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Environmental Surveillance at Los Alamos during 1995

Environmental Surveillance Program:
Air Quality, ESH-17
Water Quality and Hydrology, ESH-18
Hazardous and Solid Waste, ESH-19
Ecology, ESH-20

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Los Alamos
NATIONAL LABORATORY

Los Alamos, New Mexico 87545

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Water Quality and Hydrology, ESH-18;
Hazardous and Solid Waste, ESH-19; and
Ecology, ESH-20.

The beginning of each chapter credits all contributing authors.

Julie Johnston (ESH-20) and Louisa Lujan-Pacheco (CIC-1) compiled this report with contributions from members of ESH Division. Louisa Lujan-Pacheco edited the report. Belinda Gutierrez (ESH-20) assembled this report and completed its layout. Karen Lyncoln (ESH-19) provided technical review of the document.

Preface



"Environmental Surveillance at Los Alamos" reports are prepared annually by the Los Alamos National Laboratory (the Laboratory) as required by US Department of Energy Order 5400.1, entitled "General Environmental Protection Program."

These annual reports summarize environmental data that characterize the Laboratory's compliance with applicable federal, state, and local environmental laws and regulations, executive orders, and departmental policies. Additional data, beyond the minimum required, is also gathered and reported as part of the Laboratory's efforts to ensure public safety and to monitor environmental quality at and near the Laboratory.

These annual reports are written to be useful to the many individuals, organizations, and governmental entities interested in environmental monitoring at the Laboratory. Significant environmental efforts, special studies, and environmental quality trends of interest are highlighted. This year's report contains improved maps and new graphs designed to further clarify important issues. A glossary of terms, a listing of report contributors, and other supplementary information are included to aid the reader. Comments on how to improve the annual reports are encouraged.

This report is prepared by the Los Alamos National Laboratory, Environment, Safety, and Health Division, for the US Department of Energy.

Inquires or comments regarding these annual reports may be directed to the US Department of Energy, Office of Environment and Projects, 528 35th Street, Los Alamos, NM, 87544, or to the Los Alamos National Laboratory, Environment, Safety, and Health Division, P.O. Box 1663, MS K491, Los Alamos, NM, 87545.

Environmental Surveillance at Los Alamos during 1995 is organized differently than past environmental site reports. The reorganization was based on audience feedback received from the reports published in 1993 and 1994. This report is designed to better meet the needs of our varied audience. We have tried to make information accessible to all without compromising its scientific integrity.

Chapter 1 provides an overview of the Laboratory and highlights the major environmental programs. Chapter 2 reports the Laboratory's compliance status for 1995. Chapter 3 provides a summary of the maximum radiological dose a member of the public could have potentially received from Laboratory operations. Chapters 4–6 discuss the environmental surveillance for each media: air, water, and foodstuffs. A glossary and a list of acronyms and abbreviations in the back of the report define relevant terms and acronyms. Appendix A explains the standards for environmental contaminants, Appendix B explains the units of measurements used in this report, and Appendix C describes the Laboratory's technical areas and their associated programs.

We've also enclosed a summary booklet that briefly explains important concepts, such as radiation, and provides a summary of the monitoring results and regulatory compliance explained at length in the report.

We hope to continue to improve this report based on our audience feedback. For further information about this report, contact the Los Alamos National Laboratory's Environmental Reports Team:

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1. Introduction

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Abstract

This report describes the environmental surveillance program at Los Alamos National Laboratory (LANL or the Laboratory) during 1995. The Laboratory routinely monitors for radiation and for radioactive and nonradioactive materials at (or on) Laboratory sites as well as in the surrounding region. LANL uses the monitoring result to determine compliance with appropriate standards and to identify potentially undesirable trends. Data were collected in 1995 to assess external penetrating radiation; quantities of airborne emissions and liquid effluents; concentrations of chemicals and radionuclides in ambient air, surface waters and groundwaters, municipal water supply, soils and sediments, and foodstuffs; and environmental compliance. Using comparisons with standards, regulations, and background levels, this report concludes that environmental effects from Laboratory operations are small and do not pose a demonstrable threat to the public, Laboratory employees, or the environment.

A. Laboratory Overview

1. Introduction to Los Alamos National Laboratory

In March 1943, a small group of scientists came to Los Alamos, located on a remote mesa high above the Rio Grande, northwest of Santa Fe for Project Y of the Manhattan Project. Their goal was to develop the world's first nuclear weapon. Although planners originally expected that the task would be completed by a hundred scientists, by 1945, when the first nuclear bomb was tested at Trinity Site in southern New Mexico, more than 3,000 civilian and military personnel were working at Los Alamos Laboratory. In 1947, Los Alamos Laboratory became Los Alamos Scientific Laboratory, which in turn became Los Alamos National Laboratory (LANL or the Laboratory) in 1981.

The Laboratory's original mission to design, develop, and test nuclear weapons has broadened and evolved as technologies, US priorities, and the world community have changed. Los Alamos is a multiprogram laboratory with the central mission of reducing the nuclear danger. The central mission at the Laboratory has evolved beyond the nuclear weapons research, development, and testing role to now include five major elements to reduce the nuclear danger:

- stockpile stewardship activities ensure that we keep safe, secure, and reliable those weapons that the nation needs;
- stockpile support projects provide capabilities ranging from the dismantlement to the recertification of existing nuclear weapons;
- nuclear materials management requires that we ensure the availability or safe disposition of plutonium, highly enriched uranium, and tritium;
- effective nonproliferation and counterproliferation technologies will help us keep nuclear weapons, nuclear materials, and nuclear weapons knowledge out of the wrong hands; and
- cleaning up the legacy of 50 years of weapons production focuses our capabilities derived from nuclear weapons development in a new direction.

The Laboratory will continue its role in defense, particularly in nuclear weapons technology, and will increasingly use its multidisciplinary capabilities to solve import civilian problems (including initiatives in the areas of health, national infrastructure, energy, education, and the environment). The research and technology programs that address civilian issues, nonnuclear defense, and industrial partnerships are crucial to the support of our central mission (LANL 1995).

1. Introduction

The operating cost of the Laboratory for fiscal year (FY) 1995 was $1,007 million, with an additional $43 million for capital equipment and $5 million for construction. In FY95, $884 million of the operating cost was spent on Department of Energy (DOE) programs, including $388 million on defense programs, $209 million on Environmental Restoration and Waste Management, and $86 million on Nonproliferation and International Security. Approximately $181 million was spent on work for others, including $78 million on Department of Defense projects.

In 1995, the Laboratory employed approximately 7,000 people in permanent positions; approximately 39% of these employees are technical staff members, 7% are managers, 12% are support staff members, 26% are technicians, and 16% are either office or general support. The Laboratory also employed another 3,000 people in special programs such as work-study programs, graduate research positions, and limited-term employees. In addition, more than 2,500 people are employed by contractors providing support services, protective force services, and specialized scientific and technical services.

The Laboratory contract is administered through the DOE Los Alamos Area Office and the Albuquerque Operations Office. The Laboratory Director is ultimately responsible for all Laboratory activities. However, technical and administrative responsibility and authority have been delegated to directorates and technical and support offices. The Director is supported by a Deputy Director; both the Director and the Deputy Director are supported by Special Assistants. In 1995, the Laboratory management structure consisted of 17 division offices, 10 program offices, and 6 institutional offices. The directors of all programs and divisions form the Laboratory Leadership Council.

2. Geographic Setting

The Laboratory and the associated residential areas of Los Alamos and White Rock are located in Los Alamos County, in north central New Mexico, approximately 100 km (60 mi) north-northeast of Albuquerque and 40 m (25 mi) northwest of Santa Fe (Figure 1-1). The 111-km^2 (43-mi^2) Laboratory site is situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep east-to-west oriented canyons cut by intermittent streams (Figure 1-2). Mesa tops range in elevation from approximately 2,400 m (7,800 ft) on the flanks of the Jemez Mountains to about 1,900 m (6,200 ft) at their eastern termination above the Rio Grande Canyon.

Most Laboratory and community developments are confined to mesa tops. The surrounding land is largely undeveloped, and large tracts of land north, west, and south of the Laboratory site are held by the Santa Fe National Forest, Bureau of Land Management, Bandelier National Monument, General Services Administration, and Los Alamos County. The Pueblo of San Ildefonso borders the Laboratory to the east.

The Laboratory is divided into technical areas (TAs) that are used for building sites, experimental areas, waste disposal locations, roads, and utility rights-of-way (see Figure 1-3 and Appendix C). However, these uses account for only a small part of the total land area. Most land provides buffer areas for security and safety and is held in reserve for future use.

DOE controls the area within Laboratory boundaries and has the option to completely restrict access. The public is allowed limited access to certain areas of the Laboratory. An area north of Ancho Canyon (see Figure 1-4) between the Rio Grande and State Road 4 is open to hikers, rafters, and hunters, but woodcutting and vehicles are prohibited. Portions of Mortandad, Los Alamos, and Pueblo Canyons are also open to the public. Archaeological sites at Otowi Tract, northwest of State Road 502 near White Rock and in Mortandad Canyon, are open to the public, subject to restrictions protecting cultural resources.

3. Geology and Hydrology

Most of the finger-like mesas in the Los Alamos area are formed from Bandelier Tuff, which includes ash fall, ash fall pumice, and rhyolite tuff (Figure 1-5). The tuff, ranging from nonwelded to welded, is more than 300 m (1,000 ft) thick in the western part of the plateau and thins to about 80 m (260 ft) eastward above the Rio Grande. It was deposited as a result of major eruptions in the Jemez Mountains' volcanic center about 1.2 to 1.6 million years ago.

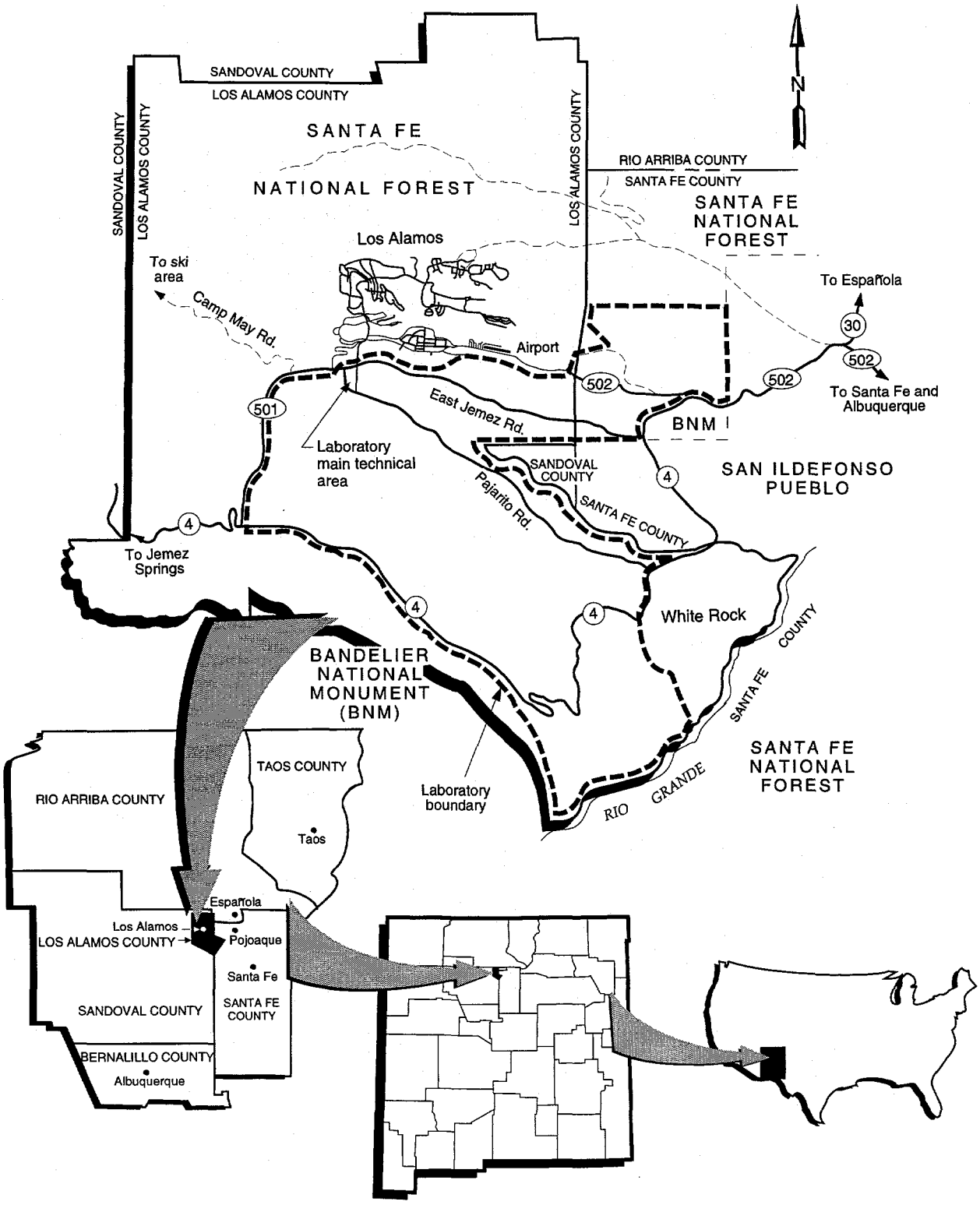


Figure 1-1. Regional location of Los Alamos National Laboratory.

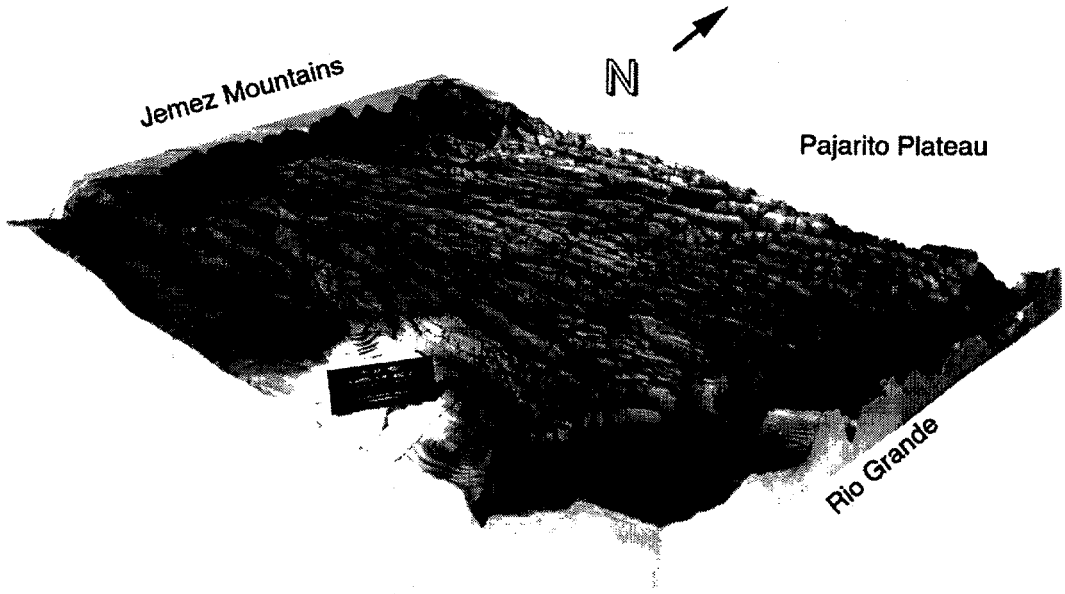


Figure 1-2. Topography of the Los Alamos area.

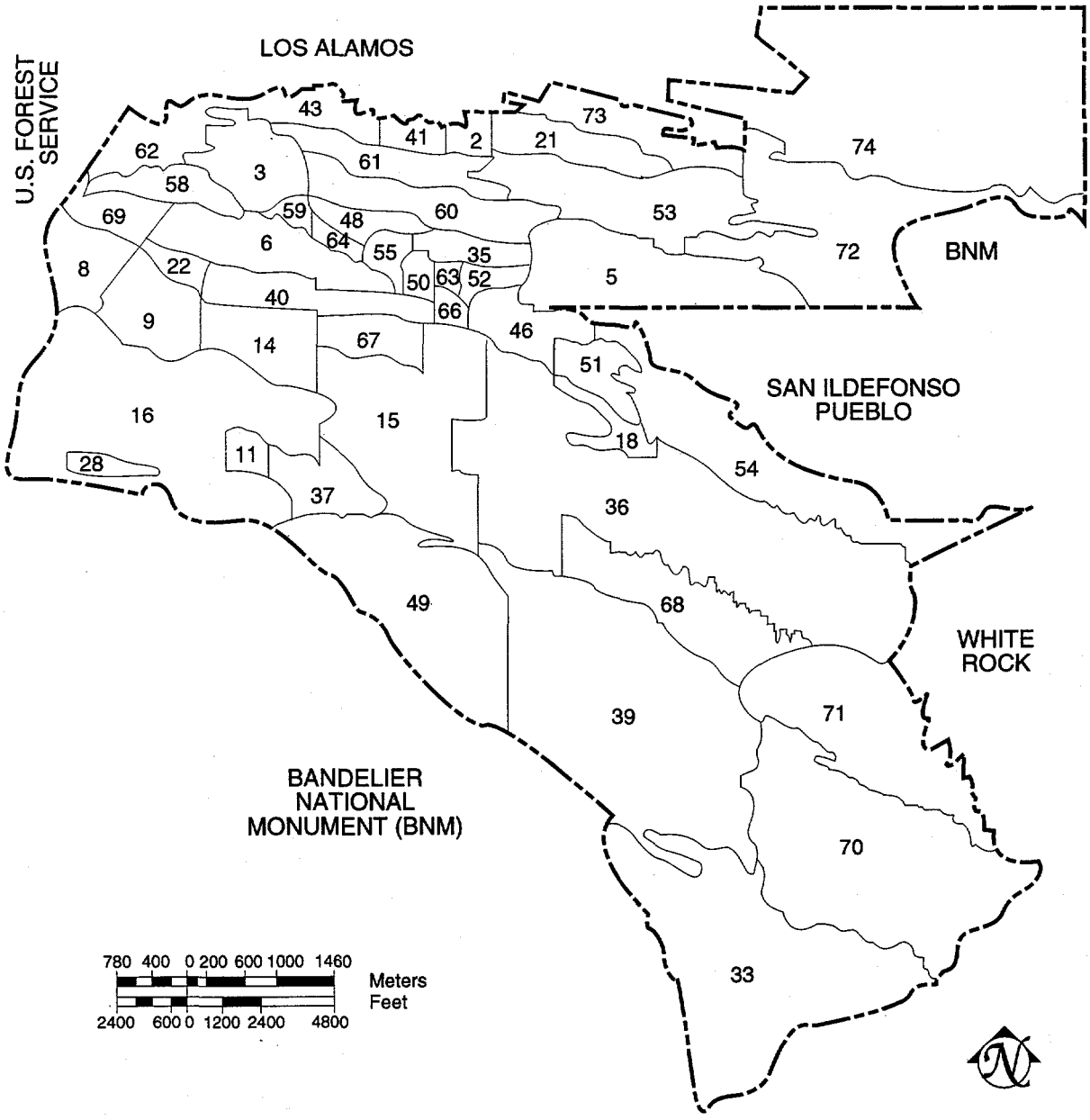


Figure 1-3. Technical areas of Los Alamos National Laboratory in relation to surrounding landholdings.

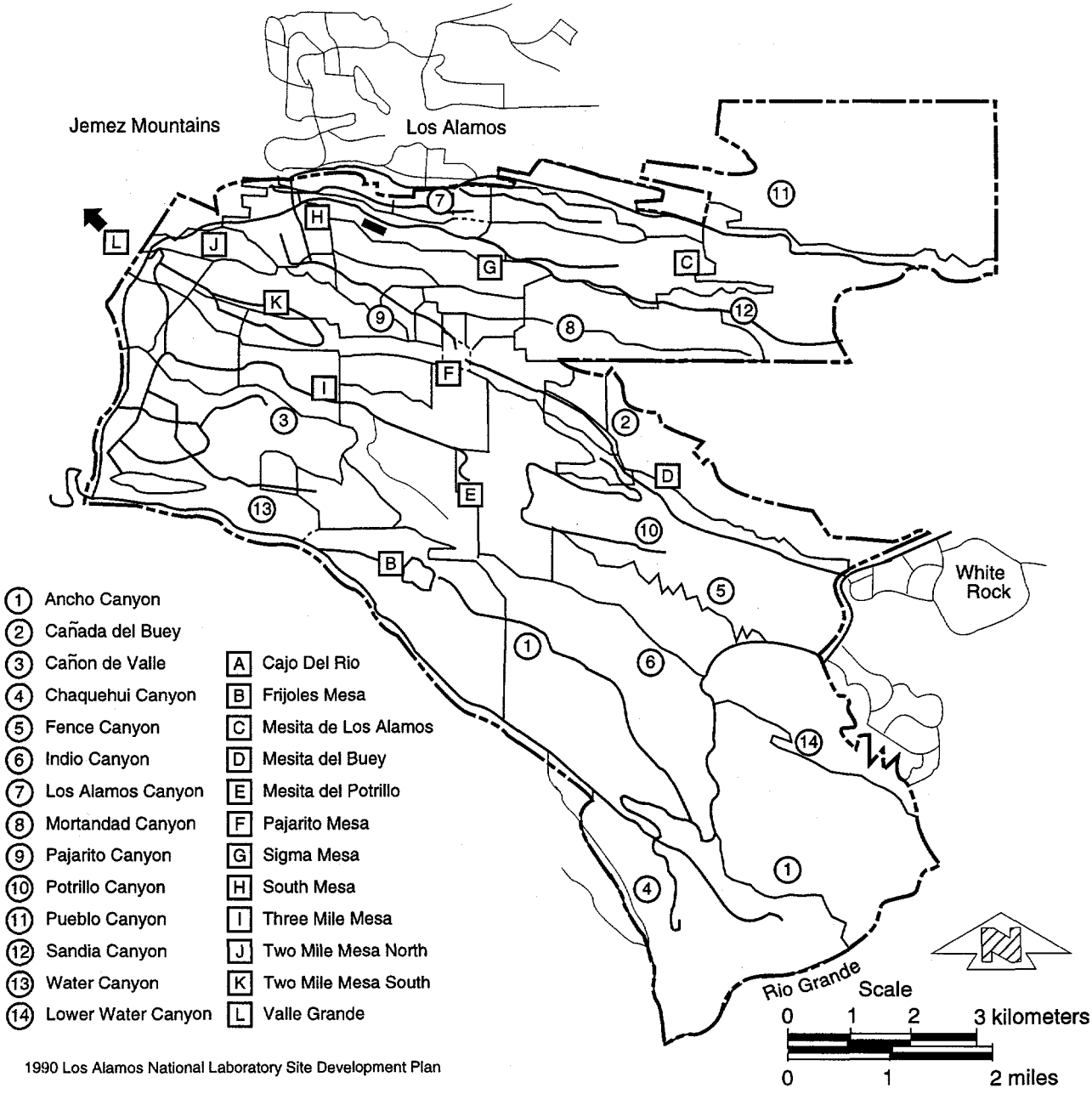


Figure 1-4. Major canyons and mesas.

