPAP	Contractor Performance Assessment Program
CPMS	Criteria Pollutant Monitoring Station
CRADA	Cooperative Research and Development Agreements

Acronyms and Abbreviations *(continued)*

CSRL	Compound Semi-Conductor Research Laboratory
CTF	Coyote Test Field
CWA	Clean Water Act
CWDR	Chemical Waste Disposal Request
CWL	Chemical Waste Landfill
CY	Calendar Year

D

D & D	decontamination and demolition
DCG	derived concentration guide
DCP	Discharge Control Program
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/HQ	U.S. Department of Energy/Headquarters
DOE/KAO	U.S. Department of Energy/Kirtland Area Office
DOT	U.S. Department of Transportation
DP	Discharge Plan
DQO	data quality objective
DSSI	Diversified Scientific Services, Inc.
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
EM	Environmental Management
EMS	Environmental Management System
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

F

FFCA	Federal Facilities Compliance Act
FFCO	Federal Facility Compliance Order
FGR	flue gas recirculation

Acronyms and Abbreviations *(continued)*

FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLAME	Fire Laboratory used for the Authentication of Models and Experiments
FONSI	Finding of No Significant Impact
FY	Fiscal Year

G

GAO	General Accounting Office
GEL	General Engineering Labs
GIF	Gamma Irradiation Facility
GPMPP	Groundwater Protection Management Program Plan
GSA	General Services Administration
GWPP	Groundwater Protection Program

H

HA	Hazard Analyses
HAP	hazardous air pollutant
HAZMAT	hazardous materials
HCF	Hot Cell Facility
HDRV	Historical Disposal Requests Validation
HE	high explosives
HERMES III	High Energy Radiation Megavolt Electron Source III
HLW	high-level radioactive waste
HSWA	Hazardous and Solid Waste Amendments
HWMF	Hazardous Waste Management Facility

I

ICP	Inductively Coupled Plasma
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectrum
IMRL	Integrated Materials Research Laboratory
INEEL	Idaho Engineering and Environmental Laboratory
IRP	Installation Restoration Program
ISMS	Integrated Safety Management System
ISRC	Intelligent Systems and Robotics Center
ISS	Integrated Safety and Security Center
ISS	Interim Storage Site
ITRI	Inhalation Toxicology Research Institute (now LRRI)
IWPP	Industrial Wastewater Pre-treatment Program

J

JCEL	Joint Computational Engineering Laboratory
JIC	Joint Information Center

K

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

Acronyms and Abbreviations *(continued)*

L

LANL	Los Alamos National Laboratory
LCBF	Lurance Canyon Burn Facility
LCBS	Lurance Canyon Burn Site
LDR	Land Disposal Restrictions
LDRD	Laboratories Directed Research and Development
LECS	Liquid Effluent Control System
LEED	Leadership in Energy & Environmental Design
LLW	low-level radioactive waste
LMF	Large Melt Facility
LRRI	Lovelace Respiratory Research Institute
LTES	Long Term Environmental Stewardship
LWDS	Liquid Waste Disposal System

M

MAC	maximum allowable concentration
MAPEP	Mixed Analyte Performance Evaluation Program
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
MCLG	maximimum contaminant level goal
MDA	minimum detectable activity
MDL	minimum detection limit
MDL	Microelectronics Development Laboratory
MEI	maximally exposed individual
MESA	Microsystems and Engineering Sciences Application
MIPP	Medical Isotope Production Project
MLLW	mixed low-level waste
MPCL	Material Processing Coating Laboratory
MSDS	Material Safety Data Sheet
MVF	Model Validation Facility
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
NMAC	New Mexico Administrative Code
NMAAQS	New Mexico Ambient Air Quality Standards
NMDOA	New Mexico Department of Agriculture
NMED	New Mexico Environment Department
NMSBA	New Mexico Small Business Assistance Program
NMWQCC	New Mexico Water Quality Control Commission

Acronyms and Abbreviations *(continued)*

NNSA	National Nuclear Security Administration
NON	notification of noncompliance
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
N/R	not required
NRC	U.S. National Response Center (phone # 1-800-424-8802)
NRC	U.S. Nuclear Regulatory Commission
NSPS	New Source Performance Standards
NSTTF	National Solar Thermal Test Facility
NTNC	Non-Transient, Non-Community
NTS	Nevada Test Site

O

ORPS	Occurrence Reporting Processing System

P

P2	Pollution Prevention
PA/SI	Preliminary Assessment/Site Inspection
PBR/SDP	Packed Bed Reactor/Silent Discharge Plasma
PBFA-II	Particle Beam Fusion Accelerator
PBT	Persistent Bioaccumulative Toxics
PCB	polychlorinated biphenyl
PEP	Performance Evaluation Program
PETL	Processing and Environmental Technology Laboratory
PG	Program Document (Sandia Corporation program overview document)
PHS	Primary Hazard Screen
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)
PPA	Pollution Prevention Act
PPE	personal protective equipment
PQL	Practical quantitation limit

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)
RMP	Risk Management Plan
RMSEL	Robotic Manufacturing Science and Engineering Laboratory
RMWMF	Radioactive and Mixed Waste Management Facility

Acronyms and Abbreviations *(continued)*

ROD	Record of Decision
RQ	reportable quantity
RVR	Robotic Vehicle Range

S

SABRE	Sandia Accelerator and Beam Research Experiment
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SATURN	(an accelerator facility)
SD	sustainable design
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer
SIC	Standard Industrial Classification
SLAMS	standards for state and local air monitoring stations
SMART	Sandia Modular Architecture for Robotics and Teleoperation
SME	Subject Matter Expert
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
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
STP	Site Treatment Plan
SUWCO	Sewer Use and Wastewater Control Ordinance
SVOC	Semi Volatile Organic Compound
SWEIS	Site-Wide Environmental Impact Statement
SWISH	Small WInd SHield (facility)
SWMR	New Mexico Solid Waste Management Regulations
SWMU	Solid Waste Management Unit
SWP3	Storm Water Pollution Prevention Plan
SWTF	Solid Waste Transfer Facility
SWRP	Southside Water Reclamation Plant

T

TA	Technical Area
TAG	Tijeras Arroyo Groundwater
TAI	Tijeras Arroyo Intercept
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
TOMP	Toxic Organic Management Plan

Acronyms and Abbreviations *(continued)*

TOX	total halogenated organics
TPH	Total extractable petroleum hydrocarbons
TQ	threshold quantity
TRI	Toxic Release Inventory
TRU	transuranic (radioactive waste)
TRU/MLLW	transuranic waste/mixed low-level waste
TRU/MW	transuranic waste/mixed waste
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSS	total suspended solids
TTF	Thermal Treatment Facility
TTR	Tonopah Test Range
TU	Temporary Unit
TWA	time weighted average

U

UNM	University of New Mexico
UPS	Uninterrupted power supply
USAF	U.S. Air Force
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank

V

VCA	Voluntary Corrective Action
VCM	Voluntary Corrective Measure
VEP	Vapor Extraction Project
VOC	volatile organic compound

W

WA	Weapons Assembly
WDDR	Waste Description Disposal Request
WERF	Waste Experimental Reduction Facility
WIPP	Waste Isolation Pilot Plant
WQG	Water Quality Group

Acronyms and Abbreviations *(continued)*

Units of Measure

°C	degree centigrade	mb	millibar
cm	centimeter	mg	milligram
°F	degrees fahrenheit	mi	mile
ft	feet	mL	milliliter
g	gram	mph	miles per hour
gal	gallon	ppb	parts per billion
gpm	gallons per minute	ppbv	parts per billion by volume
hr	hour	ppm	parts per million
in.	inch	scf	standard cubic feet
kg	kilogram	sec	second
km	kilometer	sq ft	square feet
Km^3	cubic 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
m^3	cubic meter		

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)
mR	milliroentgen
mSv	millisievert (unit of radiation dosage)
Sv	Sievert
Ci	curie
pCi	picocurie
μCi	microcurie

Chemical Abbreviations

CO	carbon monoxide
Eh	redox
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
1,1,1,-TCA	1,1,1,-trichloroethane

Acronyms and 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)	35.32	Cubic feet (ft^3)
Centimeters (cm)	0.39	Inches (in.)
Meters (m)	3.28	Feet (ft)
Kilometers (km)	0.61	Miles (mi)
Square kilometers (km^2)	0.39	Square miles (mi^2)
Hectares (ha)	2.47	Acres
Liters (L)	0.26	Gallons (gal)
Grams (g)	0.035	Ounces (oz)
Kilograms (kg)	2.20	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)
Sievert (Sv)	100	roentgen equivalent man (rem)

Executive Summary

The U.S. Department of Energy (DOE) oversees operation of Sandia National Laboratories, New Mexico (SNL/NM) through the DOE, Kirtland Area Office (KAO), which reports to the DOE, Albuquerque Operations Office (AL). Sandia Corporation, a wholly owned subsidiary of the Lockheed Martin Corporation, operates SNL/NM. 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, 2000. 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 Nuclear Weapons 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 land withdrawal area generally consists of mountains and canyons vegetated with juniper, piñon, cactus, and drought-tolerant shrubs and grasses. The highest elevation within the land withdrawal area is just less than 8,000 ft. To the west, the area grades into rolling hills and alluvial fans cut by arroyos. Further 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 mile 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 DOE's total property dedicated to SNL/NM facilities and operational areas is 8,824 acres (DOE 1999a). SNL/NM is one of the nation's premier national laboratories within the 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

All program activities are performed on a Calendar Year (CY) 2000 basis, unless otherwise noted.

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 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 non-radioactive, non-explosive, hazardous chemical wastes, including RCRA-hazardous waste, asbestos, polychlorinated biphenyls (PCBs), and biohazardous waste, are handled at this facility. A total of 12,233 individual chemical waste items (such as bottles, small bags, and lamp bulbs) were collected and cataloged at the HWMF in 2000. The HWMF shipped out the following waste categories:

Category	*Weight (kg)*
RCRA waste	70,458
Asbestos	31,432
PCBs (recycled & waste)	38,254
Biohazardous waste	396
Other recycled and chemical waste	6,453,335
Total shipped	6,593,875

- **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 2000, a total of 1,179,067 kg of solid waste was handled at the facility and an additional 744,484 kg of paper and cardboard was recycled.

- **RMWMF** – The RMWMF currently handles low-level radioactive waste (LLW), mixed waste (MW), transuranic waste (TRU), and TRU/MW. In 2000, the RMWMF managed the following quantities of radioactive waste:

Category	*Managed (kg)*
LLW	247,461
MW	109,074
TRU	7,790*

NOTE: The "Managed" column includes waste that was in inventory and waste that was generated at the close of 2000.
*This includes total inventory of TRU waste managed or stored at Radioactive Waste Operation facilities.

ER Project

The assessment and remediation of past and potential release sites due to Sandia Corporation's activities continue to be addressed by the ER Project. At the close of Fiscal Year (FY) 2000, there were 87 sites remaining to be addressed. Although the number of sites has been slightly reduced compared to the amount of sites at the close of FY99, 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 determined 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 2000, 10 sites with radiological issues were proposed for NFA.

Remediation activities continued at the Chemical Waste Landfill (CWL) and the Classified Waste Landfill (ClWL) in 2000. Remediation of all SNL/NM ER sites is expected to be complete by 2009.

Terrestrial Surveillance

Sandia Corporation conducts annual terrestrial surveillance sampling at various sites near SNL/NM facilities or in areas where contaminants could be expected to accumulate, as well as at sites from the surrounding community. Currently, soil, sediment, and vegetation are collected from on-site, perimeter, and off-site (community locations outside KAFB boundaries) locations. The terrestrial surveillance sampling objectives are to detect any potential releases or migration of contaminated material to off-site locations. In 2000, results were consistent with past years' sampling results. There were some sites that showed statistically increasing trends for some analytes, but the results for all of these sites were below average community concentrations. Other sites in areas of known contamination (usually associated with an ER site) were above off-site 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. In January 2000, the City of Albuquerque issued a Notice of Violation (NOV) to Sandia Corporation and DOE/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 20 one-time requests made for individual discharges to the ground surface. Surface discharges are only made with the approval of the Surface Discharge Program within the Environmental Management Department. All requests met NMED New Mexico Water Quality Control Commission (NMWQCC) 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 2000.

In 2000, there were six surface releases reported as occurrences and reviewed by the Surface Discharge Program. A surface discharge is defined as the spilling, leaking, pumping, pouring, emitting, or dumping into water or in a location and manner where there is a reasonable probability that the discharged substance will reach surface or subsurface water in such quantity as may with reasonable probability injure human health, animal or plant life, or degrade the environment. There was no discernable impact to the environment due to any of these surface discharges.

- **Storm Water Runoff** – In 2000, no analytical monitoring was required under NPDES. The NPDES Permit requires quarterly analytical sampling to be conducted in the second and fourth year of the five-year permit, weather permitting. The permit was reissued in 2000 for five years. The next required analytical sampling will occur beginning in October 2001. However, quarterly visual samples were collected at two points and inspected as described under "wet weather inspections" in Section 6.3.3. No unusual characteristics were noted. Sandia Corporation is in the process of expanding the storm water sampling locations from the current two stations to eight stations.

Groundwater Protection

Groundwater monitoring activities reported are those associated with Sandia Corporation's ER Project and the GWPP.

- **GWPP** – The GWPP conducts general surveillance of water quality from a network of wells not associated with the ER Project. During April and May 2000, 14 wells and one perennial spring were sampled during annual groundwater surveillance monitoring. An off-site laboratory using Environmental Protection Agency (EPA) protocols analyzed samples. Six out of the 14 wells sampled by the GWPP during the current year are wells normally sampled by the ER Project. Due to budget limitations in FY00, ER groundwater monitoring was not performed from May 2000 to September 2000. Monitoring results for these wells are summarized in section 7.2.2 and shown in Figure 7-2 of this report. Groundwater concentration trends are shown in Appendix E. Greystone well sampled for cadmium yielded concentration levels that exceeded the established maximum contaminant level (MCL) for drinking water. Previous samples from the same well did not indicate the presence of cadmium. Uranium-234 activity for SFR-2 and TRE-1 exceeded the DOE drinking water guidelines but not the newly established MCL for drinking water. These wells are located east of the Tijeras fault zone where high levels of uranium-234 occur naturally in groundwater. The results are consistent with prior data and are considered to be within background values. Additional details are provided in section 7.2.1 and Appendix E.

- **ER** – The ER Project collects groundwater samples at five general areas: the CWL, the 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 (VEP). 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 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 Lurance Canyon Burn Site (LCBS). Nitrate levels are highest in Sandia North wells. 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 five 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 2000.

- **Air Quality Compliance** – Sandia Corporation has not been 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 2000, there were 19 SNL/NM facilities reporting NESHAP-regulated emissions. The primary radionuclides released were tritium and argon-41. The results of the dose assessment showed that the maximally exposed individual (MEI) on-site received an effective dose equivalent (EDE) of 0.00350 millirem per year (mrem/yr). The off-site MEI received 0.0012 mrem/yr. Both doses are below 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).

NEPA Activities

Sandia Corporation's NEPA activities are coordinated with DOE/KAO. In November 1999, DOE 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 2000, the *SNL/NM Facilities and Safety Information Document* (SNL 1999a) and *SNL/NM Environmental Information Document* (SNL 1999b) was published. This SWEIS review represents the first annual review of SNL/NM activities in comparison to the original SWEIS analyses. In 2000, Sandia Corporation prepared 34 NEPA Checklists for proposed projects at SNL/NM. The DOE/KAO is responsible for making all NEPA determinations.

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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, 2000. The production of the ASER 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 (USFS) (Figure 1-1). The total area of DOE's property that is dedicated to SNL/NM facilities and operations is 8,824 acres. Sandia Corporation conducts its operations within five technical areas (2,842 acres) and several remote test areas. An additional 12,256 acres in remote areas are provided to DOE through land use agreements with the U.S. Air Force (USAF) (approximately 5,910 acres) and Isleta Pueblo (approximately 6,346 acres). Primarily the DOE, USAF, Bureau of Land Management (BLM), and the USFS own KAFB property. 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 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 below 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.

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

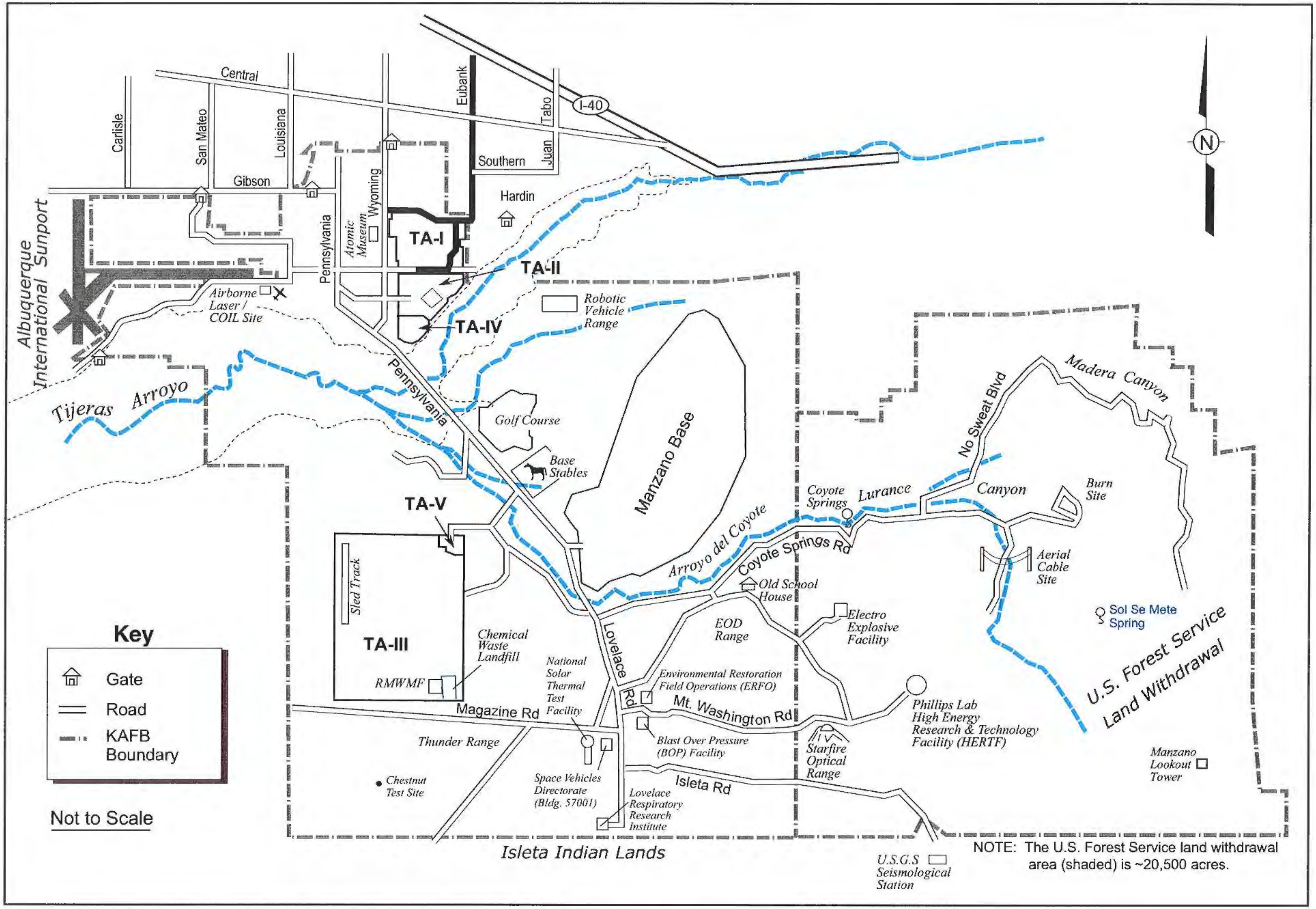

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FIGURE 1-1. Facilities Located on KAFB Military Complex Showing SNL/NM Technical Areas and the U.S. Forest Service Land Withdrawal dipping north-south faults that have created a series of down-dropped basins. There are up to five miles of structural 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 (P2), 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 AL completed the Site-Wide Environmental Impact Statement (SWEIS) 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 SNL/NM. 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

Sandia Corporation is the primary national security laboratory within DOE's complex and is the nation's leader for preventing technological surprises, anticipating threats, and providing innovative solutions to major strategic challenges. The programs at SNL/NM support the needs of the National Nuclear Security Administration (NNSA), the DOE, and other federal agencies. Sandia Corporation also works in close partnership with both universities and industry to remain on the leading edge of technology.

The primary mission of Sandia Corporation is focused on global security issues and defense-related technology programs for the 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 to respond to national security threats—both military and economic. Current defense work conducted at SNL/NM includes the weaponization of nuclear explosives (i.e., 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). 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 Sandia Corporation and its partners. Sandia Corporation conducts work under two primary categories: Laboratories Directed Research and Development (LDRD) and Cooperative Research and Development Agreements (CRADA). Recent technologies developed at SNL/NM are described on page 1-8 and 1-9, “Recent Developments From SNL/NM."

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

V http://www.sandia.gov

SANDIA VISION

Helping our nation secure a peaceful and free world through technology.

HIGHEST GOAL

Our highest goal is to become the laboratory that the U.S. turns to first for technology solutions to the most challenging problems that threaten peace and freedom for our nation and the globe.

377th Air Base Wing Host

SNL/NM is located on KAFB. 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, DOE/KAO, DOE/AL, and SNL/NM.

SNL/NM's History

In 1945, an extension of Los Alamos National Laboratory (LANL) supporting the Manhattan Project was set up at Sandia Base in Albuquerque, New Mexico (see shaded box).

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 Corporation 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.

The Manhattan Project

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

On July 16, 1945, the first successful test of a nuclear weapon was conducted at the Trinity Site in southern New Mexico. This was three and one half years after the U.S. was catapulted into World War II with the bombing of Pearl Harbor on December 7, 1941. World War II ended with the surrender of Japan on August 14, 1945.

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 Laboratories. AT&T accepted and began management on November 1, 1949, thus formally separating Sandia Laboratories from operations in Los Alamos. AT&T managed the Sandia Laboratories 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."

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

During the war era 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 World War II ended, cold war mission driven tasks took priority over environmental concerns. Waste management practices and environmental management programs during that time were inadequate throughout the DOE Complex, when judged by today's standards.

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

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 2009. Some sites will require long-term monitoring to ensure that any remaining contamination does not migrate from the site. Detailed information about ER/EM cleanup efforts throughout the DOE Complex can be found at DOE's website:

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

In 1989, DOE established 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.

DOE's Tiger Teams

In 1989, an initiative by the Secretary of Energy to conduct rigorous ES&H appraisals at DOE facilities formulated what became known as "Tiger Teams." On April 15, 1991 to May 24, 1991, a DOE Tiger Team conducted an appraisal at SNL/NM and identified 382 findings in areas of worker safety, fire protection, emergency response, and material accountability. Sandia Corporation has since completed all corrective actions resulting from this appraisal and is subject to routine self-assessments and ongoing external audits.

A History of Progress

Over the past ten 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 personnel at SNL/NM, clearly describes ES&H requirements for all levels of work conducted at SNL/NM. Improved 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. Recycling programs, P2, and other 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 over the last ten years.

1.2 SNL/NM OPERATIONAL AREAS

Technical Area I

Tech Area I is SNL/NM's center for administration and site support activities. Tech Area I is also 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 microelectronics technology. Work conducted here includes scanning electron microscopy, integrated circuit fabrication, silicon wafer testing, photolithography, etching, computer modeling and simulations, and device inspection.

- ***Processing and Environmental Technology Laboratory (PETL)*** – The primary capability of the PETL includes the specialized ability to carry out chemically intense research by using highly sensitive optical and electromechanical equipment.

- ***Advanced Manufacturing Process Laboratory (AMPL)*** – The primary capability of the AMPL includes 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*** – The mission of this laboratory is to increase the cost effectiveness of solar cell technology by using photovoltaic cells that concentrate and store solar energy

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

- ***Neutron Generator Facility (NGF)*** – The NGF fabricates war reserve neutron generators that produce pulses of neutrons that initiate nuclear fission in nuclear weapons or physics tests. Neutron generators were manufactured at the Pinellas Plant in Florida; however in 1992, the DOE formally consolidated production at SNL/NM in accordance with the Arms Agreement between Russia and the U.S.

- ***Teraflops Computer*** – The Teraflops Computer, 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 Teraflops Computer, which was built in partnership with Intel Corporation, covers about 1,600 sq ft.

- ***Integrated Materials Research Laboratory (IMRL)*** – The IMRL conducts research to study 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 Laboratory*** – This facility conducts research 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 at this facility can be used to produce and accelerate ion beams of most elements.

- ***Steam Plant*** – The Steam Plant, built in 1949, has operated non-stop. 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 Laboratory*** – This Laboratory 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.

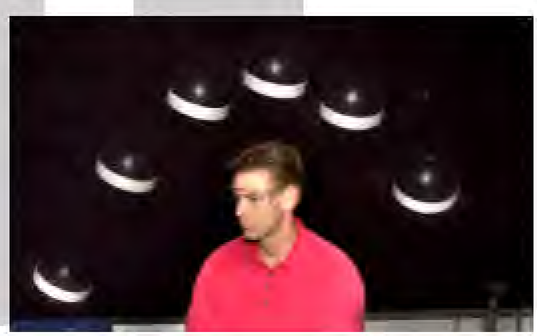
Recent Developments From SNL/NM

Portable Chemical Vapor Detection System – Sandia is developing a new chemical vapor detection system that can quickly identify 18 chemicals that are associated with the proliferation of weapons of mass destruction. The technology may also have applications related to environmental monitoring, industrial process control, and law enforcement use for drug detection.

Researchers Graham Yelton (left) and Richard Cornosek (right) watch as Alan Staton conducts a laboratory test using the light-weight portable chemical vapor detection system.

Hopping Robots – Sandia is developing a new type of robot that simulates the mobility of grasshoppers. The new robots may soon give robots unprecedented mobility for exploring other planets, gathering war-fighting intelligence, and assisting police during standoffs or surveillance operations. The new hoppers are powered by a gas combustion engine and can go as far as five miles on a tank of gas; much longer than a battery powered system.

Co-developer Gary Fischer demonstrates the leaping ability of the robotic hoppers, which can jump up to 20 ft high.



Robocop – The Remotee Andros 5A is being developed to assist the Albuquerque Police Department in handling dangerous situations or suspicious packages. The robot has three cameras, a gripper, and a double-barreled bomb disabler. This robot uses Sandia Modular Architecture for Robotics and Teleoperation (SMART) technology, which is a patented software-based robot control device that allows for a variety of robot components or functions to be integrated from off-the-shelf components.

Phil Bennett (right) discusses possible enhancements to the bomb squad robot to Detective Wayne Cunningham (left) and Patrolman Stephen Chester (center) during a recent training exercise.

Foldable Optical Mirrors – Sandia and researchers at the University of Kentucky have developed a piezoelectric thin film that may be the future for space telescope optical mirrors. The new lightweight material can be folded up and then deployed to its full size in space unlike conventional space telescope mirrors that are made out of polished glass. Once deployed, the thin film material can expand and change its shape using an exact electric field from a computer-controlled electron gun, thus allowing the mirror to assume the correct shape to within 10 millionths of an inch, which is the required accuracy for optical-quality imaging applications.

Tammy Hanson examines a new thin film, ultralight piezoelectric material that may be the future of space telescopes and surveillance satellites.

Smart Piglets – Sandia is developing ways to improve the current technology for inspecting the interior of oil and gas pipelines for cracks and corrosion. Conventional "pigs" are large and have limited sensors. Sandia Corporation's new "smart piglet" robot is loaded with sensors and has data imaging capabilities. Since they are also smaller, they can go through smaller pipes, around tight turns, and through valves.

A "smart piglet" inspects the interior of a pipe for corrosion, damage, and cracks.

Magnetic Fusion Machine – The ultimate goal of magnetic fusion is to create plentiful electric power. While there are several different ways to produce fusion, among the most promising is the Tokamak, a large doughnut-shaped magnetic confinement device. The word tokamak is an acronym derived from Russian words meaning "toroidal chamber and magnetic coil." One of the challenges with fusion technology is plasma impurities that can erode internal parts, thus impeding successful fusion. An SNL/NM researcher and external partners discovered a way to keep the fusion plasma from eroding the diverter walls by changing the nature of the plasma to a "detached diverter plasma," which utilizes deuterium in the plasma to cool the plasma near the diverter surface.

A man stands inside the DIII-D tokamak fusion machine, giving an idea of the machine's size.

- ***Robotic Manufacturing Science and Engineering Laboratory (RMSEL)*** – This facility is home to the Intelligent Systems and Robotics Center (ISRC). The ISRC 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.

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 consists of 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, cardboard, plastic, and aluminum.

Technical Area III

Tech Area III is the location of numerous 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 (LCBS) 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 (100 times the force exerted by gravity and/or acceleration due to gravity) 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 facility 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*** **(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, and 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 for validating 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 for capture of 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."

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 Tech Area IV:

- ***Z Accelerator*** – The Z Accelerator, formally known as the Particle Beam Fusion Accelerator-II (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.

- ***High Energy Radiation Megavolt Electron Source (HERMES III)*** – HERMES III is located 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.

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

- ***Short Pulse High Intensity Nanosecond X-Radiator (SPHINX)*** – The SPHINX is a 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 Laboratory*** – Several accelerators in this laboratory 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 below:

- ***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. The SPR III is currently in stand-by mode.
- ***Gamma Irradiation Facility (GIF)* –** This facility provides cobalt-60 gamma ray sources for simulating irradiation environments.

Remote Test Areas and Storage Facilities

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

- ***Manzano Storage Complex* –** The Manzano Storage Complex, located within Manzano Base, is a USAF-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.

CTF Remote Test Areas

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 USAF 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: the Small WInd Shielded (SWISH), an enclosed facility that reduces smoke and improves combustion; the Fire Laboratory used for the Authentication of Models and Experiments (FLAME); and a small bunker facility called the Igloo, which is 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 used to test robots over varied terrain. The Mobile Robotics Department operates the range as a branch of the ISRC.

- ***National Solar Thermal Test Facility (NSTTF) –*** The NSTTF, a 115-acre test facility, is devoted to the development of solar energy, including 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

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 USAF and SNL/NM facilities are built. The Albuquerque International Sunport, located 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 Sandia Mountains form a 21-km (13 mi) long escarpment distinguished by steep cliffs, pinnacles, and narrow canyons. Sandia Crest at 3,282 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, smaller arroyos, and washes.

Tijeras Arroyo

Tijeras Arroyo is 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 and extends 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. 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 (UNM) is studying the problem and working to preserve the bosque.

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 2001). 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-km (50-mi) radius of SNL/NM was 695,406 residents (DOC 2001). The Albuquerque metropolitan area alone has approximately 678,820 residents (DOC 2001). There are nine counties contained in all or part of this radius (Table 1-1 and Figure 1-2).

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 Rio Grande 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 is separated by long thin alluvial-filled valleys. 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 bound 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 channels, debris flow, 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.

TABLE 1-1. Counties Within an 80-km (50-mi) 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

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FIGURE 1-2. New Mexico Satellite Map

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

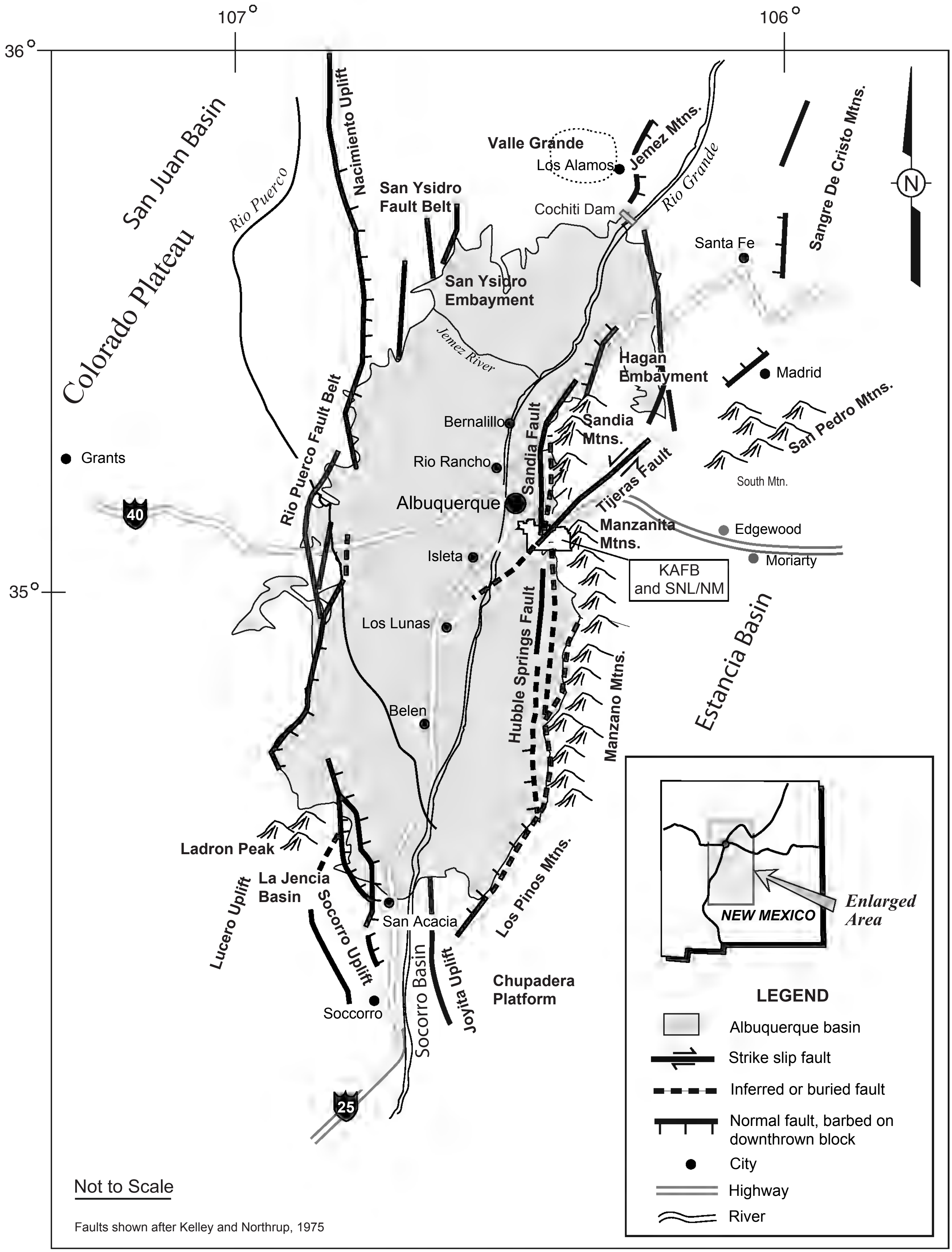

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FIGURE 1-3. The Albuquerque Basin, North Central New Mexico, Showing Bounding Faults and Uplifts

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 Tijeras 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 (at the south end 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, which are Tertiary in age (Lozinsky et al. 1991; Woodward 1982; Kelley and Northrup 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.

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 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 million years. 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.

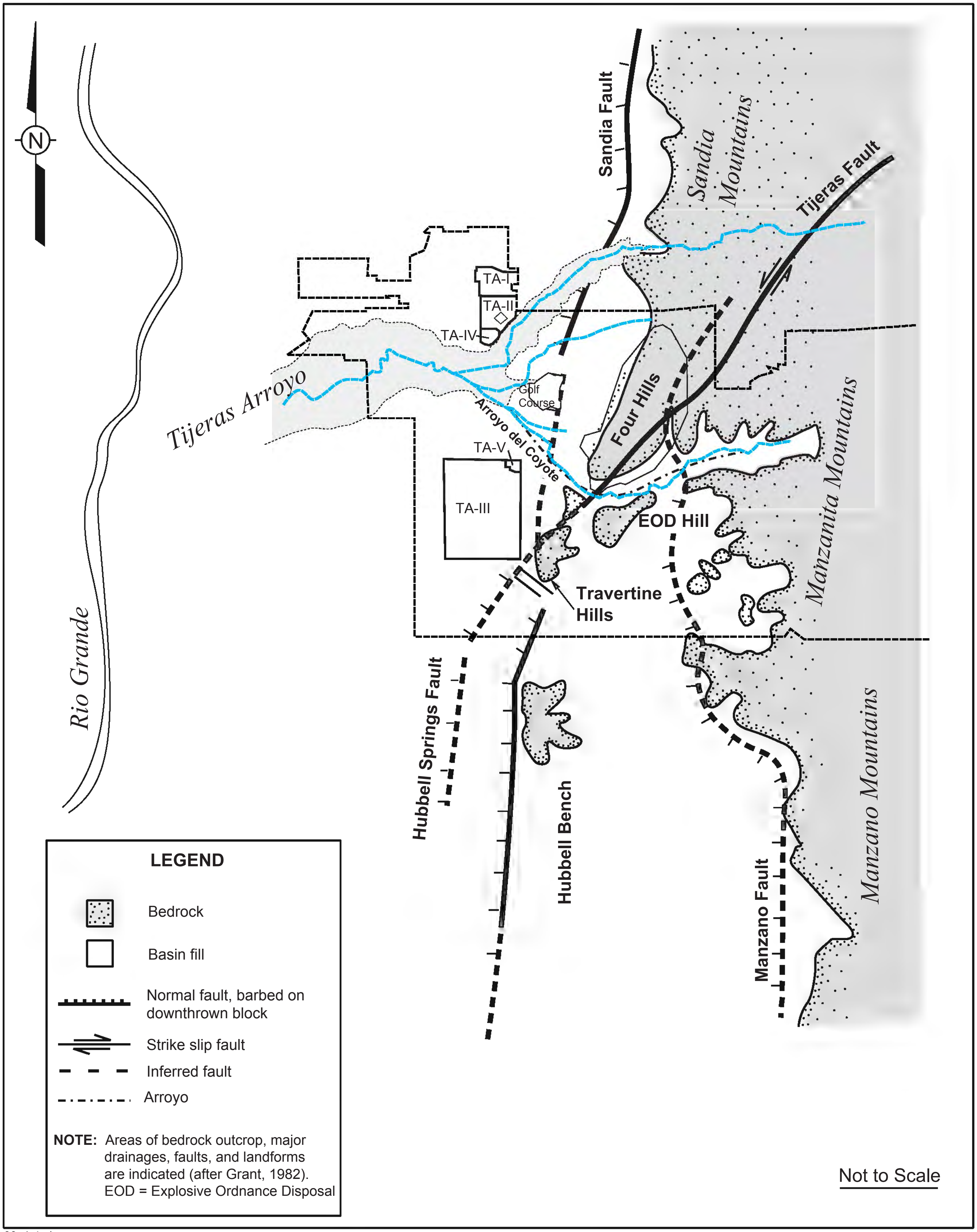

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FIGURE 1-4. Generalized Geology in the Vicinity of SNL/NM and KAFB

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 the 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 Socorro, 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:

V

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-mi 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, located west of Albuquerque, began erupting and 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. Mt. Taylor, 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 over three miles in the deepest part of the basin (SNL 1998).

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 Tijeras 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) (Thorne 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

Wide diurnal temperature extremes, monsoons, and frequent drying winds characterize the climate of the Albuquerque Basin.

Air temperatures are characteristic of high-altitude and 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 2001

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 weather systems that move across the southwest part of the U.S. 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 remaining 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 on-site. Table 1-3 lists some of the plants occurring on-site.

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 spruces, Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), gambel oak (*Quercus gambeli*), and quaking aspen (*Populus tremuloides*). Animals living here include Black bears (*Ursus americanus),* Mountain lions (*Felis concolor)*, Bobcats (*Felis rufus),* Mule deer (*Odocoileus hemionus),* rabbits, and squirrels. Numerous raptor species, such as hawks and owls, inhabit this zone.

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

The Ponderosa Pine or Transition Zone occurs in the higher elevations of the land withdrawal 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 lions, black bears, porcupines (*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

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

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

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*		

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*).

Raptor Migration in the Manzano Mountains

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 crests 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 Manzano Mountains located south of KAFB (fall migration). The station counts up to an average of 150 raptors each day during the fall migration.

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 seven miles from the western boundary 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 Rio Grande cottonwood *(Populus fremontii*), 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, rodents, reptiles, and amphibians. Red-winged blackbird (*Agelaius phoeniceus*), crows, owls, and woodpeckers are characteristic of birds found in this area.

Like the mountains, the river provides an important flyway and habitat for migrating birds. Geese, ducks, and sandhill cranes winter along the Rio Grande. Other birds present are turkeys, pheasants, quail, songbirds, and hummingbirds.

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Chapter 2

Compliance Summary

Sandia Corporation, as a prime contractor to the U.S. Department of Energy (DOE), strives to meet 100 percent regulatory compliance standards using the guidance contained in all applicable environmental regulations, statutes, and DOE Orders. Sandia Corporation conducts its operations 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 Program* (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, New Mexico (SNL/NM) (see shaded box on page 2-5). 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 and DOE Kirtland Area Office (KAO) for air, water, and waste are listed in a Table 2-7. Permit violations that occurred in 2000 are listed in Table 2-8.

2.1 COMPLIANCE STATUS WITH FEDERAL REGULATIONS

This section summarizes DOE/KAO and Sandia Corporation's compliance status with major environmental regulations, statutes, 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 U.S. National Response Center (NRC) at 1-800-424-8802. 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 2000. NRC information can be found at the following website:

V www.nrc.uscg.mil

On April 26, 2000, an internal self-assessment was conducted at the Micorelectronics Development Laboratory (MDL) of the hydrochloric acid (HCl) storage tank to ensure that the HCl concentration did not exceed the 37 percent threshold that would trigger the requirement for a Risk Management Plan (RMP) (40 CFR 68).

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)

EPCRA, also known as SARA Title III, 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 a presence of a threshold quantity (TQ) of extremely hazardous substances (EHS) equal to or greater than the threshold planning quantities or in specifically designated amounts as determined by the local community. Additionally, on August 3, 1993, Executive Order (EO) 12856, *Federal Agency Compliance with Right-to-Know Laws and Pollution Prevention Requirements* directed all federal agencies to comply with EPCRA. On April 21, 2000, EO 13148, *Greening the Government Through Leadership in Environmental Management*, superceded EO 12856, but strengthens and reiterates the goals of pollution prevention (P2) and reporting under EPCRA.

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. Awards and commendations are highlighted, where available.

Environmental performance is also tracked through the *National Nuclear Security Administration FY00 Multi-Program Laboratory Application of Sandia National Laboratories* (NNSA 2001) and *FY00 DOE/SNL Annual Appraisal Agreement* (DOE/SNL 2000). Through this process, performance measures are developed and tracked on a quarterly and annual basis. In Fiscal Year (FY) 2000, as part of laboratory operations support, performance measures were included for the following areas of Environment, Safety, and Health (ES&H) and Environmental Restoration/Waste Management (ER/WM):

- Integrated Safety Management System (ISMS)
- Comparison of Injury and Illness Rates and Lost Workday Case Rates
- Radiation Exposures and Radiological Operations
- Environmental Compliance
- Price Anderson Amendments Act
- Occurrence Reporting
- Environmental Restoration (ER) Site Closure
- Treatment and Disposal of Legacy Waste
- Treatment and Disposal of Newly Generated Waste
- Preventing Pollution and Conserving Resources

The FY00 National Nuclear Security Administration (NNSA) Multi-Program Laboratory Appraisal report indicated that, "SNL's Operations Support Performance Group is rated as Outstanding overall. The functional areas of Environment, Safety, and Health (ES&H) and Environmental Restoration/Waste Management (ER/WM)… are each rated Outstanding."

In addition, Sandia Corporation began exploring the possible enhancement of the ISMS to incorporate Environmental Management Systems (EMSs) in FY00.

EPCRA requires that the community 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.

On October 29, 1999, the EPA published a final rule under section 313 of the EPCRA, which lowers the Toxic Release Inventory (TRI) reporting thresholds for persistent bioaccumulative toxic (PBT) chemicals and adds certain other PBT chemicals to the TRI. These PBT chemicals are of particular concern, not only because they are toxic, but also because they remain in the environment for long periods of time, are not readily destroyed, and build up or accumulate in body tissue. Relatively small releases of PBT chemicals can pose human and environmental health threats. Consequently, releases of these chemicals warrant recognition by communities. The final rule includes lowered reporting thresholds for PBT chemicals and a special, lower, reporting threshold for dioxin. The rule also includes modifications to certain reporting exemptions and requirements for the chemicals newly subject to the lower reporting thresholds. EPA is developing guidance for dioxin and dioxin-like compounds and other PBT chemicals.

On June 27, 2000, the EPA deleted phosphoric acid from the list of chemicals subject to reporting requirements under section 313 of EPCRA of 1986 and section 6607 of the Pollution Prevention Act (PPA) of 1990 in response to the U.S. District Court for the District of Columbia ruling that phosphoric acid does not meet EPCRA section 313(d)(2) listing criterion. By promulgating this rule, the EPA relieves facilities of their obligation to report releases of phosphoric acid and other related waste management information that occurred during the 1999 reporting year and for activities in the future.

TABLE 2-1. 2000 SARA Title III (or EPCRA) Reporting Requirements Applicable to SNL/NM

Section	SARA Title III Section Title	Yes	No	N/R	Description
302 - 303	Notification/ Plans	✓			Sandia Corporation submits an annual report listing chemical inventories above the reportable Threshold Planning Quantities listed in 40 CFR Part 355 Appendix B, location of the chemicals and emergency contacts. The report is prepared for the DOE/KAO, which distributes it to the required entities.
304	Emergency Notification			✓	No RQ releases of an EHS, or as defined under CERCLA, occurred in 2000.
311-312	MSDSs/ Chemical Inventory Report	✓			There are two "Community Right-to-Know" reporting requirements: (a) SNL/NM completes the EPA Tier II forms for all hazardous chemicals present at the facility at any one time in amounts equal to or greater than 10,000 pounds and for all extremely hazardous substances present at the facility in an amount greater than or equal to 500 pounds or the Threshold Planning Quantity, whichever is lower; (b) SNL/NM provides MSDSs for each chemical entry on a Tier II form unless it decides to comply with the EPA's alternative MSDS reporting, which is detailed in 40 CFR Part 370.21.
313	Toxic Chemical Release Forms			✓	Sandia Corporation is below the reporting threshold in 2000 for producing a TRI Report for SNL/NM operations. SNL/NM has been below the reporting threshold for a TRI report since 1995.

NOTE: MSDS = Material Safety Data Sheets (gives relevant chemical information)
N/R = not required
RQ = reportable quantity
EHS = extremely hazardous substance
TRI = Toxic Release Inventory

There were no reportable releases at SNL/NM under EPCRA or CERCLA in 2000. Information on EPCRA can be found at the following EPA website:

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

TRI Reporting

EPCRA, Section 313, (40 CFR 372) requires that facilities with activities described in the Standard Industrial Classification (SIC) Code 20 through 39 that 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	
✓ Atomic Energy Act (AEA)	*Directs DOE and the U.S. Nuclear Regulatory Commission (NRC) in the management of nuclear materials and radioactive waste*
✓ Clean Air Act (CAA) and CAA Amendments (CAAA)	*Provides standards to protect the nation's air quality*
✓ Clean Water Act (CWA)	*Provides general water quality standards to protect the nation's water sources and byways*
✓ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	*Provides federal funding for cleanup of inactive waste sites on the National Priorities List (NPL) and mandates requirements for reportable releases of hazardous substances*
✓ Cultural resources acts	*Includes various acts that protect archeological, historical, religious sites, and resources*
✓ Endangered Species Act (ESA)	*Provides special protection status for federally-listed endangered and threatened species*
✓ Executive Orders (EOs)	*Two EOs provide specific protection for wetlands and floodplains*
✓ Federal Facilities Compliance Act (FFCA)	*Directs federal agencies in the management of mixed waste*
✓ Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	*Controls the distribution and use of various pesticides*
✓ National Emission Standards for Hazardous Air Pollutants (NESHAP)	*Specifies standards for radionuclide air emissions and other hazardous air releases*
✓ National Environmental Policy Act (NEPA)	*Ensures that federal agencies review all proposed activities that have the potential to affect the environment. NEPA provides an opportunity for public involvement for projects' potential significant impacts*
✓ Resource, Conservation, and Recovery Act (RCRA)	*Mandates the management of listed hazardous waste and materials*
✓ Safe Drinking Water Act (SDWA)	*Provides specific standards used for drinking water sources*
✓ Superfund Amendments and Reauthorization Act (SARA)	*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*
✓ Toxic Substance Control Act (TSCA)	*Specifies rules for the manufacture, distribution, and disposal of specific toxic materials such as asbestos and polychlorinated biphenyls (PCBs)*

Sandia Corporation began submitting TRI reports to the EPA and the 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 sulfuric acid was 10,000 lb. Bulk sulfuric acid in quantities exceeding this amount is routinely purchased for SNL/NM facilities. In 1995, the EPA changed the regulations to allow for the reporting of only aerosol forms of the acid, 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 hazardous chemical purchase inventory report. The *Supporting Documentation for the Hazardous Chemical Purchase Inventory, 2000 Reporting Year* (URS Corporation 2001) report 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.

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 on-site with the assumption that chemicals purchased are equivalent to chemicals used. The actual chemical inventory at any given point may be different from the purchase inventory.

Table 2-2 lists chemicals over 1,000 lb purchased in 2000 that are on the SARA Title III toxic chemical list and compares them to 1998 and 1999 purchases.

2.1.3 Resource Conservation and Recovery Act (RCRA)

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

New Rulings Under SARA Title III

New Fertilizer Rule

On April 15, 1999, a federal district court reversed the EPA's earlier denial of a petition by the fertilizer industry to remove phosphoric acid from the toxic chemical list. On June 27, 2000, the EPA proposed to remove phosphoric acid from the toxic chemical list.

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 PPA of 1990. A final rule is expected in 2001.

New Standards for PBT Chemicals

On October 29, 1999, a new EPA ruling was issued to address PBT chemicals, such as dioxin. Stricter standards will lower the threshold for TRI reporting. The PBT Rule is in effect for Calendar Year (CY) 2000.

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 with applicable RCRA requirements in 2000.

TABLE 2-2. 2000 Summary of SARA Title III Toxic Chemical Purchases at SNL/NM

Chemical Name	CAS Number	1998 Usage (lb/yr)	1999 Usage (lb/yr)	2000 Usage (lb/yr)
Aluminum oxide (fibrous forms)	*1344-28-1*	2,325	304	537
Catechol (pyrocatechol)	*120-80-9*	1,332	<1	<1
Dichloromethane (methylene chloride)	*75-09-2*	1,025	571	558
Ethylene glycol	*107-21-1*	2,691	932	966
Hydrochloric acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size)	*7647-01-0*	1,035	343	73
Isopropyl alcohol (manufacturing - strong process, no supplier notification)	*67-63-0*	4,479	3,439	3,080
Methanol	*67-56-1*	1,855	2,028	1,732
Nitric acid	*7697-37-2*	5,423	4,186	2,907
N-Methyl-2-pyrrolidone	*872-50-4*	2,999	233	308
Phosphoric acid	*7664-38-2*	1,600	*	*
Sulfuric acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size)	*7664-93-9*	30	52	30
TOTAL		24,794	12,089	10,192

NOTE: *EPA relieved facilities of their obligations to report releases of phosphoric acid and other related waste management information that occurred during the 1999 reporting year, and for activities in the future.
CAS = Chemical Abstract Service
lb/yr = pound per year

- **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 2000, the HWMF shipped a total of 70,458 kg of RCRA-regulated hazardous waste, including recycled hazardous materials.

- **Solid Waste** – Non-hazardous solid waste is regulated under RCRA "Subtitle D" and New Mexico Solid Waste Management Regulations (SWMR) administered by the Solid Waste Bureau. The SWTF screens, bales, and ships non-hazardous solid waste generated from SNL/NM. 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 for primarily paper and cardboard. In 2000, the facility handled 1,179,067 kg of solid waste and 744,484 kg of recycled paper and cardboard. About 60 percent of total recycled material was received from the following 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 SWMRs in 2000.

- **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 FY00, 87 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 28,577 kg of RCRA-hazardous ER waste in 2000. Sandia Corporation met all RCRA permit requirements for ER sites in 2000.

- **USTs** –USTs are regulated under RCRA "Subtitle I" and state regulations, which are at least as strict as the federal standards. In 2000, Sandia Corporation operated three registered USTs and met all regulatory requirements.

- **MW** – MW is dually regulated under RCRA and the Atomic Energy Act (AEA) of 1946. DOE Order 232.1A, *Occurrence Reporting and Processing of Operations Information* (DOE 1997) was issued adding additional requirements on radioactive and MW management. In 2000, a total volume of 608 ft^3 (17.2 m^3) was shipped off-site for treatment and disposal. Additionally, 81 ft^3 (2.3 m^3) was sent to the Waste Experiment Reduction Facility (WERF) and returned untreated on January 4, 2001.

  NOTE: Due to the significant weight of the containers, volume is the most efficient way to track MW.

- **Explosive Waste Disposal –** Explosive waste generated at SNL/NM is usually managed at the site of generation until it can be shipped for treatment because the HWMF does not accept explosive waste. SNL/NM has a permitted facility for the treatment of certain explosive waste streams; however, this facility was not used in 2000. The majority of explosive waste is transferred to KAFB's Explosive Ordnance Disposal (EOD) site for treatment. In 2000, 1,672 kg were sent to the EOD; 14 kg were sent to an off-site treatment facility; and two large rocket motors totaling 6,678 kg were sent to Hill Air Force Base for treatment.

- **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 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 one year during the completion of the CAMU. However, the TU option was never used.

2.1.4 Federal Facilities Compliance Act (FFCA)

On October 6, 1992, the FFCA was passed, establishing requirements for all federal facilities and amending the RCRA and the HSWA. On October 4, 1995, the NMED, the DOE, and Sandia Corporation entered into the Federal Facility Compliance Order (FFCO) for management of MW. States began to receive authorization to manage MW under hazardous waste requirements. Previously, federal facilities had sovereign immunity from some MW compliance requirements. The RCRA requires facilities to meet Land Disposal Restrictions (LDRs) for MW and implements a one-year maximum time limit for on-site storage. The management of MW is implemented by the state under "Hazardous Waste Management" (20 NMAC 4.1).

In 2000, six MW shipments were made from SNL/NM. A total of 340 ft^3 (9.6 m^3) of aqueous and organic liquids were shipped to Perma-Fix/Diversified Scientific Services, Inc. (DSSI) for thermal treatment. A volume of approximately 268 ft^3 (7.6 m^3) of soils and particulates were shipped to Envirocare of Utah, Inc. for stabilization. A volume of approximately 81 ft^3 (2.3 m^3) of mixed waste organic debris was shipped to the WERF for incineration, but was returned untreated to SNL/NM on January 4, 2001 because the incinerator at the WERF was being shut down. Currently, an investigation in the use of a Broad Spectrum Contract (BSC) is underway to include additional off-site treatment options.

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 AEA created the Atomic Energy Commission (AEC), which placed the control of atomic energy in civilian hands rather than military hands. The AEC later split into the U.S. 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 the DOE, the U.S. NRC, and the 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 the 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 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 and for 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 open burning. *Red alerts* are mandatory no-burn days 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 no exceedences in ambient air quality standards in 2000. In 2000, Sandia Corporation had 100 percent compliance with CAA and CAAA as determined by monitoring records at its six ambient air quality surveillance stations. The City of Albuquerque air quality website is:

V http://www.cabq.gov/environment.shtml

National Emission Standards for Hazardous Air Pollutants (NESHAP)

NESHAP regulates releases of hazardous air pollutants 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 to potentially exposed members of the public. The regulation requires that Sandia Corporation determine the maximum possible dose that could be delivered to an individual residing at a nearby location 24 hours per day. The result is the effective dose equivalent (EDE) to the maximally exposed individual (MEI). The dose is compared to the EPA standard of 10 millirem per year (mrem/yr) allowed from radioactive air emissions from a DOE facility.

In 2000, the MEI was located at the Kirtland Underground Munitions Storage Complex (KUMSC) just north of Tech Area V. The dose received at this location was 0.00350 mrem/yr or 0.0000350 millisieverts per year (mSv/yr). The off-site MEI was located at Tijeras Arroyo (West). The dose at this location was 0.0012 mrem/yr or 0.000012 mSv/yr. Both doses are below the EPA standard. Sandia Corporation met all NESHAP compliance requirements in 2000.

2.1.7 Clean Water Act (CWA)

The CWA sets forth goals to protect U.S. surface waters by controlling the discharge of pollutants. In relation 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 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 five wastewater monitoring stations, or outfalls, at SNL/NM permitted by the City of Albuquerque. Four of these stations discharge directly to the City of Albuquerque public sewer and one is a categorical pretreatment station that is located upstream of the general outfalls.

In 2000, three occurrences exceeded permit limits and requirements. The first occurred in January 2000 and was the result of not processing the proper permit. The process was temporarily shut down until the proper documentation was submitted to the City of Albuquerque.

In October 2000, the potential of hydrogen (pH) limit at permitted station 2069G was exceeded due to a site-wide power failure, which resulted in the failure of the control system. An additional pH violation occurred in October 2000 and was the result of the first pH excursion and low flow conditions. The City of Albuquerque did not penalize SNL/NM for any of the violations. Table 2-8 lists permit violations that occurred in 2000.

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 two permitted stations. Storm water sampling was not required in 2000. Analysis results indicated that several metals were 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 additional data becomes available, meaningful results will become more apparent. Section 6.3 discusses Sandia Corporation's 1999 storm water results. As stated in SNL/NM's storm water discharge permit, the next analytical samples will be collected in FY02.

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 containment areas must be first evaluated for compliance with regulations implemented through the New Mexico Water Quality Control

Commission (NMWQCC). Sandia Corporation issued 20 one-time surface discharge permits in 2000. Additionally, two evaporation lagoons in Tech Area IV are permitted by the NMED due to the routine nature of the discharges. The lagoons are used to contain and evaporate accumulated storm water pumped from the secondary containment areas around seven oil tanks, which support the pulsed power accelerators. All permit conditions for the two lagoons were met in 2000.

In 2000, there were six reportable surface releases that were reported as occurrences and reviewed by the Surface Discharge Program (Section 2.4).

2.1.8 Safe Drinking Water Act (SDWA)

The SDWA, passed in 1974 and amended in 1986 and 1996, sets national drinking water standards, surface water sources, and 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 the 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.:

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

In October 2000, the KAFB Water System was assessed and found to contain elevated levels of coliform bacteria exceeding the maximum contaminant level (MCL). Coliforms are bacteria that are naturally present in the environment and are used as indicators for the presence of other potentially-harmful bacteria. The EPA has not set a MCL for coliform bacteria, but has established a maximum contamination level goal (MCLG) of zero.

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 all drinking water regulations in 2000.

NOTE: Although it is KAFB's responsibility to meet regulatory monitoring and reporting requirements for potable water, SNL/NM's Industrial Hygiene Program routinely collects potable water samples in response to potable water concerns, which are analyzed for metals, coliforms, and chlorine.

2.1.9 Toxic Substances Control Act (TSCA)

TSCA addresses the import, export, use, and disposal of specifically listed toxic chemicals. In relation 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 HWMF. Sandia Corporation was in full compliance with the TSCA in 2000.

PCB – In 2000, the HWMF shipped 33,341 kg of PCB waste for disposal and 6,910 kg of PCBs for recycling.

Asbestos – In 2000, the HWMF shipped 31,432 kg of asbestos waste for disposal. Asbestos waste declined significantly from last year by 84 percent.

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. Copies of product labels and MSDSs are maintained for all pesticide products applied at SNL/NM. Sandia Corporation contracts with commercial certified pest control agencies when applying EPA-registered pesticides. SNL/NM maintains copies of certified pest control agency credentials. Sandia Corporation was in full compliance with the FIFRA in 2000.

2.1.11 National Environmental Policy Act (NEPA)

NEPA applies to federal government agencies or private entities that perform federally sponsored projects. NEPA requires federal agencies, including the 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 begins. Although a major intention of NEPA is to preserve the environment for future generations, the law does not mandate environmental protection, but 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.

2000 NEPA Documentation

During 2000, Sandia Corporation prepared a total of 34 DOE NEPA Checklists for actions at the SNL/NM site and submitted these checklists to DOE/KAO for review and determination of whether an EA or an EIS would be required. SNL/NM personnel supported DOE in preparing one EA in 2000:

- **DOE/EA-1335** – Environmental Assessment for the Microsystems and Engineering Sciences Applications (MESA) Complex, September 2000, Finding of No Significant Impact (FONSI) issued October 1, 2000.

In addition, there were 18 U.S. Air Force (USAF) Environmental Checklists (AF-813 forms) submitted for SNL/NM projects on KAFB property. SNL/NM personnel supported DOE in preparing two USAF EAs for the following projects:

- Environmental Assessment for Land-Use Modifications to Support the SNL/NM

Model Validation and System Certification Test Center in TA-III (SNL 2000f)

- Environmental Assessment for a 5-Year Permit Request for Two-Way Roadway West of Building 894 for Service/Emergency Access, PERM/0-KI-99-0001 (SNL 2000g)

NOTE: SNL/NM NEPA Program files do not contain copies of USAF NEPA determination documents for these two EAs. These NEPA determination documents can be obtained from the KAFB, 377th Civil Engineer Squadron (CES/CEV), Information Management Site, 2050 Wyoming Blvd. SE, Albuquerque, NM 87108 (505) 846-4377.

2.1.12 Endangered Species Act (ESA)

ESA applies to both the activities of private individuals and federal agencies (Section 7 of ESA specifically applies to federal agencies). At SNL/NM, ESA compliance is coordinated with NEPA compliance reviews. 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.

Wildlife

There are several state and federally-listed threatened and endangered species that have the *potential* to occur in Bernalillo County as shown in Table 2-3. Two state-listed threatened species have the potential to occur on KAFB. These include the spotted bat (*Euderma maculatum*) and gray vireo (*Vireo vicinior*). The gray vireo nests in the withdrawn area. Two state-listed species that could be transients through KAFB, include the bell's vireo (*Vireo bellii*) and baird's sparrow (*Ammondramus bairdii*).

TABLE 2-3. Threatened, Endangered, and Sensitive Species Potentially Occurring in Bernalillo County, New Mexico

Species		Federal Status	State Status
MAMMALS			
Spotted bat	*Euderma maculatum*	--	Threatened
New Mexican jumping mouse	*Zapus hudsonius luteus*	--	Threatened
Black-footed ferret	*Mustela nigripes*	Endangered	--
FISH			
Rio Grande silvery minnow	*Hybognathus amarus*	Endangered	Endangered
PLANTS			
None listed			
BIRDS			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
Common black-hawk	*Buteogallus anthracinus anthracinus*	--	Threatened
American peregrine falcon	*Falco peregrinus anatum*	--	Threatened
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	--
White-eared hummingbird	*Hylocharis leucotis borealis*	--	Threatened
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered
Whooping crane	*Grus americana*	Endangered	Endangered
Bell's vireo	*Vireo bellii*	--	Threatened
Gray vireo	*Vireo vicinior*	--	Threatened
Baird's sparrow	*Ammodramus bairdii*	--	Threatened
Neotropic cormorant	*Phalacrocorax brasilianus*	--	Threatened

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

Plants

There are no plant species known to occur on KAFB that are currently listed as endangered by the New Mexico Forestry and Resource Conservation Division. Information on sensitive plants and animals in New Mexico can be found at the New Mexico State Wildlife Agency website:

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

The *SNL/NM Environmental Information Document (EID)* (SNL 1999b), a supplementary document to the *SNL/NM 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 2000o).

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.

Historical properties, as defined by NHPA and implementing regulations, include archeological sites, historic buildings, and structures. Historic buildings and structures may include those over 50 years old that are significant, or younger structures of exceptional significance.

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 USAF property and on portions of the Cibola National Forest land withdrawal. Sandia Corporation's activities are usually planned to avoid potential impacts to such archeological sites. It is the DOE's responsibility to ensure that cultural resources are not adversely impacted by DOE activities.

SWEIS Maintenance

The SWEIS analyzed SNL/NM's operations, processes, site characteristics, and potential operational impacts for 1996 to 1997 baseline conditions and for expanded operations of selected facilities. In 2000, the "Fiscal Year 2000 Update Facilities and Safety Information Document and Environmental Information Document (Air and Water Chapters)" was published. This SWEIS review represents the first annual review of SNL/NM activities in comparison to the original SWEIS analyses. The annual reviews will support both ongoing NEPA compliance at SNL/NM and preparation of an expected supplement analysis by the DOE. Preparation of a supplement analysis is a process used to determine whether the SWEIS continues to represent the environmental impacts of SNL/NM operations, or whether a supplemental or new SWEIS should be prepared.

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 2000o).

Historical Building Assessment

In 2000, information was prepared to assist the 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 1,000 ft^2 that were built or acquired before 1990. These buildings have been documented on State of New Mexico Historic Building Inventory forms. The DOE will determine eligibility of Tech Area I buildings to the National Register in consultation with the New Mexico State Historic Preservation Officer (SHPO).

2.1.14 Environmental Compliance EOs

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

Floodplain Management, EO 11988 – This EO 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) (USACE 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 USAF property and the land withdrawal area, are managed by the USAF and the U.S. Forest Service (USFS). 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 DOE Orders

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

- 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).

In 2000, Sandia Corporation met all requirements stated in these orders.

2.2 CURRENT COMPLIANCE ISSUES AND ACTIONS

Environmental issues and actions current in 2000 relating to non-compliance or corrective actions at SNL/NM are discussed below.

- **MW Management –** Although Sandia Corporation is in compliance with the FFCO, the issue of compliance with regard to RCRA's LDRs (RCRA 3004j) remains. The FFCO acknowledges the lack of treatment capacity for MW and allows MW to be stored on-site 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 off-site disposal and off-site treatment (if not already treated at SNL/NM). The first off-site shipment of MW for treatment began in September 1996. On-site treatment of MW at SNL/NM began in 1997. However, it will be several years before all of the back accumulated MW stored on-site 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** – On October 1999, a 1-hour ozone standard was proposed to ensure that the public receives continued health protection from ground-level ozone. On July 5, 2000, EPA officially reinstated its 1-hour ozone standard in nearly 3,000 counties across the U.S.

- **Particulate Matter (PM) (Soot) Issue** – A new standard was developed for PM in 1998 to include particulates with a diameter less than or equal to 2.5 µm ($PM_{2.5}$). In 2001, the Supreme Court upheld the EPA decision to create a standard for $PM_{2.5}$, after an industry challenge. A proposed annual $PM_{2.5}$ standard of 15 µg/m^3 and a 24-hour standard of 65 µg/m^3 were established. The method for determining $PM_{2.5}$ exceedences will be concentration-based 98th percentile averaged over three years. The EPA has also changed the method of determining PM_{10} exceedences to a concentration-based 99th percentile averaged over three years. SNL/NM plans to monitor for $PM_{2.5}$ during 2001.

2.3 2000 AUDITS AND APPRAISALS

Operations at SNL/NM are routinely subjected to audits by external regulatory agencies including the 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-up 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 2001). Audits and appraisals conducted by external agencies in 2000 are listed in Table 2-4.

2.4 2000 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 the DOE's mission, security, or operations. This section describes environmental occurrences.

2.4.1 Occurrence Tracking

Occurrence reporting is tracked by the ES&H 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 1997), establishes a DOE system for identification, categorization, notification, analysis, reporting, follow-up, and closeout of occurrences. The DOE notifies appropriate agencies based on the nature of each occurrence.

TABLE 2-4. Environmental Program Audits and Appraisals Conducted in 2000

Appraising Agency	Title	Date	Summary
EXTERNAL AUDITS AND ASSESSMENTS			
DOE/KAO	Contractor Performance Assessment Program (CPAP) Annual Assessment	July 2000	An audit conducted in 2000 resulted in 16 findings, 19 observations (negative), and 32 noteworthy practices. Corrective action plans are being implemented and work is in progress.
INSPECTIONS AND OBSERVATIONS			
City of Albuquerque	EPS's Method 9 Visual Determination of Opacity	October 2000	Took 6-minute averaged opacity readings of operating Steam Plant Boilers 3 and 6. Satisfactory.
City of Albuquerque	First Annual Air Quality Compliance Inspection	October 2000	Inspected Steam Plant (Bldg. 605) and Standby Power Plant (Bldg. 862). No unusual conditions noted.
GAO	Monitoring Technologies for Measuring Emissions	October 2000	Review status of technologies for monitoring emissions
City of Albuquerque	Wastewater Discharge Permits 2069F	October 2000	Inspected several discharge points: Buildings 805, 806, 807, 893, and 894.
City of Albuquerque	Inspection: Wastewater Discharge Permits 2069A and 2069I	September 2000	Inspected several discharge points: Buildings 958, 981, 983, 905, 858, and 878.
City of Albuquerque	Inspection: Wastewater Discharge Permit 2069K	June 2000	Inspected several discharge points.
City of Albuquerque	Wastewater Discharge Permits 2069I and 2069F	January 2000	Pretreatment program inspection.
SAMPLING AND INSPECTIONS			
City of Albuquerque	Wastewater sampling and inspection	March , June, September, and December 2000	Collected routine samples and inspected five permitted wastewater discharge points.

NOTE: GAO = General Accounting Office
DOE/KAO = U.S. Department of Energy, Kirtland Area Office

Occurrence Categories

There are three types of environmental occurrences that are determined by the severity of the event as described in the shaded box on page 2-21. All significant releases in the first two categories are reportable to outside state and federal agencies and the 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.

ES&H Occurrence Reporting Guidance

An internal guidance agreement from DOE/KAO for categorizing occurrence reporting (in addition to environmental categories) was recently updated to include: (1) electrical shocks, (2) suspicious packages, (3) near-miss occurrences, (4) unauthorized firearm discharge, and (5) sealed source accountability limits. The *ES&H Manual*, Chapter 18, "Reporting, Investigating and Correcting ES&H Events," was updated in June 2000 to improve guidance for determining what constitutes an

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

Year	Waste Management	Surface Discharge or Water Quality	Air Quality	Other	Total Reportable Releases to the Environment
2000	0	10 (9)	0	1	11 (10)
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

NOTE: The numbers in parentheses for 1997 and 2000 represent the incidences for which an occurrence report was prepared.

occurrence and the proper reporting procedures (SNL 2000).

Emergency Preparedness at SNL/NM

Sandia Corporation's notification and communication procedures are given in the SNL/NM Emergency Plan (SNL 2000j). The plan also describes SNL/NM's major facilities, hazards, and potential chemical releases. In addition to Sandia Corporation and the 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, *A Comprehensive Emergency Management System*, provides the requirements for the SNL/NM Emergency Plan (SNL 2000j).

2.4.2 2000 Occurrences

There were ten reportable environmental occurrences in 2000.

1. **pH Excursion at the MDL** – On October 15, 2000, a loss of computer control in the Acid Waste Neutralization (AWN) system at the MDL caused a pH imbalance in the mixing tanks. This followed a power outage at the facility; however, the uninterrupted power supply (UPS) did not come online as designed. This resulted in an exceedence of pH at Wastewater Station WW007 (Permit no. 2069G-4). The City of Albuquerque issued a Notice of Violation (NOV) to the DOE/KAO and Sandia Corporation the following day. This occurrence was thought to be due to a faulty UPS and was therefore replaced.

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 off-site 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).

A second pH imbalance at the AWN occurred on October 29, 2000, which was also caused by a loss of computer control in the AWN system. This caused a pH exceedence at both Wastewater Stations WW007 and WW008 (Permit no. 2069I-4). The pH exceedance at WW008 was over the standard for greater than a one-hour duration.

The first occurrence was thought to be due to a faulty UPS at the MDL; however, after the second occurrence, MDL personnel evaluated the system and found that the root cause was due to a software problem in the AWN computer. The software was upgraded and the system was repaired.

NOTE: Both pH excursion occurrences were reported under one environmental occurrence report.

2. **Violation of Wastewater Discharge Permit at the MDL** – On December 8, 1999, the City of Albuquerque measured the concentration of fluoride at Wastewater Outfall Station WW007 at 68.6 mg/L, which was over the standard of 36 mg/L. On January 5, 2000, the City of Albuquerque issued a NOV to the DOE/KAO and Sandia Corporation for the fluoride excursion. Prior to this incident, fluoride effluent flowed through an unmetered system from the hydrofluoric acid neutralization vat to the mixing tank, which ultimately led to the City of Albuquerque's sewer system. To prevent a reoccurrence, a dedicated metering pump was installed between the hydrofluoric acid neutralization vat and the mixing tank. The procedures were modified to reflect the changes.

3. **Electroplating Operations in Process without Permit** – On January 21, 2000, DOE/KAO notified the Material Processing and Coating Laboratory that electroplating process operations at the laboratory did not have the necessary City of Albuquerque wastewater permit. As a result, the operation was shut down and the City of Albuquerque was notified. The required paperwork requesting a City of Albuquerque permit had not been completed and transferred to DOE/KAO before electroplating operations began. The Material Processing and Coating Laboratory provided DOE/KAO with all required paperwork for categorical processes, such as electroplating, and the appropriate permits were issued. To prevent similar occurrences, Sandia Corporation conducted a review of all potential categorical processes at SNL/NM. Additionally, since the policy of obtaining a permit was not adequately defined, disseminated, or enforced, the ES&H Manual will be updated June 30, 2001 to inform organizations of the permit requirements for categorical processes.

4. **Water Main Break** – On March 16, 2000, a 10-inch potable water supply line separated from a valve during installation of a storm sewer on 9th Street. The water was captured in the excavation and diverted to the storm sewer system. The cause was determined to be improper line installation. The valve separated from the line because the valve did not have the necessary thrust block installed. Due to the large volume of water released, the State of New Mexico was notified. Response was immediate and repairs were made in a timely manner. There was no impact to the environment.

5. **Residual Acid Leak from Secondary Containment at the MDL** – On April 10, 2000, a wet stain was discovered on the secondary containment stucco wall surrounding the bulk HCl storage tank at the MDL. Cleaning the area resulted in crumbling of the wall revealing a small hole

from which approximately one pint of HCl leaked out. The hole was immediately plugged until repairs could be made. Further investigation determined that the HCl had leaked from the secondary containment liner and became trapped between the liner and the wall. The residual HCl resulted from a previous spill into the secondary containment in June 1999. After cleanup of the June spill, MDL personnel were unaware that the liner had been compromised and HCl had leaked into the wall space. The secondary containment wall was repaired and the liner was replaced. All HCl was disposed of as hazardous waste. There was no impact to the environment.

6. **Migratory Bird Nest Damage** – On May 1, 2000, a concerned SNL/NM employee reported the removal of a swallow's nest, located near the main doorway to Building 6577 in Tech Area V, to their SNL ES&H Coordinator and the U.S. Fish and Wildlife Service (USFWS). Although the employee had a work order to remove the nest, the requesting organization was not aware that swallows are protected under the Migratory Bird Treaty Act (MBTA). Sandia Corporation's NEPA personnel were notified and the information was relayed to the DOE/KAO. The ES&H Manual will be revised to ensure that all employees and contractors are aware of which bird species are protected under the MBTA. Facilities will also develop a process for responding to bird control/removal requests or concerns.

7. **Sewage Release at the Reapplication Yard** – On June 9, 2000, 150 gallons of tap water and a small amount of sewer effluent were discharged to the surface during clearing of a sewer blockage. After the blockage was cleared, water was left running into the drain to assist with the flushing of the line. Facility personnel were called away from this job to assist with another job and left the water to run. The line eventually overflowed and discharged onto the surface and infiltrated the immediate area. There was no discharge to "Waters of the U.S." as defined in the CWA. Maintenance personnel were briefed about the importance of placing systems in a safe and operational condition prior to departure from a jobsite. There was no impact to the environment.

8. **Release of JP-8 at the Lurance Canyon Burn Facility (LCBF)** – On August 3, 2000, workers smelled fuel during the excavation of a trench to install conduit at the LCBF. Work was suspended for one week and soil samples were collected for analysis. Results of the analysis indicated that a JP-8 fuel release had occurred, but it was determined that this was an old release, which had not been previously detected. There have been no recent fuel spills at the LCBF due to strict adherence to fuel handling procedures. The LCBF is an active site that is under investigation by the ER Project.

9. **14-Inch PVC Waterline Rupture in Tech Area III** – On August 14, 2000, a ruptured PVC waterline was discovered along a road on the east side of Tech Area III. The 14-inch waterline split down its length releasing an estimated 1.2 million gallons of water. The water was immediately turned off after discovery of the waterline break, but it was estimated that it had flowed for approximately three hours, washing out part of the road. The loss of line pressure also significantly reduced fire suppression systems throughout Tech Areas III and V. Facilities personnel isolated the water and placed barriers around the affected roadway. The DOE/KAO, the NMED, and Sandia Corporation's Water Quality personnel were notified. The water infiltrated into the soil, but did not flow into any "Waters of the U.S." or impact any ER sites in the area. The cause was determined to be original damage to the PVC pipe during installation. The waterline was repaired within 48 hours. There was no impact to the environment.

10. **Loss of 10,000 Gallons of Water at the LCBF** – On October 31, 2000, site personnel discovered the loss of approximately 10,000 gallons of water from a non-potable water tank at the LCBF. There was no apparent discharge to the surface. An inspection of the area verified that all valves were closed and in proper operating condition. Further investigation determined that the water leaked from an underground rusted pipe, which allowed the water to infiltrate into the subsurface. To prevent a reoccurrence, a replacement pipe was installed aboveground. There was no impact to the environment.

Occurrence Report

On May 1, 2000, a concerned employee reported the removal of a swallow's nest, located near the main doorway to Building 6577 in Tech Area V, to their SNL/NM ES&H Coordinator and the U.S. Fish and Wildlife Service (USFWS). Although the worker had a work order to remove the nest, the requesting organization was not aware that swallows are protected under the Migratory Bird Treaty Act (MBTA). Corrective actions included revision of the ES&H Manual Chapter 10B. Information on the occurrence was also published in the Porcelain Press to increase the awareness of personnel at SNL/NM of the protected status of almost all bird species under MBTA. The Facilities Management and Operations Center has developed an improved process for responding to bird control/removal requests or concerns.

Stabilization of Archaeological Site LA53672

During the summer of 1999, while preparing to replace power line poles in Arroyo Del Coyote, a heavy equipment operator working under contract to SNL/NM inadvertently penetrated and disturbed portions of the surface and edge of the terrace on which archaeological site LA53672 is located. The disturbance uncovered cultural artifacts that were subsequently determined to be part of an eastern and previously undocumented portion of the site. In September of 2000, the site was stabilized by backfilling to prevent further damage that might be caused by erosion. This action followed an assessment by an archaeologist, preparation of a stabilization plan, and consultation and concurrence among the DOE, USAF KAFB, USFS (Cibola National Forest), and the New Mexico State Historic Preservation Officer (SHPO).

Environmental 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 is a release that goes beyond the DOE/KAO property or is 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 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 the DOE. The 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.

2.5 SUMMARY OF REPORTING REQUIREMENTS

External reporting requirements (other than to the 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 2000. 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 2000.

TABLE 2-6. Summary of Sandia Corporation's Reporting Requirements to Outside Agencies Other than the 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 to the NRC. 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 2000.	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
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
SARA = Superfund Amendments and Reauthorization Act
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 2000

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)	Tech Area IV, Lagoons I and II	DP-530	11/16/99	2/24/00 (renewal application submitted 11/24/99)*	NMED
UNDERGROUND STORAGE TANKS					
Emergency generator fuel (9,750 gallon)	Bldg. 862	06383	7/1/00	6/30/01	NMED, UST Bur.
Oil storage tank (20,000 gallons)	Bldg. 888	06384	7/1/00	6/30/01	NMED, UST Bur.
Oil storage tank (20,000 gallons)	Bldg. 888	06385	7/1/00	6/30/01	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	1/30/01	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)	9/21/00	EPA

NOTE: NMED = New Mexico Environment Department
EPA = U.S. Environmental Protection Agency
UST Bur. = Underground Storage Tank
*Additional information was requested by the State of New Mexico on February 14, 2001 and was submitted March 13, 2001. SNL/NM will continue to operate under the old DP-530 until the State of New Mexico issues a new permit.

TABLE 2-7. Summary of Environmental Permits and Registrations in Effect During 2000 *(continued)*

Permit Type and/or Facility Name	Location/Building	Permit Number	Issue Date	Expiration Date	Regulatory Agency
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)	4/30/00	6/30/03	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	1/1/01	12/31/99	New Mexico Department of Game and Fish
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)	Environmental Restoration (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 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 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.
NMED = New Mexico Environment Department

TABLE 2-7. Summary of Environmental Permits and Registrations in Effect During 2000 *(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-1-2000	1/1/00	12/31/00	City of Albuquerque
Fire Extinguisher Fire Training	Off 9th Street	76-OB-2-2000	1/1/00	12/31/00	City of Albuquerque
Burn Site (Open Pool Fire Tests)	Open Pool	76-OB-5-2000	2/18/00	1/1/01	City of Albuquerque
Burn Site (Bldg. 9830)	Igloo 9830	76-OB-3-2000	2/17/00	1/1/01	City of Albuquerque
Burn Site (Large Pool Fire Tests)	Large Pool	76-OB-6-2000	3/21/00	1/1/01	City of Albuquerque
Burn Site/Sled Track (Wood Crib Fire Tests)	Open Ring	76-OB-4-2000	2/18/00	1/1/01	City of Albuquerque
Explosive Testing	Coyote Canyon	76-OB-7-2000	5/1/00	12/30/00	City of Albuquerque
Alternative Fuel Tanks	Bldg. 6516	76-OB-8-2000	7/24/00	12/31/01	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
High Energy Radiation Megavolt Electron Source III (HERMES III)	Tech Area III, Bldg. 970	NESHAP	6/29/88	Approval††	EPA, Region VI
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 and Mixed Waste Management Facility (RMWMF)	Tech Area III, Bldg. 6920	415- M1	11/24/99	Biennial update	City of Albuquerque
Isotope Production Facility (HCF)	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
Chemical Waste Landfill (CWL) Excavation	Tech Area III, CWL	540	5/19/99	Registration	City of Albuquerque
Classified Waste Landfill (CIWL)	Tech Area II, Landfill	560	12/17/96	Biennial update	City of Albuquerque
CIWL	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, 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.
**Open Burn Permits are issued by the City of Albuquerque for no more than a year at any one time.
NESHAP = National Emission Standards for Hazardous Air Pollutants

TABLE 2-8. Permit Violations in 2000

Permit Number	Permit Type	Date	Type of Violation
--	Wastewater	January 21, 2000	Operations at the electroplating laboratory were shut down due to not having the necessary Wastewater Permit. The City of Albuquerque was notified.
2069G-4 (Station WW007)	Outfall	October 15, 2000	An exceedence in pH limits occurred for a duration of greater than one hour due to a site-wide power failure causing equipment failure, which resulted in pH levels in the mixing tanks becoming unstable.
2069I-4 (Station WW008)	Outfall	October 29, 2000	An exceedence in pH limits occurred for a duration of greater than one hour due to pH correction problems caused by power and equipment failure at permitted location 2069G-4.

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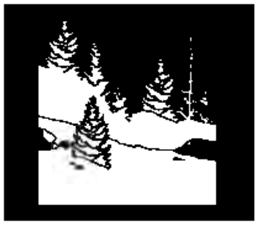

Chapter 3
Environmental Programs Information

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 Low-level Waste (MLLW) Management
- Solid Waste Management
- Biological Control Activity
- Pollution Prevention (P2) Program
- Oil Storage and Spill Control
- 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 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 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 the DOE, Kirtland Area Office (KAO), and 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 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.

3.1 ER PROJECT

Sandia Corporation's 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/KAO has oversight of 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.

In 1992, the ER Project at SNL/NM was officially initiated 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 SNL/NM site, 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.

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 scheduled for completion in 2009 with Long Term Environmental Stewardship (LTES) to follow. This date, however, may be subject to change based on available funding.

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 (HSWA) of 1984. 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 Hazardous Waste 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 Hazardous Waste 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/KAO, 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 NEPA regulations. In 1996, the ER Project prepared an Environmental Assessment (EA) to satisfy NEPA requirements (DOE 1996b). 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 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 (FY) 1992, 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 off-site locations had been investigated or transferred to other agencies. There are 87 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 environmental remediation activities.

3.1.2 Cleanup and Site Closures

Wastes 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 minor 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 and the Torrance County Landfill, just east of Albuquerque. LLW is sent to the Nevada Test Site (NTS) and MW is sent to Envirocare of Utah, Inc. (Envirocare).

In 2000, 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 site is removed from the RCRA permit, although responsibility for any future actions, should they become necessary, remain with the site owner. 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 off-site locations were investigated and proposed for NFA after assessment and/or remediation. Table 3-1 shows the ER Project status since 1992. Sandia Corporation continues 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.

TABLE 3-1. Summary of ER Project Status

	A	B	C	D	E	F **
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**
2000	**146**	**10**	**64**	**10**	**5**	**87**
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: NFA = No Further Action
** Column totals: F = A - C + E
Some of the original 219 sites included TTR, KTF, and other off-site areas in New Mexico and internationally.

3.1.3 2000 Status and Activities

At the close of 2000, there were 87 regulated sites remaining on Sandia Corporation's RCRA Part B Permit. During 2000, 20 sites were being actively remediated at SNL/NM. As the result of two Class III Permit modifications during 2000, a total of 64 sites were removed from the permit. In 2001, the ER Project expects to remove approximately 30 sites from the permit, as well as to propose seven more sites for NFA status. All NFA proposals (Class III Permit modifications) are available for review at the University of New Mexico (UNM) Zimmerman Library.

Project Highlights

Of the 20 sites undergoing remediation in 2000, the following three sites are highlighted:

- **Classified Waste Landfill (ClWL) (ER Site 2)** – The ClWL 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 175 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 FY02.

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

- **Chemical Waste Landfill (ER Site 74)** – The CWL was the most significant cleanup project remaining to be completed by the ER Project. Excavation at the CWL began in September 1999 and was completed in June 2001, with excavation to 12 ft. Some areas will be excavated deeper depending on the presence of debris and/or contaminated soil.

  In August 1999, the Vapor Extraction Project (VEP) 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 nine 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. FY00 groundwater results for the CWL are presented in Section 7.2.2 of this report.

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 adjacent to the 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). 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. In FY00, 501,660 ft^3 were sent to the CAMU.

The primary treatment processes at the CAMU will be soil washing and stabilization (cement added for solidification) and low-temperature thermal desorption, which will remove VOCs. 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 off-site permitted facilities. Once closed, the containment cell will be subject to long-term monitoring for at least 30 years.

LTES Plan

In 2000, Sandia Corporation and DOE began the formulation of a LTES Plan to address residual contamination that will remain at some ER sites after remediation. Initial cost estimates have been determined until 2070, although this is only a limitation of the budgeting software. Actual stewardship responsibilities by the DOE are not limited by that date.

A landfill worker inspects a large aluminum object excavated from the CWL.

In 2000, other activities conducted by the ER Project included media and public events for discussion of issues related to the Mixed Waste Landfill (MWL) and other sites that will be incorporated into the LTES Plan.

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 was the sixth year in a row (ending FY00) that the ER Project has received this rating, a very noteworthy achievement for Sandia Corporation.

3.2 WASTE MANAGEMENT

Waste management at SNL/NM is conducted under two departments: the Hazardous and Solid Waste Department and the Radioactive Waste/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 off-site sources such as SNL/CA, Los Alamos National Laboratory (LANL), and other DOE sites, as well as KAFB. Waste at SNL/NM is processed at three facilities: The HWMF, the 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 categorized and described in this section by waste management facility.

HWMF	RMWMF	SWTF
Hazardous & Chemical Waste	**Radioactive & Mixed Waste**	**Non-hazardous Solid Waste**
Hazardous	LLW	Sanitary
Biohazardous	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 HWMF.

3.2.1 Hazardous Waste Management Facility

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

The HWMF handles hazardous waste, asbestos, PCBs, non-regulated chemical waste, non-facilities biohazardous waste, used oil, various batteries, 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 (e.g., 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. A web-based Waste Description Disposal Request (WDDR) system is being projected for development in 2001. 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 waste remains segregated. The bays are designed with secondary containments to hold any spills and are equipped with earthquake shelving to withstand minor tremors. After sufficient quantities of items have accumulated in the bays, the items are packed into a larger container, which are 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 off-site 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 HWMF is sorted and recycled, where feasible. Asbestos and PCB waste is regulated under the TSCA. Asbestos is also regulated as a hazardous air pollutant under the NESHAP. The State of New Mexico regulates Biohazardous (infectious) waste. All applicable regulations for hazardous and chemical waste handled by the HWMF are listed in Appendix B.

2000 Activities at the HWMF

In 2000, a total of 12,233 individual items were handled by the HWMF. The HWMF shipped a total of 70,458 kg of RCRA-regulated hazardous waste (including recyclable waste). The bulk volume of waste normally handled by the HWMF is waste regulated by RCRA. However, in 2000, a larger than usual volume of contaminated soil was generated from ER projects. Table 3-2 summarizes waste handling operations at the HWMF over the last five years. Specific waste categories managed in 2000 are shown in Table 3-3 (1999 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 8,965 kg of RCRA hazardous waste and 6,715 kg of used oil was 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. A total of 29,294 kg of material was recycled in this category.

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.

TABLE 3-2. Five-Year Summary of Waste Shipped at the HWMF

Year	ER Wastes (Soils etc.) (kg)	Recycled (kg)	RCRA* Non-ER (kg)	Other Hazardous (kg)	Total Waste & Recyclables (kg)
2000	6,353,066	111,973	32,916	95,920	6,593,875
1999	31,477	128,383	56,210	270,587	486,869
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

NOTE: Routine recycled materials include batteries, used oil, mercury, and lights.
RCRA = Resource Conservation and Recovery Act
ER = Environmental Restoration
*The decrease in RCRA Non-ER waste shipped from the HWMF in 2000 compared to 1999 is due to a large amount of 2000 waste being shipped in 2001.

TABLE 3-3. Waste Shipped by the HWMF in 2000
1999 figures are shown for comparison.

Waste Categories Handled at the HWMF	1999 Waste Shipped (kg)	2000 Waste Shipped (kg)
RCRA Waste		
Hazardous Waste	56,210	32,916
Hazardous Waste (Generated by ER Project)	29,133	28,577
Recycled Hazardous Waste	19,271	8,965
Total	**104,614**	**70,458**
TSCA		
Asbestos	202,162	31,432
PCB	176	31,344
PCB (recycled)	4,168	6,910
Total	**206,506**	**69,686**
BIOHAZARDOUS		
Infectious Waste Total	**1,872**	**396**
OTHER		
Chemical Waste	64,506	30,861
Non-hazardous Solid Waste (RCRA Subtitle D)	1,871	1,887
Non-RCRA (Generated by ER Project)	2,344	6,324,489
Used Oil (recycled)	26,172	6,715
Lead (recycled)	0	60,089
Recycled (Other) – various batteries, fluorescent lamps, and non-PCB (ballasts, capacitors, and oils)	78,984	29,294
Total	**173,877**	**6,453,335**
Total Waste and Recyclables Shipped	**486,869**	**6,593,875**

NOTE: RCRA = Resource Conservation and Recovery Act
TSCA = Toxic Substances Control Act (primarily regulates asbestos and PCBs)

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 asbestos-containing building materials include floor, ceiling, and roofing tile, certain types of insulation, and other fire retardant construction material.

Similarly, in instances where laboratory equipment has asbestos-containing material in a non-friable form (which 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, ovens, and cable insulation, and. Asbestos waste from SNL/NM is disposed at a New Mexico landfill permitted to accept friable asbestos waste. In 2000, a total of 31,432 kg of asbestos waste was generated and disposed.

PCB Handling

PCBs are a class of organic chemicals that were widely used in industrial applications due to their practical physical and chemical properties. Use of PCBs included dielectric fluids (used in transformers, capacitors, etc.), hydraulic fluids, and other applications requiring stable, fire-retardant materials. Due to findings that PCBs may cause adverse health effects and due to their persistence and accumulation in the environment, the TSCA banned the manufacture of PCBs after 1978. PCB regulations, as promulgated in 40 CFR 761, include requirements specifying use, storage, marking, disposal, cleanup, decontamination, and record keeping.

Sandia Corporation has identified and replaced most PCBs and PCB-containing equipment. The largest source of regulated PCBs that remain in use at SNL/NM are capacitors contained inside fluorescent light ballasts manufactured before July 2, 1979. Other than ballasts, ten PCB regulated items remain in use or storage for reuse at SNL/NM. Eight areas of existing PCB spill contamination at SNL/NM are being actively managed through a regulatory use authorization. Significant quantities of PCB contaminated soils were generated in 2000 as a result of an ER project at the CWL.

PCB waste is managed by HWMF personnel and stored at an adjoining storage facility. PCB contaminated soils, generated by ER, are stored in two locations: the CWL and the CAMU.

In 2000, a total of 33,341 kg of PCB waste was shipped off-site, which included 25,264 kg of ER PCB contaminated soils for disposal, 1,093 kg other PCB waste for disposal, and 6,984 kg of PCB waste for recycling.

Explosive Waste

Explosive waste generated at SNL/NM is usually managed at the site of generation until it can be shipped for treatment because the HWMF does not accept explosive waste. SNL/NM has a permitted facility for the treatment of certain explosive waste streams; however, this facility was not used in 2000. The majority of explosive waste is transferred to KAFB's Explosive Ordnance Disposal (EOD) site for treatment. In 2000, 1,672 kg were sent to the EOD; 14 kg were sent to an off-site treatment facility; and two large rocket motors totaling 6,678 kg were sent to Hill Air Force Base for treatment.

3.2.2 Radioactive and Mixed Waste Management Facility

The RMWMF, located in the southeast corner of Tech Area III, manages LLW, MLLW, TRU, and TRU/MLLW. No high-level radioactive 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 MLLW generated on-site is processed through the RMWMF. However, some waste, which is already sealed and characterized, is put directly into temporary storage areas on-site. The waste processing functions at the RMWMF include waste characterization, segregation, treatment, packaging, storage, and shipment to permitted off-site facilities. Waste management includes the handling and processing of incoming waste as well as the management of the existing inventory in storage.

SNL/NM's Radioactive Waste

LLW – Most LLW in Sandia Corporation's inventory is radioactively-contaminated soils excavated from ER sites. Other LLW is decontamination and demolition (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.)

MLLW – MLLW 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.

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 Low-Level Waste (TRU/MLLW) – TRU/MLLW is a combination of radioactive and hazardous waste as described above.

Facilities at the RMWMF include Building 6925 where incoming MLLW is verified and stored. LLW is verified and stored at Building 6926. The primary waste handling facility, Building 6920, is equipped with a main control room for monitoring activities and controlling airflow 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 Buildings 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 MLLW. Applicable DOE Orders and regulations for radioactive waste and MLLW management are listed in Appendix B.

DOE Order 435.1 replaced DOE Order 5820.2a in July 1999. The new Order has significantly changed the way radioactive waste is managed at SNL/NM and a new procedure has been drafted to address the changes. Because of the Order, Sandia Corporation is also currently drafting a comprehensive plan for all radioactive waste disposal. All radioactive and MW generators must now contact the Radioactive Waste Program before generating waste and obtain prior approval. This will ensure that a proper waste pathway is in place before any waste is generated. The new Order now requires radioactive waste to be shipped off-site after a maximum storage period of one year, similar to the RCRA mandates for hazardous waste and MW. These changes require the RMWMF to characterize waste for shipment within one year, increasing the workload at the facility.

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 (Building 6596) in Tech Area V. Most MLLW and LLW stored on-site 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 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 mid to late 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.

2000 Activities at the RMWMF

In 2000, the RMWMF managed all four waste types (LLW, MLLW, TRU, and TRU/MW). LLW was shipped to Envirocare, the NTS, Perma-Fix/Diversified Scientific Services, Inc. (DSSI), and the Waste Experimental Reduction Facility (WERF) at the Idaho Engineering and Environmental Laboratory (INEEL). However, shipments to the WERF have since been discontinued.

Waste Generated by the ER Project in FY00

LLW (Managed) = 4,617 ft^3

MLLW (Managed) = 115 ft^3

TRU (None generated in 2000)

Sorting at the RMWMF

RMWMF personnel sort all radioactive and MLLW that has not been fully characterized. There are four sorting levels that 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 MLLW.

- **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 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.

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.

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

	Year	Managed (kg)	Shipped (kg)
LLW	2000	247,461 *(32,795 ft^3)*	160,317 *(12,097 ft^3)*
	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)*
MW	2000	109,074 *(8,096 ft^3)*	39,307 *(1,934 ft^3)*
	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)*
TRU	2000	7,790 * *(921 ft^3)*	0
	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

NOTE: The "Managed" column includes waste that was in inventory and waste that was generated at the close of 2000.
*This includes total inventory of TRU waste managed or stored at Radioactive Waste Operation facilities.

3.2.3 Mixed Waste Management

Regulatory Status

As discussed in Section 2.1.4, the Federal Facilities Compliance Act (FFCA) amended the RCRA and the HSWA to address, in part, 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 met all four calendar year 2000 milestone deadlines set by the FFCO and the Site Treatment Plan (STP) (SNL 2001a) regarding the treatment and shipment of specific existing back-stored MW at SNL/NM. The FFCO also requires Sandia Corporation to submit an updated STP annually. Sandia Corporation submitted an annual STP Update for FY00 in March of 2001. Sandia Corporation also submitted a proposed revision (Rev. 5) to the FFCO and is currently pending approval by the NMED.

Sandia Corporation remains in compliance with the FFCO, which allows for storage of MW on-site 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.

MW Treatment

Treatment of MW began at SNL/NM in 1997 and the first off-site shipment was made in 1994. Table 3-5 lists the current MW categories (TG-1 to TG-20 including TRU/MW) and the currently preferred treatment options for each category.

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	No waste currently in inventory
TG-2	0	Deactivation	Inorganic Debris with Water Reactive Component	No waste currently in inventory
TG-3	0	Deactivation	Reactive Metals	No waste currently in inventory
TG-4	0.24	Macroencapsulation	Elemental Lead	On-site and off-site treatment pursued through Envirocare
TG-5	0	Neutralization/ Stabilization	Aqueous Liquids (Corrosive)	No waste currently in inventory
TG-6	0	Amalgamation	Elemental Mercury	No waste currently in inventory
TG-7	0	Incineration	Organic Liquids I	No waste currently in inventory
TG-8	1.6	Thermal Desorption	Organic Debris with Organic Contaminants	Off-site incineration
TG-9	31.0	Macroencapsulation	Inorganic Debris with TCLP Metals	Off-site treatment pursued through Envirocare
TG-10	1.5	Sorting/Reclassification	Heterogeneous Debris	
TG-11	0	Hydrothermal Processing	Organic Liquids II	No waste currently in inventory
TG-12	3.1	Macroencapsulation	Organic Debris with TCLP Metals	Off-site treatment and disposal at Envirocare
TG-13	0	Deactivation/ Stabilization	Oxidizers	No waste currently in inventory
TG-14	0	Evaporative Oxidation	Aqueous Liquids with Organic Contaminants	No waste currently in inventory
TG-15	5.2	Stabilization	Soils <50% Debris and Particulates (w/TCLP Metals)	Treated on-site and off-site treatment and disposal at Envirocare
TG-16	0	Oxidation	Cyanide Waste	No waste currently in inventory
TG-17	15.5	Incineration	Liquid/Solid with Organic and/or Metal Contaminants	Off-site incineration and chemical oxidation pursued
TG-18	1.15	Incineration	Particulates with Organic Contaminants	Off-site incineration and chemical oxidation pursued
TG-19	0.06	Stabilization	Liquids with Metals	On-site and off-site treatment is being pursued
TG-20	0.3	Deactivation/ Stabilization	Propellant with TCLP Metals	On-site and off-site treatment is being pursued
TRU/MW	0.63	To Be Determined	TRU with Hazardous Components	Off-site options pursued

NOTE: Treatments are detailed in the *Compliance Order and Site Treatment Plan for Mixed Waste, SNL/NM (2000k)* (SNL 1999a) and the *Site Treatment Plan for MW, FY00 Update* (SNL 2001a).
TCLP = toxicity characteristic leaching procedure
m^3 = cubic meters
TRU/MW = transuranic/mixed waste

There are 11 on-site 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 items listed below are the treatments that have been performed on-site:

- **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 off-site commercial or DOE facilities for treatment and disposal, on-site treatment that removes the hazardous component, or re-characterization (identifying it as only radioactive or hazardous waste and not MW).

Status of MW Management in 2000

The majority of MW now being stored on-site consists of very low-level radioactive sludges from ER Project septic tank system closeouts, oils and absorbed oils, and radioactive metallic objects with RCRA metals. No off-site MW was received from other DOE sites in 2000. Six MW shipments were made in 2000:

- February 9, 2000 – Sandia Corporation shipped 6.0 m^3 of soils to Envirocare for stabilization.

- April 4, 2000 – Sandia Corporation shipped 0.03 m^3 of organic liquids to DSSI for thermal treatment.

- May 30, 2000 – Sandia Corporation shipped 1.6 m^3 of residual incineration ash to Envirocare for stabilization.

- July 17, 2000 – Sandia Corporation shipped 2.3 m^3 of organic debris to the WERF for incineration. This waste was returned untreated to SNL/NM on January 4, 2001.

- November 27, 2000 – Sandia Corporation shipped 2.9 m^3 of oils and organic liquids to DSSI for thermal treatment.

- December 19, 2000 – Sandia Corporation shipped 6.7 m^3 of septage to DSSI for thermal treatment.

3.2.4 SWTF Process Characterization

The SWTF handles non-hazardous sanitary solid waste consisting primarily of office trash, 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 recycled materials at SNL/NM.

The primary waste handling building contains a multi-story industrial compactor/baler. The disposal process at the SWTF begins with initial waste screening where 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, EO 13101 *"Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition"* mandates the level of recycling expected from government agencies. Monthly reports are sent to Sandia Corporation's P2

Group, KAFB, and LANL. Applicable DOE Orders and Regulations are listed in Appendix B.

SWTF Operations

All solid waste accepted at the SWTF 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. All non-recyclable solid waste handled by the SWTF is disposed of at the Torrance County Landfill, approximately 30 miles east of Albuquerque.

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 recycling efforts in 1999.

Recycled paper is sorted into two categories: "Mixed" and "White." Mixed paper contains mostly colored paper, newsprint, and magazines, 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 2000. Table 3-7 details the amounts of recycled materials from all cooperating agencies in 2000.

2000 Activities at the SWTF

A total of 1,179,067 kg of solid waste was compacted into 1,586 bales in 2000. This was 149,930 kg and 224 bales less than was managed at the facility in 1999. Conversely, total amounts of recycled materials greatly increased. This was largely due to the acceptance of recyclable materials from KAFB residential sources. A total of 744,484 kg was compacted into 1,163 bales. This was an additional 140,210 kg and 232 bales more recyclable materials than was handled in 1999.

TABLE 3-6. Solid Waste Transfer Facility (SWTF) Activity Summary for 2000

Category	Weight lb (kg)	Volume (yd^3)	Bales (each)
Solid Waste			
Total	**2,599,398** ***(1,179,067 kg)***	**3,009.6**	**1,586**
Other Recyclable materials			
White paper	881,230 *(399,719 kg)*	1,157.1	609
Mixed paper	48,562 *(22,027 kg)*	47.5	24
Cardboard	615,262 *(279,078 kg)*	889.2	467
Newsprint	96, 256 *(43,660 kg)*	119.7	63
Total	**1,641,310** ***(744,484 kg)***	**2,213.5**	**1,163**

TABLE 3-7. Recyclable Materials Received from Participating Agencies in 2000

Location	Category	Weight lb (kg)	Bales (each)
SNL/NM	White paper	269,546 *(122,264 kg)*	181
	Mixed paper	47,184 *(21,402 kg)*	24
	Cardboard	299,198 *(135,713 kg)*	229
LRRI	White paper	18,454 *(8,370 kg)*	13
	Cardboard	4,212 *(1,910 kg)*	3
DOE	White paper	5,892 *(2,672 kg)*	4
LANL	White paper	383,122 *(173,781 kg)*	268
KAFB	White paper	204,216 *(96,630 kg)*	143
	Newsprint	96,256 *(43,660 kg)*	63
	Cardboard	310,704 *(140,932 kg)*	235
	Total	**1,638,784** ***(747,334 kg)***	**1,163**

The SWTF works closely with P2 and Waste Minimization Program staff to implement existing and new recycling activities. In 2000, Sandia Corporation expanded the recycling program to include residential recycling for KAFB housing residents (newspapers and recyclable paper).

In 2000, several new initiatives were started at the SWTF including rendering unclassified electronic media unreadable using a degaussing program or shredding and recycling aluminum and plastic.

Recycling Recognition Award

The Air Force Materiel Command selected Kirtland's Recycling Tiger Team as one of only two winners of the General Ronald W. Yates Team Excellence Award. This was in recognition of the successful recycling program developed at KAFB in cooperation with Sandia Corporation. Residential and commercial recyclables from KAFB now include paper, cardboard, glass, aluminum, plastic, and metals.

3.3 WASTE MINIMIZATION AND POLLUTION PREVENTION (P2) PROGRAMS

3.3.1 Program Scope

The P2 Program was developed to infuse P2 practices into Sandia Corporation's corporate culture. The program focuses on reducing all waste streams—air emissions, water discharges, and hazardous, radioactive, and solid wastes. 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;
- Improve process efficiency;
- Create sustainable designs;
- Conserve energy, water, and resource use;
- Recycle/reuse potential waste items; and
- Procure products with recycled content.

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 staff provides background research on waste reduction technologies and products, performs cost-benefit analyses, and locates funding for new waste reduction processes.

Federal mandates given in EOs for the P2 and Waste Minimization efforts in federal agencies are listed in Appendix B.

P2 Awards

The year 2000 was the first year that Sandia Corporation received awards from NMED's prestigious Green Zia Environmental Excellence Program. There are three levels of awards: Excellence, Achievement and Commitment that are given to companies that have shown significant efforts to attain environmental excellence. Four SNL/NM organizations were recognized under the "Commitment Level" award this year:

- **Machine Shop –** Over the past several years, the Machine Shop has implemented a number of waste reduction processes focusing on the reduction of petroleum solvents and the substitution of less toxic chemicals. For example, petroleum-based hydraulic oils were replaced with soy-based hydraulic oil. Other improvements have included the purchase of oil skimmers and coolant recycling equipment. The average reduction of waste disposal costs at this facility has been $24,000 per year.

- **Sustainable Design (SD)** – Facilities received the award in recognition of using SD concepts during the planning and construction of a SNL/NM building. SD concepts included minimizing site disturbance, optimizing energy and water use, providing good indoor environmental quality, purchasing environmentally preferable building products, and recycling construction and demolition waste.

- **Steam Plant –** Ongoing efforts at the Steam Plant to reduce emissions included retrofitting boilers for fuel consumption. The overall plant efficiency has been increased by three to four percent and reduced emissions of nitrogen oxides by 10 percent. Annual fuel costs have been reduced by $46,000. Additionally, water pumping and cooling system improvements were implemented reducing water consumption and generating four million gallons less wastewater per year.

- **Environmentally Preferable Purchasing Program** – The Procurement Group won its award because of its strong commitment to ensuring that SNL/NM organizations purchase environmentally preferable products, whenever possible. A system has been developed that encourages SNL organizations to buy products containing recycled material such as paper, binders, toner cartridges, and plastic office items. In 2000, approximately 50 percent of all office supplies purchased contained recycled material.

Other Environmental Awards in 2000

Sandia Corporation was also recognized for the following additional awards:

- SNL/NM received an Honorable Mention under the 2000 Innovative Pollution Prevention Award that was awarded by the New Mexico Facility Managers' Network. This was in recognition of SNL/NM's continued "Reduction of Air Emissions through Process Optimization Project."

- The Environmental Protection Agency (EPA) awarded Sandia Corporation as one of its nation-wide "2000 Waste Wide Program Champions" in recognition of accomplishments in the federal government category in 1999. The award recognizes noteworthy practices for waste prevention, recycling, and purchasing recycled-content products.

3.3.2 Environmental Preferable Purchasing

Sandia Corporation purchases items that contain recycled material and are cost effective, where feasible. Common items include construction materials, vehicle products, landscape products, paper products, and non-paper office products. In 2000, 47 percent of purchases at SNL/NM were items that met the EPA's recommendations for recycled content.

3.3.3 SD Concept

SD is based on the idea that buildings, processes, and products should be designed and built with the environment in mind. The concept uses a variety of methods to reduce the environmental impact of human activities, including preference for renewable and or recycled materials, incorporating systems for water harvesting, using alternative energy, such as photovoltaics, and choosing building materials that will generate smaller quantities of waste and reduce energy use to manufacture, maintain, or dispose.

Sandia Corporation is revising its procurement procedures, standard construction specifications, and the Design Manual to reflect industry best practices for SD in the construction of large facilities. SD is also gradually being included in smaller projects site-wide. The goal is to minimize overall resource consumption by using building products with a high recyclable content and selecting materials and designs that will contribute to lower operational costs for the facility. SD also incorporate "indoor environmental quality" concepts such as maximizing natural light sources and incorporating harmonious meeting places for employees.

Integrating SD into construction projects at SNL/NM involves the collaborative effort of the Energy Manager, the Water Conservation Officer, the P2 Program, and facilities engineers and architects. SD team members look at materials, components, and systems from different perspectives and work together for the optimum solution. The solutions are based on the following parameters: quality of the workplace, initial cost, life cycle cost, overall efficiency, environmental impact, productivity, creativity, and future flexibility. SNL/NM uses the Leadership in Energy & Environmental Design (LEED) rating system and the U.S. Green Building Council to help establish design direction and design submittals for LEED criteria.

Several achievements for SD in 2000 include:

- The "Green conference room," which used recycled materials for carpeting, ceiling tiles, and renewable sisal material for wall coverings. The use of these materials not only reduced impacts to the environment, but also reduced costs by up to 50 percent over the use of traditional materials.

- Renovations to the Model Validation Facility (MVF), a 19,000 ft^2 building, were designed to incorporate day lighting to improve both indoor environmental quality and reduce energy costs by 30 percent. The design also incorporates water harvesting, use of recovered materials, and a "built-in" recycling center. Approximately 66 percent of all construction wastes were recycled and approximately 25 to 50 percent of all recovered material will be used in construction. The use of native plants in landscaping will provide a water-conserving, pleasing, southwestern look to the exterior of the facility. All the SD elements were incorporated within the original budget.

- The Joint Computational Engineering Laboratory (JCEL) and Microsystems and Engineering Sciences Application (MESA) (DOE 2000b) facilities, totaling over 400,000 ft^2, are both in the early design stages. Architects chosen to design these facilities were evaluated partially on their experience with SD. Because of SD practices, a 30 percent reduction in energy costs and is expected and both buildings are expected to receive the U.S. Green Building's LEED certifications.

3.3.4 Recycling and Waste Minimization

Sandia Corporation continues to work on improving recycling programs. As described under the waste management sections in 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 and construction materials. Table 3-8 summarizes the quantities of materials that Sandia Corporation recycled in all categories during 2000. 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, lead bricks, and BB's. Lead may be recast or reapplied. In 2000, a total of 60,239 kg of lead bricks and lead sheets were decontaminated and/or reapplied.

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

TABLE 3-8. Categories of Waste Recycled at SNL/NM in 2000

Recycled Categories	Weight (kg)
Scrap metal (steel, iron, stainless steel)	304,555
Concrete	8,319,849
Copper	4,400
Aluminum metal	17,468
Lead	60,239
Printed circuit boards	2,550
Engine oils	11,571
Toner cartridges	8,956
Batteries	15,741
Tires	1,044
Construction debris	712,431
Plastic	1,870
Mercury items	2,988
Transformers. Capacitors, and PCB items	10,488
Light bulbs (fluorescent, sodium, incandescent etc.)	10,007
Non-PCB light ballasts	8,667
Office paper (white and mixed)	143,717
Cardboard	135,752
Phone books	8,267
Aluminum cans	663
Other chemicals	295
Total	**9,781,518**

NOTE: kg = kilogram

3.4 BIOLOGICAL CONTROL ACTIVITY

The Biological Control Activity provides customer support related to animal control issues and compiles information on pesticide use at SNL/NM. Animal control support includes providing general information and resolving issues related to removing nuisance animals. Requests for assisting in resolving nuisance animal problems are relayed and documented through Sandia Corporation's industrial hygienists. This effort may entail interfacing, as necessary, with U.S. Air Force (USAF) and State of New Mexico agencies to resolve animal control issues. No animals were captured and/or relocated in 2000. The Biological Control Activity also involves providing support in addressing animal-borne disease concerns (e.g., Hanta Virus) through activities such as disinfecting, sanitizing, and cleanup of areas infested with rodents or pigeons.

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 pest control agencies. Material Safety Data Sheets (MSDS) and product labels 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 5.5 million gallons. In 2000, DOE owned 98 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 containment, although Sandia Corporation provides spill containment 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 these 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 rivers, lakes, oceans, water channels (tributaries) such as streambeds, and arroyos that connect to a river. 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 1999f). Regulated facilities are those that contain 660 gallons of oil or more in one container or 1,320 gallons 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 and substations,
- Temporary or portable tanks, and
- Other oil-containing equipment.

USTs

In 1990, the State of New Mexico adopted federal standards contained in RCRA Subpart I for USTs. There are three fiberglass USTs in inventory at SNL/NM: two 20,000 gallon tanks at Building 888 and one 9,750 gallon tank at Building 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 determining 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/KAO. Sandia Corporation provides DOE/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 personnel review projects for conformance to DOE-existing NEPA documents and determinations. For some projects, a NEPA checklist is prepared for DOE determination. DOE/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 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 451.1B, *National Environmental Policy Act Compliance Program* (October 26, 2000), 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)

As a matter of policy, the DOE prepares a SWEIS for each of its large, multiple-facility sites. In November 1999, DOE issued the final SWEIS for the SNL/NM site, and in December 1999, issued the Record of Decision (ROD). The ROD selected the "Expanded Operations" alternative as the preferred alternative.

The SWEIS allows DOE to "tier" its NEPA documents and reduce the need to revisit the same discussions for each new project proposed. By doing so, DOE can focus on project-specific issues in its NEPA determinations. In accordance with 10 CFR 1021, DOE will examine the SWEIS every five years to decide whether the analysis remains valid, or if a new or supplemental SWEIS should be prepared.

Integrated Safety Management System (ISMS) Software NEPA Module

In 2000, the ISMS Software development and NEPA teams worked together to field and test a development version of the ISMS Software NEPA Module. NEPA Subject Matter Experts (SMEs) and line organization personnel tested the NEPA Module in November and December. The use of the ISMS Software NEPA Module is expected to facilitate SNL/NM-internal project reviews citing existing NEPA documentation (such as the SWEIS), and to streamline preparation of DOE NEPA checklists, when required. The NEPA Module will support Quality Assurance by providing a consistent framework and by making NEPA compliance documentation and information readily available. The NEPA Module will also support DOE in response to information requests, and in supplying information for appraisals and audits.

Chapter 4

Terrestrial Surveillance Program

Terrestrial surveillance is conducted at Sandia National Laboratories, New Mexico (SNL/NM) to detect the possible migration of contaminated material to off-site locations and to determine the potential impact, if any, of SNL/NM's operations to human health or the environment. Terrestrial surveillance includes the collection of surface soil, vegetation, and sediment samples from on-site, perimeter, and off-site locations. Samples are analyzed for radiological and non-radiological (metal) constituents. Statistical and trend analysis is performed using results to compare individual sample locations and on-site and perimeter results with off-site results.

The Terrestrial Surveillance Program also measures external radiation exposure rates, using thermoluminescent dosimeters (TLDs) at on-site, perimeter, and off-site locations.

The Ecological Surveillance Program includes species and population studies of small mammals, birds, and vegetation at various locations on Kirtland Air Force Base (KAFB), as well as some limited contamination monitoring of small mammals.

4.1 PROGRAM BACKGROUND

Terrestrial Surveillance sampling began at SNL/NM in 1959 with the collection of environmental samples for radiological analysis. In 1983, external gamma radiation measurements began; in 1993, the program was expanded to analyze for non-radiological constituents in soils. Sediment sampling was also added to the program in 1993. In 1996, non-radiological analysis of vegetation samples began, as did the Ecological Surveillance Program.

4.1.1 Program Objectives

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

- Collect and analyze samples in order to characterize environmental conditions and define increasing or decreasing trends;
- Establish background levels of pollutants to define baseline conditions;
- Provide continuing assessment of pollution abatement programs;
- Identify and quantify new or existing environmental quality problems and their potential impacts, if any; and
- Verify compliance with applicable environmental laws, 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 designed and conducted in accordance with the requirements set by DOE Order 5400.1, *General Environmental Protection Program* (DOE 1990). Concentration limits for radiological and non-radiological in terrestrial media are not well defined; however, SNL/NM does compare the results from on-site and perimeter locations to off-site results to identify the possible impact to the environment. In addition, U.S. Surface Soil average concentrations, published in *Trace Elements in Soils and Plants* (Kabata-Pendias and Pendias, 1992), or local/regional surface soil average concentrations, published in *Elements in North American Soils* (Dragun and Chiasson, 1991), are used as points of comparison for non-radiological results. These publications provide a broad range of normal values for metals present in soils.

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

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

4.1.3 Statistical Analysis

Samples are generally collected from fixed locations to effectively make statistical comparisons with results from previous years. Statistical analysis is the process used to determine if a result is significantly different from off-site values or to determine if there is an increasing trend. Potential areas of concern are addressed with the appropriate program to minimize any effects. Since multiple data points are necessary to provide an accurate view of a system, the Terrestrial Surveillance Program does not rely on the results from any single year's sampling event to characterize on-site environmental conditions. Furthermore, results from a single sampling point may vary from year to year, due to 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.

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 Environmental Restoration (ER) Project.

4.2 SAMPLING LOCATIONS, PARAMETERS, AND TERRESTRIAL MEDIA

4.2.1 Sampling Locations

Annual sampling was performed in July 2000 at 72 fixed locations in three distinct areas:

- **On-site** – 39 locations
- **Perimeter** – 17 locations
- **Off-site** – 16 locations

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

Criteria for Choosing Sampling Locations

On-site – On-site sampling locations are selected within or near areas of past or present SNL/NM operations. This includes SNL/NM's five technical areas and active and inactive sites within the land withdrawal, such as the at Lurance Canyon Burn Facility (LCBF).

TABLE 4-1. On-site Terrestrial Surveillance Locations and Sample Types
There are 39 on-site sampling locations.

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

NOTE: *Replicate sampling locations: In addition to single samples taken for each medium, two replicate samples are collected for internal checks on comparability of sampling and analysis.

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	X	X		X
5	McCormick Gate	X	X		X
12	Northeast Perimeter	X	X		
16	Four Hills		X		X
18	North Perimeter Road				X
19	USGS Seismic Center Gate		X		X
39	Northwest DOE Complex				X
40	Tech Area I, northeast (by Bldg. 852)				X
58	North KAFB Housing	X	X		
59	Zia Park (southeast)		X		
60	Tijeras Arroyo (down-gradient)	X	X	X	
61	Albuquerque International Sunport (west)		X		
63	No Sweat Boulevard		X		
64 *	North Manzano Base	X	X		
65E	Tijeras Arroyo, east (up-gradient)		X	X	
73 *	Tijeras Arroyo (up-gradient)			X	
80	Madera Canyon		X		

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

TABLE 4-3. Off-site Terrestrial Surveillance Locations and Sample Types
There are 16 off-site sampling locations within a 25-mile radius of SNL/NM.

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

NOTE: *Replicate sampling locations: In addition to single samples taken for each medium, two replicated samples are collected for internal checks on comparability of sampling and analysis.
TLD = thermoluminescent dosimeter

Locations are primarily chosen near 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, meteorology, and the proximity to other sampling sites. On-site and perimeter sampling locations are shown in Figure 4-1.

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

Off-site – Off-site samples are collected from the community (outside of KAFB boundaries), within a 25-mi radius of SNL/NM facilities (shown in Figure 4-2). Sample locations are chosen in off-site areas where concentrations of pollutants are expected to be minimal.

New sampling locations are added, as necessary and as resources allow, to monitor changes resulting from SNL/NM's activities, such as new facility startups and the initiation of ER activities, or to better characterize an area if elevated values or increasing trends are present. Conversely, sampling locations may be dropped from the survey if historical data continue to show that there is no concern at a particular site. This allows resources to be allocated in higher priority areas. No changes were made to the sampling locations in 2000.

4.2.2 Terrestrial Sampling Media

The Terrestrial Surveillance Program currently analyzes surface soils, sediment, and vegetation for both radiological and non-radiological constituents. 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 as a result of surface water runoff. Approximately 1,500 g of soil is collected from the top two inches of soil using a hand trowel. Detailed sampling procedures are found in FOP 95-03, *Terrestrial Surveillance Operating Procedure* (Nieto 2001). In 2000, soil samples were collected from 50 locations (31 on-site, 13 perimeter, and six off-site locations).

Sediment – Sediment samples are collected from four on-site locations within Tijeras Arroyo and Arroyo del Coyote to determine the presence of potential waterborne pollutants. Perimeter samples are collected at up-gradient and down-gradient locations within Tijeras Arroyo near the KAFB boundary. Off-site sediment samples are collected from the banks of the Rio Grande and Las Huertas Creek. Approximately 1,500 g of sediment is collected in the same manner as surface soils.

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 no livestock are present on KAFB property. Grass samples are typically collected because of its abundance, but small leafy plants may be used where grass is not available. Approximately 500 g of vegetation is collected by cutting a few inches of growth from the plant(s). Detailed sampling procedures are found in FOP 95-03, *Terrestrial Surveillance Operating Procedure* (Nieto 2001). In 2000, samples were obtained from 28 locations (16 on-site, six perimeter, and six off-site locations).

Surface water – In 2000, with the concurrence of the DOE Kirtland Area Office (KAO), SNL/NM discontinued surface water sampling as part of the Terrestrial Surveillance Program, but storm water monitoring is still conducted in order to comply with the Clean Water Act (CWA). The only perennial surface water

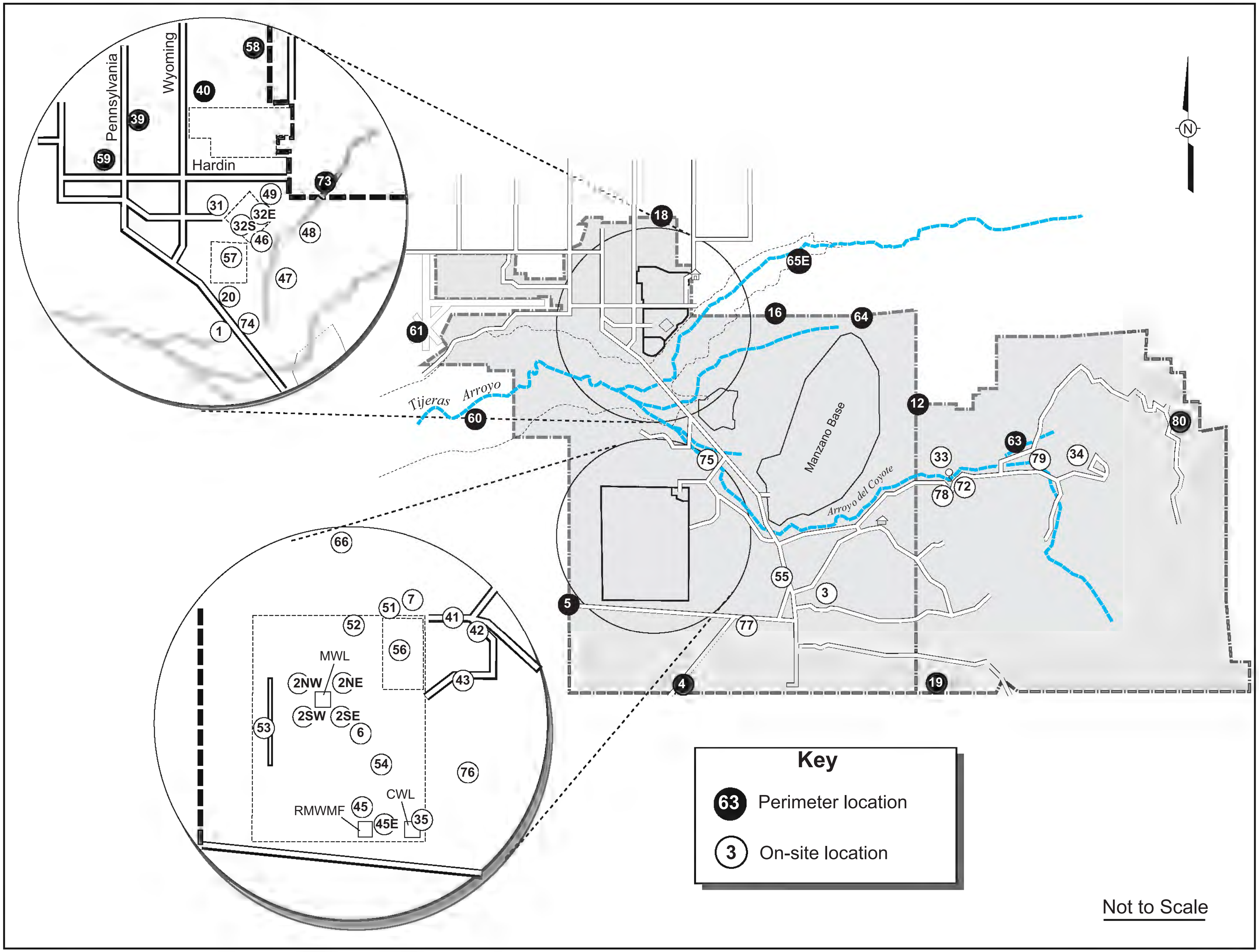

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FIGURE 4-1. Terrestrial Surveillance Program On-site and Perimeter Sampling Locations
On-site locations are within areas of SNL/NM operations. Perimeter locations are located both on and off KAFB property.

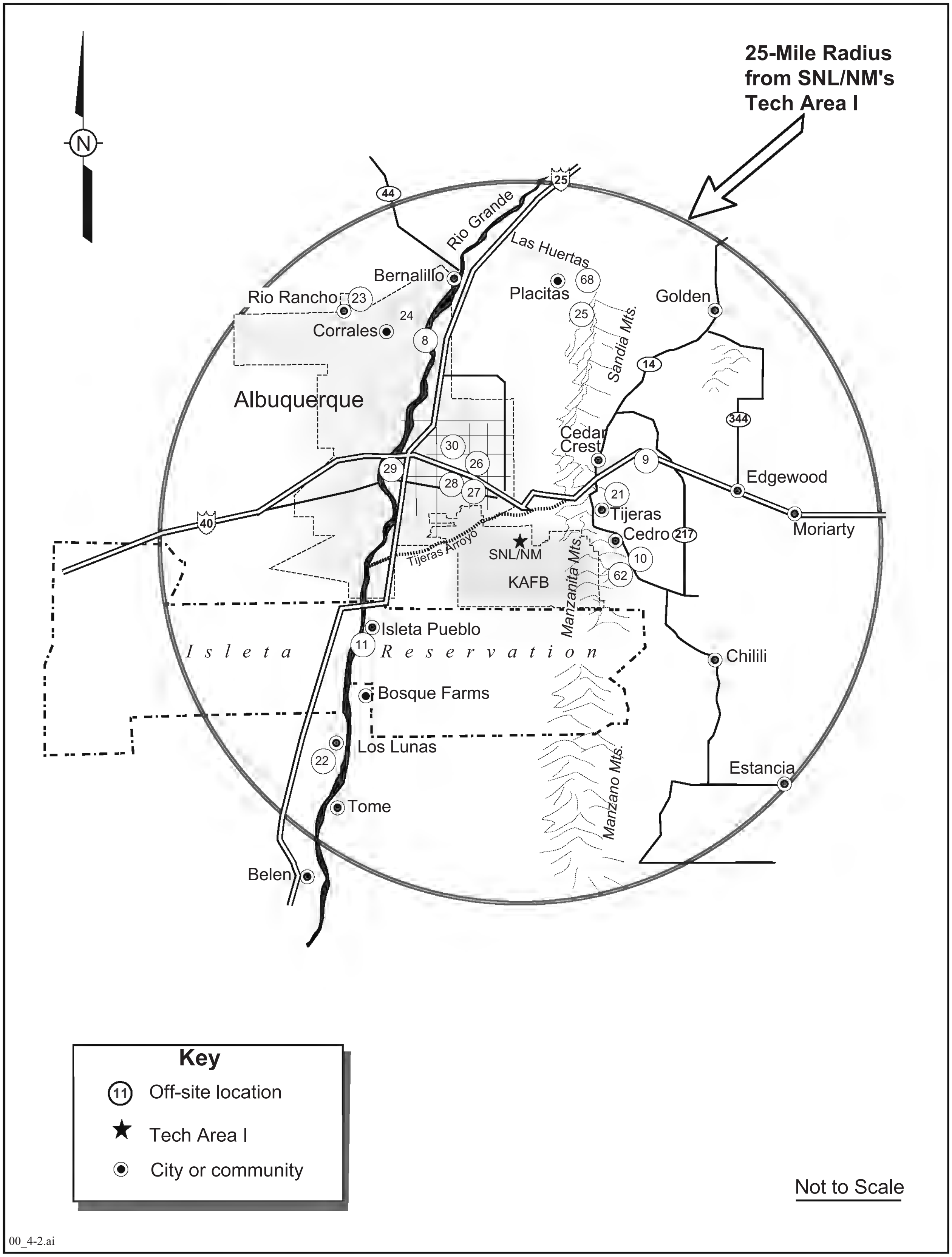

FIGURE 4-2. Terrestrial Surveillance Program Off-site Sampling Locations

available on KAFB property is at several springs located in and near Arroyo del Coyote and one spring located in the Manzanita Mountains. Coyote Springs is sampled by SNL/NM's Groundwater Protection Program (GWPP), the results of which are provided in Chapter 7 and Appendix E. Additionally, it was determined that there was little benefit or knowledge to be gained by continuing to perform a single, annual sampling event at off-site locations, as was done previously of the Rio Grande and Las Huertas Creek on the eastern slope of the Sandia Mountains.

4.2.3 Prioritization of Results

Terrestrial surveillance results are designated into 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 as Category 1 (CAT-1), Category 2 (CAT-2), Category 3 (CAT-3), or Category 4 (CAT-4). The decision matrix is shown in Table 4-4. A CAT-1 designation is the most significant concern level, indicating contaminants at an on-site or perimeter location that were both statistically higher than off-site values and demonstrating an increasing trend. (There have been no CAT-1 results to date). A CAT-2 designation indicates an on-site or perimeter result that is higher than off-site values, but with no indication of an increasing trend. A CAT-3 designation indicates an on-site or perimeter location with an increasing trend, but a concentration that is not statistically greater than off-site values. Finally, a CAT-4 designation indicates a sample result that is statistically equivalent to off-site values, with no increasing trends, and thus no concern is warranted.

Any CAT-2 or CAT-3 result is compared against U.S. Soil Surface Concentrations, where applicable.

Monitoring results for radiological and non-radiological parameters are discussed in sections 4.3 and 4.4, respectively.

New Analytical Laboratory in 2000

Terrestrial Surveillance samples were sent to a new analytical laboratory for Calendar Year (CY) 2000. This change may affect some of the trends noted in previous reports. In general, analytical results and detection limits appear to be lower for both radiological and non-radiological analyses. As a result, there has been an increase in the number of sample locations with decreasing trends. While the Terrestrial Surveillance Program believes that use of the new analytical laboratory will be a benefit in the long-term, changes in the statistical analysis methodology may be required in the future to compensate for the lower analytical values.

4.3 RADIOLOGICAL PARAMETERS AND RESULTS

4.3.1 Radiological Parameters

Radiological analyses are performed on all soil, sediment, and vegetation samples. The CY00 analytical results are presented in Appendix F of this report. In addition, the detailed statistical analyses are published in the *2000 Data Analysis in Support of the Annual Site Environmental Report* (SNL 2001b). Radiological parameters include:

- ***Gamma-emitting radionuclides*** – Gamma spectroscopy is used to detect the emission of gamma radiation from radioactive materials. Radionuclide identification is possible by measuring the spectrum of gamma energies associated with a sample, since each radionuclide has a unique and consistent series of gamma emissions.

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

Category	Are results higher than off-site?*	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 off-site 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 off-site, there may not be a statistically significant difference.

Cesium–137 is an example of a long-lived gamma emitter that is prevalent in the environment (as fallout from historical nuclear weapons testing) and is used as a possible indicator of environmental contamination from reactor facilities.

- ***Tritium*** **-** Tritium is a radioactive isotope of hydrogen with a half-life of 12.5 years. Unlike the most common element of hydrogen, which has a single proton in its nucleus, tritium contains one proton and two neutrons. Tritium occurs naturally at low levels in the environment and is also a common material in nuclear weapons research and development. Tritium levels are determined by first extracting the available water from the sample, and the analyzing the water using a liquid scintillation counter.

- ***Uranium*** – Uranium occurs naturally in soils, and may also be present as a pollutant in the environment, due to past testing conducted at SNL/NM. Total uranium analysis is used to measure all uranium isotopes present in a sample. A high total uranium measurement may trigger an isotope-specific analysis to determine the possible source of uranium (natural or man-made, enriched or depleted).

- ***External gamma radiation exposure rates -*** TLDs are used to measure ambient gamma exposure rates. Several natural gamma radiation sources exist, including cosmic radiation and radioactive materials that exist in geologic materials at SNL/NM. Many sources of low-level gamma radiation exist, such as reactor and accelerator facilities. The TLD network was established to determine the regional gamma exposure rate due to natural sources and to determine the impact, if any, of SNL/NM's operations on these levels. The dosimeters are placed on aluminum poles at a height of 1 to 1.5 m and are exchanged and measured quarterly (January, April, July, and October) at 34 on-site, perimeter, and off-site locations.

Change in TLD Station Status

In 1996, the Radioactive and Mixed Waste Management Facility (RMWMF) opened for operation. Gamma radiation exposure rates have increased in the immediate vicinity of the facility as a result of storing and handling low-level radioactive waste. The increase is detectable at two nearby TLD stations (locations 45 and 45E). Since the RMWMF is within a Tech Area III SNL/NM-controlled area, with higher allowable exposure rates than in uncontrolled areas, these TLD results are no longer considered in the statistical analysis of on-site results. These locations are considered "operational" and the quarterly results are provided to the Radiation Protection Operations personnel supporting the facility.

4.3.2 Overview Discussion of Radiological Results

No locations were identified as CAT-1 for any radiological parameter. Of the 49 on-site and perimeter locations, eleven were identified as either CAT-2 (higher than off-site) or CAT-3 (increasing trend) for any radiological parameter or matrix type (e.g., soil).

Although not discussed in the sections below, the statistical analysis showed multiple locations with decreasing trends for Cesium-137, tritium, or total uranium. Decreasing trends have been noted in the past, and were more prevalent in 2000 due to a change of using another analytical laboratory, which resulted in a decrease in detection limits and reported results for many analytes. To avoid masking a possible increasing trend, Sandia Corporation may change the trending start date to later than 1991 to compensate for the lower reported results.

Tables of summary statistics are provided in this chapter for each sample medium. CY00 data for each sampling location is presented in Appendix F. The data in this chapter is presented in the following basic sequence and format for each sample medium:

- Tables are provided showing summary statistics, over time, by sample grouping (i.e., on-site, perimeter, and community, for example Table 4-5). The information provided in these tables includes units of measure, the sample size (i.e., the number of data points used in the analysis), as well as the average, median, minimum, maximum, and standard deviation of each data set.

- Tables are provided showing the summary statistics, over time, for each location identified as CAT 2 and another for each location identified as CAT 3 in CY00 (e.g., Tables 4-6 and 4-7). The types of information provided in these tables are essentially the same, but apply only to the specific location.

False Uranium Trend

Beginning in 1997, statistical analysis showed an apparent increasing trend in the concentration of total uranium in soil at many on-site and off-site locations, which is an unlikely event, but worthy of investigation. It was discovered that the increasing trend was due to a laboratory error in 1991 and 1992, which resulted in the reporting of lower than actual results. The mistake was revealed in early 1999 during an audit at the analytical laboratory. In an interview with laboratory personnel, it was determined that there had been mechanical difficulties with the laboratory equipment used to measure total uranium during the 1991-1992 time frame. The laboratory 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 from 1991 and 1992 was deleted from the statistical analysis in 1999 and the analysis was run again to determine if the apparent trend was true. The adjusted data set showed no evidence of an increasing trend in uranium isotopes. Total uranium results from 1991 and 1992 are no longer used in the trend analysis.

4.3.3 Soil

No locations were identified as CAT-1 for soil. Table 4-5 shows the summary statistics for soil samples between 1991 and 2000 and identifies which locations were classified as either a CAT-2 or CAT-3. No new trends were identified in 2000 and several trends noted in 1999 were not observed this year. No CAT-2 or CAT-3 locations for total uranium were identified, and as a result, total uranium is not discussed below.

Cesium-137

Perimeter locations (12, 64, and 80) continue to be classified as CAT-2. Locations 12 and 80 are located on the U.S. Forest Service (USFS) land withdrawal area and Location 64 is located on the north end of the Manzano Mountains on KAFB property near the Four Hills subdivision. Locations 12 and 64 have been classified as CAT-2 for Cesium-137 since 1995. Location 80 is a newer sampling location that was added in 1995. Location 80 was first identified as a CAT-2 location in 1997. Table 4-6 shows the individual summary statistics for these individual locations. Cesium-137 is prevalent in surface soils world wide due to fallout from past nuclear weapons testing. Elevated Cesium-137 at these sampling locations is a result of higher elevations and not due to SNL/NM operations.

Two on-site locations (2NW and 33) and one perimeter location (59) continue to be classified as CAT-3. Locations 33 and 59 were first identified in 1999 as having a CAT-3 for Cesium-137. Location 2NW has been identified as CAT-3 since 1997. Locations 33 and 59 are located within KAFB boundaries, but outside of any SNL/NM operations. Table 4-7 shows the individual summary statistics for these locations.

Tritium

Three on-site locations (2NE, 32E, and 32S) continue to be identified as CAT-2. All three locations were first identified in 1995 as having higher concentrations of tritium than off-site locations.

All three of these locations are in areas of known tritium contamination. Locations 32E and 32S were proposed for No Further Action (NFA) under the ER project in June 1995. Note that the highest concentrations at these locations were observed prior to June 1995. Table 4-6 shows the summary statistics for these locations.

One perimeter location (64) continues to be identified as CAT-3 for tritium. This location was first identified as CAT-3 in 1999. Table 4-7 shows the summary statistics for this location.

4.3.4 Sediment

No locations were identified as CAT-1 for sediment. Table 4-8 shows the summary statistics for sediment samples between 1991 and 2000 and identifies which locations were classified as either a CAT-2 or CAT-3. No CAT-2 or CAT-3 trends were identified for Cesium-137, tritium, or total uranium.

4.3.5 Vegetation

No locations were identified as CAT-1 for vegetation. Table 4-9 shows the summary statistics for vegetation samples between 1991 and 2000 and identifies which locations were classified as either a CAT-2 or CAT-3. No CAT-2 or CAT-3 trends were identified for Cesium-137 or total uranium.

Tritium

One on-site location (2NE) continues to be identified as a CAT-2. This location was also identified as a CAT-2 for tritium concentrations in soil as discussed above. Table 4-10 shows the summary statistics for this location.

TABLE 4-5. Radiological Summary Statistics for Soil Samples (1991 to 2000)

Analyte	Location Type	Units	Sample Size	Average	Median	Std Dev	Min	Max
Cesium-137	On-site	pCi/g	402	0.29	0.2	0.27	-0.03	1.8
	Perimeter	pCi/g	160	0.45	0.24	0.47	-0.02	1.9
	Off-site	pCi/g	83	0.30	0.2	0.28	-0.06	1.2
Tritium	On-site	pCi/mL	409	17.59	0.115	150.29	-0.19	2300
	Perimeter	pCi/mL	164	0.21	0.08	0.75	-0.6	8.6
	Off-site	pCi/mL	83	0.07	0.04	0.15	-0.11	0.86
Total Uranium	On-site	µg/g	328	1.20	1.1	0.63	0.3	5.22
	Perimeter	µg/g	133	1.32	1.3	0.65	0.079	4.8
	Off-site	µg/g	66	1.69	1.6	0.78	0.3	3.7

NOTE: Summary statistics for total uranium only reflect 1993 to 2000.
Std Dev = Standard deviation
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter
µg/g = microgram per gram

TABLE 4-6. Summary Statistics for Soil Locations (1991-2000) Noted as CAT-2 During CY00

Analyte	Units	Location	Sample Size	Average	Std Dev	Min	Max
Cesium-137	pCi/g	12	14	1.09	0.42	0.43	1.8
		64	14	1.15	0.42	0.435	1.9
		80	6	0.96	0.42	0.37	1.5
Tritium	pCi/mL	2NE	14	33.65	49.56	1.48	200
		32E	14	208.65	471.70	-0.12	1800
		32S	14	249.19	614.69	0.0345	2300

NOTE: Std Dev = Standard deviation
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter

TABLE 4-7. Summary Statistics for Soil Locations (1991-2000) Noted as CAT-3 During CY00

Analyte	Units	Location	Sample Size	Average	Std Dev	Min	Max
Cesium-137	pCi/g	2NW	14	0.365	0.174	0.1	0.63
		33	14	0.307	0.176	0.05	0.63
		59	14	0.224	0.098	0	0.34
Tritium	pCi/mL	64	14	0.584	0.867	-0.12	3.2

NOTE: Std Dev = Standard deviation
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter

TABLE 4-8. Radiological Summary Statistics for Sediment Samples (1991 to 2000)

Analyte	Location Type	Units	Sample Size	Average	Median	Std Dev	Min	Max
Cesium-137	On-site	pCi/g	26	0.08	0.07	0.06	-0.02	0.24
	Perimeter	pCi/g	26	0.03	0.03	0.05	-0.05	0.20
	Off-site	pCi/g	32	0.10	0.0	0.08	-0.006	0.37
Tritium	On-site	pCi/mL	26	0.10	0.07	0.15	-0.09	0.62
	Perimeter	pCi/mL	27	0.05	0.06	0.08	-0.21	0.17
	Off-site	pCi/mL	33	0.03	0.03	0.07	-0.10	0.19
Total Uranium	On-site	µg/g	26	1.41	1.35	0.57	0.344	2.6
	Perimeter	µg/g	29	1.52	1.40	0.57	0.661	3.0
	Off-site	µg/g	33	1.59	1.70	0.52	0.482	2.6

NOTE: Summary statistics for total uranium only reflect 1993 to 2000.
Std Dev = Standard deviation
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter
µg/g = microgram per gram

TABLE 4-9. Radiological Summary Statistics for Vegetation Samples (1991 to 2000)

Analyte	Location Type	Units	Sample Size	Average	Median	Std Dev	Min	Max
Cesium-137	On-site	pCi/g	115	0.010	0.011	0.153	-0.46	0.56
	Perimeter	pCi/g	47	0.014	0	0.138	-0.29	0.36
	Off-site	pCi/g	34	0.004	0.004	0.173	-0.47	0.36
Tritium	On-site	pCi/mL	295	0.74	0.06	2.56	-0.26	26
	Perimeter	pCi/mL	127	0.19	0.03	1.45	-0.19	16
	Off-site	pCi/mL	79	0.03	0.02	0.11	-0.15	0.45
Total Uranium	On-site	µg/g	79	0.04	0.03	0.05	-0.2	0.31
	Perimeter	µg/g	28	0.03	0.01	0.05	-0.2	0.19
	Off-site	µg/g	28	0.03	0.02	0.05	-0.2	0.19

NOTE: Summary statistics for total uranium only reflect 1993 to 2000.
Std Dev = Standard deviation
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter
µg/g = microgram per gram

TABLE 4-10. Summary Statistics for Vegetation Locations (1991-2000) Noted as CAT-2 During CY00

Analyte	Units	Location	Sample Size	Average	Std Dev	Min	Max
Tritium	pCi/mL	2NE	14	9.06	6.58	0.68	26

NOTE: Std Dev = Standard deviation
pCi/mL = picocurie per milliliter

4.3.6 TLD Results

The 2000 sampling period took place from January 18, 2000 to January 18, 2001. Table 4-11 shows the average exposure from 1991 to 2000. On-site and perimeter locations are statistically indistinguishable from off-site locations. Figure 4-3 portrays the TLD results from 1991 to 2000. Appendix F (Table F-16) shows TLD results for quarter 2000 by location type.

TABLE 4-11. TLD Summary Statistics (1991 to 2000)

Summary Statistic	SNL/NM (mrem/yr)	Perimeter (mrem/yr)	Off-site (mrem/yr)
Average	100.27	97.83	95.67
Std Dev	5.32	6.21	4.73
Minimum	92.51	88.86	85.33
Maximum	109.32	109.64	100.55
Range	16.81	20.78	15.22

NOTE: Std Dev = Standard deviation
mrem/yr = millirem per year

4.4 NON-RADIOLOGICAL PARAMETERS AND RESULTS

4.4.1 Non-radiological Parameters

Beginning in 1993, the scope of the Terrestrial Surveillance Program was broadened to include non-radiological (metals) analysis of soil samples. With the exception of mercury, the metals are quantified using the 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 list of 21 metals has been modified over time to best represent a broad range of toxic pollutant indicators based on Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) target list metals. For example, calcium, silicon, strontium, and titanium were removed from the list because they are naturally abundant in the soil and are not useful indicators of pollution. These metals were replaced with more representative indicators (e.g., 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)	

Non-radiological results for these locations also were categorized from CAT-1 to CAT-4 for metals based on a comparison of concentrations between on-site, perimeter, and off-site locations. In 2000, no sites were designated as CAT-1. CAT-4 locations are not discussed because they are of no environmental concern.