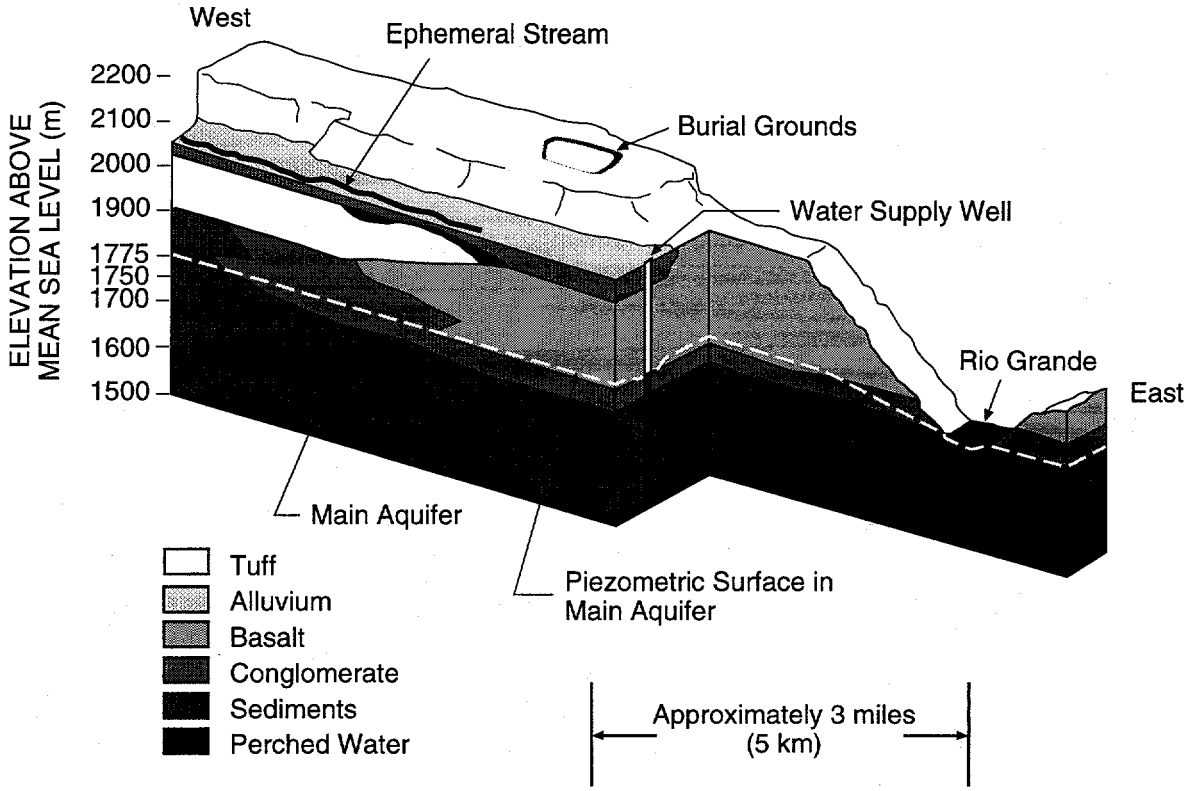


Figure 1-5. Conceptual illustration of geologic and hydrologic relationship in Los Alamos area.

1. Introduction

On the western part of the Pajarito Plateau, the Bandelier Tuff overlaps onto the Tschicoma Formation, which consists of older volcanics that form the Jemez Mountains. The tuff is underlain by the conglomerate of the Puye Formation (Figure 1-5) in the central plateau and near the Rio Grande. Chino Mesa basalts interfinger with the conglomerate along the river. These formations overlay the sediments of the Santa Fe Group, which extend across the Rio Grande Valley and are more than 1,000 m (3,300 ft) thick. The Laboratory is bordered on the east by the Rio Grande, within the Rio Grande Rift. Because the rift is slowly widening, the area experiences frequent but minor seismic disturbances.

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams. Perennial springs on the flanks of the Jemez Mountains supply base flow into upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the Laboratory site before they are depleted by evaporation, transpiration, and infiltration. Runoff from heavy thunderstorms or heavy snowmelt reaches the Rio Grande several times a year in some drainages. Effluents from sanitary sewage, industrial waste treatment plants, and cooling-tower blowdown enter some canyons at rates sufficient to maintain surface flows for varying distances.

Groundwater in the Los Alamos area occurs in three modes: (1) water in shallow alluvium in canyons, (2) perched water (a body of groundwater above a less permeable layer that is separated from the underlying main body of groundwater by an unsaturated zone), and (3) the main aquifer of the Los Alamos area.

Ephemeral and interrupted streams have filled some parts of canyon bottoms with alluvium that ranges from less than 1 m (3 ft) to as much as 30 m (100 ft) in thickness. Runoff in canyon streams percolates through the alluvium until its downward movement is impeded by layers of weathered tuff and volcanic sediment that are less permeable than the alluvium. This creates shallow bodies of perched groundwater that move down gradient within the alluvium. As water in the alluvium moves down the canyon, it is depleted by evapotranspiration and movement into underlying volcanics (Purtymun 1977). The chemical quality of the perched alluvial groundwaters show the effects of discharges from the Laboratory.

In portions of Pueblo, Los Alamos, and Sandia Canyons, perched groundwater occurs beneath the alluvium at intermediate depths within the lower part of the Bandelier Tuff and within the underlying conglomerates and basalts. Perched groundwater has been found at depths of about 37 m (120 ft) in the midreach of Pueblo Canyon, to about 137 m (450 ft) in Sandia Canyon near the eastern boundary of the Laboratory. This intermediate-depth perched water discharges at several springs in the area of Basalt Spring in Los Alamos Canyon. These intermediate-depth groundwaters are formed in part by recharge from the overlying perched alluvial groundwaters and show the effects of radioactive and inorganic contamination from Laboratory operations.

Perched water may also occur within the Bandelier Tuff in the western portion of the Laboratory just east of the Jemez Mountains. The source of this perched water might be infiltration from streams discharging from the mouths of canyons along the mountain front and underflow of recharge from the Jemez Mountains. Industrial discharges from Laboratory operations may also contribute to perched groundwater in the western portion of the Laboratory. Perched groundwater in the Tschicoma Formation is the source of water supply for the ski area located just west of the Laboratory boundary in the Jemez Mountains.

The main aquifer of the Los Alamos area is the only aquifer in the area capable of serving as a municipal water supply. The surface of the aquifer rises westward from the Rio Grande within the Tesuque Formation (part of the Santa Fe Group) into the lower part of the Puye Formation beneath the central and western part of the plateau. Depth to the main aquifer is about 300 m (1,000 ft) beneath the mesa tops in the central part of the plateau. The main aquifer is separated from alluvial and perched waters by about 110 to 190 m (350 to 620 ft) of tuff and volcanic sediments with low (less than 10%) moisture content.

Water in the main aquifer is under artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande (Purtymun 1974). The source of recharge to the aquifer is presently uncertain. Early research studies concluded that major recharge to the main aquifer is probably from the Jemez Mountains to the west, because the piezometric surface slopes downward to the east, suggesting easterly groundwater flow beneath the Pajarito Plateau. The small amount of recharge available from the Jemez Mountains relative to water supply pumping quantities, along with differences in isotopic and trace element composition, appear to rule this out. Further, isotopic and chemical composition of some waters from wells near the Rio Grande suggest that the source of water underlying the eastern part of the Pajarito Plateau may be the Sangre de Cristo Mountains (Blake 1995). Groundwater flow along the Rio Grande rift from the north is another possible recharge source. The main aquifer

discharges into the Rio Grande through springs in White Rock Canyon. The 18.5-km (11.5-mi) reach of the river in White Rock Canyon between Otowi Bridge and the mouth of Rito de los Frijoles receives an estimated 5.3 to 6.8×10^6 m^3 (4,300 to 5,500 ac-ft) annually from the aquifer.

4. Ecology and Cultural Resources

a. Ecology. The Pajarito Plateau is considered a biologically diverse area. The diversity of ecosystems in the Los Alamos area is due partly to the dramatic 1,500-m (5,000-ft) elevation gradient from the Rio Grande on the east, to the Jemez Mountains 20 km (12 mi) to the west, and partly to the many steep canyons that dissect the area. Six major vegetative community types are found in Los Alamos County: juniper-grassland, piñon-juniper, ponderosa pine, mixed conifer, spruce-fir, and subalpine grassland. The juniper-grassland community is found along the Rio Grande on the eastern border of the plateau and extends upward on the south-facing sides of canyons, at elevations between 1,700 and 1,900 m (5,600 to 6,200 ft). The piñon-juniper community, generally in the 1,900- to 2,100-m (6,200- to 6,900-ft) elevation range, covers large portions of the mesa tops and north-facing slopes at the lower elevations. Ponderosa pines are found in the western portion of the plateau in the 2,100- to 2,300-m (6,900- to 7,500-ft) elevation range. These three communities predominate, each occupying roughly one-third of the Laboratory site. The mixed conifer community, at an elevation of 2,300 to 2,900 m (7,500 to 9,500 ft), overlaps the ponderosa pine community in the deeper canyons and on north slopes and extends from the higher mesas onto the slopes of the Jemez Mountains. The subalpine grassland community is mixed with the spruce-fir communities at higher elevations of 2,900 to 3,200 m (9,500 to 10,500 ft). Twenty-seven wetlands and several riparian areas enrich the diversity of plant and animals found on LANL lands.

The plant and animals found on or near LANL property include approximately 500 plant species, 29 mammals, 200 birds, 19 reptiles, 8 amphibians, and hundreds of insects. Roughly 20 of these are designated as a threatened species, an endangered species, or a species of concern at the federal and/or state level.

b. Cultural Resources. Approximately 67.5% of DOE land in Los Alamos County has been surveyed for prehistoric and historic cultural resources, and close to 1,500 sites have been recorded. More than 85% of the ruins date from the 14th and 15th centuries. Most of the sites are found in the piñon-juniper vegetation zone, with 80% lying between 1,760 and 2,150 m (5,800 and 7,100 ft) in elevation. Almost three-quarters of all ruins are found on mesa tops.

5. Climatology

Los Alamos has a temperate, semiarid mountain climate. However, its climate is strongly influenced by elevation, and large temperature and precipitation differences are observed in the area due to the topography.

Los Alamos has four distinct seasons. Winters are generally mild, but occasionally winter storms dump large snows and cause below-freezing temperatures. Spring is the windiest season of the year. Summer is the rainy season in Los Alamos, when afternoon thunderstorms and associated hail and lightning are common. Fall marks the end of the rainy season and a return to drier, cooler, and calmer weather. The climate statistics given below summarize analyses given in Bowen (1990 and 1992).

Several factors influence the temperature in Los Alamos. An elevation of 7,400 ft helps to counter its southerly location, making for milder summers than nearby locations with lower elevations. The sloping nature of the Pajarito Plateau causes cold-air drainage, making the coolest air settle into the valley. Also, the Sangre de Cristo Mountains to the east act as a barrier to arctic air masses affecting the central and eastern United States. The temperature does occasionally drop well below freezing, however. Another factor affecting the temperature in Los Alamos is the lack of moisture in the atmosphere. With less moisture there is less cloud cover, which allows a significant amount of solar heating during the daytime and radiative cooling during the nighttime. This heating and cooling often causes a wide range of daily temperature.

Winter temperatures range from –1°C to 10°C (30°F to 50°F) during the daytime, to –9°C to –4°C (15°F to 25°F) during the nighttime. The record low temperature recorded in Los Alamos is –28°C (–18°F). Winter is usually not particularly windy, so extreme wind chills are uncommon at Los Alamos.

Summer temperatures range from 21°C to 31°C (70°F to 88°F) during the daytime, to 10°C to 15°C (50°F to 59°F) during the nighttime. Temperatures occasionally will break 32°C (90°F). The highest temperature ever recorded in Los Alamos is 35°C (95°F).

The average annual precipitation (including both rain and the water equivalent of frozen precipitation) in Los Alamos is 47.57 cm (18.73 in.). The average snowfall for a year is 149.6 cm (58.9 in.). Freezing rain and sleet are rare at Los Alamos. Winter precipitation in Los Alamos is often caused by storms entering the United States from the Pacific Ocean, or by cyclones forming or intensifying in the lee of the Rocky Mountains. When these storms cause upslope flow over Los Alamos, large snowfalls can occur. The record snowfall for one day at Los Alamos is 56 cm (22 in.), and the record snowfall in one season is 389 cm (153 in.). The snow is usually a dry, fluffy powder, with an average equivalent water-to-snowfall ratio of 1:20.

The summer rainy season accounts for 48% of the annual precipitation. During the July–September period, afternoon thunderstorms form because of the monsoonal flow of moist air from the Gulf of Mexico and the Pacific Ocean and because of convection and the orographic uplift as air flows up the sides of the Jemez Mountains. These thunderstorms can bring large downpours, but sometimes they only cause strong winds and dangerous lightning. Hail frequently occurs from these rainy-season thunderstorms.

Winds in Los Alamos are also affected by the complex topography, particularly in the absence of a large-scale disturbance affecting the area. Often a distinct daily cycle of the winds around Los Alamos is evident. During the daytime, upslope flow sometimes exists on the Pajarito Plateau, causing an southeasterly component to the winds on the plateau (see Figure 4-16). During the nighttime, as the mountain slopes and plateau cool, the flow becomes downslope, causing light westerly and northwesterly flow (see Figure 4-17). Cyclones moving through the area disturb and override the cycle. Flow within the canyons of the Pajarito Plateau can be quite varied and complex.

B. Major Environmental Programs

1. Environmental Protection Program

a. Purpose and Objectives. The Environment, Safety, and Health (ESH) Division is in charge of performing environmental measurements and activities to help ensure that Laboratory operations do not adversely affect public health or the environment and that the Laboratory conforms with applicable environmental regulatory requirements as required by DOE Orders 5400.1 (DOE 1988) and 5400.5 (DOE 1990).

Although the Laboratory Director has primary responsibility for ESH management, ESH Division provides line managers with assistance in preparing and completing environmental documentation such as reports required by the National Environmental Policy Act (NEPA) of 1969 and the federal Resource Conservation and Recovery Act (RCRA) and its state counterpart, the New Mexico Hazardous Waste Act (NMHWA). With assistance from the Laboratory Counsel, ESH Division helps to define and recommend Laboratory policies with regard to applicable federal and state environmental regulations and laws and DOE orders and directives. The ESH Division is responsible for communicating environmental policies to Laboratory employees and ensuring that appropriate environmental training programs are available.

Several committees provide environmental reviews for Laboratory operations. The Laboratory's ESH Identification Process, which in 1994 replaced the Environmental, Safety, and Health Questionnaire Review Committee, provides reviews of proposed projects to ensure that appropriate environmental, as well as health and safety, issues are properly addressed. The Laboratory Environmental Review Committee reviews NEPA documentation for projects before submitting the documents to DOE. The Environmental, Safety, and Health Council provides senior management level oversight of environmental activities and policy development.

The Emergency Management Office is responsible for the Laboratory's Emergency Management Plan, which is designed for prompt mitigation of all incidents, including those with environmental impact, and provides the means for coordinating all Laboratory resources in the mitigation effort.

b. Environmental Surveillance. Four groups in ESH Division (Air Quality [ESH-17], Water Quality & Hydrology [ESH-18], Hazardous & Solid Waste [ESH-19], and Environmental Assessments & Resource Evaluations [ESH-20]) initiate and promote Laboratory programs for environmental protection and are responsible for environmental surveillance and regulatory compliance. Personnel in the LANL environmental protection programs prepare permits, interpret regulations, provide technical advice, and conduct cultural and biological investigations across the site. They are responsible for environmental monitoring: collecting, analyzing, and interpreting samples of air, water, soil, sediments, food, and hazardous materials. Data are also gathered from

measurements of natural radiation and LANL radiation sources. Weather conditions are monitored to assess the transport of airborne contaminants to the environment. The results of these analyses help identify impacts of LANL operations on the environment.

Monitoring and sampling locations for various types of environmental measurements are generally organized into two groups:

- Off-site locations include regional and perimeter stations.

  Regional stations are located within the five counties surrounding Los Alamos County (Figure 1-1) at distances up to 80 km (50 mi) from the Laboratory. They provide a basis for determining conditions beyond the range of potential influence from normal Laboratory operations.

  Perimeter stations are located within about 4 km (2.5 mi) of the Laboratory boundary, and many are in residential and community areas. They are used to document conditions in areas regularly occupied by the public and potentially affected by Laboratory operations.

- On-site stations are within the Laboratory boundary, and most are in areas accessible only to employees during normal working hours. They measure environmental conditions at the Laboratory where public access is limited.

More than 450 sampling locations are used for routine environmental monitoring. The general location of all monitoring stations is presented in maps in the text.

Samples of air particles and gases, water, soils, sediments, and foodstuffs are routinely collected at the monitoring stations for subsequent analyses. External penetrating radiation from cosmic, terrestrial, and Laboratory sources are also measured. Meteorological conditions are continually monitored to assess the transport of contaminants in airborne emissions to the environment and to aid in forecasting local weather conditions.

Additional samples are collected and analyzed to obtain information about particular events, such as major surface runoff events, nonroutine releases, or special studies. Each year, over 200,000 analyses for chemical and radiochemical constituents are conducted on more than 11,000 environmental samples. Data from these analyses are used for dose calculations, comparisons with standards and background levels, and interpretations of the relative risks associated with Laboratory operations, as presented in Sections 3, 4, 5, and 6 of this report. Methods and procedures for acquiring, analyzing, and recording data are presented in each resource section. Comprehensive information about environmental regulatory standards is presented in Appendix A.

c. Environmental, Safety, and Health Training. The Laboratory maintains an extensive training program of ESH courses that meet compliance requirements under the Occupational Safety and Health Administration/Act (OSHA), EPA, and Department of Transportation regulations, as well as the DOE orders and LANL's Radiological Control Manual. These courses are designed, developed, delivered, and/or coordinated by the ESH Training Group (ESH-13). In 1995, training was available in the following categories: radiation safety training, including courses for radiological workers and radiological control technicians; safety training, including courses on electrical safety, cranes, forklifts, lasers, lockout/tagout, and OSHA standards; health training, including courses on a variety of chemical hazards, first aid/cardiopulmonary resuscitation, and respirators; and environment training, including courses on waste management, spill coordination, and hazardous waste operations.

All new employees, contractors, affiliates, long-term visitors, students, and current employees working at sites governed by DOE Order 5480.20 (DOE 1991a) are required to take General Employee Training, which consists of introductory information covering Laboratory ESH topics, including OSHA Rights and Responsibilities, Industrial Hygiene, Industrial Safety, Fire Protection, Emergency Management, General Employee Radiological Training, and Occupational Medicine. All internally developed Laboratory-wide training is done in conjunction with subject matter experts who validate technical content.

2. Waste Management Program

a. Purpose and Objectives. The waste management function at the Laboratory was formed in 1948 as part of the Los Alamos Area Office of the Atomic Energy Commission. Waste management activities have been focused on minimizing the adverse effects of radioactive wastes on the environment, maintaining compliance with regulations and permits, and ensuring that wastes are managed safely. The Chemical Sciences and Technology (CST) Division at the Laboratory became responsible for waste management activities during 1994.

1. Introduction

Wastes generated at the Laboratory are divided into categories based on the radioactive and chemical content. No high-level radioactive wastes are generated at the Laboratory. Major categories of waste managed at the Laboratory are presented below:

Low-Level Radioactive Waste. The level of radioactive contamination in low-level waste (LLW) is not strictly defined. Rather, LLW is defined by what it is not. It does not include nuclear fuel rods, wastes from processing nuclear fuels, transuranic (TRU) waste, or uranium mill tailings.

LLW at the Laboratory includes solid waste contaminated with radioactive materials, including plutonium, americium, uranium, or tritium from weapons design and test work; tracer and medical isotopes from scientific studies; mixed fission materials from nuclear energy work; and activation products from physics experiments. (Activation products are formed when a substance is struck by protons or neutrons. The atoms of the original substance are converted to another element that is unstable and, therefore, radioactive.)