Analytical results for CY00 are found in Appendix F of this report. In addition, the detailed statistical analyses are published in *2000 Data Analysis in Support of the Annual Site Environmental Report* (SNL 2001b).

Overview Discussion of Non-radiological Results

No locations were identified as CAT-1 for any non-radiological parameter.

Although not discussed in the sections below, the statistical analysis showed multiple locations

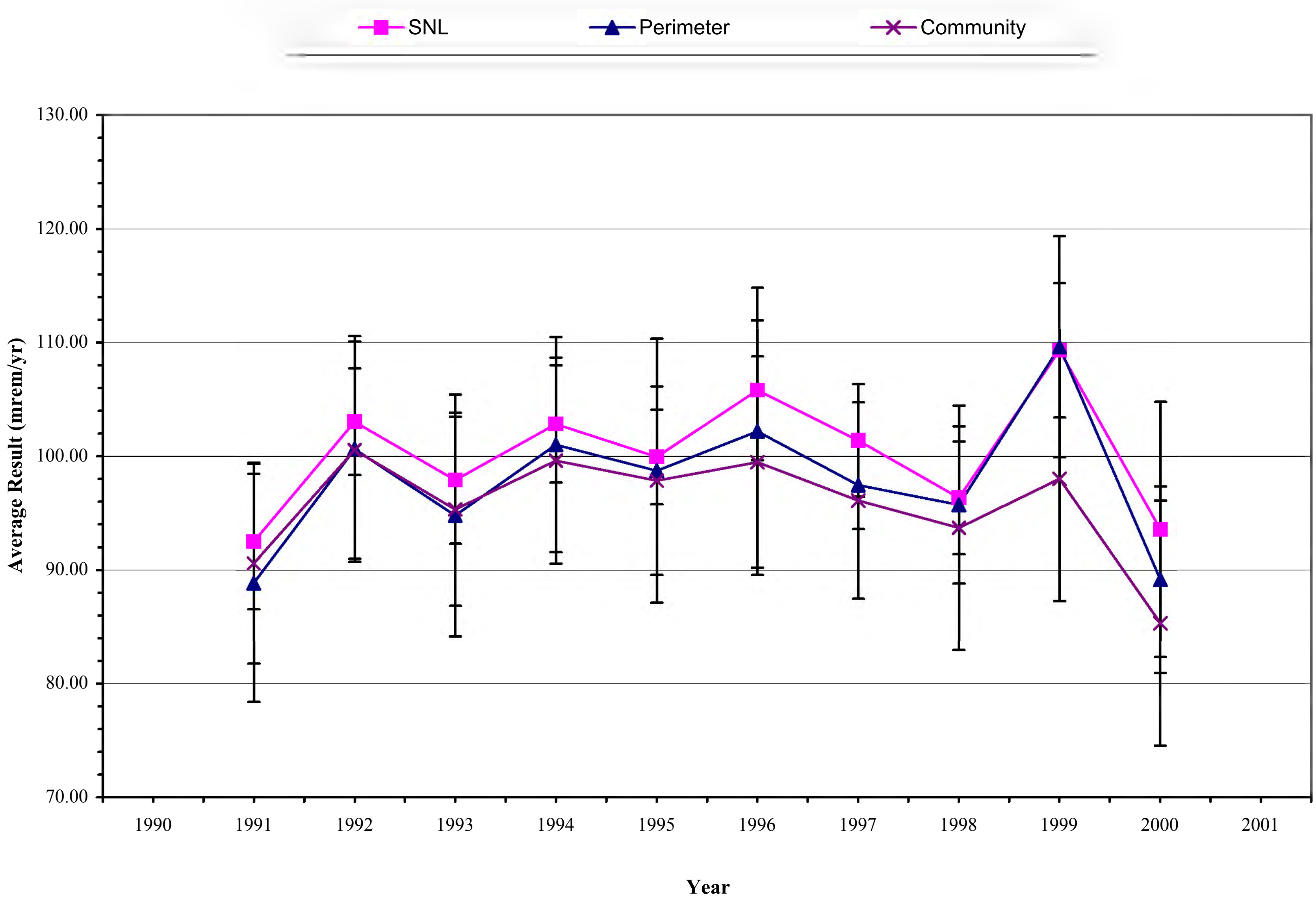

FIGURE 4-3. TLD Results Summarized Over the Past Ten Years (1991 to 2000)

with a decreasing trend for multiple non-radiological parameters. Decreasing trends have been noted in the past, but were more prevalent in 2000 due to a change of using another analytical laboratory, which resulted in a decrease in detection limits and reported results for many analytes. To avoid masking a possible increasing trend, Sandia Corporation may change the trending start date to later than 1991 to compensate for the lower reported results.

Tables of summary statistics are provided in this chapter for each sample medium. CY00 data for each sampling location is presented in Appendix F. The data in this chapter is presented in the following basic sequence and format for each sample medium:

- Tables are provided showing the summary statistics, over time, by sample grouping (i.e., on-site, perimeter and community, for example Table 4-5). The information provided in these tables include units of measure, the sample size (i.e., the number of data points used in the analysis), as well as the average, median, minimum, maximum, and standard deviation of each data set.

- Tables are provided showing the summary statistics, over time, for each location identified as CAT 2 and another for each location identified as CAT 3 in CY00 (e.g., Tables 4-5 and 4-6). The types of information provided in these tables are essentially the same, but apply only to the specific location.

4.4.2 Soil

No locations were identified as CAT-1 for soil. Table 4-12 shows the summary statistics for soil samples between 1993 and 2000 and identifies which locations were classified as either a CAT-2 or CAT-3. Of the 44 on-site and perimeter locations, 15 were identified at least once for any of the non-radiological parameters. The following non-radiological parameters showed no locations identified as CAT-2 or CAT-3: aluminum, arsenic, beryllium, chromium, mercury, nickel, selenium, silver, or thallium.

Three locations (20, 64 and 65E) were identified as CAT-2 for three or more non-radiological parameters. These three locations are discussed individually below and are the only locations identified as CAT-2.

Location 20

Location 20 is located near the USAF Skeet Range, which is now closed and undergoing remediation. Because the Skeet Range is USAF property, SNL/NM is not involved in its cleanup. This location continues to be identified as CAT-2 for lead, antimony, and cadmium and is not unexpected given the lead shot in the soil. Lead values are expected to remain above normal, and by association, so will antimony and cadmium. To determine whether or not lead was 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. Table 4-13 shows the summary statistics for each of the metals identified as CAT-2 for Location 20. Location 20 did not have any metals identified as CAT-3.

Location 64

Perimeter Location 64 is located on the north end of the Manzano Mountains on KAFB property near the Four Hills subdivision. This location continues to be identified as CAT-2 for cobalt, iron, magnesium, and zinc. In 2000, Location 64 was also identified as CAT-2 for manganese. Manganese did not show up as CAT-2 in 1999, but did in 1997 and 1998. Table 4-13 shows the summary statistics for each of the metals identified as CAT-2 for Location 64. Location 64 did not have any metals identified as CAT-3.

Location 65E

Perimeter Location 65E is located within the up-gradient portion of the Tijeras Arroyo near the Four Hills subdivision. This location continues

TABLE 4-12. Non-radiological Summary Statistics for Soil (1991 to 2000) (all units in mg/kg)

Metal	Location Type	Sample Size	Average	Median	Std Dev	Min	Max	U.S. Surface Soil Concentration
Aluminum	On-site	310	8847	8300	5392	3150	92000	N/A
	Perimeter	134	9531	9100	3310	4040	24000	N/A
	Off-site	66	10673	10400	5961	1930	28000	N/A
Antimony	On-site	138	6.83	5	26.98	0.0815	320	0.25 - 0.6
	Perimeter	64	4.00	5	1.99	0.0815	5	0.25 - 0.6
	Off-site	30	4.02	5	2.00	0.0815	5	0.25 - 0.6
Arsenic	On-site	138	15.56	15	14.43	1.25	130	1 - 93
	Perimeter	64	15.88	13.5	11.48	1.16	53	1 - 93
	Off-site	30	12.75	14	8.62	1.97	34	1 - 93
Barium	On-site	310	97.71	86	43.80	49	400	20 - 1500
	Perimeter	134	124.20	118	43.99	46.1	250	20 - 1500
	Off-site	66	160.73	170	42.01	82	260	20 - 1500
Beryllium	On-site	310	0.51	0.5	0.10	0.174	1.1	0.04 - 2.54
	Perimeter	134	0.55	0.5	0.20	0.227	2.5	0.04 - 2.54
	Off-site	66	0.61	0.52	0.18	0.134	1.1	0.04 - 2.54
Cadmium	On-site	310	0.57	0.5	0.46	0.0382	5	0.41 - 0.57
	Perimeter	13	0.47	0.5	0.12	0.0382	0.7	0.41 - 0.57
	Off-site	66	0.48	0.5	0.13	0.0382	0.9	0.41 - 0.57
Chromium	On-site	310	20.97	19	9.65	4.51	60	7 - 1500
	Perimeter	134	21.87	19	10.64	2.84	72	7 - 1500
	Off-site	66	26.94	22.5	29.52	2.82	250	7 - 1500
Cobalt	On-site	310	3.91	3.6	1.02	2.2	6.9	3 - 50
	Perimeter	134	5.27	5.25	2.20	2.05	14	3 - 50
	Off-site	66	5.28	5.45	2.22	1.43	10	3 - 50
Copper	On-site	310	9.14	8.4	3.86	3.84	47	3 - 300
	Perimeter	134	10.85	11	4.22	3.61	26	3 - 300
	Off-site	66	12.75	10.1	10.12	2.88	68	3 - 300

NOTE: Std Dev = Standard deviation
mg/kg = milligram per kilogram
N/A = not available

TABLE 4-12. Non-radiological Summary Statistics for Soil (1993 to 2000) *(concluded)* (all units in mg/kg)

Metal	Location Type	Sample Size	Average	Median	Std Dev	Min	Max	U.S. Surface Soil Concentration
Iron	On-site	310	10030	9500	2592	4640	17000	N/A
	Perimeter	134	12307	12000	4999	4330	29000	N/A
	Off-site	66	12154	12750	4404	3030	25000	N/A
Lead	On-site	310	182.56	9.13	1407.6	3.62	16000	10 - 70
	Perimeter	134	23.77	11	113.43	3.78	1300	10 - 70
	Off-site	66	18.38	12	20.15	5	110	10 - 70
Magnesium	On-site	310	2822	2700	913	230	6600	N/A
	Perimeter	134	4041	3900	1707	1160	11000	N/A
	Off-site	66	3482	3400	1394	1050	7800	N/A
Manganese	On-site	310	182.0	170	55.2	0.7	410	20 - 3000
	Perimeter	134	281.5	280	146.2	110	760	20 - 3000
	Off-site	66	356.9	340	130.7	130	570	20 - 3000
Mercury	On-site	155	0.08	0.1	0.03	0.0053	0.1	0.02 - 1.5
	Perimeter	64	0.08	0.1	0.04	0.0103	0.2	0.02 - 1.5
	Off-site	30	0.08	0.1	0.03	0.00499	0.1	0.02 - 1.5
Nickel	On-site	310	7.82	7	2.23	3.72	15	5 - 150
	Perimeter	134	8.65	8	3.05	3.46	18	5 - 150
	Off-site	66	10.46	10	4.77	2.97	21	5 - 150
Potassium	On-site	310	2157	2100	578	581	5300	N/A
	Perimeter	134	2489	2400	938	1010	6800	N/A
	Off-site	66	2401	2300	1029	569	5500	N/A
Selenium	On-site	138	4.08	5	2.25	0.146	10	0.1 - 4
	Perimeter	64	4.59	5	2.72	0.146	13	0.1 - 4
	Off-site	30	4.50	5	2.46	0.146	9	0.1 - 4
Silver	On-site	310	5.32	0.5	22.19	0.101	150	0.2 - 3
	Perimeter	112	0.47	0.5	0.13	0.101	0.9	0.2 - 3
	Off-site	66	14.83	0.5	60.26	0.101	320	0.2 - 3

NOTE: Std Dev = Standard deviation
mg/kg = milligram per kilogram
N/A = not available

TABLE 4-13. Summary Statistics for Soil Locations (1993-2000) Identified as CAT-2 for Metals in CY00 (all units in mg/kg)

Location	Metal	Sample Size	Average	Std Dev	Min	Max	U.S. Surface Soil Concentration
20	**Antimony**	5	85.04	135.19	0.219	320	0.25 –0.6
	Cadmium	10	1.76	0.70	0.5	40	0.41 - 0.57
	Lead	10	5360	6100	62.6	16000	<10 – 70
64	**Cobalt**	11	8.46	1.96	7	14	3 – 50
	Iron	11	20555	3717	17000	29000	1K – 100000
	Magnesium	11	6597	1136	5600	9400	300 – 100000
	Manganese	11	565	78.6	490	760	20 – 3000
	Zinc	11	77.8	14.4	64	110	13 – 300
65E	**Cobalt**	7	9.6	2.5	5.2	12	3 – 50
	Iron	7	22114	5234	12000	28000	1K – 100000
	Magnesium	7	8290	2563	3900	11000	300 – 100000
	Manganese	7	569.4	190.9	220	750	20 – 3000
	Potassium	7	4660	1443	2200	6800	1900 – 63000
	Vanadium	7	37.4	8.7	23	50	0.7 – 98
	Zinc	7	80.6	23.7	41	110	13 – 300

NOTE: U.S. Soil Surface Concentration not available for cadmium, iron, magnesium, and potassium; used NM Surface Soil values

to be identified as CAT-2 for cobalt, iron, magnesium, potassium, vanadium, and zinc. In 2000, Location 65E was also identified as CAT-2 for manganese. Manganese did not show up as CAT-2 in 1999, but did in 1997 and 1998. Table 4-13 shows the summary statistics for each of the metals identified as CAT-2 for Location 65E. Location 65E did not have any metals identified as CAT-3.

The remaining nine on-site locations and three perimeter locations were identified as CAT-3 for soil. The following metals had at least one location that was identified as CAT-3.

Barium

Three on-site locations (6, 33, and 57) were identified as CAT-3 for barium. All of the concentrations were within U.S. Surface Soil Concentrations. Table 4-14 shows the summary statistics for these locations and how they compare to U.S. Soil Surface Concentrations.

Cobalt

Two on-site locations (6 and 32E) were identified as CAT-3 for cobalt. All concentrations noted at these locations were within U.S. Surface Soil Concentrations. Table 4-14 shows the summary statistics for these locations and how they compare to U.S. Soil Surface Concentrations.

Copper

Four on-site locations (6, 52, 53, and 76) and one perimeter location (61) were identified as CAT-3 for copper. All concentrations noted at these locations were within U.S. Surface Soil Concentrations. Table 4-14 shows the summary statistics for these locations and how they compare to U.S. Soil Surface Concentrations.

Lead

Four on-site locations (2NW, 33, 52, and 56) and one perimeter location (59) were identified as CAT-3 for lead. All lead concentrations were within U.S. Surface Soil Concentrations. Table 4-14 shows the summary statistics for

TABLE 4-14. Summary Statistics for Soil Locations (1993-2000) Identified as CAT-3 for Metals During CY00 (all units in mg/kg)

Analyte	Location Type	Location	Sample Size	Average	Std Dev	Min	Max	U.S. Surface Soil Concentration
Barium	On-site	6	11	81.0	21.7	61	130	20 – 1500
	On-site	33	9	123.9	26.3	86	150	20 – 1500
	On-site	57	10	182.5	34.4	140	240	20 – 1500
Cobalt	On-site	6	11	3.8	0.9	2.8	5.9	3 – 50
	On-site	32E	10	4.2	0.8	2.8	5.2	3 – 50
Copper	On-site	6	11	8.6	1.9	5.8	12	3 – 300
	On-site	52	11	10.9	2.3	8	14	3 – 300
	On-site	53	9	9.0	3.0	6	16	3 – 300
	On-site	76	7	8.7	2.9	6.9	15	3 – 300
	Perimeter	61	11	8.1	3.0	5	15	3 – 300
Lead	On-site	2NW	11	9.2	2.4	6	14	<10 – 70
	On-site	33	9	13.1	2.1	10	16	<10 – 70
	On-site	52	11	9.8	3.0	5	15	<10 – 70
	On-site	56	11	10.1	4.4	6	21	<10 – 70
	Perimeter	59	11	16.2	5.6	8	26	<10 – 70
Manganese	On-site	6	11	166	32	130	240	20 – 3000
	Perimeter	63	11	334	47	250	410	20 – 3000
Zinc	On-site	57	10	42	9	29	56	13 – 300
	Perimeter	59	11	33	9	26	57	13 – 300

NOTE: Std Dev = Standard deviation
mg/kg = milligram per kilogram

these locations and how they compare to U.S. Soil Surface Concentrations.

Manganese
One on-site location (6) and one perimeter location (63) were identified as CAT-3 for manganese. All concentrations at both these locations were within the U.S. Surface Soil Concentrations. Table 4-14 shows the summary statistics for these locations and how they compare to U.S. Soil Surface Concentrations.

Zinc
One on-site location (57) and one perimeter location (59) were identified as CAT-3 for zinc. All concentrations noted at these locations were within U.S. Surface Soil Concentrations. Table 4-14 shows the summary statistics for these locations and how they compare to U.S. Soil Surface Concentrations.

4.4.3 Sediment

No locations were identified as CAT-1 or CAT-2. Table 4-15 shows the summary statistics for sediment samples between 1993 and 2000 and identifies which locations were classified as either a CAT-2 or CAT-3. The following non-radiological parameters showed no location identified as CAT-2 or CAT-3: antimony, arsenic, beryllium, cadmium, chromium, iron, mercury, selenium, silver, thallium, and vanadium.

Three of the four on-site locations for sediment, as well as one of the three perimeter locations, were identified as CAT-3 for at least one metal.

TABLE 4-15. Non-radiological Summary Statistics for Sediment (1993 to 2000) (all units in mg/kg)

Metal	Location Type	Units	Sample Size	Average	Std Dev	Min	Max
Aluminum	On-site	mg/kg	32	7064.06	2778.40	4200	18000
	Perimeter	mg/kg	29	6674.48	6510.45	3530	39000
	Off-site	mg/kg	33	8011.21	3474.12	2300	17000
Antimony	On-site	mg/kg	18	3.91	2.10	0.0815	5
	Perimeter	mg/kg	15	4.02	2.04	0.0815	5
	Off-site	mg/kg	15	4.02	2.04	0.0815	5
Arsenic	On-site	mg/kg	18	11.00	6.58	2.05	23
	Perimeter	mg/kg	15	18.43	22.22	1.03	91
	Off-site	mg/kg	15	13.25	8.50	2.17	28
Barium	On-site	mg/kg	32	102.06	45.05	36	220
	Perimeter	mg/kg	29	74.71	25.17	39.8	120
	Off-site	mg/kg	33	185.15	90.90	88	590
Beryllium	On-site	mg/kg	32	0.52	0.08	0.39	0.9
	Perimeter	mg/kg	29	0.48	0.08	0.271	0.7
	Off-site	mg/kg	33	0.55	0.14	0.316	1.1
Cadmium	On-site	mg/kg	32	0.45	0.15	0.0382	0.6
	Perimeter	mg/kg	29	0.46	0.14	0.0382	0.6
	Off-site	mg/kg	33	0.49	0.07	0.156	0.6
Chromium	On-site	mg/kg	32	23.87	10.32	7.65	47
	Perimeter	mg/kg	29	28.16	12.05	3.04	61
	Off-site	mg/kg	33	26.22	12.50	4.23	56
Cobalt	On-site	mg/kg	32	4.66	1.51	2.4	10
	Perimeter	mg/kg	29	4.75	1.39	2.91	10
	Off-site	mg/kg	33	4.27	1.47	1.8	8.3
Copper	On-site	mg/kg	32	10.32	3.47	6	25
	Perimeter	mg/kg	29	8.07	1.73	4.28	12
	Off-site	mg/kg	33	9.59	4.89	2.8	26
Magnesium	On-site	mg/kg	32	3784.38	1029.78	2300	7200
	Perimeter	mg/kg	29	2806.21	775.36	1800	5800
	Off-site	mg/kg	33	3685.76	1355.36	960	6400

NOTE: Std Dev = Standard deviation
mg/kg = milligram per kilogram

TABLE 4-15. Non-radiological Summary Statistics for Sediment (1993 to 2000) *(concluded)*
(all units in mg/kg)

Metal	Location Type	Units	Sample Size	Average	Std Dev	Min	Max
Manganese	On-site	mg/kg	32	245.13	48.93	180	366
	Perimeter	mg/kg	29	220.62	37.88	150	330
	Off-site	mg/kg	33	279.58	80.93	110	460
Mercury	On-site	mg/kg	20	0.08	0.03	0.00811	0.1
	Perimeter	mg/kg	15	0.08	0.04	0.00516	0.1
	Off-site	mg/kg	15	0.08	0.03	0.0121	0.1
Nickel	On-site	mg/kg	32	8.49	1.89	5	13
	Perimeter	mg/kg	29	5.76	1.69	2	11
	Off-site	mg/kg	33	8.60	3.11	3	16
Potassium	On-site	mg/kg	32	1576.56	741.54	790	4000
	Perimeter	mg/kg	29	1450.17	349.02	885	2400
	Off-site	mg/kg	33	1769.70	711.65	660	3200
Selenium	On-site	mg/kg	18	4.31	2.51	0.146	9
	Perimeter	mg/kg	15	4.10	2.06	0.146	6
	Off-site	mg/kg	15	4.03	2.01	0.146	5
Silver	On-site	mg/kg	30	0.45	0.14	0.101	0.6
	Perimeter	mg/kg	25	0.45	0.13	0.101	0.5
	Off-site	mg/kg	27	0.46	0.13	0.101	0.5
Thallium	On-site	mg/kg	18	11.92	9.82	0.205	40
	Perimeter	mg/kg	15	14.59	12.06	0.205	44
	Off-site	mg/kg	15	12.18	9.82	0.205	39
Vanadium	On-site	mg/kg	32	20.64	7.14	12	45
	Perimeter	mg/kg	29	22.82	15.44	12.5	98
	Off-site	mg/kg	33	18.50	4.71	10.1	28
Zinc	On-site	mg/kg	32	31.49	8.05	21	58
	Perimeter	mg/kg	29	27.23	5.65	19	47
	Off-site	mg/kg	33	37.67	34.47	16	220

NOTE: Std Dev = Standard deviation
mg/kg = milligram per kilogram

Aluminum
Two on-site locations (72 and 75) were identified as CAT-3 for aluminum. Table 4-16 shows the summary statistics for these locations. Location 72 has been sampled since 1993 and Location 75 was added as a sampling location in 1995.

Barium
Three on-site locations (72, 75 and 79) were identified as CAT-3 for barium. Table 4-16 shows the summary statistics for these locations. Location 72 has been sampled consistently since 1993, while both Locations 75 and 79 were added as sampling locations in 1995.

Cobalt
One on-site location (72) was identified as CAT-3 for cobalt. Table 4-16 shows the summary statistics for this location.

Copper
One on-site location (72) was identified as CAT-3 for copper. Table 4-16 shows the summary statistics for this location.

Lead
One on-site location (75) was identified as CAT-3 trends for lead. Results for May 1995, August 1995, July 1996, and July 1997 were all recorded at the minimum detection limit (MDL) of 5 mg/kg. Results for 1998 to 2000 were 6 mg/kg, 7mg/kg, and 8.06 mg/kg, respectively. Excluding the results from 1995 and 1996, this location still showed as CAT-3 for lead. Table 4-16 shows the summary statistics for this location using data from 1997 to 2000 (sample size = 4; minimum of 4 data points needed to determine if trend exists).

TABLE 4-16. Summary Statistics for Sediment Locations Identified as CAT-3 for Metals During CY00 (all units in mg/kg)

Analyte	Location Type	Location	Sample Size	Average	Std Dev	Min	Max
Aluminum	On-site	72	11	8782	3670	5000	18000
	On-site	75	7	5487	976	4200	7110
Barium	On-site	72	11	108	50	52	220
	On-site	75	7	53.8	19.2	36	85.8
	On-site	79	7	116	26	89	160
Cobalt	On-site	72	11	4.7	1.2	3.1	7.44
Copper	On-site	72	11	10.7	2.7	6.7	15.7
Lead	On-site	75	4*	6.5	1.3	5	8.06
Magnesium	On-site	72	11	4320	1280	2400	7200
	On-site	75	7	3139	329	2800	3600
Manganese	On-site	72	11	256	53	190	361
Nickel	On-site	72	11	9.1	2.1	6	13
Potassium	On-site	75	7	1093	184	790	1300
Zinc	On-site	72	11	33.8	10.4	21	58
	On-site	75	7	26.1	5.3	22	35.8
	Perimeter	60	11	28.0	2.9	24	34.1

NOTE: Used reduced sample size for lead. Data for 1995 to 1997 were non-detects (results recorded at MDL of 5). Data from 1995 and 1996 were excluded and analysis re-run. Using data from 1997 to 2000, an increasing trend is still observed and was reported even though the sample size was small.
mg/kg = milligram per kilogram

Magnesium
Two on-site locations (72 and 75) were identified as CAT-3 for magnesium. Table 4-16 shows the summary statistics for these locations. Location 72 has been sampled consistently since 1993, while Location 75 was sampled in 1995.

Manganese
One on-site location (72) was identified as CAT-3 for manganese. Table 4-16 shows the summary statistics for this location.

Nickel
One on-site location (72) was identified as CAT-3 for nickel. Table 4-16 shows the summary statistics for this location.

Potassium
One on-site location (75) was identified as CAT-3 for potassium. Table 4-16 shows the summary statistics for this location.

Zinc
Two on-site locations (72 and 75) and one perimeter location (60) were identified as CAT-3 for zinc. Table 4-16 shows the summary statistics for these locations.

4.4.4 Vegetation

In 1996, non-radiological sampling for vegetation began. Since four data points are needed to determine a trend, the first year that trends were recorded was in 1999. Due to limited vegetation at some locations during the 2000 sampling period, some trends must be repeated (these are discussed in more detail below). There were no locations identified as CAT-1.

Table 4-17 shows the summary statistics for vegetation samples between 1996 and 2000 and identifies which locations were classified as either CAT-2 or CAT-3. Due to limited vegetation, four out of 28 vegetation locations (perimeter [58 and 60] and off-site [10 and 62] locations) had no vegetation collected at their respective sites. Locations 58 and 60 and Locations 10 and 62 have only data from 1996 to 1999. Locations 58 and 60, as well as a Location 10, were identified as either CAT-2 or CAT-3 in 1999. These classifications remain the same without additional data. Location 60 still remains as CAT-2 for magnesium and potassium. Location 58 was identified as CAT-3 for zinc and Location 10 was identified as CAT-3 for aluminum, barium, and iron. No further discussion is necessary since the site locations remain unchanged from 1999.

Excluding the locations listed above, there were no other CAT-2 locations.

Magnesium
Location 20 was observed as CAT-3 for magnesium. Table 4-18 shows the summary statistics for magnesium at this location. This was the first time this trend was observed at Location 20.

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 2000. 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 ER areas including the Classified Waste Landfill (ClWL). The control site is located at the southeastern end of KAFB near the perimeter fence between KAFB and Isleta Pueblo.

TABLE 4-17. Non-radiological Summary Statistics for Vegetation (1996 to 2000) (all units in mg/kg)

Metal	Location Type	Sample Size	Average	Median	Std Dev	Min	Max
Aluminum	SNL/NM	80	434.26	340	422.29	5.26	2600
	Perimeter	28	305.95	160	368.75	24	1400
	Off-site	28	299.45	85.3	634.38	12.6	3300
Antimony	SNL/NM	77	3.98	5	2.01	0.0815	5
	Perimeter	28	4.30	5	1.74	0.0815	5
	Off-site	28	4.31	5	1.73	0.0815	5
Arsenic	SNL/NM	77	4.03	5	1.91	0.131	5
	Perimeter	28	4.32	5	1.70	0.131	5
	Off-site	28	4.35	5	1.62	0.275	5
Barium	SNL/NM	80	19.83	20	8.67	1.04	46
	Perimeter	28	21.63	19.5	10.72	3.35	48
	Off-site	28	16.87	19.5	10.39	0.769	49
Beryllium	SNL/NM	80	0.41	0.5	0.19	0.0311	0.5
	Perimeter	28	0.43	0.5	0.17	0.0311	0.5
	Off-site	28	0.43	0.5	0.17	0.0311	0.5
Cadmium	SNL/NM	80	0.41	0.5	0.19	0.0382	0.7
	Perimeter	28	0.46	0.5	0.20	0.0382	1.1
	Off-site	28	0.43	0.5	0.16	0.0382	0.5
Chromium	SNL/NM	80	0.82	0.8	0.49	0.0645	2.6
	Perimeter	28	0.94	0.7	0.92	0.0645	4.8
	Off-site	28	0.89	0.55	1.03	0.0645	5.3
Cobalt	SNL/NM	80	0.43	0.5	0.19	0.0555	1
	Perimeter	28	0.46	0.5	0.19	0.0555	0.9
	Off-site	28	0.50	0.5	0.39	0.0555	2.3
Copper	SNL/NM	80	6.27	5.85	3.33	1.04	14
	Perimeter	28	6.65	5.66	2.93	2.13	13
	Off-site	28	4.43	4	2.15	1.34	10
Iron	SNL/NM	80	450	364.5	376	25.2	2400
	Perimeter	28	389	230	427	63	1800
	Off-site	28	383	150	823	24.9	4400
Lead	SNL/NM	80	4.24	5	2.05	0.099	11
	Perimeter	28	4.32	5	1.71	0.099	5
	Off-site	28	4.36	5	1.60	0.099	5
Magnesium	SNL/NM	80	1469	1400	673	215	4000
	Perimeter	28	1910	1350	1518	688	6300
	Off-site	28	1148	965	814	240	3700
Manganese	SNL/NM	80	33.3	29.25	16.4	6.68	89
	Perimeter	28	45.5	35.5	26.7	13.5	130
	Off-site	28	54.4	44.5	44.8	7.81	240
Mercury	SNL/NM	80	0.08	0.1	0.04	0	0.1
	Perimeter	28	0.09	0.1	0.03	0.0152	0.1
	Off-site	28	0.09	0.1	0.03	0.00971	0.1

NOTE: Std Dev = Standard deviation
mg/kg = milligram per kilogram

TABLE 4-17. Non-radiological Summary Statistics for Vegetation (1996 to 2000) *(concluded)* (all units in mg/kg)

Metal	Location Type	Sample Size	Average	Median	Std Dev	Min	Max
Nickel	SNL/NM	80	1.74	2	0.70	0.072	3
	Perimeter	28	1.75	2	0.63	0.151	2
	Off-site	28	1.84	2	0.83	0.072	4
Potassium	SNL/NM	80	11588	12000	5812	1940	33000
	Perimeter	28	18888	14500	16840	4200	69000
	Off-site	28	13579	13000	8232	3000	43000
Selenium	SNL/NM	70	4.11	5	1.91	0.274	8
	Perimeter	28	4.67	5	1.97	0.499	10
	Off-site	28	4.44	5	1.63	0.295	6
Silver	SNL/NM	80	0.42	0.5	0.16	0.101	0.5
	Perimeter	28	0.44	0.5	0.14	0.101	0.5
	Off-site	28	0.44	0.5	0.14	0.101	0.5
Thallium	SNL/NM	70	7.78	10	4.15	0.205	11
	Perimeter	28	8.82	10	3.75	0.205	16
	Off-site	28	8.92	10	4.00	0.205	19
Vanadium	SNL/NM	80	0.94	0.8	0.66	0.074	4.2
	Perimeter	28	0.86	0.6	0.80	0.074	3.7
	Off-site	28	0.93	0.5	1.67	0.074	9.2
Zinc	SNL/NM	80	16.40	15	8.64	4.41	48
	Perimeter	28	21.02	18.5	10.19	4	44
	Off-site	28	19.59	21.5	8.10	3.86	35

NOTE: Std Dev = Standard deviation
mg/kg = milligram per kilogram

TABLE 4-18. Summary Statistics for Vegetation Locations Identified as CAT-3 for Metals During CY00 (all units in mg/kg)

Analyte	Location Type	Location	Sample Size	Average	Std Dev	Min	Max
Magnesium	SNL/NM	20	5	1264	350	730	1690

NOTE: Std Dev = Standard deviation
mg/kg = milligram per kilogram

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 2000, 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*)
- White-footed mouse (*Peromyscus leucopus*)

Sixteen 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 (i.e., tritium, strontium-90, total uranium) and non-radiological (gamma spectroscopy) parameters.

Non-radiological parameters included all metals 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:

- Grasshopper mouse (*Onychomys leucogaster*)
- Silky pocket mouse (*Perognathus flavus)*
- Deer mouse (*Peromyscus maniculatus*)
- White-footed mouse *(Peromyscus leucopus)*
- Merriam's kangaroo rat (*Dipodmys merriami*)

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

Prairie dogs (Cynomys gunnisoni) are abundant on KAFB.

Biota Dose

Biota dose calculations are currently not performed at SNL/NM for the following reasons:

- There are currently no requirements to perform such assessments.
- The radiological results of the terrestrial and ecological surveillance programs indicate that biota dose assessments are not warranted at SNL/NM.

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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 (AQC) Program ensures that all non-radiological air emission sources at SNL/NM, such as generators, boilers, chemical users, and vehicles meet applicable air quality standards.

5.1 METEOROLOGICAL MONITORING PROGRAM

The Meteorological Monitoring Program at SNL/NM commenced operations in 1994 with the initiation of the CAN Program due to a Tiger Team finding in 1991. Prior to 1991, meteorological monitoring was provided by the meteorological tower located at the Albuquerque International Sunport. Both meteorological monitoring and ambient air monitoring (Section 5.2) are conducted under the CAN Program under the Environmental Management Department. Regulations and the U.S. Department of Energy (DOE) Orders applicable to the Meteorological Monitoring Program are listed in Appendix B.

Tower Instrumentation

SNL/NM conducts meteorological monitoring through a network of eight fully instrumented meteorological towers located throughout Kirtland Air Force Base (KAFB) on or near SNL/NM property:

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

Meteorological Monitoring Towers

All meteorological towers are instrumented to measure temperature and wind velocity* at 3- and 10-meter levels (with the exception of tower A15, which only has a 10-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 (except tower A15) with 3-meter instrumented levels. Rainfall is measured at the 1-meter levels at towers A36, A21, and SC1. Barometric pressure is measured at the 2-meter levels at towers A36 and A21.

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

All instrumentation at the meteorological towers is routinely calibrated and checked on a weekly basis. The CAN network of meteorological towers and ambient air monitoring station locations are shown in Figure 5-1. During 2000, the CW1 station was moved approximately ¼ mile to the north.

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 of 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 SNL/NM's research and development projects.

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 urbanization effects not seen within the rest of the CAN network. The 2000 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 CAN 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

Annual wind roses for three locations across SNL/NM are illustrated in Figure 5-3. 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 shown in Figure 5-3, wind directions and speeds 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.

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

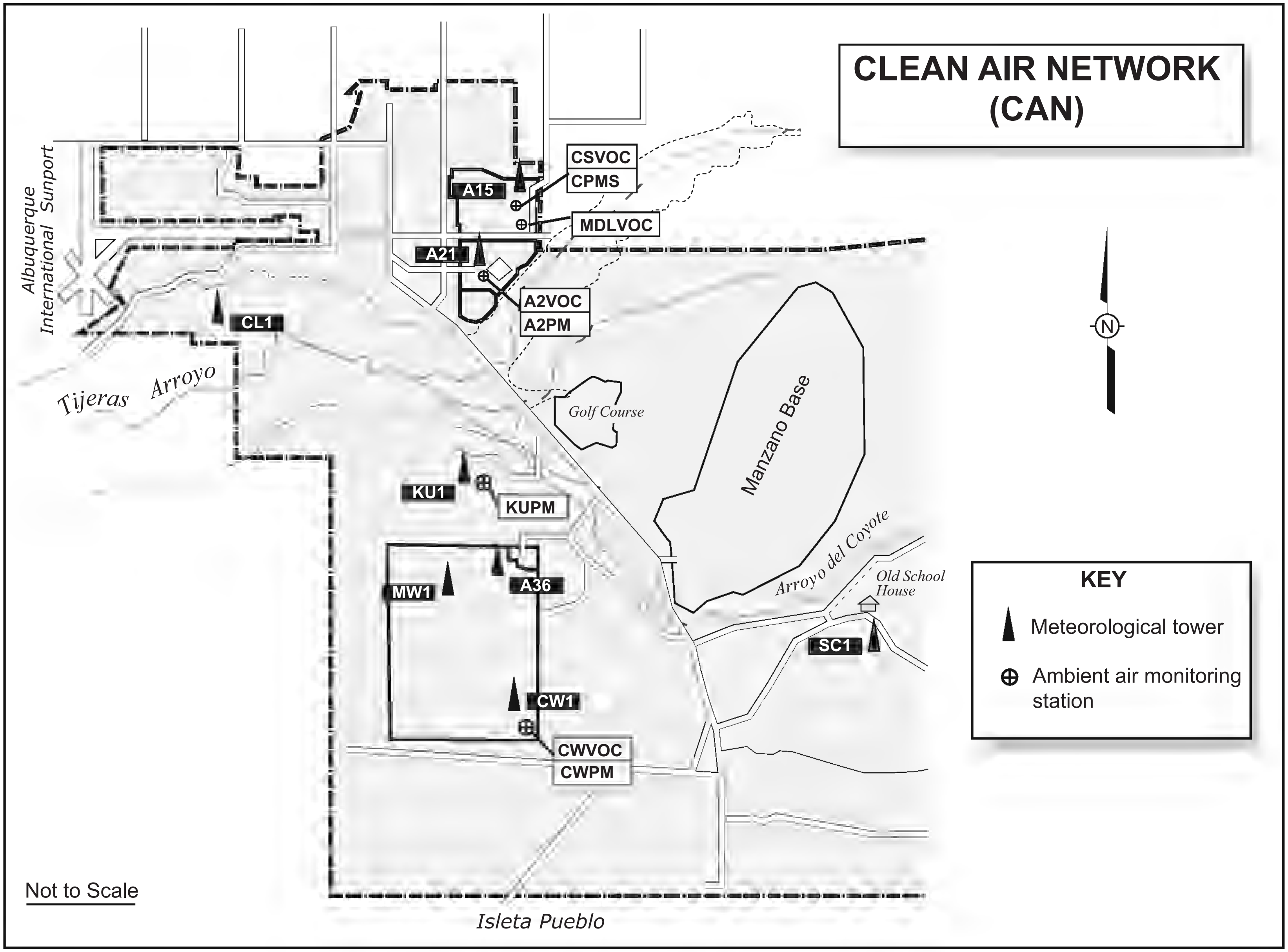

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FIGURE 5-1. The Clean Air Network (CAN) of Meteorological Towers and Ambient Air Monitoring Stations

TABLE 5-1. 2000 Annual Climatic Summary from Tower A36

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Totals
Temperature (°C)													
Daily Maximum	12.05	13.34	14.39	20.71	27.91	27.25	27.25	28.72	26.81	23.09	8.94	7.80	**19.9**
Daily Minimum	-2.98	0.77	1.31	3.24	13.09	20.54	20.63	19.27	12.89	3.74	-1.06	-3.82	**7.3**
Average	5.33	7.62	8.52	14.89	21.52	23.47	25.19	24.66	22.30	12.61	3.85	3.12	**14.4**
Temperature Extremes (°C)													
High	19.31	19.14	20.53	28.38	35.43	35.62	36.05	35.30	33.49	30.50	15.95	12.99	**36.0**
Low	-8.60	-5.21	-3.88	-2.56	5.02	13.41	13.04	12.88	3.15	2.11	-6.04	-8.54	**-8.6**
Relative Humidity (%)													
	42.13	39.52	41.85	28.55	17.82	33.71	37.51	39.89	29.90	61.17	56.22	52.17	**40.0**
Precipitation (cm)													
Monthly	0.36	0.74	3.66	0.00	0.00	0.86	1.02	3.18	0.20	6.22	2.44	0.64	**19.3**
24 Hour Max	0.30	0.46	1.02	0.00	0.00	0.48	0.36	1.45	0.13	1.32	1.55	0.33	**1.5**
Wind (m/s)													
Monthly	3.05	3.46	4.30	4.74	4.16	4.44	3.81	3.50	3.77	3.54	3.21	3.17	**3.8**
24 Hour Max	6.46	6.74	11.41	10.18	7.46	9.92	5.85	5.66	7.54	9.01	6.47	8.06	**11.4**
Maximum Gust	19.65	25.25	26.85	23.65	27.65	27.65	28.45	19.65	24.45	19.65	18.05	28.45	**28.4**
Barometric Pressure (mb)													
	836.1	835.7	832.0	834.4	832.5	834.9	837.0	837.6	836.3	836.1	834.2	837.0	**835.3**

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

°C = degree centigrade
cm = centimeter
m/s = meters per second
mb = millibars

A comparison of the A15 tower wind speed data with the rest of the CAN network reveals building effects 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. The diurnal pattern of wind flow common through many areas of KAFB is completely lost in the annual frequency distribution. Figure 5-4 shows the day and night wind frequency distributions for tower A36, respectively. 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 towards the mountains or channel into the canyons.

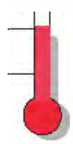
5.2 AMBIENT AIR SURVEILLANCE PROGRAM

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 objective of the Ambient Air Surveillance Program is to comply with the National Ambient Air Quality Standards (NAAQS) (40 CFR 50) and New Mexico Ambient Air Quality Standards (NMAAQS). Surveillance is also

Wind Speed

	Minimum (m/sec)	Maximum (m/sec)	Spread (m/sec)
Average Annual Wind Speed	2.84 *tower A15*	3.97 *tower CW1*	1.13
Greatest Difference in Wind Speed over 24 hours	6.42 *tower CL1*	11.6 *tower A21*	5.16
Greatest Difference in Daily Maximum Wind Speed	17.25 *tower SC1*	30.85 *tower A15*	13.6
Average Difference in Daily Wind Speed	1.36 *(all towers)*		

Temperature



	Minimum (°C)	Maximum (°C)	Spread (°C)
Average Annual Temperature	14.04 *tower SC1*	14.64 *tower KU1*	0.60
Network Annual Temperature Extremes	-10.0 *tower CW1*	36.3 *tower A15*	46.3
Greatest Difference in Daily Minimum Temperature	-8.5 *tower KU1*	-1.78 *tower A21*	6.72
Greatest Difference in Average Daily Temperature	6.14 *tower A36*	10.3 *tower A21*	4.19
Greatest Difference in Daily Maximum Temperature	31.8 *tower SC1*	35.4 *tower A15*	3.56

Precipitation

	Minimum (cm)	Maximum (cm)	Spread (cm)
Annual Precipitation (Extremes)*	19.3 *tower A36*	27.0 *tower SC1*	7.7
Daily Rainfall Variation	0	2.31 *tower SC1*	2.31
Greatest Monthly Precipitation Difference	6.22 *tower A36*	7.77 *tower SC1*	1.55
Greatest in Monthly Rainfall		7.77 *tower SC1*	

NOTE: Winter precipitation that falls as snow is underestimated (mostly at the SC1 tower) due to type of monitor being used (does not heat snow to measure precipitation)

00_5-2a.ai

FIGURE 5-2. Variations and Extremes in Meteorological Measurements Across the Meteorological Tower Network during CY00

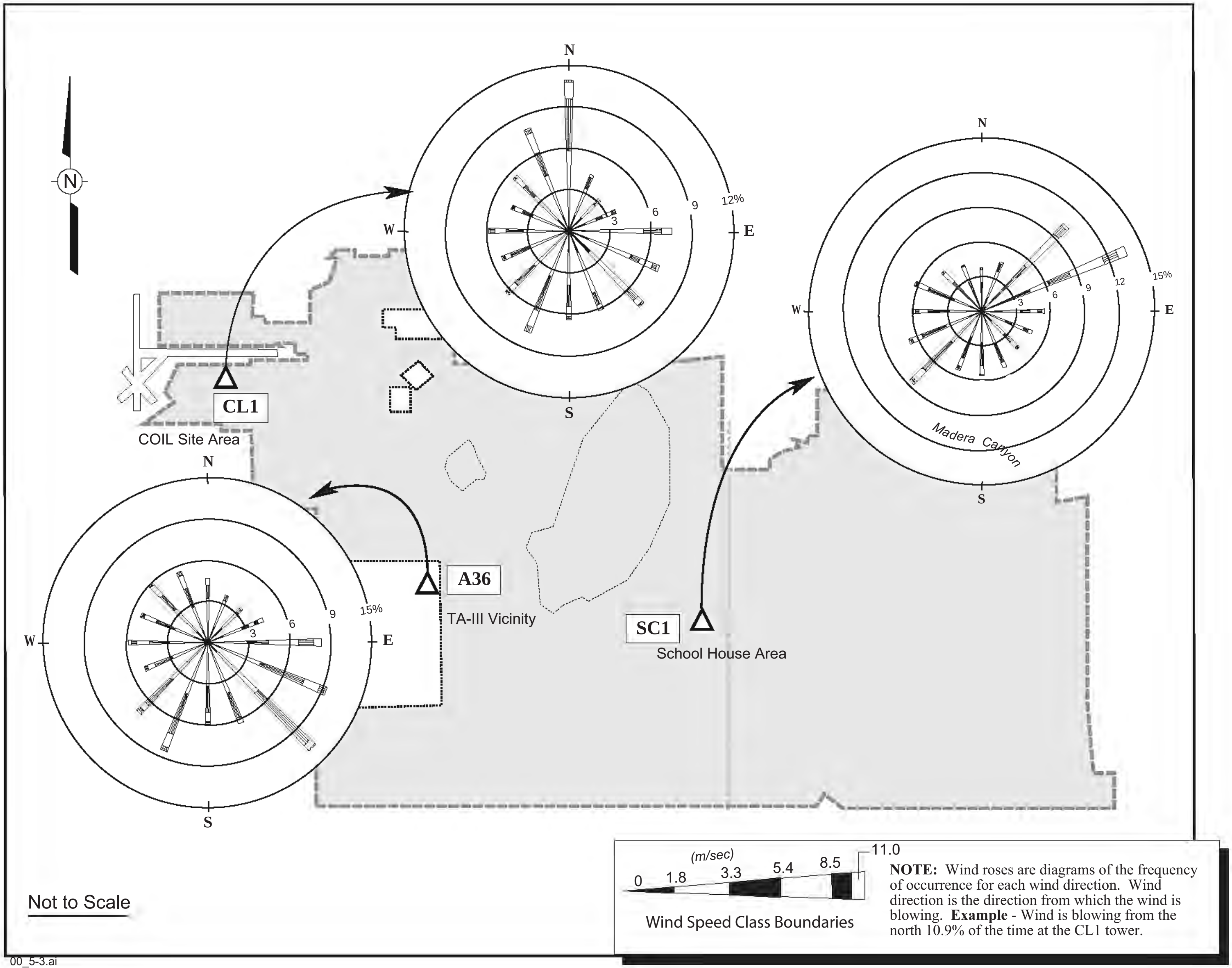


FIGURE 5-3. 2000 Annual Wind Roses for Towers CL1, A36, and SC1

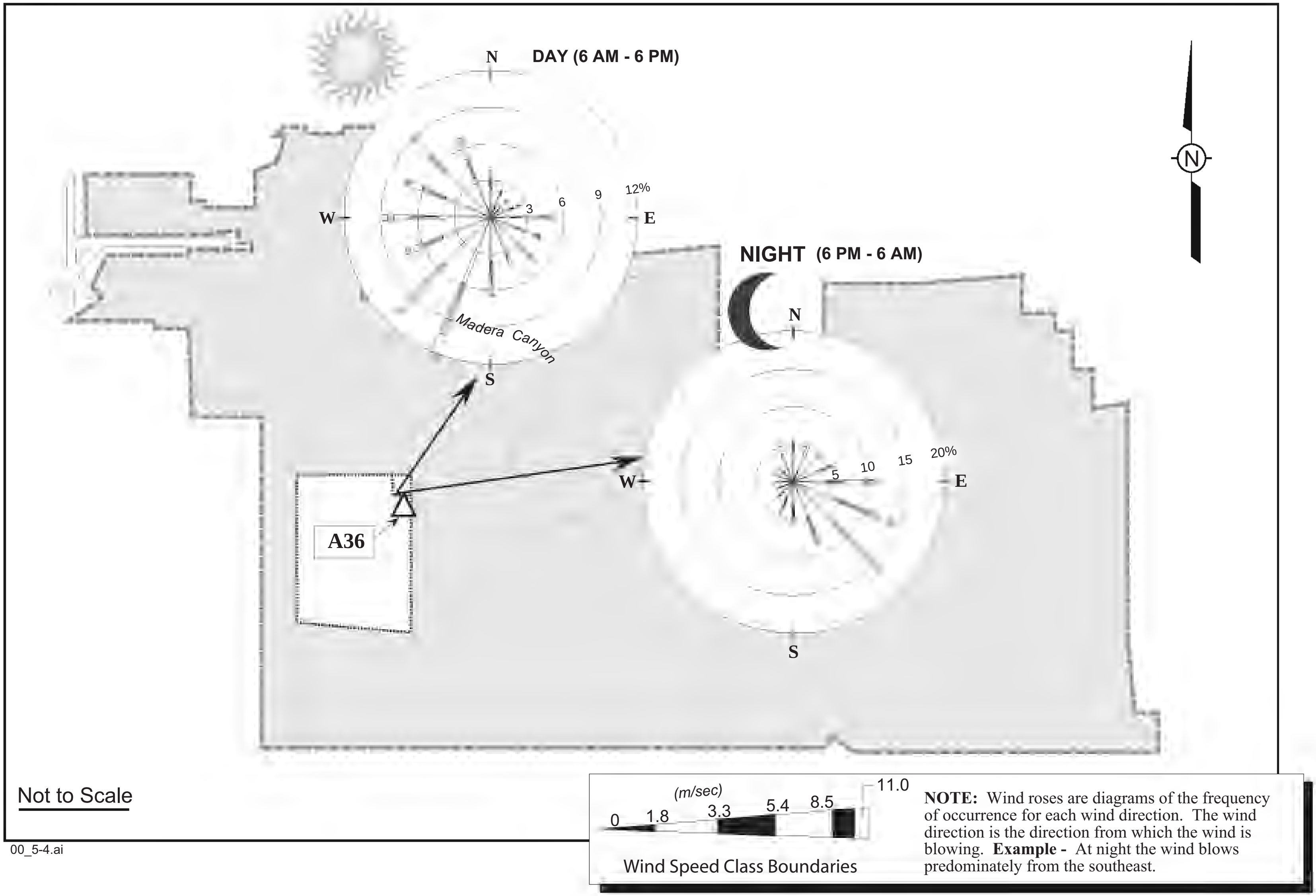


FIGURE 5-4. 2000 Annual Wind Roses for Daytime and Nighttime Wind Frequency at the A36 Tower

important to establish background concentration levels for pollutants of concern and evaluate the effects, if any, on the public and the environment because of operations at SNL/NM. Applicable regulations and DOE Orders are listed in Appendix B.

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 CPMS in the CAN 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 matter (PM) is a part of the CPMS. Lead, a criteria pollutant, is one of 23 metals analyzed from PM samples at this station.

- ***PM Stations*** – There are four PM monitoring stations (CPMS, A2PM, KUPM, and CWPM) distributed throughout the site. 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 23 metals, gross alpha, gross beta, beryllium-7, potassium-40, and total uranium.

- ***Volatile Organic Compound (VOC) Stations*** – There are four VOC monitoring stations (CPMS, MDL, CW, and TA2). VOC samples are collected once a month over a 24-hour period.

5.2.1 Ambient Air Monitoring Results

Criteria Pollutants

In 2000, the automated data recovery for criteria pollutants was 97.7 percent SO_2, 89.0 percent NO_x, 97.8 percent CO, and 98.1 percent O_3. Table 5-2 lists the results from the CPMS and compares them to NAAQS and NMAAQS for criteria pollutants.

Criteria Pollutants

The U.S. Environmental Protection Agency (EPA) has listed the following as criteria pollutants:

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 from nonferrous smelters.

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

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.

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 VOC and NO_X precursors.

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 microns (PM_{10}) is considered a criteria pollutant because it poses an inhalation hazard.

Lead emissions primarily derive from non-ferrous smelters, battery plants, and other stationary sources of lead emissions.

Although violations of annual federal standards for criteria pollutants are not allowed, exceedences for 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 changed from an hourly standard of 0.120 parts per million (ppm) to an 8-hour standard of 0.080 ppm. On February 27, 2001, the Supreme Court upheld the way the federal government sets clean air standards, rejecting an industry challenge of the decision. The fourth highest daily maximum may not exceed this value.

PM_{10}

Data recovery for PM_{10} was 88 percent complete based on an every sixth day sampling schedule. In general, 24-hour (daily) PM_{10} concentrations were low except for the second quarter of the year. The second highest daily particulate loading (75 $\mu g/m^3$) occurred at the KUPM site (Table 5-2). This station also had the highest annual loading for 2000. Table 5-3 lists the quarterly PM_{10} averages and the annual average at each location. During 2000, there were no violations of federal or state standards for PM_{10} although the short-term 24-hour particulate loading at the KUPM site was exceeded once during construction.

2000 Ambient Air Monitoring Results

Criteria Pollutants – There were no violations or short-term exceedences in 2000. Measured criteria pollutants were significantly below maximum EPA standards.

PM – There were no violations of federal or state standards for PM_{10} during 2000.

VOC – All measured VOCs were significantly below threshold limit values (TLVs).

All filters collected from the PM_{10} stations are analyzed for 23 metals plus five radionuclides (gross alpha, gross beta, beryllium-7, potassium-40, and uranium). Filters are collected every sixth day and are consolidated into monthly composites for analyses. In 2000, monthly composites varied from three to five filters per month, depending on the sampling schedule and some missed samples. Analyses are conducted by a EPA-approved off-site laboratory. The laboratory results for the samples are subtracted from the monthly blank analysis and the final analytical results are averaged over the year (Table 5-5) and compared to TLVs, where established. TLVs are used as a reference using time-weighted averages (TWAs). Although TLVs are not legal limits, these values serve as a guide for determining potential health hazards.

PM_{10} analytical results are generally consistent with metals found in local soil analyses at SNL/NM. As shown in Table 5-4, beryllium (a total metal) was not found above the minimum detection limit (MDL), but was found in the gamma spectroscopy 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 misinterpreted as a significant difference.

In 1998, a new standard was developed for PM to include particulates with a diameter less than or equal to 2.5 µm ($PM_{2.5}$). In 2001, the Supreme Court upheld the EPA decision to create a standard for $PM_{2.5}$, after an industry challenge. A proposed annual $PM_{2.5}$ standard of 15 $\mu g/m^3$ and a 24-hour standard of 65 $\mu g/m^3$ were established. The method for determining $PM_{2.5}$ exceedences will be concentration-based 98th percentile averaged over three years. The EPA has also changed the method of determining PM_{10} exceedences to a

TABLE 5-2. 2000 Criteria Pollutant Results as Compared to Regulatory Standards

Criteria Pollutant	Averaging Time	Unit	NMAAQS Standard	NAAQS Standard	Yearly Summary of Measured Concentrations
Carbon Monoxide	1 hour	ppm	13.1	35	4.90
	8 hours	ppm	8.7	9	2.11
Nitrogen Dioxide	24 hours	ppm	0.10	-	0.030
	Annual	ppm	0.05	0.053	0.013
Sulfur Dioxide §	3 hours	ppm	-	0.50	0.007
	24 hours	ppm	0.10	0.14	0.002
	Annual	ppm	0.02	0.03	0.001
Ozone	1 hour	ppm	0.12	0.12	0.100
	8 hour	ppm	-	0.080	0.074
PM_{10}	24 hours	µg/m^3	150	150	75*
	Annual	µg/m^3	-	50	20.6
$PM_{2.5}$	24 hours	µg/m^3	-	65	-
	Annual	µg/m^3	-	15	-
Total Suspended Particulates	7 days	µg/m^3	110	-	-
	30 days	µg/m^3	90	-	-
Lead	30 days	µg/m^3	-	-	0.0021
	Any quarter	µg/m^3	-	1.5	<0.0010

NOTE: ppm = parts per million
µg/m^3 = micrograms per cubic meter
NMAAQS = New Mexico Ambient Air Quality Standards
NAAQS = National Ambient Air Quality Standards
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)
§Standards are defined in µg/m^3 and have been converted to ppm.
* Reported as the second highest concentration at the KU1 site.

TABLE 5-3. Quarterly and Annual Averages of PM_{10} at SNL/NM for 2000

Station	Jan-Mar (µg/m^3)	Apr-Jun (µg/m^3)	Jul-Sep (µg/m^3)	Oct-Dec (µg/m^3)	Annual (µg/m^3)
CPMS	11.42	13.87	12.80	11.93	12.21
A2PM	11.44	18.78	15.13	9.75	13.50
CWPM	8.33	13.02	12.75	6.53	10.07
KUPM	19.06	38.62	13.75	10.73	20.56

NOTE: µg/m^3 = micrograms per cubic meter
PM_{10} = respirable particulate matter (diameter equal to or less than 10 microns)

TABLE 5-4. PM_{10} Average Annual Concentration by Station Location

Analyte	Units	A2PM	CPMS	CWPM	KUPM	TLV*
Metals						
Aluminum	µg/m^3	0.08668	0.23467	0.08113	0.34980	10,000
Arsenic	µg/m^3	0.00000	0.00000	0.00000	0.00000	10
Barium	µg/m^3	0.00326	0.02699	0.00911	0.01347	500
Beryllium	µg/m^3	0.00000	0.00000	0.00000	0.00000	2
Cadmium	µg/m^3	0.00000	0.00000	0.00000	0.00000	10
Calcium	µg/m^3	0.36105	0.60326	0.21508	0.91908	10,000
Chromium	µg/m^3	0.00039	0.00016	0.00037	0.00059	10
Cobalt	µg/m^3	0.00000	0.00000	0.00001	0.00002	20
Copper	µg/m^3	0.01280	0.01711	0.00726	0.00827	1,000
Iron	µg/m^3	0.10769	0.10785	0.08760	0.26799	5,000
Lead	µg/m^3	0.00010	0.00000	0.00000	0.00026	50
Magnesium	µg/m^3	0.03827	0.14859	0.03515	0.14310	10,000
Manganese	µg/m^3	0.00304	0.00307	0.00226	0.00719	200
Molybdenum	µg/m^3	0.00000	0.00065	0.0000	0.00003	10,000
Nickel	µg/m^3	0.00010	0.00005	0.00003	0.0018	1,500
Potassium	µg/m^3	0.04860	0.09351	0.05015	0.16986	10,000
Selenium	µg/m^3	0.00000	0.00000	0.00000	0.00000	200
Silicon	µg/m^3	0.04389	0.36477	0.04692	0.32356	50
Silver	µg/m^3	0.00002	0.00010	0.00000	0.00000	100
Sodium	µg/m^3	0.42452	0.82119	0.91129	1.61052	10,000
Thallium	µg/m^3	0.00000	0.00000	0.00016	0.00038	100
Vanadium	µg/m^3	0.00011	0.00008	0.00012	0.00041	50
Zinc	µg/m^3	0.00341	0.00739	0.00946	0.00226	10,000
Radionuclides						
Gross Beta	pCi/m^3	0.02085	0.02429	0.02450	0.02750	N/A
Gross Alpha	pCi/m^3	0.00995	0.01193	0.01085	0.01193	N/A
Beryllium-7	pCi/m^3	0.10970	0.08831	0.08387	0.06119	N/A
Potassium-40	pCi/m^3	0.02098	0.01879	0.01514	0.01386	N/A
Uranium-total	µg/m^3	0.00002	0.00002	0.00001	0.00002	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 workday and a 40-hour week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.
µg/m^3 = micrograms per cubic meter
pCi/m^3 = picocuries per cubic meter

VOCs

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

concentration-based 99th percentile averaged over three years. SNL/NM plans to monitor for $PM_{2.5}$ during 2001.

VOCs

In 2000, the data recovery for VOC monitoring was 100 percent. Monthly VOC samples were analyzed for 33 VOC species plus total non-methane hydrocarbon (TNMHC). As shown in Table 5-5, monthly results for compounds detected are reported as averaged concentrations. These are not considered annual averages due to the method of including the sample only if the compound is detected. This method 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 are found in solvents. An analysis of variance was performed to determine if any statistical differences existed between locations for each VOC. The analysis of variance did not reveal any unexpected results. VOC results were significantly below TLVs, where established. TLVs are not legal limits, but serve as a guide for determining potential health hazards.

5.3 RADIOLOGICAL AIR EMISSIONS

The Environmental Management Department provides NESHAP compliance support to all SNL/NM facilities and operations. 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 millirems per year (mrem/yr) resulting from all radiological air emissions produced from a DOE facility.

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. The DOE/KAO submits the annual report to EPA, and the City of Albuquerque, Environmental Health Division. 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 the EPA, the DOE, and the NMED upon request. The NESHAP reports prepared in 2000 include the *NESHAP Annual Report for CY00, Sandia National Laboratories, New Mexico* (SNL 2001c), and the *Radiological Dose Calculations and Supplemental Dose Assessment Data for NESHAP Compliance, Sandia National Laboratories, New Mexico 2000* (SNL 2001f).

5.3.2 SNL/NM NESHAP Facilities

SNL/NM currently has 19 NESHAP facilities that may be defined as either point or diffuse emissions 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.

TABLE 5-5. VOC Average Concentrations Compiled from Monthly Results at Four Stations
Average was computed using only detected results.

Compound	VOC Stations				TLV* (ppbv)
	CPMS (ppbv)	CWLVOC (ppbv)	MDLVOC (ppbv)	A2VOC (ppbv)	
1,1,1-Trichloroethane	0.108	4.191	20.127	0.053	350,000
1,1,2-Trichlorotrifluoroethane	0.175	0.108	0.107	0.096	1,000,000
1,2-Dichlorobenzene	0.132	--	0.032	--	10,000
1-Butene/Isobutene	0.588	0.558	0.589	0.538	N/A
2,2,4-Trimethylpentane	0.285	0.071	0.178	0.100	N/A
2-Butanone	1.344	0.576	0.968	0.869	200,000
2-Methylbutane	7.270	1.407	8.094	2.206	1,770,000
3-Methylpentane	0.290	0.204	0.253	0.122	N/A
4-Methyl-2-pentanone (MIBK)	0.208	0.057	0.125	0.080	50,000
cis/trans-4-Methyl-2-pentene	0.044	--	0.062	--	N/A
Acetone	5.688	4.988	12.423	6.554	500,000
Benzene	0.471	0.150	0.333	0.233	500
Carbon tetrachloride**	0.079	0.074	0.084	0.075	5,000
Chlorobenzene	0.048	--	0.048	--	10,000
Chloromethane	0.557	0.587	0.600	0.592	50,000
Dichlorodifluoromethane	0.535	0.539	0.555	0.555	10,000
Ethylbenzene	0.240	0.074	0.162	0.110	100,000
Isohexane	0.421	0.187	0.331	0.232	500,000
Methylene chloride**	0.789	0.655	0.945	0.762	50,000
n-Butane	1.646	0.600	1.390	0.862	800,000
n-Hexane	0.440	0.321	0.634	0.182	50,000
n-Pentane	4.317	0.850	6.986	1.363	600,000
n-Undecane	0.862	0.178	0.642	0.326	N/A
o-Xylene	0.237	0.081	0.179	0.131	100,000
m/p-Xylene	0.602	0.129	0.398	0.272	100,000
Tetrachloroethene	0.534	0.149	0.129	0.603	25,000
Toluene	2.391	0.264	1.577	0.713	50,000
Trichloroethene	0.081	0.221	0.088	--	50,000
Trichlorofluoromethane	0.375	0.326	0.359	0.315	1,000,000*
TNMHC (total non-methane hydrocarbons)	30.478	11.645	24.295	18.400	N/A

NOTE: ppbv = parts per billion by volume
ND = not detected
N/A = not applicable or not measured or not available
VOC = volatile organic compounds. VOCs may be shown of as separate species as well as in combination with another analyte.
TLV= threshold limit value. (TLVs are guidelines and not legal standards. TLV guidelines assist in the control of health hazards.) (ACGIH 2000)
*Values listed are time-weighted averages (TWAs) except where marked. TWA is the concentration for a normal 8-hour workday and a 40-hour week, to which nearly all workers may be repeatedly exposed without adverse effect. Short-term exposure limit (STEL) is a 15-minute TWA which should not be exceeded at any time during the workday even if the 8-hour TWA is within the TLV.
** Ozone depleting compounds.

Table 5-6 lists the radionuclides and the total reported emissions (in curies) from each SNL/NM NESHAP source in 2000. Of the 19 sources, 16 were point sources and three were diffuse sources (landfills). Three of the 19 facilities reported zero emissions in 2000. The Classified Waste Landfill (ClWL), which is not a routine NESHAP source, was continuously monitored using PM_{10} air samplers (for particulates) and tritium bubblers. Calculations were used to estimate the emissions from the Chemical Waste Landfill (CWL), which is another non-routine source.

The 19 SNL/NM NESHAP facilities located in five Tech Areas (Figure 5-5) are described below. Each facility process that produces radioactive air emissions is also briefly described.

Tech Area I Sources

Calibration Laboratory – Calibration on radiation detection equipment resulted in small releases of tritium.

Cleaning and Contamination Control Laboratory (CCCL) – The CCCL is used for research and development of new and superior materials for government and industrial needs. Carbon-14 was the only radionuclide emission reported in 2000.

Metal Tritide Shelf-Life Laboratory – This laboratory, which conducts research on tritium materials, released negligible levels of tritium (five billionths of a curie).

Neutron Generator Facility (NGF) – The NGF is the nation's principal production facility for neutron generators used in nuclear weapons. This facility currently emits only tritium. The facility has two stacks, but only utilizes the main stack in the Tritium Envelope North Wing. In 2000, 9.5 Curies (Ci) were reported released from the North Wing stack, based on continuous stack monitoring. Although anticipated tritium releases do not exceed the regulatory threshold requiring continuous monitoring, it is performed voluntarily at the NGF as a best management practice (BMP).

Radiation Laboratory – Small-scale radiation experiments resulted in the release of air-activation products and tritium.

Sandia Tomography and Radionuclide Transport (START) Laboratory – This laboratory is used to perform small-scale experiments. In 2000, the facility reported emissions of sodium-22, technetium-99, plutonium-241, americium-241, and uranium-232.

TANDEM Accelerator – This is an ion solid interaction and defect physics accelerator facility. Although the TANDEM did not operate in 2000, the facility reported emissions of tritium that was being housed in the facility.

Weapons Assembly (WA) System Level Testing Facility – This is a research facility that assembles weapons trainers for various tests. Zero emissions have been reported since 1997. Operations within the facility are not expected to change in the future. As a result, the WA System Level Testing Facility has been removed from the NESHAP program.

Tech Area II Sources

ClWL – The ClWL is considered a diffuse source of airborne contamination. The primary contaminants identified at the ClWL in 2000 were tritium, depleted uranium (DU), and radium. Since the landfill was largely uncharacterized, continuous air monitoring was conducted over the duration of remediation. Air samples were analyzed for gross alpha, gross beta, and tritium. Additionally, composite samples were analyzed by gamma spectroscopy. The results of these analyses were compared to predetermined baseline levels. Gross alpha and

TABLE 5-6. Summary of Radionuclide Releases from the 19 NESHAP Sources in 2000

Tech Area	Facility Name	Location	Monitoring Method *	CAP88 Input?	Radionuclide	Reported Release (Ci/yr)
I	Sandia Tomography and Radionuclide Transport (START) Laboratory	Bldg. 823	Calculation	no	Sodium-22 Technetium-99 Uranium-232 Americium-241 Plutonium-241	2.4×10^{-12} 1.0×10^{-13} 1.0×10^{-13} 1.0×10^{-13} 1.0×10^{-13}
I	Radiation Laboratory	Bldg. 827	Calculation	no	Tritium Nitrogen-13 Nitrogen-16 Argon-41	1.0×10^{-5} 1.0×10^{-8} 2.0×10^{-7} 1.0×10^{-9}
I	Calibration Laboratory	Bldg. 869	Calculation	no	Tritium	1.17×10^{-5}
I	NGF – North Wing Tritium Envelope	Bldg. 870	Calculation	**yes**	Tritium	9.45
I	TANDEM Accelerator	Bldg. 884	Calculation	no	Tritium	1.0×10^{-6}
I	Metal Tritide Shelf-Life Laboratory	Bldg. 891	Calculation	no	Tritium	$< 5.0 \times 10^{-9}$
I	Cleaning and Contamination Control Laboratory (CCCL)	Bldg. 897	Calculation	no	Carbon-14	3.50×10^{-5}
II	Classified Waste Landfill (ClWL) **(Diffuse emissions)		Continuous	no	Gross Alpha*** Gross Beta*** Tritium***	$-6.14 \times 10^{-17} – 1.97 \times 10^{-14}$ $8.15 \times 10^{-15} – 6.62 \times 10^{-14}$ $-2.86 \times 10^{-12} – 1.51 \times 10^{-11}$
II	Explosive Components Facility (ECF)	Bldg. 905	Calculation	no	Tritium	1.24×10^{-3}
III	MWL (Diffuse emissions)	North end	Periodic	**yes**	Tritium	0.294
III	RMWMF	Bldg. 6920	Continuous	**yes**	Tritium	0.355
III	Chemical Waste Landfill (CWL) (Diffuse emissions)	South end	Calculation	**yes** (not routine)	Cobalt-60 Tritium Thorium-232 Radium-228 Thorium-228 Actinium-228 Radium-224 Lead-212 Bismuth-212 Thallium-208 Uranium-235 Thorium-231 Uranium-238 Radium-226 Lead-214 Bismuth-214	7.7×10^{-4} 6.8×10^{-7} 1.5×10^{-7} 1.6×10^{-7} 1.3×10^{-7} 1.6×10^{-7} 1.7×10^{-7} 1.4×10^{-7} 1.7×10^{-7} 1.4×10^{-7} 1.3×10^{-8} 1.5×10^{-8} 2.1×10^{-5} 1.2×10^{-7} 1.6×10^{-9} 1.4×10^{-9}

NOTE: * Monitoring Method: Periodic = Based on periodic measurements
Calculation = Calculated from known parameters
Continuous = Based on continuous air monitoring results

** These values include background and represent the range observed in the sampling results collected from March 2, 1998 to March 20, 2000.

*** Units are in Ci/m^3.

Ci/yr = curies per year

RMWMF = Radioactive and Mixed Waste Management Facility

NGF = Neutron Generator Facility

CAP88 = Clean Air Act Assessment Package-1988

MWL = Mixed Waste Landfill

TABLE 5-6. Summary of Radionuclide Releases from the 19 NESHAP Sources in 2000 *(concluded)*

Tech Area	Facility Name	Location	Monitoring Method *	CAP88 Input?	Radionuclide	Release (Ci/yr)
IV	HERMES III	Bldg. 970	Periodic	**yes**	Nitrogen-13 Oxygen-15	4.58×10^{-4} 4.58×10^{-5}
IV	Saturn Facility	Bldg. 981	Calculation	**no** (no releases in 2000	none	0
IV	SPHINX	Bldg. 981	Periodic	**no** (no releases in 2000)	none	0
IV	Z-Facility (Accelerator)	Bldg. 983	Calculation	**yes**	Uranium-234 Uranium-235 Uranium-238	(2.6E-06 Ci/yr) (1.2E-07 Ci/yr) (2.5E-06 Ci/yr)
V	Hot Cell Facility (HCF)	Bldg. 6580	Periodic	**no** (no releases in 2000)	none	0
V	Annular Core Research Reactor (ACRR)	Bldg. 6588	Periodic	**yes**	Argon-41	18.33
V	Sandia Pulsed Reactor (SPR)	Bldg. 6590	Periodic	**yes**	Argon-41	0.57

NOTE: *Monitoring Method: Periodic = Based on periodic measurements
Calculation = Calculated from known parameters
Continuous = Based on continuous air monitoring results
Ci/yr = curies per year
HERMES III = High Energy Radiation Megavolt Electron Source III
CAP88 = Clean Air Act Assessment Package-1988
SPHINX = Short Pulse High Intensity Nanosecond X-Radiator

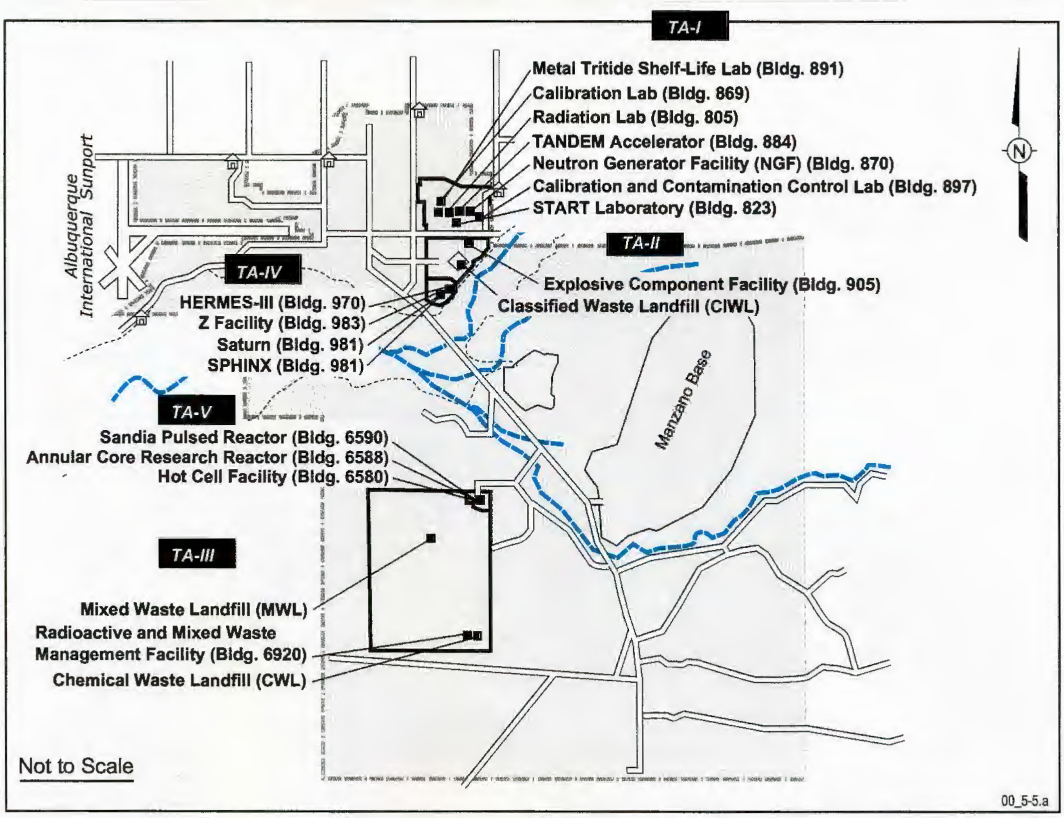


FIGURE 5-5. Locations of the 19 Facilities at SNL/NM that Provided Radionuclide Release Inventories in 2000

gross beta concentrations that were over the established critical values were sent to an analytical laboratory for additional analyses by alpha spectroscopy, liquid scintillation counting, or both. Only naturally occurring radionuclides were identified by these methods. Likewise, gamma spectroscopy results identified only naturally occurring radionuclides. Tritium results did not exceed established limits. Excavation of the ClWL was completed in February 2000.