LLW includes items such as equipment, paper, rags, radiation protective clothing, demolition debris from decontamination and decommissioning activities, and contaminated soils and debris from environmental cleanup activities. LLW handled at the Laboratory may require special handling and shielding to protect workers and the public. Most LLW generated at the Laboratory is disposed of on site in pits and shafts designed and engineered for this purpose within TA-54, Area G. Approximately 3,032 m^3 (107,074 ft^3) of LLW were managed at the Laboratory in calendar year (CY) 1995.

Transuranic Waste. TRU waste consists of rags, equipment, solidified wastewater treatment sludge, paper, and protective clothing that contain radioactive elements heavier than uranium above a designated threshold. The major radioactive contaminants at the Laboratory, plutonium and americium, both have long half-lives. Less than 95 m^3 (3,353 ft^3) of TRU waste were managed at the Laboratory during CY95.

Mixed Waste. Mixed waste contains low-level radioactive elements mixed with nonradioactive hazardous waste. Low-level mixed waste (LLMW) at the Laboratory includes gases, liquids, and solids, such as gas cylinders of hydrogen with a tracer radioactive isotope; contaminated solvents and oils; spent solutions from electroplating operations; contaminated lead shielding; or solid chemicals that react violently with water. Solid LLMW is stored at the site pending the availability of off-site commercial treatment or the development of technologies to treat those wastes that cannot be treated by the commercial sector. Liquid LLMW generated at the Laboratory is stored on site. TRU mixed wastes at the Laboratory are solids. The major hazardous component is solvent contamination or the presence of heavy metals like cadmium or lead. Approximately 52 m^3 (1,836 ft^3) of mixed waste were managed at the Laboratory in CY95.

Hazardous Waste. Hazardous special wastes are defined by regulations under RCRA and the NMHWA. Hazardous wastes at the Laboratory include gases, liquids, and solids such as compressed gas cylinders containing combustible gases; acids, bases, solvents; out-of-date laboratory chemicals; and lead bricks. At present, no disposal facility for hazardous chemical waste exists at the Laboratory. Hazardous wastes are shipped off site for further treatment and disposal to facilities designated in accordance with RCRA. Approximately 1,158,638 kg (2,554,359 lb) of RCRA hazardous waste was managed at the Laboratory in CY95.

Nonhazardous Special Waste. Nonhazardous waste is waste that does not fall under the technical definition of hazardous waste but still requires special handling. Other regulations apply to some of these wastes, such as asbestos, infectious wastes, oils, coolants, and other materials that are controlled for reasons of health, safety, or security. Approximately 1,230,578 kg (2,712,960 lb) of nonhazardous waste were managed by the Laboratory in CY95.

b. Waste Minimization and Pollution Prevention. Today, DOE and the Laboratory conduct business in an atmosphere of sharply declining budgets and increasing public scrutiny, which mandate that operations become both more cost effective and environmentally aware. Incorporation of waste minimization (WMin) methodologies into the daily conduct of operations can provide significant returns in avoided waste management costs, both for the waste generating programs and the Laboratory Waste Management (WM) Program, as well as increases in employee productivity.

The existence of a functional, proactive, pollution prevention program is necessary to comply with the Hazardous and Solid Waste Amendments (HSWA) module of the Laboratory's RCRA permit, the Federal Facility Compliance Agreement, RCRA Subtitle A, Superfund Amendments and Reauthorization Act Subtitle 313, DOE Order 5400.1, and other regulations. As such, pollution prevention is an essential element of the LANL WM Program. Additionally, due to the limited amount of waste disposal capacity remaining in current WM on-site

Table 1-1. Source Reduction and Recycling Activities Implemented in Calendar Year 1995

Sanitary	*Routine*	Site-wide recycling activities	811.45
		Johnson Controls, Inc. Environmental reuse of SM-22 Power Plant residue in sand/salt winter traction mixture	.90
	Nonroutine	Environmental Restoration recycle/reuse activities	1,406.46
		Environmental Restoration procedural changes	20.84
		Chemical reuse program	2.54
		Materials sent to redistribution and marketing for reuse	.15
		Total	**2,242.34 mt**
State-regulated	*Routine*	Site-wide recycling activities	192,267
		Johnson Controls, Inc. Environmental reclassification of cooling tower sediment as sanitary	9,090.91
	Nonroutine	Chemical reuse program	11.5
		Environmental Restoration procedural changes	377.73
		Total	**201,747.38 kg**
Resource Conservation and Recovery Act	*Routine*	Site-wide recycling activities	92,291.97
		TA-55 replacement of HCl in heavy metals recovery with common solvent; reuse of solvent	318.18
		Intervention into disposal of clean drill cuttings	150,000
		Site-wide materials substitution of tetrachloroethylene	2,655.45
		Site-wide materials substitution of trichloroethane	886.36
	Nonroutine	Chemical reuse program	1,908.41
		Federal Facility Compliance Agreement LD200 Lead Regulatory Milestone to Recycle Decontaminated Lead Bricks	47,330
		Total	**295,390.37 kg**
Toxic Substance Control Act	*Nonroutine*	Site-wide recycling/energy reuse activities	8,163.44
		Recategorization and release for recycle of suspect polychlorinated biphenyl equipment	5,840.91
		Total	**14,004.35 kg**
Low-Level Waste	*Routine*	Reuse of spent vacuum oil from foundry furnace vacuum systems to cover depleted uranium chips and turnings	.38
	Nonroutine	Environmental Restoration survey, segregation, and/or decontamination and reuse/recycle	1,082.47
		Environmental Restoration procedural changes	107.4
		Environmental Restoration volume reduction activities	125.11
		Recycle from direct generator assistance program	44.93
		Total	**1,360.29 m^3**
Mixed Low-Level Waste	*Routine*	Substitution of nonhazardous degreaser in RAD areas	.2
		Substitution of nonharzardous paint stripper in NMT Division	2.1
		Change of fluorescent lightbulbs in TA-55, PF-4 on an as-needed basis as opposed to annual changeout	4
	Nonroutine	Federal Facility Compliance Agreement LD200 Lead Regulatory Milestone to decontaminate lead bricks for recycle	8
		Environmental Restoration procedural changes	10,702.35
		Total	**10,716.65 m^3**
Transuranic	*Routine*	Sort/segregation of suspect transuranic using portable spectrometry	
	Nonroutine		16.6
		Total	**16.6 m^3**

mt = metric tonnes (2,200 lb or 1,000 kg).
kg = kilograms.
m^3 = cubic meters.

facilities, pollution prevention is a primary component in WM strategic planning. The Laboratory's Environmental Stewardship Office (ESO) (formerly the Pollution Prevention Program Office) activities provide for a comprehensive program designed to address the requirements of DOE orders as well as federal environmental regulations and executive orders.

The organization of the Laboratory pollution prevention program is modeled after the guidance provided in the DOE Pollution Prevention Crosscut Plan (DOE 1995). This plan sets forth the responsibilities of the various DOE departments and establishes what activities they are responsible for funding. Source reduction and recycling activities implemented in CY95 that resulted in quantifiable waste avoidance are listed in Table 1-1. The chart is arranged by waste type and groups waste minimization efforts by whether they affected routine or nonroutine waste generation.

ESO was also involved in activities during CY95 that cannot be quantified. The most notable among those are listed below:

- continuation of the WMin chargeback system (now called the Set-Aside Program) to provide a financial incentive for WMin/Pollution Prevention actions at the Laboratory by placing a "tax" on wastes generated, as well as to provide a pool of funding to support the accomplishment of specific waste reduction activities;
- award of cash prizes for innovative pollution prevention ideas;
- development of an ESO homepage on the Internet at http://perseus.lanl.gov; and
- coordination of an environmental stewardship forum at which representatives from more than 14 Laboratory divisions and program offices presented to an estimated audience of more than 200 people from both national and international organizations.

Research and development of new pollution prevention technologies are listed below:

- development of direct chemical analysis technologies such as the micro atmospheric measurement system and laser ablation inductively coupled plasma mass spectroscopy to minimize waste generated during sampling and analysis by allowing the analysis to be performed *in situ*;
- development of portable field screening detectors that can determine if more extensive characterization is necessary to minimize waste generated from unnecessarily performed extensive site characterizations;
- collaboration of CST Division and Faraday Technology, Inc., to develop electrochemical treatment technology to treat mixed waste without increasing the end-result volume (planned pilot-scale operation for mid-1996);
- initiation of a cooperative research and development agreement with Canberra Industries to develop a passive neutron barrel counter to permit accurate assay of plutonium in TRU and LLW without breaching the waste containers, thereby not generating any secondary waste; and
- development and on-site use of a nonintrusive zero waste generation characterization technology, ultrasonic interferometry.

3. Environmental Restoration Project

a. Purpose and Objectives. The Environmental Restoration (ER) Program within the DOE office of Environmental Restoration and Waste Management is responsible for assessing, cleaning up, decontaminating and decommissioning sites at DOE facilities and sites formerly used by DOE. The objectives of the ER Project at the Laboratory meet the goals of environmental management and augment the Laboratory's environmental surveillance program by identifying and characterizing potential threats to human health and the environment from past Laboratory operations, and by mitigating those threats through corrective actions that comply with applicable environmental regulations. The project is also responsible for decontaminating and decommissioning surplus facilities at the Laboratory. Corrective actions may include source containment to prevent contaminant migration, controls on future land use, and excavation and/or treatment of the source to remove or, at a minimum, reduce chemical and/or radiological hazards to acceptable human health and environmental levels.

The ER Project at the Laboratory responds to two primary laws: RCRA, which is the statutory basis for the ER Project at the Laboratory, and the Comprehensive Environmental Response, Compensation, and Liability Act, which provides a framework for remediating sites at the Laboratory that contain certain hazardous substances not covered by RCRA. The HSWA to RCRA mandates that certain facilities which handle hazardous wastes, including the Laboratory, operate under a formal permit system. The HSWA Module of the Laboratory's RCRA permit prescribes a specific corrective action program. The New Mexico Environment Department regulates the Laboratory's corrective action program under RCRA. The DOE has oversight for those sites not subject to RCRA and for the decommissioning program.

b. Organization. The Laboratory is divided into five contiguous field units based upon both geographical proximity and historical and present uses of the lands in question to cover corrective action activities. Characterization activities have been occurring at many potential (contaminant) release sites (PRSs) to determine the nature and extent of any contamination present. Characterization (drilling, sampling, analysis, and assessment) may lead to a decision of no further action for a particular PRS or aggregate of PRSs, or to containment or cleanup of the site. These decisions are recommended by the Laboratory to the regulatory agency, who must concur before any decision is final. The public also has the opportunity to comment on the Laboratory's recommendations. PRSs that have complete descriptions (the source of the contamination, transport potentials, risks, etc.) and quantitative health-based risk assessments which indicate a threat to human health and/or the environment are subject to corrective action which may include cleanup. A sixth field unit is responsible for decommissioning activities within the ER Project at the Laboratory.

The projection for the completion of the characterization/remediation process at the Laboratory is highly dependent on the availability of funding for the ER Project. Depending on funding, the current projection is between 2005 and 2010. The decommissioning project completion date is subject to the Laboratory's current operations. A summary of ER Project activities completed in 1995 is presented in Section 2.B.1.i.

C. Overview of Quality Assurance Programs

Quality is the extent to which an item or activity meets or exceeds requirements. Quality assurance (QA) includes all the planned and systematic actions and activities necessary to provide adequate confidence that a facility, structure, system, component, or process will perform satisfactorily. In 1995, the Quality Assurance Support Group (ESH-14) provided support for QA functions at the Laboratory. ESH-14 performs QA and quality control audits and surveillance of Laboratory and subcontractor activities in accordance with the Quality Assurance Plan (QAP) for the Laboratory and for specific activities, as requested. The Laboratory's Internal Assessment Group (AA-2) manages an independent environmental appraisal and auditing program that verifies appropriate implementation of environmental requirements. The Quality and Planning Program Office provides management and coordination of the effort to become a customer-focused, unified Laboratory. This office launched a number of initiatives in continuous improvement, including a Quality Council, quality awareness training, staff-level continuous quality improvement (CQI) teams, and management-initiated "re-engineering" teams aimed at the Laboratory's core processes.

Each monitoring activity sponsored by the ESH Division has its own QAP. QAPs are unique to activities but are guided by the need to establish policies, requirements, and guidelines for the effective implementation of regulatory requirements and to meet the requirements of DOE Orders 5400.1 (DOE 1988) and 5700.6C (DOE 1991b). Each QAP must address the criteria for management, performance, and assessments.

QAPs for each environmental monitoring program performed by groups in ESH Division have been included in the current Environmental Monitoring Plan (EMP) (EARE 1995). The EMP is reviewed every year and revised every three years. The QAPs will be revised under DOE Order 5700.6C within two years.

D. Overview of University of California/Department of Energy Performance Assessment Program

During 1996, the Laboratory will be evaluated by the University of California (UC) and DOE based on mutually negotiated performance measures that were established for January 1995 through June 1996. Future performance measure rating periods will be from July to June. The environmental aspects of these performance measures include the following categories:

- radiation protection of the public;
- release incidents;
- toxic chemical releases;
- permit exceedances;
- cited environmental violations, fines, and penalties;
- status of regulatory commitments and milestones;
- waste minimization and pollution prevention; and
- survey of regulator satisfaction.

Specific information on the metrics and the assessments (when available) can be obtained from the new Northern New Mexico University of California Office. Request the document titled "1996 Appendix F Measures for Environment, Safety, and Health."

E. Community Relations and Stakeholder Involvement

In order to develop a more open and participatory culture, as well as to comply with external directives, the Laboratory has committed itself to ensuring that stakeholders receive appropriate information on existing and planned facilities, programs, and technologies. Successful interaction and dialogue are based upon honesty and forthrightness, and enable stakeholders to understand issues important to their welfare, to participate in the decision-making process, and to interact with the Laboratory in a climate fostering trust and cooperation.

Recognizing that an increase in public involvement initiatives would require carefully planned and coordinated efforts, in November 1993, the Laboratory established the Stakeholder Involvement Office to form strong and lasting relationships with internal customers and external stakeholders that are based on mutual respect and trust. In August 1995, the Bradbury Science Museum and the Laboratory Outreach Group also became part of the office, and its name was changed to Community Involvement and Outreach (CIO).

The CIO works with the Laboratory's stakeholders including neighboring individuals and groups, local and state governments, tribal governments, special interest groups, UC, DOE, federal agencies, and Laboratory staff.

One of the primary responsibilities of the CIO was to oversee the public involvement related activities of Laboratory programs from an institutional perspective to ensure consistency and quality across programs, and to provide technical information at a level appropriate for its intended audience. Other core responsibilities in 1995 included the following:

- stakeholder involvement guidance and support to technical divisions, program offices, operational divisions, resources organizations, and for institutional efforts;
- development and implementation of Laboratory policy and vehicles for stakeholder involvement and information dissemination;
- stakeholder inreach and relationship building with DOE, LANL, and UC;
- communication and relationship building with tribal governments, local governments, and special interest groups; and
- administration of the Laboratory's Native American Program.

Public Meetings

During 1995, the CIO planned, managed, or supported 130 meetings on various topics such as Stockpile Stewardship and Management, domestic production of molybdenum-99, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility, environmental restoration, and diversity. This increased from 82 public meetings in 1994.

The CIO coordinated, managed, or supported public involvement for 37 projects, including continuing support for the Northern New Mexico Citizens' Advisory Board to DOE and LANL, the Laboratory's Diversity Strategic Plan and its Strategic Thinking Process, the Site-Wide Environmental Impact Statement (EIS), and the DARHT EIS.

The CIO will continue to collaborate with Laboratory technical programs to sponsor special public briefings and tours of waste management facilities, sampling sites for the ER Project, and facilities related to selected programmatic initiatives.

Tribal Government Liaison

Through the Tribal Government Liaison, the CIO supports the LANL/Tribal Environmental Quality Working Group and the Tribal Cooperative Agreement Implementation Team. Work during 1995 included assisting in the implementation of cooperative agreements with several neighboring pueblos.

Rio Grande Intergovernmental Council

The CIO played a key role in the establishment of the Rio Grande Intergovernmental Council, composed of government representatives from 11 municipalities and 5 counties within a 60-mi radius of the Laboratory. Monthly meetings address issues of mutual concern to local governments and the Laboratory.

Tours and Queries

The CIO is the primary Laboratory recipient of all queries from local and tribal governments and special interest groups and queries having environmental, safety, and health; technical; or programmatic content. Some vehicles for involvement include public and special meetings and specialized tours. The CIO provided tours for interested members of neighboring pueblos, special interest groups, local government officials, and community leaders of facilities or areas related to issues such as expedited cleanup, expansion of a waste disposal site, and hyrodynamic testing.

Community Reading Room

During 1995, the Los Alamos Community Reading Room received 1,281 visitors, an increase from the 1,249 visitors in 1994. The Reading Room serves as a repository for documents of interest to the public about the Laboratory's activities. Other repositories for information were established in public libraries in Santa Fe, Española, Taos, and Las Vegas.

Bradbury Science Museum

The Bradbury Science Museum is an area of the Laboratory that is open to the public and where aspects of the Laboratory's work can be viewed. During 1995, the Museum received more than 130,000 visitors, the majority of whom live out of New Mexico. In addition, the Museum hosted more than 5,000 students, ranging from elementary school students to college attendees. The co-location of the Museum and the Community Reading Room in the Los Alamos townsite encourages people to visit both locations.

Speakers' Bureau

The Laboratory supplies speakers to organizations that would like to learn more about aspects of the Laboratory and its work. In 1995, Laboratory speakers gave approximately 542 talks to an estimated audience of more than 57,000 people. Some of the topics covered were accelerator technology, DARHT, and the Laboratory's environmental programs.

Taos Outreach Office

As part of its effort to improve dialogue with surrounding communities, the CIO opened its second outreach office in 1995, in Taos. The purpose of the office is to provide residents of northern New Mexico with easy, local access to information about the Laboratory and to engage in ongoing communication between the Laboratory and residents of Taos County.

Public Information

Some primary vehicles for information dissemination include the Community Reading Room, fact sheets, special publications, quarterly reports, briefings, advertisements, and a stakeholder mail list and database. In 1995, the CIO instituted both an electronic mail address (cio@lanl.gov) and "community" pages for the Internet (http:/www.lanl.gov/Public/Community/Welcome.html), which are accessible from the Laboratory's external home page. The "community" pages on the Internet present an opportunity for the Laboratory to reach a global audience, while at the same time posing a challenge to put forth public information in a way that is timely, appropriate, and unique among other DOE national laboratories. In addition to primary telephone banks, toll-free telephone lines are maintained for receiving queries (1-800-508-4400).

The CIO is committed to using these types of communication tools to create viable access points for the public to the Laboratory and disseminating information that is accurate, complete, and timely.

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2. Compliance Summary

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A. Introduction

Many Los Alamos National Laboratory (LANL or the Laboratory) activities and operations involve or produce liquids, solids, and gases that contain radioactive and/or nonradioactive hazardous materials. Laboratory policy directs its employees to protect the environment and meet compliance requirements of applicable federal and state environmental protection regulations. This policy fulfills Department of Energy (DOE) requirements to protect the public, the environment, and worker health and to comply with applicable environmental laws, regulations, and orders.

Federal and state environmental laws address handling, transport, release, and disposal of contaminants, pollutants, and wastes, as well as protection of ecological, archaeological, historic, atmospheric, and aquatic resources. Regulations provide specific requirements and standards to ensure maintenance of environmental qualities. Table 2-1 presents a list of the major environmental legislation that affects the activities of the Laboratory and serves as an outline for the first section of this chapter. The Environmental Protection Agency (EPA), DOE, the New Mexico Environment Department (NMED), and the New Mexico Environmental Improvement Board (NMEIB) are the principal authorities administering the regulations to implement these laws. The environmental permits issued by these organizations and the specific operations and/or sites affected are presented in Table 2-2.

The Compliance Summary is divided into two sections: Compliance Status and Current Issues and Actions. The Compliance Status section discusses the major environmental acts that the Laboratory operated under in 1995. The Current Issues and Actions section discusses other compliance issues that are not covered under the Compliance Status.

B. Compliance Status

1. Resource Conservation and Recovery Act

a. Introduction. The Laboratory produces a wide variety of hazardous wastes. The Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984, mandates a comprehensive program to regulate hazardous wastes, from generation to ultimate disposal. The amendments emphasize reducing the volume and toxicity of hazardous waste. They require treatment of hazardous waste before land disposal. Table 2-3 lists the hazardous waste management facilities at the Laboratory.

EPA or an authorized state grants RCRA permits to specifically regulate hazardous waste and the hazardous component of radioactive mixed waste. A RCRA Part A permit application identifies (1) facility location, (2) owner and operator, (3) hazardous or mixed wastes to be managed, and (4) hazardous waste management methods and units. A facility that has submitted a RCRA Part A permit application for an existing unit is allowed to manage hazardous or mixed wastes under transitional regulations known as the Interim Status Requirements pending issuance (or denial) of a RCRA Operating Permit. (Note: The term unit as it is used in this section refers to RCRA hazardous waste management areas). The RCRA Part B permit application consists of a detailed narrative description of all facilities and procedures related to hazardous or mixed waste management. The DOE and the University of California (UC) were granted a hazardous waste facility permit on November 8, 1989.

The EPA granted base RCRA authorization to New Mexico on January 25, 1985, transferring regulatory control of hazardous wastes under RCRA to the NMED. State authority for hazardous waste regulation is set forth in the New Mexico Hazardous Waste Act (NMHWA) and Hazardous Waste Management Regulations (20 NMAC 4.1) which adopted, with a few minor exceptions, all of the federal codification for regulations in effect on July 1, 1993, concerning the generation and management of hazardous waste. On July 25, 1990, the State of New Mexico's Hazardous Waste Program was authorized by the EPA to regulate mixed waste in lieu of the federal program.