Explosive Components Facility (ECF) – The ECF conducts destructive testing on neutron generators. The only release in 2000 was tritium. Noise caused by explosive testing activities is addressed in the *SNL Final Site-Wide Environmental Impact Statement* (DOE 1999a).

Tech Area III Sources

CWL – The CWL is a non-routine NESHAP source. The primary contaminants identified at this diffuse source are cobalt-60, tritium, potassium-40, and uranium and thorium series radionuclides. 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 2000. A worst case analysis was perfomed, which assumed that all radioactivity present was re-suspended into the air.

Mixed Waste Landfill (MWL) – The MWL was closed in 1988. Although a diverse inventory of radionuclides is present in the MWL, measurements indicate that tritium is the only radionuclide released into the air. In 1992 and 1993, two special studies were conducted to quantify the tritium emissions (Radian 1994).

Radioactive and Mixed Waste Management Facility (RMWMF) – The RMWMF primarily handles low-level (LLW), mixed waste (MW), and some transuranic (TRU) waste. In 2000, the RMWMF reported only tritium releases, as determined by continuous stack monitoring. Although anticipated tritium releases do not exceed the regulatory threshold requiring continuous monitoring, it is performed voluntarily at the RMWMF as a BMP.

Tech Area IV Sources

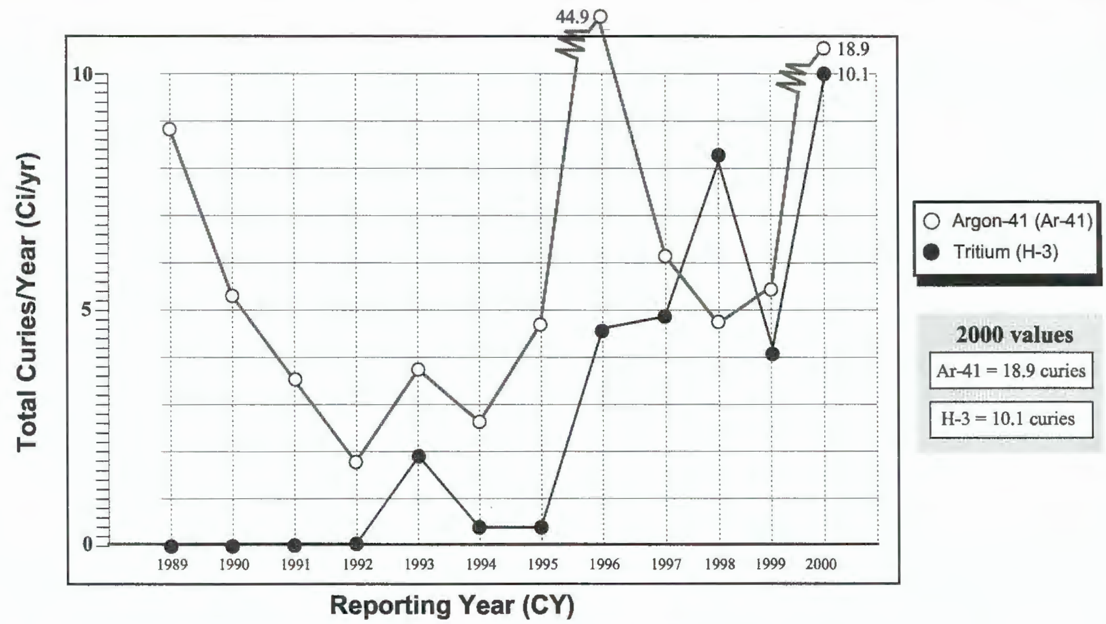
High-Energy Radiation Megavolt Electron Source III (HERMES III) – The HERMES III accelerator is used to test the effects of prompt radiation on electronics and complete military systems. This facility produces air activation products, primarily nitrogen-13 and oxygen-15.

Saturn Accelerator – This is a modular, high powered, variable spectrum, x-ray simulation source that reproduces the radiation effects of nuclear countermeasures on electronic and material components. Zero emissions were reported in 2000.

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 2000.

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 2000, uranium targets were utilized. Consequently, the facility reported releases of uranium-234, uranium-235, and uranium-238.

Tech Area V Sources



NOTE: The atmosphere contains 72% nitrogen, 21% oxygen, 0.93% argon, 0.03% carbon dioxide, and minor concentrations of neon, methane, hydrogen, helium, and krypton. 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 Argon-41 and Tritium from SNL/NM Facilities Since 1989

15,790	Dairy cattle
32,696	Beef cattle
87.7	Food crops square miles (sq mi)
695,406	Population (within 80-km [50-mi] radius)

On-site and Off-site Public Receptors

A total of 30 receptor locations (22 on-site at KAFB and eight off-site) in the vicinity of SNL/NM have been identified as potential locations of maximum exposure to a member of the public. Off-site 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 Albuquerque International Sunport west of KAFB. On-site receptors include U.S. Air Force (USAF) facilities, offices and housing areas, as well as other non-DOE and non-U.S. Department of Defense (DoD) facilities on KAFB. In October 2000, the United States Geological Survey (USGS) Seismic Center receptor relocated to Building 57001, which is the former location of KAFB's Space Vehicle Directorate. USAF occupants of this building were moved to various other locations within KAFB that are already on SNL/NM's list of receptors. Because Building 57001 is no longer occupied, it will be removed from the list of SNL/NM receptors.

Meteorology

Data from four meteorological towers (CW1, A36, A21, and MW1) in the proximity of NESHAP emission sources were used in 2000. Data from each tower consisted of approximately 35,000 hourly observations of wind direction, wind speed, and stability class (inferred from wind and solar insolation 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 estimates air dispersion in both the horizontal and vertical directions. Individual EDEs to off-site and on-site receptors are presented in Tables 5-7 and 5-8, respectively. Dose assessment results are summarized in Table 5-9.

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 2000.

Hot Cell Facility (HCF) – The HCF provides full capability to remotely handle and analyze radioactive materials such as irradiated targets. The facility is in standby mode to support MIPP should production be required in the future. No emissions were reported in 2000.

Sandia Pulsed Reactor (SPR) – The SPR is used to produce intense neutron bursts for effects testing on materials and electronics. In 2000, only argon-41 was released. In September 2000, the reactor was placed in temporary storage. Operations are expected to resume in Calendar Year (CY) 2003.

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, the available pathways in the environment (food chain, air, and water), radionuclide quantities and properties, and meteorological conditions. Historically, radioactive releases from SNL/NM have resulted in doses to the public that are several orders of magnitude below the EPA's standard of 10 mrem/yr. Radiation protection standards specific to DOE facilities are given in Appendix A.

5.4.1 NESHAP Dose Assessment Input

Emission Sources

To assess compliance, all NESHAP facilities at SNL/NM submit annual facility emission data to the NESHAP Program administrator. The emissions from eight "primary" sources (ACRR, SPR, HCF, Z Facility, HERMES-III, NGF, RMWMF and MWL) are modeled using version 2 of the EPA's Clean Air Act Assessment Package-1988 (CAP88) (EPA 2001) to estimate the annual dose to each of 20 identified public receptors. Primary sources are those that determine their emissions by direct measurements or by calculations based on measured operational parameters. The HCF was the only primary source to report zero emissions in CY00.

The NESHAP regulation requires DOE to continuously monitor any radionuclide air emission source that has the potential to produce a dose of 0.1 mrem/yr to the maximally exposed individual (MEI); however, there are no facilities at SNL/NM that exceed this criterion. As a BMP, some SNL/NM facilities do perform continuous stack monitoring. Other facilities base their emission estimates on periodic confirmatory measurements or engineering calculations.

In 2000, the highest emissions were argon-41 and tritium. Historically, these radionuclides have been the most significant contributors to the effective dose equivalent (EDE) of the MEI. Figure 5-6 shows the annual reported release in curies of argon-41 and tritium over the past 12 years.

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 (50-mi) radius study area. The densities for resident 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). In 2000, NESHAP calculation for resident population was based on the state's 1994 to 1995 estimated urban and county population data and U.S. Census Bureau data (DOC 2001). 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 2001). The following values were used in the 2000 CAP88 calculation:

The total dose at each receptor location is determined by summing the individual doses resulting from each source. The dose to the MEI member of the public is then compared to the EPA limit of 10 mrem/yr.

In 2000, the MEI was again located on KAFB, at the Kirtland Underground Munitions Storage Complex (KUMSC), northwest of Tech Area V. The MEI dose of 0.0035 mrem/yr resulted primarily from releases of 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 5-9). Collective dose calculations are not required by NESHAP regulations; however, it provides a useful numerical comparison of the public dose from year to year. Collective dose is calculated by multiplying a representative individual dose, within a population, by the total population. SNL/NM calculates the collective population dose for both the KAFB housing areas and the general Albuquerque area population within an 80-km (50-mi) radius.

Regional – The Albuquerque regional collective population dose in 2000 was 0.0802 person-rem/yr. 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 assuming a total residential population of 4,430. This resulted in an estimated population dose of 0.0023 person-rem/yr.

5.5 AIR QUALITY REQUIREMENTS AND COMPLIANCE STRATEGIES

Air quality standards are implemented by regulations promulgated by local and federal governments 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 non-radiological pollutants. Radionuclide air emissions are currently regulated by the EPA under NESHAP, as discussed in Section 5.4, although the radionuclide 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, O_3, 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 (HAP) 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 pollutant standards for ambient air is met through ambient air surveillance, periodic direct emission sampling, and fuel throughput tracking

TABLE 5-7. Annual Source-Specific Effective Dose Equivalent (EDE) to Off-site Receptors in 2000

Receptor	ACRR (Bldg. 6588)	SPR (Bldg. 6590)	HERMES III (Bldg. 970)	RWMWF (Bldg. 6920)	MWL (TA-III)	NGF (Bldg. 870)	Z Facility (Bldg. 983)	Effective Dose Equivalent (mrem/yr)
Albuquerque City Offices	4.5E-04	1.4E-05	2.3E-09	4.2E-06	8.5E-06	4.4E-04	6.1E-05	**9.8E-04**
East Resident	2.2E-05	6.7E-07	6.4E-12	3.2E-06	6.5E-06	3.9E-04	2.6E-06	**4.3E-04**
Eubank Gate Area (Building 8895)	2.4E-04	7.6E-06	1.1E-08	3.6E-06	7.3E-06	7.0E-04	6.1E-05	**1.0E-03**
Four Hills	2.6E-04	8.2E-06	2.2E-09	3.6E-06	7.8E-06	4.3E-04	1.7E-05	**7.3E-04**
Isleta Bingo	6.5E-05	2.1E-06	1.9E-11	3.6E-06	6.5E-06	4.0E-04	7.1E-06	**4.8E-04**
Northeast Resident	1.0E-04	3.2E-06	3.0E-10	3.6E-06	7.2E-06	4.0E-04	7.4E-06	**5.2E-04**
Seismic Center (USGS)	6.8E-05	2.2E-06	4.6E-11	3.5E-06	7.1E-06	4.0E-04	4.3E-06	**4.9E-04**
Tijeras Arroyo (West)	6.6E-04	2.1E-05	3.2E-09	4.6E-06	9.7E-06	4.4E-04	3.3E-05	**1.2E-03**

NOTE: mrem/yr = millirem per year
ACRR = Annular Core Research Reactor
SPR = Sandia Pulsed Reactor
HERMES III = High Energy Radiation Megavolt Electron Source III
RMWMF = Radioactive Mixed Waste Management Facility
MWL = Mixed Waste Landfill
NGF = Neutron Generator Facility
USGS = U.S. Geological Survey
EDE = effective dose equivalent

TABLE 5-8. Annual Source-Specific Effective Dose Equivalent (EDE) to On-site Receptors in 2000

Receptor	ACRR (Bldg. 6588)	SPR (Bldg. 6590)	HERMES III (Bldg. 970)	RWMWF (Bldg. 6920)	MWL (TA-III)	NGF (Bldg. 870)	Z Facility (Bldg. 983)	Effective Dose Equivalent (mrem/yr)
Airport (Bldg. 760)	5.5E-04	1.2E-05	6.2E-09	6.4E-07	1.3E-06	1.0E-04	7.8E-05	**7.4E-04**
Airport East (Bldg. 1064)	3.0E-04	9.3E-06	4.2E-09	5.4E-07	1.1E-06	1.1E-04	5.3E-05	**4.7E-04**
Bldg. 20706, U.S. Air Force (USAF)	4.1E-04	1.3E-05	2.9E-08	5.0E-07	1.2E-06	1.7E-04	1.9E-04	**7.9E-04**
Bldg. 24499 (USAF)	2.2E-04	6.9E-06	7.6E-09	4.2E-07	9.4E-07	2.6E-04	4.8E-05	**5.4E-04**
Chestnut Test Site	4.7E-04	1.6E-05	2.1E-10	5.3E-06	2.4E-06	1.3E-05	7.6E-06	**5.1E-04**
East Capehart	1.9E-04	5.9E-06	4.2E-09	3.9E-07	8.5E-07	8.0E-05	4.2E-05	**3.2E-04**
Golf Course Clubhouse	1.3E-03	4.1E-05	8.6E-09	9.9E-07	4.1E-06	4.5E-05	5.4E-05	**1.5E-03**
Golf Course Maintenance Area	8.4E-04	2.6E-05	1.6E-08	8.2E-07	3.2E-06	6.4E-05	1.1E-04	**1.0E-03**
Honeywell Instrument Support Site	5.5E-04	1.7E-05	1.3E-07	5.8E-07	1.5E-06	1.3E-04	1.0E-03	**1.7E-03**
ITRI/Lovelace	1.6E-04	5.4E-06	1.3E-10	7.0E-07	1.1E-06	1.0E-05	5.2E-06	**1.8E-04**
Kirtland Air Force Base (KAFB) Fire Station #4 (Bldg. 90002)	2.2E-04	7.3E-06	6.5E-11	1.7E-06	1.3E-06	1.2E-05	5.6E-06	**2.5E-04**
KAFB Landfill	4.5E-04	1.4E-05	6.0E-08	6.2E-07	2.1E-06	1.3E-04	2.1E-04	**8.1E-04**
Kirtland Underground Munitions Storage Complex (KUMSC)	3.3E-03	1.0E-04	3.6E-09	1.5E-06	6.1E-06	3.7E-05	4.6E-05	**3.5E-03**
Loop Housing	2.1E-04	6.5E-06	8.4E-09	4.1E-07	9.4E-07	2.6E-04	7.2E-05	**5.5E-04**
Manzano Offices (Fire Station)	5.8E-04	1.9E-05	1.1E-09	1.2E-06	2.9E-06	2.5E-05	1.3E-05	**6.4E-04**
Maxwell Housing	2.9E-04	9.0E-06	1.1E-09	4.5E-07	1.1E-06	5.6E-05	2.3E-05	**3.8E-04**
Pershing Park Housing	2.5E-04	5.4E-06	4.2E-09	3.8E-07	8.2E-07	1.5E-04	4.7E-05	**4.5E-04**
Riding Club	1.5E-03	4.7E-05	2.1E-09	1.2E-06	4.3E-06	3.2E-05	2.8E-05	**1.6E-03**
Sandia Federal Credit Union	3.6E-04	1.1E-05	1.6E-08	4.6E-07	1.1E-06	4.4E-04	1.1E-04	**9.2E-04**
Space Vehicles Directorate (Bldg. 57001)	1.9E-04	6.2E-06	2.2E-10	1.0E-06	1.3E-06	1.2E-05	6.5E-06	**2.2E-04**
West Capehart	2.6E-04	8.0E-06	8.4E-10	4.2E-07	7.4E-07	3.8E-05	1.9E-05	**3.3E-04**
Zia Park Housing	3.5E-04	1.1E-05	8.4E-09	5.8E-07	1.2E-06	1.8E-04	8.6E-05	**6.3**

NOTE: ACRR = Annular Core Research Reactor
SPR = Sandia Pulsed Reactor
HERMES III = High Energy Radiation Megavolt Electron Source III
RMWMF = Radioactive Mixed Waste Management Facility
mrem/yr = millirem per year
MWL = Mixed Waste Landfill
NGF = Neutron Generator Facility
USGS = U.S. Geological Survey
EDE = effective dose equivalent

TABLE 5-9. Calculated Dose Assessment Results for On-site and Off-site Receptors and for Collective Populations in 2000

Dose to Receptor	Location	2000 Calculated Dose	NESHAP Standard
Individual Dose			
On-site Receptor EDE to the MEI	KUMSC	0.0035 mrem/yr *(0.0000350 mSv/yr)*	10 mrem/yr *(0.1 mSv/yr)*
Off-site Receptor EDE to the MEI	Tijeras Arroyo (West) West of KAFB	0.0012 mrem/yr *(0.000012 mSv/yr)*	10 mrem/yr *(0.1 mSv/yr)*
Collective Dose			
Collective Regional Population[1]	Residents within an 80-km (50-mi) radius	0.0802 person-rem/yr *(0.000802 person-Sv/yr)*	No standard available
Collective KAFB Population[2]	KAFB housing	0.0023 person-rem/yr *(0.000023 person-Sv/yr)*	No standard available

NOTE: mSv/yr = millisievert per year
person-Sv/yr = person-seviert per year
mrem/yr = millirem per year
EDE = effective dose equivalent
MEI = maximally exposed individual
KUMSC = Kirtland Underground Munitions Storage Complex
NESHAP = National Emissions Standards for Hazardous Air Pollutants
[2]Based on a population of 4,430 people estimated to be living in permanent on-base housing.
[1]Based on a population of 695,406 people estimated to be living within an 80-km (50-mi) radius.

and reporting. As discussed in the previous section, ambient air measurements taken in the vicinity of SNL/NM facilities have been well below maximum TLVs and guidelines for criteria pollutants.

New EPA Standard for Ozone

As discussed in Section 2.3, the EPA revoked the NAAQS in 1998 for the 1-hour standard of 0.12 ppm for 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 decided that tougher laws were needed to protect children and adults with respiratory problems. On July 5, 2000, the EPA officially reinstated its 1-hour ozone standard in nearly 3,000 counties across the U.S.

The significant sources of criteria pollutants at SNL/NM are listed below.

Steam Plant – The Steam Plant produces steam heat for buildings in Tech Area I as well as some facilities east 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 2000. The volume of fuel (throughput) used in the boilers is reported to the City of Albuquerque. In 2000, fuel throughput reported at the Steam Plant was as follows:

Natural Gas (scf)	Diesel (gal)
659,248,191	152,133

NOTE: scf = standard cubic feet
gal = gallon

As defined by 20 NMAC 11.67, "Equipment Emissions, and Limitations," the Steam Plant falls below the applicable minimum emission limits for NO_x. Stack sampling is not required for the Steam Plant since it is a "grandfathered" source and no permit has been previously required. There are no current regulations that apply to the Steam Plant. However, the Steam Plant's air emissions will be subject to the requirements of Title V, since it has the potential to emit greater than 100 tons per year (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 managed by the General Services Administration (GSA). Currently, there are approximately 800 GSA vehicles in SNL/NM's fleet. All GSA vehicles must comply with the same emission standards set for all personal and non-personal vehicles that are issued KAFB vehicle passes. As required by 20 NMAC 11.100, "Motor Vehicle Inspection-Decentralized," Sandia Corporation submits an annual vehicle inventory update and inspection plan to the City of Albuquerque for approximately ten vehicles.

Emergency Generators – Sandia Corporation operates four main standby diesel generators for emergency power supply. These generators are located in Building 862 within Tech Area I 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 2000, one additional generator was added at the Processing and Environmental Technology Laboratory (PETL) located in Building 701.

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 (FGR) was completed, and actual retrofitting was accomplished in 1999. Plans were also drawn up to retrofit the remaining boilers (1, 2, and 3). Boiler 3 was retrofitted with FGR in 2000. Retrofitting the two large 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 boilers with FGR have since been reduced by 68 percent.

The success of the Steam Plant Optimization Project earned SNL/NM the *"Joint Industry and Government Pollution Prevention (P2) Award for 2000*" given by the New Mexico Facility Managers Network in conjunction with the City of Albuquerque.

In 2000, the fuel throughput reported was 5,854 gallons of diesel. In anticipation of a 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 a year for each generator, which is the same usage assumed for all other on-site generators.

Open Burns – As required by 20 NMAC 11.21, "Open Burning," Sandia Corporation obtains open burn permits for each applicable 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 eight permits issued in 2000. Open-burn permits are required for:

- Disposal of Explosives by Burning (avoids the hazards of transport and handling);
- Aboveground Detonation of Explosives (over 20 lb);
- Burning Liquid Fuel 2,000 gallons 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 CAAA of 1990 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 tpy or greater of any criteria pollutant,
- 10 tpy of any HAP, or
- 25 tpy of any combination of HAPs.

SNL/NM is considered a major source based on its potential to emit NO_x and 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 rather 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, the DOE will submit one air compliance report and one fee to the City of Albuquerque on an annual basis. The Title V Operating Permit will integrate all CAAA requirements into one site-wide permit for the 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 a Title V Operating Permit by March 13, 1996. The DOE/KAO 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 was March 13, 1998 and the permit was anticipated to be issued in 2000, the City of Albuquerque has yet to issue the final permit.

Small Business Assistance

The New Mexico Small Business Assistance (NMSBA) Program, which is managed by SNL/NM, assisted a Roswell, New Mexico business in preparing the EPA's proposed Standards for Reinforced Plastic Composite and Production, 40 CFR 63.

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 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 potential compliance with Title V by recording fuel throughput for all significant sources. In 2000, SNL/NM's total reported emission, based on throughput, was 74 tons. At $31 per ton, this resulted in a fee of $3,774. In 2000, Steam Plant Boiler 3 was retrofitted for FGR under the Steam Plant Optimization Project.

Risk Management Plan (RMP)

A self-assessment audit found the hydrochloric acid (HCl) storage tank at the Microelectronics Development Laboratory (MDL), located in Building 858, to be below the 37 percent threshold quantity (TQ) requirement for an RMP (40 CFR 68).

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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. In this chapter, effluent monitoring is confined to water monitoring activities that include wastewater discharges, which are made up of sanitary and industrial effluents, 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), the five SNL/NM wastewater monitoring stations are permitted by the City of Albuquerque. Storm water is the only NPDES regulated discharge at SNL/NM. Sandia Corporation also adheres to the water quality guidelines contained in U.S. Department of Energy (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 (TOMPs) and general good housekeeping and engineering practices. Pollution prevention (P2) 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 (SWRP)
SNL/NM's sewer system connects to the City of Albuquerque's sanitary sewer line at four sanitary permitted wastewater outfall stations. SNL/NM also has one additional industrial permitted wastewater outfall station at the Microelectronics Development Laboratory (MDL), which is upstream of the final discharge points. Wastewater effluent discharging from any of the five stations must meet the City of Albuquerque's Sewer Use and Wastewater Control Ordinance (SUWCO) requirements. SUWCO information can be found at the City of Albuquerque's website:

www.amlegal.com/albuquerque_nm/

All SNL/NM wastewater discharges to the Tijeras Arroyo Intercept (TAI) and terminates at the SWRP, which services all of the Albuquerque area and is the largest water treatment facility in New Mexico. The water treatment process begins with primary treatment that removes the large solids by bar screens followed by a grit chamber and primary clarification. The resultant sludge from this process is collected and transported to landfill sites. The effluent from the primary clarification tank flows to the aeration basin, which start the secondary treatment process. Microorganisms within the aeration basin break down the sewage by natural biological processes. Final clarification followed by disinfection complete the process prior to discharge to the Rio Grande. The sludge produced from the final clarification process is combined with sludge from the primary clarification process, digested, (producing methane gas), dewatered, collected, and transported to the composting site. The sludge is tilled into the ground or sold as compost to local nurseries.

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. All effluent discharge standards for the City of Albuquerque are defined in its NPDES Permit and have been within established limits.

Wastewater Compliance Awards
The City of Albuquerque's reporting requirements are defined under its Industrial Wastewater Pre-treatment Program (IWPP). The IWPP specifies the discharge quality and requirements that the City of Albuquerque will accept at its SWRP. Sandia Corporation received four "Gold Pre-treatment Awards" and one "Silver Pre-Treatment Award" from the City of Albuquerque for the 1999 to 2000 reporting year. A Gold Award is given based on a facility's 100 percent compliance to discharge limits set in permits or exceptional source reduction and P2.

6.1.2 Permitting and Reporting

The City of Albuquerque Public Works Department, Liquid Waste Division, implements the EPA's water quality standards under the authority of the SUWCO. Sandia Corporation submits semi-annual wastewater reports to the City of Albuquerque. Results from the January 1 to June 30, 2000 period were submitted by July 31, 2000; results from the July 1 to December 31, 2000 period were submitted by January 31, 2001. 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 (WQG) maintains a Discharge Control Program (DCP) to track wastewater discharges resulting from ongoing chemical, manufacturing, and industrial processes at SNL/NM 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 process or discharge changes to the facility prior to the annual review, the facility owner must notify the WQG. Generally, processes are well characterized and any constituents that are detected over the limits at a wastewater monitoring station can usually 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 five on-site wastewater monitoring stations permitted by the City of Albuquerque, as shown in Figure 6-1. (Wastewater permits are listed in Table 2-7 of Chapter 2). Four of these stations discharge directly to the public sewer, which flows into the TAI and one station is for an upstream categorical pre-treatment process located at Building 858.

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 (AWN) at the MDL in Tech Area I.

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-Volatile organic compounds (SVOCs)
- Chemical oxygen demand (COD)

Wastewater Monitoring

All outfall stations are equipped with flow meters and potential of hydrogen (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 personnel at SNL/NM 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 gallons of wastewater 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 requirements. NMED is notified when sampling is scheduled to occur and is offered the opportunity to obtain samples for analysis. All samples are obtained as 24-hour flow proportional or time weighted composites. Sandia Corporation sends its split samples to an

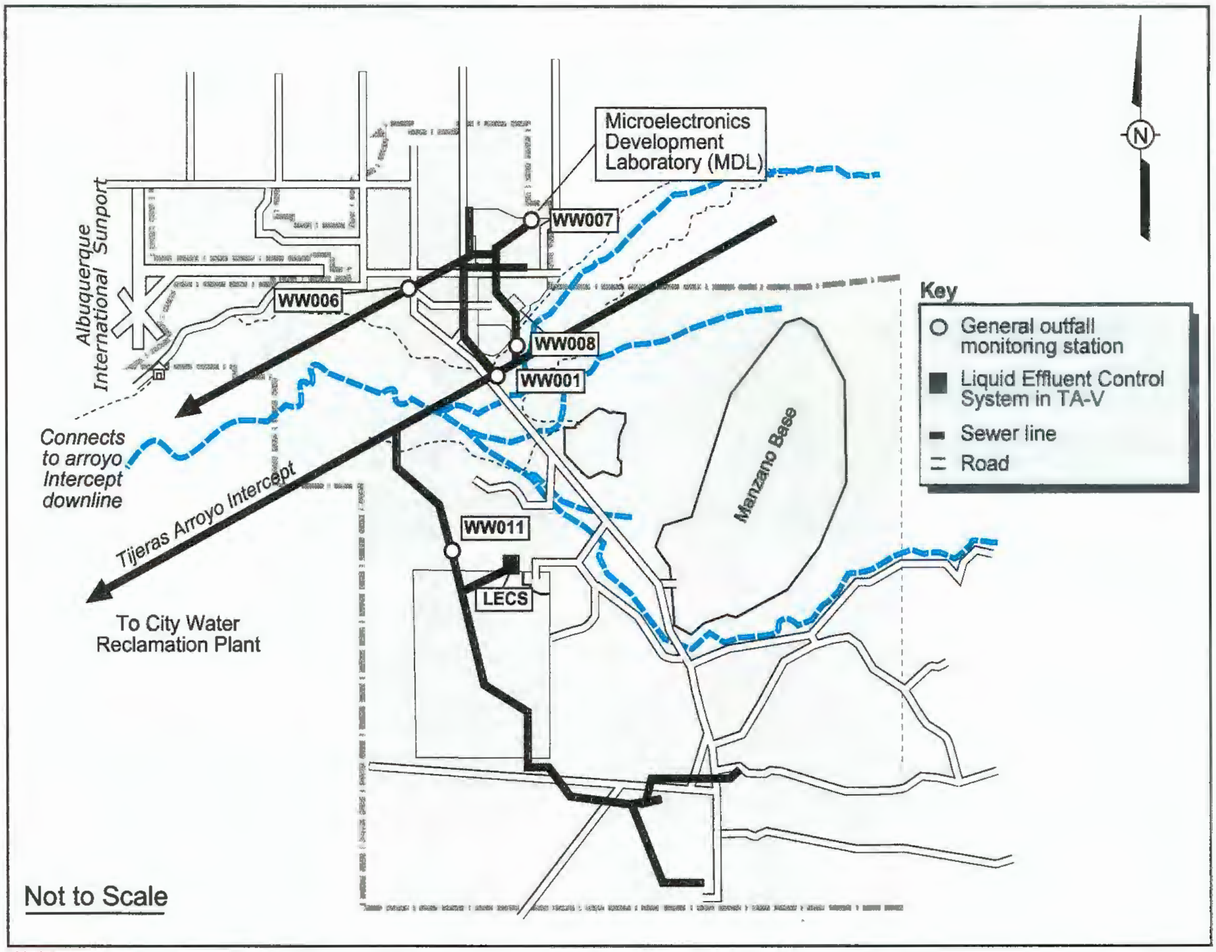

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FIGURE 6-1. Wastewater Monitoring Station Locations

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	MDL	45° v-notch Weir
Not Permitted		
LECS	Radiological screening of Tech Area V process water	N/A

NOTE: "All waste streams" include both domestic and industrial discharges.
*A Parshall Fume is a primary flow-measuring device characterized by a constricted throat that produces a head that is related to discharge flow rate. This type of flume is used in sanitary sewer systems because it is self-cleaning.
LECS = Liquid Effluent Control System
MDL= Microelectronics Development Laboratory
N/A = not applicable

EPA-approved laboratory for analysis. Sandia Corporation sampling 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.

Septic Systems
Sandia Corporation maintains three active septic tank systems in remote areas on Kirtland Air Force Base (KAFB), which are used only for domestic sanitary sewage collection. Since these tanks receive only domestic sewage and no industrial discharges, they do not require sampling prior to pumping and discharge to the public sewer. However, as a Best Management Practice (BMP), Sandia Corporation periodically obtains samples from these active 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 screened using the Liquid Effluent Control System (LECS) and can be sampled for radiological contaminants before the contents are released to the public sewer system.

Discharges to the sanitary sewer have not exceeded standards for radionuclides at any of SNL/NM's wastewater stations, including the LECS.

The LECS consists of three 5,000-gal tanks and one 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

The MDL uses acids for etching electronic boards and other components.

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 and 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 discharged to the public sewer system.

6.1.5 Summary of Monitoring Results

During 2000, 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 2000 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 2000 also met regulatory standards for radiological levels in wastewater.

All permit conditions were met in 2000, except for the following:

- On January 21, 2000, DOE notified Department 1670-1, Supporting Technologies, Material Processing and Coating Laboratory (MPCL) that the electroplating operations in process did not have the necessary City of Albuquerque Wastewater Permit. As a result, the operation was shut down and the City of Albuquerque notified.

- On October 15, 2000, a loss of computer control in the AWN system at the MDL caused a pH imbalance in the mixing tanks. This followed a power outage at the facility, however, the uninterruptable power supply (UPS) did not come online as designed. This resulted in an exceedence of pH at Wastewater Station WW007 (Permit no. 2069G-4). The City of Albuquerque filed a Notice of Violation (NOV) to the DOE Kirtland Area Office (KAO) the following day. This occurrence was thought to be due to a faulty UPS and was therefore replaced.

  A second pH imbalance in the AWN system occurred on October 29, 2000, which was also due to a loss of computer control. This caused a pH exceedence at both Wastewater Stations WW007 (Permit no. 2069G-4) and WW008 (Permit no. 2069I-4). The pH exceedence at WW008 was over the standard for greater than a one-hour duration.

  The first occurrence was thought to be due to a faulty UPS at the MDL; however, after the second occurrence, MDL personnel evaluated the system and found that the root cause was due to a software problem in the AWN computer. The software was upgraded and the system was repaired.

6.2 SURFACE DISCHARGE PROGRAM

All water and water based compounds that discharge 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. These regulations are designed to protect the groundwater and surface water of the state for potential use as a domestic potable water source. 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 and water based compounds 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 discharge complies with strict water quality 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 Environmental Restoration (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.

2000 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 exist. 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 2000, 20 individual surface discharge requests were made; all met state standards and were approved.

6.2.2 Surface Discharge Releases in 2000

The Surface Discharge Program must be contacted in the event of an accidental release or spill to the ground surface. In 2000, the following releases occurred:

- On March 6, 2000, a 10-inch domestic water line broke at the intersection of 9th and H Avenue. Domestic water flowed from the break for approximately 30 minutes at an estimated flow rate of approximately 1,000 gallons per minute before the flow was stopped. The source of the discharge was a 7-foot split in the line. Repairs were completed by facilities engineering. It was estimated that between 30,000 to 100,000 gallons of water entered the storm drainage system through various inlets. These inlets discharge to the Tijeras Arroyo. The release infiltrated into the soil column before reaching the main arroyo channel.

- On March 14, 2000, contractors working on the 9th Street project were digging when a valve on a 10-inch water line was broken. Approximately 100,000 to 200,000 gallons of domestic water were discharged into the lined storm drain system. The discharge entered the underground culvert and flowed along the concrete lined ditch to the energy dissipater located southwest of SNL/NM Tech Area IV on Pennsylvania Avenue. The discharge collected within a construction site where additional work was being preformed as part of the storm water system modernization project. The release infiltrated into the soil column.

- On June 9, 2000, 150 gallons of tap water and a small amount of sewer effluent were discharged onto the surface during clearing of a sewer blockage. Water was reported to be coming out of clean out drains on the east and northwest sides of Building 996. The discharge soaked into the soil column and did not enter any storm drain or impact any “Waters of the U.S.”

- On April 10, 2000, a reportable discharge of approximately one pint of liquid occurred at Building 858. During a routine inspection of the outside secondary containment wall surrounding the bulk hydrochloric acid (HCl) storage tank, a dried stain was observed on the asphalt pavement adjacent to a wet stain on the wall itself. The source of the release was residual HCl trapped between the concrete portion of the secondary containment wall and inner flexible liner (the inner liner is corrosive resistant). It is believed that a small quantity of HCl from a previous release within the secondary containment area penetrated the liner at one of the many seams and eventually worked its way to a hole in the concrete portion of the secondary containment. During the previous release, the HCl was contained within the secondary containment and there was no HCl released to the environment.

- On August 11, 2000, a 14-inch water line in Tech Area III ruptured along a 15-foot section releasing approximately 1.2 million gallons of domestic water to the surface. The water from this system is used for secondary fire suppression within Tech Areas III and V. The released water infiltrated into the soil column at three locations and did not enter any arroyo channels or "Waters of the U.S." No facilities or ER sites were affected.

- On October 31, 2000, SNL/NM personnel from the Lurance Canyon Burn Site (LCBS) reported a loss of water from a non-potable water tank. A series of leak tests were performed to isolate and confirm possible leaks. These tests indicated a leak in the fill line leading to the storage tank. The event was reported to the NMED on November 15, 2000 after the leaks into the soil column were confirmed. Excavation of the fill line indicated two leaks and soil samples were taken at these leak sites. The supply well was also sampled to eliminate the possibility that water flowed into the well. Results of the sampling from the leak sites and the well indicated no adverse effects to the environment. LCBS personnel designed corrective actions to repair the leaks and redesign the fill system to run above ground with drain ports for freeze protection that will fill the tank from the top. NMED approved SNL/NM's corrective action plan on February 1, 2001. NMED Hazardous Waste Bureau personnel inspected the site on April 18, 2001 and determined it was satisfactory and No Further Action (NFA) was required.

These occurrences are also discussed under occurrence reporting in Chapter 2, Section 2.4.

6.2.3 Pulsed Power Evaporation Lagoons

The Surface Discharge Program reports water quality results from routine samples taken from 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 Renewal Application, DP-530, SNL/NM* (SNL 1999).

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 gallons in capacity. 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

Large oil tanks in Tech Area IV are equipped with secondary containments to contain accumulated precipitation. One evaporation lagoon is shown at left.

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 during even numbered years, as required by DP-530 (SNL 1999). Water level measurements were obtained from Lagoon I on December 1, 2000. The water level in Lagoon I was recorded at 28 percent of capacity and the water level in Lagoon II was at 8 percent of capacity. Biennial samples were obtained from both lagoons on September 14, 2000; no analytical parameters were found to exceed the NMWQCC maximum allowable concentration (MAC) standards documented in 20 NMAC 6.2 Section 3103. Lagoon I was cleaned and inspected on May 5, 2000 and the liner was determined to be sound and intact. Lagoon II was cleaned and inspected on November 30, 2000 and the liner also was determined to be sound and intact.

The current DP-530 was scheduled to expire on February 24, 2000. The renewal application was submitted to NMED 120 days prior to the expiration date on November 24, 1999. NMED published the information from the DP-530 renewal application for public comment on April 16, 2001. Pending issuance of a new discharge plan from NMED, SNL/NM has and will continue to comply with the expired plan.

6.3 STORM WATER PROGRAM

6.3.1 Storm Drain System

Storm water runoff flowing over the ground surface has the potential to pickup and transport contaminants. This is especially true in industrial areas where runoff can be significant after heavy showers since pavement and buildings prevent precipitation from infiltrating to the ground. The Storm Water Program works in coordination with the P2 Group, the Surface Discharge Program, and the ER Project to implement measures and BMPs to prevent or reduce potential contaminants from being transported in storm water runoff. Potential contaminants may derive from:

- Oils and solvents from machine shops and manufacturing areas;
- Vehicle residues from streets and parking lots;
- Hazardous chemicals and metals from waste handling facilities;
- Residual radioactive and hazardous constituents from Solid Waste Management Units (SWMUs);
- Building material contaminants from construction activities; and
- Pesticides and fertilizers from landscaped areas.

Sandia Corporation controls the potential contaminants that may be picked up by storm water runoff by limiting storm water contact with chemical storage containers and carefully controlling runoff in areas where wastes, chemicals, and oils are stored or handled. Secondary containments for all outdoor oil storage tanks and chemical containers prevent potential pollutants from being transported in storm water runoff. Some facilities, such as the Hazardous Waste Management Facility (HWMF) and the Radioactive and Mixed Waste Management Facility (RMWMF) are designed to divert all runoff from the facility to a lined catchment basin. Water that accumulates in the basin evaporates. If evaporation is not adequate due to meteorological conditions, the accumulated water is evaluated and pumped to either the storm drain system if it meets NPDES permit limits or to the sanitary sewer for disposal.

NPDES Regulations

The 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). 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. Any runoff that flows into the arroyo through a channel, arroyo conduit, or overland surface flow is considered a discharge point.

As shown in Figure 6-2, Tijeras Arroyo enters KAFB from the northeast, flows just south of Tech Areas I, II, and IV, exits at KAFB's west boundary, and continues about eight miles to its discharge point at the Rio Grande. The arroyo has created a significant topographic feature across KAFB where erosion of unconsolidated basin sediments has resulted in a channel over one half mile wide in some areas.

Affected Areas at SNL/NM

In Tech Areas I, II, and IV, storm drains, culverts, and channels divert storm water runoff to discharge points on the north side of Tijeras Arroyo. Runoff from Tech Areas III and V does not flow to Tijeras Arroyo. In these areas, drainages are short, undeveloped, and runoff generally infiltrates quickly into the highly permeable soils. However, in the remote mountain and canyon areas where Sandia Corporation conducts various activities, runoff can reach Tijeras Arroyo through Arroyo del Coyote, which converges with the Tijeras Arroyo northwest of the KAFB Golf Course.

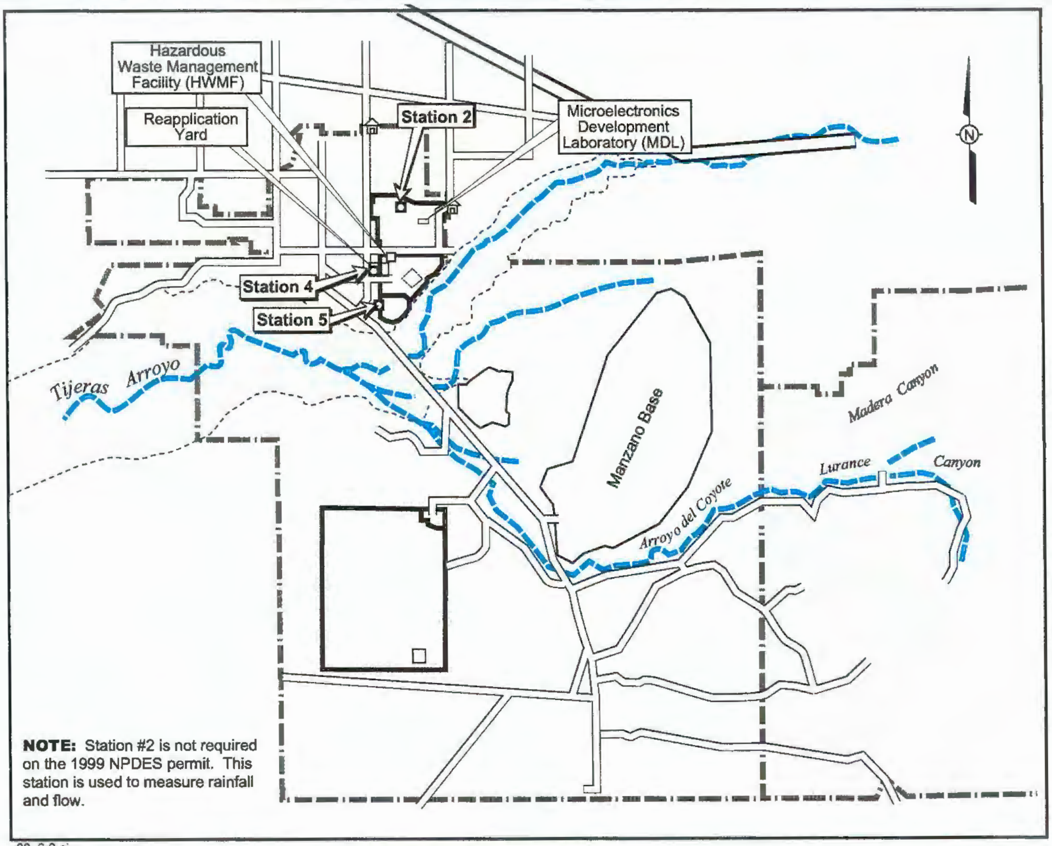


FIGURE 6-2. Storm Water Monitoring Station Locations at Three Locations

Beginning in October 2001, several stations will be added to monitor runoff in the Arroyo del Coyote watershed. The planned expansion of the Storm Water Program is discussed in Chapter 6, Section 6.3.2.

NPDES Permit

The EPA and NMED provide joint regulatory oversight for SNL/NM's Storm Water Program. SNL/NM facilities are covered under the NPDES "Multi-Sector General Storm Water Permit" issued by the EPA in 1997. Currently, there are two SNL/NM stations on the permit (Stations 4 and 5). The permit was reissued in 2000 for five years and covers four primary industrial activities at SNL/NM as defined in 40 CFR 122. Key facilities affected by NPDES regulations are listed in Table 6-2. Appendix B and Appendix C of this report lists all applicable regulations and program documents, respectively.

Construction activities that disturb over five acres also require permitting under NPDES. (Individual construction projects are not listed on the Multi-Sector General Storm Water Permit). A construction permit requires the ground to be stabilized upon completion of the project. In 2000, two storm water construction permits were in effect: the Processing and Environmental Technology Laboratory (PETL) and the Storm Drain, Sanitary Sewer, Domestic Water System Modernization (SSWM) Project. Storm water permits are listed in Table 2-7.

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 and Station 5 (located on the north rim of Tijeras Arroyo), monitors runoff from the majority of industrial activities in Tech Areas I, II, and IV.

TABLE 6-2. SNL/NM Facilities Subject to Storm Water Permitting
These facilities are in areas where storm water can potentially drain to Tijeras Arroyo.

Description of SIC 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 Facilities	- Regulated hazardous chemical and radioactive waste	- HWMF - Manzano Storage Complex - SWMUs (including those in Lurance and Madera Canyons)
Electronic and Electrical Equipment Manufacturing	- Raw chemical storage such as acid and sodium hydroxide - Electroplating processes	- MDL - AMPL - CSRL
Short-Term Construction Permits		
Construction Activities in 2000	- Building material pollutants - Disturbed soil	- PETL - Storm Drain Modernization Project

NOTE: *The EPA requires a National Pollution Discharge Elimination System (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 will be monitored under the expanded Storm Water Program, which will be in effect by October 2001. The expanded program is documented in the revised Storm Water Pollution Prevention Plan (SWP3) (SNL 2000a).

AMPL = Advanced Manufacturing Process Laboratory
CSRL = Compound Semi-Conductor Research Laboratory
HWMF = Hazardous Waste Management Facility
SWMU = Solid Waste Management Unit
MDL = Microelectronics Development Laboratory
PETL = Processing and Environmental Technology Laboratory

EPA Appraisal

On July 15, 1999, an EPA enforcement officer conducted an assessment of the Storm Water Program at SNL/NM. As a result of this inspection and at the request of EPA, the Storm Water Pollution Prevention Plan (SWP3) for SNL/NM was revised and expanded (SNL 2000a). Specific improvements to the plan included the addition of six new storm water monitoring stations. The new stations will be self-contained portable units (not dependent on a dedicated power supply) that will facilitate monitoring in remote areas. Three stations will be deployed in the Arroyo del Coyote watershed to monitor runoff from SWMUs located in Lurance and Madera Canyons, waste storage areas at the Manzano Storage Complex, and the active LCBS.

Three new storm water monitoring stations will also be placed in SNL/NM's industrial sector near Tech Areas I and II. The new monitoring stations will satisfy the EPA's request for storm water monitoring closer to the MDL and the HWMF. The new stations will also be closer to other key facilities such as the Compound Semi-Conductor Research Laboratory (CSRL) and the Neutron Generator Facility (NGF) in Tech Area I.

6.3.3 Routine Inspections

All routine inspection results are attached to the SWP3. The following routine inspections are conducted:

Construction Site Monitoring

Sandia Corporation mitigates potential storm water pollution from all 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 greater than five acres, the activity must be permitted under NPDES regulations. All permitted construction activities must develop a site-specific storm water P2 plan.

Once a construction project is completed, disturbed areas must be stabilized before the permit is terminated. Stabilization techniques include:

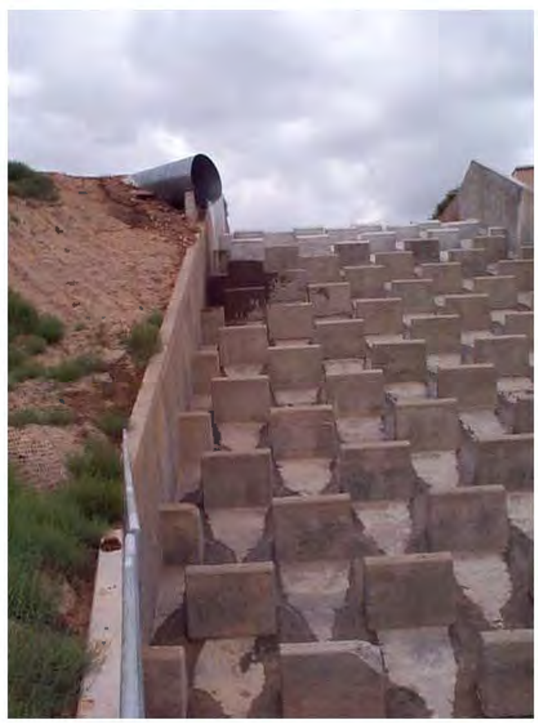
(1) Constructing drainages/diversions;
(2) Reseeding open areas;
(3) Xeriscaping (landscaping method that employs using drought-resistant plants in order to conserve resources, especially water) and other landscaping; and
(4) Asphalting to prevent the transport of residual pollutants and erosion.

✓ **Monitoring station inspections** are conducted monthly to ensure that samplers and other equipment are functioning properly.

✓ **Material storage area inspections** are conducted quarterly. All 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 personnel awareness and responsibility for storm water P2.

✓ **Wet weather inspections** are conducted quarterly during a storm event, if possible, but generally during the rainy season from April through September. Samples are collected and visually inspected for foaminess, clarity, and the presence of oil. These inspections also provide an opportunity to check for broken levees and floating debris.

✓ **Dry weather inspections** are conducted quarterly 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 NPDES permit-approved discharges would be water used during fire training exercises or fire hydrant testing. Dry weather inspections also provide an opportunity to inspect ditches for excess vegetation, accumulated sediment, and debris. Storm channels are cleaned out annually, or as necessary.



Storm Water Station 5 (the roofline shown just to the right of this channel) samples storm water at a discharge point to Tijeras Arroyo.

Sampling Protocols

The NPDES Permit requires quarterly analytical sampling to be conducted in the second and fourth year of the five-year permit, weather permitting. 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 as a grab sample by the automatic sampler. The discharge is collected within 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. All samples are sent to off-site laboratories and analyzed according to protocols established by the EPA.

6.3.4 2000 Activities

2000 Sampling Results

In 2000, no analytical monitoring was required under NPDES. The next required analytical sampling will occur beginning in October 2001 (FY02). However, quarterly visual samples were collected at two points and inspected as described under "wet weather inspections." No unusual characteristics were noted.

Past Sampling Results

Past sampling results from 1998 and 1999 analysis have shown a presence of metals such as zinc, magnesium, and iron, elevated above benchmark values (Table 6-3). However, since the collection of storm water samples at SNL/NM did not begin until 1997, there is not yet enough data to draw meaningful conclusions. The presence of these metals may be due to natural conditions associated with rocks and soils derived from the igneous/metamorphic complex of the Manzanita Mountains.

Storm Drain Modernization Project

In 1999, construction began on the SSWM Project. Phases 1, 2, and 3, completed in 2000, consisted of the realignment of 20th Street near KAFB's Eubank Gate and replacement of existing earth ditches in Tech Area I with concrete channels up to Station 5. Phase 4, which is pending further funding, will include the replacement of underground storm sewer pipes in the northwest section of Tech Area I.

TABLE 6-3. 1999 and 1998 Storm Water Sampling Results
(Results in bold are above benchmark values given in the EPA permit.)

		1999 *					1998 **	
Analytes	**Units**	**Station 4 1st Qtr**	**Station 4 2nd Qtr**	**Station 5 1st Qtr**	**Station 5 3rd Qtr**	**Station 5 4th Qtr**	**Station 5**	**Benchmark Values**
TSS	mg/L	150	27	113	131	233	--	100
pH	--	8.1	8.4	8.5	8.3	8.1	--	N/A
Oil & Grease	mg/L	(ND)	6	(ND)	6	11	--	15
COD	mg/L	48	22	72	413	61	--	120
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: Source: SNL 2000p
Analytical samples were not collected in 2000 since sampling is only required in 2nd and 4th year of the permit.
*In 1999, rainfall throughout the year was sufficient to produce five good samples: two from Station 4 and three from Station 5.
**Only one sampling event was collected in 1998 from Station 5, which was not adequate to produce meaningful results.
TSS = total suspended solids (The benchmark value is 100 mg/L.)
J = Detected below the reporting limit or is an estimated concentration
ND = not detected
N/A = not available
COD = chemical oxygen demand
Qtr = quarter
pH = potential of hydrogen
µg/L = micrograms per liter
mg/L = milligrams per liter

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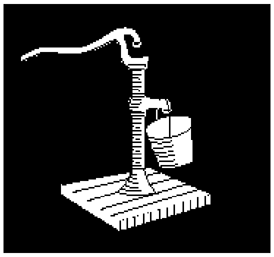

Chapter 7

Groundwater Programs

Groundwater monitoring wells are located at and around Sandia National Laboratories, New Mexico (SNL/NM) operational areas and environmental remediation sites to determine potential impacts to groundwater, monitor the effectiveness of groundwater protection strategies, characterize potential contamination at Environmental Restoration (ER) sites, and demonstrate compliance with federal, state, and local groundwater requirements. Monitoring is conducted on an annual, biannual, or quarterly basis, depending on individual project areas. Water level measurements are conducted quarterly and monthly.

Two programs within Sandia Corporation collect groundwater data: The Groundwater Protection Program (GWPP) and the ER Project. The GWPP is responsible for groundwater surveillance to determine the impacts on groundwater of current operations at SNL/NM. The ER Project is responsible for identifying, investigating, and remediating groundwater contamination from historic activities at the facility. Program goals and objectives are coordinated under the Groundwater Protection Management Program Plan (GPMPP) for SNL/NM. The type of groundwater data collected includes water quality information as well as information on the physical aspects of the groundwater system. Specific task areas performed in Fiscal Year (FY) 2000 under both programs are shown in Figure 7-1. As shown in Figure 7-1, coordination with outside groundwater monitoring agencies is a key component of the GWPP.

The ER Project at SNL/NM is funded directly by the U.S. Department of Energy (DOE) with local oversight provided by the Kirtland Area Office (KAO). The GWPP works in concert with ER Project sites requiring groundwater monitoring to provide well registry and oversight for ER wells and other SNL/NM-owned wells.

The GWPP Groundwater Surveillance Task collects groundwater samples from a network of wells at SNL/NM and Kirtland Air Force Base (KAFB) that are not associated with ER Project sites. The GWPP publishes the *Groundwater Protection Program (FY00) Annual Groundwater Monitoring Report for SNL/NM* (October 1, 1999 to September 30, 2000) to summarize data results generated from both the ER Project and the GWPP (SNL 2001g).

Figure 7-2 shows groundwater wells located on and around KAFB. Wells shown in Figure 7-2 include ER monitoring wells, GWPP surveillance wells, City of Albuquerque production wells, KAFB production wells, U.S. Geological Survey (USGS) monitoring wells, and KAFB Installation Restoration Program (IRP) wells. The 58 wells sampled during FY00 by the GWPP or the ER Project appear in bold in Figure 7-2.

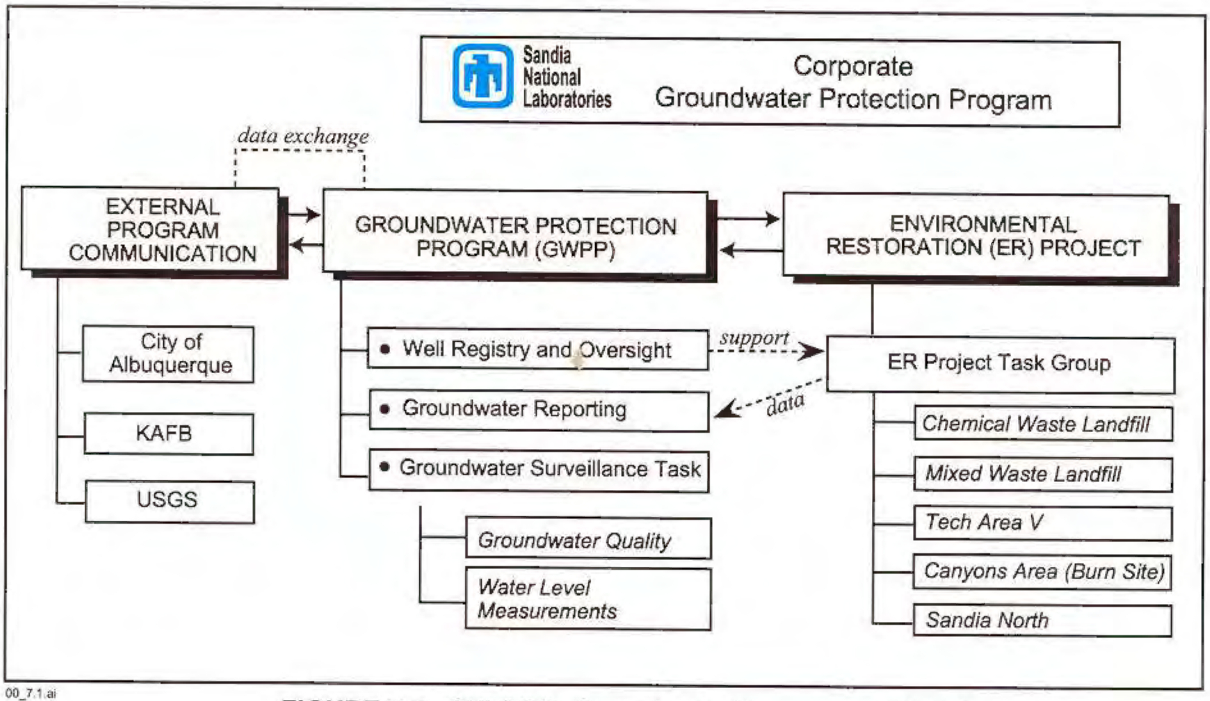

FIGURE 7-1. SNL/NM's Groundwater Programs and Interfaces

7.1 OVERVIEW OF GROUNDWATER PROGRAMS AT SNL/NM

GWPP and ER Project sites and activities are described in this section.

7.1.1 GWPP Activities

The GWPP is mandated 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). The program is funded indirectly by DOE as part of the overhead cost of the facility, which is operated by Lockheed Martin Corporation. Additional applicable regulations are listed in Appendix B. Groundwater quality results are compared to federal, state, and DOE guidelines, where established. The GWPP has structured its surveillance activities to conform to Resource Conservation and Recovery Act (RCRA) groundwater monitoring guidelines.

The primary function of the GWPP is to conduct groundwater surveillance monitoring to detect groundwater contamination from current operations or undiscovered legacy contamination. The following outlines the specific purpose of surveillance monitoring:

- 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.

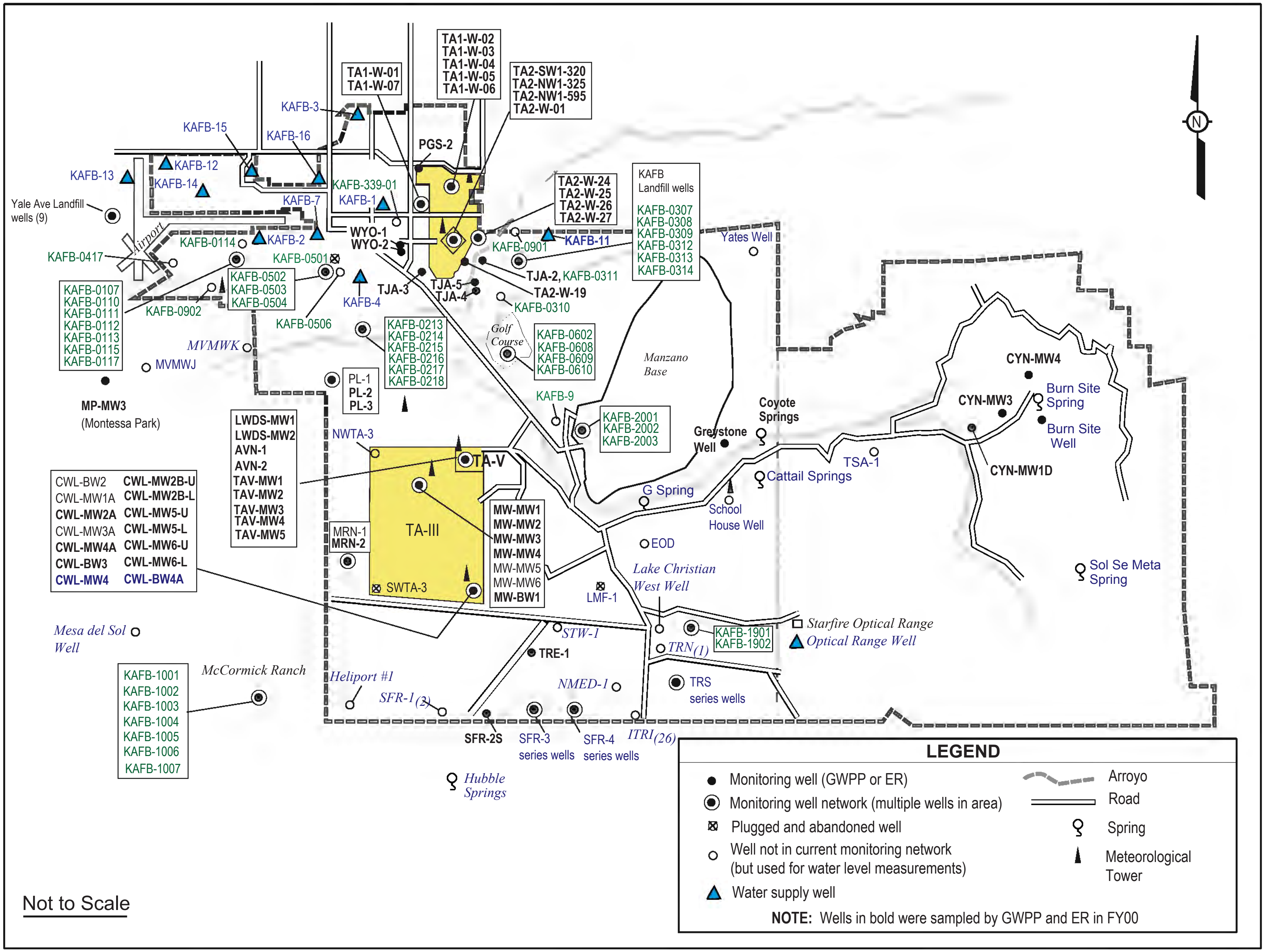

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FIGURE 7-2. Wells and Springs on SNL/NM and KAFB

Generally, the GWPP samples the same wells each year. 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 ER Project wells and characterization boreholes. The primary purpose of the GWPP Well Registry and Oversight task is to ensure that all wells owned by SNL/NM are properly constructed and maintained to protect groundwater resources. The GWPP works with SNL/NM well owners to review new well design proposals, record construction information, track well ownership and maintenance records, perform annual well inspections, and consult with owners, if and when plugging and abandonment of a well or borehole is required.

Trend Data

The GWPP performs statistical trending on groundwater surveillance results by comparing past years' data with current year results. Trend data for groundwater contaminants that exceed regulatory limits is presented in Appendix E, which provides statistical descriptors and graphical representation. Data are analyzed to determine if the results are within a normal range of expected values or if a significant difference is present. By doing so, early detection and possible source identification can be made when contaminants are at levels far below regulatory concern. Conversely, unchanging baseline levels demonstrate Sandia Corporation's successful groundwater best management practices (BMPs) and protection strategies.

7.1.2 ER Project Groundwater Activities

ER Project activities are directed by RCRA regulations that mandate 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 the Chemical Waste Landfill (CWL) have interim operating permits and some septic systems, which were identified after the permit was issued and are not listed on the HSWA permit.

In RCRA, ER sites are known as Solid Waste Management Units (SWMUs). Many SWMUs are listed 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.

ER sites with the potential to contaminate groundwater are conducting groundwater investigations, including contaminant monitoring. The New Mexico Environment Department's (NMED) Hazardous Waste Bureau provides regulatory oversight for remediation activities, including groundwater monitoring performed at ER sites.

There are currently five ER Project areas with ongoing groundwater investigations:

- CWL
- Mixed Waste Landfill (MWL)
- Tech Area V
- Sandia North
- Canyons Area

CWL – From 1962 to 1989, the CWL, covering just over two acres in the southeast corner of Tech Area III, was used to dispose of liquid chemical wastes by discharging them into pits. Some of the pits were lined, while others were not. The area was also used for aboveground storage of 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 multiple screen wells.

The CWL 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, *Chemical Waste Landfill Final Closure Plan and Postclosure Permit Application* (SNL 1993), has been developed. The ER Project began excavation and remediation at the CWL in 1998. A Corrective Action Management Unit (CAMU) was established adjacent to the CWL to facilitate site cleanup and the CAMU allows for temporary storage and on-site treatment of hazardous waste excavated from the CWL. The CAMU has extensive containment and detection systems to prevent groundwater contamination at the facility.

Vapor Extraction Project (VEP) at the CWL

The VEP 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 VEP, TCE levels in groundwater were measured above regulatory levels in four wells. In 1999, TCE was detected in only one well above the limits, and in 2000, TCE was not detected above the limits in any well.

MWL – The MWL is a 2.6-acre site located in Tech Area III that was operational from 1959 to 1989and was used to dispose of radioactive and mixed waste (MW). The 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 MW were buried in unlined trenches and pits. The total activity of waste at the time of disposal was 6,300 Curies (Ci). No bulk liquid waste was disposed of at the MWL except in 1967 when 271,000 gallons of reactor coolant water with a total activity of 1 Ci were discharged into an unlined trench (Peace 1996). Cesium-137 and tritium are present in surface soil samples (see Chapter 4). Tritium has been detected in the unsaturated zone up to 120 ft below the surface, approximately 400 ft above the present water table at concentrations slightly above the detection limits of the analysis. Tritium has not been detected above its minimum detectable activity (MDA) (~300 pCi/L) in any groundwater samples to date. The U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) for tritium in drinking water is 20,000 pCi/L.

Tech Area V – The Gamma Irradiation Facility (GIF) and the Hot Cell Facility (HCF), both reactor facilities, are located in Tech Area V. From 1967 to 1971, the Liquid Waste Disposal System (LWDS) located in Tech Area V was used to dispose of reactor coolant water. Groundwater contaminants of concern at the LWDS are nitrates and VOCs such as TCE, which was first detected in the groundwater in 1993. Elevated nitrate levels have been detected in two wells. There are currently nine active monitoring wells at this site.

Tijeras Arroyo Groundwater (TAG) – The TAG Task (formerly the Sandia North Groundwater Investigation) includes the collective ER sites located in and around Tech Areas I and II and the Tijeras Arroyo. There are currently 23 monitoring wells in the TAG 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), but contain insufficient quantities of water to be produced for domestic use. TCE and nitrates are the contaminants of concern for TAG. The discovery of TCE in several Tech Areas I and II wells led to the Sandia North Groundwater Investigation in an effort to identify the source of the contamination and characterize the perched groundwater system (to date, no source has been found).

Canyons Area – The Canyons Area is located around the active Lurance Canyon Burn Site (LCBS) Facility. Groundwater investigations were initiated in 1997 at the request of NMED after elevated nitrate levels were discovered in the LCBS water well. In 1997, one groundwater monitoring well was installed, and in 1999, two additional wells were installed, including two piezometers to detect any groundwater flow at the interface of the arroyo sediments and bedrock. To date, both piezometers have remained dry. The LCBS Facility is the only ER site within the U.S. Forest Service (USFS) land withdrawal where groundwater contamination has been detected.

7.2 GROUNDWATER QUALITY ANALYSIS RESULTS

Analytical results for groundwater quality monitoring conducted by the GWPP and the ER Project are compared to state, federal and DOE standards as shown in Table 7-1. The frequency of groundwater monitoring performed at SNL/NM is shown in Table 7-2. All groundwater samples are analyzed in accordance with EPA protocols.

Water quality results for both the GWPP and the ER Project are published in the *Groundwater Protection Program (FY00) Annual Groundwater Monitoring Report for SNL/NM* (SNL 2001g).

7.2.1 GWPP Surveillance Results

During April and May 2000, annual sampling of groundwater was conducted by the GWPP Groundwater Surveillance Task. Samples were collected from 14 wells and one spring. The ER Project normally samples six of the wells sampled during the current year; however, budget limitations forced a cancellation of ER groundwater monitoring during May 2000 to September 2000. To avoid a gap in groundwater data for these important wells, the GWPP collected and analyzed groundwater from selected wells in three ER operable units with groundwater contamination. The results for the six ER wells sampled are presented in Section 7.2.2 of this chapter. Groundwater surveillance samples for the GWPP were analyzed for the following parameters:

- VOCs
- Metals
- Major Ions including nitrate
- Total Halogenated Organics (TOX)
- Gamma Spectroscopy
- Selected Radionuclides
- Gross Alpha & Beta Activity

Metals, excluding mercury, were analyzed from filtered groundwater samples to conform to New Mexico Water Quality Control Commission (NMWQCC) Standards for dissolved concentration limits.

In addition, field measurements taken at each well included alkalinity, turbidity, dissolved oxygen, potential of hydrogen (pH), specific conductivity, oxidation reduction potential (or redox [Eh]), and temperature.

VOCs
No groundwater samples exceeded MCLs for VOCs. Trace concentrations of methylene chloride, acetone, and chloroform were detected. Methylene chloride and acetone are attributed to laboratory contamination of samples because the same constituents were found in quality control (QC) sample blanks. Chloroform was detected in well TRE-1 at a concentration of 6.9 µg/L.

TABLE 7-1. Guidelines Used for Groundwater Quality Sample Comparisons

Agency	Regulation/Requirements	Limits
EPA	National Primary Drinking Water Regulations (40 CFR 141)	MCL
State of New Mexico	NMWQCC, Standards for Groundwater	MAC
DOE	DOE Drinking Water Guidelines for Radionuclides	DCG

NOTE: DCG = derived concentration guide
MAC = maximum allowable concentration
MCL = maximum contaminant level

TABLE 7-2. Sampling Frequency for Groundwater Quality Monitoring at SNL/NM During FY00

	Sampling Period	GWPP	ER Project Sites				
			CWL	MWL	Tech Area V	Sandia North	Canyons Area
FY00	Oct 99		✓				
	Nov 99				✓		
	Dec 99					✓	✓
	Jan 00						
	Feb 00		✓ (bi-annual)		✓		
	Mar 00					✓	✓
	Apr 00			✓ (annual)			
	May 00	✓					
	Jun 00						
	Jul 00						
	Aug 00						
	Sep 00						

NOTE: ER = Environmental Restoration
GWPP = Groundwater Protection Program
CWL = Chemical Waste Landfill
MWL = Mixed Waste Landfill

There is no established EPA MCL for chloroform; however, the maximum allowable concentration (MAC) established by the NMWQCC is 100 µg/L.

Non-metal Inorganic Compounds and Phenolics

No groundwater samples exceeded MCLs for any of the non-metallic inorganic constituents:

- Nitrate plus nitrite (as nitrogen)
- Phenolics
- TOX
- Total cyanide
- Alkalinity (calcium carbonate)
- Ions (bromide, chloride, fluoride, and sulfate)

Fluoride and chloride exceeded the NMWQCC MAC in water samples collected from Coyote Springs. The elevated concentrations are from natural sources and are consistent with background concentrations determined for this location.

Metals

The analyses were conducted for dissolved metals using filtered samples, except for mercury, which were analyzed for the total concentration. The groundwater standards of the NMWQCC are based on dissolved concentration. The following metals analyses were conducted:

- Aluminum
- Antimony
- Barium
- Calcium
- Cobalt
- Iron
- Arsenic
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead

- Magnesium
- Mercury
- Potassium
- Silver
- Thallium
- Manganese
- Nickel
- Selenium
- Sodium
- Zinc

NOTE: The metals list was compiled from the EPA's primary drinking water standards and NMWQCC standards.