2. Compliance Summary

Current permitting activities center around the NMED's newly proposed approach to permitting facilities at LANL. Permits will be issued for individual technical areas (TAs). Previously there was only one umbrella permit covering all hazardous and mixed waste units at all TAs. There are approximately 12 TAs that conduct either treatment or storage of hazardous and/or mixed waste. The Laboratory is currently negotiating a schedule to submit permit applications to NMED for interim status and new units. These applications will address several categories of waste handling units. Competition for funding of these permitting activities is driven by compliance needs.

The application LANL submitted for the modification of transuranic (TRU) pads 1, 2, 4 and the addition of TRU storage domes A, B, C, and D was conditionally approved by NMED on May 11, 1994. A waste analysis plan and a schedule for further characterization of the TRU wastes on pads 1, 2, and 4 that responded to all of the state's requirements was provided to NMED on March 31, 1995. LANL had not received a response to this submittal from NMED in 1995.

LANL is developing a revised application for the units at TA-16. This application will encompass needed changes to the operations to improve combustion efficiency while reducing air emissions. Additionally, this revision will cover the eventual closure of the burn pad and the oil solvent burn tray operation while including those two operations at a newly improved adjacent location. This will address NMED concerns of the burn pad potentially recontaminating an Environmental Restoration (ER) Project site currently under remediation downgradient from the burn pad.

The development of a permit application for TA-55 is nearing completion. The Hazardous & Solid Waste Group (ESH-19) will submit the application to NMED for review in 1996. An application addressing units at TA-14, 15, 36, and 39 is in the early stages of development; submittal is anticipated for sometime in 1996. LANL submitted modification packages for storage at the Radioassay and Nondestructive Testing (RANT) facility at TA-54, West; storage at Waste Characterization, Reduction, and Repackaging Facility at TA-50; and storage at the TA-50-1 Decontamination Facility.

LANL is continuing a dialogue with NMED to establish a strategy for permitting the remaining mixed waste units at TA-54, along with the renewal of the existing permit for that TA. Inclusion of the Transuranic Waste Inspectable Storage Project (TWISP) pads and domes, as well as the RANT facility, will have to be considered in order to follow NMED's new approach for permitting TAs.

A decision to close the Controlled Air Incinerator (CAI) at TA-50 was made; a RCRA closure plan for this unit has been submitted to NMED for its approval. Additionally, a request was made to EPA Region 6 to cancel the Toxic Substances Control Act (TSCA) authorization for this unit. EPA responded and withdrew the authorization to incinerate TSCA waste on February 21, 1996. Closure activities are scheduled to be completed by the end of fiscal year (FY) 96.

In calendar year (CY) 95, LANL notified NMED of its intent to conduct five hazardous waste treatability studies. The studies treated and evaluated 48 kg (106 lb) of waste. The two Laboratory facilities that received Research, Development, and Demonstration (RD&D) permits, issued to LANL in CY94 by NMED for the treatment of hazardous waste, did not, in fact, treat any waste in CY95. During the fall of 1995, LANL submitted a modification package to NMED for its RD&D permit for the Packed Bed/Silent Discharge Plasma Unit at TA-35, which would allow the technology to be tested for its capability to destroy hazardous waste.

b. Solid Waste Disposal. The Laboratory has a commercial/special waste RCRA, Subtitle D landfill located at TA-54, Area J. This landfill is in compliance with the requirements of the New Mexico Solid Waste Management Regulations-4 (SWMR). In CY95, LANL/DOE completed the required Solid Waste Facility annual report for the previous year (CY94). In CY95, the TA-54, Area J landfill received and disposed 128 yd^3 of solid waste. Approximately 460 yd^3 of nonradioactive asbestos waste were shipped off site to an approved disposal site. On October 27, 1995, the NMED Solid Waste Bureau conducted an inspection at the Laboratory's TA-54, Area J, special waste landfill. No violations of the NM SWMR-4 were found during the inspection. Radioactive asbestos and asbestos suspected of being contaminated with radioactive material continue to be disposed in a monofill-constructed disposal cell (a cell that receives only one type of waste) at TA-54, Area G. On October 11, 1994, LANL/DOE submitted a groundwater monitoring suspension request to NMED for the TA-54, Area J landfill. The suspension request offered vadose zone (the subsurface above the main aquifer) monitoring in place of groundwater monitoring. NMED has yet to respond to the suspension request.

LANL also disposes of sanitary solid waste and rubble at the Los Alamos County landfill on East Jemez Road, which is DOE property that is operated by the county under a special use permit. Los Alamos County has day-to-

day operating responsibility for the landfill and is responsible for obtaining all related permits for this activity with the state. LANL contributed 22% (2,402,643 kg [2,649 tons]) of the total volume of trash landfilled at this site during CY95 with the remainder contributed by Los Alamos County and the City of Española. LANL also sent 5,159,923 kg (5,689 tons) of concrete/rubble, 703,832 kg (776 tons) of construction and demolition debris, 74,374 kg (82 tons) of brush for composting, and 40,815 kg (45 tons) of metal for recycling to the county landfill construction and demolition area.

Table 2-4 presents a summary of the materials recycled by Johnson Controls, Inc. (JCI), the Laboratory's support services subcontractor, in FY95. This effective waste minimization program, which continues to be expanded, conforms to RCRA, Subtitle D. (See Sections 1.B.2.b and 2.B.1.h. for more information on the Laboratory's recycling program.)

c. Resource Conservation and Recovery Act Closure Activities. Several solid waste management units (SWMUs) are subject to both the HSWA Module VIII corrective action requirements and the closure provisions of RCRA. The corrective action process occurs concurrently with the closure process, thereby satisfying both sets of regulations. NMED is the lead regulatory agency for these sites. The status of these sites is given below.

TA-35, Surface Impoundments. Closure plans for the two surface impoundments for waste oil that are associated with Buildings 85 and 125 at TA-35 were first submitted in October 1988, and the state subsequently gave oral approval to proceed with closure activities. All contents of the impoundments and underlying contaminated soil were removed and disposed of as hazardous waste. Sampling to verify the removal of contaminants from the area was completed in October 1989. Preliminary results of the sampling effort revealed that the criteria for clean closure had been met. The impoundments were backfilled and revegetated at that time. Upon receipt of the final analytical results, it was found that the allowed sample holding times had been exceeded; consequently, the data could not be verified. The closure plan was modified to reflect the events of the field work that occurred and to include bore sampling to be used as the final verification of clean closure. Bore sampling performed in December 1990 determined that the levels of contamination found to remain after this cleanup effort did not exceed the EPA's health-based, risk-based cleanup levels. By achieving these cleanup levels, the Laboratory could still achieve clean closure status for these two units and no post-closure care would be necessary.

The initial closure report and closure certification letters for the TA-35-125 surface impoundments were completed as of July 31, 1991, and were submitted to NMED in August 1991. The NMED sent a Notice of Deficiency (NOD) to DOE in July 1992 and denied approval of clean closure for the TA-35-125 unit. An amended closure plan was submitted to the state on September 4, 1992. The Laboratory received final regulatory approval from NMED in September 1993 on the TA-35-125 amended closure report. No further action is required for this surface impoundment.

The initial closure report and closure certification letters for TA-35-85 were submitted by the Laboratory on December 20, 1991. An amended closure plan for TA-35-85 was submitted to NMED for approval on November 1, 1993. On March 31, 1995, NMED issued an amended closure plan that had not been finalized by the end of the year, although a final closure plan is expected to be approved by NMED in early 1996. The Laboratory expects that additional field work will be required to support the closure.

TA-40, Scrap Detonation Site. On September 13, 1991, NMED notified the Laboratory that the closure plan for the TA-40 Scrap Detonation Site had been approved. The start date of the closure plan was September 30, 1991. This closure is proceeding behind schedule because the original closure plan did not anticipate contamination, which was detected above action levels at several different locations during the sampling phase. The closure plan modification and clean closure equivalency demonstration included risk assessments for the areas where contamination was detected above action levels and was submitted to NMED in May 1993. The Notice of Intent (NOI) to close the site and terminate interim status was issued by NMED on November 1, 1993, which started a 30-day period for receiving comments from the public. An amendment to the closure plan was submitted to NMED in February 1993. The NMED approved the amended closure plan on May 2, 1994. A final closure report was submitted to NMED on March 27, 1995, and approved by NMED on August 23, 1995.

TA-54, Waste Oil Storage Tanks. After discovering hazardous waste in six aboveground waste oil storage tanks, the Laboratory pumped and disposed of the contents as hazardous waste. The tanks were moved to TA-54, Area G to make room for needed facilities at TA-54, Area L. In April 1990, the Laboratory elected to proceed with the closure of these vessels in anticipation of receiving an approved storage plan. After the tanks had been cleaned several times, the final decontamination was completed in August 1990. A final closure plan/report that reflected

the actual closure process of these units was submitted in June 1991. An addendum to the final closure plan was submitted in July 1992. NMED approved the plan in August 1992. Soil sampling at TA-54, Area L to demonstrate clean closure will be performed in conjunction with the HSWA permit corrective activities scheduled during 1999.

TA-16, Landfill at Material Disposal Area P. Closure and post-closure-care plans for the Area P landfill were submitted on November 25, 1985. This area has not been used since 1984. In late 1987, these plans were modified to incorporate standards that this unit would be subject to once the Laboratory received its RCRA permit. Since that time, the ER Project, which oversees closures, has been established. The Laboratory requested an extension of the closure deadlines for this and other units that appear within the HSWA Module of the RCRA permit. An extension of the closure window would allow the ER Project to incorporate the results of the RCRA facility investigation (RFI)/Corrective Actions Study into the closure process. The NMED rejected this approach and requested a revised closure plan by September 1993. NMED indicated that it would allow an extension for evaluation of the outstanding issues.

The Laboratory submitted an amended closure plan on August 31, 1993, proposing additional sampling around the landfill to verify that there is no potential for migration of contaminants during snowmelt or storm events. Pending NMED approval, an asphalt lined surface water diversion channel around the landfill was constructed in November 1993. A NOD for the August 1993 closure plan was received in June 1994. Responses to the NOD, as well as a request for a 120-day extension to address groundwater issues, was submitted to NMED. NMED issued a public notice in early August 1994 that LANL intended to close TA-16, Material Disposal Area P, per the 1993 closure plan. During this time, LANL conducted a cost/benefit study on clean closing versus capping TA-16, Area P. The study concluded that clean closing the landfill would be the most cost effective and environmentally sound option. Therefore, LANL withdrew the August 1993 closure plan. A new closure plan was submitted to NMED in early February 1995 and identifies TA-16, Area P as a waste pile to allow for clean closure under 40 Code of Federal Regulations (CFR) 265.250. The closure plan was under review by NMED at the end of 1995.

TA-53, Surface Impoundments. A closure plan for two of the three surface impoundments located at TA-53 was submitted to NMED in February 1993. This plan was submitted as an alternative to permitting the impoundments as mixed waste units. NMED's comments on the Laboratory closure plan proposing clean closure for the two TA-53 surface impoundments were addressed by the Laboratory in a January 14, 1994, submittal. A revised closure plan for the two surface impoundments was submitted to NMED in early September 1994. A NOD on this closure plan was received by LANL in late October 1994. A response to the NOD was submitted to NMED in mid-December 1994. Additional clarifying information on the closure plan was submitted to NMED in early March 1995; an NOD on this closure plan was received by LANL in late July 1995. The Laboratory responded to the NOD in mid-August 1995. No response from NMED had been received by the end of 1995.

d. Underground Storage Tanks. The Laboratory's underground storage tanks (USTs) are regulated under the New Mexico Underground Storage Tank Regulations. At the end of CY95, the Laboratory had 13 regulated USTs. Of those 13, 11 USTs and their ancillary equipment must be upgraded or taken out of service by the end of CY98.

One UST was removed in CY95. This UST, TA-0-6th Street, was discovered by LANL's ER Project and is suspected to have been abandoned in the late 1960s. When found, the UST held 13,462 L (3,500 gal.) of a water and heating-fuel oil mixture. Upon removal, the UST was found to be leaking. LANL initiated corrective actions and received a letter from NMED in January 1996 stating that no further action was required for this former UST site.

UST TA-18-PL30 contained 2,154 L (560 gal.) of diesel fuel and was removed in September 1993. The site underwent extensive groundwater monitoring due to site contamination from petroleum releases associated with the UST. The groundwater data show concentrations of benzo-a-pyrene and naphthalenes below the concentration listed in Part 3 of the New Mexico Water Quality Control Commission (NMWQCC) regulations. On November 17, 1995, LANL received a letter from NMED stating that no further action was required on this former UST site.

In July 1994, the top of UST TA-16-1456 (containing 38,462 L [10,000 gal.] of unleaded gasoline) was excavated to conduct cathodic protection repairs on the tank. During the excavation, light soil staining and a faint odor of gasoline in the soil near the UST's fuel inlet pipe and vent line were noted. On August 3, 1994, NMED was notified regarding gasoline release from UST TA-6-1456. Several sources were determined to have contributed to the gasoline contamination, but the primary sources were determined to be two other former USTs that had resided in the same area as UST TA-16-1456 in the 1980s prior to their removal. One of these two former

USTs was UST TA-16-196, which was removed in 1987. This UST formerly held 15,385 L (4,000 gal.) of leaded gasoline. Upon removal, it was observed that the UST was extensively corroded and was leaking. Remediation actions involved the removal of several truck loads of contaminated soil from the site, but removal of all the soil was unsuccessful. Currently, the UST site is still under investigation to determine the extent of the former UST TA-16-196 gasoline contamination.

A UST inspection was conducted on January 23 and 24, 1995, by the NMED. From this inspection, DOE received two field Notices of Violation (NOVs) on January 27, 1995. The NOVs cited the absence of a drop tube in UST TA-3-MP-1, located at TA-60, and the lack of monthly fuel inventory reconciliations at UST TA-3-36-2. On February 24, 1995, Certification of Compliance documents were sent to NMED with $200 for the fines associated with the NOVs. There was no petroleum release associated with these NOV findings.

e. Other Resource Conservation and Recovery Act Activities. TA-54, Area L, located on Mesita del Buey, was used for disposal of hazardous waste since before the time such disposal became regulated under RCRA/NMHWA until 1985. Area L is now used for storage of hazardous waste and some mixed waste. Small amounts of new RCRA regulated waste were once placed in TA-54, Area G prior to the effective date of RCRA. Area G was also used for the disposal of mixed waste until 1985; Area G is currently being used for storage of mixed wastes. Information on a groundwater monitoring waiver for both Areas L and G has been submitted to NMED. Vadose zone monitoring is being conducted quarterly throughout Areas L and G to identify any releases from the disposal units. This type of monitoring is used to detect the presence of organic vapor in the vadose zone.

ESH-19 conducts a RCRA Self-Assessment Program designed to assist the Waste Management Coordinators (WMCs) and waste generators in proper storage of hazardous and mixed waste according to environmental, safety, and health requirements and policies. This self-assessment program utilizes personnel from the operating organization, ESH-19, and others, where appropriate. Its goals are to maintain regulatory compliance, to apply regulations and Laboratory policy consistently, and to improve the Laboratory's regulatory compliance performance. The self-assessment program is a formal procedure that follows written guidelines designed to be easily understood and achievable. The program includes an established process to correct deficiencies found during the self-assessment. The WMC has 30 days to respond to ESH-19 indicating what corrective actions were taken, if needed, or the status of any corrective actions that may take longer than the 30 day time limit. ESH-19 maintains a database to track all the observations and whether or not corrective actions were taken. The ESH-19 RCRA Self-Assessment Program is under development and subject to modifications, as needed. This program is an attempt to recognize and resolve specific needs of waste generators in maintaining regulatory compliance and was developed in coordination with the Waste Management Coordinator Program. The program was developed during 1995, and self assessments began in late 1995.

f. Resource Conservation and Recovery Act Compliance Inspection. NMED conducted its annual hazardous waste compliance inspection September 12–18, 1995 (Table 2-5). NMED inspectors visited hazardous waste satellite accumulation, storage, and treatment facilities located throughout the Laboratory.

g. Resource Conservation and Recovery Act Training. During 1995 the ESH Training Group (ESH-13), in conjunction with ESH-19, updated the Laboratory's RCRA training program. RCRA personnel training, a five-hour introductory course, was held for treatment, storage, and disposal (TSD) and less-than-90-day storage area workers. RCRA personnel must take refresher training courses annually. During 1995, 106 workers were trained in RCRA personnel training, 306 received the RCRA refresher training course, and 650 workers were trained in Waste Generation Overview, instruction for hazardous and mixed waste generators.

RCRA TSD personnel who must take Hazardous Waste Operations (HAZWOPER) training have been doing so at LANL for the last several years. In October 1994, ESH-13 developed a HAZWOPER refresher course specific to TSD workers. The course meets the regulatory requirements for both HAZWOPER and RCRA refresher training and is offered monthly throughout the year. During 1995, 202 persons completed the HAZWOPER refresher for TSD Workers.

The RCRA training program, as described in the RCRA permit, is complete and only experienced modifications and revisions in 1995 that reflect regulatory, organizational, and/or programmatic changes. The training courses that were developed in CY95 includethe following:

Waste Management Coordinator Training

Spill Prevention Control and Countermeasures (SPCC) Plan Training

HAZWOPER Refresher for TSD Workers
HAZWOPER Refresher for Environmental Restoration Workers
HAZWOPER - First Responder at the Awareness Level
Storm Water Pollution Prevention Plan Training

A class on Radioactive Materials Management Area training was developed and delivered during 1995. The class is being revised during 1996 to reflect changes in the Laboratory's requirements for handling radioactive waste.

h. Waste Minimization. Section 1003 of RCRA cites the minimization of the generation and land disposal of hazardous wastes as a national objective and policy. All hazardous waste must be handled in ways that minimize the present and future threat to human health and the environment. The act promotes process substitution, materials recovery, and properly conducted recycling, reuse, and treatment as alternatives to land disposal of hazardous waste.

The generation rates for total, routine, and nonroutine RCRA-hazardous and mixed low-level waste generation for CY93, CY94, and CY95 are provided in the list below:

	RCRA-hazardous (kg)			Mixed low-level (m^3)		
	1993	**1994**	**1995**	**1993**	**1994**	**1995**
Routine	75,570	58,147	25,725	29.47	21.12	6.29
Nonroutine	600	126,960	1,132,740	2.42	42.43	80.56
Total	76,170	185,107	1,159,465	31.89	63.55	86.85

DOE defines routine waste generation as

> "waste produced from any type of production operation, analytical and/or R&D laboratory operations; TSD operations, 'work for others', or any other periodic and recurring work that is considered ongoing in nature" (DOE 1995).

Routine/normal waste generation at LANL includes those activities that occur regularly and generate a waste stream of a predictable quantity and characterization. Routine activities constitute the waste generation baseline for that area which can be trended over an extended time period, provided the mission of the area did not change to the extent that it altered the waste generating activities of that area.

DOE defines nonroutine waste generation as

> "wastes produced from environmental restoration program activities, including primary and secondary wastes associated with retrieval and remediation operations; 'legacy wastes'; and D&D/Transition operations..." including one-time operations waste, facility upgrades, PCB and/or asbestos abatement and removal operations" (DOE 1995).

Nonroutine/off-normal waste generation at LANL can be identified as those waste generating activities that occur on an unscheduled basis and/or that produce a waste stream of unpredictable quantity and/or characterization. Because of the unpredictable schedule and/or characterization of the waste, generation from nonroutine/off-normal activities cannot be trended over an extended time period.

As evidenced in the waste generation list above, LANL continues to minimize its routinely generated hazardous and mixed low-level waste generation. Nonroutine waste generation has steadily increased, however, for both waste types due in large part to the increase in environmental restoration/decontamination and decommissioning activities occurring at LANL. Increased total mixed low-level waste generation in 1995 can also be explained by the moratorium on mixed low-level waste generation from May 8, 1992, to March 15, 1994. A full description of the moratorium is found in "Environmental Surveillance at Los Alamos during 1994" (EG 1996).

i. Hazardous and Solid Waste Amendments Compliance Activities. In 1995, the ER Project remained in compliance with Module VIII of the RCRA permit; however, NMED notified the Laboratory that its groundwater

monitoring and characterization are not sufficient to meet the requirements of the special conditions of the permit. Two Class 3 permit modification proposals were submitted in March and April 1995, requesting removal of 148 SWMUs from the HSWA Module list and recommending no further action for 428 areas of concern that are not on the HSWA Module list. EPA has not yet approved these proposals.

During 1995, an additional 356 sites were proposed for no further action in 19 field investigation reports submitted to EPA. The ER Project also cleaned up 45 sites, including areas in the Los Alamos townsite. The work plan for Los Alamos and Pueblo Canyons' investigation was submitted in November 1995, but other canyon work plans have been delayed because of funding constraints.

It was determined that the ER Project would not generate as much mixed waste as originally thought. Therefore, it was decided during 1995 to terminate work on the design for the mixed waste disposal facility. Work on the facility may resume in the future if need for it once again becomes apparent.

In 1995, the ER Project began negotiations on a Document of Understanding (DOU) among the Laboratory, Sandia National Laboratory, DOE, EPA, and NMED. This DOU is intended to facilitate timely and cost-effective implementation of ER programs at the Laboratory and Sandia. It provides a basis for standardization in planning and execution of both programs. The DOU should be finalized in 1996.

2. Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 mandates actions for certain releases of hazardous substances into the environment. LANL is not listed on the EPA's National Priority List but is subject to the CERCLA guidelines for remediating ER Project sites that contain certain hazardous substances not covered by RCRA.