Cadmium was the only metal detected above the MCL. Previous analyses of water samples from this well did not yield cadmium above the minimum detection limit (MDL). Because this is a singular event, no trending data is provided in Appendix E.

CADMIUM *MCL = 0.005 mg/L*		
Well	**Concentration**	**Period**
Greystone	0.00698 mg/L	Apr/May 2000

Radionuclide Activity
Radioisotopic analyses were conducted on all samples. Specific evaluations included:

- Gamma spectroscopy
- Gross alpha & beta
- Radium-226 and -228
- Uranium-233/234
- Uranium-235 and -238

Gamma spectroscopy analyses indicated the presence of potassium-40 in the sample from Coyote Springs at an activity of 67 pCi/L, as compared to the DOE drinking water guideline of 280 pCi/L. Gamma spectroscopy analyses for the KAFB-11 production well sample determined radium-226 at an activity of 12.6 pCi/L, which is over twice the MCL of 5 pCi/L established for combined radium-226 and -228. Since gamma spectroscopy is not a very reliable analytical technique for radium-226 (primarily an alpha particle emitter), alpha spectroscopy was conducted to identify the specific radioisotopes. This analytical technique, which is more sensitive to alpha particle-emitters, reported an activity of 0.333 pCi/L for the same sample.

All groundwater samples were analyzed for uranium-238, uranium-235/236, and uranium-234 using analytical techniques specific to alpha emitters. The activities for uranium-234 in samples from SFR-2S and TRE-1 slightly exceeded the DOE drinking water guideline of 20 pCi/L. These wells are located east of the Tijeras fault complex (Figure 7-3). In this region, groundwater contacts bedrock that is naturally high in uranium. The activity for uranium-234 detected in SFR-2S and TRE-1 is consistent with uranium background activities for this well as established by the groundwater analytical data from prior years.

URANIUM - 234 *DOE Drinking Water Guideline = 20.0 pCi/L*		
Well	**Concentration**	**Period**
SFR-2S	21.3 pCi/L	Apr/May 2000
TRE-1	20.5 pCi/L	Apr/May 2000

Data trends in Appendix E indicate these values are consistent with previous values when the uncertainty associated with the individual data values is considered.

7.2.2 ER Project Water Quality Results

CWL
Semi-annual groundwater monitoring for VOCs and total metals (40 CFR 264, Appendix IX) was performed in October 1999 and February 2000. Samples were collected from 10 monitor wells located at the CWL.

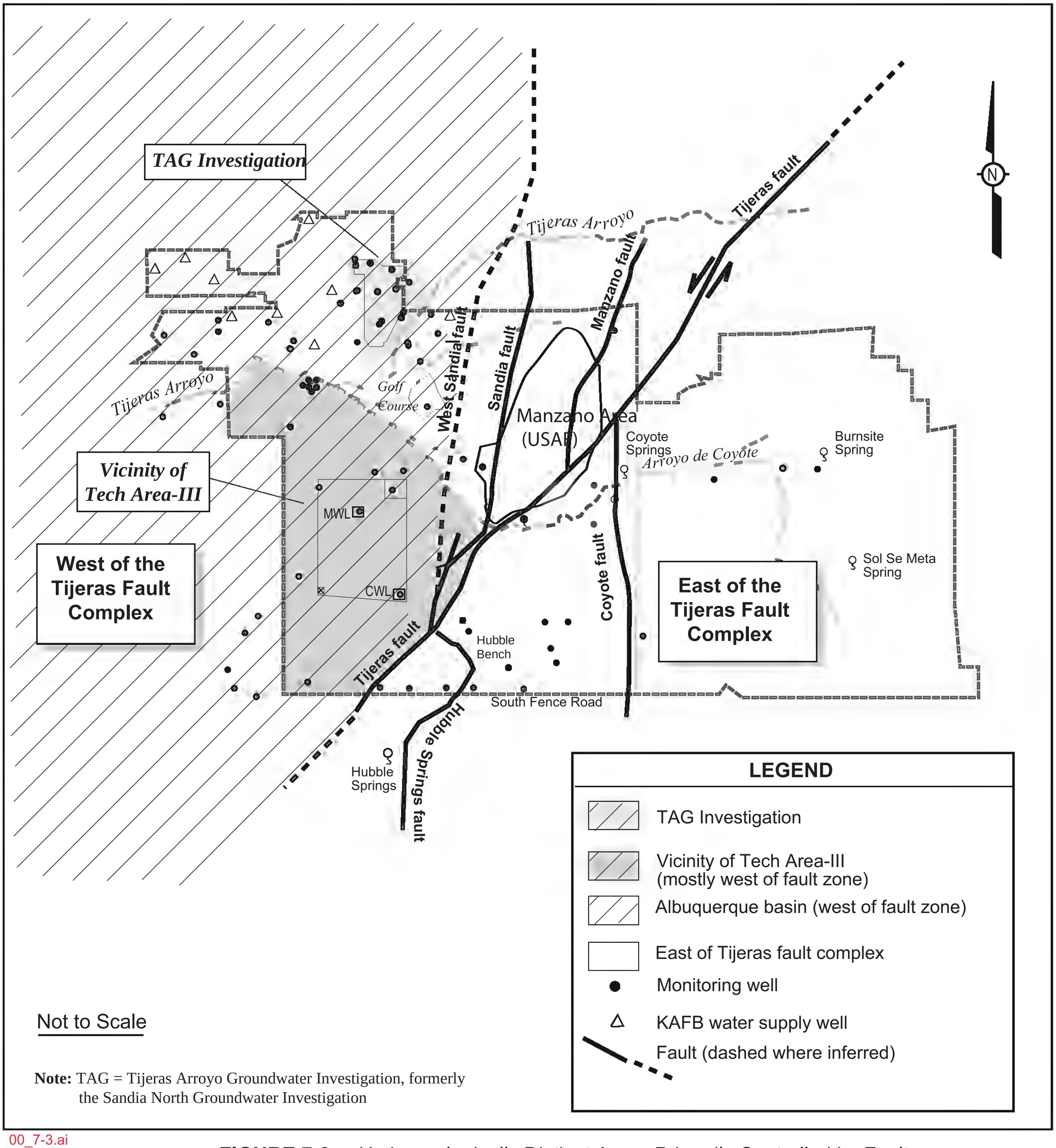


FIGURE 7-3. Hydrogeologically Distinct Areas Primarily Controlled by Faults

VOCs

VOCs were not detected at concentrations above MCLs or above the laboratory practical quantitation limit (PQL). Three VOCs that were detected below the laboratory PQLs were toluene, TCE, and ethyl methacrylate.

Metals

Analyses for the following total metals (unfiltered) were conducted:

- Arsenic
- Antimony
- Beryllium
- Barium
- Cadmium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Mercury
- Nickel
- Selenium
- Silver
- Tin
- Thallium
- Vanadium
- Zinc

NOTE: The metals list was compiled from 40 CFR 264 Appendix IX metals, plus iron.

Nickel and Chromium were the only metals detected above MCLs in any CWL well. Nickel and chromium in this instance are associated with well screen corrosion and do not reflect contamination from surface sources migrating to groundwater.

NICKEL *MCL = 0.1 mg/L*		
Well	**Concentration**	**Period**
CWL-MW2A	0.68 mg/L	Oct 1999
CWL-MW4	1.5 mg/L	Oct 1999
CWL- MW2A	0.55 mg/L	Feb 2000
CWL-MW4	1.20 mg/L	Feb 2000

CHROMIUM *MCL = 0.1 mg/L*		
Well	**Concentration**	**Period**
CWL-MW2A	0.12 mg/L	Feb 2000

Trend data in Appendix E suggests that nickel concentrations are increasing over time. This interpretation is consistent with the screen corrosion hypothesis. Trend data for Chromium at well CWL-MW2A was not done because historical values are primarily non-detects or are qualified for chromium being present in QC samples.

Results for biennial sampling conducted in February 2000 did not exceed established MCLs, where applicable. Almost all were below the PQL. Analytes included semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), sulfide, and cyanide. The SVOC, Bis (2-ethylhexyl) phthalate, was the only analyte detected above the PQL; however, this compound does not have an established MCL.

Radionuclides

Tritium and gamma spectroscopy analyses conducted on samples showed no radionuclides detected above MCLs or above the DOE's established drinking water guidelines, where established. Radionuclides were detected at background concentrations.

MWL

Groundwater samples from the MWL wells were collected in April 2000 and analyzed for VOCs, nitrate plus nitrite (as nitrogen), RCRA metals plus nickel, and radionuclides. Five monitoring wells at the MWL were sampled.

Almost ten years of groundwater monitoring at the MWL has demonstrated that no contamination has migrated to groundwater. Consequently, NMED reduced the sampling frequency from biannual to annual starting FY00.

VOCs

VOCs were not detected above established MCLs. Trace levels of toluene and methylene chloride were detected above the PQL in several of the April samples. Toluene was detected above the PQL in two samples: MWL-BW1 at 2.54 µg/L and the split sample from MWL-MW4 at 2.7 µg/L. Methylene chloride was detected in a duplicate sample from MWL-MW1 at a concentration of 1.21J µg/L (the "J" denoted means that analyte was detected just below the quantitation limit). Although toluene was detected well below the MCL of

1,000 µg/L, the two wells with detected trace toluene (ppb) were resampled in October 2000. No VOC species were detected in the resampling event.

Nitrate plus Nitrite

Nitrate plus nitrite (as nitrogen) was not detected above the MCL of 10 mg/L; concentrations ranged between 2.0 and 5.55 mg/L.

Metals

Samples were analyzed for total and dissolved concentrations for the following metals:

- Arsenic
- Barium
- Cadmium
- Chromium
- Lead
- Mercury
- Nickel
- Selenium
- Silver

NOTE: The metals list was compiled from the EPA's primary drinking water standards, plus silver.

In addition to the analytes listed above, an analysis for a more inclusive suite of metals was conducted on a duplicate sample from MWL-MW1 for the following metals.

- Aluminum
- Antimony
- Beryllium
- Calcium
- Cobalt
- Copper
- Iron
- Magnesium
- Manganese
- Potassium
- Sodium
- Thallium
- Vanadium
- Zinc

Nickel was the only metal detected in groundwater above the MCL at the MWL. The elevated nickel has been attributed to corrosion of the stainless steel well screens.

NICKEL
MCL = 0.1 mg/L

Well	Concentration	Date
MWL-MW1	0.281 mg/L	Apr 2000
MWL-MW1 (duplicate)	0.288 mg/L	Apr 2000
MWL-MW1 (split)	0.270 mg/L	Apr 2000
MWL-MW1 (filtered)	0.279 mg/L	Apr 2000
MWL-MW2	0.124 mg/L	Apr 2000

Nickel trend data values for MWL-MW1 and MWL-MW2 are evaluated in Appendix E. Concentration values for MWL-MW1 are increasing gradually over time as is expected for the screen corrosion hypothesis. MWL-MW2 historical data shows insignificant chromium concentrations. The value for the current year is anomalous.

Radionuclide Activity

The radiochemical analyses of MWL groundwater samples included:

- Gross alpha & beta
- Tritium
- Strontium-90
- Gamma spectroscopy

No radionuclides were detected above EPA standards or DOE guidelines for drinking water. Gross alpha and gross beta activities were measured at levels slightly above the MDA in all samples analyzed, but below the MCL of 15 pCi/L. Gross alpha activities ranged from 3.24 ± 0.06 pCi/L (MWL-MW1) to 10.6 ± 2.86 pCi/L (MWL-BW1). Gross beta activities ranged from 2.12 ± 0.68 pCi/L (MWL-MW1) to 6.88 ± 1.99 pCi/L (MWL-MW3).

Gamma spectroscopy analyses did not detect any isotopes above associated MDAs, except for short-lived, naturally occurring radon daughter products.

Strontium-90 and tritium were not detected above associated MDAs in any MWL groundwater sample.

Tech Area V

Quarterly groundwater samples were collected from nine wells at Tech Area V in October and November 1999 and February 2000. However, the third and fourth quarter sampling periods were canceled due to budget limitations. To fill the gap in data, the GWPP sampled two Tech Area V wells (LWDS-MW1 and TAV-MW1) in June 2000. Monitoring well locations are shown in Figure 7-2.

The samples collected in October and November 1999 and February 2000 were analyzed for VOCs and nitrate plus nitrite (as nitrogen). The samples from LWDS-MW1 and TAV-MW1 collected in June of 2000 by the GWPP were analyzed for VOCs, TOX, phenolics, non-metallic inorganics, metals, alkalinity, and radionuclides.

VOCs

VOC concentrations exceeding MCLs were not detected in samples from any Tech Area V wells with the exception of TCE at LWDS-MW1.

TRICHLOROETHENE (TCE) *MCL = 5 μg/L*		
Well	Concentration	Period
LWDS-MW1	22 μg/L	Oct/Nov 1999
LWDS-MW1	23 μg/L	Feb 2000
LWDS-MW1	20.6 μg/L	Jun 2000

TCE concentrations for LWDS-MW1 are evaluated in Appendix E. Historically, the concentration of TCE has been increasing in this well and recent data suggests the concentrations have leveled off and are no longer increasing.

Non-Metallic Inorganic Chemicals

Inorganic chemicals analyzed included:

- Alkalinity (calcium carbonate)
- Nitrate plus nitrite (as nitrogen)
- Ions (bromide, chloride, fluoride, and sulfate)
- phenolics

Nitrate concentrations exceeded the MCL of 10 mg/L in samples from several wells, but LWDS-MW1 consistently exceeded the MCL for every sampling period.

Nitrate values for wells AVN-1 and AVN-2 have shown an unusually large increase during the first quarter of the current reporting period. Assuming these data are valid, nitrate concentrations in these wells are increasing. If the suspect data are discounted, nitrate concentrations in these wells show a slight decreasing trend. Nitrate values continue to increase for LWDS-MW1. Trend data for nitrate values are evaluated in Appendix E.

NITRATE (AS NITROGEN) *MCL = 10 mg/L*		
Well	Concentration	Period
AVN-1	11 mg/L	Nov 1999
AVN-2	16 mg/L	Nov 1999
LWDS-MW1	11 mg/L	Nov 1999
AVN-2	10 mg/L	Feb 2000
LWDS-MW1	12 mg/L	Feb 2000
LWDS-MW1	13.6 mg/L	Jun 2000

Metals

In June 2000, dissolved metal analyses were conducted on groundwater samples collected by the GWPP at wells LWDS-MW1 and TAV-MW1. Analyses for the following metals were conducted:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Zinc

NOTE: The metals list was compiled from the EPA's Appendix IX parameters and from the EPA's primary drinking water standards.

No metals were detected above MCLs in any Tech Area V well.

Radionuclide Activity
Gamma spectroscopy and radioisotopic analyses were conducted on two groundwater samples (LWDS-MW1 and TAV-MW1) collected by the GWPP in June 2000. All radionuclide activities reported by both methods were below MCLs and DOE drinking water guidelines. Radioisotopes analyzed included radium-226 and -228 and uranium-233/234, -235/236, and -238.

Sandia TAG

The TAG Investigation (formerly the Sandia North Groundwater Investigation) performed quarterly groundwater sampling during November and December 1999 and March and April 2000. The third and fourth quarter sampling periods, which would have occurred in June and September 2000, were canceled due to budget limitations. In May 2000, the GWPP sampled three TAG monitor wells (which were not sampled in March and April 2000) to provide additional data.

Tijeras Arroyo wells are either screened in the regional aquifer or within a shallow water-bearing (perched) zone above the regional aquifer.

As shown in Figure 7-2, samples were collected from 23 wells. Twelve were perched wells and 11 were regional wells.

Samples were analyzed for VOCs, metals, non-metallic inorganics (phenolics, alkalinity, and anions including nitrate), gross alpha, gross beta, radioisotopic analysis, and gamma spectroscopy.

VOCs
TCE was detected in groundwater samples of one regional well (WY0-1) and several wells completed in shallow water-bearing zones.

As discussed in Appendix E, TCE concentration trend data show a slight decreasing trend. The data for WYO-1 and WYO-2 indicate TCE concentrations may have peaked and are leveling off.

TCE *MCL = 5 µg/L*		
Well	**Concentration**	**Period**
SHALLOW WELLS		
WYO-2	6.9 µg/L	Dec 1999
WYO-2 (split)	6.6 µg/L	Dec 1999
TA2-W-26	8.7 µg/L	Dec 1999
TA2-W-26	9.2 µg/L	May 2000
REGIONAL WELLS		
WYO-1	5.9 µg/L	Dec 1999
WYO-1	5.68 µg/L	May 2000

Non-metallic Inorganic Chemical Analyses
Inorganic chemical analysis of quarterly groundwater samples consisted of phenolics (May sampling event only), alkalinity, and major anions such as bromide, chloride, fluoride, nitrate, and sulfate.

Historically, nitrate has been consistently detected in wells TA2-SW1-320 and TJA-4 above the MCL of 10 mg/L. During the two quarterly sampling events, nitrate was over the MCL in two other wells (PGS-2 and TJA-2).

NITRATE (as Nitrogen) *MCL = 10 mg/L*		
Well	**Concentration**	**Period**
SHALLOW WELLS		
TA2-SW1-320	44 mg/L	Dec 1999
TA2-SW1-320	30 mg/L	Mar 2000
TJA-2	14 mg/L	Dec 1999
REGIONAL WELLS		
PGS-2	12 mg/L	Mar 2000
TJA-4	29 mg/L	Dec 1999
TJA-4	25 mg/L	Mar 1999

The nitrate values for the first quarter of the current reporting period are inconsistent with historical data. Some of the affected wells are separated by considerable distance, yet show the same nitrate spike. If the suspect data are ignored, the nitrate concentration trend is level for TA2-SW1-320, TJA-2, and TJA-4. In PGS-2, the concentrations appear to

Be decreasing over time. Trends for nitrate concentrations in these wells are analyzed and illustrated in Appendix E.

All other inorganic analytes were below established MCLs.

Metals

Analyses for the following total metals (unfiltered) were conducted:

- 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 the EPA's primary drinking water standards.

Selenium was detected at a concentration above the established MCL in TA1-W-03. Prior analyses of samples from this shallow well have resulted in similar values of selenium.

SELENIUM *MCL = 50 µg/L*		
Well	Concentration	Period
TA1-W-03	58 µg/L	Dec 1999
TA1-W-03	74 µg/L	Mar 2000

Selenium appears to be increasing in this well. The scatter of the data is such that the trend for selenium in this well is very uncertain. See Appendix E for additional information.

Radionuclide Activity

No radionuclides were above established MCLs or DOE drinking water guidelines. Samples were analyzed for:

- Gross alpha & beta
- Tritium
- Uranium-233/234, -235, and –238
- Radium 226 & 228 (May samples only)

Canyons Area

The LCBS is the only ER site in the Canyons area with groundwater issues. Quarterly samplings at three Canyon monitoring wells were conducted in October and December 1999 and March 2000. The LCBS production well was also sampled in December 1999. Sampling during the fourth quarter was cancelled due to ER budget limitations; however, the GWPP collected samples from CYN-MW3 in May 2000 to fill the gap in the data. Groundwater samples were analyzed for VOCs, non-metallic inorganics, phenolics, metals, and radionuclides.

VOCs

The contaminants of concern at the LCBS are petroleum products associated with fuels used in burn tests. Sampled parameters included:

- VOCs
- SVOCs
- Total extractable petroleum hydrocarbons (TPH)(diesel)
- TPH (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 (ethyl benzene, toluene, and xylene) were detected, although all VOCs were well below associated MCLs. VOCs concentrations in this well have been decreasing over time.

Low levels of TPH (diesel) were detected in CYN-MW1D and CYN-MW4. No MCLs have been established for these analytes.

Non-metallic Inorganic Chemicals
Inorganic chemical analyses included:

- Alkalinity
- Nitrate plus nitrite (as nitrogen)
- Ions (bromide, chloride, fluoride, and sulfate)
- Phenolics

Nitrate concentrations were elevated above the MCL of 10 mg/L in two wells.

NITRATE *MCL - 10.0 mg/L*		
Well	**Concentration**	**Period**
CYN-MW1D	15.7 mg/L	Oct 1999
CYN-MW1D (split)	22 mg/L	Oct 1999
CYN-MW3	12.1 mg/L	Oct 1999
CYN-MW1D	16.9 mg/L	Dec 1999
CYN-MW3 (split)	17 mg/L	Dec 1999
CYN-MW1D	16.9 mg/L	Mar 2000
CYN-MW1D (split)	20 mg/L	Mar 2000
CYN-MW3	13 mg/L	Mar 2000
CYN-MW3 (split)	11 mg/L	Mar 2000
CYN-MW3	12.5 mg/L	May 2000
CYN-MW3 (dup)	12.6 mg/L	May 2000

As detailed in Appendix E, nitrate concentrations appear to be increasing in CYN-MW1D. The trend for CYN-MW3 is shown to be level in the plot in Appendix E, although the few data limit the confidence in the trend analysis. All other non-metallic inorganic analytes were reported below established MCLs.

Metals
Groundwater samples from all wells were analyzed for total metals (unfiltered) for the following:

- Aluminum
- Arsenic
- Beryllium
- Calcium
- Cobalt
- Iron
- Magnesium
- Nickel
- Antimony
- Barium
- Cadmium
- Chromium
- Copper
- Lead
- Manganese
- Potassium
- Selenium
- Sodium
- Vanadium
- Mercury
- Silver
- Thallium
- Zinc

No metals were detected above established MCLs.

Radionuclide Activity
Groundwater samples were examined for radionuclide activity by analyzing for gross alpha, gross beta, and gamma spectroscopy. All radionuclide activity was below EPA and DOE drinking water guidelines. No radionuclides were detected above the MDA for the analysis.

7.3 WATER LEVELS

Water levels are a means to assess the physical changes of the groundwater system over time. This includes changes in the local water table, the quantity of water available, as well as the direction and speed of groundwater movement. The GWPP gathers groundwater level measurements from a large network of wells on and around KAFB. In addition to wells owned by SNL/NM, data is solicited for the U.S. Air Force (USAF) IRP, the City of Albuquerque, and the USGS wells. In FY00, data from 126 wells were incorporated into the monitor well water level database. Water levels were measured monthly or quarterly by each agency in the following number of wells:

Well Owner	# Sampled
ER Project (SNL/NM)	51
GWPP (SNL/NM)	19
KAFB IRP	46
City of Albuquerque	12
USGS	2

7.3.1 Regional Hydrology

Groundwater Conceptual Model

A brief overview of the regional hydrology is given in Chapter 1, section 1.5 of this report. 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 regional aquifer is located within these units 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. These areas are delineated by bounding 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 west of the Tijeras fault complex and the Sandia fault are 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.

Regional Water Table

The Regional Water Elevation Contour map for SNL/KAFB, FY00 is presented in Figure 7-4. The extent of the contoured map area, which is shaded in Figure 7-4, was constructed using August and September 2000 static water level data from 45 wells. Generally, these wells are screened across the regional water table in the upper unit of the Santa Fe Group. They penetrate different depths into the aquifer, and have various lengths of screened intervals. Although most of the water level data represent an unconfined water table, some water levels may represent semi-confined aquifer conditions.

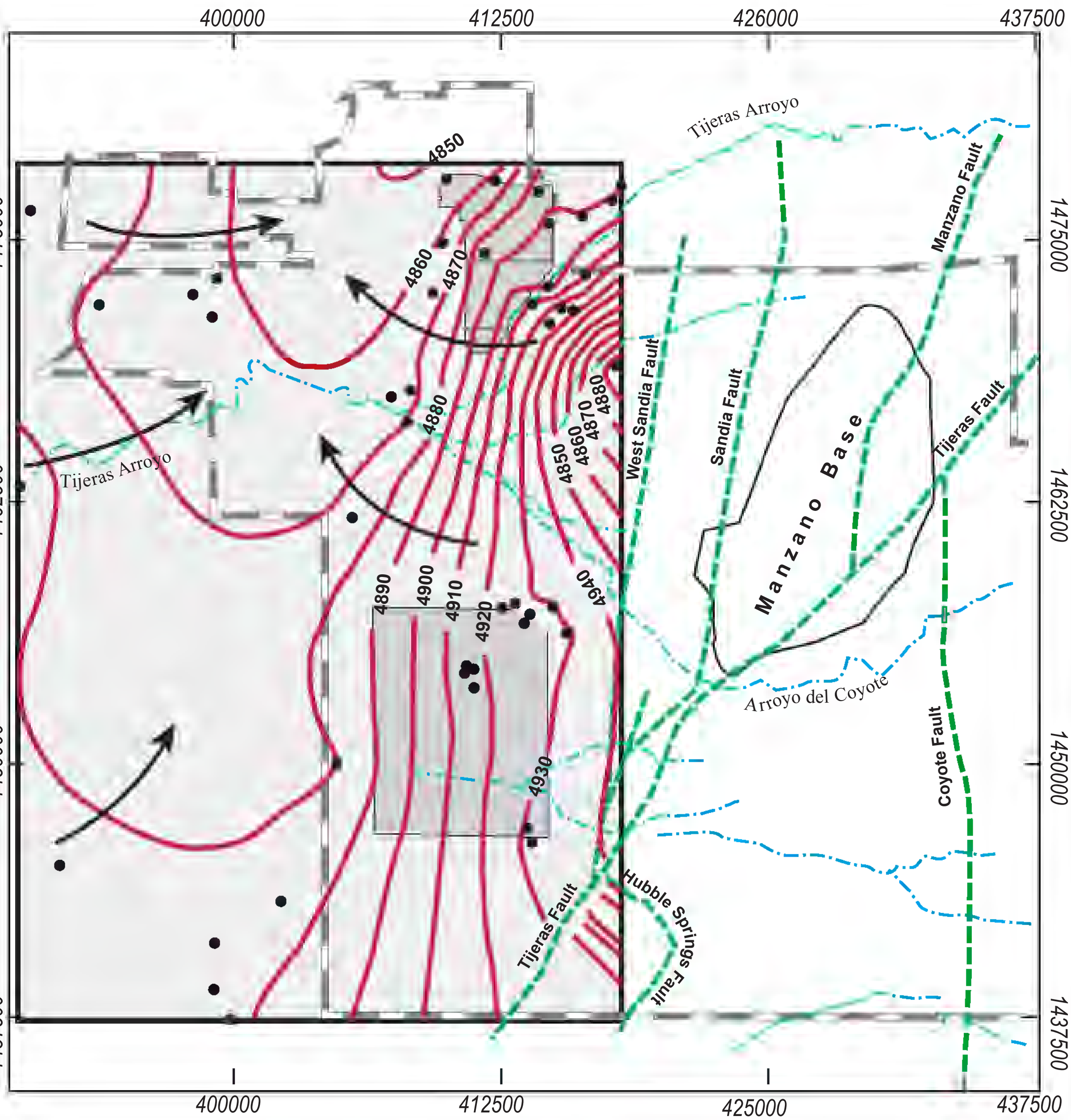
The contour lines shown on Figure 7-4 represent lines of equal elevation of the groundwater table. Groundwater flow is perpendicular to these lines in the direction of decreasing elevation. The arrows in Figure 7-4 show large-scale regional groundwater flow directions. The apparent direction of groundwater flow within the region (west of the Tijeras fault complex) is west and northwest. This contrasts with the southwesterly direction reported by Bjorklund and Maxwell (1961). This change in flow direction results from groundwater pumping by KAFB production wells at the northern portion of the KAFB and nearby City of Albuquerque production wells. The groundwater withdrawal has created a depression in the water table. This semi-ellipsoidal depression with the major axis running north-to-south, extends as far south as the Isleta Pueblo, and is a result of preferential flow through highly conductive ancestral Rio Grande fluvial deposits, which are the primary aquifer material in this area. In comparing the FY00 map with the FY99 map, it is apparent that the trough is continuing to expand primarily to the south.

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 within the basin.

Recharge potential to the groundwater system is directly related to the amount of precipitation. The regional climate for the Albuquerque basin area is semi-arid. Average precipitation ranges from eight inches per year near the Rio Grande up to 35 inches per year at the crest of the Sandia Mountains. The majority of rainfall in the Albuquerque area falls during the summer monsoon period from July through September.

Precipitation is measured at two locations at SNL/NM: the A36 tower in Tech Area III and the SCI tower near the Schoolhouse well in the foothills of the Manzanita Mountains. Precipitation at A36 tower measured at 4.37 inches for FY00 and measure 7.6 inches for



LEGEND

- Groundwater flow direction
- Extent of water elevation map
- Well used to construct water table contours
- Kirtland Air Force Base Boundary
- Contoured surface
- Drainage
- Faults
- SNL/NM Technical Area

This map is based on the original map constructed by Sandia National Laboratories, New Mexico, Environmental Geographic Information System (GIS)

Mapid=010286 02/03/00 SNL GIS ORG. 6135 Doug Rizor

00_7-4.ai

FIGURE 7-4. Regional Water Elevation Contour Map for SNL/KAFB, FY00

CY00. Precipitation at SC1 was measured at 7.05 inches during FY00 and measured at 10.62 inches during CY00. Much of the precipitation measured at the SC1 tower fell in the form of snow. During FY99, 11.11 inches of precipitation was measured at the SC1 tower.

NOTE: Snow is underestimated due to monitor used (it is difficult to determine by how much). In order to estimate precipitation due to snow, the towers would need to be equipped with heated monitors. Currently, the towers are not equipped with heated monitors. Annual snowfall in Albuquerque is minimal overall.

KAFB water supply pumping is the primary groundwater withdrawal. KAFB production wells extract groundwater from a depth of up to 2,000 ft in the upper and middle unit of the Santa Fe Group, which constitutes the primary aquifer for the Albuquerque Metropolitan Area. In FY00, KAFB pumped approximately 1.38 billion gallons (4,235 acre-ft) of groundwater from eight water supply wells. In comparison, 1.22 gallons (3,748 acre-ft) of water were pumped for the same period of time in FY99. The increase of water usage is a reflection of reduced precipitation in FY00.

7.3.2 Groundwater Level Trends

The USGS conducted a two-year study on the Santa Fe Group and the Albuquerque area, and in 1995, found that the quantity of water in the aquifer was significantly less than previously estimated (Thorne et al. 1993). The imbalance between recharge and groundwater withdrawal, as shown in Figure 7-5, has resulted in a general decline in water levels. Figure 7-5 shows the contour map of the annual water table elevation changes recorded for the western area of KAFB. Water level changes in 30 wells were used to construct the map. The wells were selected based on consistency of data as observed in their hydrographs. In order to provide sufficient data points, water level data for a 24-month period (FY99 and FY00) were used. Linear regression was applied to the data to calculate a rate of decline. The rates of decline at the location of the 30 wells were contoured to develop Figure 7-3.

As illustrated in Figure 7-5, water levels continue to decline at rates of up to 1.6 ft/yr in the western area of KAFB. The most dramatic declines are occurring in the vicinity of McCormick Ranch, where the annual decline is about 1.6 ft/yr. In the eastern portion of the mapped area, including Tech Area III, water levels show moderate declines of approximately 0.6 ft/yr. In contrast to the trend of water level declines throughout most of the region, the water levels in the northeast portion of the mapped area are actually rising. In some cases, the water levels rise is as much as 1.4 ft/yr. This area coincides with a potential recharge area associated with Tijeras Arroyo.

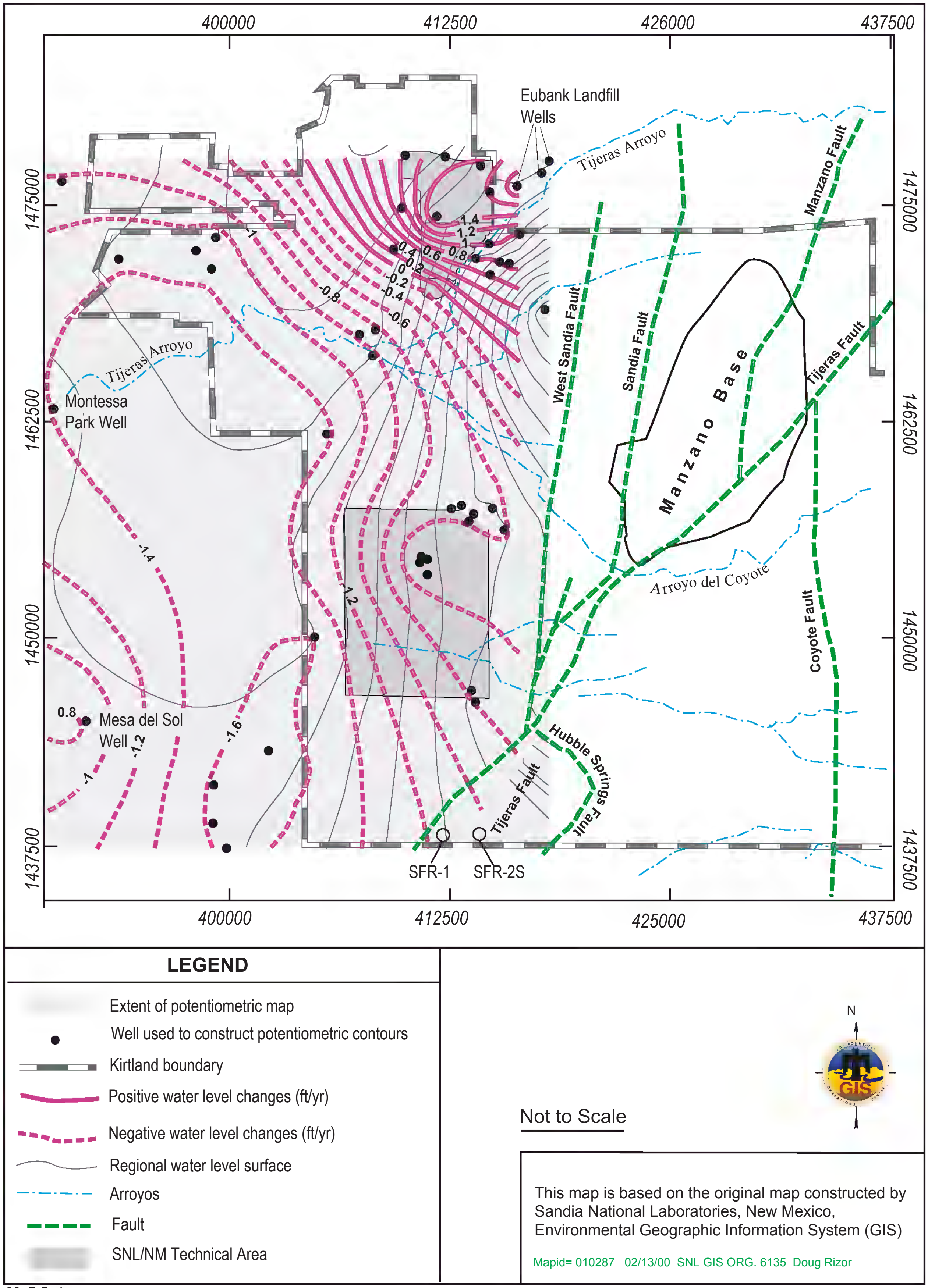


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FIGURE 7-5. Annual Water Table Changes for the East Side of KAFB Including SNL/NM Tech Areas, FY99/00

(FY99 - October 1, 1998 to September 30, 1999; FY00 - October 1, 1999 to September 30, 2000)

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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 1999). Sandia Corporation has also developed its own QA Program as given in *Corporate Quality Assurance Program* (SNL2000n).

Most of the environmental programs at Sandia National Laboratories, New Mexico (SNL/NM) reside under the Integrated Safety and Security (ISS) Center (7100). The Environmental Restoration (ER) Project resides under the Geoscience and Environment Center (6100).

8.1 CORPORATE LEVEL QA

Integrated Safety Management System (ISMS)

ISMS was developed by the 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 website address:

http://tis.eh.doe.gov/ism/

The DOE's ISMS principles, represented by a star, identify five critical elements of project planning, implementation, and feedback:

- **Plan Work**
- **Analyze Hazards**
- **Hazard Controls**
- **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).

In 1998, a *Center 7100 Quality Policy* (West 1998) was developed 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 QA

Environmental Sampling

Environmental samples are collected through various programs and analyzed for radiological and non-radiological contaminants. Some sampling is specifically mandated by regulations to meet compliance while other sampling activities, which are not regulatory driven, are carried out in accordance with DOE Orders. The following sampling activities directly support regulatory compliance:

- **Wastewater** sampling is conducted at various permitted outfall stations to meet the City of Albuquerque discharge requirements.
- **Storm water** runoff sampling is conducted at two stations to satisfy U.S. Environmental Protection Agency (EPA) requirements. (The Storm Water Program plans to add six stations in 2000).
- **ER Project** groundwater sampling is required by the EPA Resource Conservation and Recovery Act (RCRA) permit requirements.
- **Waste** sampling is performed, as necessary, to characterize radioactive and hazardous waste. This satisfies several regulatory requirements including the necessity to meet U.S. Department of Transportation (DOT) regulations before waste can be shipped off-site 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 Kirtland Air Force Base (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 conducted to satisfy DOE Order 5400.1 requirements. Results are compared against Clean Air Act (CAA) standards for criteria pollutants.
- **Air emission** sampling from non-radioactive 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 off-site 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 areas:

- 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 are carried out in accordance with applicable policies and procedures set forth in the PGs. 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 performing 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 by 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 contains applicable QA elements. These documents are prepared and implemented in accordance with the *Sample Management Office (SMO) Quality Assurance Plan (QAP)* (SNL 1996a), and meet appropriate federal, state, and local regulatory guidelines for conducting sampling and analysis activities.

SMO Roles and Responsibilities

The 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.

Prior to fieldwork commencing, project leaders and SMO coordinators confer to ensure that the requirements of the sampling plan are established and coordinated with the analytical laboratory. This step ensures that the data quality objectives (DQOs) (such as minimum detection limits [MDL]) stated in the sampling plan will be achievable by the laboratory before the project begins. An Analysis Request and Chain-of-Custody (ARCOC) form is filled out for each sample once the project begins. The SMO assigns a unique control number to each ARCOC and sample. Samples are labeled and documented on the ARCOC and the sample collection log or logbook. The SMO is responsible for QA and quality control (QC) once the samples are relinquished to the SMO by field team members. 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 SAPs

Each program involved in environmental monitoring and sampling develops and follows 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 off-site contract laboratories are selected based on an appraisal (pre-award audit) as described in the SMO QAP (SNL 1996a). 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.

Contract laboratories are required to participate in applicable DOE and EPA programs for blind-audit check sampling to monitor the overall accuracy of analyses routinely performed on SNL/NM samples.

Program QC Measures

The QC process monitors the quality of data generated by each contract 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 accuracy among 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 that may be present in the ambient air during soil sampling. Blank samples assess the quality and unavoidable contamination present in the sampling and analytical processes.
- ***Equipment blank sampling*** – Rinse water is collected off sampling equipment to determine the effectiveness of the decontamination process of field equipment.
- ***Trip blank sampling*** – A sample is prepared in the laboratory and carried through the entire sampling process (e.g., 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 the accuracy of laboratory analyses.

Laboratory QC Measures
With each SNL/NM sample batch, laboratory QC samples are concurrently prepared at defined frequencies and analyzed for each method. Analytical accuracy, precision, contamination, and matrix effects associated with each analytical measurement are determined.

QC sample results are compared to statistically established control criteria for acceptance. Analytical results generated concurrently 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 contract laboratories for SNL/NM.

8.4 2000 SMO ACTIVITIES

In 2000, the SMO processed a total of 7,133 samples in support of Sandia Corporation projects, which included environmental monitoring (air and water), waste characterization, decontamination and demolition (D & D), and ER. Of these, 2,119 were for environmental monitoring and surveillance projects. A total number of 810 QC samples were submitted to monitor overall contract laboratory performance. Approximately 198 QC samples were for environmental monitoring and surveillance projects.

Contract Laboratories work to both a Sandia Corporation statement of work and the *DOE/AL Model Statement of Work* (DOE 2000c).

SMO Sample Handling

SMO handled the following types of samples in 2000:

- **Radioactive waste**
- **Hazardous waste**
- **D & D**
- **D & D materials**
- **Underground Storage Tank (UST) sludges and liquids**
- **Soil**
- **Groundwater**
- **Solid Waste characterization**
- **Air**
- **Environmental Restoration**
- **Wastewater effluent**
- **Surface water**
- **Storm water**
- **Soil gas**
- **Air filter swipes**

Inter-Laboratory Comparisons
SMO contract laboratories are required to participate in the inter-laboratory comparison programs of the EPA's Environmental Monitoring Systems Laboratory (EMSL). In 2000, all result expectations were met.

The DOE Assessment Programs include the Mixed Analyte Performance Evaluation Program (MAPEP), the inter-laboratory QAP, and an EPA-approved vendor program with a similar scope as the privatized EPA Water

Pollution and Water Supply studies. SMO contract laboratories have a history of achieving a 90 percent or greater success rate during these comparisons. Acceptable results are based on either established control limits as stated in the applicable methods or statistically applied acceptance windows as determined by the Performance Evaluation Program (PEP). Windows are typically two or three standard deviation around the true value.

Laboratory QA

The SMO continued on-site 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 on-site visit; the laboratories are not notified in advance and 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 2000, Sandia Corporation employed three contract laboratories for the analysis of SNL/NM samples:

- **ACCULABS –** Golden, Colorado;
- **General Engineering Labs (GEL) –** Charleston, South Carolina;
- **Severn Trent –** St. Louis, Missouri; Santa Ana, California; and Richland, Washington.

QA Audits

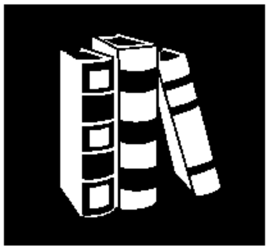
The SMO conducted audits in 2000 at all three of its contract laboratories using the centralized QA program criteria established by the DOE/AL Analytical Management Program (AMP) (SNL 1999d). The SMO together with the AMP work closely with the contract laboratories to expeditiously resolve audit findings. Decisions regarding sample distribution to the contract laboratories are based on audit findings and unresolved corrective actions.

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 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 according to the laboratory's QA plan, standard operating procedures, and client specific requirements;
- By a qualified member of Sandia Corporation's SMO personnel, 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 Project Leader determines the decision of data usability.

In addition, a pre-determined percent of data are validated to the methods in accordance with the *SNL/ER Data Validation Procedure for Chemical and Radiochemical Data* (SNL 2000e).



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ACTS and STATUTES

American Indian Religious Freedom Act (AIRFA) of 1978 (42 U.S.C. § 1996)

Archaeological Resources Protection Act (ARPA) of 1979 (16 U.S.C. § 470aa)

Atomic Energy Act (AEA) of 1954 (42 U.S.C. § 2011 et seq.)

Clean Air Act (CAA) and **CAA Amendments (CAAA) of 1990** (42 U.S.C. §7401)

Clean Water Act (CWA) of 1977 (the **Federal Water Pollution Control Act)** (33 U.S.C. §1251)

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. §9601) Amended by the Superfund Amendments and Reauthorization Act (SARA)

Emergency Planning and Community Right to Know Act (EPCRA) of 1986 (42 U.S.C. §11001 et seq.)

Endangered Species Act (ESA) (16 U.S.C.§1531 et seq.)

Federal Facility Compliance Act (FFCA) of 1992 (42 U.S.C. § 6961)

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

National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. §4321).

National Historic Preservation Act of 1966 (16 U.S.C. §470).

Pollution Prevention Act of 1990 (42 U.S.C. §13101 et seq.)

Resource Conservation and Recovery Act (RCRA) of 1976 (42 U.S.C. §6901 et seq.)

Safe Drinking Water Act (SDWA) (42 U.S.C §300f).

Superfund Amendments and Reauthorization Act (SARA) of 1986 (see CERCLA)

Toxic Substances Control Act (TSCA) of 1976 (15 U.S.C. §2601 et seq.).

NOTE: U.S.C = United States Code

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APPENDIX A

2000 Annual Site Environmental Report
for the
Kauai Test Facility (KTF)

Operated by
Sandia Corporation

ACKNOWLEDGEMENTS

This report was written with contributions from Alonzo Lopez, Dean Manning, Joan Harris, Jennifer Payne, and Heidi Herrera.

Kauai Test Facility

CONTENTS

FIGURE

TABLES

Acronyms and Abbreviations

AIRFA	American Indian Religious Freedom Act
AL	Albuquerque Operations Office
ARPA	Archeological Resources Protection Act
ASER	Annual Site Environmental Report
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
EHS	Extremely Hazardous Substance
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
HAR	Hawaii's Administrative Rule
HCRR	Hawaiian Administration Rules
KAO	Kirtland Area Office
KTF	Kauai Test Facility
MSDS	Material Safety Data Sheet
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
NPL	National Priorities List
N/R	Not required
NSPS	New Source Performance Standards
NSP	Non-covered Source Permit
PCB	polychlorinated biphenyl
PMRF	Pacific Missile Range Facility
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RQ	Reportable Quantity
SARA	Superfund Amendments and Reauthorization Act
SDI	Strategic Defense Initiative
SDWA	Safe Drinking Water Act
SNL/KTF	KTF Facilities under Sandia Corporation's control
SNL/NM	Sandia National Laboratories/New Mexico
SPCC	Spill Prevention Control and Countermeasures (Plan)
STARS	Strategic Targeting System
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
UST	underground storage tank

Night Launch of a STARS Rocket

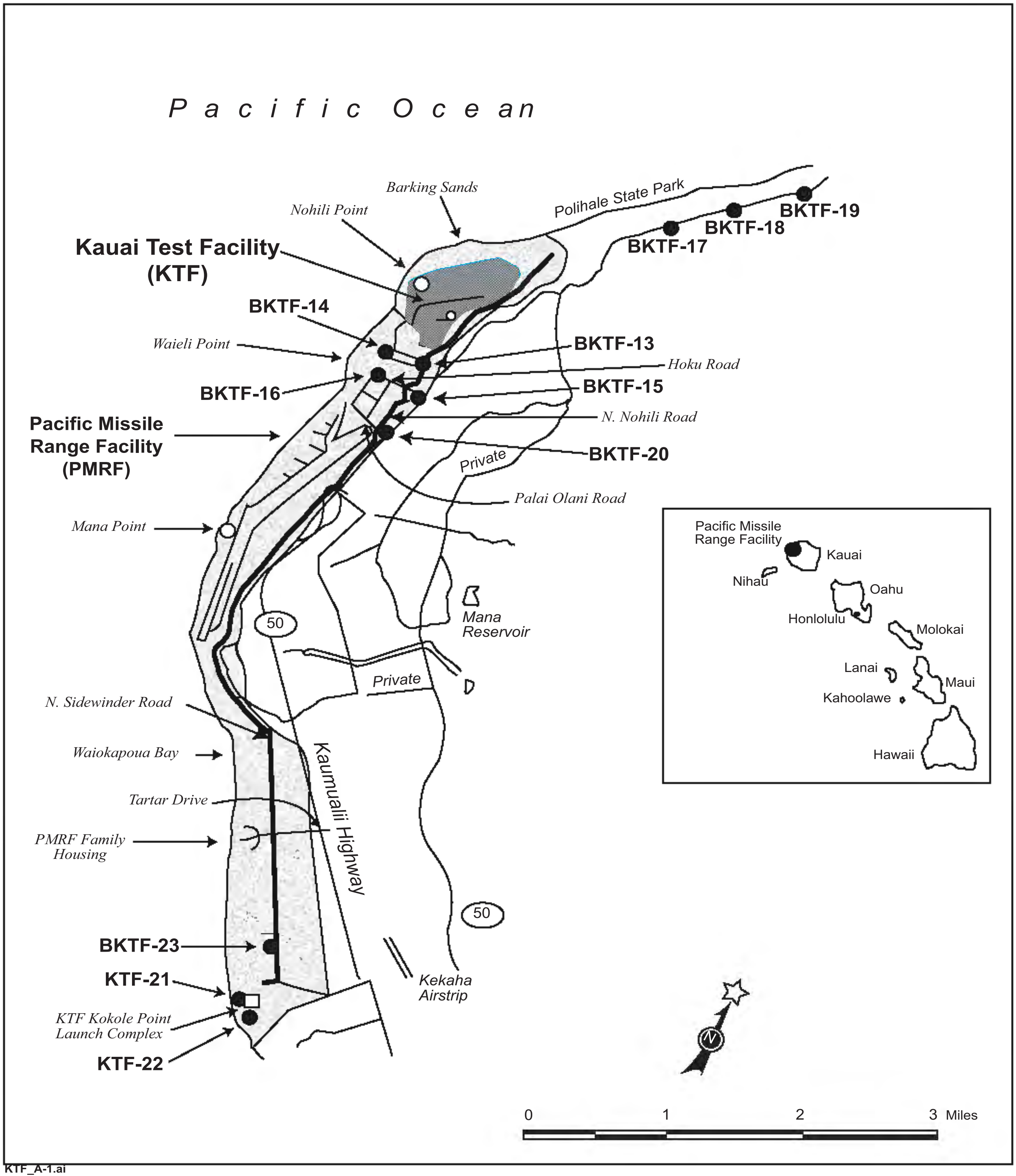


FIGURE A-1. Map of the Pacific Missile Range Facility (PMRF) and the Adjacent Area
The Kauai Test Facility (KTF) is to the north, near Nohi li Point

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. Sandia National Laboratories/Kauai Test Facility (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, 2000. 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 1996a).

A.1 FACILITIES AND OPERATIONS

SNL/KTF has been an active rocket-launching facility since 1962. The KTF and Range Interfaces Department under Sandia National Laboratories/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 1999, there have been 13 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.

A.2 2000 ROCKET LAUNCHES

There were no rockets launched from SNL/KTF in 2000.

A.3 DEMOGRAPHICS

There are 13 permanent on-site 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 2000. 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 on-site.

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 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.

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.

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	
✓ Clean Air Act (CAA) and CAA Amendments (CAAA)	*Provides standards to protect the nation's air quality*
✓ Clean Water Act (CWA)	*Provides general water quality standards to protect the nation's water sources and byways*
✓ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	*Provides federal funding for cleanup of inactive waste sites on the National Priorities List (NPL) and mandates requirements for reportable releases of hazardous substances.*
✓ Cultural resources acts	*Includes various acts that protect archeological, historical, and religious sites and resources*
✓ Endangered Species Act (ESA)	*Provides special protection status for federally-listed endangered and threatened species*
✓ Executive Order (EO) 11988	*Specific protection for wetlands and floodplains*
✓ Federal Facilities Compliance Act (FFCA)	*Directs federal agencies in the management of mixed waste*
✓ Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	*Controls the distribution and use of various pesticides*
✓ National Emission Standards for Hazardous Air Pollutants (NESHAP)	*Specifies standards for radionuclide air emissions and other hazardous air releases*
✓ National Environmental Policy Act (NEPA)	*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*
✓ Resource, Conservation, and Recovery Act (RCRA)	*Mandates the management of listed hazardous waste and hazardous materials*
✓ Safe Drinking Water Act (SDWA)	*Provides specific standards for sources used for drinking water*
✓ Superfund Amendments and Reauthorization Act (SARA)	*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*
✓ Toxic Substance Control Act (TSCA)	*Specifies rules for the manufacture, distribution, and disposal of specific toxic materials such as asbestos and polychlorinated biphenyls (PCBs)*

TABLE A-2. 2000 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 report listing chemical inventories above the reportable Threshold Planning Quantities listed in 40 CFR Part 355 Appendix B, location of the chemicals and emergency contacts. The report is prepared for the DOE/KAO, which distributes it to the required entities.
304	Emergency Release Notification			✓	No reportable quantity (RQ) releases of an extremely hazardous substance (EHS), or as defined under CERCLA, occurred in 2000.
311-312	MSDSs and Chemical Inventory Report	✓			There are two "Community Right-to-Know" reporting requirements: (a) SNL/KTF completes the EPA Tier II forms for all hazardous chemicals present at the facility at any one time in amounts equal to or greater than 10,000 pounds and for all extremely hazardous substances present at the facility in an amount greater than or equal to 500 pounds or the Threshold Planning Quantity, whichever is lower; (b) SNL/KTF provides MSDSs for each chemical entry on a Tier II form unless it decides to comply with the EPA's alternative MSDS reporting, which is detailed in 40 CFR Part 370.21.
313	Toxic Release Inventory (TRI) Reporting			✓	Sandia Corporation is below the reporting threshold in 2000 for producing a TRI Report for SNL/KTF operations.

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

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 2000 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 includes the Endangered Species Act (ESA) and cultural resources acts, which are discussed in the following paragraphs.

The DOE/KAO coordinates NEPA compliance at SNL/KTF with SNL/NM.

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 1998).

Prior to Sandia Corporation beginning any proposed action that may potentially affect sensitive species or habitats, a NEPA Checklist is submitted to DOE/KAO for a determination. As it is applicable, DOE/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.

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.

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.

Executive Orders (EOs)
The two primary EOs applicable at SNL/KTF are as follows:

- EO 11990, *Protection of Wetlands*
- EO 11988, *Floodplain Management*

One NEPA Checklist was submitted to DOE/KAO for determination on proposed actions at SNL/KTF in 2000:

- Navy Theatre Wide Program at SNL/KTF. No rockets were launched under this program in 2000.

Clean Air Act (CAA) and Clean Air Act Amendments (CAAA) of 1990
Ambient air quality is regulated by Hawaii's Administrative Rules (HAR), Title 11, Chapter 59 under the jurisdiction of the Hawaii Department of Health, Clean Air Branch. 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 61, "National Emission Standards for Hazardous Air Pollutants" (NESHAP). Within

TABLE A-3. Threatened, Endangered, and Sensitive Species Potentially Occurring on KTF

Species		Federal Status	State of Hawaii Status
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
'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

TABLE A-3. Threatened, Endangered, and Sensitive Species Potentially Occurring on KTF *(continued)*

Species		Federal Status	State of Hawaii Status
PLANTS *(continued)*			
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
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

TABLE A-3. Threatened, Endangered, and Sensitive Species Potentially Occurring on KTF *(continued)*

Species		Federal Status	State of Hawaii Status
PLANTS *(concluded)*			
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
MAMMALS			
Hawaiian hoary bat	*Lasiurus cinereus semotus*	Endangered	Endangered
Hawaiian monk seal	*Monachus schauinslandi*	Endangered	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
No common name	*Psittirostra psittacea*	Endangered	Endangered
Dark-rumped petrel	*Pterodroma phaeopygia sandwichensis*	Endangered	Endangered
Newell's shearwater	*Puffinus auricularis*	Threatened	Threatened
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

TABLE A-3. Threatened, Endangered, and Sensitive Species Potentially Occurring on KTF *(concluded)*

Species		Federal Status	State of Hawaii Status
SNAILS			
Newcomb's snail	*Erinna newcombi*	T	T
ARACHNIDS			
Kauai cave wolf spider	*Adelocosa anops*	E	E
INSECTS			
Blackburn's sphinx moth	*Manduca blackburni*	E	E
Kauai pomace fly	*Drosophila musaphila*	PE	PE
CRUSTACEANS			
Kauai cave amphipod	*Spelaeorchestia koloana*	E	E

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) (Hawaii Department of Health 1998).

Rocket launches are mobile sources and do not require reporting of reportable quantity (RQ) releases.

As required by the EPA, the 2000 Annual Fee and Monitoring Report (air emissions) was submitted to the State of Hawaii on February 5, 2001. Sandia Corporation was in compliance with all air quality regulations in 2000.

Clean Water Act (CWA)

There were no compliance issues with respect to any state or federal water pollution regulations in 2000. There are three septic tanks on-site 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 U.S. Navy. There were no issues or changes in status for this tank during 2000. There is also one 10,000-gallon above ground fuel tank inside the Main Compound. Sandia Corporation cooperates with the U.S. Navy's spill control guidelines contained in the *Spill Prevention Control and Countermeasures (SPCC) Plan, Pacific Missile Range Facility* (NFEC 1997).

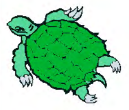
Safe Drinking Water Act (SDWA)

The SDWA does not apply directly to Sandia Corporation activities at SNL/KTF because all drinking water is obtained through PMRF's facilities or is purchased from commercial suppliers.

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.

Surveys Completed in Support of 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 (ASI 1990).

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 2000.

A.5 ENVIRONMENTAL PROGRAM ACTIVITIES

This section describes three environmental programs: the NEPA Program, the ER Project, and the Spill Prevention Program.

NEPA Program Activities
In completing the KTF EA in 1992 (DOE 1992), several environmental baseline surveys were conducted. These are discussed under the ESA.

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 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

There were no environmental surveillance and monitoring activities performed at the KTF in 2000.

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
On-site 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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SNL 1992 Sandia National Laboratories, "CDX Rocket Motor Effluent Monitoring," Memo from W. E. Stocum (7712) to R. G. Hay (2723). Sandia National Laboratories, Albuquerque, NM (1992).

LAWS, REGULATIONS, AND EXECUTIVE ORDERS

- **American Indian Religious Freedom Act (AIRFA) of 1978** (42 U.S.C. §1996).
- **Archaeological Resources Protection Act (ARPA) of 1979** (16 U.S.C. § 470aa).
- **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980** (42 U.S.C. §9601) (Amended by SARA).
- **Superfund Amendments and Reauthorization Act (SARA) of 1986** (see CERCLA).
- **Clean Air Act (CAA)** and **CAA Amendments (CAAA) of 1990** (42 U.S.C. §7401).
- **Clean Water Act (CWA) of 1977** (**The Federal Water Pollution Control Act**) (33 U.S.C. §1251).
- **Endangered Species Act (ESA)** (16 U.S.C. §1531 et seq.).
- **Executive Order (EO) 11988, *Floodplain Management*** (Signed May 24, 1977).
- **Executive Order (EO) 11990, *Protection of Wetlands*** (Signed May 24, 1977).
- **Federal Facility Compliance Act (FFCA) of 1992** (42 U.S.C. § 6961).
- **Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)** (7 U.S.C. § 136).
- **Hawaii Administrative Rules (HAR), Title ll, Chapter 59, "Ambient Air Quality Standards."**
- **Migratory Bird Treaty Act** (16 U.S.C. § 703).
- **National Environmental Policy Act (NEPA) of 1969** (42 U.S.C. §4321).
- **National Historical Preservation Act of 1966** (16 U.S.C. § 470).
- **National Emission Standards for Hazardous Air Pollutants (NESHAP)** (40 CFR 61).
- **Quiet Communities Act of 1978** (42 U.S.C. § 4901 et seq.).
- **Resource Conservation and Recovery Act (RCRA) of 1976** (42 U.S.C. § 6901 et seq.).
- **Safe Drinking Water Act (SDWA)** (42 U.S.C. §300f).
- **Toxic Substances Control Act (TSCA) of 1976** (15 U.S.C. §2601).

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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) and CAA Amendments (CAAA) of 1990

Meteorological Monitoring Program

40 CFR 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans"

Ambient Air Surveillance Program

40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards," (20 NMAC 11)

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*

Risk Management Plans

40 CFR 68, "Chemical Accident Provisions"

Air Quality Compliance Program

(See Table B-1)

Water Quality Programs

All Water Quality Programs

Clean Water Act (CWA) (Federal Water Pollution Control Act)

20 NMAC 6.2, "Ground and Surface Water Protection"

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 20 NMAC 11.03	Conformity of Federal Actions (State and Federal Plans) General and Transportation
	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
	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	40 CFR 85-86	20 NMAC 11.100	Motor Vehicle Inspection
	212-219		20 NMAC 11.101	- Decentralized and Centralized (respectively)
	211	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	National Emission Standards for Hazardous Air Pollutants (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 used for the Authentication of Models and Experiments

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, "National Secondary Drinking Water Regulations"

Wastewater Program

City of Albuquerque, "Sewer Use and Wastewater Control Ordinance" (Albuquerque Code of Ordinances Chapter 6, Article 3)

40 CFR 403, "General Pretreatment Regulations for Existing and New Sources of Pollution"

10 CFR 20, "Standards for Protection Against Radiation" (addresses radiological levels in wastewater)

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"

20 NMAC 6.2, "Groundwater and Surface Water Protection"

Groundwater Monitoring at ER Project Sites

40 CFR 265, Subpart F, "Groundwater monitoring at Interim Sites" Chemical Waste Landfill (CWL)

40 CFR 264.101, "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 Hazardous Waste TSD Facilities" (20 NMAC 4.1, Subpart V)

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 Prohibitions"

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

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, "Solid Waste Management"

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 from 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 the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities"

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 1954

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)

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)

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	FFCA Passed	The FFCA allows storage of MW over one-year RCRA time limit. Requires U.S. Department of Energy (DOE) to submit a site treatment plan for MW.
Dec 30, 1992	NON Issued	U.S. Environmental Protection Agency (EPA) issued a NON for storage of RCRA-regulated 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	Historical Disposal Requests Validation (HDRV) Project Initiated	The HDRV Project was initiated to characterize and sort legacy MW. Project continued into 1997 but was replaced with new sorting procedures
Oct 4, 1995	Federal Facility Compliance Order (FFCO) Agreement Signed	The FFCO, an agreement between State, DOE, and Sandia Corporation, details specific actions required with regard to MW management, including the requirement to develop of a Site Treatment Plan (STP), to be updated annually
Oct 6, 1995	Compliance Order Issued	NMED issued a Compliance Order enforcing SNL/NM's STP
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	On-site 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	STP 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	STP 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 transuranic/mixed waste (TRU/MW)
1999	Proposed Revisions to STP	Submitted revised plan to state
1999	STP FY98 Update	Submitted annual update
2000	Proposal for FFCO Amendment 3	Submitted a proposal to amend FFCO

NOTE: NON = Notification of Non-compliance
RCRA = Resource Conservation and Recovery Act
HSWA = Hazardous and Solid Waste Amendements
FFCA = Federal Facilities Compliance Act
NMED = New Mexico Environment Department
DSSI = Diversified Scientific Services, Inc.

New Mexico Pesticide Control Act

21 NMAC 17.50, "Pesticides"

Pollution Prevention Program

Pollution Prevention Act of 1990

RCRA Section 6002, "Federal Procurement"

EO 13101 Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition

EO 13148 Greening the Government Through Leadership in Environmental Management

EO 12856 Federal Agency Compliance With Right-to-Know Laws and Pollution Prevention Requirements (superceded by EO 13148)

EO 13149 Greening the Government Through Federal Fleet and Transportation Efficiency

EO 13123 Greening the Government Through Efficient Energy Management

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 Management Programs

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. 9601 et. seq.)

Superfund Amendments and Reauthorization Act (SARA) of 1986

Emergency Planning and Community Right to Know Act (EPCRA) of 1986 (42 U.S.C. 11001 et seq.)

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP)

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 the DCGs 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*

Radionuclide	Ingested Water DCG (µCi/ml)	Ingested Water f_1 Value**	Inhaled Air† DCG (µCi/ml)	Inhaled Air† 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}) §	6×10^{-6}	--	1×10^{-13}	Y

NOTE: μCi/ml = microcuries per milliliter
* From Figure III-1, 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.
§ Listed DCG's for U_{tot} are based on U_{nat} listing in 5400.5. Conversion from microcuries per milliliter (μCi/ml) to micrograms per liter (µg/L) may be made using:

$$\mu g / L = X \ \mu Ci / ml \frac{[1.48 \, x 10^9 \mu g / L]}{[1 \ \mu Ci / ml]}$$

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 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).
mrem/yr = millirem per year   mSv/yr = millisievert per year

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. EPA Primary Drinking Water Supply Standards/New Mexico Drinking Water Standards

Inorganic Chemicals	MCL	Units
Antimony	0.006	mg/L
Arsenic	0.05	mg/L
Asbestos	7	MFL
Barium	2.0	mg/L
Beryllium	0.004	mg/L
Cadmium	0.005	mg/L
Chromium	0.1	mg/L
Copper	1.3*	mg/L
Cyanide (free cyanide)	0.2	mg/L
Fluoride	4.0	mg/L
Lead	0.015**	mg/L
Mercury (inorganic)	0.002	mg/L
Nickel (New Mexico only) [5]	0.1	mg/L
Nitrate (measured as N)	10	mg/L
Nitrite (measured as N)	1	mg/L
Total Nitrate and Nitrite (measured as N)	10	mg/L
Selenium	0.05	mg/L
Thallium	0.002	mg/L
Organic Chemicals	**MCL**	**Units**
Alachlor	0.002	mg/L
Atrazine	0.003	mg/L
Benzene	0.005	mg/L
Benzo(a)pyrene	0.0002	mg/L
Carbofuran	0.04	mg/L
Carbon tetrachloride	0.005	mg/L
Chlordane	0.002	mg/L
Chlorobenzene	0.1	mg/L
2,4-D	0.07	mg/L
Dalapon	0.2	mg/L
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	mg/L
o-Dichlorobenzene	0.6	mg/L
p-Dichlorobenzene	0.075	mg/L
1,2-Dichloroethane	0.005	mg/L
1,1-Dichloroethylene	0.007	mg/L
cis-1,2-Dichloroethylene	0.07	mg/L
trans-1,2-Dichloroethylene	0.1	mg/L
Dichloromethane	0.005	mg/L
1,2-Dichloropropane	0.005	mg/L
Di(2-ethylhexyl)adipate	0.4	mg/L
Di(2ethylhexyl)phthalate	0.006	mg/L
Dinoseb	0.007	mg/L
Dioxin (2,3,7,8-TCDD)	0.00000003	mg/L
Diquat	0.02	mg/L
Endothall	0.1	mg/L
Endrin	0.002	mg/L

TABLE B-6. EPA Primary Drinking Water Supply Standards/New Mexico Drinking Water Standards *(concluded)*

Organic Parameter *(continued)*	MCL	Units
Ethylbenzene	0.7	mg/L
Ethylene Dibromide	0.00005	mg/L
Glyphosate	0.7	mg/L
Heptachlor	0.0004	mg/L
Heptachlor epoxide	0.0002	mg/L
Hexachlorobenzene	0.001	mg/L
Hexachlorocyclopentadiene	0.05	mg/L
Lindane	0.0002	mg/L
Methoxychlor	0.04	mg/L
Oxamyl (Vydate)	0.2	mg/L
Polychlorinated biphenyls (PCBs)	0.0005	mg/L
Pentachlorophenol	0.001	mg/L
Picloram	0.5	mg/L
Simazine	0.004	mg/L
Styrene	0.1	mg/L
Tetrachloroethylene	0.005	mg/L
Toluene	1	mg/L
Toluene	1	mg/L
Total Trihalomethanes (TTHMs)	0.1	mg/L
Toxaphene	0.003	mg/L
2,4,5-TP (Silvex)	0.05	mg/L
1,2,4-Trichlorobenzene	0.07	mg/L
1,1,1-Trichloroethane	0.2	mg/L
1,1,2-Trichloroethane	0.005	mg/L
Trichloroethylene	0.005	mg/L
Vinyl chloride	0.002	mg/L
Xylenes (total)	10	mg/L
Radionuclides	**MCL**	**Units**
Beta particles and photon emitters	4	mrem/ yr
Gross alpha particle activity	15	pCi/L
Radium 226 and Radium 228 (combined)	5	pCi/L
Uranium	0.030	mg/L

NOTE: *action level concentrations which trigger systems into taking treatment steps if 10% of tap water samples exceed the value
**New Mexico Drinking Water Standard only, EPA removed nickel in 1995
MCL = Maximum Contaminant Level
mg/L = milligram per liter; ml = milliliter
MFL= Micro-fibers per liter
mrem/yr = millirem per year
pCi/L = picocurie per liter

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

NOTE: mg/L = milligram per liter
pH = potential of hydrogen (acidity)

TABLE B-8. New Mexico Water Quality Control Commission (NMWQCC) Standards for Groundwater of 10,000 mg/L total dissolved solid (TDS) Concentration or Less

Contaminant	MAC	Units
A. Human Health Standards		
Arsenic	0.1	mg/L
Barium	1.0	mg/L
Cadmium	0.01	mg/L
Chromium	0.05	mg/L
Cyanide	0.2	mg/L
Fluoride	1.6	mg/L
Lead	0.05	mg/L
Total Mercury	0.002	mg/L
Nitrate (as N)	10.0	mg/L
Selenium	0.05	mg/L
Silver	0.05	mg/L
Uranium	5.0	mg/L
Radioactivity: Radium-226 & Radium 228	30.0	pCi/L
Benzene	0.01	mg/L
Polychlorinated biphenyls (PCB's)	0.001	mg/L
Toluene	0.75	mg/L
Carbon Tetrachloride	0.01	mg/L
1,2-dichloroethane (EDC)	0.01	mg/L
1,1-dichloroethylene (1,1-DCE)	0.005	mg/L
1,1,2,2-tetrachloroethylene (PCE)	0.02	mg/L
1,1,2- trichloroethylene (TCE)	0.1	mg/L
Ethylbenzene	0.72	mg/L
Total Xylene	0.62	mg/L
Methylene Chloride	0.1	mg/L
Chloroform	0.1	mg/L
1,1 –dichloroethane	0.025	mg/L
Ethylene dibromide (EDB)	0.0001	mg/L
1,1,1 –trichloroethane	0.06	mg/L
1,1,2 –trichloroethane	0.01	mg/L
1,2,2,2 –tetrachloroethane	0.01	mg/L
Vinyl Chloride	0.001	mg/L
PAHs: total naphtalene + monomethylnapthalenes	0.03	mg/L
Benzo(a)pyrene	0.0007	mg/L
B. Other Standards for Domestic Water Supply		
Chloride	250.0	mg/L
Copper	1.0	mg/L
Iron	1.0	mg/L
Manganese	0.2	mg/L
Phenols	0.005	mg/L
Sulfate	600.0	mg/L
Total Dissaolved Solids	1000.0	mg/L
Zinc	10.0	mg/L
pH	Between 6 and 9	

NOTE: mg/L = milligram per liter
pH = potential of hydrogen (acidity)
pCi/L = picocurie per liter
MAC = maximum allowable concentration

TABLE B-8. New Mexico Water Quality Control Commission (NMWQCC) Standards for Groundwater of 10,000 mg/L total dissolved solid (TDS) Concentration or Less *(concluded)*

Contaminant	MAC	Units
C. Standards for Irrigation Use – Groundwater shall meet the standards of Subsection A,B, and C unless other wise provided		
Aluminum	5.0	mg/L
Boron	0.75	mg/L
Cobalt	0.05	mg/L
Molybdenum	1.0	mg/L
Nickel	0.2	mg/L

NOTE: mg/L = milligram per liter
MAC = maximum allowable concentration
pCi/L = picocurie per liter

References

DOE 1990: U.S. Department of Energy, *General Environmental Protection Program*, DOE Order 5400.1. DOE, Washington, DC (June 29, 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 (January 7, 1993).

Regulations

Resource Conservation and Recovery Act (RCRA) of 1976. (42 U.S.C. § 6901 et seq.)

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.

New Mexico Administrative Code, Title 20, Chap. 6. Part 2, *Ground and Surface Water Protection*

New Mexico Administrative Code, Title 20, Chap. 7. Part 1, *Drinking Water*

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APPENDIX C

Documents Important to Sandia Corporation's Environmental Programs at SNL/NM

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CONTENTS

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Environmental Restoration (ER Project)

- Multiple documents too numerous to list here.