3. Emergency Planning and Community Right-to-Know Act

a. Introduction. Title III, Section 313, of the Emergency Planning and Community Right-to-Know Act (EPCRA) requires facilities meeting certain standard industrial classification (SIC) code criteria to submit an annual Toxic Chemical Release Inventory (TRI) report. A report describing the use and emissions from Section 313 chemicals must be submitted to EPA and the New Mexico Emergency Management Bureau every July for the preceding calendar year.

The Laboratory does not meet the SIC code criteria for reporting but has voluntarily submitted annual TRI reports since 1987. All research operations are exempt under provisions of the regulation, and only pilot plants, production, or manufacturing operations at the Laboratory are reported. In previous years, this has limited the Laboratory's release reporting to regulated chemical use at the Plutonium Processing Facility at TA-55.

On August 3, 1993, the President of the United States issued Executive Order (EO) 12856 requiring all federal facilities, regardless of SIC code to report under Title III, Section 313 of EPCRA. Research operations remain exempt. This requirement was effective for the July 1995 report that covered the preceding CY94. The Laboratory, along with DOE, elected to begin reporting under the new guidelines for the 1994 report. The 1995 report included two chemicals, chlorine for water treatment and sulfuric acid used to deionize water at the Laboratory's main power plant (TA-3-22); the 1995 report covers the releases of chlorine and sulfuric acid during 1994. Approximately 7,636 kg (16,799 lb) of chlorine were used in water purification operations involving noncontact cooling water, sewage treatment, and drinking water resulting in air emissions of 368 kg (810 lb) of chloroform and 1.8 kg (4 lb) of chlorine. An estimated 1,447 kg (3,184 lb) of chlorine were released with the discharged water. In addition, 13,960 kg (30,711 lb) of sulfuric acid used to deionize water at the Laboratory's main power plant were reported. Sulfuric acid use at the power plant was substantially decreased (10,470 kg [23,034 lb] less than that used in 1993) due to the installation of newer, more efficient ionization beds. Sulfuric acid operations resulted in less than a half kg (less than a lb) of air emissions. All spent sulfuric acid was completely neutralized before discharge to the environment.

Nitric acid used in 1994 for plutonium processing at TA-55 did not meet the threshold reporting limit of 4,546 kg (10,000 lb) due to operational shutdowns at the facility.

b. Emergency Planning and Community Right-to-Know Act Summary. The Laboratory submits four reports each year in compliance with DOE guidance for EPCRA:

		Reporting Required		
Statute		**Yes**	**No**	**Not Required**
EPCRA 302-303:	Planning Notification	×		
EPCRA 304:	Extremely Hazardous Substances Release Notification	×		
EPCRA 311-312:	Material Data Safety Sheet/ Chemical Inventory	×		
EPCRA 313:	TRI Reporting	×		

c. Emergency Planning. In accordance with DOE orders in the 5500 series, it is the Laboratory's policy to develop and maintain an emergency management system that includes emergency planning, emergency preparedness, and effective response capabilities for responding to and mitigating the consequences of an emergency. The Laboratory's Emergency Management Plan is a document that describes the entire process of planning, responding to, and mitigating the potential consequences of an emergency. The most recent revision of the plan was completed in September 1994; future revisions will be distributed on an as-needed basis.

4. Toxic Substances Control Act

Unlike other statutes which regulate chemicals and their risk after they have been introduced into the environment, TSCA was intended to require testing and risk assessment before a chemical is introduced into commerce. TSCA also establishes record keeping and reporting requirements for new information regarding adverse health and environmental effects of chemicals; governs the manufacture, use, storage, handling, and disposal of polychlorinated biphenyls (PCBs); and sets standards for PCB spill clean ups. Because the Laboratory's activities are in the realm of research and development and do not involve introducing chemicals into commerce, the PCB regulations (40 CFR 761) have been the Laboratory's main concern under TSCA. Substances that are governed by the PCB regulations include but are not limited to dielectric fluids, contaminated solvents, oils, waste oils, heat transfer fluids, hydraulic fluids, slurries, soils, and materials contaminated as a result of spills. Most of the provisions of the regulations apply to transformers, capacitors, and other PCB items with concentrations above a specified level. For example, the regulations regarding storage and disposal of PCBs generally apply to items with PCB concentrations of 50 ppm or greater.

In 1995, the last seven high concentration (>500 ppm PCBs) PCB transformers were replaced with non-PCB transformers. The Laboratory still operates 18 PCB-contaminated (between 50 and 500 ppm PCBs) transformers which will be replaced as funding becomes available. The Laboratory, through JCI, is conducting a PCB survey which is scheduled to be completed in 1996. PCB items identified during the survey are added to the Laboratory's PCB inventory. The inventory is continually updated as items are disposed of and new items are discovered during the survey. During 1995, 1,195 structures were inspected, 1,490 potential PCB items were inspected, 202 samples of potential PCB items were collected and analyzed, and 88 PCB items were identified. The types of items inventoried by the survey include transformers, various pumps, oil-filled switches, light ballasts, generators, small transformers, and capacitors. Most items are scheduled for disposal as soon as they are discovered. The survey involves visual inspection, manufacturers' data, record searches, sample collection, and laboratory analytical testing.

Analytical testing for PCBs is also performed for other TSCA compliance activities such as waste characterizations and transformer concentration verifications. A total of 257 samples was analyzed for PCBs at the Laboratory in 1995. Analytical results are attached to waste tracking forms, and the item tested is appropriately marked. Once identified, inventoried, and marked, waste materials with 50 ppm PCBs or greater which do not contain radioactive constituents are transported off site for treatment and disposal in accordance with TSCA.

In 1995, the Laboratory had 10 off-site shipments of PCB waste. The total weight of PCBs in those shipments was 1,420,073 kg (3,130,692 lb). PCB wastes are sent to EPA-permitted disposal and treatment facilities. The quantities of waste types disposed were 80 capacitors, 23 drums of light ballasts, 7 transformers, 1 drum of water, 10,933 kg (24,105 lb) of PCB oil, and 1,272,392 kg (2,805,115 lb) of PCB contaminated soil. All wastes are tracked from the point of generation to final disposal. Documentation, such as waste manifests and verification of

shipment receipts, is kept on file. Certificates of Destruction for each waste are sent to the Laboratory by all treatment or disposal facilities.

Liquids containing greater than 50 ppm PCBs and radioactive constituents are stored at the TA-54, Area L TSCA storage facility. Many of these items have exceeded TSCA's one year storage limit. A total of 51 drums of PCB and radioactively contaminated wastes are stored awaiting completion of a national storage agreement involving DOE and EPA. These wastes must be stored due to the lack of any EPA-approved disposal facility for this type of waste. This noncompliance issue is well documented and numerous communications have been taking place between EPA Region 6 and LANL/DOE representatives. Nonliquid wastes containing greater than 50 ppm PCBs and radioactive constituents are disposed at the Laboratory's EPA-authorized TSCA landfill located at TA-54, Area G.

The Laboratory's TSCA disposal facility at TA-54, Area G disposed 16 kg (35 lb) of radioactively contaminated PCB waste during 1995. Although the volumes of this type of waste were expected to be minimal over the next several years, environmental restoration cleanups may generate more significant volumes of waste to be disposed on site if suitable off-site options are not identified. LANL has therefore requested renewal of the 1980 EPA authorization for on-site PCB waste disposal. Representatives of the Laboratory have actively discussed renewal conditions with EPA since 1991. New authorization is expected to be final in 1996.

Compliance documents pertaining to the above activities are compiled and written on a routine basis. The two primary compliance documents are the Annual PCB Document (LANL 1996) (includes the annual inventory log and disposal records required by 40 CFR 760.180) and a semiannual PCB letter (required by Condition 6 of the EPA Approval for LANL to Operate a PCB Landfill). EPA did not conduct an audit of the Laboratory's PCB management program during 1995.

5. Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the manufacturing of pesticides, with requirements on registration, labeling, packaging, record keeping, distribution, worker protection, certification, experimental use, and tolerances in foods and feeds. Sections of this act that are applicable to the Laboratory include recommended procedures for storage and disposal, and requirements for certification of workers who apply pesticides. The Laboratory is also regulated by the New Mexico Pest Control Act, administered by the New Mexico Department of Agriculture (NMDA), which regulates pesticide use, storage, and certification. NMDA conducts annual inspections of JCI's compliance with the act. The application, storage, disposal, and certification of these chemicals is conducted in compliance with these regulations. JCI certified applicators apply pesticides at the direction of the Laboratory's Pest Control Program Administrator. The Laboratory Pest Control Management Plan, which includes programs for vegetation, insects, and small animals, was established in 1984 and is revised as needed by the Pest Control Oversight Committee, a committee established to review and recommend policy changes in the overall pest management program at the Laboratory. NMDA did not conduct an annual inspection of the Laboratory's pesticide application program and certified application equipment during 1995.

6. Federal Clean Air Act

a. Federal Regulations. The Laboratory is subject to a number of federal air quality regulations. These include

- National Emission Standards for Hazardous Air Pollutants (NESHAP);
- National Ambient Air Quality Standards;
- New Source Performance Standards (NSPS);
- Stratospheric Ozone Protection (SOP); and
- Operating Permit Program.

All of the above requirements that are applicable to LANL, except the NESHAP for radionuclides and provisions relating to SOP, have been adopted by the State of New Mexico as part of its State Implementation Plan.

Therefore, all of these regulations, except the radionuclide NESHAP and SOP, are discussed in Section 7, New Mexico Air Quality Control Act.

In addition to the existing federal programs, the 1990 amendments to the Clean Air Act (CAA) mandate new programs that may affect the Laboratory. The new requirements include control technology for hazardous air pollutants, enhanced monitoring, prevention of accidental releases, and chlorofluorocarbon replacement. The Laboratory will track new regulations written to implement the act, determine their effects on Laboratory operations, and implement programs as needed.

b. Compliance Activities.

Radionuclide NESHAP. Under 40 CFR 61, Subpart H, the EPA limits the effective dose equivalent to any member of the public from radioactive airborne releases from DOE facilities, including LANL, to 10 mrem/yr. The 1995 effective dose equivalent (as calculated using EPA-approved methods which do not allow the use of shielding factors) was 5.05 mrem/yr, primarily from the Los Alamos Neutron Science Center (LANSCE) operations. LANSCE was formerly called the Los Alamos Meson Physics Facility. Any construction or modifications undertaken at LANL that will increase airborne radioactive emissions require preconstruction approval from EPA. In 1995, 169 such projects were received by Air Quality (ESH-17) for Laboratory review; only one of these was determined to require preconstruction approval.

A detailed description of the NESHAP Federal Facility Compliance Agreement (FFCA) is in Section 2.C.1.d.

Stratospheric Ozone Protection. Effective July 1, 1992, Section 608 (National Emission Reduction Program) of the Clean Air Act Amendments (CAAA) of 1990 prohibits individuals from knowingly venting ozone depleting substances (ODS) used as refrigerants into the atmosphere while maintaining, servicing, repairing, or disposing of air conditioning or refrigeration equipment. JCI recovers and recycles all ODS during servicing and repair of all refrigeration equipment at the Laboratory and does not vent ODS to the atmosphere. Final regulations concerning the type of recovery/recycling equipment to be used and the procedures for using this equipment became effective on July 13, 1993.

Section 609 (Servicing of Motor Vehicle Air Conditioners) of the CAAA established standards and requirements related to recycling equipment used in the servicing of motor vehicle air conditioners, and training and certification of technicians providing such services. JCI, in full compliance with these regulations, provides all servicing and maintenance relating to automotive air conditioning equipment at the Laboratory.

Section 611 (Labeling of Products Using ODS) of the CAAA established requirements that no product containing Class I or II ODS or any product containing Class I ODS may be shipped across state lines unless it bears an appropriate warning label. This regulation came into effect on November 11, 1993. ESH-17 worked with groups that ship ODS products and ODS-containing waste off site to ensure that the proper labeling requirements were met.

7. New Mexico Air Quality Control Act

a. State Regulations. The NMEIB, as provided by the New Mexico Air Quality Control Act, regulates air quality through a series of air quality control regulations in the New Mexico Administrative Code (NMAC). These regulations are administered by NMED. The NMACs (formerly called Air Quality Control Regulations) relevant to Laboratory operations are discussed below.

b. Compliance Activities.

20 NMAC 2.60-Regulation to Control Open Burning. Provisions of 20 NMAC 2.60 regulate the open burning of materials. Under this regulation, open burning of explosive materials is permitted when transport of these materials to other facilities may be dangerous. Provisions of this regulation allow DOE and the Laboratory to burn waste explosives. Research projects require open burning permits. In 1995, the Laboratory had five open burning permits: one for the open burning of jet fuel and wood for ordnance testing at TA-11, K Site; one for the open burning of explosive-contaminated materials at TA-14; one for the open burning of explosive-contaminated materials at TA-16; one for burning explosive-contaminated wood at TA-36; and one for open burning of explosive-contaminated materials TA-39 (Table 2-2).

20 NMAC 2.61-Regulations to Control Smoke and Visible Emissions. Provisions of 20 NMAC 2.61 limit the visible emissions allowed from the Laboratory boilers to less than 20% opacity. Opacity is the degree to which emissions reduce the transmission of light and obscure the view of a background object. Because the

Laboratory boilers are fueled by clean-burning natural gas, exceeding this standard is unlikely. It may, however, occur during start-up with oil, the backup fuel for the boilers. Although oil is used infrequently, the boilers must be periodically switched to oil to ensure that the backup system is operating properly. Opacity is read during these switches. Only one exceedance of the opacity standard occurred in 1995; it occurred at the TA-16 steam plant. Notification procedures, as required by 20 NMAC 2.07, were followed.

20 NMAC 2.11-Asphalt Process Equipment. Provisions of 20 NMAC 2.11 set emission standards according to process rate and require the control of emissions from asphalt-processing equipment. The asphalt concrete plant operated by JCI is subject to this regulation. The plant, which has a 68,162 kg/h (75 ton/h) capacity, is required to meet an emission limit of 15 kg (33 lb) of particulate matter per hour. A stack test of the asphalt plant in August 1992 indicated an average emission rate of 1.9 kg/h (4.2 lb/h) and a maximum rate of 2.3 kg/h (5.1 lb/h) over three tests (Kramer 1993). Although the plant is old and is not required to, it meets NSPS stack emission limits for asphalt plants.

20 NMAC 2.18-Oil Burning Equipment-Particulate Matter. This regulation applies to an oil burning unit having a rated heat capacity greater than 250 million Btu per hour. Oil burning equipment of this capacity must emit less than 0.03 lb per million Btu of particulate. Although the Laboratory boilers use oil as a backup fuel, all have maximum rated heat capacities below this level; consequently, this regulation does not apply. The TA-3 power plant operates the three highest heat capacity boilers, each of which had an observed maximum capacity of 210 million Btu/h.

20 NMAC 2.33-Gas Burning Equipment-Nitrogen Dioxide. Provisions of 20 NMAC 2.33 require gas burning equipment built before January 10, 1972, to meet an emission standard of 0.3 lb of nitrogen dioxide per million Btu when natural gas consumption exceeds 1×10^{12} Btu/yr/unit. Only the TA-3 steam plant has the capacity to operate at this level. While the TA-3 steam plant has the capacity to operate at this level, it never has and is therefore not an applicable source for this regulation. However, stack tests done in 1995 indicate that the TA-3 power plant meets the emission standard.

20 NMAC 2.31-Oil Burning Equipment-Sulfur Dioxide. This regulation applies to oil burning equipment having a heat input of greater than 1×10^{12} Btu/yr. Although the Laboratory uses oil as a backup fuel, no oil-fired equipment exceeds this threshold heat input rate. Therefore, this regulation did not apply during 1995 to the Laboratory fuel burning equipment. Should such equipment operate above the heat input limit, emissions of sulfur dioxide would be required to be less than 0.34 lb per million Btu.

20 NMAC 2.34-Oil Burning Equipment-Nitrogen Dioxide. This regulation applies to oil burning equipment having a heat input of greater than 1×10^{12} Btu/yr. Although the Laboratory uses oil as a backup fuel, no oil-fired equipment exceeds this threshold heat input rate. Therefore, this regulation did not apply during 1995 to the Laboratory fuel burning equipment. Should such equipment operate above the heat input limit, emissions of nitrogen dioxide would be required to be less than 0.3 lb per million Btu.

20 NMAC 2.72-Permits. Provisions of 20 NMAC 2.72 require permits for any new or modified source of potentially harmful emissions if they exceed threshold emission rates. More than 500 toxic air pollutants are regulated, and each chemical's threshold hourly rate is extrapolated from an occupational exposure limit. The Laboratory reviews each new and modified source and makes conservative estimates of maximum hourly chemical usage and emissions. These estimates are compared with the applicable 20 NMAC 2.72 limits to determine if additional permits are required. During 1995, over 190 source reviews were conducted. None of these sources required permits under 20 NMAC 2.72.

20 NMAC 2.74-Prevention of Significant Deterioration. These regulations have stringent requirements that must be addressed before the construction of any new, large stationary source can begin. Wilderness areas, national parks, and national monuments receive special protection under this regulation. This could impact the Laboratory due to the proximity of Bandelier National Monument's Wilderness Area. Each new or modified source at the Laboratory is reviewed to determine whether this regulation applies; however, none of the new or modified sources in 1995 have resulted in emission increases considered "significant," and they were therefore not subject to this regulation.

20 NMAC 2.78-Emission Standards for Hazardous Air Pollutants. In this regulation, NMEIB adopted by reference all of the federal NESHAP, except those for radionuclides and residential wood heaters. The impact of each applicable NESHAP is discussed below:

Asbestos. Under the NESHAP for asbestos, the Laboratory must ensure that no visible asbestos emissions to the atmosphere are produced by asbestos removal operations at the Laboratory. During 1995, no Laboratory operation

produced visible asbestos emissions.

The Laboratory is also required to notify NMED of asbestos removal activities and disposal quantities. Such activities involving less than 15 m^2 (160 ft^2) or 74 m (260 lin ft) are covered by an annual small job notification to NMED. For projects involving greater than these amounts of asbestos, separate notification to NMED is required in advance of each project. NMED is notified of asbestos wastes (both small and large jobs) on a quarterly basis, which includes any material contaminated, or potentially contaminated, with radionuclides. Radioactively contaminated material is disposed of on site in a designated radioactive asbestos burial area. Nonradioactive asbestos is transported off site to designated asbestos disposal areas.

During 1995, LANL shipped off site for disposal 52 m^3 (1,846 ft^3) of small job asbestos waste. One ER project generated an additional 66.9 m^3 (2,362 ft^2) of nonfriable asbestos waste.

A total of 107.6 m^3 (3,799 ft^3) of potentially radioactive contaminated asbestos and asbestos wastes known to have low-level contamination was disposed of on site. Small job activity accounted for 68.2 m^3 (2,407 ft^3). The large demolition job at TA-21-3 and 4 South that was started in 1993 and is not complete, accounted for 38.2 m^3 (1,349 ft^3). A small amount, 1.2 m^3 (43 ft^3) came from a large job that was scaled back and then canceled at the Chemistry and Metallurgy Research (CMR) building.

Beryllium. The beryllium NESHAP includes requirements for notification, emission limits, and stack performance testing for beryllium sources. The Laboratory has previously received four beryllium permits from NMED (Table 2-2) and has registered several additional facilities. The registered facilities do not require permits under the regulations because they existed before the adoption of the federal NESHAP. Exhaust air from each of the beryllium operations passes through air pollution control equipment before exiting from a stack. A fabric filter controls emissions from TA-3-39. The other operations use high-efficiency particle air filters to control emissions, with efficiencies of 99.95%. Source tests for the existing operations have demonstrated that all beryllium operations meet the permitted emission limits set by NMED and have a negligible impact on ambient air quality.

20 NMAC 2.70-Operating Permits. The NMED Operating Permit Program was approved by EPA in December 1994. This regulation requires major sources of air pollution to obtain an operating permit with the NMED. Because of LANL's large potential to emit regulated air pollutants (primarily from the steam plants), LANL is considered a major source. The permit specifies the operational terms and limitations required to meet all federal and state air quality regulations. During 1995, the Laboratory prepared the Operating Permit application. It was submitted to NMED in December 1995.

20 NMAC 2.71-Fees. As part of the new Operating Permit Program, the State of New Mexico will begin to charge yearly fees to sources of air pollution that are required to obtain an operating permit. Fees will depend on the amount of air pollutants described in the source's permit.

20 NMAC 2.07-Excess Emissions during Malfunction, Start-up, Shutdown, or Scheduled Maintenance. This provision allows for excess emissions from process equipment during malfunction, start-up, shutdown, or scheduled maintenance, provided the operator verbally notifies NMED either before or within 24 hours of the occurrence, followed by written notification within 10 days of the occurrence. One incidence of excess particulate emissions was recorded in 1995. This occurred at the TA-3-29 beryllium machine shop and was found during routine testing of the bag house filtration system. Notification procedures as required by 20 NMAC 2.07 were followed. New start-up and shutdown procedures were initiated in order to reduce the likelihood of excess emissions caused by the separation of the bag house filter from its housing.

One exceedance of the opacity standard occurred in 1995 at the TA-16 steam plant. Refer to Section 2.B.7.b for details.

8. Clean Water Act

a. National Pollutant Discharge Elimination System Program Overview. The primary goal of the Clean Water Act (CWA) (33 U.S.C. 446 *et seq.*) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The Act established the National Pollutant Discharge Elimination System (NPDES) that requires permitting point-source effluent discharges to the nation's waters. The NPDES permits establish specific chemical, physical, and biological criteria that an effluent must meet before it is discharged. Although most of the Laboratory's effluent is discharged to normally dry arroyos, the Laboratory is required to meet effluent limitations under the NPDES permit program.