Waste Management

All Waste Management Programs

- *Storm Water Pollution Prevention Plan (SWP3)* (SNL 1997c)
- *Programmatic Waste Acceptance Criteria (*SNL 2001d)
- *Waste Management Program Document* (SNL 1999d)
- *Waste Characterization Project Overview (*SNL 2000b)

Hazardous Waste

- *Hazardous Waste Generator Biennial Report* (SNL 2000d)
- Section 19A, "Hazardous Waste Management," *ES&H Manual* (SNL 2001e)
- Section 10E, "Chemical Spills," *ES&H Manual* (SNL 1997a)

Radioactive Waste

- *Site Treatment Plan for Mixed Waste, FY00 Update*, Rev. 4. (SNL 2001a)
- Section 19B, "Low-Level Radioactive Waste Management," *ES&H Manual* (SNL 2000c)
- *Radioactive Waste/Nuclear Materials Disposition Department (RWNMDD) Waste Management Program* (SNL 2001i)
- *Compliance Order and Site Treatment Plan for Mixed Waste, SNL/NM, Revision 4* (SNL 2000k)
- *Manzano Nuclear Facilities Maintenance Support Program* (SNL 2001h)
- Section 19D, "Radioactive Material Management Areas (RMMAs)," *ES&H Manual* (SNL 1998b)
- Section 19C, "Mixed Waste Management," *ES&H Manual* (SNL 2000m)
- Section 19E, "Treatability Studies for Hazardous and Mixed Waste," *ES&H Manual* (SNL 1997b)

TSCA Waste

- Section 6S, "Toxic Substances Control Act (TSCA)," *ES&H Manual* (SNL 1997l)

Solid Sanitary Waste and Recycling

- Section 19F, "Other Waste," *ES&H Manual* (SNL 1999e)

Air Quality

Ambient Air Surveillance and Meteorological Monitoring

- *Quality Assurance Project Plan (QAPjP) Meteorological and Ambient Air Monitoring Program* (SNL 1997j)

Air Quality Compliance

- *Title V Operating Permit Application # 515*, 1998 update (7-volume document; Volume 1 of 7 is for Sandia National Laboratories) (DOE 1998)
- *Air Quality* (SNL 1999g)
- *Supporting Documentation for the Hazardous Chemical Purchase Inventory, 2000 Reporting Year* (URS Corporation 2001)
- *Corporate Ozone-Depleting Substances Management Program* (SNL 1997h)
- Section 17B, "Air Permits in Bernalillo County," *ES&H Manual* (SNL 1998a)
- Section 17C, "Air Emissions Control Measures," *ES&H Manual* (SNL 1997f)
- Section 17D, "Ozone Depleting Substances," *ES&H Manual* (SNL 1999c)

NESHAP

- (1) *NESHAP Annual Report for CY00, SNL/NM (SNL 2001c)*
  (2) *Radiological Dose Calculations and Supplemental Dose Assessment Data for NESHAP Compliance, SNL/NM, 2000* (SNL 2001f)
- *Radiological NESHAP Quality Assurance Project Plan (QAPjP)* (SNL 1997g)

Water Quality

All Water Quality

- *Water Quality* (SNL 1997k)
- Section 10E, "Chemical Spills," *ES&H Manual* (SNL 1997a)
- Sandia National Laboratories, *Sandia National Laboratories, New Mexico Emergency Plan, ES&H Manual* supplement, PN471011 Sandia National Laboratories, Albuquerque, NM (May 2000). (SNL 2000j)

Wastewater Program

- Chapter 10, Section H, "Discharges to the Sanitary Sewer System," *ES&H Manual* (SNL 1997)
- *SNL/NM Wastewater Sampling and Analysis Plan (*SNL 1996)

Storm Water Program

- *Storm Water Pollution Prevention Plan (SWP3)* (SNL 2000a)
- Section T, "Surface and Storm Water Discharges," *ES&H Manual* (SNL 1997i)
- *Storm Water and Non-storm Water Discharge Sampling and Analysis Project Plan for SNL/NM* (SNL 1996c)

Surface Discharges

- *Discharge Plan Renewal Application, DP-530, SNL/NM* (SNL 1999)
- Section T, "Surface and Storm Water Discharges," *ES&H Manual* (SNL 1997i)
- Section 10F, "Oils, Greases, and Fuels," *ES&H Manual* (SNL 1997d)

Groundwater

- *Groundwater Protection Program (FY00) Annual Groundwater Monitoring Report for SNL/NM* (SNL 2001g)

Biological Control Activity

- Section 6K, "Hazardous Waste Operations and Emergency Response (HAZWOPER)," *ES&H Manual* (SNL 1998e)
- Section 6D, "Hazard Communication Standard," *ES&H Manual* (SNL 1998c)

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 2000l)
- *Environmental ALARA Program* (SNL 1996b)
- *Quality Assurance Project Plan (QAPjP) for Terrestrial Surveillance at SNL/NM* (SNL 1998d)
- *2000 Data Analysis in Support of the Annual Site Environmental Report* (SNL 2001b)
- *Environmental Monitoring Plan* (SNL 2000h)
- *Ecological Monitoring for 1999: Small Mammals, Birds, and Vegetation* (SNL 1999h)

Oil Storage and Spill Containment

- *Sandia National Laboratories Spill Prevention Control and Countermeasures (SPCC) Plan* (SNL 1999f)
- 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 2000i)
- *Sandia National Laboratories Final Site-Wide Environmental Impact Statement (SWEIS)* (DOE 1999a)
- *Environmental Assessment(EA) Rapid Reactivation Project* (DOE 1999c)
- *Sandia National Laboratories/New Mexico Facilities and Safety Information Document (FSID)* (SNL 1999a)
- *Sandia National Laboratories/New Mexico Environmental Information Document (EID*) (SNL 1999b)
- Section 10B, "NEPA, Sensitive Species, and Historic Properties," *ES&H Manual* (SNL 2000o)

Quality Assurance

Sample Management Office (SMO)

- *DOE/AL Model Statement of Work* (DOE 2000c)
- *Sample Management Office (SMO) Quality Assurance Plan* (SNL 1996a)

References

See Chapter 9, "References," for all references listed in this appendix.

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APPENDIX D

2000 Wastewater Monitoring Results

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CONTENTS

TABLES

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TABLE D-1. Permitted Sanitary Outfalls, March 2000

(All results reported 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:	03/28/00	03/28/00	03/28/00	03/28/00	03/28/00	COA
Sample ID:	51119	51115	51116	51117	51118	(mg/L)
Analyte						
Aluminum	0.0685	0.17	0.306	0.209	0.228	900
Arsenic	0.0175	0.0232	0.00257	0.0152	0.0157	0.051
Cadmium	0.000631	0.000631	0.000631	0.000631	0.000631	0.5
Chromium	0.00195	0.00127	0.00106	0.00218	0.00258	4.1
Copper	0.0237	0.00779	0.00184	0.0114	0.0326	5.3
Lead	0.00183	0.00183	0.00183	0.00183	0.00183	1
Molybdenum	0.0784	0.0302	0.00105	0.0111	0.0173	2
Nickel	0.00309	0.00309	0.00309	0.00309	0.00309	2
Selenium	0.00236	0.00236	0.00236	0.00236	0.00236	0.46
Silver	0.00356	0.00177	0.0013	0.00143	0.0058	5
Zinc	0.0616	0.0293	0.0268	0.0437	0.144	2.2
Boron	0.135	0.235	0.00933	0.0863	0.166	NE
Fluoride	0.621	0.735	5.08	3.54	0.61	36

Permit Number:	2069A	2069F	2069G	2069I	2069K	Regulatory
Station:	WW001	WW006	WW007	WW008	WW011	Limit
Date Collected:	03/29/00	03/29/00	03/29/00	03/29/00	03/29/00	COA
Sample ID:	51114	51120	51121	51122	51123	(mg/L)
Analyte						
Aluminum	0.0663	0.34	0.226	0.189	0.373	900
Arsenic	0.0129	0.0188	0.00257	0.011	0.0133	0.051
Cadmium	0.000631	0.000631	0.000631	0.000631	0.000631	0.5
Chromium	0.0013	0.00143	0.00136	0.00216	0.00298	4.1
Copper	0.0192	0.0136	0.00184	0.00986	0.0324	5.3
Lead	0.00183	0.00185	0.00183	0.00183	0.00438	1
Molybdenum	0.06	0.0447	0.00105	0.0121	0.0169	2
Nickel	0.00309	0.00309	0.00309	0.00309	0.00309	2
Selenium	0.00236	0.00236	0.00236	0.00236	0.00236	0.46
Silver	0.0046	0.00171	0.00189	0.00178	0.0205	5
Zinc	0.0553	0.0857	0.0182	0.0441	0.199	2.2
Boron	0.124	0.25	0.372	0.243	0.137	NE
Fluoride	0.695	0.706	7.33	6.38	0.432	36

NOTE: COA = City of Albuquerque

TABLE D-1. Permitted Sanitary Outfalls, March 2000 *(concluded)*
(All results reported 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:		**03/30/00**	**03/30/00**	**03/29/00**		**COA**
Sample ID:		**51577**	**51578**	**51579**		**(mg/L)**
Analyte						
Cyanide, Total	Not Sampled	2.76 µg/L	3.32 µg/L	4.57 µg/L	Not Sampled	0.45

NOTE: COA = City of Albuquerque
µg/L = microgram per liter

Other sampling performed during 1st quarter, Calendar Year 2000

Permit Number:	**2069G**			**Regulatory Limit COA (mg/L)**
Station:	**WW007**			
Analyte	**Date Collected**	**Sample ID**	**Result**	
Fluoride	01/19/00	50866	12	36
Fluoride	02/09/00	51280	10.5	36

NOTE: COA = City of Albuquerque
mg/L = milligram per liter

TABLE D-2. Summary of Sanitary Outfalls of Radiological Analyses, March 2000
(All results reported 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:	**03/29/00**		**03/28/00**		**03/28/00**		**03/28/00**		
Sample ID:	**51124**		**51225**		**51226**		**51227**		
Analyte									
Actinium-228	12.4 ± 10	U	11.9 ± 11	U	17.1 ± 11	U	7.87 ± 10	U	300000
Americium-241	-2.14 ± 12	U	28.6 ± 22		3.02 ± 14	U	-3.1 ± 13	U	200
Cerium-144	-10.9 ± 16	U	-3.43 ± 16	U	7.31 ± 17	U	8.68 ± 14	U	30000
Cesium-134	0.808 ± 2	U	-0.0744 ± 3	U	0.404 ± 3	U	-1.02 ± 2	U	9000
Cesium-137	3.46 ± 5	U	4.58 ± 3	U	0.778 ± 3	U	0.214 ± 2	U	10000
Chromium-51	-0.0166 ± 34	U	-13.2 ± 31	U	-30.9 ± 42	U	-3.64 ± 32	U	5000000
Cobalt-60	-0.0611 ± 2	U	2.2 ± 2	U	-3.06 ± 3	U	-0.453 ± 2	U	30000
Gross Alpha	4.22 ± 2		Not Sampled		4.72 ± 2		1.79 ± 2		NE
Gross Beta	17.2 ± 2		Not Sampled		12 ± 2		11.1 ± 2		NE
Iron-59	-0.0467 ± 6	U	-0.73 ± 7	U	-0.073 ± 7	U	-2.73 ± 6	U	100000
Lead-212	1.45 ± 7	U	0 ± 5	U	5.83 ± 10	U	3.08 ± 7	U	20000
Lead-214	3.06 ± 6	U	0 ± 10	U	4.2 ± 6	U	2.65 ± 8	U	1000000
Potassium-40	62 ± 34	U	44.9 ± 52	U	30.8 ± 82	U	59.9 ± 46		40000
Radium-226	6.77 ± 5	U	2.86 ± 12	U	0.504 ± 11	U	3.19 ± 12	U	600
Radium-228	12.4 ± 10	U	11.9 ± 11	U	17.1 ± 11	U	7.87 ± 10	U	600
Ruthenium-103	-0.582 ± 3	U	-0.00748 ± 4	U	-2.48 ± 3	U	0.32 ± 3	U	300000
Ruthenium-106	-5.61 ± 23	U	-10.3 ± 26	U	17.6 ± 25	U	5.28 ± 20	U	30000
Thorium-231	-4.69 ± 14	U	2.02 ± 14	U	-0.19 ± 15	U	13.2 ± 12	U	300
Thorium-232	1.42 ± 7	U	0 ± 5	U	5.71 ± 10	U	3.02 ± 7	U	500000
Thorium-234	158 ± 106	U	0 ± 140	U	194 ± 161	U	118 ± 137	U	50000
Tritium	-238 ± 130	U	-224 ± 128	U	-12.6 ± 136	U	84 ± 138	U	10000000
Uranium-235	11.6 ± 16	U	25.1 ± 16	U	3.24 ± 17	U	11.1 ± 15	U	3000
Uranium-238	158 ± 106	U	0 ± 140	U	194 ± 161		118 ± 137	U	3000
Yttrium-88	2.34 ± 3	U	0.606 ± 3	U	0.486 ± 3	U	-1.42 ± 3	U	100000
Zirconium-95	1.59 ± 5	U	-3.3 ± 5	U	1.74 ± 6	U	3.79 ± 5	U	200000

NOTE: U = The analyte was analyzed for, but not detected, below this concentration. For organic and inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the decision level.
NE = Not Established

TABLE D-3. Permitted Sanitary Outfalls, June 2000

(All results reported 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:	06/20/00	06/20/00	06/20/00	06/20/00	06/20/00	COA
Sample ID:	51872	51873	51874	51875	51876	(mg/L)
Analyte						
Aluminum	0.0815	0.343	0.0234	0.0234	0.127	900
Arsenic	0.0196	0.0186	0.00376	0.0148	0.0157	0.051
Cadmium	0.000631	0.000631	0.000631	0.000631	0.000631	0.5
Chromium	0.00384	0.00204	0.0011	0.00176	0.00292	4.1
Copper	0.0428	0.0249	0.00184	0.0155	0.0447	5.3
Lead	0.00223	0.00353	0.00183	0.00427	0.00326	1
Molybdenum	0.00933	0.0361	0.00763	0.0147	0.248	2
Nickel	0.00309	0.00309	0.00309	0.00309	0.00334	2
Selenium	0.00305	0.00236	0.00236	0.00236	0.00295	0.46
Silver	0.000884	0.000529	0.000529	0.000529	0.00218	5
Zinc	0.0986	0.0609	0.00469	0.064	0.138	2.2
Boron	0.142	0.208	0.00721	0.0817	0.161	NE
Fluoride	0.731	0.699	7.57	3.28	0.52	36

Permit Number:	2069A	2069F	2069G	2069I	2069K	Regulatory
Station:	WW001	WW006	WW007	WW008	WW011	Limit
Date Collected:	06/20/00	06/20/00	06/20/00	06/20/00	06/20/00	COA
Sample ID:	52493	52494	52495	52496	52497	(mg/L)
Analyte						
Aluminum	0.0234	0.157	0.0234	0.0271	0.0234	900
Arsenic	0.0213	0.0166	0.00345	0.0186	0.0142	0.051
Cadmium	0.000631	0.000631	0.000631	0.000631	0.000631	0.5
Chromium	0.00106	0.00106	0.00215	0.00222	0.00147	4.1
Copper	0.0224	0.0137	0.00184	0.0185	0.0264	5.3
Lead	0.00183	0.00183	0.00408	0.00363	0.00219	1
Molybdenum	0.00992	0.0269	0.00808	0.0117	0.182	2
Nickel	0.00309	0.00309	0.00309	0.00309	0.00362	2
Selenium	0.00236	0.00236	0.00236	0.00288	0.00236	0.46
Silver	0.000529	0.000529	0.000529	0.000529	0.00092	5
Zinc	0.0515	0.0499	0.00389	0.047	0.0685	2.2
Boron	0.142	0.197	0.00609	0.0955	0.159	NE
Fluoride	0.668	0.525	10.6	5.02	0.532	36

NOTE: COA = City of Albuquerque
NE = Not Established

TABLE D-4. Summary of Sanitary Outfalls of Radiological Analyses, June 2000
(All results reported 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:	06/20/00		06/20/00		06/20/00		06/20/00		
Sample ID:	51872		51873		51875		51876		
Analyte									
Actinium-228	0 ± 14	U	0.269 ± 16	U	4.76 ± 15	U	9.09 ± 8	U	300000
Americium-241	-2.65 ± 11	U	-4.23 ± 11	U	11.4 ± 9	U	-3.6 ± 11	U	200
Cerium-144	-4.65 ± 12	U	3.42 ± 13	U	9.23 ± 12	U	-3.99 ± 12	U	30000
Cesium-134	0.712 ± 2	U	1.05 ± 3	U	0.248 ± 2	U	-0.105 ± 2	U	9000
Cesium-137	0.681 ± 2	U	-0.361 ± 2	U	-0.721 ± 2	U	1.91 ± 2	U	10000
Chromium-51	9.69 ± 26	U	-9.84 ± 28	U	8.25 ± 24	U	25.2 ± 24	U	5000000
Cobalt-60	0.00924 ± 2	U	0.495 ± 2	U	-0.941 ± 2	U	0.656 ± 2	U	30000
Gross Alpha	6.13 ± 2		3.8 ± 2		3.46 ± 1		3.38 ± 1		NE
Gross Beta	19.7 ± 3		16 ± 3		9.11 ± 2		9.41 ± 2		NE
Iron-59	2.4 ± 5	U	2.42 ± 5	U	0.383 ± 5	U	1.3 ± 6	U	100000
Lead-212	2.37 ± 6	U	4.04 ± 8	U	3.51 ± 7	U	5.72 ± 4	U	20000
Lead-214	6.97 ± 5	U	5.76 ± 5	U	1.23 ± 7	U	0 ± 12	U	1000000
Potassium-40	2.12 ± 41	U	14.4 ± 69	U	10.1 ± 58	U	0 ± 30	U	40000
Radium-226	2.69 ± 8	U	5.27 ± 9	U	5.21 ± 7	U	0 ± 7	U	600
Radium-228	0 ± 14	U	0.269 ± 16	U	4.76 ± 15	U	9.09 ± 8	U	600
Ruthenium-103	-0.789 ± 3	U	-0.0641 ± 3	U	0.0319 ± 3	U	0.238 ± 2	U	300000
Ruthenium-106	12.9 ± 18	U	2.32 ± 21	U	3.82 ± 17	U	4.89 ± 18	U	30000
Thorium-231	-4.44 ± 10	U	11.4 ± 12	U	-0.277 ± 10	U	-3.84 ± 10	U	300
Thorium-232	2.33 ± 6	U	3.96 ± 8	U	3.45 ± 7	U	5.63 ± 4	U	500000
Thorium-234	0 ± 201	U	128 ± 97	U	0 ± 76	U	144 ± 95	U	50000
Tritium	-56 ± 150	U	-96 ± 141	U	-126 ± 146	U	-86.4 ± 146	U	10000000
Uranium-235	1.88 ± 13	U	0.855 ± 14	U	14.7 ± 13	U	-0.772 ± 13	U	3000
Uranium-238	0 ± 201	U	128 ± 97	U	0 ± 76	U	144 ± 95	U	3000
Yttrium-88	1.69 ± 2	U	-0.277 ± 2	U	1.8 ± 2	U	1.11 ± 3	U	100000
Zirconium-95	0.58 ± 4	U	1.27 ± 4	U	2.86 ± 4	U	-1.27 ± 4	U	200000

NOTE: NE = Not Established

U = The analyte was analyzed for, but not detected, below this concentration. For organic and inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the decision level.

Error is ± Standard Deviations

TABLE D-5. Summary of Sanitary Outfalls of Volatile Organic Compound Analyses, June 2000

(All results reported in micrograms per liter [µg/L] unless otherwise noted.)

Permit Number:	**2069A**		**2069F**		**2069I**		**2069K**	
Station:	**WW001**		**WW006**		**WW008**		**WW011**	
Date Collected:	**06/20/00**		**06/20/00**		**06/20/00**		**06/20/00**	
Sample ID:	**51872**		**51873**		**51875**		**51876**	
Analyte								
1,1,1-Trichloroethane	0.093	U	0.093	U	0.093	U	0.093	U
1,1,2,2-Tetrachloroethane	0.273	U	0.273	U	0.273	U	0.273	U
1,1,2-Trichloroethane	0.193	U	0.193	U	0.193	U	0.193	U
1,1-Dichloroethane	0.099	U	0.099	U	0.099	U	0.099	U
1,1-Dichloroethylene	0.09	U	0.09	U	0.09	U	0.09	U
1,2-Dichloroethane	0.158	U	0.158	U	0.158	U	0.158	U
1,2-Dichloropropane	0.07	U	0.07	U	0.07	U	0.07	U
2-Butanone	2.07	J	4.23	J	1.7	J	28.4	
2-Hexanone	1.74	U	1.74	U	1.74	U	1.74	U
4-Methyl-2-pentanone	0.696	U	0.696	U	0.696	U	0.696	U
Acetone	39.8		47.5		128		113	
Benzene	0.149	U	0.149	U	0.149	U	0.149	U
Bromodichloromethane	0.024	U	0.024	U	0.024	U	0.024	U
Bromoform	0.085	U	0.085	U	0.085	U	0.085	U
Bromomethane	0.628	U	0.628	U	0.628	U	0.628	U
Carbon tetrachloride	0.124	U	0.124	U	0.124	U	0.124	U
Chlorobenzene	0.603	U	0.603	U	0.603	U	0.603	U
Chloroethane	0.14	U	0.14	U	0.14	U	0.14	U
Chloroform	0.198	U	0.198	U	0.198	U	0.198	U
Chloromethane	0.179	U	0.179	U	0.179	U	0.179	U
cis-1,2-Dichloroethylene	0.129	U	0.129	U	0.129	U	0.129	U
cis-1,3-Dichloropropylene	0.035	U	0.035	U	0.035	U	0.035	U
Dibromochloromethane	0.089	U	0.089	U	0.089	U	0.089	U
Ethylbenzene	0.051	U	0.051	U	0.051	U	0.051	U
Methylene chloride	0.971	U	0.971	U	0.971	U	0.971	U
Toluene	0.262	U	0.262	U	0.262	U	0.262	U
trans-1,2-Dichloroethylene	0.105	U	0.105	U	0.105	U	0.105	U
trans-1,3-Dichloropropylene	0.106	U	0.106	U	0.106	U	0.106	U
Trichloroethylene	0.15	U	0.15	U	0.15	U	0.15	U
Vinyl chloride	0.096	U	0.096	U	0.096	U	0.096	U

NOTE: U = The analyte was analyzed for, but not detected, below this concentration. For organic and inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the decision level.

TABLE D-6. Permitted Sanitary Outfalls, September 2000
(All results reported 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:	**09/11/00**	**09/11/00**	**09/11/00**	**09/11/00**	**09/11/00**	**COA**
Sample ID:	**53203**	**53204**	**53205**	**53206**	**53207**	**(mg/L)**
Analyte						
Aluminum	0.0234	0.521	0.028	0.0234	0.031	900
Arsenic	0.0156	0.0132	0.00257	0.00936	0.00971	0.051
Cadmium	0.000631	0.000631	0.000631	0.000631	0.000631	0.5
Chromium	0.00106	0.00471	0.00311	0.00141	0.00141	4.1
Copper	0.0367	0.0519	0.00184	0.0171	0.0207	5.3
Lead	0.00323	0.00937	0.00183	0.00307	0.00336	1
Molybdenum	0.0111	0.0349	0.0111	0.049	0.208	2
Nickel	0.00309	0.00336	0.00309	0.00309	0.00309	2
Selenium	0.00236	0.00337	0.00236	0.00236	0.00236	0.46
Silver	0.000529	0.00117	0.00132	0.000529	0.000529	5
Zinc	0.0475	0.0987	0.00557	0.106	0.0503	2.2
Boron	0.15	0.329	0.0126	0.0826	0.142	NE
Fluoride	0.756	0.693	8.76	6.01	0.555	36

Permit Number:	**2069A**	**2069F**	**2069G**	**2069I**	**2069K**	**Regulatory**
Station:	**WW001**	**WW006**	**WW007**	**WW008**	**WW011**	**Limit**
Date Collected:	**09/12/00**	**09/12/00**	**09/12/00**	**09/12/00**	**09/12/00**	**COA**
Sample ID:	**53209**	**53210**	**53211**	**53212**	**53213**	**(mg/L)**
Analyte						
Aluminum	0.0234	0.0402	0.106	0.0234	0.0234	900
Arsenic	0.0134	0.00991	0.00257	0.0101	0.00831	0.051
Cadmium	0.000631	0.000631	0.000631	0.000631	0.000631	0.5
Chromium	0.00106	0.00106	0.00728	0.00405	0.00126	4.1
Copper	0.0219	0.0103	0.00184	0.00803	0.00963	5.3
Lead	0.00269	0.00228	0.00183	0.00226	0.00314	1
Molybdenum	0.137	0.0423	0.00744	0.43	0.137	2
Nickel	0.00309	0.00309	0.00406	0.00309	0.00309	2
Selenium	0.00331	0.00236	0.00236	0.00236	0.00236	0.46
Silver	0.000628	0.000529	0.000529	0.000529	0.00117	5
Zinc	0.0618	0.0277	0.00389	0.038	0.0243	2.2
Boron	0.154	0.229	0.00955	0.08	0.135	NE
Fluoride	0.752	0.751	9.37	4.03	0.564	36

NOTE: COA = City of Albuquerque
NE = Not Established

TABLE D-6. Permitted Sanitary Outfalls, September 2000 *(concluded)*
(All results reported 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:			03/30/00	03/29/00		COA
Sample ID:			51578*	51579*		(mg/L)
Analyte						
Cyanide, Total	Not Sampled	Not Sampled	2.76 µg/L	2.76 µg/L	Not Sampled	0.45

NOTE: *Reported Cyanide result is an average of four samples taken on the same day.
COA = City of Albuquerque
µg/L = microgram per liter

TABLE D-7. Summary of Sanitary Outfalls of Radiological Analyses, September 2000

(All results reported 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:	**09/11/00**		**09/11/00**		**09/11/00**		**09/11/00**		
Sample ID:	**53203**		**53204**		**53206**		**53207**		
Analyte									
Actinium-228	0.59 ± 14.1	U	21.7 ± 17	U	6.39 ± 12.2	U	1.06 ± 19.2	U	300000
Americium-241	5.74 ± 13.2	U	12.1 ± 22.2	U	-0.185 ± 10.3	U	-1.02 ± 13.3	U	200
Cerium-144	-0.233 ± 13.1	U	1.38 ± 28.8	U	7.74 ± 11.1	U	5.52 ± 11.9	U	30000
Cesium-134	-1.47 ± 2.06	U	-0.354 ± 4.59	U	-0.221 ± 2.02	U	0.228 ± 2.16	U	9000
Cesium-137	3.61 ± 2.75		5.26 ± 4.37	U	0.233 ± 2.07	U	1.4 ± 1.93	U	10000
Chromium-51	-4.63 ± 33.5	U	11.6 ± 74.5	U	18.5 ± 32.8	U	3.01 ± 32.3	U	5000000
Cobalt-60	0.117 ± 2.05	U	2.37 ± 4.02	U	-0.157 ± 1.91	U	0.572 ± 2.25	U	30000
Gross Alpha	1.53 ± 1.91		1.39 ± 1.37		2.73 ± 1.69		0.369 ± 1.29	U	NE
Gross Beta	13.4 ± 2.67		17.7 ± 3.6		8.02 ± 1.89		15.9 ± 2.71		NE
Iron-59	1 ± 6.16	U	2.71 ± 12.8	U	2.97 ± 5.18	U	-3.15 ± 5.85	U	100000
Lead-212	1.64 ± 8.18	U	11.2 ± 14	U	8.2 ± 5.86		6.36 ± 6.96		20000
Lead-214	0 ± 4.63	U	2.83 ± 21	U	6.66 ± 8.2		8.98 ± 7.48		1000000
Potassium-40	38.2 ± 45.9	U	7.24 ± 103	U	44.6 ± 27.8	U	40.2 ± 52.5		40000
Radium-226	1.59 ± 8.65	U	14.4 ± 19.2	U	22.3 ± 10.9		12.1 ± 10.7		600
Radium-228	0.59 ± 14.1	U	21.7 ± 17	U	6.39 ± 12.2	U	1.06 ± 19.2	U	600
Ruthenium-103	1.1 ± 3.13	U	-0.784 ± 6.66	U	-0.564 ± 3.4	U	0.547 ± 3.88	U	300000
Ruthenium-106	-3.24 ± 18.6	U	-13.9 ± 38.1	U	-8.59 ± 17.1	U	-1.22 ± 17	U	30000
Thorium-231	15.5 ± 11.2	U	-6.88 ± 24.4	U	2.25 ± 10.3	U	-0.916 ± 10.4	U	300
Thorium-232	1.59 ± 7.93	U	10.9 ± 13.6	U	7.95 ± 5.68		6.16 ± 6.74		500000
Thorium-234	207 ± 184		132 ± 373	U	61.4 ± 168	U	115 ± 178	U	50000
Tritium	-29.9 ± 149000	U	-89 ± 143000	U	60 ± 157000	U	-59 ± 144000	U	10000000
Uranium-235	10.9 ± 13.2	U	13.5 ± 31.3	U	9.91 ± 18.4	U	13.5 ± 12.5	U	3000
Uranium-238	207 ± 184		132 ± 373	U	61.4 ± 168	U	115 ± 178	U	3000
Yttrium-88	4.41 ± 6.21	U	-1.96 ± 11	U	-0.168 ± 2.71	U	-0.0877 ± 2.72	U	100000
Zirconium-95	1.71 ± 5.18	U	-1.16 ± 9.27	U	2.67 ± 4.13	U	0.032 ± 4.49	U	200000

NOTE: U = The analyte was analyzed for, but not detected, below this concentration. For organic and inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the decision level.

NE = Not Established

TABLE D-8. Permitted Sanitary Outfalls, December 2000
(All results reported in milligrams per liter [mg/L] unless otherwise noted.)

Permit Number:	2069A	2069F	2069G	2069I	2069K	Regulatory
Station:	WW001	WW006	WW007	WW008	WW0011	Limit
Date Collected:	12/19/00	12/19/00	12/19/00	12/19/00	12/19/00	COA
Sample ID:	54419	54420	54421	54422	54423	(mg/L)
Analyte						
Aluminum	0.0336	0.238	0.879	0.228	0.0291	900
Arsenic	0.0129	0.0103	0.00457	0.0079	0.0136	0.051
Cadmium	0.000272	0.000343	0.000251	0.000251	0.000251	0.5
Chromium	0.0018	0.0012	0.000781	0.00105	0.00169	4.1
Copper	0.11	0.0173	0.00267	0.0106	0.0304	5.3
Lead	0.00344	0.00344	0.00344	0.00344	0.00344	1
Molybdenum	0.0137	0.0148	0.000594	0.0802	0.143	2
Nickel	0.00256	0.0344	0.00235	0.00145	0.00116	2
Selenium	0.00309	0.0031	0.00309	0.00309	0.00309	0.46
Silver	0.000197	0.00153	0.000197	0.000197	0.0004	5
Zinc	0.0757	0.0574	0.00353	0.0618	0.0545	2.2
Boron	0.0849	0.199	0.00679	0.0605	0.141	NE
Fluoride	0.718	1.57	7.95	4.4	0.466	36

Permit Number:	2069A	2069F	2069G	2069I	2069K	Regulatory
Station:	WW001	WW006	WW007	WW008*	WW0011	Limit
Date Collected:	12/20/00	12/20/00	12/20/00	12/20/00	12/20/00	COA
Sample ID:	54426	54427	54428	54429	54430	(mg/L)
Analyte						
Aluminum	0.0478	0.11	0.0856	0.0069	0.00889	900
Arsenic	0.0114	0.0136	0.00457	0.0116	0.0107	0.051
Cadmium	0.000251	0.000251	0.000251	0.000251	0.000251	0.5
Chromium	0.000781	0.000781	0.0015	0.0012	0.000781	4.1
Copper	0.0432	0.0165	0.00267	0.0173	0.0226	5.3
Lead	0.00344	0.00344	0.00344	0.00344	0.00344	1
Molybdenum	0.0238	0.0208	0.000594	0.0273	0.114	2
Nickel	0.00175	0.00317	0.000834	0.0101	0.00142	2
Selenium	0.00309	0.00309	0.00309	0.00309	0.00309	0.46
Silver	0.000197	0.000197	0.000197	0.000197	0.00083	5
Zinc	0.0539	0.035	0.00281	0.0486	0.0349	2.2
Boron	0.192	0.336	0.00857	0.077	0.123	NE
Fluoride	0.617	0.753	7.02	3.51	0.288	36

NOTE: COA = City of Albuquerque
NE = Not Established

TABLE D-9. Summary of Sanitary Outfalls of Radiological Analyses, September 2000
(All results reported in picocuries per liter [pCi/L] unless otherwise noted.)

Permit Number:	**2069A**		**2069F**		**2069I**		**2069K**		**Regulatory Limit 10 CFR 20**
Station:	**WW001**		**WW006**		**WW008**		**WW0011**		
Date Collected:	**12/19/00**		**12/19/00**		**12/19/00**		**12/19/00**		
Sample ID:	**54419**		**54420**		**54422**		**54423**		
Analyte									
Actinium-228	4.68 ± 14.4	U	0 ± 16	U	9.38 ± 7.38	U	10.1 ± 10.2	U	300000
Americium-241	-7.99 ± 14.7	U	-1.73 ± 14.4	U	0.481 ± 13.3	U	2.24 ± 4.43	U	200
Cerium-144	4.33 ± 9.33	U	-6.77 ± 11.7	U	2.22 ± 11.1	U	0.0195 ± 12.8	U	30000
Cesium-134	-0.601 ± 1.74	U	-1.45 ± 1.92	U	-1.84 ± 2.01	U	-6.4 ± 2.84	U	9000
Cesium-137	1.26 ± 3.79	U	-1.68 ± 2	U	5.48 ± 3.18		3.87 ± 3.44	U	10000
Chromium-51	-11.8 ± 20.1	U	2.56 ± 31	U	-19.9 ± 24.1	U	6.31 ± 29.9	U	5000000
Cobalt-60	-0.942 ± 1.6	U	0.789 ± 2.1	U	-1.28 ± 2.24	U	0.626 ± 3.24	U	30000
Gross Alpha	1.96 ± 2.01		2.18 ± 1.5		1.89 ± 1.18		1.99 ± 1.61		NE
Gross Beta	17 ± 2.88		23.3 ± 2.85		7.67 ± 1.57		10.6 ± 1.79		NE
Iron-59	2.48 ± 4.16	U	-3.06 ± 6.04	U	1.01 ± 4.93	U	-5.87 ± 6.89	U	100000
Lead-212	1.12 ± 5.54	U	3.22 ± 6.46	U	0 ± 3.61	U	0.825 ± 8.22	U	20000
Lead-214	3.15 ± 3.56	U	1.45 ± 7.43	U	0 ± 4.4	U	7.07 ± 9.55	U	1000000
Potassium-40	41.6 ± 45.9		20 ± 52.1	U	60.7 ± 45.3		57.7 ± 32.4	U	40000
Radium-226	2.58 ± 8.02	U	7.33 ± 9.14		0 ± 11.2	U	0 ± 5.92	U	600
Radium-228	4.68 ± 14.4	U	0 ± 16	U	9.38 ± 7.38	U	10.1 ± 10.2	U	600
Ruthenium-103	0.428 ± 2.02	U	-0.824 ± 2.85	U	0.656 ± 2.45	U	-1.14 ± 3.29	U	300000
Ruthenium-106	-6.48 ± 14.3	U	-3.3 ± 17.8	U	-1.89 ± 16.7	U	2.77 ± 24.9	U	30000
Thorium-231	3.38 ± 8.37	U	5.28 ± 10.1	U	7.26 ± 9.92	U	16.8 ± 11.7	U	300
Thorium-232	1.1 ± 5.42	U	3.12 ± 6.27	U	0 ± 3.53	U	0.808 ± 8.04	U	500000
Thorium-234	171 ± 258	U	40.4 ± 191	U	18.4 ± 202	U	54.5 ± 100	U	50000
Tritium	-156 ± 191000	U	-328 ± 186000	U	-144 ± 191000	U	-208 ± 188000	U	10000000
Uranium-235	6.17 ± 17.2	U	1.18 ± 21.8	U	5.18 ± 11.3	U	0 ± 29.1	U	3000
Uranium-238	171 ± 258		40.4 ± 191	U	18.4 ± 202	U	54.5 ± 100	U	3000
Yttrium-88	1.63 ± 1.8	U	0.718 ± 2.45	U	-0.571 ± 2.25	U	-0.797 ± 2.3	U	100000
Zirconium-95	1.92 ± 2.98	U	2.57 ± 4.58	U	2.73 ± 5.98	U	3.21 ± 6.01	U	200000

NOTE: U = The analyte was analyzed for, but not detected, below this concentration. For organic and inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the decision level.
NE = Not Established

TABLE D-10. Summary of Sanitary Outfalls of Volatile Organic Compound Analyses, December 2000
(All results reported in micrograms per liter [µg/L] unless otherwise noted.)

Permit Number:	**2069A**		**2069F**		**2069I**		**2069K**	
Station:	**WW001**		**WW006**		**WW008**		**WW011**	
Date Collected:	**12/19/00**		**12/19/00**		**12/19/00**		**12/19/00**	
Sample ID:	**54419**		**54420**		**54422**		**54423**	
Analyte								
1,1,1-Trichloroethane	0.18	HU	0.18	HU	0.18	HU	0.18	HU
1,1,2,2-Tetrachloroethane	0.15	HU	0.15	HU	0.15	HU	0.15	HU
1,1,2-Trichloroethane	0.11	HU	0.11	HU	0.11	HU	0.11	HU
1,1-Dichloroethane	0.07	HU	0.07	HU	0.07	HU	0.07	HU
1,1-Dichloroethylene	0.28	HU	0.28	HU	0.28	HU	0.28	HU
1,2-Dichloroethane	0.14	HU	0.14	HU	0.14	HU	0.14	HU
1,2-Dichloroethylene (total)	0.47	HU	0.47	HU	0.47	HU	0.47	HU
1,2-Dichloropropane	0.16	HU	0.16	HU	0.16	HU	0.16	HU
2-Butanone	2.24	HJ	2.64	HJ	1.39	HJ	0.81	HU
2-Hexanone	0.79	HU	0.79	HU	0.79	HU	0.79	HU
4-Methyl-2-pentanone	0.7	HU	0.7	HU	0.7	HU	0.7	HU
Acetone	42.4	HB	43.1	HB	21.7	HB	4.92	HBJ
Benzene	0.14	HU	0.254	HJ	0.14	HU	0.14	HU
Bromodichloromethane	0.15	HU	0.15	HU	0.15	HU	0.15	HU
Bromoform	0.36	HJ	0.1	HU	0.287	HJ	0.349	HJ
Bromomethane	0.24	HU	0.24	HU	0.24	HU	0.24	HU
Carbon tetrachloride	0.16	HU	0.16	HU	0.16	HU	0.16	HU
Chlorobenzene	0.2	HU	0.2	HU	0.2	U	0.2	HU
Chloroethane	0.32	HU	0.32	HU	0.32	HU	0.32	HU
Chloroform	0.17	HU	0.237	HJ	0.17	HU	0.269	HJ
Chloromethane	0.21	HU	0.21	HU	0.21	HU	0.21	HU
cis-1,2-Dichloroethylene	0.18	HU	0.18	HU	0.18	HU	0.18	HU
cis-1,3-Dichloropropylene	0.18	HU	0.18	HU	0.18	HU	0.18	HU
Dibromochloromethane	0.16	HU	0.16	HU	0.313	HJ	0.16	HU
Ethylbenzene	0.15	HU	0.15	HU	0.15	HU	0.15	HU
Methylene chloride	0.63	HU	0.63	HU	0.63	HU	0.63	HU
Toluene	0.22	HU	0.22	HU	0.327	HJ	0.22	HU
trans-1,2-Dichloroethylene	0.31	HU	0.31	HU	0.31	HU	0.31	HU
trans-1,3-Dichloropropylene	0.17	HU	0.17	HU	0.17	HU	0.17	HU
Trichloroethylene	0.16	HU	0.16	HU	0.16	HU	0.16	HU
Vinyl chloride	0.26	HU	0.26	HU	0.26	HU	0.26	HU

NOTE: B = The analyte was found in the blank above the efective MDl (organics), or the effective PQL (inorganics)
H = Holding time was exceeded
J = Estimated value, the analyte concentration fell above the effective MDL and below the effective PQL
U= The analyte was analyzed for, but not detected, below this concentration. For organic and inorganic analytes the result is less than the effective MDL. For radiochemical analytes the result is less than the decision level.

TABLE D-11. Summary Statistics for Sanitary Outfalls, 2000
(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
2069-A	**WW001**	Aluminum	8	0.046	0.024	0.0234	0.0815	900
		Arsenic	8	0.016	0.004	0.0114	0.0213	0.051
		Cadmium	8	0.001	0.000	0.000251	0.000631	0.5
		Chromium	8	0.002	0.001	0.000781	0.00384	4.1
		Copper	8	0.040	0.030	0.0192	0.11	5.3
		Lead	8	0.003	0.001	0.00183	0.00344	1
		Molybdenum	8	0.043	0.046	0.00933	0.137	2
		Nickel	8	0.003	0.000	0.00175	0.00309	2
		Selenium	8	0.003	0.000	0.00236	0.00331	0.46
		Silver	8	0.001	0.002	0.000197	0.0046	5
		Zinc	8	0.063	0.017	0.0475	0.0986	2.2
		Cyanide, Total (µg/L)	4	1.050	0.637	0.24	1.7	0.45
		Boron	8	0.140	0.030	0.0849	0.192	NE
		Fluoride	8	0.695	0.055	0.617	0.756	36
2069F-4	**WW006**	Aluminum	8	0.240	0.155	0.0402	0.521	900
		Arsenic	8	0.016	0.005	0.00991	0.0232	0.051
		Cadmium	8	0.001	0.000	0.000251	0.000631	0.5
		Chromium	8	0.002	0.001	0.000781	0.00471	4.1
		Copper	8	0.019	0.014	0.00779	0.0519	5.3
		Lead	8	0.003	0.003	0.00183	0.00937	1
		Molybdenum	8	0.031	0.010	0.0148	0.0447	2
		Nickel	8	0.007	0.011	0.00309	0.0344	2
		Selenium	8	0.003	0.000	0.00236	0.00337	0.46
		Silver	8	0.001	0.001	0.000197	0.00177	5
		Zinc	8	0.056	0.026	0.0277	0.0987	2.2
		Cyanide, Total (µg/L)	1	2.760		2.76	2.76	0.45
		Boron	8	0.248	0.055	0.197	0.336	NE
		Fluoride	8	0.804	0.318	0.525	1.57	36

NOTE: COA = City of Albuquerque
NE = Not established
µg/L = microgram per liter
Std Dev = Standard deviation

TABLE D-11. Summary Statistics for Sanitary Outfalls, 2000 *(continued)*
(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
2069G-2	**WW007**	Aluminum	8	0.210	0.289	0.0234	0.879	900
		Arsenic	8	0.003	0.001	0.00257	0.00457	0.051
		Cadmium	8	0.001	0.000	0.000251	0.000631	0.5
		Chromium	8	0.002	0.002	0.000781	0.00728	4.1
		Copper	8	0.002	0.000	0.00184	0.00267	5.3
		Lead	8	0.003	0.001	0.00183	0.00408	1
		Molybdenum	8	0.005	0.004	0.000594	0.0111	2
		Nickel	8	0.003	0.001	0.000834	0.00406	2
		Selenium	8	0.003	0.000	0.00236	0.00309	0.46
		Silver	8	0.001	0.001	0.000197	0.00189	5
		Zinc	8	0.009	0.009	0.00281	0.0268	2.2
		Cyanide, Total (µg/L)	5	2.872	0.250	2.76	3.32	0.45
		Boron	8	0.054	0.129	0.00609	0.372	NE
		Fluoride	14	7.019	3.305	1.12	12	36
2069I-3	**WW008**	Aluminum	8	0.091	0.098	0.0069	0.228	900
		Arsenic	8	0.012	0.004	0.0079	0.0186	0.051
		Cadmium	8	0.001	0.000	0.000251	0.000631	0.5
		Chromium	8	0.002	0.001	0.00105	0.00405	4.1
		Copper	8	0.014	0.004	0.00803	0.0185	5.3
		Lead	8	0.003	0.001	0.00183	0.00427	1
		Molybdenum	8	0.080	0.144	0.0111	0.43	2
		Nickel	8	0.004	0.003	0.00145	0.0101	2
		Selenium	8	0.003	0.000	0.00236	0.00309	0.46
		Silver	8	0.001	0.001	0.000197	0.00178	5
		Zinc	8	0.057	0.022	0.038	0.106	2.2
		Cyanide, Total (µg/L)	5	3.122	0.809	2.76	4.57	0.45
		Boron	8	0.101	0.058	0.0605	0.243	NE
		Fluoride	8	4.521	1.177	3.28	6.38	36

NOTE: COA = City of Albuquerque
NE = Not established
µg/L = microgram per liter
Std Dev = Standard deviation

TABLE D-11. Summary Statistics for Sanitary Outfalls, 2000 *(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
2069K	**WW011**	Aluminum	8	0.105	0.132	0.00889	0.373	900
		Arsenic	8	0.013	0.003	0.00831	0.0157	0.051
		Cadmium	8	0.001	0.000	0.000251	0.000631	0.5
		Chromium	8	0.002	0.001	0.000781	0.00298	4.1
		Copper	8	0.027	0.010	0.00963	0.0447	5.3
		Fluoride	8	0.496	0.101	0.288	0.61	36
		Lead	8	0.003	0.001	0.00183	0.00438	1
		Molybdenum	8	0.133	0.083	0.0169	0.248	2
		Nickel	8	0.003	0.001	0.00116	0.00362	2
		Selenium	8	0.003	0.000	0.00236	0.00309	0.46
		Silver	8	0.004	0.007	0.0004	0.0205	5
		Zinc	8	0.089	0.063	0.0243	0.199	2.2
		Boron	8	0.146	0.015	0.123	0.166	NE
		Fluoride	8	0.496	0.101	0.288	0.61	36

NOTE: COA = City of Albuquerque
NE = Not Established
Std Dev = Standard deviation

TABLE D-12. Summary Statistics for Sanitary Outfalls, 2000

(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)
2069-A	**WW001**	Actinium-228	4	4.417	5.714	0	12.4	300000
		Americium-241	4	-1.760	5.657	-7.99	5.74	200
		Cerium-144	4	-2.863	6.492	-10.9	4.33	30000
		Cesium-134	4	-0.138	1.096	-1.47	0.808	9000
		Cesium-137	4	2.253	1.501	0.681	3.61	10000
		Chromium-51	4	-1.689	9.003	-11.8	9.69	5000000
		Cobalt-60	4	-0.219	0.487	-0.942	0.117	30000
		Gross Alpha	4	3.460	2.136	1.53	6.13	NE
		Gross Beta	4	16.825	2.593	13.4	19.7	NE
		Iron-59	4	1.458	1.212	-0.0467	2.48	100000
		Lead-212	4	1.645	0.529	1.12	2.37	20000
		Lead-214	4	3.295	2.854	0	6.97	1000000
		Potassium-40	4	35.980	24.900	2.12	62	40000
		Radium-226	4	3.408	2.296	1.59	6.77	600
		Radium-228	4	4.417	5.714	0	12.4	600
		Ruthenium-103	4	0.039	0.885	-0.789	1.1	300000
		Ruthenium-106	4	-0.608	9.108	-6.48	12.9	30000
		Thorium-231	4	2.438	9.480	-4.69	15.5	300
		Thorium-232	4	1.610	0.521	1.1	2.33	500000
		Thorium-234	4	134.000	91.706	0	207	50000
		Tritium	4	-119.975	95.628	-238	-29.9	10000000
		Uranium-235	4	7.637	4.533	1.88	11.6	3000
		Uranium-238	4	134.000	91.706	0	207	3000
		Yttrium-88	4	2.518	1.302	1.63	4.41	100000
		Zirconium-95	4	1.450	0.596	0.58	1.92	200000

NOTE: NE = Not Established

TABLE D-12. Summary Statistics for Sanitary Outfalls, 2000 (*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)
2069F-4	**WW006**	Actinium-228	4	8.467	10.421	0	21.7	300000
		Americium-241	4	8.685	15.095	-4.23	28.6	200
		Cerium-144	4	-1.350	4.616	-6.77	3.42	30000
		Cesium-134	4	-0.207	1.027	-1.45	1.05	9000
		Cesium-137	4	1.950	3.483	-1.68	5.26	10000
		Chromium-51	4	-2.220	11.438	-13.2	11.6	5000000
		Cobalt-60	4	1.464	0.959	0.495	2.37	30000
		Gross Alpha	3	2.457	1.229	1.39	3.8	NE
		Gross Beta	3	19.000	3.820	16	23.3	NE
		Iron-59	4	0.335	2.748	-3.06	2.71	100000
		Lead-212	4	4.615	4.724	0	11.2	20000
		Lead-214	4	2.510	2.456	0	5.76	1000000
		Potassium-40	4	21.635	16.366	7.24	44.9	40000
		Radium-226	4	7.465	4.971	2.86	14.4	600
		Radium-228	4	8.467	10.421	0	21.7	600
		Ruthenium-103	4	-0.420	0.444	-0.824	-0.00748	300000
		Ruthenium-106	4	-6.295	7.236	-13.9	2.32	30000
		Thorium-231	4	2.955	7.623	-6.88	11.4	300
		Thorium-232	4	4.495	4.597	0	10.9	500000
		Thorium-234	4	75.100	65.524	0	132	50000
		Tritium	4	-184.250	114.171	-328	-89	10000000
		Uranium-235	4	10.159	11.570	0.855	25.1	3000
		Uranium-238	4	75.100	65.524	0	132	3000
		Yttrium-88	4	-0.228	1.237	-1.96	0.718	100000
		Zirconium-95	4	-0.155	2.605	-3.3	2.57	200000

NOTE: NE = Not Established
Std Dev = Standard deviation

TABLE D-12. Summary Statistics for Sanitary Outfalls, 2000 *(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)
2069I-3	**WW008**	Actinium-228	4	9.408	5.474	4.76	17.1	300000
		Americium-241	3	3.679	5.329	-0.185	11.4	200
		Cerium-144	4	6.625	3.050	2.22	9.23	30000
		Cesium-134	4	-0.352	1.027	-1.84	0.404	9000
		Cesium-137	4	1.443	2.762	-0.721	5.48	10000
		Chromium-51	4	-6.013	23.213	-30.9	18.5	5000000
		Cobalt-60	4	-1.360	1.227	-3.06	-0.157	30000
		Gross Alpha	4	3.200	1.199	1.89	4.72	NE
		Gross Beta	4	9.200	1.965	7.67	12	NE
		Iron-59	4	1.073	1.341	-0.073	2.97	100000
		Lead-212	4	4.385	3.495	0	8.2	20000
		Lead-214	4	3.023	2.998	0	6.66	1000000
		Potassium-40	4	36.550	21.453	10.1	60.7	40000
		Radium-226	4	7.004	10.464	0	22.3	600
		Radium-228	4	9.408	5.474	4.76	17.1	600
		Ruthenium-103	4	-0.589	1.355	-2.48	0.656	300000
		Ruthenium-106	4	2.735	11.132	-8.59	17.6	30000
		Thorium-231	4	2.261	3.533	-0.277	7.26	300
		Thorium-232	4	4.277	3.392	0	7.95	500000
		Thorium-234	4	68.450	87.565	0	194	50000
		Tritium	4	-55.650	96.580	-144	60	10000000
		Uranium-235	4	8.258	5.128	3.24	14.7	3000
		Uranium-238	4	68.450	87.565	0	194	3000
		Yttrium-88	4	0.387	1.038	-0.571	1.8	100000
		Zirconium-95	4	2.500	0.513	1.74	2.86	200000

NOTE: NE = Not Established

Std Dev = Standard deviation

TABLE D-12. Summary Statistics for Sanitary Outfalls, 2000 (*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)
2069K	**WW011**	Actinium-228	4	7.030	4.083	1.06	10.1	300000
		Americium-241	4	-1.370	2.653	-3.6	2.24	200
		Cerium-144	4	2.557	5.644	-3.99	8.68	30000
		Cesium-134	4	-1.824	3.096	-6.4	0.228	9000
		Cesium-137	4	1.849	1.523	0.214	3.87	10000
		Chromium-51	4	7.720	12.366	-3.64	25.2	5000000
		Cobalt-60	4	0.350	0.537	-0.453	0.656	30000
		Gross Alpha	4	1.882	1.232	0.369	3.38	NE
		Gross Beta	4	11.753	2.854	9.41	15.9	NE
		Iron-59	4	-2.612	2.956	-5.87	1.3	100000
		Lead-212	4	3.996	2.547	0.825	6.36	20000
		Lead-214	4	4.675	4.092	0	8.98	1000000
		Potassium-40	4	39.450	27.738	0	59.9	40000
		Radium-226	4	3.822	5.720	0	12.1	600
		Radium-228	4	7.030	4.083	1.06	10.1	600
		Ruthenium-103	4	-0.009	0.765	-1.14	0.547	300000
		Ruthenium-106	4	2.930	2.978	-1.22	5.28	30000
		Thorium-231	4	6.311	10.210	-3.84	16.8	300
		Thorium-232	4	3.905	2.479	0.808	6.16	500000
		Thorium-234	4	107.875	37.891	54.5	144	50000
		Tritium	4	-67.350	119.891	-208	84	10000000
		Uranium-235	4	5.957	7.396	-0.772	13.5	3000
		Uranium-238	4	107.875	37.891	54.5	144	3000
		Yttrium-88	4	-0.299	1.085	-1.42	1.11	100000
		Zirconium-95	4	1.441	2.448	-1.27	3.79	200000

NOTE: NE = Not Established
Std Dev = Standard deviation

TABLE D-13. Summary Statistics for Sanitary Outfalls, 2000

(All results in milligrams per liter (µg/L) unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Average	Std Dev	Min	Max
2069-A	**WW001**	1,1,1-Trichloroethane	2	0.137	0.062	0.093	0.18
		1,1,2,2-Tetrachloroethane	2	0.212	0.087	0.15	0.273
		1,1,2-Trichloroethane	2	0.152	0.059	0.11	0.193
		1,1-Dichloroethane	2	0.085	0.021	0.07	0.099
		1,1-Dichloroethylene	2	0.19	0.13	0.09	0.28
		1,2-Dichloroethane	2	0.149	0.013	0.14	0.158
		1,2-Dichloroethylene (total)	1	0.47		0.47	0.47
		1,2-Dichloropropane	2	0.12	0.06	0.07	0.16
		2-Butanone	2	2.16	0.12	2.07	2.24
		2-Hexanone	2	1.27	0.67	0.79	1.74
		4-Methyl-2-pentanone	2	0.698	0.003	0.696	0.7
		Acetone	2	41.1	1.838	39.8	42.4
		Benzene	2	0.145	0.006	0.14	0.149
		Bromodichloromethane	2	0.087	0.089	0.024	0.15
		Bromoform	2	0.223	0.194	0.085	0.36
		Bromomethane	2	0.434	0.274	0.24	0.628
		Carbon tetrachloride	2	0.142	0.025	0.124	0.16
		Chlorobenzene	2	0.402	0.285	0.2	0.603
		Chloroethane	2	0.23	0.13	0.14	0.32
		Chloroform	2	0.184	0.020	0.17	0.198
		Chloromethane	2	0.195	0.022	0.179	0.21
		cis-1,2-Dichloroethylene	2	0.155	0.036	0.129	0.18
		cis-1,3-Dichloropropylene	2	0.108	0.103	0.035	0.18
		Dibromochloromethane	2	0.125	0.050	0.089	0.16
		Ethylbenzene	2	0.101	0.070	0.051	0.15
		Methylene chloride	2	0.801	0.241	0.63	0.971
		Toluene	2	0.241	0.030	0.22	0.262
		trans-1,2-Dichloroethylene	2	0.208	0.145	0.105	0.31
		trans-1,3-Dichloropropylene	2	0.138	0.045	0.106	0.17
		Trichloroethylene	2	0.16	0.01	0.15	0.16
		Vinyl chloride	2	0.178	0.116	0.096	0.26

NOTE: Std Dev = Standard deviation

TABLE D-13. Summary Statistics for Sanitary Outfalls, 2000 *(continued)*
(All results in milligrams per liter (µg/L) unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Average	Std Dev	Min	Max
2069F-4	**WW006**	1,1,1-Trichloroethane	2	0.137	0.062	0.093	0.18
		1,1,2,2-Tetrachloroethane	2	0.212	0.087	0.15	0.273
		1,1,2-Trichloroethane	2	0.152	0.059	0.11	0.193
		1,1-Dichloroethane	2	0.085	0.021	0.07	0.099
		1,1-Dichloroethylene	2	0.19	0.13	0.09	0.28
		1,2-Dichloroethane	2	0.149	0.013	0.14	0.158
		1,2-Dichloroethylene (total)	1	0.47		0.47	0.47
		1,2-Dichloropropane	2	0.12	0.06	0.07	0.16
		2-Butanone	2	3.435	1.124	2.64	4.23
		2-Hexanone	2	1.27	0.67	0.79	1.74
		4-Methyl-2-pentanone	2	0.698	0.003	0.696	0.7
		Acetone	2	45.30	3.11	43.1	47.5
		Benzene	2	0.202	0.074	0.149	0.254
		Bromodichloromethane	2	0.087	0.089	0.024	0.15
		Bromoform	2	0.093	0.011	0.085	0.1
		Bromomethane	2	0.434	0.274	0.24	0.628
		Carbon tetrachloride	2	0.142	0.025	0.124	0.16
		Chlorobenzene	2	0.402	0.285	0.2	0.603
		Chloroethane	2	0.23	0.13	0.14	0.32
		Chloroform	2	0.218	0.028	0.198	0.237
		Chloromethane	2	0.195	0.022	0.179	0.21
		cis-1,2-Dichloroethylene	2	0.155	0.036	0.129	0.18
		cis-1,3-Dichloropropylene	2	0.108	0.103	0.035	0.18
		Dibromochloromethane	2	0.125	0.050	0.089	0.16
		Ethylbenzene	2	0.101	0.070	0.051	0.15
		Methylene chloride	2	0.801	0.241	0.63	0.971
		Toluene	2	0.241	0.030	0.22	0.262
		trans-1,2-Dichloroethylene	2	0.208	0.145	0.105	0.31
		trans-1,3-Dichloropropylene	2	0.138	0.045	0.106	0.17
		Trichloroethylene	2	0.155	0.007	0.15	0.16
		Vinyl chloride	2	0.178	0.116	0.096	0.26

NOTE: Std Dev = Standard deviation

TABLE D-13. Summary Statistics for Sanitary Outfalls, 2000 *(continued)*

(All results in milligrams per liter (μg/L) unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Average	Std Dev	Min	Max
2069I-3	**WW008**	1,1,1-Trichloroethane	2	0.137	0.062	0.093	0.18
		1,1,2,2-Tetrachloroethane	2	0.212	0.087	0.15	0.273
		1,1,2-Trichloroethane	2	0.152	0.059	0.11	0.193
		1,1-Dichloroethane	2	0.085	0.021	0.07	0.099
		1,1-Dichloroethylene	2	0.19	0.13	0.09	0.28
		1,2-Dichloroethane	2	0.149	0.013	0.14	0.158
		1,2-Dichloroethylene (total)	1	0.47		0.47	0.47
		1,2-Dichloropropane	2	0.12	0.06	0.07	0.16
		2-Butanone	2	1.55	0.22	1.39	1.7
		2-Hexanone	2	1.27	0.67	0.79	1.74
		4-Methyl-2-pentanone	2	0.698	0.003	0.696	0.7
		Acetone	2	74.85	75.165	21.7	128.0
		Benzene	2	0.145	0.006	0.14	0.149
		Bromodichloromethane	2	0.087	0.089	0.024	0.15
		Bromoform	2	0.186	0.143	0.085	0.287
		Bromomethane	2	0.434	0.274	0.24	0.628
		Carbon tetrachloride	2	0.142	0.025	0.124	0.16
		Chlorobenzene	2	0.402	0.285	0.2	0.603
		Chloroethane	2	0.23	0.13	0.14	0.32
		Chloroform	2	0.184	0.020	0.17	0.198
		Chloromethane	2	0.195	0.022	0.179	0.21
		cis-1,2-Dichloroethylene	2	0.155	0.036	0.129	0.18
		cis-1,3-Dichloropropylene	2	0.108	0.103	0.035	0.18
		Dibromochloromethane	2	0.201	0.158	0.089	0.313
		Ethylbenzene	2	0.101	0.070	0.051	0.15
		Methylene chloride	2	0.801	0.241	0.63	0.971
		Toluene	2	0.295	0.046	0.262	0.327
		trans-1,2-Dichloroethylene	2	0.208	0.145	0.105	0.31
		trans-1,3-Dichloropropylene	2	0.138	0.045	0.106	0.17
		Trichloroethylene	2	0.16	0.01	0.15	0.16
		Vinyl chloride	2	0.178	0.116	0.096	0.26

NOTE: Std Dev = Standard deviation

TABLE D-13. Summary Statistics for Sanitary Outfalls, 2000 *(concluded)*
(All results in milligrams per liter (µg/L) unless otherwise noted.)

Permit No	Station	Analyte	Sample Size	Average	Std Dev	Min	Max
2069K	**WW011**	1,1,1-Trichloroethane	2	0.137	0.062	0.093	0.18
		1,1,2,2-Tetrachloroethane	2	0.212	0.087	0.15	0.273
		1,1,2-Trichloroethane	2	0.152	0.059	0.11	0.193
		1,1-Dichloroethane	2	0.085	0.021	0.07	0.099
		1,1-Dichloroethylene	2	0.19	0.13	0.09	0.28
		1,2-Dichloroethane	2	0.149	0.013	0.14	0.158
		1,2-Dichloroethylene (total)	1	0.47		0.47	0.47
		1,2-Dichloropropane	2	0.12	0.06	0.07	0.16
		2-Butanone	2	14.61	19.51	0.81	28.4
		2-Hexanone	2	1.27	0.67	0.79	1.74
		4-Methyl-2-pentanone	2	0.698	0.003	0.696	0.7
		Acetone	2	58.96	76.42	4.92	113.0
		Benzene	2	0.145	0.006	0.14	0.149
		Bromodichloromethane	2	0.087	0.089	0.024	0.15
		Bromoform	2	0.217	0.187	0.085	0.349
		Bromomethane	2	0.434	0.274	0.24	0.628
		Carbon tetrachloride	2	0.142	0.025	0.124	0.16
		Chlorobenzene	2	0.402	0.285	0.2	0.603
		Chloroethane	2	0.23	0.13	0.14	0.32
		Chloroform	2	0.234	0.050	0.198	0.269
		Chloromethane	2	0.195	0.022	0.179	0.21
		cis-1,2-Dichloroethylene	2	0.155	0.036	0.129	0.18
		cis-1,3-Dichloropropylene	2	0.108	0.103	0.035	0.18
		Dibromochloromethane	2	0.125	0.050	0.089	0.16
		Ethylbenzene	2	0.101	0.070	0.051	0.15
		Methylene chloride	2	0.801	0.241	0.63	0.971
		Toluene	2	0.241	0.030	0.22	0.262
		trans-1,2-Dichloroethylene	2	0.208	0.145	0.105	0.31
		trans-1,3-Dichloropropylene	2	0.138	0.045	0.106	0.17
		Trichloroethylene	2	0.16	0.01	0.15	0.16
		Vinyl chloride	2	0.178	0.116	0.096	0.26

NOTE: Std Dev = Standard deviation

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APPENDIX E

2000 Groundwater Contaminant Concentration Trends

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CONTENTS

TABLES

FIGURES

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E.1 INTRODUCTION

Appendix E provides both statistical information and graphical representation regarding trend groundwater contaminants that exceed the regulatory limit for the specific analyte during fiscal year 2000 (FY00). The FY00 data is presented in the context of historical values for the groundwater analyte concentrations at specific well locations. The summary statistics are provided to evaluate the significance of the exceedence of the regulatory limit during the FY00 reporting period (in light of the monitoring history for the analyte). In addition to the average (Avg), median (Med), and minimum/maximum values of the historical monitoring data, measures of the scatter of the data are provided in standard deviation (Std Dev, SD) and coefficient of variation (CV) terms. The CV statistic is a normalization of the Std Dev by the Avg value. This allows for comparison of the amount of scatter among different data sets for the same analyte as obtained from different monitor wells. The concentration values are plotted on graphs to provide a visual representation to determine the significance of the current contaminant values in context of the historical data for the well. The +1 SD and -1 SD lines are plotted on the graphs to illustrate extent of Std Dev from the Avg value of the data set. Trend lines are constructed on the graph using linear or second order polynomial regression analysis. Each data set was tested for linear or non-linear fit with the better of the two used to illustrate the data trend. The significance that can be attributed to these trend lines is related to the number of data points and the scatter of the data. Under ideal conditions, the trend lines can be used to infer future or expected data values.

Trichloroethene (TCE)

Four Environmental Restoration (ER) Project wells contained TCE concentrations above the maximum contaminant level (MCL) of 5 µg/L during FY00. Table E-1 shows the summary statistics of TCE concentrations for wells associated with the Technical Area V and the Tijeras Arroyo Groundwater (TAG).

Figures E-1 through E-4 show the sampling history for TCE concentrations for wells TA2-W-26, WYO-1, WYO-2, and LWDS-MW1. As shown in Figure E-1, the trend line for TA2-W-26 indicates a modest decrease in TCE concentrations over time. TCE concentrations in wells WYO-1, WYO-2, and LWDS-MW1 have historically increased; however, the non-linear trend for each of these wells show that concentrations may have peaked and appear to be leveling off or decreasing.

Nitrate

During FY00, groundwater samples from nine ER Project wells had nitrate concentrations above the MCL of 10 mg/L. Table E-2 shows the summary statistics of nitrate concentrations from historical samples collected from three separate ER operable unit wells (Canyons, TAG, and Technical Area V) that were affected.

TABLE E-1. Summary Statistics of Wells with TCE Concentrations Greater Than the MCL of 5 µg/L in FY00

Project	Well ID	Sample Size	Avg	Med	Std Dev	Min	Max	Range	CV	-1 SD	+1 SD
Units µg/L											
TAG	TA2-W-26	9	8.41	8.70	0.97	6.8	9.6	2.8	0.12	7.44	9.38
	WYO-1	13	5.36	5.60	1.12	2.9	6.8	3.9	0.21	4.24	6.47
	WYO-2	12	6.05	6.35	1.12	3.7	7.5	3.8	0.19	4.93	7.17
TAV	LWDS-MW1	14	18.81	19	3.17	14	23	9	0.17	15.65	21.98

NOTE: µg/L = microgram per liter
MCL = maximum contaminant level
CV = coefficient of variance

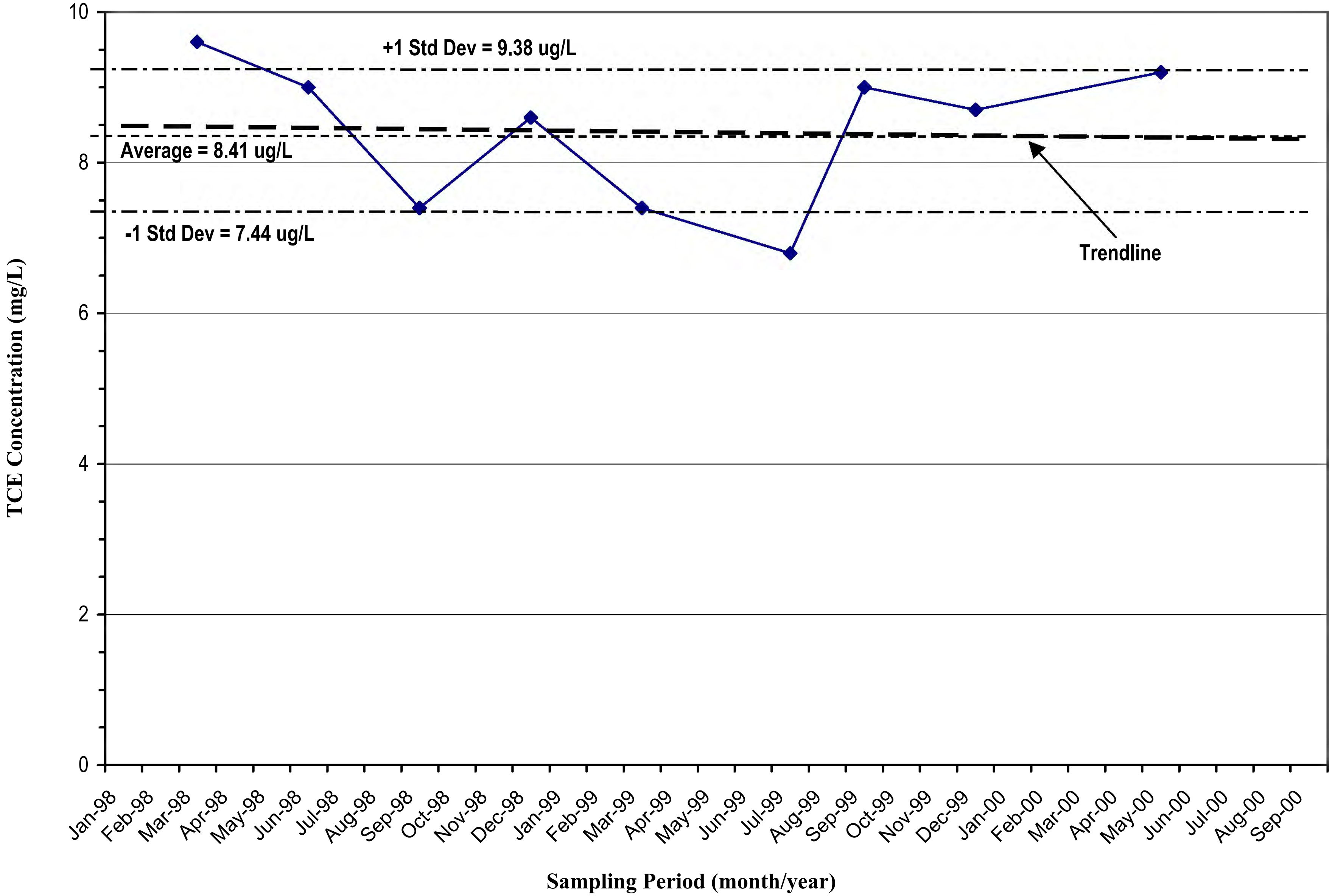

FIGURE E-1. TCE Concentrations for Well TA2-W-26

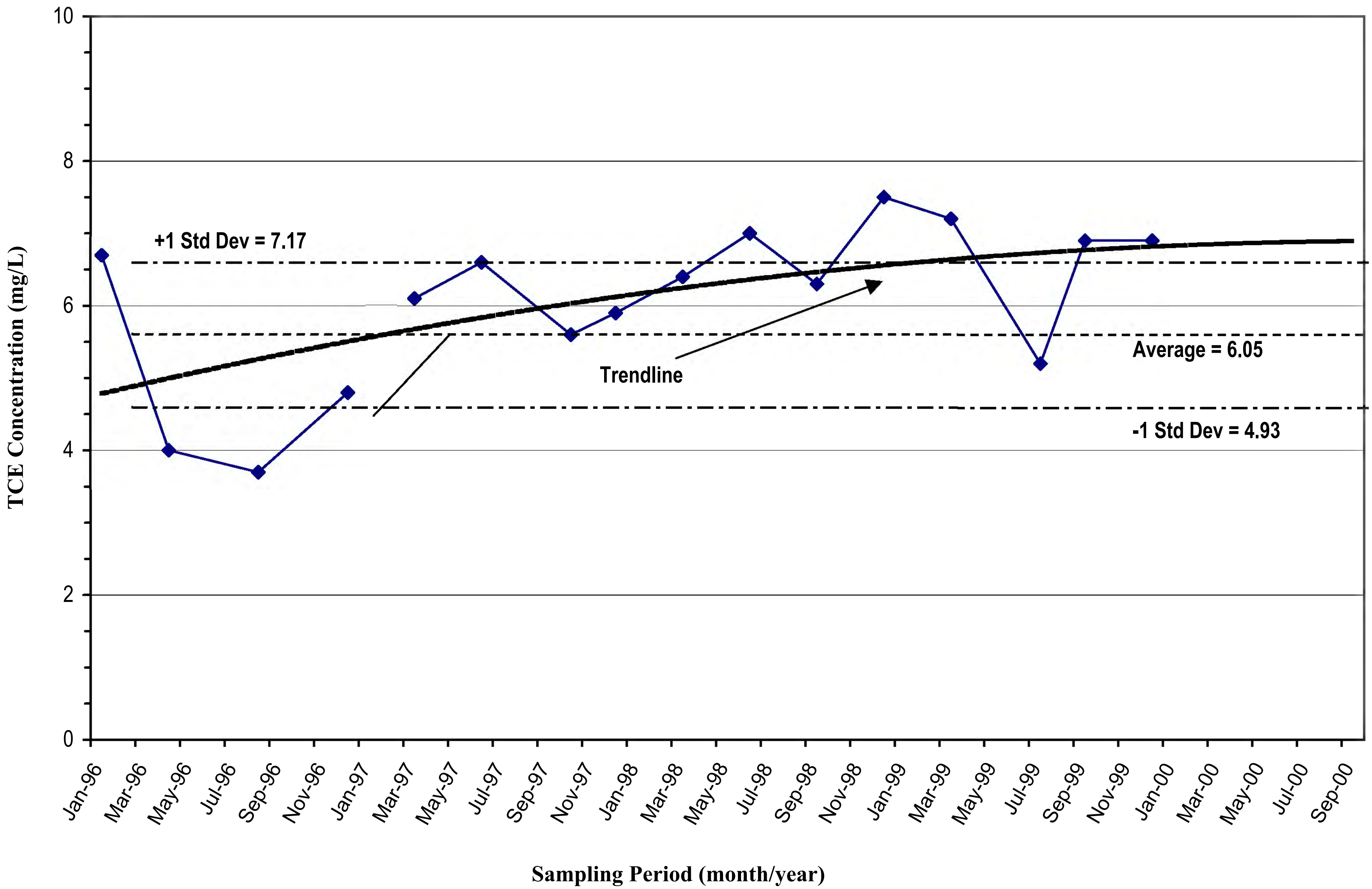

FIGURE E-3. TCE Concentrations for Well WYO-2

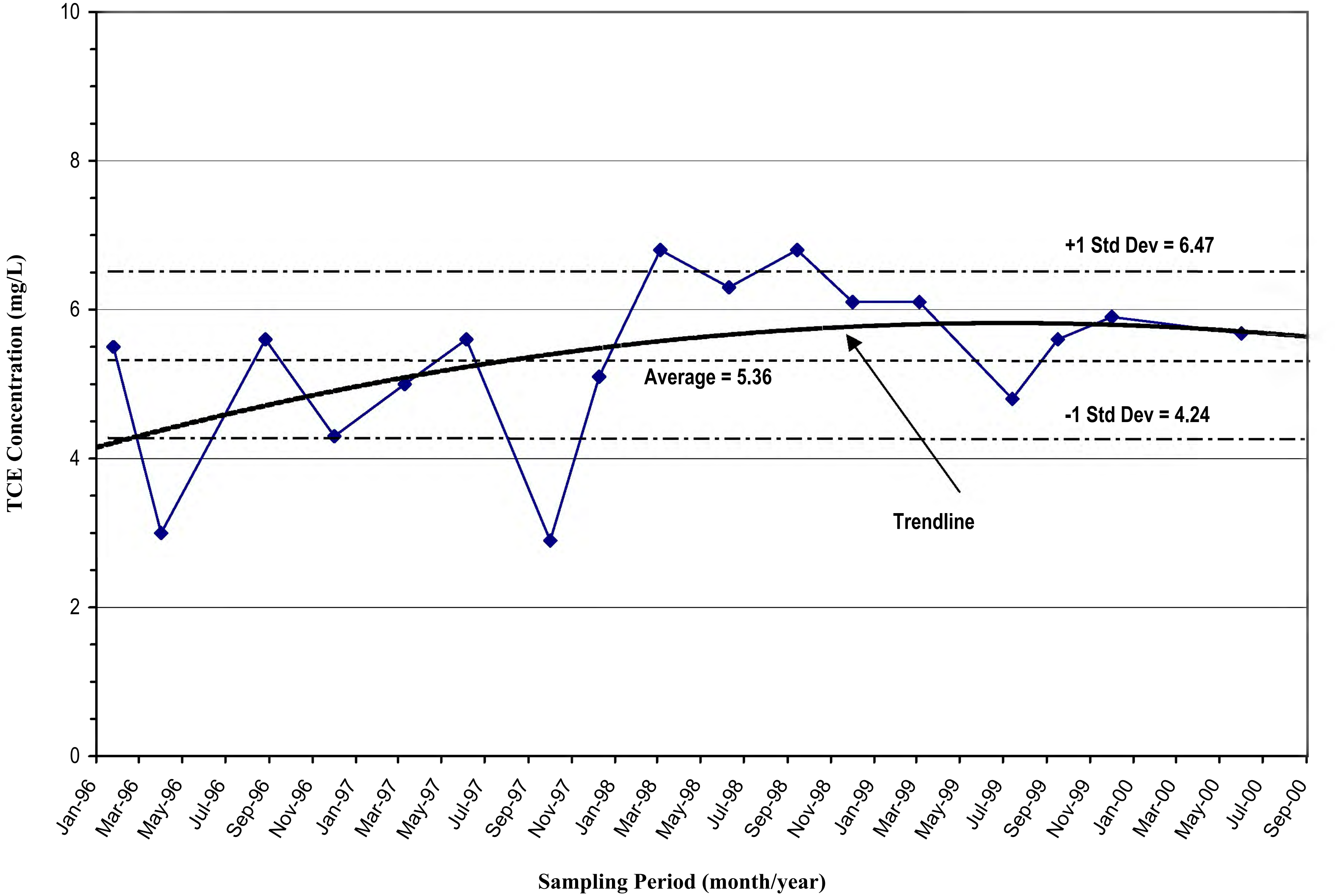

FIGURE E-2. TCE Concentrations for Well WYO-1

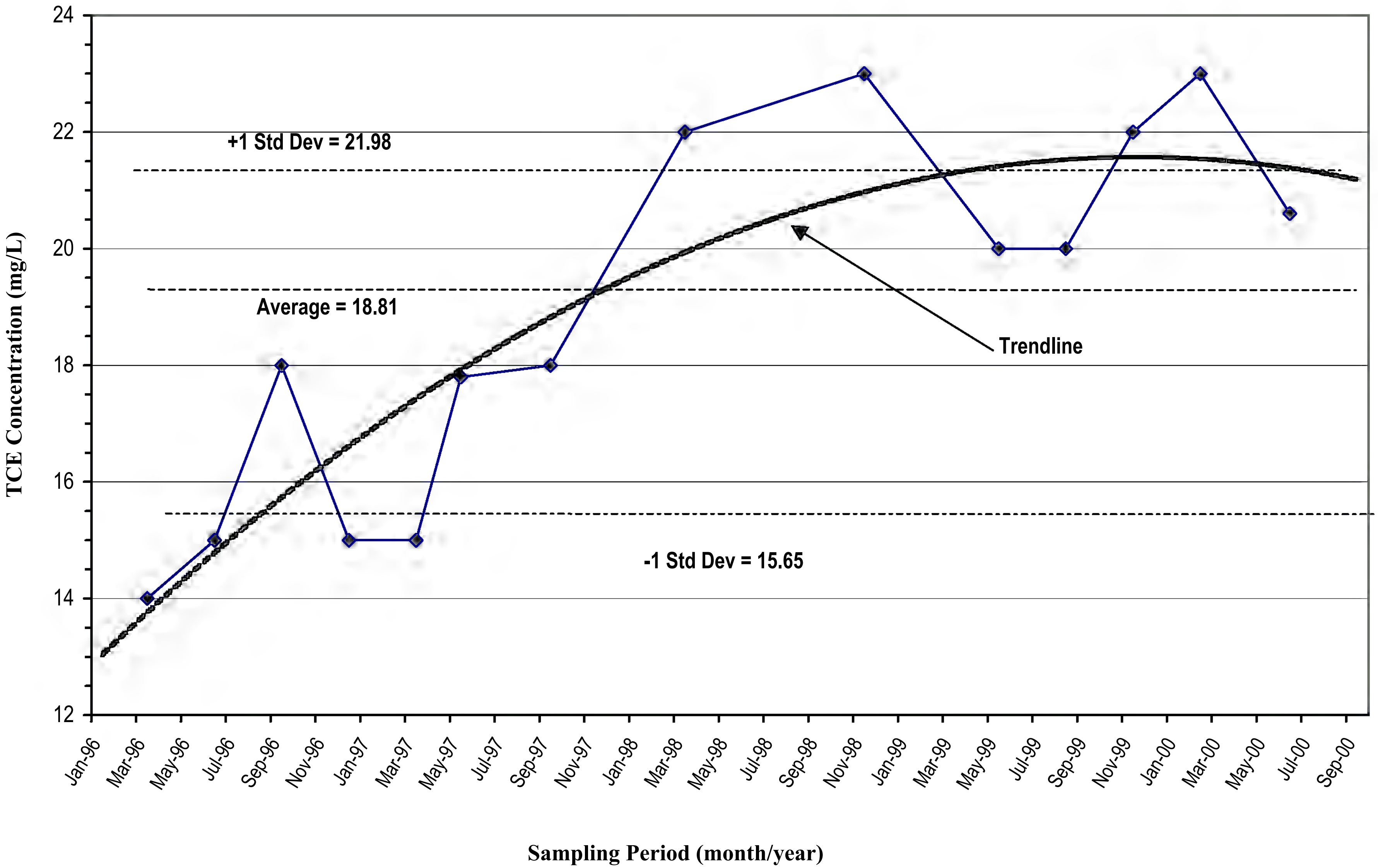

FIGURE E-4. TCE Concentrations for Well LWDS-MW1

TABLE E-2. Summary Statistics of Wells with Nitrate Concentrations Greater Than the MCL of 10 mg/L in FY00

Project	Well ID	Sample Size	Avg	Med	Std Dev	Min	Max	Range	CV	-1 SD	+1 SD
Units mg/L											
Canyons	CYN-MW1D	8	13.75	13.85	2.85	10	16.9	6.9	0.21	10.90	16.60
	CYN-MW3	5	12.14	12.5	1.39	9.8	13.3	3.5	0.11	10.75	13.53
TAG (Shallow)	TA2-SW1-320	16	26.09	26.09	5.62	20	44	24	0.22	20.47	31.71
	TJA-2	16	7.97	7.35	2.03	4.7	14	9.3	0.25	5.94	10.00
TAG (Regional)	PGS-2	16	2.99	2.05	2.97	0.8	12	11.2	0.99	0.02	5.96
	TJA-4	6	24.83	25	2.86	20	29	9	0.12	21.98	27.69
TAV	AVN-1	15	8.27	8	1.87	5.9	12	6.1	0.23	6.40	10.14
	AVN-2	14	9.23	8.95	2.34	6.8	16	9.2	0.25	6.89	11.57
	LWDS-MW1	15	11.41	11	2.39	8.4	16.3	7.9	0.21	9.01	13.80

NOTE: mg/L = milligram per liter
MCL = maximum contaminant level
CV = coefficient of variance

Figures E-5 through E-13 show the sampling history of nitrate concentrations of wells listed in Table E-2. The graphs indicate anomalous high nitrate values in the first and second quarter of FY00. ~~The u~~Unusually high values occur~~s~~ simultaneously at wells that are separated by some distance and associated with different ER Project sites. The likelihood of such a coincidence due to natural groundwater processes is rare. The high values may be the result of a change in analytic technique or reporting protocol. The acceptance or rejection of the validity of nitrate concentration values reported in the first quarter of FY00 bear significantly on the trend of nitrate concentrations at these wells (i.e. the nitrate concentrations at these sites are increasing, and in some cases, they exceed the MCL values).

- Figure E-5 shows the trend of nitrate concentrations at CYN-MW1D and appears to be increasing over time.

- Interpretation of the concentration trend is limited due to the few data for CYN-MW3. Figure E-6 shows that the trend for this well is level and coincides with the average concentration of 12.14 mg/L.

- Figure E-7 shows nitrate concentrations at TA2-SW1-320 appear to be increasing. If the anomalous high nitrate concentration value for November 1999 is discounted, the trend line would be level, although the average concentration at 26.09 mg/L is still above the MCL of 10 mg/L.

- As shown in Figure E-8, if the nitrate concentration for November 1999 is discounted, the nitrate concentration trend for TJA-2 would be level and the values below the MCL.

- Figure E-9 shows nitrate concentrations at PGS-2 are decreasing. Other than the anomalous concentration for March 2000, values are below the MCL.

- Figure E-10 shows nitrate concentrations at TJA-4 consistently above the MCL and appear to be increasing; however, if the November 1999 data point is removed, the trend for the most recent data suggests nitrate concentrations are leveling off and averaging 24.83 mg/L.

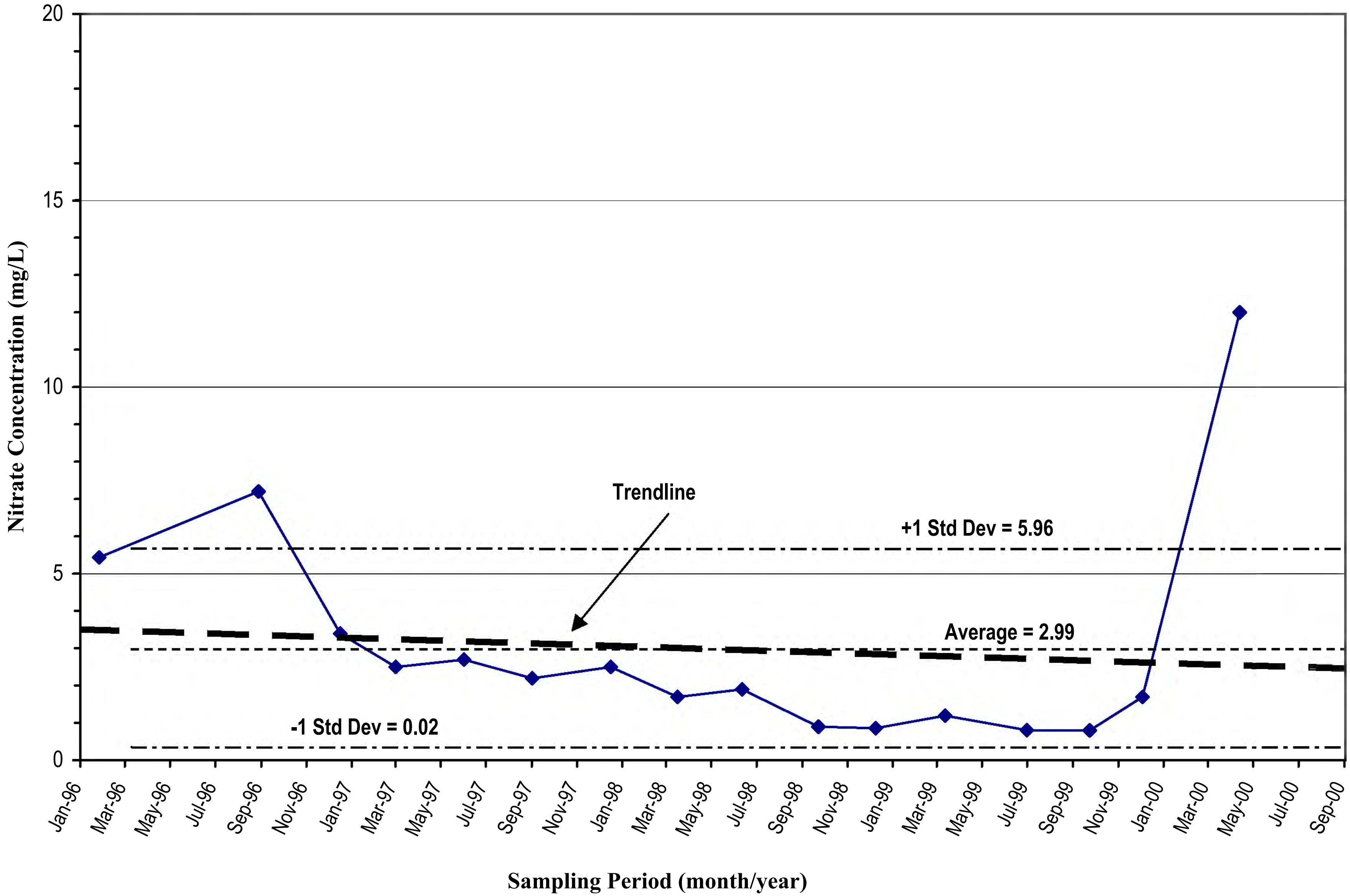

FIGURE E-9. Nitrate Concentrations for Well PGS-2

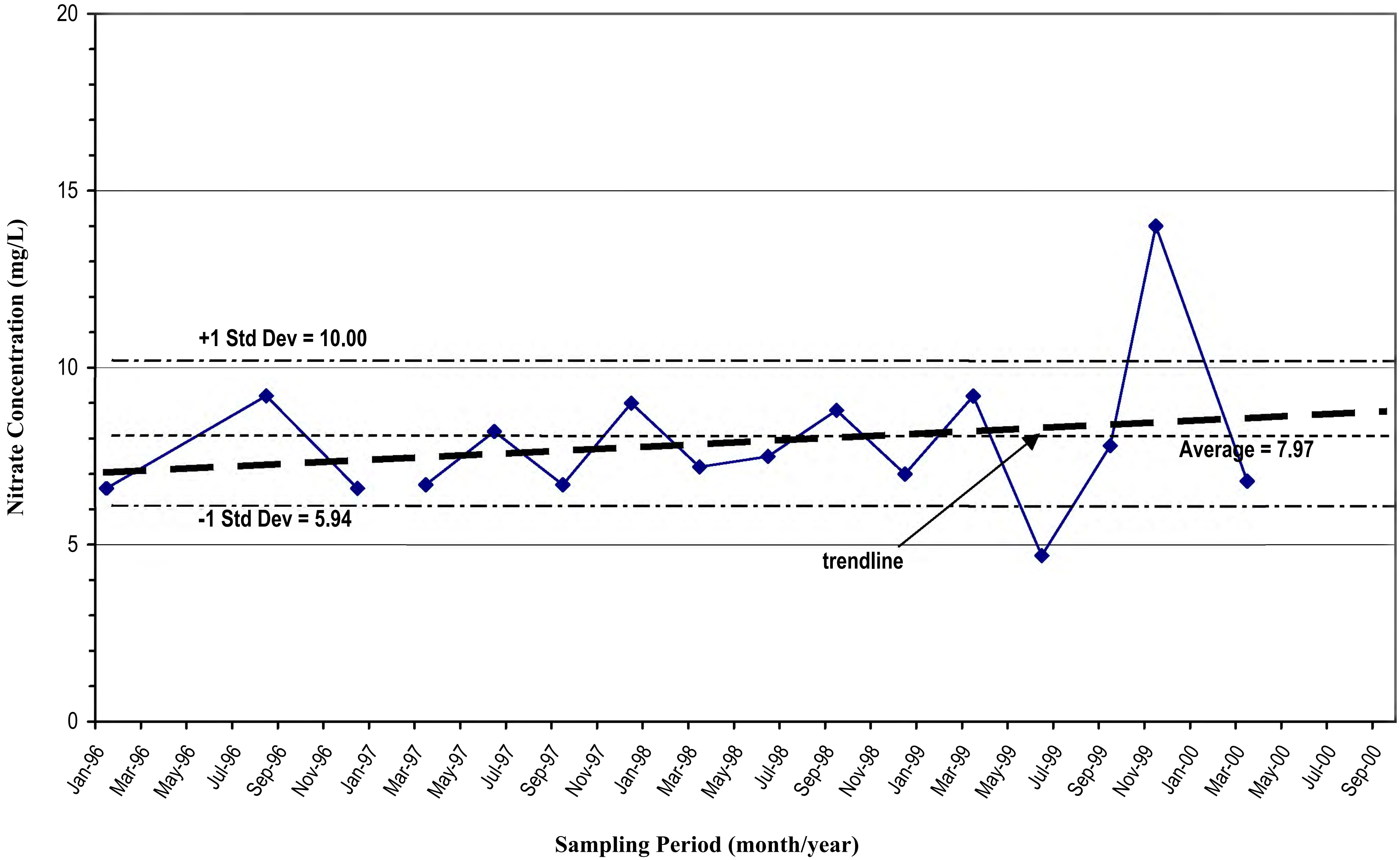

FIGURE E-8. Nitrate Concentrations for Well TJA-2

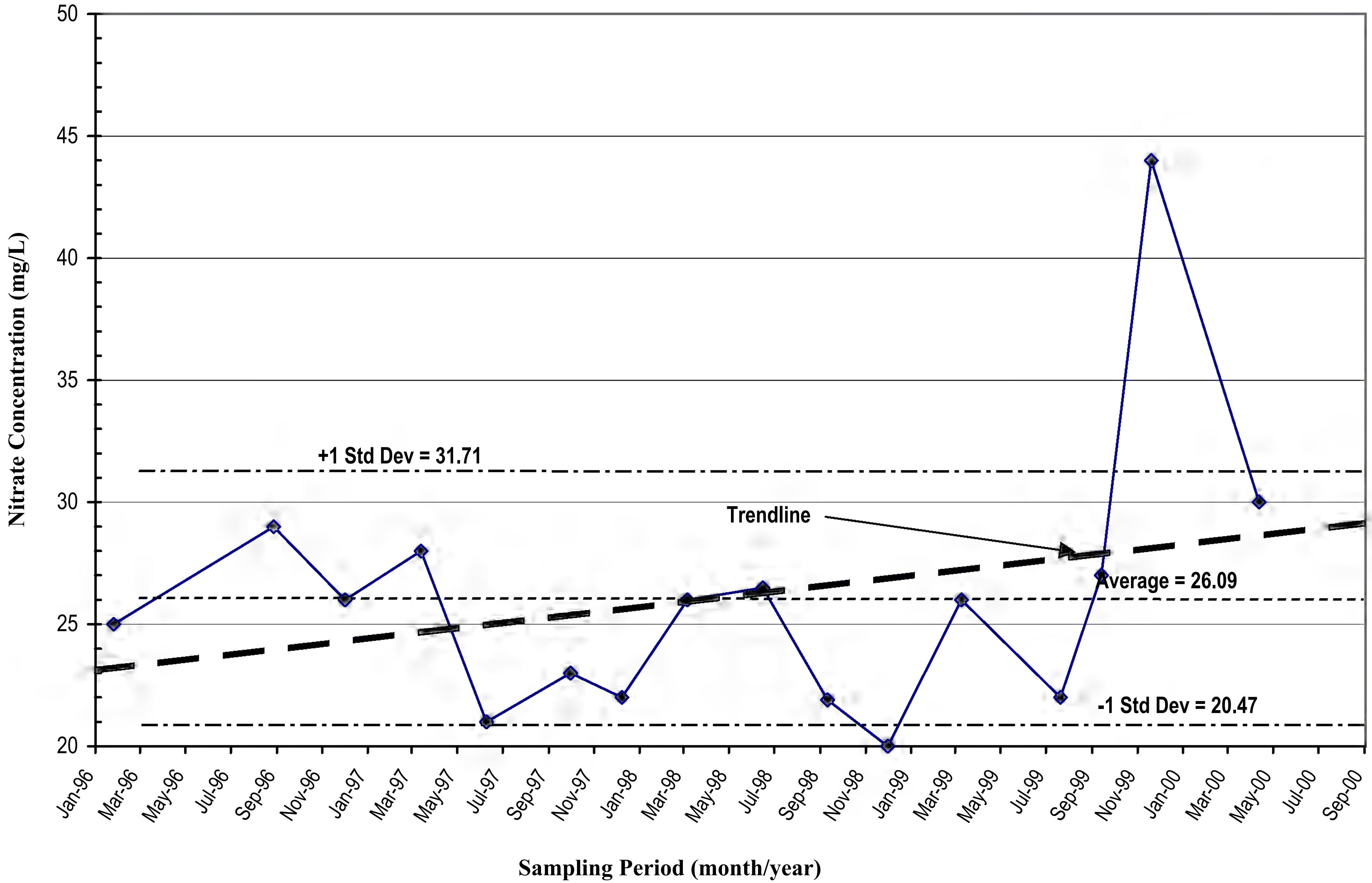

FIGURE E-7. Nitrate Concentrations for Well TA2-SW1-320

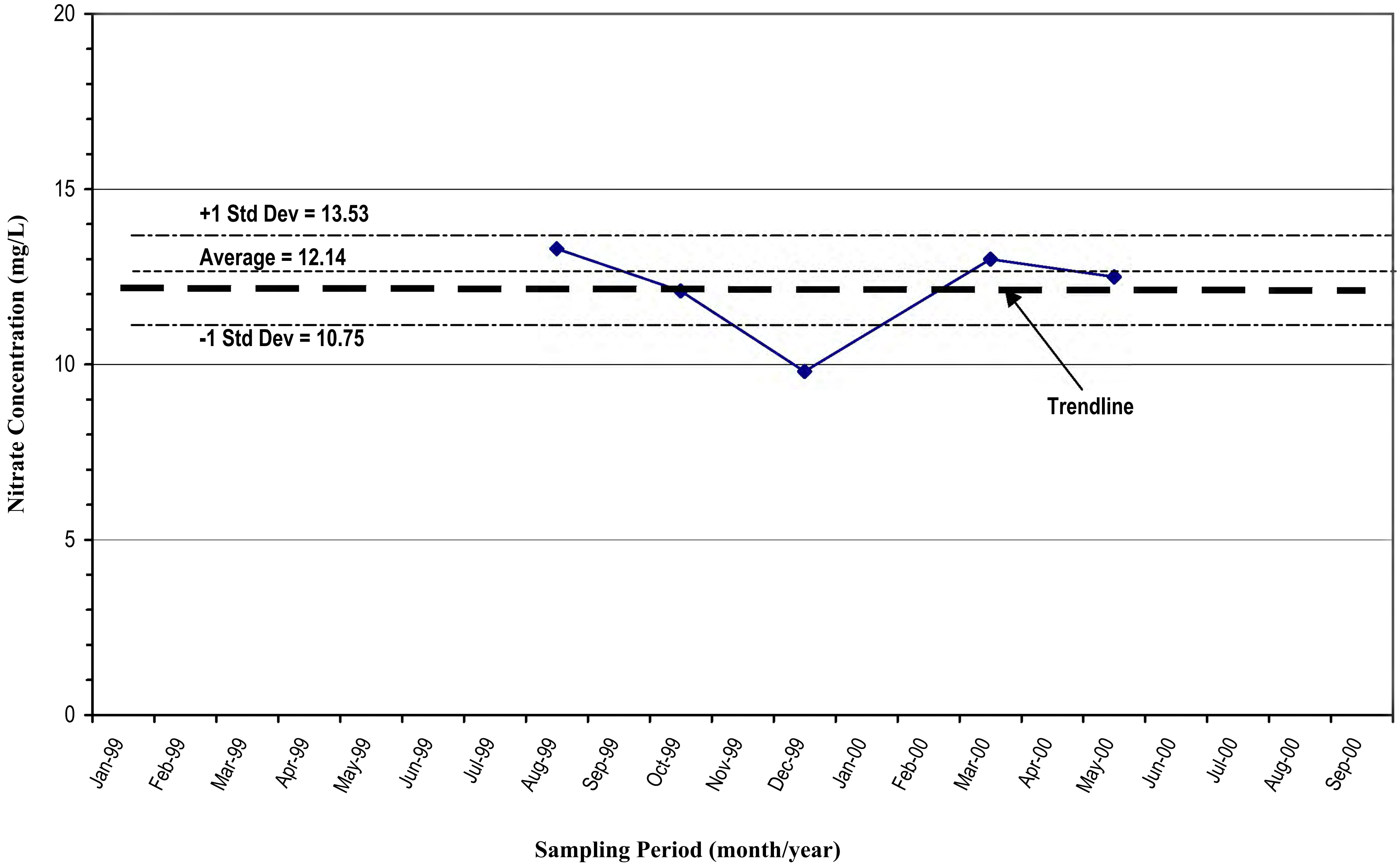

FIGURE E-6. Nitrate Concentrations for Well CYN-MW3

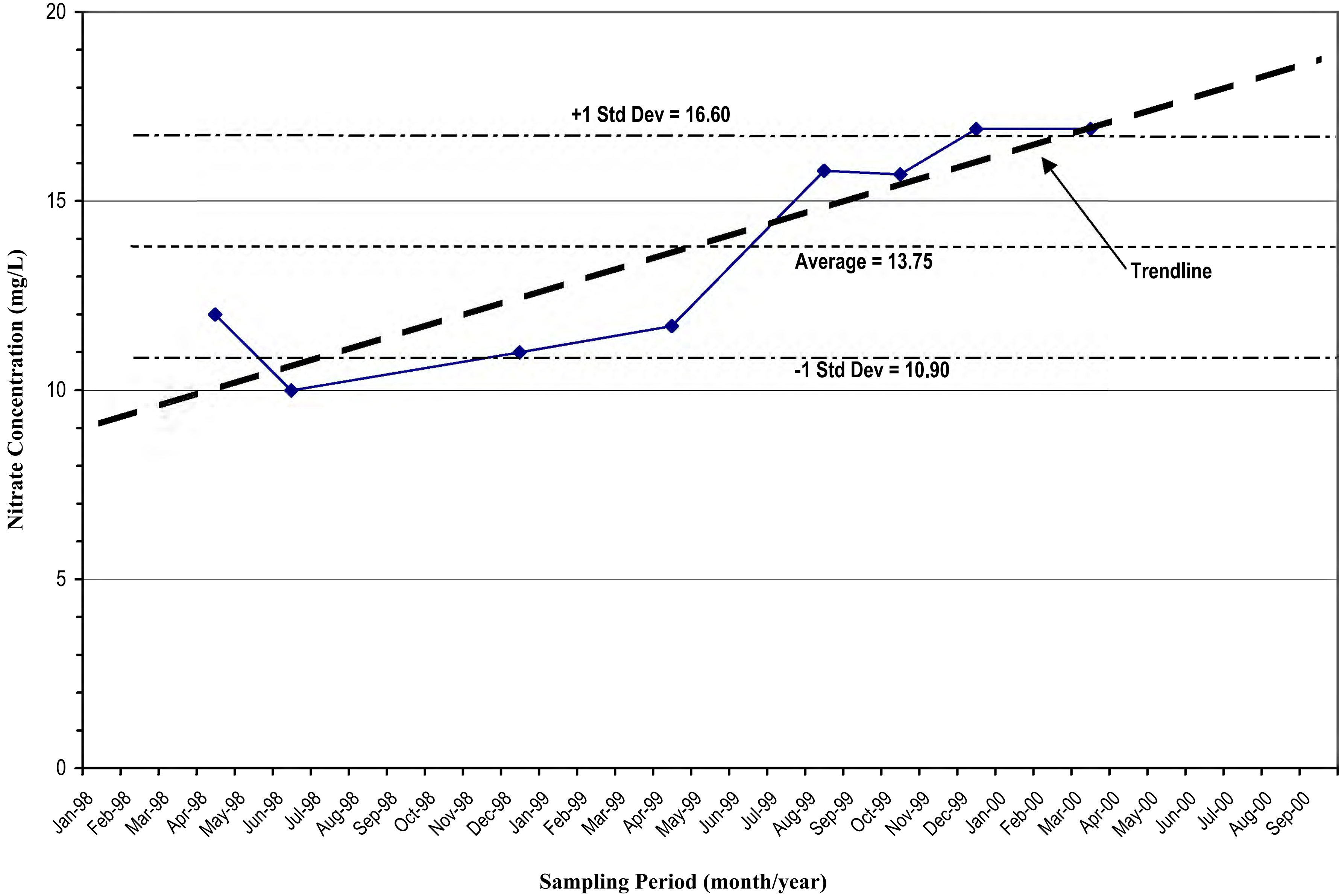

FIGURE E-5. Nitrate Concentrations for Well CYN-MW1D

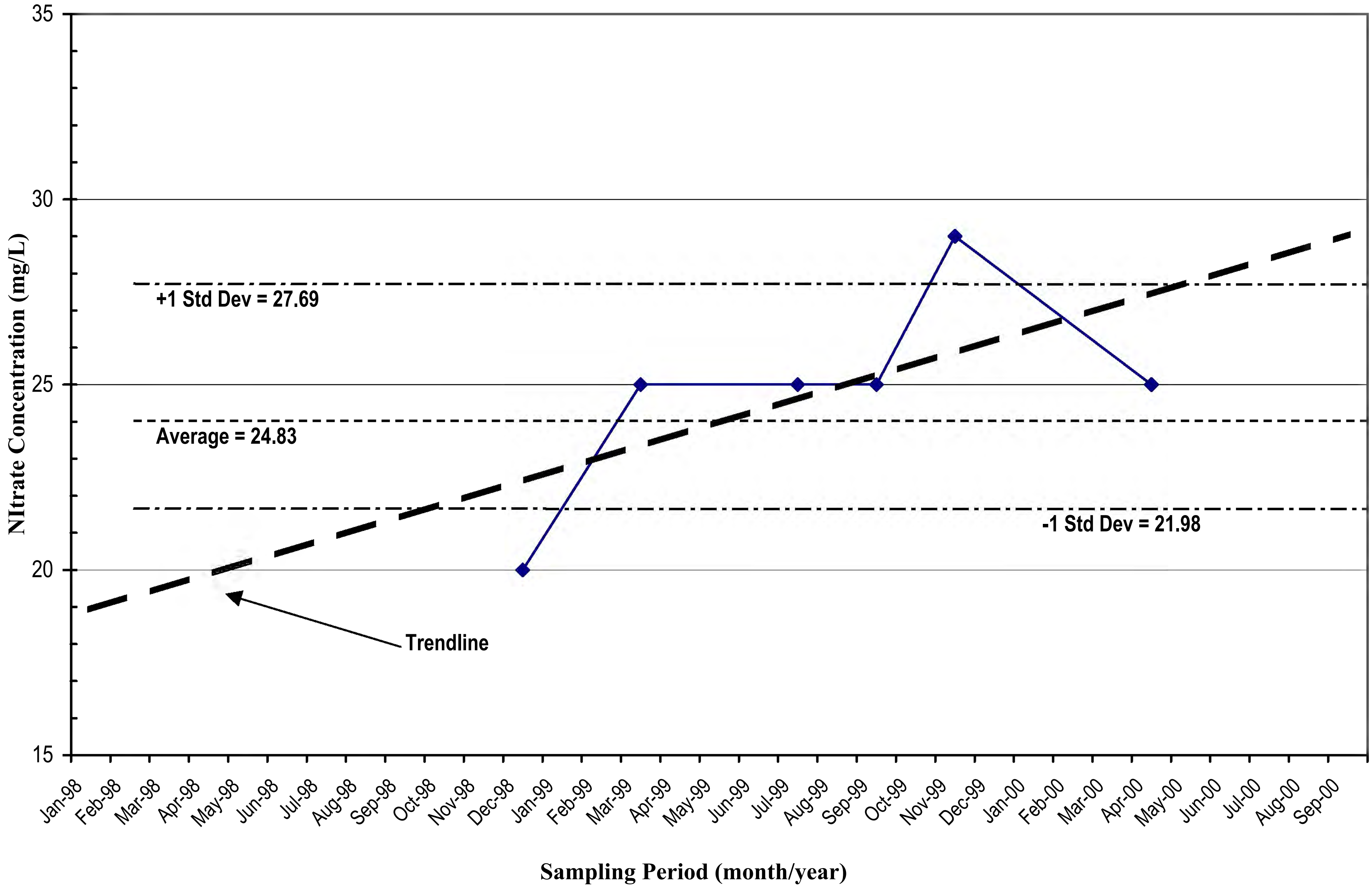

FIGURE E-10. Nitrate Concentrations for Well TJA-4

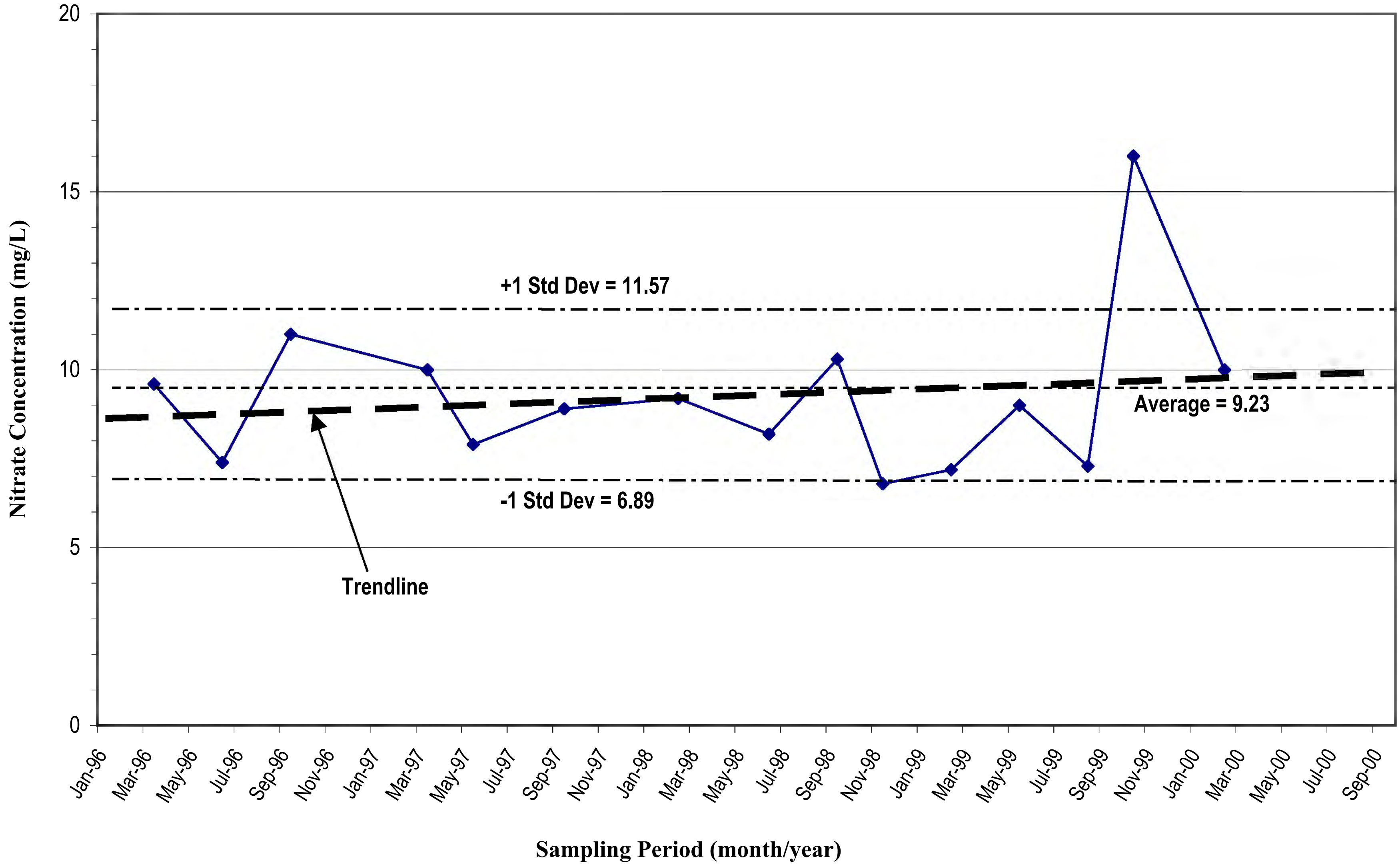

FIGURE E-12. Nitrate Concentrations for Well AVN-2

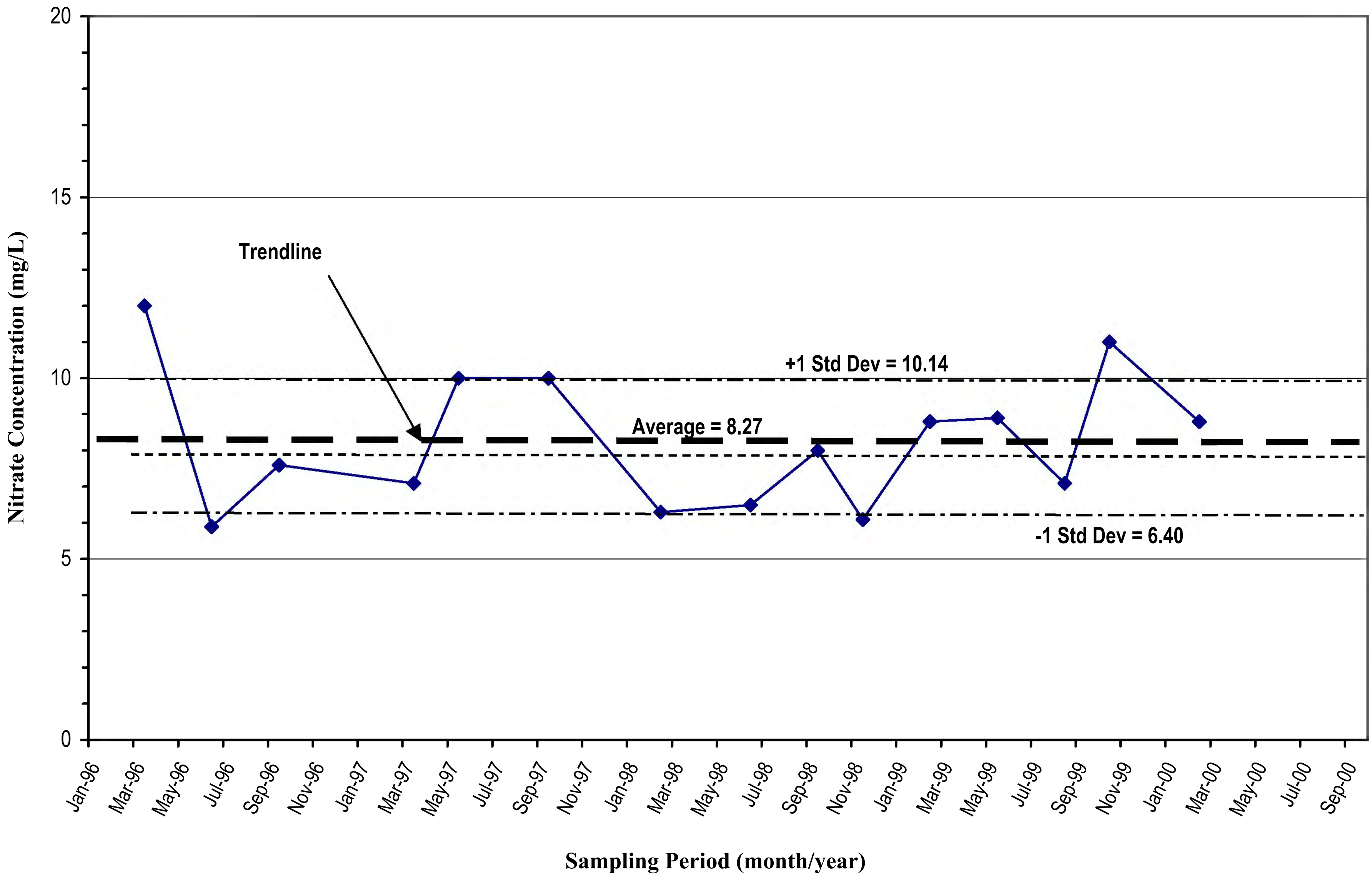

FIGURE E-11. Nitrate Concentrations for Well AVN-1

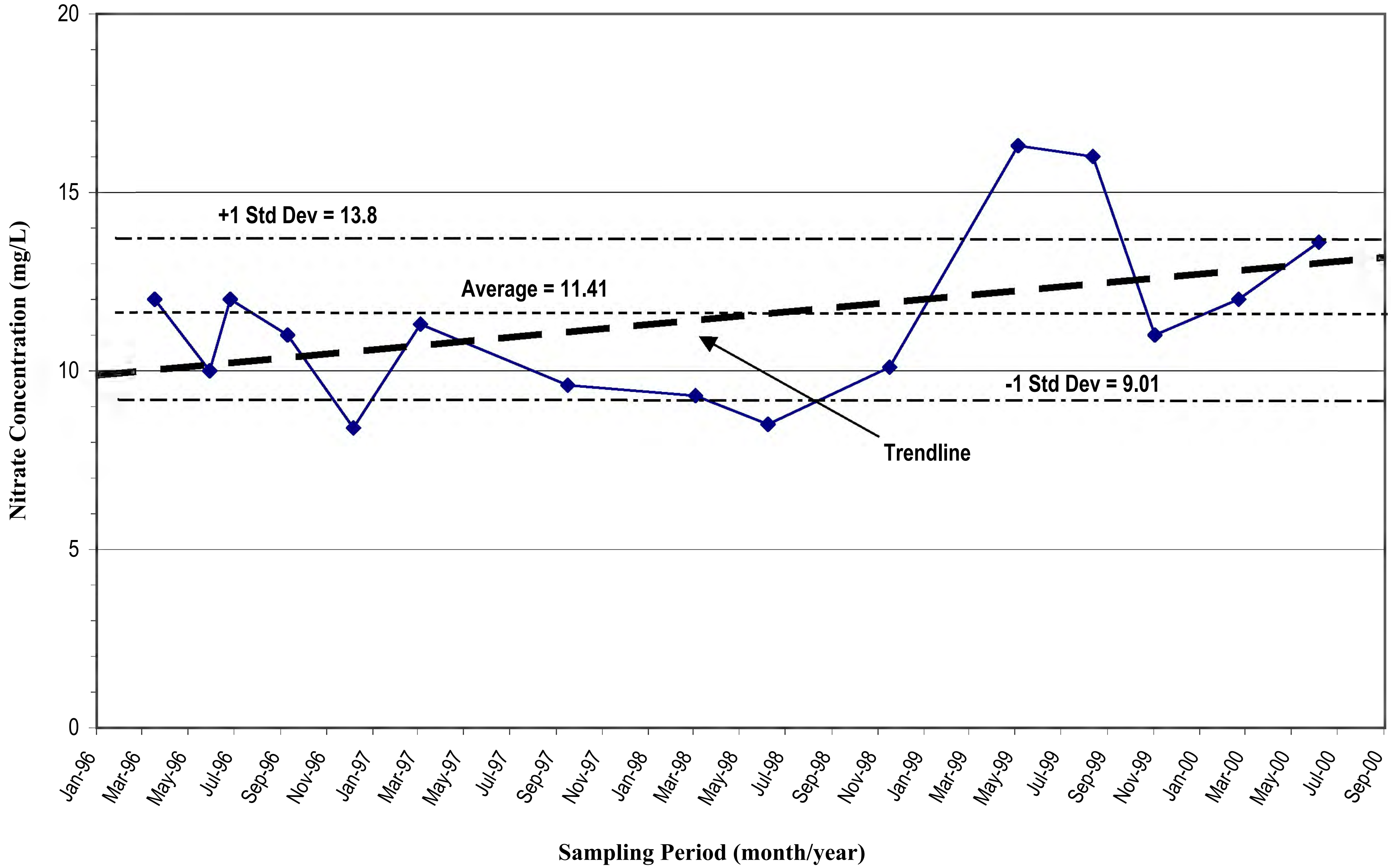

FIGURE E-13. Nitrate Concentrations for Well LWDS-MW1

- Figure E-11 shows the trend of nitrate concentrations for AVN-1 to be level, while the trend in Figure E-12 for AVN-2 shows an increase in concentrations over time. If the November 1999 data values are removed for both wells, the trend of nitrate concentrations would actually show a decrease. In addition, nitrate values would be below the MCL for the previous two years of monitoring.

- Figure E-13 shows the trend for nitrate concentrations at LWDS-MW1 is increasing. Nitrate and TCE were co-disposed into the LWDS leach field. The increase in nitrate is consistent with the trend associated with TCE at this location and reflects the break-through of the contaminant plume to the water table.

Uranium-234 (U-234)

Two Groundwater Protection Program (GWPP) surveillance wells (SFR-2S and TRE-1) were identified as having U-234 activities greater than the U.S. Department of Energy (DOE) drinking water guideline of 20 pCi/L (Table E-3). The proposed U.S. Environmental Protection Agency (EPA) drinking water is 30 µg/L of the MCL, which is equivalent to 27 pCi/L using an average mass-to-activity ratio of 1.11 as assumed by the EPA. SFR-2S and TRE-1 are located east of the Tijeras Fault Zone where uranium values are naturally elevated. The numbers for these wells are consistent with background activities for U-234 in this geologic setting.

SFR-2S and TRE-1 U-234 activities are shown in Figures E-14 and E-15, respectively. The trends for U-234 activities for wells SFR-2S and TRE-1 should be viewed jointly. U-234 activity in both wells is of natural origin. There are no ER sites or contaminant sources in the vicinity of these two wells and slopes of the trend lines for wells SFR-2S and TRE-1 are very small numerically as determined by the linear regression.

- Figure E-14 shows a slight increase for SFR-2S.

- Figure E-15 shows a slight decrease for U-234 activity at TRE-1.

Ideally, since both wells represent background activities of U-234 the trend lines should be level. Note that there is a level of uncertainty as illustrated by the errors bars associated with the data points. Consequently, there is also a high degree of uncertainty in the trend interpretations.

Nickel

Analysis of groundwater samples from four ER wells identified nickel concentrations greater than the drinking water MCL of 0.1 mg/L. Two wells (CWL-MW2A and CWL-MW4) are located at the Chemical Waste Landfill (CWL) and the two other wells (MWL-MW1 and MWL-MW2) are located at the Mixed Waste Landfill (MWL). Nickel is not a contaminant of concern at either site. Field observations and laboratory tests have demonstrated corrosion of the type of stainless steel used in the screens under groundwater immersion conditions. All four of the wells with high nickel concentrations have stainless steel well screens. The nickel, as well as chromium contamination in some wells, appears to be the result of the corrosion of the well screens since both nickel and chromium are prominent components of stainless steel. Nickel

TABLE E-3. Summary Statistics of Wells with Uranium-234 Activity Greater Than 20 pCi/L in FY00

Project	Well ID	Sample Size	Avg	Med	Std Dev	Min	Max	Range	CV	-1 SD	+1 SD
Units pCi/L											
GWPP	SFR-2S	4	20.25	20.4	1.30	18.8	21.4	2.6	0.06	18.95	21.55
	TRE-1	4	22.45	22.75	1.49	20.5	23.8	3.3	0.07	20.96	23.94

NOTE: CV = coefficient of variance
pCi/L = picocurie per liter
CV = coefficient of variance

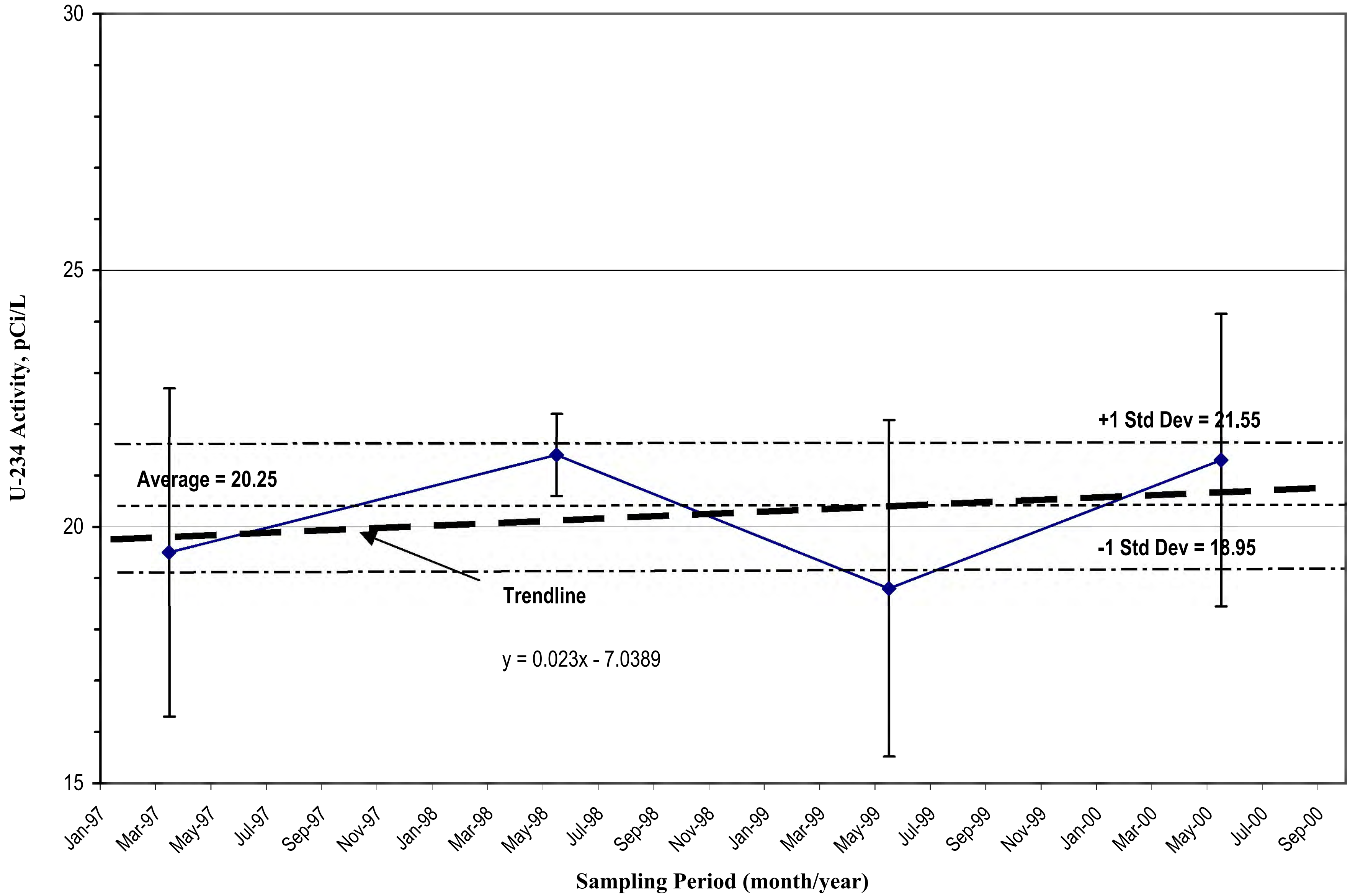

FIGURE E-14. Uranium-234 Activity for Well SFR-2S

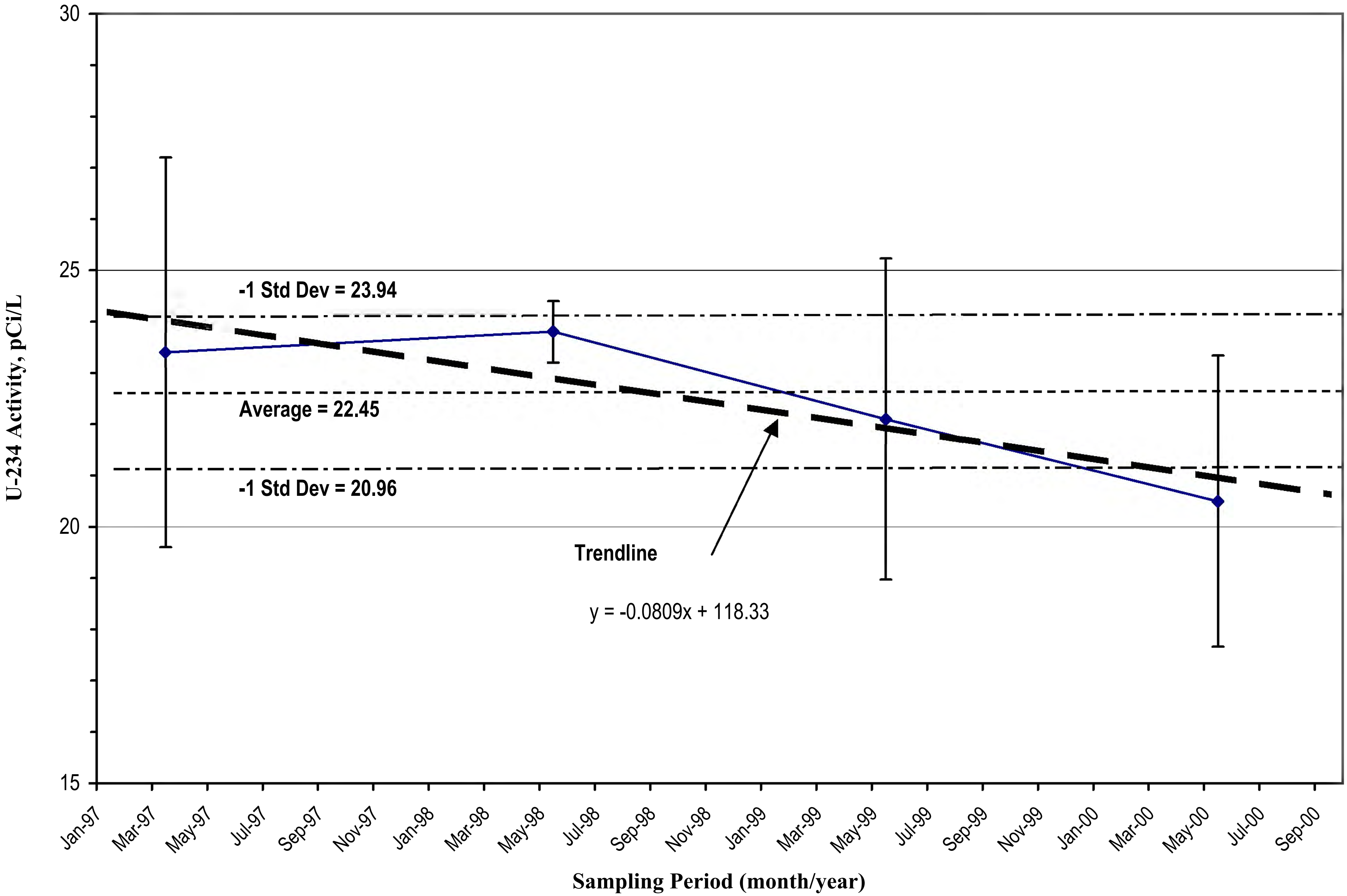

FIGURE E-15. Uranium-243 Activity for Well TRE-1 concentrations have been routinely above the MCL, except MWL-MW2. The MCL was exceeded in only the most recent analytical groundwater data from well MWL-MW2. The coefficient of variance (CV) for well MWL-MW2 is significantly different from the three other wells suggesting that the most recent data value has introduced an unusual amount of variance into the data. Previous nickel concentrations in this well were consistently below the MCL concentration.

Nickel concentrations for wells listed in Table E-4 are shown in Figures E-16 through E-19, respectively.

- As shown in Figures E-16 and E-17, the data for the CWL wells (CWl-MW2A and CWL-MW4) are consistent, although the concentration values are higher in CWL-MW4. The trends for nickel concentrations at both wells are increasing, which is consistent with the screen corrosion hypothesis.

- As shown in Figures E-18 and E-19, the data for the MWL wells (MWL-MW1 and MWL-MW2) is erratic and trend interpretation is ambiguous. Nickel concentrations for MWL-MW1 appears to be slightly increasing over time (Figure E-18). The value of concentration reported in March 2000 for MWL-MW2 is inconsistent with the values reported previously (Figure E-19). In neglecting this last value, the nickel concentrations in the well are insignificant and well below the MCL.

Selenium

Selenium is a naturally occurring metal in groundwater at Kirtland Air Force Base (KAFB). The shallow or perched groundwater concentrations of selenium appear to be higher than the concentrations values obtained from the regional aquifer. TA1-W-03 is a shallow well and is the only well where selenium concentrations in groundwater exceed the MCL value of 50 µg/L. Table E-5 summarizes the available selenium data for TA1-W-03.

Figure E-20 shows selenium concentrations for TA1-W-03. The data shows considerable scatter so the trend line is difficult to interpret. If the data point for July 1999 is identified as an outlier and removed, the trend line would demonstrate a significant increase in selenium concentrations over time. As it is currently reported, the trend line shows a modest increase.

TABLE E-4. Summary Statistics of Wells with Nickel Concentrations Greater Than the MCL of 0.1 mg/L in FY00

Project	Well ID	Sample Size	Avg	Med	Std Dev	Min	Max	Range	CV	-1 SD	+1 SD
Units mg/L											
CWL	CWL-MW2A	7	0.463	0.548	0.250	0.063	0.78	0.717	0.541	0.213	0.713
	CWL-MW4	14	1.157	1.210	0.668	0.230	2.71	2.480	0.577	0.489	1.825
MWL	MWL-MW1	5	0.346	0.313	0.150	0.145	0.5	0.355	0.434	0.196	0.496
	MWL-MW2	5	0.028	0.004	0.054	0.003	0.124	0.121	1.895	-0.025	0.082

NOTE: CV = coefficient of variance; pCi/L = picocurie per liter; CV = coefficient of variance

TABLE E-5. Summary Statistics for Well with Selenium Concentrations Greater Than the MCL of 50 µg/L in FY00

Project	Well ID	Sample Size	Avg	Med	Std Dev	Min	Max	Range	CV	-1 SD	+1 SD
TAG	TA1-W-03	9	48.2	54	20.3	4.8	74	69.2	0.42	27.85	68.55

NOTE: CV = coefficient of variance; pCi/L = picocurie per liter; CV = coefficient of variance

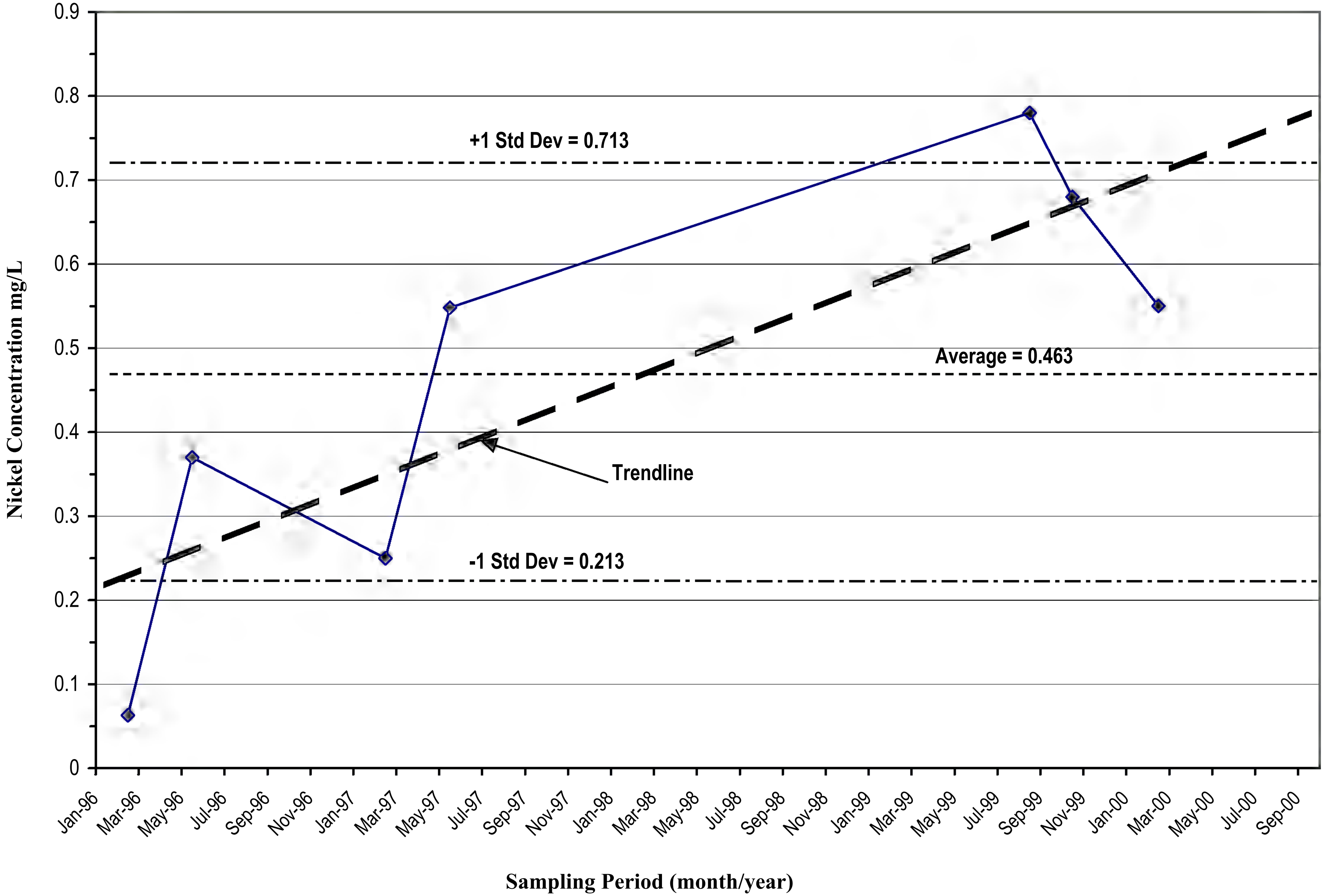

FIGURE E-16. Nickel Concentrations for Well CWL-MW2A

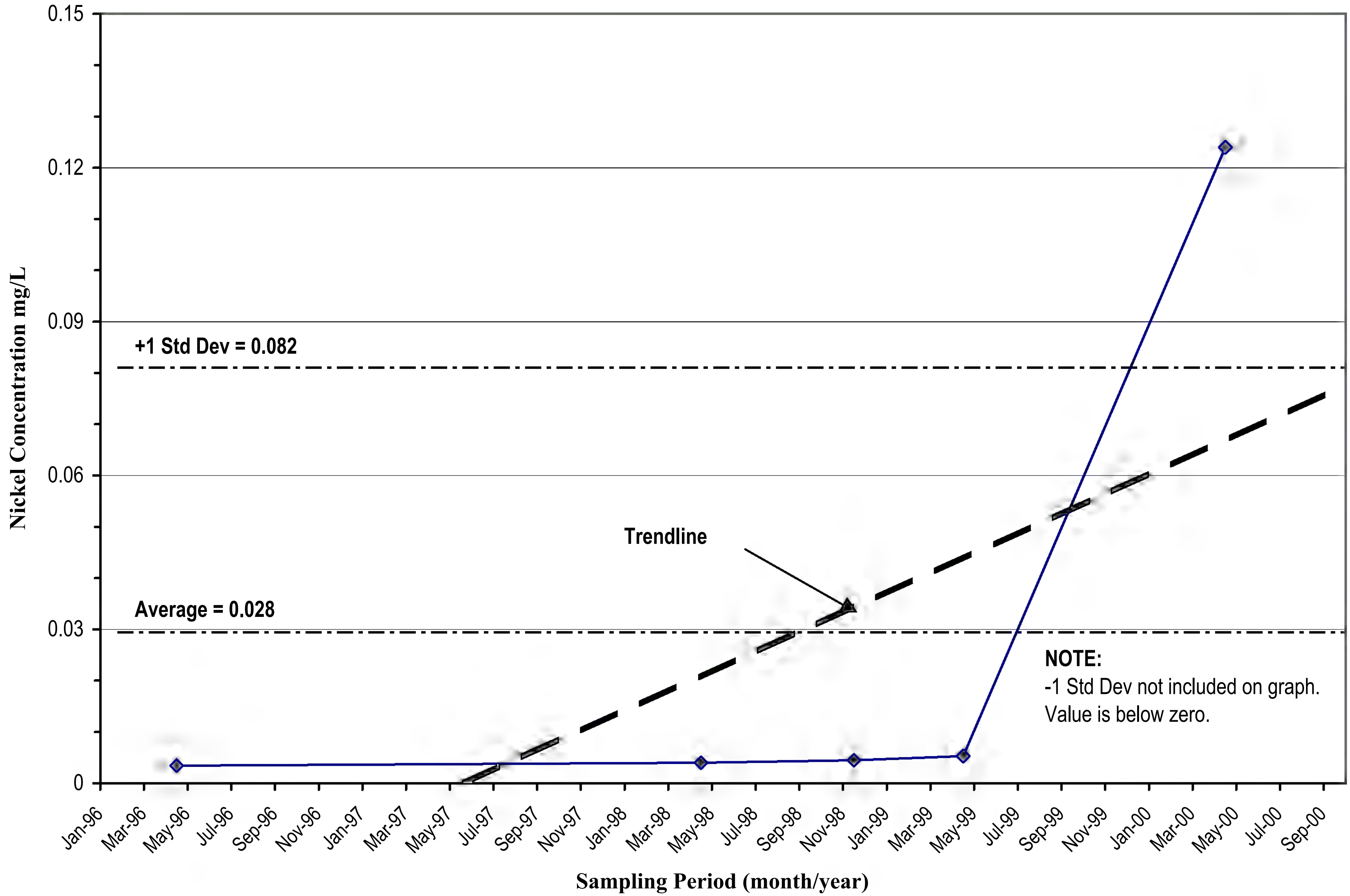

FIGURE E-19. Nickel Concentrations of Well MWL-MW2

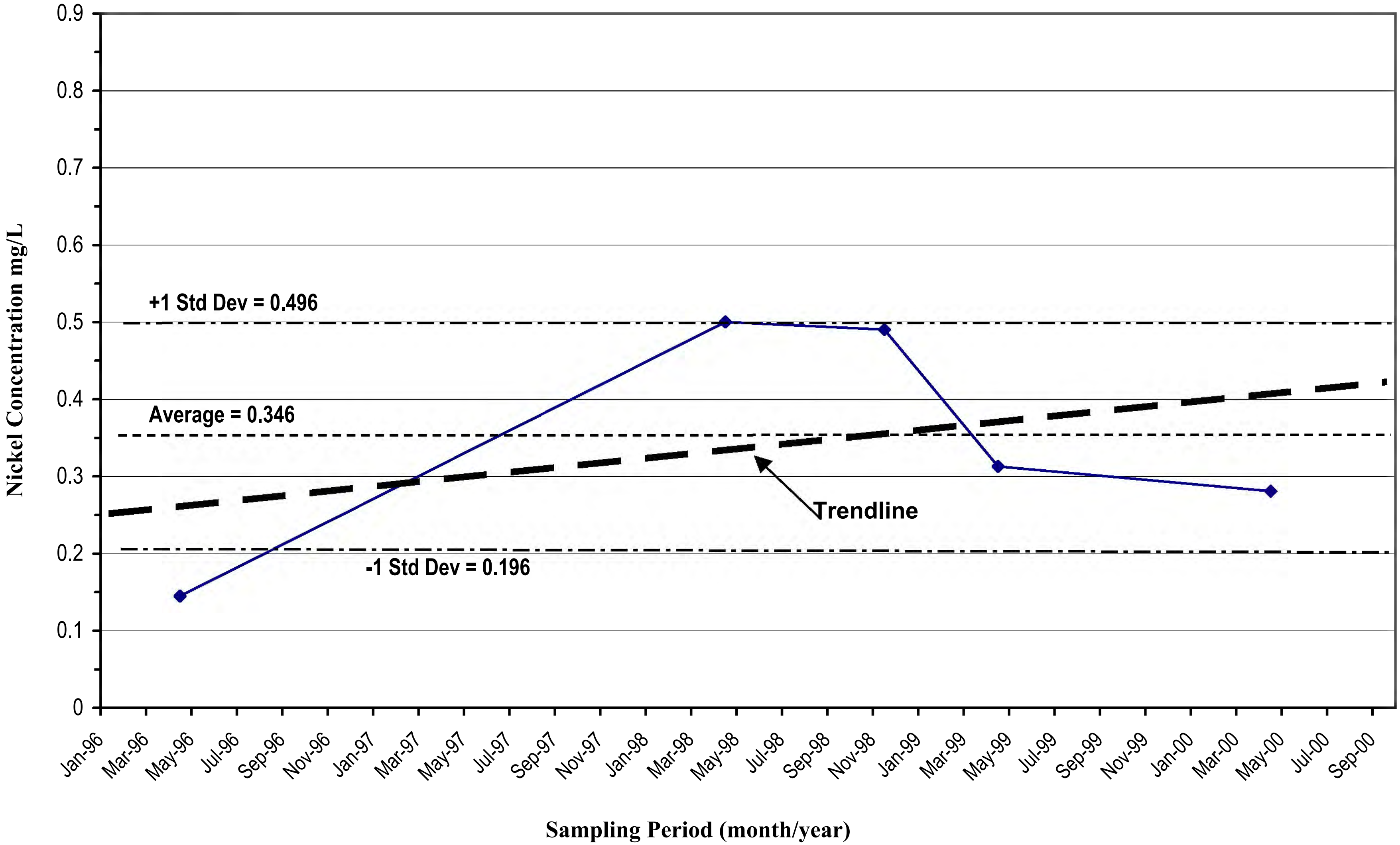

FIGURE E-18. Nickel Concentrations of Well MWL-MW1

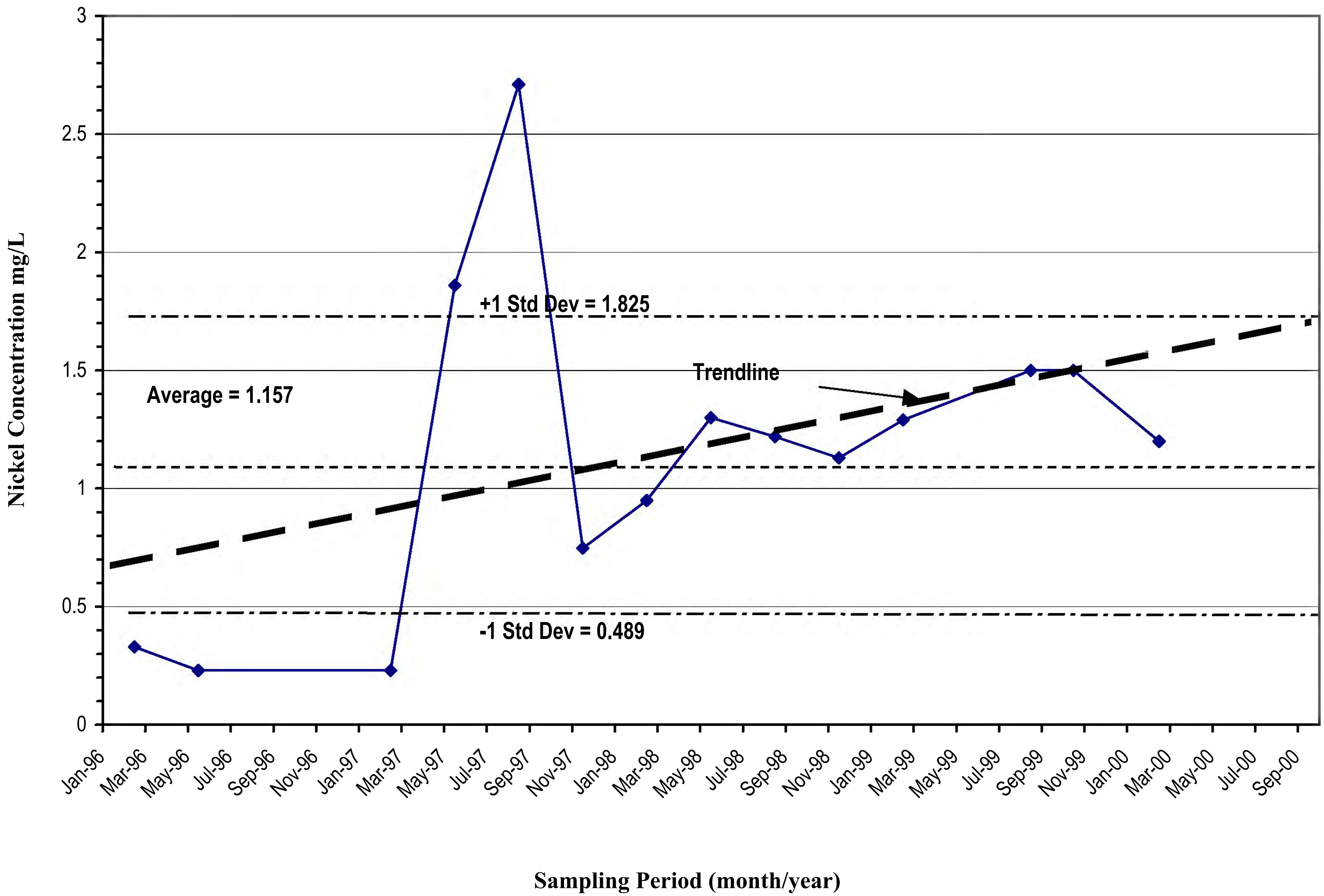

FIGURE E-17. Nickel Concentrations of Well CWL-MW4

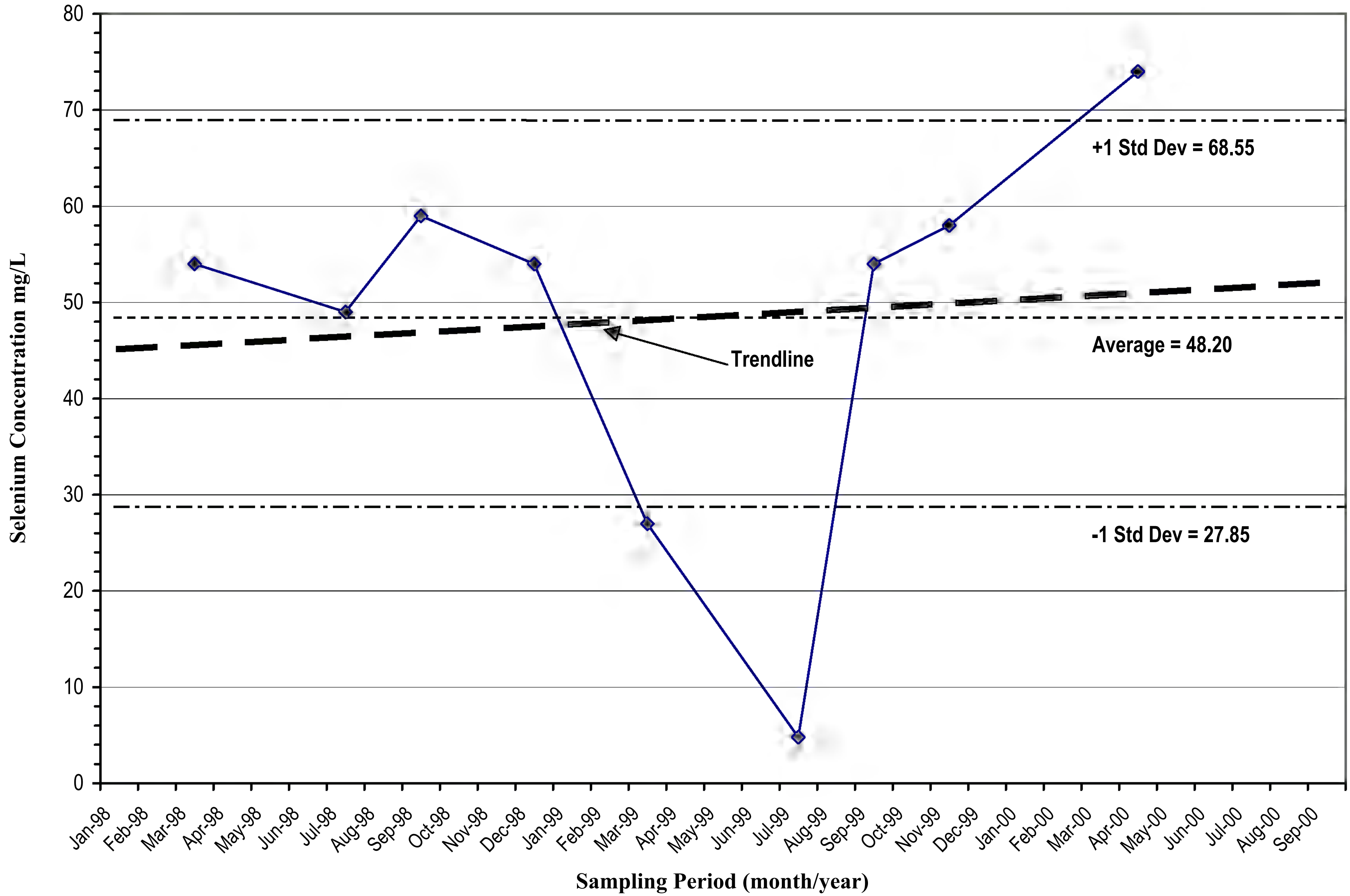

FIGURE E-20. Selenium Concentrations of Well TA1-W-03

APPENDIX F

2000 Terrestrial Surveillance Results

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CONTENTS

TABLES

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TABLE F-1. Radiological Results by Location for Calendar Year 2000, Soil