In 1995, LANL had 10 NPDES permits; 1 covering the effluent discharges at Los Alamos, 1 covering the hot dry rock geothermal facility located 50 km (30 mi) west of Los Alamos at Fenton Hill, and 8 covering storm water discharges (Tables 2-2 and 2-6). The UC and DOE are co-owners on the permits covering Los Alamos. The permits are issued and enforced by EPA Region 6 in Dallas, Texas. However, NMED performs some compliance evaluation inspections and monitoring for EPA through a Section 106 water quality grant.

In January 1995, the Laboratory's NPDES outfall permit for Los Alamos included 2 sanitary wastewater treatment facilities and 122 industrial outfalls. By the end of 1995, the Laboratory had eliminated 27 permitted industrial outfalls in the NPDES permit. A summary of these outfalls is included in Table 2-7. The NPDES permit for the geothermal facility at Fenton Hill includes only one industrial outfall. This outfall did not discharge during 1995. Under the Laboratory's existing NPDES permit for Los Alamos, samples are collected for analysis on a weekly basis, and results are reported to EPA and NMED at the end of the monitoring period for each respective outfall category. During 1995, effluent limits were not exceeded in any of the 166 samples collected from the sanitary wastewater facilities. Effluent limits were exceeded 22 times in the 1,751 samples collected from the industrial outfalls. Overall compliance for the sanitary and industrial waste discharges during 1995 was 100% and 98.7%, respectively. Tables 2-7 through 2-11 present monitoring standards and Laboratory exceedances from those standards.

b. Business Plan for National Pollutant Discharge Elimination System Permit Compliance and Outfall Reduction. The Water Quality and Hydrology Group (ESH-18) in coordination with DOE/Los Alamos Area Office (LAAO) developed a business plan for NPDES permit compliance and outfall reduction as a result of the Administrative Order (AO) Docket No. VI-94-10-59 received in 1994 for noncompliances. A primary function of the business plan is to establish cross-functional teams to address and improve operational, technical, and regulatory facets of the Laboratory's NPDES compliance record. The business plan enhances the Laboratory's existing plan to ensure compliance with regulations and outlines the program necessary to achieve 100% compliance, improve environmental awareness across the Laboratory, and establish ownership for compliance. It also instills accountability within the Laboratory, sets aggressive goals for employees and divisions, and improves root cause analysis of occurrences.

The business plan was finalized by LANL and approved by DOE/LAAO on October 12, 1995. After DOE's approval of the plan, ESH-18 established working groups for each of five major outfall categories contained in LANL's NPDES permit. These categories include sanitary wastewater treatment plant effluent, heating and cooling system releases, high explosives wastewater discharges, radioactive liquid waste treatment facility effluent, and photographic rinse water. These working groups are composed of individuals from DOE, ESH-18, LANL operating groups, and, in some cases, NMED.

Charters outlining the goals and objectives of each working group were developed and submitted to affected management for signature. Several of the working groups have been very involved in the identification and elimination of unnecessary outfalls from LANL's NPDES permit. This has contributed to the successful elimination of 27 outfalls from the Laboratory's permit during 1995. Other efforts of the working groups have emphasized the resolution of specific effluent violations, clearly defining the root causes of these violations, and the development of proactive strategies to achieve and maintain compliance with applicable federal and state laws.

c. Waste Stream Characterization Program and Corrections Project. ESH-18 implemented the Waste Stream Corrections Project to correct Laboratory-wide noncomplying waste streams and potential unpermitted outfalls that discharge to the environment, as identified by the Waste Stream Characterization (WSC) survey conducted from 1991 to 1994.

Waste stream deficiencies identified by the WSC survey were compiled into 83 reports that were finalized and distributed to the responsible division directors for facilities under their management in March 1994. Correction of waste stream deficiencies is required in compliance with the CWA NPDES permit regulations and with the schedule requirements set forth by EPA AO Docket No. VI-94-1242. AO Docket No. VI-94-1242 requires the Laboratory to complete 25% of the corrective actions that were recommended by the WSC survey by September 30, 1994, and 50% by September 30, 1995. These requirements have been met. The Laboratory must be in 100% compliance by October 1, 1996, pursuant to the AO.

The Laboratory has secured institutional funding of approximately $3 million to perform the corrective actions needed to bring Laboratory facilities into compliance with the NPDES permit program. ESH-18 is managing this funding for the Laboratory and utilizing maintenance and construction expertise of the Facilities Project Delivery

Group (FSS-6) to complete the projects before the October 1, 1996, deadline. Facility Managers (FMs) and operating groups are directly responsible for completing corrective actions in their facilities and for securing any additional funding and other resources as necessary for successful completion of the project.

d. National Pollution Discharge Elimination System Storm Water Program. On November 16, 1990, the EPA promulgated the final rule for NPDES Regulations for Storm Water Discharges and modified 40 CFR 122, 123, and 124. This rule was required to implement Section 402(p) of the CWA (added by Section 405 of the Water Quality Act of 1987).

On September 9, 1992, EPA published the final general permits for storm water discharges associated with industrial and construction activity. The Laboratory chose to apply for coverage under the General Permit. Currently the Laboratory has eight NPDES General Permits for its storm water discharges (Table 2-6). One permit is for the Laboratory site and includes the following industrial activities: hazardous TSD facilities operating under interim status or a permit under Subtitle C of RCRA, (this category includes SWMUs); landfills, land application sites, and open dumps including those that are subject to regulation under Subtitle D of RCRA; and steam electric power generating facilities. One permit is for the remediation of an ER site off of DOE property. The other six permits are for construction activities disturbing more than five acres.

The conditions of the General Permit require the development and implementation of a Storm Water Pollution Prevention (SWPP) Plan. During 1995, the Laboratory has developed and implemented 55 SWPP Plans for activities regulated under the NPDES General Permit for storm water discharges.

Under the General Permit, monitoring activities are required at Section 313 of EPCRA facilities and land disposal units/incinerators. In 1995 monitoring was conducted at TA-54, Areas G and J and at TA-50. This analytical data must be submitted annually to EPA in the form of a Discharge Monitoring Report (DMR). The Laboratory submitted its 1995 DMR to EPA on October 27, 1995.

As part of the NPDES Storm Water Program, in 1994 the US Geological Survey (USGS) installed and began operating stream monitoring stations on the canyons entering and leaving the Laboratory. In 1994, there were a total of 17 stations on the various watercourses at the Laboratory. Information gathered by the USGS will be published in the New Mexico Water Resources Data, Water Year 1994. In 1995, 17 stations on the various watercourses at the Laboratory were operated, and 2 additional stations were constructed in Mortandad Canyon to be operated in 1996. Information gathered by ESH-18 will be published in a separate report. See Table 2-12 for a summary of flows from these stations for the Water Year 1995.

e. National Pollutant Discharge Elimination System Compliance Inspection. An inspection, scheduled for October 1995, was canceled; no NPDES compliance inspection was conducted during 1995.

f. Spill Prevention Control and Countermeasures Program. The Laboratory's Spill Prevention Control and Countermeasures (SPCC) Plan is a comprehensive plan developed to meet the regulatory requirements of the EPA and NMED that regulate water pollution from oil and hazardous chemical spills. The SPCC Plan, as required by the CWA, was developed in accordance with 40 CFR 112. The purpose of the SPCC Plan is to ensure that adequate prevention and response measures are provided to prevent oil spills from reaching a water course. Prevention measures include maintenance and inspections of facilities to ensure the integrity of the oil and chemical handling equipment, and proper operator training. Because of the wide variety of operating conditions at the Laboratory, the SPCC Plan has also diversified coverage with the implementation of a Group SPCC Implementation Plan (GSIP) approach.

The location of the 120 SPCC characterized sites and areas, including 47 aboveground storage tanks for petroleum fuel and oils and 18 aboveground storage tanks for chemicals, which are grouped into 17 major GSIPs (some plans contain multiple sites), are listed below:

TA-3-22	Power Plant
TA-15/36	Dynamic Experimentation Division
TA-3-316	Marx Generator
TA-16	Steam Plant
TA-21	Radioactive Liquid Waste Treatment Facility
TA-35	Chemical Science and Technology Division
TA-50	Waste Treatment Facilities

TA-53	Accelerator Operations
TA-55	Plutonium Facility
TA-3-37	Asphalt Batch Plant
TA-3	Computing, Information, and Communications Division
TA-21	Steam Plant
TA-35	Physics Division
TA-53	Liquid Scintillator
TA-54	Area L
TA-57	Fenton Hill
TA-60	Fuel Yard

In keeping with the site-specific GSIP approach, the operating conditions for each location are addressed, and as these change, only the individual GSIP will be revised. In addition to requiring secondary containment provisions for all aboveground storage tanks, the plan also provides for spill control on drum and container storage, transfer, and loading/unloading areas. Training is provided for the operating group's designated Spill Coordinator on the requirements of the SPCC Plan. The Spill Coordinator plays the major role in implementation of the SPCC Plan at the group level. Revision 3 of the SPCC Plan was completed in September 1993; a training course for Spill Coordinators was presented in 1994 and is offered quarterly through the ESH-13.

g. Sanitary Sewage Sludge Management Program. In December 1992, the EPA promulgated 40 CFR Part 503: The Standards for Use or Disposal of Sewage Sludge. The purpose of these regulations is to establish numerical, management, and operational standards for the beneficial use or disposal of sewage sludge through land application or surface disposal. Under the Part 503 regulations, the Laboratory is required to collect representative samples of sewage sludge in order to demonstrate that it is not a hazardous waste and that it meets the minimum federal standards for pollutant concentrations. In addition, sewage sludge is monitored for radioactivity in order to demonstrate that it meets the standards set forth in the Laboratory's Administrative Requirement 3-5. During 1995, approximately 38 dry tons of sewage sludge was generated at the TA-46 Sanitary Wastewater System Consolidation (SWSC) Plant as part of routine wastewater treatment operations; analytical monitoring of this sludge in 1995 demonstrated 100% compliance with the minimum federal and Laboratory standards for land application.

Also during 1995, approximately 83 dry tons of sewage sludge generated at the SWSC plant in 1993, 1994, and 1995 were land applied along the TA-61/53 gas pipeline utility easement as a soil additive to promote revegetation. In 1995, the Laboratory submitted a groundwater discharge plan application to the Ground Water Protection and Remediation Bureau of NMED for the land application of dried sanitary sludge from the TA-46 SWSC plant. On June 30, 1995, the NMED approved the groundwater discharge plan application for a period of five years.

9. Safe Drinking Water Act Program

a. Introduction. This program includes sampling from various points in the Laboratory, Los Alamos County, and Bandelier National Monument's water distribution systems and from the water supply well heads to ensure compliance with the Safe Drinking Water Act (SDWA) (40 CFR 141). The DOE provides drinking water to Los Alamos County and Bandelier National Monument. The EPA has established maximum contaminant levels (MCLs) for microbiological organisms, organic and inorganic constituents, and radioactivity in drinking water. These standards have been adopted by the state and are included in the New Mexico Drinking Water Regulations (NMEIB 1995). The NMED has been given authority by EPA to administer and enforce federal drinking water regulations and standards in New Mexico.

Compliance samples are analyzed at two state certified laboratories: New Mexico Health Department's Scientific Laboratory Division (SLD) in Albuquerque for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic constituents, and radioactivity; and Triangle Laboratories in Durham, North Carolina, for dioxin. The SLD reports its analytical results directly to NMED. Triangle Laboratories reports its analytical results to ESH-18, who, in turn, transmits the results to NMED. The JCI Environmental (JENV) laboratory also collects samples from the Laboratory, Los Alamos County, and Bandelier National Monument's distribution systems and tests them for microbiological contamination, as required under the SDWA. The JENV laboratory is certified by NMED for microbiological testing of drinking water.

b. Compliance Activities. During 1995, all chemical, radiological, and microbiological parameters regulated under the SDWA were in compliance with the MCLs established by regulation. The analytical results for SDWA compliance sampling in 1995 are presented in the following tables: total trihalomethanes (Table 5-25), radioactivity (Table 5-26), radon (Table 5-27), inorganic constituents (Table 5-31), lead and copper (Table 5-32), VOCs (Table 5-33), SOCs (Table 5-34), and bacteria (Table 5-35).

Radon sampling was performed at well heads and points of entry of water from the two well fields into the distribution system. This sampling was done to collect information prior to the issuance of a final EPA regulation governing radon in drinking water. The sampling indicates that radon treatment may be required if EPA finalizes the radon standard with the same 300 pCi/L limit contained in the proposed rule. Depending on the final rule's provisions, waters from some well fields may need radon treatment by extended storage to allow radioactive decay or adsorption removal.

Each month during 1995, an average of 46 microbiological samples was collected at designated sample taps in the Laboratory, county, and Bandelier National Monument's water distribution systems. The microbiological samples are analyzed for free chlorine residual and the presence or absence of total coliform, fecal coliform, and noncoliform bacteria. Sample collection and analysis were performed by personnel from the JENV laboratory. During 1995, of the 555 samples analyzed, only 2 indicated the presence of total coliforms, and only 1 indicated the presence of fecal coliforms. This was not an SDWA violation because the fecal coliform positive sample was not repeated during follow-up sampling. Noncoliforms were present in 14 of the microbiological samples. Monthly data for 1995 is presented in Table 5-35. Noncoliform bacteria are not regulated, but their presence in repeated samples may serve as indicators of biofilm growth in water pipes.

Coliforms are the standard indicators of sewage pollution because they inhabit the intestinal tract of humans and other animals and therefore may indicate the presence of sewage or animal waste in the water. They are generally easier and safer to culture than specific pathogens. Fecal coliforms are defined as a subclass of coliforms that can be cultured on specific media at an elevated temperature (44.5°C). The fecal coliform test methods are intended to select for bacteria that originate in the intestines of warm-blooded animals. Biofilms are colonies of bacteria that are normally present in drinking water pipes and that may include coliforms and noncoliforms, as well as other types of bacteria.

10. Groundwater

a. Groundwater Protection Compliance Issues. Groundwater monitoring and protection efforts at the Laboratory have evolved from the early programs initiated by the USGS to present efforts. The major regulations, orders, and policies pertaining to groundwater are as follows.

DOE Order 5400.1. DOE Order 5400.1 requires the Laboratory to prepare a Groundwater Protection Management Program Plan (GWPMPP). The program was required by the order to (1) document the groundwater regime with respect to quantity and quality; (2) design and implement a groundwater monitoring program to support resource management and comply with applicable environmental laws and regulations; (3) establish a management program for groundwater protection and remediation, including specific SDWA, RCRA and CERCLA actions; (4) summarize and identify areas that may be contaminated with hazardous substances; (5) develop strategies for controlling sources of these contaminants; (6) establish a remedial action program that is part of the site CERCLA program required by DOE Order 5400.4; and (7) have in place decontamination and decommissioning, and other remedial programs contained in DOE directives.

The Laboratory completed a major revision of the draft GWPMPP in 1994 and continued in 1995 to refine the document to address review comments of DOE and the NMED/Agreement in Principle (AIP) Oversight and Monitoring Program. The GWPMPP focuses on protection of groundwater resources in and around the Los Alamos area and ensures that all groundwater-related activities comply with the applicable federal and state regulations.

The GWPMPP also fulfills the requirements of Chapter IV, Section 9 of DOE Order 5400.1. This section requires development of a Groundwater Monitoring Plan (GMP) as a specific element of the GWPMPP. The GMP identifies all DOE requirements and regulations applicable to groundwater protection and includes monitoring strategies for sampling, analysis, and data management. The general requirements outlined in Section 9b for the GWPMPP include: (1) determination of baseline groundwater quality and quantity conditions; (2) demonstration of compliance with, and implementation of, all applicable regulations and DOE orders; (3) data that will allow early detection of groundwater pollution or contamination; (4) a reporting mechanism for detection of groundwater

pollution or contamination; (5) identification of existing and potential groundwater contamination sources and maintaining surveillance of these sources; and (6) data upon which decisions can be made concerning land disposal practices and the management and protection of groundwater resources.

The GWPMPP contains a business plan in which a prioritized list of activities and studies addresses the above requirements. The business plan also shows the suggested organization for accomplishing the tasks, the proposed funding sources, and a preliminary cost estimate.

Section 9c of Chapter IV of the DOE Order 5400.1 requires that groundwater monitoring needs be determined by site-specific characteristics and, where appropriate, groundwater monitoring programs be designed and implemented in accordance with 40 CFR Part 264, Subpart F, or 40 CFR Part 265, Subpart F. The section also requires that monitoring for radionuclides be in accordance with DOE orders in the 5400 series dealing with radiation protection of the public and the environment.

RCRA Permit/HSWA Module. Module VIII of the RCRA permit, i.e. the HSWA Module, Task III, requires the Laboratory to collect information to supplement and verify existing information on the environmental setting at the facility and collect analytical data on groundwater contamination. Under Task III, Section A.1, the Laboratory is required to conduct a program to evaluate hydrogeologic conditions. Under Task III, Section C.1, the Laboratory is required to conduct a groundwater investigation to characterize any plumes of contamination at the facility.

Historically, the groundwater monitoring requirements of RCRA (40 CFR 264 Subpart F) were not applied to the Laboratory's regulated units because DOE and LANL had submitted groundwater monitoring waiver demonstrations. However, as of May 30, 1995, the NMED denied the DOE/LANL groundwater monitoring waiver demonstrations, and groundwater monitoring program plans were requested for DOE/LANL to be in compliance with RCRA. In the denial letter, NMED recommended the development of a comprehensive groundwater monitoring program plan which addresses both site-specific and Laboratory-wide groundwater monitoring objectives.

New Mexico Water Quality Control Commission Regulations. NMWQCC regulations control liquid discharges onto or below ground surface to protect all groundwater of the State of New Mexico. Under the provisions, a groundwater discharge plan must be submitted by the facility and approved by NMED or the Oil Conservation Division for energy/mineral extraction activities. Subsequent discharges must be consistent with the terms and conditions of the plan.

The NMWQCC regulations were significantly expanded in 1995 with the adoption of comprehensive abatement regulations. The purpose of the regulations is to abate both surface and subsurface contamination for designated or future uses. Of particular importance to DOE/LANL is the contamination which may be present in alluvial groundwater.

The Laboratory has three approved groundwater discharge plans to meet NMWQCC regulations. One for TA-57 (Fenton Hill); one for the TA-46 Sanitary Wastewater Treatment Plant, which is the location for the SWSC project; and one for the land application of dried sanitary sewage sludge from the TA-46 SWSC plant.

The Laboratory has three existing general NOIs for discharges of water from the Laboratory's water distribution system, line disinfection activities, and steam distribution system. The Laboratory tracks all discharges handled under the general NOIs and submits this data annually to NMED. Additionally, in 1995, there were three miscellaneous potable water discharges primarily from line leaks and fire hydrant flushing. On December 20, 1995, NMED issued a general "No Discharge Plan Required" to the Laboratory for the discharge of up to 6 gal./day of deionized water used for the purpose of rinsing soil sampling equipment. This general NOI was issued as a result of the Laboratory submitting several formal NOI applications for work of this nature in preceding years. In 1995 there were six discharges of deionized rinse water used to clean soil sampling equipment. The Laboratory is pursuing a general NOI from NMED for discharges of water in excess of 6 gal. used to rinse field sampling equipment.

Among other regulations related to groundwater protection compliance issues are the following:

(1) New Mexico Solid Waste Management Regulations,

(2) Safe Drinking Water Act, and the

(3) National Pollutant Discharge Elimination System Permit.

b. Groundwater Compliance Activities. The Laboratory continued an ongoing study of the hydrogeology and stratigraphy of the region, as required by the HSWA Module of the RCRA permit and DOE Order 5400.1. Much of the activity was centered on compiling and assessing existing information on the Laboratory collected over the previous 50 years. Studies by various Laboratory programs are integrated by the Groundwater Protection Management Program, administered by ESH-18. Some key activities are listed as follows:

(1) ESH-18 published a compilation report of borehole and well completion records (Purtymun 1995). This includes an inventory of wells and borings drilled through 1992.

(2) ESH-18 and the ER Project published an analysis of all known Laboratory hydraulic property measurements of the Bandelier Tuff (Rogers 1995). Estimates are made of the rate and direction of water movement through the tuff.

(3) New geologic mapping has been performed by the ER Project at TA-21, TA-33, TA-49, TA-54, and TA-67. The TA-21 work has been compiled to include reports on results of deep drilling in Los Alamos and DP canyons, detailed outcrop studies of the Bandelier stratigraphy and mineralogy, and preliminary evaluation of the hydrogeology (Broxton 1995).

(4) The Seismic Hazards Program has recently completed a major field investigation to delineate faulting on the Pajarito Plateau.

(5) The Waste Management Program prepared a series of reports in support of the ongoing Performance Assessment of MDA G (Hollis 1995). Critical geological, hydrological, and geochemical data have been assembled into a basic data report to formulate a conceptual hydrogeological model. Preliminary computer simulations forecast the long-term performance of the disposal area over thousands of years. The analysis includes an initial evaluation of the role of fractures on contaminant migration within the mesa.

(6) Detailed field investigations are ongoing at the major waste disposal areas.

(7) The USGS, in cooperation with the Laboratory, completed a numerical computer simulation of regional groundwater flow near Los Alamos (Frenzel 1995).

(8) LANL received notice from NMED of denial of previously submitted groundwater monitoring waiver demonstrations and a request by NMED to develop a hydrogeologic work plan to address NMED's concerns.

11. National Environmental Policy Act

a. Introduction. The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4331 *et seq.*) mandates that federal agencies consider the environmental impact of their proposed major actions and allow public input before making a final decision on what actions to take. The DOE is the sponsoring agency for most LANL activities, and it is DOE's policy to follow the letter and spirit of NEPA. DOE must comply with the regulations for implementing NEPA published by the Council on Environmental Quality at 40 CFR Parts 1500–1508 and its own NEPA Implementing Procedures as published at 10 CFR Part 1021. Under these regulations and DOE orders 5440.1D and 5440.1E, DOE reviews proposed LANL activities and determines whether the activity is categorically excluded from the requirements to prepare the following:

- an Environmental Assessment (EA), evaluating environmental impacts, leading to either a finding of no significant impact (FONSI) if the impacts are indeed found to be not significant or requiring an Environmental Impact Statement (EIS) if the impacts are significant,
- an EIS, in which impacts of proposed and alternative actions are evaluated and mitigation measures proposed. The EIS is followed by a Record of Decision (ROD) in which the agency decides if and how to proceed with a project.

If an EA or an EIS is required, the DOE is responsible for directing its preparation. In some situations, a LANL project may require an EA but, because the project is connected to a larger action requiring an EIS (e.g., the LANL Site-Wide EIS or a programmatic EIS done at the nationwide level), a regular EA is not prepared. For this type of project, DOE has determined that an analysis of the project be completed to the same level of detail as in an EA; and these EA-type documents are appended to the EIS in order for the connected actions to be considered together. No standard terminology has emerged yet for these EA-type documents.

LANL project personnel initiate NEPA reviews by completing Environment, Safety, and Health (ESH) identification documents, which form the basis of a DOE Environmental Checklist (DEC) written by the Environmental Assessments and Resource Evaluations Group (ESH-20) using the format specified by the DOE Albuquerque Field Office (DOE/AL). As part of the NEPA review process, proposed projects are evaluated for possible effects on cultural resources (archeological sites or historic buildings), in accordance with the National Historic Preservation Act (NHPA) of 1966. In addition, proposed projects are evaluated for potential impact on threatened, endangered, or sensitive species, in accordance with the Endangered Species Act, and on floodplains or wetlands, in accordance with relevant executive orders. The DEC is submitted to DOE/LAAO, which uses it to assist DOE in determining the appropriate level of NEPA documentation. In August 1995, DOE granted LANL the authority to determine if a project fell within the scope of a DEC for which a categorical exclusion had already been made by DOE. This is referred to as a "prior" determination.

b. Compliance Activities. In 1995, LANL sent 115 DECs to DOE for review. Also in 1995, DOE categorically excluded 119 actions and made a "prior" determination for 1 other action. LANL made a "prior" determination for 45 actions. DOE issued five FONSIs in 1995. An EA-type document was completed for one project to be included in the Stockpile Stewardship and Management Programmatic EIS. Twelve specific projects were scoped for possible inclusion in the Site-Wide EIS. For 2 of those 12 projects, an EA-type document was completed to be included in the Site-Wide EIS. In 1995, DOE determined that one project required an EIS.

c. Environmental Assessments. An EA presents the purpose of the proposed action, then describes the proposed action and reasonable alternatives. The EA includes a description of the affected environment and evaluates impacts to air quality (radioactive and nonradioactive emissions), water quality, waste management, and human health. The impacts to cultural and biological resources are also discussed in the EA. The DOE submits draft EAs to the NMED, potentially affected Native American tribes, and interested stakeholders for review before making a determination. After that decision (FONSI or EIS) has been made, DOE places copies of the EAs in public reading rooms in Los Alamos and Albuquerque. The depth and breadth of analysis of impacts in an EIS is greater than in an EA, and there are more opportunities for public input.

Table 2-13 presents the status of the Laboratory's major NEPA documentation as of December 1995. Project descriptions follow which are listed in the same order as in Table 2-13.

Atlas. The proposed action is to design, build and operate the Atlas facility at TA-35. Pulsed power experiments performed at the Atlas facility would be used to simulate certain hydrodynamic effects and radiation effects of a nuclear explosion. The Atlas facility would be used to investigate issues relating to thermonuclear secondary weapons components, as well as some issues related to primary components. The facility would also be used for basic research in physics, astrophysics, geophysics and in the study of fundamental properties of non-nuclear materials. An alternative to the proposed action would be the continued use of the Pegasus II pulsed power facility at its current energy level and current rate of experiments. Potential environmental, safety, and health issues include nonradioactive air emissions, waste management, and exposure to electrical hazards, magnetic field hazards, and x-rays.

Actinide Source-Term Waste Test Program. The Actinide Source-Term Waste Test Program is a two to five year study designed to provide data on the behavior of actinide elements (chemically similar radioactive materials with atomic numbers ranging from 89–103) in actual TRU waste immersed in brine. The proposed study is required to fulfill EPA requirements for the Waste Isolation Pilot Project (WIPP). The tests would be conducted in a controlled and enclosed environment within the basement of Wing 9 of the CMR Building in TA-3 at the Laboratory. Alternatives to the proposed action include taking no action (no testing), conducting tests at facilities outside LANL, and conducting the tests at other laboratories at LANL. Potential environmental, safety, and health issues include radioactive air emissions, radiation exposures to workers and the public, and generation and disposal of radioactive wastes. This EA received a FONSI in January 1995.

Weapons Component Testing Facility Relocation. The Weapons Component Testing Facility (WCTF) is one of the primary component instrumentation, diagnostics, and testing laboratories at LANL. The proposed action is to relocate the WCTF from Building 450 to Building 207, both at TA-16. Relocation would allow the WCTF operations to become more efficient and productive by increasing the usable space, consolidating with similar testing operations, and increasing the testing capabilities for larger components. Increased efficiency and productivity would allow the WCTF to better fulfill a LANL programmatic responsibility to maintain weapons development capability and test stored weapons components. The alternative is to keep the WCTF operations at their existing location. No changes in current operations of the WCTF are anticipated as a result of the relocation; no new waste would be generated in the operations after the relocation. The relocation would not change the quantity of sanitary effluent. This EA received a FONSI in February 1995.

High-Explosive Wastewater Treatment Facility. LANL proposes to improve its current management of wastewater contaminated with high-explosive (HE) residues and solvents. Improvements to existing wastewater management are necessary to ensure that discharges conform to LANL's NPDES permit. The proposed action would consist of minimizing the use of water in HE processes and treating all remaining HE-contaminated water at a new treatment facility. No untreated wastewater would be released to the environment. The proposed treatment facility would remove organic contaminants by passing the water through activated carbon filters. The alternative, which was not selected, would consist of constructing two treatment facilities and a system of pipes to collect HE-contaminated wastewater and deliver it to the treatment facilities. This alternative would not minimize water use in HE processes. The principal potential environmental, safety, and health issues include air and water quality, soils, wetlands, wildlife, and safety. This EA received a FONSI in September 1995.

Low-Energy Accelerator Laboratory (formerly Accelerator Prototype Laboratory). The proposed action is to erect a 100-ft by 70-ft preengineered metal building that would contain a high bay area where physicists could conduct research and development of linear particle injection systems. A linear particle injection system is the first part of a linear particle accelerator. The next generation of higher power particle accelerators must have a higher flux of subatomic particles, or beam current, supplied by an improved injection system, in order to operate. The linear particle injection systems to be developed would not create any radioactive wastes or air activation products; the energy would be dissipated in the form of heat and x-rays. Shielding inside the building would protect personnel from exposure from x-rays. Alternative actions include construction and operation at another location and not constructing nor operating the facility. Potential environmental issues include discharge of cooling water, land use, and personnel safety. This EA received a FONSI in April 1995.

Radioactive Source Recovery Program. The proposed action is to receive and recover (reprocess) unwanted and excess plutonium-beryllium (plutonium-238-beryllium) and americium-beryllium (americium-241-beryllium) sealed neutron sources now being held by commercial and other federal entities. This proposed program would enhance the DOE's and the US Nuclear Regulatory Commission's joint capabilities in the safe management of commercially held radioactive source materials. Currently there are no federal or commercial options for the recovery, storage, or disposal of sealed neutron sources. About 1 kg (2.2 lb) of plutonium and 3 kg (6.6 lb) of americium would be recovered over a 15 year project. The process would take place at TA-3 in the hot cells of the CMR Building, Wing 9 and at TA-55 in PF-4. Recovery reduces the neutron emissions from the source material and refers to a process by which: (1) the stainless steel cladding is removed from the neutron source material, (2) the mixture of the radioactive material (plutonium-238 or americium-241) and beryllium that constitutes the neutron source material is chemically separated (recovered), and (3) the recovered plutonium-238 or americium-241 is converted to an oxide form. The proposed action would include placing the recovered oxidized plutonium-238 and americium-241 in interim storage in a special nuclear material vault at the LANL Plutonium Facility. Potentially affected resources identified for the proposed action are water quality, land use for waste management, worker health effects, and air quality. This EA received a FONSI in December 1995.

Medical Radioisotope Production. Molybdenum-99 and iodine-125 radioisotopes are extensively used in human medical diagnosis and treatment. Several radiopharmaceutical supply firms have asked DOE to provide a backup source of supply because only one reactor in Canada now supplies the entire needs of North America. The proposed action is for DOE to use the production technologies that are registered with the US Food and Drug Administration Master Drug File and produce these radioisotopes. During 1994, the project was rescoped. DOE proposes to produce targets at LANL. Highly enriched uranium-235 would be electroplated inside target tubes in the CMR Building at TA-3. The sealed tubes would be irradiated in the Annular Core Research Reactor at Sandia National Laboratories and the desired radioisotopes would be separated from the mixed fission products in the

adjacent hot cell facility. The molydbenum-99 and iodine isotopes would be packaged for shipment to commercial radiopharmaceutical suppliers for final purification. Alternatives considered were production at other sites and no production. Potential environmental concerns include radioactive air emissions, liquid wastes, mixed fission product and other solid radioactive waste management, worker exposure to highly radioactive material, transportation, and public exposures. This EA was completed in May 1995, and DOE determined that an EIS was required.

Expansion of TA-54, Area G. Routine activities at the Laboratory generate solid low-level radioactive wastes (LLWs) that are disposed of or stored at TA-54, Area G, which is currently a 63-acre site. For some types of waste, burial in pits or shafts is the only feasible disposal method that complies with all regulations. The proposed action is to develop Zone 4 at Area G, the 30-acre area immediately west of the active disposal area, and 40 acres west of Area L, and dispose of LLW there when the active area is filled. This acreage includes two ER exclusion zones and the easement for the proposed Public Service Company of NM Ojo Transmission Line Extension, areas which could not be used immediately. Alternatives to expanding TA-54, Area G include using the currently active disposal area until it is full, developing an alternative disposal site within the Laboratory, or transporting future solid LLW off site. Potential environmental, safety, and health issues include air quality, geology, soil, surface water, wetlands, threatened and endangered species, cultural resources, environmental restoration, transportation, human health, and land use. The Specific Project Review for this project was submitted to the Site-Wide EIS Project Office in December 1995.

Radioactive Liquid Waste Treatment Facility. The proposed action is to build and operate a new Radioactive Liquid Waste Treatment Facility (RLWTF) to replace an existing 30 year old radioactive wastewater treatment plant. The new RLWTF would be constructed at TA-63 and would use the following technologies: influent storage tank treatment, ultraviolet oxidation, chemical pretreatment, membrane separation, reverse osmosis, and evaporation. A new pretreatment facility would be constructed at TA-50 to recover and concentrate nitric and hydrochloric acid waste streams for reuse at TA-55. The alternative actions include continuing to operate the existing RLWTF and pretreatment facilities until closure is required, and privatizing the design, construction, and operation of a new RLWTF. Potential environmental, safety, and health issues include worker exposure to radiation, air quality, water quality, cumulative long-term impacts, and waste management. DOE had previously determined that an EIS is required for the proposed action. The Specific Project Review for this facility was submitted to the Site-Wide EIS Project Office in December 1995.

Chemical and Metallurgy Research Building Upgrades. The CMR Building was constructed as a major chemical research and analysis laboratory facility for radioactive materials in 1952. Despite some repairs and upgrades since that time, the CMR Building does not meet current DOE regulations governing construction of a new nonreactor nuclear facility. LANL proposes to extend the life of the building 20 years by upgrading several major systems including seismic upgrades, ventilation system replacements and confinement zone separations, acid vents and drain lines replacements, and electrical system upgrades. The alternative action is not to upgrade the facility. Potential environmental issues include worker safety while the work is performed and LLW disposal.

Hazardous Waste Treatment Unit and Mixed Waste Receiving and Storage Facility. The proposed action was to construct a new Hazardous Waste Treatment Unit (HWTU) and a Mixed Waste Receiving and Storage Facility (MWRSF) within the laboratory complex at TA-63. The construction and operation of these facilities had been identified as critical milestones in the RCRA Federal Facility Compliance Agreement (FFCAgreement) at LANL. The proposed HWTU was designed to provide a central location for use of existing hazardous and mixed waste treatment processes and a location for development of alternative treatment processes for existing and future wastes that would otherwise be stored. The proposed MWRSF would have complemented the HWTU by providing a centralized location for receiving and storing wastes identified for treatment in the HWTU. Alternatives to building the HWTU and MWRSF included transporting untreated wastes off site, developing and utilizing alternative waste treatment processes at various sites throughout the Laboratory, and continuing to manage the waste using current treatment and storage procedures. Potential environmental, safety, and health issues included radioactive and hazardous air emissions, radioactive and hazardous effluents, transportation, and cumulative, long-term impacts associated with operation of the proposed facility. These types of treatment units are no longer planned for LANL; DOE determined in December 1995 that an EA would not be required for this project.

Low-Energy Demonstration Accelerator. The proposed action is to design, build, and test critical components of a full-size prototype accelerator system for tritium production using a proton linear accelerator at LANL. The Low-Energy Demonstration Accelerator (LEDA) project would be divided into five separate stages which would develop and test an accelerator apparatus section by section over the next six years. Personnel at LANL would modify an existing proton accelerator facility at TA-53 and conduct component and prototype tests in order to verify equipment and prototype design and resolve related performance and production issues for future full scale operation. The potential environmental, safety, and health issues for LEDA include utility demands, air emissions, environmental restoration, human health, and waste management.

TRU Waste Drum Staging Building. The proposed action is designed to increase safety and minimize the volume of waste generated at the Laboratory's Plutonium Processing Facility at TA-55. This action consists of using a prefabricated, concrete-floored, metal building for temporary storage of drums of solid TRU waste that is pending certification and transport to a longer term storage area. Alternatives to the proposed action include constructing a new building or continuing operations under current conditions. Some of the potential environmental, safety, and health issues include air emissions, worker safety, on-site TRU waste management, and TRU waste transportation. The draft EA was submitted to DOE in December 1995.

12. Cultural Resources

a. Introduction. The Cultural Resources Team in ESH-20 is responsible for maintaining a database of all cultural resources found on DOE land, compliance with appropriate cultural resource legislation as listed below, and providing appropriate information to the public on cultural resource management issues. Cultural resources are defined as archaeological sites, prehistoric or historic districts, sites, buildings, structures, traditional use areas, or objects included in, or eligible for inclusion in, the National Register of Historic Places. Artifacts, records, and remains related to and located within such properties are considered cultural resources.

b. Compliance Overview. Section 110 of the NHPA of 1966 and EO 11593, Protection and Enhancement of the Cultural Environment (3 CFR 154, 16 USF 470), require federal agencies to inventory cultural (historic and prehistoric) resources on their lands and to assess their eligibility for inclusion on the National Register of Historic Places. Cultural resources may be eligible for inclusion under four criteria: Criterion A, their association with an event important in the history of the nation or a specific cultural group; Criterion B, association with a person important in the nation's history or the history of a particular cultural group; Criterion C, their unique artistic value or representative style; or Criterion D, their potential to yield information important to historical or prehistoric research.

LANL conducts field surveys to locate archaeological sites. At the end of 1995, 17,493.2 acres had been surveyed by currently accepted standards. This represents 61% of all DOE land. An additional 1,858 acres have also been surveyed to a lesser degree of reliability. Combining both levels of field survey, 19,351.2 acres, or 67.5% of the 28,637.6 acres of DOE land have been surveyed.

A total of 1,392 archaeological sites have been identified as a result of these surveys. Most of these sites (1,302) were occupied in the prehistoric period and represent the material remains of pueblos and camps that were used from 6000 B.C. to the mid-1500's A.D. These sites are tabulated in Figure 2-1 by type description.

The remaining 88 sites date to the historic period (Figure 2-2). Most of those included in this tabulation are associated with Hispanic and Anglo homesteading activities on the Pajarito Plateau during the late 19th to early 20th centuries. Some Laboratory structures over 50 years old are also included in this tabulation; however, not all Laboratory structures meeting the 50-year-age requirement for inclusion on the National Register of Historic Places have been evaluated for significance. Those not evaluated are not included in the tabulation.

Section 106 of the NHPA (implemented by 36 CFR 800, Public Law 89-665) requires agencies to evaluate the impact of all undertakings on cultural resources and to consult with the State Historic Preservation Officer (SHPO) and/or National Advisory Council on Historic Preservation concerning possible effects to identified resources. Amendments to this law in 1992 provide for greater involvement of Native American groups in the consultation process. All cultural resource survey reports are sent to the Pueblos of San Ildefonso, Cochiti, Santa Clara, and Jemez for review and comment.

The Cultural Resources Team reviews all Laboratory actions to determine if they are "undertakings" as defined in 36 CFR 800. Undertakings are activities that have the potential to affect a cultural resource and are typically activities outside buildings that disturb the ground. All undertakings must be reviewed to determine whether they affect a cultural resource. There are five ways a project can come to the attention of the Cultural Resources Team:

through the ESH Identification Process, siting studies initiated by the Facilities Safeguards and Support Division, quality assurance (QA) review, excavation permits, and direct request for information. Many projects may be reviewed by cultural resources staff through more than one pathway. During 1995, Laboratory archaeologists evaluated 888 Laboratory actions.

Once an action has been determined to be an undertaking, the archaeology staff conducts surveys to determine if a cultural resource is affected and if so, whether the effect is adverse. In 1995, 47 new field surveys were conducted to identify cultural resources.

The results of surveys are written as controlled release LANL documents (LA-CP). Copies are sent to the SHPO for concurrence in findings of effects and determinations of eligibility for National Register inclusion of any cultural resources located during the survey. Copies are also sent to the governors of the Pueblos of San Ildefonso, Santa Clara, Cochiti, and Jemez for comment and identification of any traditional cultural properties which may be affected by the undertaking. In 1995, 27 consultations with the SHPO and Native Americans were conducted, and 22 archaeological survey reports were submitted to the SHPO or land owning agency and Native American groups for review and concurrence. No adverse effects to prehistoric cultural resources were identified in 1995.

The American Indian Religious Freedom Act (AIRFA) of 1978 (Public Law 95-341) stipulates that federal undertakings should not impact the practice of traditional religions. Notification must be given to tribal groups of possible alteration of traditional and sacred places. The Native American Grave Protection and Repatriation Act (NAGPRA) of 1990 (Public Law 101-601) states that if burials or cultural objects are inadvertently disturbed by federal activities, work must stop in that location for 30 days and the closest lineal descendent must be consulted for disposition of the remains.

In 1995, meetings were held with tribal representatives from the Pueblos of San Ildefonso, Cochiti, Santa Clara, and Jemez to review LANL undertakings which had the potential to affect cultural sites identified in the Section 106 process as well as any possible impacts to traditional cultural places that fall under AIRFA or NAGPRA jurisdiction. General cultural resource issues were discussed at these meetings and field tours of cultural resources were conducted when requested by tribal representatives. Tours were given of artifacts now curated at the Museum of New Mexico, and discussions continued on repatriation issues. No new human remains requiring NAGPRA consultation were discovered in 1995.

The Archeological Resources Protection Act (ARPA) of 1979 (implemented by 43 CFR 7, Public Law 96-95, 16 USC 470) provides protection of cultural resources and sets penalties for their damage or removal from federal land without a permit. Criminal penalties can be assessed up to $20,000 and two years imprisonment for a first offense and $100,000 and five years imprisonment for a second offense; civil penalties may consist of the cost to mitigate damages plus forfeiture of all equipment and vehicles used to facilitate a violation.

One pot-hunting incident was discovered on DOE land in 1995. The site damaged, Laboratory of Anthropology 6787-A, is a low pueblo mound of approximately 10 rooms. Damage to the site consists of two holes that were dug into the roomblock: one hole is 50 cm by 50 cm wide and 10 cm deep, and the second is 70 cm by 70 cm wide and 1 m deep. Security personnel from Bandelier National Monument attempted unsuccessfully to identify any suspects.

In addition to the compliance related activities listed above, the Cultural Resources Team provides general information to the public on DOE cultural resources. In 1995, 20 presentations, tours, and interviews about cultural resources were conducted. These included tours for DOE and non-DOE professional groups, several universities, local teachers programs, and other local groups. Tours were also given to members of the four surrounding Indian tribes, which included presentations on cultural resource issues related to specific DOE undertakings as well as general overviews of the LANL cultural resource program. Interviews with the local newspaper and television station were also given.