Location Type	Location	Cesium-137 (pCi/g)		Tritium (pCi/L)		Total Uranium (µg/g)	
		Activity	MDA	Activity	MDA	Activity	MDA
Community	10	0.34 ± 0.0983	0.0276	0 ± 168	142	0.48	0.0018
	11	0.0552 ± 0.0417	0.00854	-28.8 ± 128	109	0.614	0.0018
	25	0.0303 ± 0.0422	0.0142	-117 ± 164	142	0.49	0.0018
	62	0.387 ± 0.0637	0.0122	39.6 ± 164	137	0.807	0.0018
	8	0.0377 ± 0.0279	0.0132	90.7 ± 167	138	0.651	0.0018
	9	0.683 ± 0.0902	0.0116	-4 ± 172	145	0.475	0.0018
Perimeter	12	1.07 ± 0.132	0.0156	171 ± 215	184	0.566	0.0018
	16	0.0867 ± 0.0364	0.0115	478 ± 196	155	0.779	0.0018
	19	0.176 ± 0.0383	0.0061	207 ± 181	152	0.43	0.0018
	4	0.0971 ± 0.0399	0.01	-28.7 ± 148	126	0.314	0.0018
	5	0.317 ± 0.0588	0.00948	0 ± 398	334	0.3	0.0018
	58	0.11 ± 0.0341	0.0152	-44.9 ± 212	184	0.947	0.0018
	59	0.234 ± 0.0479	0.0136	-137 ± 205	182	0.403	0.0018
	60	0.013 ± 0.0219	0.0148	6 ± 174	147	0.738	0.0018
	61	0.0115 ± 0.0248	0.0123	-46.4 ± 180	153	0.486	0.0018
	63	0.374 ± 0.0628	0.016	298 ± 184	151	0.577	0.0018
	64	0.435 ± 0.0655	0.0135	390 ± 348	292	0.95	0.0018
	65E	0.142 ± 0.039	0.0177	-105 ± 184	162	1.32	0.0018
	80	0.777 ± 0.103	0.0152	238 ± 200	168	0.692	0.0018

NOTE: MDA = minimum detectable activity
pCi/g = picocurie per gram
pCi/L = picocurie per liter
µg/g = microgram per gram

TABLE F-1. Radiological Results by Location for Calendar Year 2000, Soil *(concluded)*

Location Type	Location	Cesium-137 (pCi/g)		Tritium (pCi/L)		Total Uranium (µg/g)	
		Activity	MDA	Activity	MDA	Activity	MDA
On-site	1	0 ± 0.0419	0.00693	-58.5 ± 148	128	5.22	0.0018
	20	0.409 ± 0.0646	0.00959	-535 ± 256	220	0.519	0.0018
	2NE	0.149 ± 0.0389	0.00845	1480 ± 280	144	0.399	0.0018
	2NW	0.123 ± 0.0474	0.00789	957 ± 203	110	0.358	0.0018
	2SE	0.169 ± 0.0358	0.0057	384 ± 177	122	0.41	0.0018
	2SW	0.107 ± 0.0509	0.0081	393 ± 182	125	0.387	0.0018
	3	0.0132 ± 0.0256	0.0136	127 ± 175	150	0.507	0.0018
	32E	0.0302 ± 0.0339	0.00904	181 ± 221	171	0.744	0.0018
	32S	0.138 ± 0.0589	0.00936	34.5 ± 159	131	0.835	0.0018
	33	0.393 ± 0.0645	0.0159	215 ± 208	176	0.663	0.0018
	34	0.054 ± 0.0324	0.015	-38.8 ± 177	159	0.547	0.0018
	35	0.194 ± 0.0511	0.00935	0 ± 152	127	0.415	0.0018
	41	0.163 ± 0.0371	0.00977	-27.6 ± 142	121	0.305	0.0018
	42	0.0606 ± 0.0412	0.0122	-82.2 ± 136	120	0.338	0.0018
	43	0.0475 ± 0.0236	0.00824	0 ± 144	121	0.391	0.0018
	45	0.391 ± 0.0651	0.00882	115 ± 160	127	0.334	0.0018
	46	0.0675 ± 0.0284	0.00812	32.3 ± 194	166	0.602	0.0018
	49	0.314 ± 0.0562	0.0135	-115 ± 195	172	0.581	0.0018
	51	0.0478 ± 0.0295	0.0116	138 ± 191	151	0.549	0.0018
	52	0.0724 ± 0.0481	0.00883	29.2 ± 155	128	0.687	0.0018
	53	0.0381 ± 0.0584	0.0112	85.2 ± 136	108	0.447	0.0018
	54	0.209 ± 0.0439	0.00919	0 ± 268	225	0.395	0.0018
	55	0.702 ± 0.102	0.01	-84.1 ± 140	123	0.599	0.0018
	56	0.0485 ± 0.0236	0.00926	-86.3 ± 143	126	0.344	0.0018
	57	0.0442 ± 0.0238	0.00829	123 ± 200	168	1.2	0.0018
	6	0.24 ± 0.0473	0.00962	146 ± 164	128	0.467	0.0018
	66	0.0553 ± 0.0331	0.00761	58.6 ± 158	128	0.563	0.0018
	7	0.457 ± 0.0859	0.00947	39.4 ± 209	173	0.412	0.0018
	76	0.168 ± 0.0559	0.0117	-28 ± 144	123	0.361	0.0018
	77	0.357 ± 0.108	0.0129	0 ± 146	123	0.39	0.0018
	78	0.223 ± 0.0479	0.0113	146 ± 175	149	0.401	0.0018

NOTE: MDA = minimum detectable activity
pCi/g = picocurie per gram
pCi/L = picocurie per liter
µg/g = microgram per gram

TABLE F-2. Radiological Results by Location for Calendar Year 2000, Sediment

Location Type	Location	Cesium-137 (pCi/g)		Tritium (pCi/L)		Total Uranium (µg/g)	
		Activity	MDA	Activity	MDA	Activity	MDA
Community	11	0.0604 ± 0.0397	0.00786	56.7 ± 134	108	0.482	0.0018
	68	-0.0059 ± 0.0222	0.016	-88.4 ± 159	137	1.19	0.0018
	8	0.099 ± 0.0365	0.0155	24.4 ± 163	137	0.61	0.0018
Perimeter	60	-0.00171 ± 0.0248	0.0113	-115 ± 320	272	0.933	0.0018
	65E	0.0186 ± 0.0197	0.0116	11.4 ± 218	187	0.661	0.0018
	73	0.0108 ± 0.0166	0.00805	-167 ± 232	205	0.971	0.0018
On-site	72	0.144 ± 0.0426	0.0157	223 ± 281	240	0.718	0.0018
	74	0.183 ± 0.0582	0.0118	173 ± 239	189	0.845	0.0018
	75	0.0888 ± 0.0615	0.025	172 ± 193	151	0.695	0.0018
	79	0.182 ± 0.0581	0.0121	148 ± 220	189	0.826	0.0018
	2NW	-0.00306 ± 0.0279	0.0186	640 ± 225	163	0.011	0.0018
	33	0.0481 ± 0.0462	0.0352	65.1 ± 211	166	0.0018	0.0018
	34	0 ± 0.0974	0.0485	-109 ± 221	180	0.0018	0.0018
	35	0.0345 ± 0.0508	0.0406	150 ± 235	183	0.0018	0.0018
	42	-0.0954 ± 0.11	0.0793	-57.9 ± 224	181	0.0018	0.0018
	43	-0.0115 ± 0.0719	0.0802	-361 ± 244	207	0.0018	0.0018
	45	0.0263 ± 0.038	0.027	-45.6 ± 239	193	0.0018	0.0018
	46	0.0319 ± 0.0852	0.0467	-196 ± 229	190	0.0459	0.0018
	49	0.0417 ± 0.0391	0.0313	-139 ± 230	189	0.0339	0.0018
	51	-0.00338 ± 0.0375	0.0427	-276 ± 218	184	0.0018	0.0018
	52	0.0543 ± 0.0574	0.0424	-175 ± 223	185	0.0018	0.0018
	55	0 ± 0.0981	0.0648	-154 ± 210	174	0.0378	0.0018
	6	-0.0612 ± 0.0695	0.035	-61.5 ± 207	167	0.0018	0.0018
	66	0.0275 ± 0.0299	0.0226	-110 ± 232	189	0.0018	0.0018

NOTE: MDA = minimum detectable activity
pCi/g = picocurie per gram
pCi/L = picocurie per liter
µg/g = microgram per gram

TABLE F-3. Radiological Results by Location for Calendar Year 2000, Vegetation

Location Type	Location	Cesium-137 (pCi/g)		Tritium (pCi/L)		Total Uranium (µg/g)	
		Activity	MDA	Activity	MDA	Activity	MDA
Community	11	0.042 ± 0.0517	0.0408	-242 ± 275	243	0.0068	0.0018
	25	0 ± 0.0728	0.0566	-122 ± 185	154	0.0018	0.0018
	8	0 ± 0.0586	0.0618	-85.2 ± 191	158	0.0104	0.0018
	9	0.0422 ± 0.102	0.0756	-231 ± 192	163	0.0038	0.0018
Perimeter	12	0.00845 ± 0.0568	0.0271	-155 ± 224	184	0.0018	0.0018
	4	0.00784 ± 0.0468	0.053	-171 ± 224	185	0.0018	0.0018
	5	-0.00471 ± 0.0588	0.051	-160 ± 224	185	0.0018	0.0018
	64	0 ± 0.0662	0.0319	-105 ± 213	174	0.0018	0.0018
On-site	20	0.0327 ± 0.0712	0.0395	-90.5 ± 228	184	0.0018	0.0018
	2NE	0.0156 ± 0.0294	0.0194	1650 ± 261	163	0.0156	0.0018
	2NW	-0.00306 ± 0.0279	0.0186	640 ± 225	163	0.011	0.0018
	33	0.0481 ± 0.0462	0.0352	65.1 ± 211	166	0.0018	0.0018
	34	0 ± 0.0974	0.0485	-109 ± 221	180	0.0018	0.0018
	35	0.0345 ± 0.0508	0.0406	150 ± 235	183	0.0018	0.0018
	42	-0.0954 ± 0.11	0.0793	-57.9 ± 224	181	0.0018	0.0018
	43	-0.0115 ± 0.0719	0.0802	-361 ± 244	207	0.0018	0.0018
	45	0.0263 ± 0.038	0.027	-45.6 ± 239	193	0.0018	0.0018
	46	0.0319 ± 0.0852	0.0467	-196 ± 229	190	0.0459	0.0018
	49	0.0417 ± 0.0391	0.0313	-139 ± 230	189	0.0339	0.0018
	51	-0.00338 ± 0.0375	0.0427	-276 ± 218	184	0.0018	0.0018
	52	0.0543 ± 0.0574	0.0424	-175 ± 223	185	0.0018	0.0018
	55	0 ± 0.0981	0.0648	-154 ± 210	174	0.0378	0.0018
	6	-0.0612 ± 0.0695	0.035	-61.5 ± 207	167	0.0018	0.0018
	66	0.0275 ± 0.0299	0.0226	-110 ± 232	189	0.0018	0.0018

NOTE: MDA = minimum detectable activity
pCi/g = picocurie per gram
pCi/L = picocurie per liter
µg/g = microgram per gram

TABLE F-4. Non-radiological Results for Community Locations in Calendar Year 2000, Soil

Location Type	Location	Aluminum 0.615	Antimony 0.0815	Arsenic 0.131	Barium 0.0465	Beryllium 0.0311	Cadmium 0.0382	Chromium 0.0645	Cobalt 0.0555	Copper 0.1	Iron 1.14	Lead 0.099
Community	10	8790	0.0815	2.77	109	0.551	0.0927	8.87	5.65	7.45	9120	8.82
	11	4040	0.0815	1.97	171	0.241	0.0986	5.33	2.89	4.19	5800	5.41
	25	1930	0.0815	2.46	82.5	0.134	0.194	2.82	1.43	2.88	3030	7.45
	62	10800	0.0815	2.92	144	0.596	0.125	12.6	7.14	10	11300	9.88
	8	4550	0.0815	2.63	128	0.318	0.0382	5.38	3.43	10.2	6230	21.1
	9	11600	0.0815	4.62	186	0.692	0.123	13.1	7.04	12.6	12500	16.7

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-4. Non-radiological Results for Community Locations in Calendar Year 2000, Soil *(concluded)*

Location Type	Location	Magnesium 0.184	Manganese 0.0885	Mercury 0.0152	Nickel 0.072	Potassium 2.3	Selenium 0.146	Silver 0.101	Thallium 0.205	Vanadium 0.074	Zinc 0.138
Community	10	2290	462	0.0283	9.27	1580	0.146	0.101	0.933	19.5	25.6
	11	2240	279	0.0153	4.52	1200	0.146	0.101	0.205	14.1	17
	25	1050	139	0.00499	2.97	569	0.146	0.101	0.579	6.81	14.5
	62	3280	454	0.0214	13.6	2350	0.146	0.101	0.764	20.4	41
	8	2700	214	0.0344	5.83	1470	0.146	0.101	0.642	11.9	49.9
	9	4360	315	0.027	12.4	2200	0.146	0.101	1.09	27.8	43.5

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-5. Non-radiological Results for Perimeter Locations in Calendar Year 2000, Soil

Location Type	Location	Aluminum 0.615	Antimony 0.0815	Arsenic 0.131	Barium 0.0465	Beryllium 0.0311	Cadmium 0.0382	Chromium 0.0645	Cobalt 0.0555	Copper 0.1	Iron 1.14	Lead 0.099
Perimeter	12	7780	0.0815	2.49	116	0.464	0.0811	8.83	6.02	11.8	9420	13.7
	16	4080	0.0815	1.16	46.1	0.239	0.0382	2.84	3.12	4.57	6110	3.78
	19	7990	0.0815	3.34	128	0.431	0.0857	11.5	6.19	12	9680	15.9
	4	6040	0.0815	2.24	87.5	0.289	0.0382	5.42	2.63	5.39	5470	6.33
	5	4260	0.0815	1.3	49.4	0.227	0.0382	3.96	2.05	3.61	4330	5.41
	58	7220	0.0815	2.55	153	0.361	0.206	5.97	4.07	10.5	8370	15.1
	59	4770	0.0815	1.89	96.9	0.253	0.205	4.85	2.55	8.16	5370	23.7
	60	8900	0.0815	3.07	142	0.542	0.104	8.84	6.03	11.4	10600	8.23
	61	4040	0.0815	3.05	193	0.252	0.155	3.84	2.32	6.59	4630	8.44
	63	8960	0.0815	3.37	175	0.572	0.101	10.2	6.63	10.6	10600	10.8
	64	10500	0.0815	2.9	126	0.528	0.0382	5.92	9.07	14.5	18100	12.7
	65E	15400	0.0815	3.98	232	0.788	0.285	11.1	10.2	19.7	19800	17.1
	80	8280	0.0815	3.11	148	0.495	0.216	10.4	5.21	10.6	9750	12.1

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-5. Non-radiological Results for Perimeter Locations in Calendar Year 2000, Soil *(concluded)*

Location Type	Location	Magnesium 0.184	Manganese 0.0885	Mercury 0.0152	Nickel 0.072	Potassium 2.3	Selenium 0.146	Silver 0.101	Thallium 0.205	Vanadium 0.074	Zinc 0.138
Perimeter	12	3370	295	0.0159	8.68	1700	0.298	0.101	0.205	16.5	36.1
	16	2230	168	0.0136	3.96	1250	0.146	0.101	0.205	10.3	20.9
	19	3980	328	0.0154	12.1	1950	0.146	0.101	0.205	18.6	34
	4	2550	125	0.0164	5.36	2110	0.146	0.101	0.205	12.7	20.7
	5	1160	115	0.0157	3.46	1010	0.146	0.101	0.205	7.98	15.1
	58	3740	204	0.0103	7.88	2030	0.146	0.205	0.614	18.6	38.1
	59	2240	139	0.0106	5.27	1240	0.146	0.225	0.205	11.5	31.6
	60	4380	332	0.0286	10.4	3380	0.146	0.101	0.616	19.2	40.1
	61	2280	120	0.0156	4.03	1090	0.146	0.101	0.824	12.5	21
	63	3570	410	0.0175	13	1710	0.146	0.101	0.205	20.2	35.2
	64	7770	637	0.0174	9.63	3080	0.146	0.101	0.205	26.9	78.9
	65E	8630	606	0.0217	12.4	5120	0.146	0.276	0.793	34.9	82.3
	80	4450	288	0.0167	11.3	2050	0.146	0.101	1.08	16.7	40.1

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-6. Non-radiological Results for On-site Locations in Calendar Year 2000, Soil

Location Type	Location	Aluminum 0.615	Antimony 0.0815	Arsenic 0.131	Barium 0.0465	Beryllium 0.0311	Cadmium 0.0382	Chromium 0.0645	Cobalt 0.0555	Copper 0.1	Iron 1.14	Lead 0.099
Community	1	4380	0.0815	1.39	72.2	0.237	0.0382	4.99	4.43	5.74	11400	3.62
	20	7020	0.219	2.09	97.4	0.359	2.12	8.45	4.6	9.49	9730	62.6
	2NE	5270	0.0815	1.55	62.5	0.294	0.207	5.19	2.5	4.88	5570	7.31
	2NW	4100	0.0815	1.25	58.1	0.237	0.141	4.51	2.32	3.84	5070	11.6
	2SE	6410	0.0815	2.06	81.2	0.36	2.79	5.22	2.6	5.32	6060	6.26
	2SW	4760	0.0815	1.61	65.1	0.279	0.148	4.91	2.44	4.03	5310	5.14
	3	6290	0.0815	4.7	340	0.294	0.0382	5.22	3.23	4.79	5610	5.21
	32E	8220	0.0815	2.79	134	0.405	0.408	7.29	4.73	11.2	9010	8.01
	32S	6820	0.0815	2.25	98.5	0.335	0.56	6.6	4.18	12.6	8730	14.4
	33	6290	0.0815	4.53	135	0.952	0.397	8.33	5.12	9.76	8510	15.2
	34	8410	0.0815	3.69	143	0.549	0.214	8.92	5.19	8.72	9030	9.14
	35	6580	0.0815	1.7	66.3	0.345	0.0382	6.55	3.21	6.93	6700	9.12
	41	5360	0.0815	1.54	53	0.32	0.189	4.92	2.49	5.03	5180	9.11
	42	5930	0.0815	1.77	60.5	0.356	0.0382	5.48	2.97	5.91	5850	4.82
	43	6220	0.0815	1.95	64.4	0.324	0.0764	5.31	2.59	5.45	5660	4.93
	45	5370	0.0815	1.56	58	0.284	0.0382	5.24	2.51	4.83	5610	7.58
	46	6320	0.0815	2.68	221	0.339	0.129	5.37	3.78	7.5	7950	7.23
	49	7760	0.0815	1.74	106	0.403	0.178	8.13	4.66	8.21	9020	11.9
	51	8290	0.0815	2.51	109	0.461	0.0382	31.3	3.37	8.45	7340	7.29
	52	14100	0.0815	4.04	185	0.736	0.149	11.3	5.61	13.4	11500	12.2
	53	11500	0.0815	3.39	110	0.628	0.12	9.38	4.45	9.11	10000	8.67
	54	6740	0.0815	2.1	81.4	0.357	0.762	5.74	2.96	7.32	6250	12.4
	55	6140	0.0815	2.28	73.7	0.311	0.125	5.35	2.62	5.3	5770	7.82
	56	3150	0.0815	1.29	53.2	0.174	0.0382	5.35	2.95	6.45	4640	10.6
	57	6040	0.0815	2.91	235	0.311	0.118	5.66	3.57	6.53	7400	6.55
	6	12000	0.0815	3	105	0.626	0.0382	9.61	4.52	11	9910	10
	66	9300	0.0815	3.61	128	0.596	0.0382	7.92	4.44	8.44	8610	6.6
	7	6120	0.0815	1.38	64.1	0.347	0.122	6.31	3.39	6.91	6440	10.7
	76	7440	0.0815	1.55	69.5	0.39	0.097	6.2	3.21	7.51	6790	10.9
	77	7530	0.0815	2.08	91.9	0.374	0.122	6.81	3.26	6.59	6810	8.97
	78	5230	0.0815	1.94	70.1	0.3	0.105	5.49	3.76	7.17	7450	7.84

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-6. Non-radiological Results for On-site Locations in Calendar Year 2000, Soil *(concluded)*

Location Type	Location	Magnesium 0.184	Manganese 0.0885	Mercury 0.0152	Nickel 0.072	Potassium 2.3	Selenium 0.146	Silver 0.101	Thallium 0.205	Vanadium 0.074	Zinc 0.138
Community	1	2490	193	0.0053	4.61	1020	0.146	0.101	0.205	23	23
	20	3390	248	0.0096	9.86	2010	0.146	0.101	0.205	17	34.5
	2NE	1710	117	0.00808	4.65	1280	0.146	0.101	0.205	10.2	20.1
	2NW	1420	105	0.00928	3.72	1190	0.146	0.101	0.205	9.23	27.2
	2SE	2040	106	0.0233	6.01	1520	0.146	0.101	0.205	11.2	19.5
	2SW	1610	116	0.0109	4.03	1060	0.146	0.101	0.205	9.76	17.1
	3	5980	90.5	0.019	6.59	1310	0.146	0.101	1.44	18.5	17.5
	32E	3480	212	0.0225	7.29	1980	0.146	0.192	0.205	19.9	36.6
	32S	3170	194	0.019	7.19	1740	0.146	0.214	0.205	17.9	62.4
	33	3870	322	0.0243	10.4	1910	0.146	0.101	0.73	14.2	69.4
	34	3110	239	0.0209	10.5	1790	0.146	0.101	0.205	17.9	29.6
	35	1870	185	0.0258	5.78	1580	0.146	0.101	0.205	11.2	24.6
	41	1860	114	0.0165	4.68	1490	0.146	0.101	0.205	9.76	22
	42	2520	127	0.0135	5.88	1640	0.146	0.101	0.205	11	20.4
	43	2020	111	0.014	5.03	1710	0.146	0.101	0.205	12.7	20
	45	1580	141	0.021	4.62	1390	0.146	0.101	0.205	9.62	19.9
	46	2850	183	0.00973	5.74	1880	0.146	0.101	0.205	16.8	33.9
	49	3870	298	0.0219	9.22	1980	0.146	0.101	0.205	15.5	34.1
	51	2840	133	0.0231	7.07	1710	0.146	0.101	0.205	15.2	63.6
	52	4440	229	0.0241	11.1	2780	0.146	0.305	0.205	23	60.5
	53	2890	169	0.0184	8.11	1970	0.146	0.101	0.205	19.2	27.6
	54	1930	136	0.0172	6.94	1470	0.146	0.101	0.205	11.9	33
	55	2290	164	0.0218	4.98	1650	0.146	0.101	0.205	10.5	22.5
	56	1410	88	0.0121	5.26	581	0.146	0.101	0.205	10.3	48.7
	57	3910	167	0.0118	6.19	1600	0.146	0.101	0.98	20.5	42
	6	2840	178	0.025	8.67	2290	0.146	0.101	0.205	18.8	32.1
	66	3570	190	0.0154	8.43	1900	0.146	0.101	0.205	19.2	26.9
	7	1920	181	0.0199	5.65	1530	0.146	0.101	0.205	11.3	25
	76	2070	158	0.0176	5.81	1690	0.146	0.101	0.205	11.7	24.8
	77	2430	182	0.0238	6.23	1960	0.146	0.101	0.205	12.6	25.3
	78	2470	197	0.00857	6.53	1380	0.146	0.101	0.205	11.2	23.7

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-7. Non-radiological Results for Calendar Year 2000, Sediment

Location Type	Location	Aluminum 0.615	Antimony 0.0815	Arsenic 0.131	Barium 0.0465	Beryllium 0.0311	Cadmium 0.0382	Chromium 0.0645	Cobalt 0.0555	Copper 0.1	Iron 1.14	Lead 0.099
Community	11	10800	0.0815	2.41	161	0.572	0.379	9.02	5.16	7.96	9160	8.44
	68	4940	0.0815	4.18	109	0.324	0.156	6.07	3.51	4.81	5960	5.8
	8	4430	0.0815	2.17	121	0.316	0.579	4.23	3.28	6.59	5530	5.64
Perimeter	60	5360	0.0815	2.1	95.6	0.279	0.0382	6.31	4.23	7.12	10500	7.37
	65E	3970	0.0815	1.35	48.2	0.277	0.0908	3.04	3.23	5.64	6910	4.05
	73	3530	0.0815	1.03	39.8	0.271	0.102	9.38	2.91	4.28	7290	3.14
On-site	72	10300	0.0815	3.45	160	0.603	0.0382	11.4	7.44	15.7	13100	16.3
	74	10000	0.0815	2.39	144	0.501	0.103	8.58	6.16	11.8	11800	10.1
	75	7110	0.0815	2.05	85.8	0.395	0.0382	7.65	4.31	10.5	8230	8.06
	79	6440	0.0815	3.18	140	0.39	0.156	8.33	4.25	8.74	8780	9.82

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-7. Non-radiological Results for Calendar Year 2000, Sediment *(concluded)*

Location Type	Location	Magnesium 0.184	Manganese 0.0885	Mercury 0.0152	Nickel 0.072	Potassium 2.3	Selenium 0.146	Silver 0.101	Thallium 0.205	Vanadium 0.074	Zinc 0.138
Community	11	4270	282	0.0158	9.59	2050	0.146	0.101	0.205	17.9	30.1
	68	2930	256	0.0121	7.46	1010	0.146	0.101	2.07	10.5	21.1
	8	2770	198	0.026	5.64	1020	0.146	0.101	0.497	10.1	21.9
Perimeter	60	3090	213	0.00516	6.3	1690	0.146	0.101	0.919	20.2	34.1
	65E	2350	207	0.0152	3.98	1280	0.146	0.101	0.697	14.2	25.1
	73	2040	178	0.0152	5.82	885	0.146	0.101	0.205	12.5	23.5
On-site	72	5820	361	0.0165	12	2160	0.146	0.101	0.205	23.9	45.1
	74	4460	366	0.0234	9.64	3890	0.146	0.101	0.205	22.1	44.2
	75	3570	222	0.0141	8.24	1280	0.146	0.101	0.205	16.5	35.8
	79	3550	235	0.00811	8.66	1280	0.146	0.101	1.03	15.1	34.5

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-8. Non-radiological Results for Calendar Year 2000, Vegetation

Location Type	Location	Aluminum 0.615	Antimony 0.0815	Arsenic 0.131	Barium 0.0465	Beryllium 0.0311	Cadmium 0.0382	Chromium 0.0645	Cobalt 0.0555	Copper 0.1	Iron 1.14	Lead 0.099
Community	11	12.6	0.0815	0.275	0.769	0.0311	0.0382	0.0645	0.0555	1.34	24.9	0.099
	25	29.1	0.0815	0.408	8.98	0.0311	0.0382	0.194	0.0555	3	47.3	0.851
	8	84.6	0.329	0.469	11.2	0.0311	0.0382	0.157	0.0555	1.5	98.5	0.363
	9	22.4	0.0815	0.684	22.3	0.0311	0.0382	0.273	0.0555	2.9	35	0.718
Perimeter	12	70.7	0.203	0.287	8.41	0.0311	0.0382	0.0645	0.0555	5.83	78.6	0.099
	4	113	0.0815	0.131	16.9	0.0311	0.0382	0.0645	0.0555	5.04	102	0.219
	5	114	0.0815	0.355	13.1	0.0311	0.0801	0.0645	0.0555	5.32	118	0.241
	64	116	0.0815	0.131	3.35	0.0311	0.0382	0.0645	0.0555	2.13	206	0.261
On-site	20	31.3	0.0815	0.131	1.04	0.0311	0.0382	0.0645	0.0555	1.67	44.3	0.253
	2NE	138	0.0815	0.59	12.4	0.0311	0.0775	0.241	0.0555	5.28	133	0.521
	2NW	33.7	0.0815	0.56	5.58	0.0311	0.0382	0.149	0.0555	3.72	40	0.099
	33	5.26	0.0815	0.131	5.82	0.0311	0.193	0.0645	0.0555	1.04	25.2	0.099
	34	161	0.0815	0.131	8.2	0.0311	0.0382	0.0645	0.0555	1.23	158	0.319
	35	899	0.0815	0.413	20.4	0.0311	0.0382	0.7	0.248	2.45	693	1.82
	42	121	0.0815	0.131	18.9	0.0311	0.0382	0.0645	0.0555	1.18	123	0.099
	43	540	0.0815	0.383	17.9	0.0311	0.0382	0.451	0.0555	1.59	413	0.704
	45	136	0.0815	0.29	7.82	0.0311	0.0382	0.0645	0.0555	3.58	135	0.542
	46	664	0.0815	0.592	24.1	0.0311	0.0382	0.507	0.226	5.69	727	0.896
	49	277	0.0815	0.287	10.3	0.0311	0.0382	0.385	0.0555	3.76	369	0.739
	51	58.3	0.0815	0.131	9.72	0.0311	0.0382	0.0645	0.0555	2.01	60.5	0.206
	52	121	0.0815	0.26	17.9	0.0311	0.0382	0.0645	0.0555	2.95	113	0.267
	55	460	0.0815	0.381	23.8	0.0311	0.0382	0.316	0.128	2.87	441	0.896
	6	410	0.0815	0.304	10.3	0.0311	0.0382	0.374	0.0555	5.05	378	0.458
	66	408	0.0815	0.391	13.4	0.0311	0.0382	0.276	0.0555	4.89	382	0.404

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-8. Non-radiological Results for Calendar Year 2000, Vegetation *(concluded)*

Location Type	Location	Magnesium 0.184	Manganese 0.0885	Mercury 0.0152	Nickel 0.072	Potassium 2.3	Selenium 0.146	Silver 0.101	Thallium 0.205	Vanadium 0.074	Zinc 0.138
Community	11	392	10.4	0.0152	0.072	5900	0.295	0.101	0.205	0.074	3.86
	25	295	28.5	0.00971	0.177	6850	0.55	0.101	0.205	0.074	8.58
	8	407	46.1	0.0171	0.072	5510	0.654	0.101	0.205	0.074	5.14
	9	437	7.81	0.0152	0.072	6250	0.807	0.101	0.205	0.074	35
Perimeter	12	737	13.8	0.0152	0.151	8060	0.766	0.101	0.205	0.074	18
	4	688	14.4	0.0152	0.279	7410	0.608	0.101	0.205	0.196	26.7
	5	992	19	0.0152	0.396	9980	0.894	0.101	0.205	0.186	14.9
	64	1280	13.5	0.0152	0.151	11000	0.499	0.101	0.205	0.338	10.6
On-site	20	1690	19.9	0.0152	0.286	12300	0.339	0.101	0.205	0.074	4.57
	2NE	1250	21.2	0.0152	0.265	8720	1.3	0.101	0.205	0.264	9.27
	2NW	1450	6.68	0.0152	0.249	7650	1.08	0.101	0.205	0.074	5.39
	33	670	10.5	0.0152	0.072	7270	0.732	0.101	0.205	0.074	15.2
	34	215	12.1	0.0152	0.224	1940	0.47	0.101	0.205	0.32	7.48
	35	858	37.1	0.0217	0.84	1960	1.13	0.101	0.205	1.34	6.12
	42	1270	14.1	0.0152	0.219	3400	0.299	0.101	0.205	0.217	6.58
	43	706	11.1	0.015	0.629	3540	0.795	0.101	0.205	0.813	4.41
	45	1100	15.9	0.00619	0.323	8100	0.675	0.101	0.205	0.316	7.38
	46	1250	29.5	0.0152	0.654	7440	0.997	0.101	0.205	1.26	11.1
	49	745	14.9	0.0152	0.278	7170	0.518	0.101	0.205	0.689	6.16
	51	508	21.9	0.0152	0.325	6290	0.274	0.101	0.205	0.074	18.9
	52	1140	16	0.0152	0.25	7810	0.454	0.101	0.205	0.214	9.08
	55	439	25.1	0.0152	0.82	3520	0.804	0.101	0.205	0.845	6.25
	6	1260	12.5	0.0152	0.937	9900	1.09	0.101	0.205	0.7	8.45
	66	1040	21.2	0.0152	0.472	6850	0.747	0.101	0.205	0.721	13

NOTE: Minimum Detection Limits are the numbers listed in the shaded portion under the metal name.

TABLE F-9. Radiological Replicate Sampling for Calendar Year Soil, 2000

Location Type	Location	Sample ID	Analyte	Units	Result	Error	MDA	Avg	Std Dev	CV
Community	11	051107-001	Cesium-137	pCi/g	0.0552	0.0417	0.00854	0.0733	0.0170	23.23%
		051107-002	Cesium-137	pCi/g	0.089	0.0332	0.00929			
		051107-003	Cesium-137	pCi/g	0.0757	0.0361	0.00771			
		051107-001	Tritium	pCi/mL	-0.0288	0.128	0.109	0.019	0.059	314.80%
		051107-002	Tritium	pCi/mL	0	0.129	0.108			
		051107-003	Tritium	pCi/mL	0.0854	0.137	0.108			
		051107-001	Total U	µg/g	0.614		0.0018	0.75	0.34	45.44%
		051107-002	Total U	µg/g	1.14		0.0018			
		051107-003	Total U	µg/g	0.5		0.0018			
Perimeter	64	051060-001	Cesium-137	pCi/g	0.435	0.0655	0.0135	0.578	0.190	32.85%
		051060-002	Cesium-137	pCi/g	0.793	0.115	0.0127			
		051060-003	Cesium-137	pCi/g	0.505	0.0795	0.0128			
		051060-001	Tritium	pCi/mL	0.39	0.348	0.292	0.300	0.101	33.61%
		051060-002	Tritium	pCi/mL	0.191	0.173	0.146			
		051060-003	Tritium	pCi/mL	0.32	0.322	0.273			
		051060-001	Total U	µg/g	0.95		0.0018	0.86	0.09	10.47%
		051060-002	Total U	µg/g	0.85		0.0018			
		051060-003	Total U	µg/g	0.771		0.0018			
On-site	20	051074-001	Cesium-137	pCi/g	0.409	0.0646	0.00959	0.4813	0.0824	17.11%
		051074-002	Cesium-137	pCi/g	0.571	0.083	0.00952			
		051074-003	Cesium-137	pCi/g	0.464	0.0684	0.00999			
		051074-001	Tritium	pCi/mL	-0.535	0.256	0.22	-0.094	0.386	-409.70%
		051074-002	Tritium	pCi/mL	0.0683	0.219	0.188			
		051074-003	Tritium	pCi/mL	0.184	0.251	0.212			
		051074-001	Total U	µg/g	0.519		0.0018	0.547	0.030	5.54%
		051074-002	Total U	µg/g	0.542		0.0018			
		051074-003	Total U	µg/g	0.579		0.0018			
On-site	2NE	051099-001	Cesium-137	pCi/g	0.149	0.0389	0.00845	0.125	0.027	21.36%
		051099-002	Cesium-137	pCi/g	0.0963	0.0461	0.00794			
		051099-003	Cesium-137	pCi/g	0.131	0.0375	0.00765			
		051099-001	Tritium	pCi/mL	1.48	0.28	0.144	1.39	0.10	6.90%
		051099-002	Tritium	pCi/mL	1.29	0.244	0.126			
		051099-003	Tritium	pCi/mL	1.41	0.257	0.13			
		051099-001	Total U	µg/g	0.399		0.0018	0.393	0.010	2.50%
		051099-002	Total U	µg/g	0.399		0.0018			
		051099-003	Total U	µg/g	0.382		0.0018			
On-site	33	051050-001	Cesium-137	pCi/g	0.393	0.0645	0.0159	0.356	0.059	16.56%
		051050-002	Cesium-137	pCi/g	0.387	0.066	0.0133			
		051050-003	Cesium-137	pCi/g	0.288	0.0594	0.018			
		051050-001	Tritium	pCi/mL	0.215	0.208	0.176	0.173	0.262	151.78%
		051050-002	Tritium	pCi/mL	0.411	0.276	0.228			
		051050-003	Tritium	pCi/mL	-0.108	0.226	0.195			
		051050-001	Total U	µg/g	0.663		0.0018	0.738	0.065	8.77%
		051050-002	Total U	µg/g	0.777		0.0018			
		051050-003	Total U	µg/g	0.773		0.0018			

NOTE: CV = coefficient of variation
MDA = minimum detectable activity
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter
Std Dev = Standard Deviation
µg/g = microgram per gram

TABLE F-9. Radiological Replicate Sampling for Calendar Year 2000, Soil *(concluded)*

Location Type	Location	Sample ID	Analyte	Units	Result	Error	MDA	Avg	Std Dev	CV
On-site	53	051098-001	Cesium-137	pCi/g	0.0381	0.0584	0.0112	0.047	0.010	21.47%
		051098-002	Cesium-137	pCi/g	0.044	0.0478	0.00829			
		051098-003	Cesium-137	pCi/g	0.0576	0.0314	0.00783			
		051098-001	Tritium	pCi/mL	0.0852	0.136	0.108	0.114	0.049	43.03%
		051098-002	Tritium	pCi/mL	0.17	0.144	0.108			
		051098-003	Tritium	pCi/mL	0.0855	0.137	0.108			
		051098-001	Total U	µg/g	0.447		0.0018	0.469	0.023	4.80%
		051098-002	Total U	µg/g	0.492		0.0018			
		051098-003	Total U	µg/g	0.468		0.0018			

NOTE: CV = coefficient of variation
MDA = minimum detectable activity
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter
Std Dev = Standard Deviation
µg/g = microgram per gram

TABLE F-10. Radiological Replicate Sampling for Calendar Year 2000, Sediment

Location Type	Location	Sample ID	Analyte	Units	Result	Error	MDA	Avg	Std Dev	CV
Community	11	051109-001	Cesium-137	pCi/g	0.0604	0.0397	0.00786	0.1060	0.0529	38.51%
		051109-002	Cesium-137	pCi/g	0.0937	0.0387	0.00784			
		051109-003	Cesium-137	pCi/g	0.164	0.0581	0.00989			
		051109-001	Tritium	pCi/mL	0.0567	0.134	0.108	0.0568	0.0001	0.18%
		051109-002	Tritium	pCi/mL	0.0569	0.134	0.108			
		051109-003	Tritium	pCi/mL	0.0568	0.134	0.108			
		051109-001	Total U	µg/g	0.482		0.0018	0.519	0.048	9.32%
		051109-002	Total U	µg/g	0.502		0.0018			
		051109-003	Total U	µg/g	0.574		0.0018			
On-site	74	051014-001	Cesium-137	pCi/g	0.183	0.0582	0.0118	0.150	0.0.072	48.18%
		051014-002	Cesium-137	pCi/g	0.199	0.0365	0.0073			
		051014-003	Cesium-137	pCi/g	0.0669	0.0352	0.0111			
		051014-001	Tritium	pCi/mL	0.173	0.239	0.189	0.296	0.227	76.89%
		051014-002	Tritium	pCi/mL	0.156	0.179	0.152			
		051014-003	Tritium	pCi/mL	0.558	0.398	0.331			
		051014-001	Total U	µg/g	0.845		0.0018	0.771	0.064	8.33%
		051014-002	Total U	µg/g	0.742		0.0018			
		051014-003	Total U	µg/g	0.727		0.0018			

NOTE: CV = coefficient of variation
MDA = minimum detectable activity
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter
Std Dev = Standard Deviation
µg/g = microgram per gram

TABLE F-11. Radiological Replicate Sampling for Calendar Year 2000, Vegetation

Location Type	Location	Sample ID	Analyte	Units	Result	Error	MDA	Avg	Std Dev	CV
Community	11	051108-001	Cesium-137	pCi/g	0.042	0.0517	0.0408	0.0161	0.0227	141.61%
		051108-002	Cesium-137	pCi/g	0.00656	0.0582	0.0416			
		051108-003	Cesium-137	pCi/g	-0.000394	0.033	0.0231			
		051108-001	Tritium	pCi/mL	-0.242	0.278	0.243	-0.174	0.119	-68.55%
		051108-002	Tritium	pCi/mL	-0.0363	0.203	0.181			
		051108-003	Tritium	pCi/mL	-0.244	0.273	0.239			
		051108-001	Total U	µg/g	0.0068		0.0018	0.0074	0.0044	58.98%
		051108-002	Total U	µg/g	0.0121		0.0018			
		051108-003	Total U	µg/g	0.0034		0.0018			
On-site	33	051051-001	Cesium-137	pCi/g	0.0481	0.0462	0.0352	0.0296	0.0208	70.21%
		051051-002	Cesium-137	pCi/g	0.0335	0.051	0.0451			
		051051-003	Cesium-137	pCi/g	0.00713	0.0509	0.044			
		051051-001	Tritium	pCi/mL	0.0651	0.211	0.166	-0.0036	0.0768	-2113.3%
		051051-002	Tritium	pCi/mL	-0.0865	0.204	0.166			
		051051-003	Tritium	pCi/mL	0.0105	0.222	0.177			
		051051-001	Total U	µg/g	0.0018		0.0018	0.0329	0.0286	87.02%
		051051-002	Total U	µg/g	0.0387		0.0018			
		051051-003	Total U	µg/g	0.0581		0.0018			

NOTE: CV = coefficient of variation
MDA = minimum detectable activity
pCi/g = picocurie per gram
pCi/mL = picocurie per milliliter
Std Dev = Standard Deviation
µg/g = microgram per gram

TABLE F-12. Non-radiological Replicate Sampling for Calendar Year 2000, Soil

Location Type	Location	Analyte	Units	Minimum Detectable Limit	Replicate Sample 01	Replicate Sample 02	Replicate Sample 03	Average	Std Dev	CV
Community	11	Aluminum	mg/kg	0.615	4040	4040	3460	3847	335	8.71%
		Antimony	mg/kg	0.0815	0.0815	0.0815	0.0815	0.0815	0.00	0%
		Arsenic	mg/kg	0.131	1.97	2	1.83	1.93	0.09	4.69%
		Barium	mg/kg	0.0465	171	154	144	156	14	8.73%
		Beryllium	mg/kg	0.0311	0.241	0.241	0.214	0.232	0.016	6.72%
		Cadmium	mg/kg	0.0382	0.0986	0.133	0.119	0.117	0.017	14.80%
		Chromium	mg/kg	0.0645	5.33	5.23	4.78	5.11	0.29	5.73%
		Cobalt	mg/kg	0.0555	2.89	2.85	2.68	2.81	0.11	3.97%
		Copper	mg/kg	0.1	4.19	4.11	3.49	3.93	0.38	9.75%
		Iron	mg/kg	1.14	5800	5830	5170	5600	373	6.66%
		Lead	mg/kg	0.099	5.41	5.23	4.99	5.21	0.21	4.04%
		Magnesium	mg/kg	0.184	2240	2280	1920	2147	197	9.19%
		Manganese	mg/kg	0.0885	279	288	258	275	15	5.60%
		Mercury	mg/kg	0.0152	0.0153	0.014	0.0159	0.0151	0.0010	6.45%
		Nickel	mg/kg	0.072	4.52	5.23	4.34	4.70	0.47	10.02%
		Potassium	mg/kg	2.3	1200	1310	1210	1240	61	4.91%
		Selenium	mg/kg	0.146	0.146	0.333	0.358	0.279	0.116	41.53%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	14.1	14.3	13.4	13.9	0.5	3.39%
		Zinc	mg/kg	0.138	17	19.3	16.8	17.7	1.4	7.85%
Perimeter	64	Aluminum	mg/kg	0.615	10500	10800	11200	10833	351	3.24%
		Antimony	mg/kg	0.0815	0.0815	0.0815	0.0815	0.0815	0.00	0%
		Arsenic	mg/kg	0.131	2.9	2.44	2.8	2.71	0.24	8.92%
		Barium	mg/kg	0.0465	126	121	123	123	3	2.04%
		Beryllium	mg/kg	0.0311	0.528	0.527	0.552	0.536	0.014	2.64%
		Cadmium	mg/kg	0.0382	0.0382	0.0382	0.0382	0.0382	0.00	0%
		Chromium	mg/kg	0.0645	5.92	6.51	6.33	6.25	0.30	4.84%
		Cobalt	mg/kg	0.0555	9.07	8.6	9.51	9.06	0.46	5.02%
		Copper	mg/kg	0.1	14.5	14.9	14.6	14.7	0.2	1.42%
		Iron	mg/kg	1.14	18100	18300	19500	18633	757	4.06%
		Lead	mg/kg	0.099	12.7	16.8	11.6	13.7	2.7	20.00%
		Magnesium	mg/kg	0.184	7770	7410	7880	7687	246	3.20%
		Manganese	mg/kg	0.0885	637	664	686	662	25	3.71%
		Mercury	mg/kg	0.0152	0.0174	0.0205	0.0223	0.0201	0.0025	12.35%
		Nickel	mg/kg	0.072	9.63	9.42	9.55	9.53	0.11	1.11%
		Potassium	mg/kg	2.3	3080	3270	3190	3180	95	3.00%
		Selenium	mg/kg	0.146	0.146	0.146	0.274	0.189	0.074	39.17%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	26.9	25.1	27	26.3	1.1	4.06%
		Zinc	mg/kg	0.138	78.9	80.4	81.6	80.3	1.4	1.68%

NOTE: CV = coefficient of variation
mg/kg = milligram per kilogram
Std Dev = Standard Deviation

TABLE F-12. Non-radiological Replicate Sampling for Calendar Year 2000, Soil *(continued)*

Location Type	Location	Analyte	Units	Minimum Detectable Limit	Replicate Sample 01	Replicate Sample 02	Replicate Sample 03	Average	Std Dev	CV
On-site	2NE	Aluminum	mg/kg	0.615	5270	5980	5620	5623	355	6.31%
		Antimony	mg/kg	0.0815	0.0815	0.0815	0.0815	0.0815	0.00	0%
		Arsenic	mg/kg	0.131	1.55	1.88	1.52	1.65	0.20	12.11%
		Barium	mg/kg	0.0465	62.5	71.4	68.8	67.6	4.6	6.77%
		Beryllium	mg/kg	0.0311	0.294	0.328	0.308	0.310	0.017	5.51%
		Cadmium	mg/kg	0.0382	0.207	0.318	0.227	0.251	0.059	23.60%
		Chromium	mg/kg	0.0645	5.19	5.7	5.44	5.44	0.26	4.68%
		Cobalt	mg/kg	0.0555	2.5	2.76	2.62	2.63	0.13	4.95%
		Copper	mg/kg	0.1	4.88	5.25	4.98	5.04	0.19	3.80%
		Iron	mg/kg	1.14	5570	6360	5940	5957	395	6.64%
		Lead	mg/kg	0.099	7.31	7.13	7.08	7.17	0.12	1.69%
		Magnesium	mg/kg	0.184	1710	1850	1740	1767	74	4.17%
		Manganese	mg/kg	0.0885	117	126	119	121	5	3.92%
		Mercury	mg/kg	0.0152	0.00808	0.0106	0.00802	0.0089	0.0015	16.55%
		Nickel	mg/kg	0.072	4.65	5.12	5.03	4.93	0.25	5.06%
		Potassium	mg/kg	2.3	1280	1350	1260	1297	47	3.64%
		Selenium	mg/kg	0.146	0.146	0.146	0.146	0.146	0.00	0%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	10.2	11.5	10.6	10.8	0.7	6.18%
		Zinc	mg/kg	0.138	20.1	21.2	20.8	20.7	0.6	2.69%
On-site	20	Aluminum	mg/kg	0.615	7020	6740	6430	6730	295	4.39%
		Antimony	mg/kg	0.0815	0.219	0.0815	0.0815	0.1273	0.0794	62.34%
		Arsenic	mg/kg	0.131	2.09	2.02	1.95	2.02	0.07	3.47%
		Barium	mg/kg	0.0465	97.4	101	95.9	98.1	2.6	2.67%
		Beryllium	mg/kg	0.0311	0.359	0.327	0.319	0.335	0.021	6.32%
		Cadmium	mg/kg	0.0382	2.12	0.827	0.684	1.210	0.791	65.36%
		Chromium	mg/kg	0.0645	8.45	7.12	8.88	8.15	0.92	11.26%
		Cobalt	mg/kg	0.0555	4.6	4.75	4.46	4.60	0.15	3.15%
		Copper	mg/kg	0.1	9.49	8.75	8.05	8.76	0.72	8.22%
		Iron	mg/kg	1.14	9730	9260	9330	9440	254	2.69%
		Lead	mg/kg	0.099	62.6	44.9	38.6	48.7	12.4	25.55%
		Magnesium	mg/kg	0.184	3390	3370	3190	3317	110	3.32%
		Manganese	mg/kg	0.0885	248	245	239	244	5	1.88%
		Mercury	mg/kg	0.0152	0.0096	0.0944	0.00595	0.0367	0.0500	136.55%
		Nickel	mg/kg	0.072	9.86	8.77	8.54	9.06	0.71	7.79%
		Potassium	mg/kg	2.3	2010	2070	2000	2027	38	1.87%
		Selenium	mg/kg	0.146	0.146	0.146	0.146	0.146	0.00	0%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	17	16.1	16.4	16.5	0.5	2.78%
		Zinc	mg/kg	0.138	34.5	34.1	32.3	33.6	1.2	3.48%

NOTE: CV = coefficient of variation
mg/kg = milligram per kilogram
Std Dev = Standard Deviation

TABLE F-12. Non-radiological Replicate Sampling for Calendar Year 2000, Soil *(concluded)*

Location Type	Location	Analyte	Units	Minimum Detectable Limit	Replicate Sample 01	Replicate Sample 02	Replicate Sample 03	Average	Std Dev	CV
On-site	33	Aluminum	mg/kg	0.615	6290	6970	7010	6757	405	5.99%
		Antimony	mg/kg	0.0815	0.0815	0.0815	0.0815	0.0815	0.00	0%
		Arsenic	mg/kg	0.131	4.53	4.05	5.47	4.68	0.72	15.42%
		Barium	mg/kg	0.0465	135	134	134	134	1	0.43%
		Beryllium	mg/kg	0.0311	0.952	0.839	0.977	0.923	0.074	7.97%
		Cadmium	mg/kg	0.0382	0.397	0.365	0.314	0.359	0.042	11.67%
		Chromium	mg/kg	0.0645	8.33	9	8.88	8.74	0.36	4.09%
		Cobalt	mg/kg	0.0555	5.12	5.31	5.64	5.36	0.26	4.91%
		Copper	mg/kg	0.1	9.76	11.2	10.6	10.5	0.7	6.88%
		Iron	mg/kg	1.14	8510	9220	9350	9027	452	5.01%
		Lead	mg/kg	0.099	15.2	15.1	14.9	15.1	0.2	1.01%
		Magnesium	mg/kg	0.184	3870	4140	4180	4063	169	4.15%
		Manganese	mg/kg	0.0885	322	312	359	331	25	7.48%
		Mercury	mg/kg	0.0152	0.0243	0.0223	0.0237	0.0234	0.001	4.38%
		Nickel	mg/kg	0.072	10.4	11	12	11.1	0.8	7.26%
		Potassium	mg/kg	2.3	1910	2070	2110	2030	106	5.21%
		Selenium	mg/kg	0.146	0.146	0.534	0.399	0.360	0.197	54.76%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.73	0.556	0.477	0.588	0.129	22.03%
		Vanadium	mg/kg	0.074	14.2	15.8	16.1	15.4	1.0	6.65%
		Zinc	mg/kg	0.138	69.4	66.3	62.9	66.2	3.3	4.91%
On-site	53	Aluminum	mg/kg	0.615	11500	8170	8980	9550	1737	18.18%
		Antimony	mg/kg	0.0815	0.0815	0.0815	0.0815	0.0815	0.00	0%
		Arsenic	mg/kg	0.131	3.39	2.25	2.3	2.65	0.64	24.34%
		Barium	mg/kg	0.0465	110	81.9	87	93.0	15.0	16.10%
		Beryllium	mg/kg	0.0311	0.628	0.436	0.474	0.513	0.102	19.83%
		Cadmium	mg/kg	0.0382	0.12	0.153	0.146	0.140	0.017	12.45%
		Chromium	mg/kg	0.0645	9.38	6.94	7.62	7.98	1.26	15.78%
		Cobalt	mg/kg	0.0555	4.45	3.47	3.72	3.88	0.51	13.12%
		Copper	mg/kg	0.1	9.11	6.87	7.9	7.96	1.12	14.09%
		Iron	mg/kg	1.14	10000	7710	8190	8633	1208	13.99%
		Lead	mg/kg	0.099	8.67	8.27	8.57	8.50	0.21	2.45%
		Magnesium	mg/kg	0.184	2890	2180	2340	2470	372	15.08%
		Manganese	mg/kg	0.0885	169	142	155	155	14	8.69%
		Mercury	mg/kg	0.0152	0.0184	0.0135	0.016	0.0160	0.0025	15.35%
		Nickel	mg/kg	0.072	8.11	6.15	6.79	7.02	1.00	14.24%
		Potassium	mg/kg	2.3	1970	1420	1680	1690	275	16.28%
		Selenium	mg/kg	0.146	0.146	0.146	0.146	0.146	0.00	0%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	19.2	13.7	14.6	15.8	3.0	18.63%
		Zinc	mg/kg	0.138	27.6	22.3	24.3	24.7	2.7	10.82%

NOTE: CV = coefficient of variation
mg/kg = milligram per kilogram
Std Dev = Standard Deviation

TABLE F-13. Non-radiological Replicate Sampling for Calendar Year 2000, Sediment

Location Type	Location	Analyte	Units	Minimum Detectable Limit	Replicate Sample 01	Replicate Sample 02	Replicate Sample 03	Average	Std Dev	CV
Community	11	Aluminum	mg/kg	0.615	10800	10100	9750	10217	535	5.23%
		Antimony	mg/kg	0.0815	0.0815	0.0815	0.0815	0.0815	0.00	0%
		Arsenic	mg/kg	0.131	2.41	2.09	2.27	2.26	0.16	7.11%
		Barium	mg/kg	0.0465	161	155	151	156	5	3.23%
		Beryllium	mg/kg	0.0311	0.572	0.55	0.522	0.548	0.025	4.57%
		Cadmium	mg/kg	0.0382	0.379	0.334	0.483	0.399	0.076	19.17%
		Chromium	mg/kg	0.0645	9.02	8.01	7.88	8.30	0.62	7.52%
		Cobalt	mg/kg	0.0555	5.16	4.87	4.77	4.93	0.20	4.11%
		Copper	mg/kg	0.1	7.96	8.16	7.83	7.98	0.17	2.08%
		Iron	mg/kg	1.14	9160	8000	7720	8293	764	9.21%
		Lead	mg/kg	0.099	8.44	8.12	7.8	8.12	0.32	3.94%
		Magnesium	mg/kg	0.184	4270	4090	3970	4110	151	3.67%
		Manganese	mg/kg	0.0885	282	259	297	279	19	6.85%
		Mercury	mg/kg	0.0152	0.0158	0.0186	0.0218	0.0187	0.00	16.03%
		Nickel	mg/kg	0.072	9.59	9.23	8.78	9.20	0.41	4.41%
		Potassium	mg/kg	2.3	2050	1950	1860	1953	95	4.87%
		Selenium	mg/kg	0.146	0.146	0.146	0.146	0.146	0.00	0%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	17.9	16.1	15.9	16.6	1.1	6.62%
		Zinc	mg/kg	0.138	30.1	28.7	27.5	28.8	1.3	4.52%
On-site	74	Aluminum	mg/kg	0.615	10000	8820	6700	8507	1672	19.66%
		Antimony	mg/kg	0.0815	0.0815	0.0815	0.0815	0.0815	0.00	0%
		Arsenic	mg/kg	0.131	2.39	2.85	2.05	2.43	0.40	16.52%
		Barium	mg/kg	0.0465	144	147	104	132	24	18.23%
		Beryllium	mg/kg	0.0311	0.501	0.532	0.385	0.473	0.077	16.39%
		Cadmium	mg/kg	0.0382	0.103	0.154	0.0382	0.098	0.058	58.98%
		Chromium	mg/kg	0.0645	8.58	8.89	6.51	7.99	1.29	16.19%
		Cobalt	mg/kg	0.0555	6.16	6.67	5.18	6.00	0.76	12.61%
		Copper	mg/kg	0.1	11.8	12.9	8.49	11.1	2.3	20.75%
		Iron	mg/kg	1.14	11800	12600	10300	11567	1168	10.09%
		Lead	mg/kg	0.099	10.1	14	8.67	10.9	2.8	25.26%
		Magnesium	mg/kg	0.184	4460	5240	3960	4553	645	14.17%
		Manganese	mg/kg	0.0885	366	424	311	367	57	15.40%
		Mercury	mg/kg	0.0152	0.0234	0.0158	0.0105	0.0166	0.0065	39.14%
		Nickel	mg/kg	0.072	9.64	10.9	8.06	9.53	1.42	14.93%
		Potassium	mg/kg	2.3	3890	4310	2840	3680	757	20.58%
		Selenium	mg/kg	0.146	0.146	0.509	0.146	0.267	0.210	78.49%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	22.1	21	16.9	20.0	2.7	13.70%
		Zinc	mg/kg	0.138	44.2	52	38.5	44.9	6.8	15.09%

NOTE: CV = coefficient of variation
mg/kg = milligram per kilogram
Std Dev = Standard Deviation

TABLE F-14. Non-radiological Replicate Sampling for Calendar Year 2000, Vegetation

Location Type	Location	Analyte	Units	Minimum Detectable Limit	Replicate Sample 01	Replicate Sample 02	Replicate Sample 03	Average	Std Dev	CV
Community	11	Aluminum	mg/kg	0.615	12.6	9.89	10.3	10.93	1.46	13.36%
		Antimony	mg/kg	0.0815	0.0815	0.0815	0.0815	0.0815	0.00	0%
		Arsenic	mg/kg	0.131	0.275	0.131	0.35	0.252	0.111	44.17%
		Barium	mg/kg	0.0465	0.769	0.353	0.35	0.491	0.241	49.13%
		Beryllium	mg/kg	0.0311	0.0311	0.0311	0.0311	0.0311	0.00	0%
		Cadmium	mg/kg	0.0382	0.0382	0.0382	0.0731	0.0498	0.0201	40.43%
		Chromium	mg/kg	0.0645	0.0645	0.0645	0.0645	0.0645	0.00	0%
		Cobalt	mg/kg	0.0555	0.0555	0.0555	0.0555	0.0555	0.00	0%
		Copper	mg/kg	0.1	1.34	2.52	3.4	2.42	1.03	42.71%
		Iron	mg/kg	1.14	24.9	31.6	43.9	33.5	9.6	28.79%
		Lead	mg/kg	0.099	0.099	0.099	0.099	0.099	0.00	0%
		Magnesium	mg/kg	0.184	392	523	753	556	183	32.87%
		Manganese	mg/kg	0.0885	10.4	18	31.1	19.8	10.5	52.80%
		Mercury	mg/kg	0.0152	0.0152	0.00594	0.0152	0.0121	0.0053	44.14%
		Nickel	mg/kg	0.072	0.072	0.153	0.495	0.240	0.225	93.55%
		Potassium	mg/kg	2.3	5900	6920	6860	6560	572	8.73%
		Selenium	mg/kg	0.146	0.295	0.319	0.453	0.356	0.085	23.94%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	0.074	0.074	0.656	0.268	0.336	125.38%
		Zinc	mg/kg	0.138	3.86	5.46	9.42	6.25	2.86	45.82%
On-site	33	Aluminum	mg/kg	0.615	5.26	88.7	22.1	38.69	44.12	114.05%
		Antimony	mg/kg	0.0815	0.0815	0.215	0.0815	0.126	0.077	61.17%
		Arsenic	mg/kg	0.131	0.131	0.131	0.131	0.131	0.00	0%
		Barium	mg/kg	0.0465	5.82	17.6	10.5	11.31	5.93	52.46%
		Beryllium	mg/kg	0.0311	0.0311	0.0311	0.0311	0.0311	0.00	0%
		Cadmium	mg/kg	0.0382	0.193	0.17	0.297	0.22	0.07	30.76%
		Chromium	mg/kg	0.0645	0.0645	0.0645	0.0645	0.0645	0.00	0%
		Cobalt	mg/kg	0.0555	0.0555	0.0555	0.0555	0.0555	0.00	0%
		Copper	mg/kg	0.1	1.04	2.18	2.08	1.77	0.63	35.73%
		Iron	mg/kg	1.14	25.2	103	48.9	59.03	39.88	67.55%
		Lead	mg/kg	0.099	0.099	0.254	0.228	0.194	0.083	42.86%
		Magnesium	mg/kg	0.184	670	1750	1840	1420	651	45.85%
		Manganese	mg/kg	0.0885	10.5	20.2	35.8	22.2	12.8	57.58%
		Mercury	mg/kg	0.0152	0.0152	0.0152	0.0152	0.0152	0.00	0%
		Nickel	mg/kg	0.072	0.072	0.229	0.35	0.217	0.139	64.23%
		Potassium	mg/kg	2.3	7270	9180	11200	9217	1965	21.32%
		Selenium	mg/kg	0.146	0.732	0.871	1.28	0.961	0.285	29.64%
		Silver	mg/kg	0.101	0.101	0.101	0.101	0.101	0.00	0%
		Thallium	mg/kg	0.205	0.205	0.205	0.205	0.205	0.00	0%
		Vanadium	mg/kg	0.074	0.074	0.184	0.074	0.111	0.064	57.39%
		Zinc	mg/kg	0.138	15.2	29.2	68.1	37.5	27.4	73.09%

NOTE: CV = coefficient of variation
mg/kg = milligram per kilogram
Std Dev = Standard Deviation

TABLE F-15. Summary TLD Results for Calendar Year 2000, SNL/NM

Location Type	Units	No. Locations	Total Exposure	Std Dev	Minimum	Maximum	# Days
Off-site	mR	12	85.33	10.78	73.20	105.40	366
Perimeter	mR	7	89.16	8.21	78.90	102.90	366
On-site	mR	14	93.57	11.23	82.70	119.70	366
Operational*	mR	2	136.16	19.45	122.40	149.90	366

NOTE: *Operational Locations are not included in statistical analyses.
mR = milliroentgen
Std Dev = Standard Deviation

TABLE F-16. TLD Measurements by Quarter and Location Type for Calendar Year 2000, SNL/NM

Location Class	Loc	Units	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Yearly		
			Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days
Community	10	mR	26.8	1.8	90	21.5	1	77	30.9	1.1	116	26.2	2	83	105.4	3.07	366
Community	11	mR	20.8	2.1	90	14	1.5	77	20	1.6	116	18.4	2.2	83	73.2	3.75	366
Community	21	mR	23.9	1.8	90	18.2	0.9	77	24.5	1.1	116	23.1	1.9	83	89.7	2.98	366
Community	22	mR	20.3	1.7	90	14.9	0.9	77	21.1	1	116	19.9	1.9	83	76.2	2.88	366
Community	23	mR	20.8	1.8	90	16.3	0.9	77	22.4	1.1	116	18.7	1.9	83	78.2	2.98	366
Community	24	mR	20	2.3	90	15.3	1.7	77	21.4	1.8	116	17	2.4	83	73.7	4.14	366
Community	25	mR	22	1.7	90	16.7	0.7	77	22	0.9	116	18	1.8	83	78.7	2.73	366
Community	26	mR	26.6	1.8	90	22.2	0.9	77	30.9	1.1	116	22.3	1.9	83	102	2.98	366
Community	27	mR	24.5	1.9	90	19.9	1.1	77	27	1.2	116	19	2	83	90.4	3.20	366
Community	28	mR	21.4	1.9	90	16.2	1.1	77	23.9	1.2	116	22.5	2	83	84	3.20	366
Community	29	mR	21.3	1.6	90	16.9	0.6	77	23.3	0.9	116	18.1	1.8	83	79.6	2.64	366
Community	30	mR	25.7	2.1	90	19.8	1.5	77	26.9	1.6	116	20.5	2.3	83	92.9	3.81	366
Averages			22.8	1.9		17.7	1.1		24.5	1.2		20.3	2.0		85.3	3.2	

NOTE: mR = milliroentgen

TABLE F-16. TLD Measurements by Quarter and Location Type for Calendar Year 2000, SNL/NM *(continued)*

Location Class	Loc	Units	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Yearly		
			Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days
Perimeter	40	mR	22.1	2.8	90	16.1	1.5	77	22.5	1.2	116	21.3	2.6	83	82	4.28	366
Perimeter	39	mR	29	1.2	90	17.5	2	77	22.7	2.2	116	21.7	2.3	83	90.9	3.95	366
Perimeter	5	mR	21.3	1.9	90	16	0.7	77	21.2	1.4	116	20.4	2.2	83	78.9	3.30	366
Perimeter	16	mR	22.7	1.9	90	22.4	2.2	77	30.2	1.9	116	27.6	2.4	83	102.9	4.22	366
Perimeter	18	mR	23.8	1.2	90	17.5	2.6	77	23.8	2.4	116	22.9	2.3	83	88	4.39	366
Perimeter	4	mR	22.7	1.4	90	18.1	2.6	77	24.8	1	116	20.1	2.3	83	85.7	3.87	366
Perimeter	19	mR	25.2	1.6	90	18.8	2	77	27.3	1.1	116	24.4	2.6	83	95.7	3.81	366
Averages			23.8	1.7		18.1	1.9		24.6	1.6		22.6	2.4		89.2	4.0	

NOTE: mR = milliroentgen

TABLE F-16. TLD Measurements by Quarter and Location Type for Calendar Year 2000, SNL/NM *(continued)*

Location Class	Loc	Units	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Yearly		
			Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days
On-site	31	mR	22.5	1.5	90	16.9	2.2	77	23.2	1.4	116	21.6	2.6	83	84.2	3.98	366
On-site	46	mR	25.7	1.4	90	19	2.7	77	29.6	1.6	116	23.5	2.1	83	97.8	4.03	366
On-site	6	mR	23.8	1.2	90	18.7	2.2	77	24	1.5	116	22.2	2.1	83	88.7	3.60	366
On-site	2NW	mR	22.3	1.8	90	17.2	2.1	77	22.4	1.4	116	20.8	2.2	83	82.7	3.80	366
On-site	20	mR	25.5	1.8	90	18.4	2.5	77	25.6	1	116	50.2	2.3	83	119.7	3.97	366
On-site	41	mR	24.3	1.8	90	17.4	1.4	77	23.9	1.3	116	48.5	3.4	83	114.1	4.30	366
On-site	42	mR	22.9	2.2	90	17.1	2.5	77	22.5	1.4	116	20.8	2.2	83	83.3	4.23	366
On-site	43	mR	22.8	2.5	90	16.9	1.7	77	23.2	1.6	116	21.4	2.7	83	84.3	4.36	366
On-site	3	mR	23.8	2.3	90	18.3	2.3	77	25.2	1.4	116	21.8	2.1	83	89.1	4.12	366
On-site	7	mR	25.5	1.5	90	18.9	1.9	77	26.2	2	116	23.3	2.4	83	93.9	3.95	366
On-site	47	mR	24.2	1.1	90	18.2	1.5	77	26.2	1.4	116	22.9	2.4	83	91.5	3.34	366
On-site	48	mR	25.6	0.9	90	20	1	77	30.8	1.7	116	24.1	2.1	83	100.5	3.02	366
On-site	1	mR	24.7	1.6	90	19.1	1.3	77	25.1	2.2	116	21.7	2.5	83	90.6	3.92	366
On-site	66	mR	24.7	1	90	17.9	1.8	77	24.1	1.3	116	22.9	2.7	83	89.6	3.64	366
Averages			24.2	1.6		18.1	1.9		25.1	1.5		26.1	2.4		93.6	3.9	

NOTE: mR = milliroentgen

TABLE F-16. TLD Measurements by Quarter and Location Type for Calendar Year 2000, SNL/NM *(concluded)*

Location Class	Loc	Units	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Yearly		
			Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days	Exposure	Error	Days
Operational	45	mR	32.8	2.1	90	25.8	3.3	77	33.8	1.9	116	57.5	8.4	83	149.9	9.46	366
Operational	45E	mR	25.4	1.5	90	19.3	1.6	77	25.4	1.7	116	52.3	3.5	83	122.4	4.47	366
Averages			29.1	1.8		22.6	2.4		29.6	1.8		54.9	6.0		136.1	7.0	

NOTE: mR = milliroentgen

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