13. Biological Resources

a. Introduction. The DOE and the Laboratory must comply with the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald Eagle Protection Act. The Laboratory also considers plant and animal species listed under the New Mexico Conservation Act and the Endangered Species Act.

b. Compliance Activities. During 1995, ESH-20 reviewed 640 proposed Laboratory actions for potential impact on threatened and endangered species. Of these, 199 proposed actions were identified through the ESH Identification Process. The Ecological Studies Team (EST) of ESH-20 identified 60 projects that required reconnaissance surveys (Level I surveys). These surveys are designed to evaluate the amount of previous

development or disturbance at the site and to determine the presence of any surface water or floodplains in the site area. EST also identified nine projects that required quantitative surveys (Level II surveys) to determine if the appropriate habitat types and habitat parameters were present to support any threatened or endangered species. In addition, EST identified three projects that required an intensive survey designed to determine the presence or absence of a threatened or endangered species at the project site (Level III survey). The Laboratory adhered to protocols and permit requirements of the New Mexico State Game and Fish Department.

c. Environmental Assessments. EST identified projects requiring a survey by first reviewing a literature database that compiles all habitat requirements of federal and state endangered, threatened, and candidate species. After the surveys were completed, the habitat characteristics of the surveyed sites were compared with the habitat requirements of the species in question. Biological evaluations are being prepared for projects requiring a Level II or Level III survey, and consultation with US Fish and Wildlife for written concurrence of findings, as required under the Endangered Species Act, will be undertaken.

At one project area, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility, one federally protected species was confirmed within the proposed project site. Highly suitable habitat also exists for many of these species (e.g., goshawk, Jemez Mountains salamander, meadow jumping mouse) within other project sites.

14. Floodplain and Wetland Protection

a. Introduction. The Laboratory must comply with EO 11988, Floodplain Management, and EO 11990, Protection of Wetlands (EPA 1989) and Section 404 of the Clean Water Act.

b. Compliance Activities. During 1995, 640 proposed Laboratory actions were reviewed for impact to floodplains and wetlands. Nine proposed projects required a Floodplain and Wetland Assessment.

c. Environmental Assessments. In September of 1994, the Laboratory received notice from the Army Corps of Engineers that erosion from a road and sewer line crossing was causing damage to Sandia Canyon wetlands. This represents noncompliance with soil stabilization requirements under the NPDES permit, which authorized the construction of the road and sewer line across the Sandia Canyon wetland. Pursuant to Section 404 of the CWA, the Corps requested that the Laboratory repair the erosion and stabilize the slopes in question. The erosion control project for this area was completed in 1995.

C. Current Issues and Actions

1. Compliance Agreements

a. Mixed Waste Federal Facility Compliance Agreement. On May 14, 1992, DOE/LAAO, with support from a Laboratory team, began negotiations with EPA Region 6 for an FFCAgreement to ensure compliance with the land disposal restrictions storage prohibition for mixed waste (hazardous and radioactive waste) found in Section 3004(j) of the RCRA and 40 CFR Section 268.50. The draft FFCAgreement was released for public review and comment on July 27, 1993. The FFCAgreement was signed by DOE and EPA on March 15, 1994. The FFCAgreement provided a plan and schedule for the treatment of mixed wastes; it included some 47 specific compliance milestones, 17 of which were due in 1994 and 8 of which were due in 1995. DOE and LANL have successfully complied with all 25 milestones. The focus of certain FFCAgreement activities was redirected in 1995 in accordance with new regulatory requirements and reductions in DOE operating budgets. The DOE, and consequently LANL, are required by the Federal Facility Compliance Act of 1992 (Section 3021 [b] of RCRA), to prepare Site Treatment Plans (STPs) describing the development of treatment capacities and technologies for treating mixed waste. DOE/AL prepared the Albuquerque Mixed Waste Treatment Plan, which together with the FFCAgreement, formed the basis of LANL's proposed STP delivered to NMED in March 1995. The FFCAgreement between DOE and EPA was terminated on October 4, 1995, when the State of New Mexico issued the Federal Facility Compliance Order (FFCO) requiring DOE compliance with LANL's plan for treatment of mixed waste. To date, the Laboratory has complied with all FFCO/STP milestones.

b. New Mexico Environment Department Compliance Orders for Hazardous Waste Operations. The Laboratory received two RCRA Compliance Orders (COs) from NMED during 1995. CO NMHWA 95-03 was issued on March 22, 1995 as a result of NMED's RCRA inspection in September 1994. It alleged 28 violations, of

which 9 required corrective actions within 5, 10, or 30 working days. All corrective actions were completed on time. NMED proposed fines of $103,539; the final negotiated penalty amount was $48,329. CO NMHWA 95-08 was issued on November 30, 1995, as a result of NMED's annual hazardous waste compliance inspection of September 12–18, 1995. It alleged nine violations of the act and proposed fines totaling $14,795. The alleged violations were all of an administrative nature, including lack of decontamination equipment, lack of accumulation start dates, containers without covers, and unlabeled containers. The final negotiated penalties totaled $11,190 for seven alleged violations.

c. National Pollutant Discharge Elimination System Federal Facility Compliance Agreement and Administrative Order. AO Docket No. VI-94-1242, issued to the Laboratory on June 15, 1994, incorporated the revised HE Wastewater Treatment Facility schedule and the schedule for completion of the remaining corrective actions for the WSC project. The Laboratory met the September 30, 1995, deadline to complete 50% of the WSC corrective actions, as specified in the AO.

d. National Emission Standards for Hazardous Air Pollutants Federal Facility Compliance Agreement. In 1991 and 1992 the Laboratory received two Notices of Noncompliance (NONs) from the EPA for not meeting all provisions of 40 CFR 61, Subpart H. Specific findings of the NON included deficiencies in LANL's identification and evaluation of release sources, noncompliant stack monitoring equipment on all point release sources, incomplete quality assurance programs, and incomplete reporting. The 1992 NON stated that LANL had used a shielding factor without prior EPA approval and exceeded the 10 mrem/yr standard. As a result of the NON, the DOE is negotiating a FFCA with EPA Region 6. The FFCA will include schedules that the Laboratory will follow to come into compliance with the CAA and will continue to address the issues raised in the 1991 NON. Negotiations continued in 1995, and the FFCA is expected to be signed during CY96. The Laboratory has been actively engaged in a program to achieve compliance with the provisions of 40 CFR 61, Subpart H. Progress toward full compliance includes the following:

- A comprehensive identification of point release sources has been completed. Diffuse (nonpoint) release sources are being identified. These lists identify and describe sources of radioactive air emissions. Both inventories are continually updated as new information is received and old information is revised.
- Stack monitoring equipment at LANSCE has been upgraded to meet the requirements of 40 CFR 61, Subpart H, monitoring requirements. All tritium stacks are in physical compliance. Also, various stacks at TA-3-29, TA-48, TA-50, and TA-55 have been upgraded to meet the NESHAP requirements. The Laboratory is in the final phases of completing the QA plans necessary to achieve full compliance with this regulation.
- For monitoring radioactive air emissions at LANSCE, a QA project plan has been completed, approved by DOE, and implemented. This plan has been reviewed by DOE and found to be sufficient to meet EPA requirements. QA project plans are being developed for sampling radioactive particulate emissions and tritium emissions. In addition, an overall QA project plan has been drafted for the management of radioactive air emissions; necessary procedures have been written, approved, and updated. LANL ceased using the shielding factor for EPA compliance reporting in 1992. The LANL dose to the public has not exceeded the 10 mrem/yr standard since 1991.

2. Environmental Oversight and Monitoring Agreement

a. Introduction. The Environmental Oversight and Monitoring Agreement (known as the AIP) between DOE and the State of New Mexico provides technical and financial support by DOE for state activities in environmental oversight, environmental surveys and sampling, site visits, and document review. The AIP was originally signed in October 1990 and covers Los Alamos and Sandia national laboratories, WIPP, and the Inhalation Toxicology Research Institute. NMED is the lead state agency under the AIP.

The AIP was renewed on October 1, 1995, for an additional five-year period. There are four primary objectives of the program:

(1) to assess DOE's compliance with existing laws, including regulations, rules, and standards;

(2) to participate in DOE's prioritization of cleanup and compliance activities;

(3) to develop and implement a vigorous program of independent monitoring and oversight; and

(4) to communicate with the public to increase public knowledge of environmental matters about the facilities, including coordination with local and tribal governments.

b. Monitoring Laboratory Compliance Activities. During 1995, the NMED/AIP staff conducted oversight of several of the Laboratory's environmental programs. Highlights of these activities are presented below (NMED 1996).

Groundwater: NMED/AIP staff continued development of a conceptual hydrogeological model for the site, including modeling of the perched groundwater system in Mortandad Canyon. NMED/AIP staff participated in a series of meetings regarding the Laboratory's Groundwater Protection Management Program Plan. The plan is scheduled for completion by the summer of 1996 and will be implemented starting in 1999.

Surface Water: NMED/AIP staff collected grab samples and deployed portable storm water samplers to collect samples of the runoff from summer storm events. Samples were collected in canyons on LANL property and at the eastern Laboratory boundary along State Road 4. Preliminary data show elevated levels of mercury, uranium, strontium-90, and gross alpha and beta below several potential release sites in Los Alamos Canyon.

Spill Closures: NMED/AIP staff accompanied ESH-18 staff during unplanned liquid release cleanup verifications. Upon verification of adequate cleanup of the release sites, the NMED AIP staff administratively closed out the spills. In 1995, the NMED/AIP staff administratively closed out 18 of 29 releases.

Sampling: Extensive sampling activities were conducted at LANL in 1995. Sampling is done in coordination with the LANL environmental surveillance activities and NPDES permit program in order to obtain split or duplicate samples. Split samples are submitted to the state SLD and independent laboratories for analysis. The activities included sampling of groundwater, NPDES outfalls, springs, stream bed sediment, soils, snowmelt and storm water runoff, air, external penetrating radiation, foodstuffs, and wetlands. Oversight split or duplicate sampling of approximately 90 sites included springs, wells, streams, 50 environmental monitoring stations at LANL, 5 independent stations, and 5 stations at the Pueblo of San Ildefonso.

As part of a cooperative initiative with LANL, five real-time air radiation monitors were deployed throughout northern New Mexico as part of the Neighborhood Environmental Watch Network system (known as NEWNET). Data from these stations are accessible over the Internet. In 1995, two environmental sampling and surveillance trips in White Rock Canyon were conducted. Analytical results of sampling activity in 1995 at LANL were consistent with regional background levels.

Environmental Restoration: Oversight activities with the ER Project included technical reviews of site assessment documents, including site-wide environmental studies; RCRA Facility Investigation work plans; expedited cleanups; voluntary corrective actions; and proposals for no further action.

NMED/AIP staff provided recommendations regarding the use of best management practices to comply with the NMWQCC regulations, some of which the Laboratory has begun to implement.

Waste Management: NMED/AIP staff visited the principal facilities involved with the generation, treatment, or storage of wastes at LANL. In addition, programs that direct or influence waste management practices at the Laboratory were reviewed in order to understand policy implementation.

3. Corrective Activities

High-Explosive Wastewater Treatment Facility. This project consists of an HE Wastewater Treatment Facility. No piped collection system will be utilized; all wastewater will be trucked to the treatment facility. Title I design for the facility was completed in FY94; construction is planned for FY96. Upgrading the HE wastewater facilities is required under the Laboratory's NPDES FFCA and AO.

Water Supply and Cross Connection Controls (CCC) Survey. The CCC Survey continued in 1995. As of the end of December, 141 of the 409 Laboratory buildings with potable water service, or about 34%, had been surveyed. As of the end of December, 1,092 potential cross connections or other identifiable plumbing deficiencies had been identified by the survey; 581 corrective actions were completed, and 511 low-priority corrective actions were backlogged pending the availability of additional resources.

Drinking Water Lead Survey. This survey was initiated in 1993 by ESH-18 as a best management practice and Tiger Team Corrective Action because some drinking fountains at the Laboratory had demonstrated lead levels higher than the EPA action level of 15 ppb. In the summer of 1994, approximately 1,300 drinking water

taps at the Laboratory were sampled for lead; 62 of those taps sampled demonstrated lead levels equal to or greater than the EPA action level of 15 ppb and were resampled for confirmation purposes in the fall of 1994. Of the 62 taps resampled, 47 drinking water taps were removed in spring 1995 and disposed of in accordance with all applicable regulations.

Waste Stream Characterization Program and Corrections Project. Fifty percent of the corrective actions identified and recommended by the WSC survey were completed September 30, 1995, as required by the schedule set forth in AO Docket No. VI-94-1242. ESH-18 and Facilities, Security, and Safeguard (FSS) Division facility maintenance and construction personnel continue to work with Laboratory FMs and operating groups to complete the remaining corrective actions recommended in the 83 WSC reports.

4. Waiver or Variance Requests

Groundwater monitoring is required for all RCRA surface impoundments, landfills, waste piles, and land treatment units. This requirement may be waived if it can be demonstrated that there is little or no potential for a release from the units to migrate to the uppermost aquifer. Waiver demonstrations were provided to NMED for several units located at TA-16, 35, 53, and 54. A letter denying the waiver demonstrations was received from NMED, and negotiations are ongoing.

5. Significant Accomplishments

ESH-17 and DOE have made significant progress toward obtaining an FFCA with EPA Region 6. The draft FFCA and Compliance Plan was published by EPA in the summer of 1995 for public comment.

ESH-17 submitted the CAA Operating Permit application to NMED in December 1995. The group developed an innovative application that includes voluntary Plantwide Applicability Limits that better define the Laboratory's emissions of regulated air pollutants.

LANL was successful in obtaining formal EPA approval of representative sampling and the use of the shrouded probe as an alternative radionuclide sampling method. This new technology may be used in some of LANL's facilities to demonstrate compliance with 40 CFR 61, Subpart H "Radionuclide Emission Other than Radon from DOE Facilities."

ESH-18 continued to identify all waste streams that may potentially enter NPDES outfalls and to verify that each is included in the proper outfall category. Specific accomplishments of the Laboratory's WSC program during 1995 include

- elimination of 27 unpermitted outfalls, and
- ESH and FSS Divisions secured funding of $3 million and implemented the Waste Stream Corrections Project to correct the waste stream deficiencies that were identified by the WSC survey. Implementation of this project allowed the Laboratory to correct 50% of the waste stream deficiencies by September 30, 1995, as required to comply with the NPDES permit and AO No. VI-94-1242.

ESH-18 also installed stream monitoring stations on all of the significant canyons entering and leaving the Laboratory. This is the first year the Laboratory will know the volume of water entering and leaving its boundaries. In addition, the automated storm water monitoring network was fully implemented at TA-54, Area G. This network provides automated sampling and operator notification of monitoring events.

The ESH-18 business plan team achieved recognition for its efforts in coordinating with Laboratory operating groups, DOE, and the State of New Mexico. A DOE Quality Award was given to program participants on October 16, 1995, in recognition of their exceptional contributions and commitment to an ethic of quality performance within the DOE.

ESH-19 staff completed many activities during 1995. In addition to its routine hazardous and solid waste assignments, ESH-19 worked with NMED on successfully resolving a number of compliance orders and on the FFCAgreement; submitted the RCRA Closure Plan for the CAI, a permit modification for TA-50 and TA-54, and a permit application and revision for TA-16; and assisted Chemical Science and Technology (CST) Division and DOE with completion and approval of the STP. During fall of 1995, LANL submitted a modification package to NMED for a RCRA RD&D permit. If approved, the modifications to the permit will allow LANL to test a Packed-Bed/Silent Discharge Plasma technology for destruction of hazardous waste. In addition, ESH-19 drafted a Solid

Waste Management Plan for the Laboratory, including developing a position on the Laboratory's industrial vs. commercial solid waste generation, and authored the Roles, Responsibility, and Authority Plan for USTs.

During 1995, the Ecological Studies Team in ESH-20 submitted the Monitoring and Surveillance Planning document (Haarmann 1995) to LANL and DOE management. LANL management committed to follow through the plan to completion.

The ESH-20 Environmental Reports Team collaborated with ESH-17, ESH-18, and ESH-19 and published the LANL Environmental Monitoring Plan for 1996–1998 (EARE 1995). This plan was approved by DOE/LAAO in December 1995.

The LANL Site-Wide Environmental Impact Statement Project Office was opened in October 1994 in order to support DOE and its contractor by identifying baseline environmental, programmatic, facility and operations, project-specific, and socioeconomic data. The project office worked principally in two areas: developing and implementing a management structure for the project office staff and its interactions with other Laboratory personnel, DOE, and their EIS consultants; and delivery of technical products in support of DOE.

The baseline data summary was compiled and formally submitted to DOE and their consultants on June 30, 1995. Summary material on the Laboratory's environmental setting and DOE programs at LANL was also submitted in June 1995. The project office also established field liaisons and subject matter experts to provide additional support and information to the consultants.

The ESO reviewed two awards during CY95

- R&D 100 Award for CST Division's development of polymer filtration technology that results in separation of metal from a water solution so effectively that the resultant metal can be recycled, and the water meets all regulatory requirements for discharge; and
- R&D 100 Award for Nuclear Materials Technology Division's development of hydride-dehydride recycle process. The process is a one-step, zero-waste method of recovering metallic plutonium from the thousands of nuclear weapons built during the Cold War.

6. Significant Issues

a. Lawsuits. On November 16, 1994, two citizens' groups (the Los Alamos Study Group and the Concerned Citizens for Nuclear Safety) filed a lawsuit in the US District Court, Albuquerque, NM, to enjoin DOE from proceeding with the DARHT project until completion of an EIS and issuance of the ROD. On November 22, 1994, DOE published a Federal Register notice of its intent to prepare the DARHT EIS [59 FR 60134]. On January 27, 1995, the court issued a preliminary injunction enjoining DOE from further construction of the DARHT facility and related activities pending completion of the EIS and the related ROD. The draft DARHT EIS was issued in May 1955 and the final EIS (DOE/EIS-0228) in August 1995, and a ROD was issued on October 10, 1995. The injunction was subsequently lifted by the court on April 16, 1996.

In 1994, a citizen's group filed suit against the DOE and the Laboratory under the Clean Air Act. The lawsuit alleged noncompliance with 40 CFR 61 Subpart H. The litigation was unresolved throughout 1995.

b. Other Issues. NMED notified DOE and LANL that they did not have a waste analysis plan that would properly characterize the waste stored on the TRU pads at TA-54, Area G. LANL has prepared a new waste analysis plan that addressed the criteria identified by NMED in their NOD. That plan was submitted by March 31, 1995. No response to this submittal was received in 1995.

7. Department of Energy/Headquarters Audits and Assessments

The DOE Albuquerque Field Office conducted an on-site appraisal for the pilot oversight programs for line ESH management. The report contains results of the environmental portion of the appraisal conducted October 1–November 9, 1995. Several functional areas involving air quality were evaluated. The air quality program review focused on nonradioactive air quality programs. Performance objectives, criteria, and measures developed to analyze the air quality program were Clean Air Act Applicability, Applicable Requirements, and Verification Systems. For all three areas, ESH Division met all objectives. The Air Quality Program provided indications of excellence in strategic planning, regulatory agency relations and creative development of compliance tools. Two noteworthy practices were identified including (1) LANL's program to determine applicability of regulations and (2) having a process in place to capture chemical purchases at the Laboratory.

Table 2-1. Major Environmental Acts under which the Laboratory Operated in 1995

Legislation	Federal Regulatory Citation	Responsible Agency	Related Legislation and Regulations
Resource Conservation and Recovery Act (RCRA)	40 CFR 257, 258, 260–268, 270–272, 280, and 281	EPA/NMED	Hazardous and Solid Waste Amendments (HSWA) Federal Facilities Compliance Act Amendments NM Hazardous Waste Act (NMHWA) NM Hazardous Waste Management Regulations NM Solid Waste Act NM Solid Waste Regulations NM Groundwater Protection Act NM Underground Storage Tank Regulations
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	40 CFR 300–311	EPA	Superfund Amendments and Reauthorization Act (SARA) Designation, Reportable Quantities, and Notification NM Emergency Management Act
Emergency Planning and Community Right-to-Know Act (EPCRA)	40 CFR 350–373	EPA	Executive Order (EO) 12856
Toxic Substances Control Act (TSCA)	40 CFR 700–766	EPA	
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	40 CFR 150–189	EPA/NM Department of Agriculture	NM Pest Control Act
Clean Water Act (CWA)	40 CFR 121–136 40 CFR 400–424	EPA/NMED	National Pollutant Discharge Elimination System (NPDES)
		NMED/WQCC	NM Water Quality Control Commission (NMWQCC) Regulations NM Liquid Waste Disposal Regulations NM Water Quality Act Water Quality Standards for Interstate & Intrastate Streams
	40 CFR 503	EPA/NMED	EPA Standards for the Use or Disposal of Sewage Sludge

Table 2-1. Major Environmental Acts under which the Laboratory Operated in 1995 (Cont.)

Legislation	Federal Regulatory Citation	Responsible Agency	Related Legislation and Regulations
Safe Drinking Water Act (SDWA)	40 CFR 141–148	EPA/NMED	NM Drinking Water Regulations
Federal Clean Air Act (CAA)	40 CFR 50–99	EPA/NMED/NMEIB	National Emission Standards for Hazardous Air Pollutants (NESHAP) for Radionuclides (40 CFR 61, Subpart H) requires emission reporting, monitoring, and quality assurance and establishes a yearly public emission standard; Asbestos (40 CFR 61, Subpart M) requires abatement and rate procedures; Beryllium (40 CFR 61, Subpart C) requires notification, emission limits, and stack performance testing. Unleaded fuel (40 CFR 80, Subpart B) requires labeling and other gas pump controls. Refrigerants (40 CFR 82) require practice controls on recovery and recycling refrigerants. Ambient Air quality Standards (40 CFR 50) NM Air Quality Control Act and regulations
National Environmental Policy Act (NEPA)	40 CFR 1500–1508, 10 CFR 1021	Council on Environmental Quality/DOE	EO 12898: Federal Actions to address Environmental Justice in Minority Populations and Low Income Populations
National Historic Preservation Act (NHPA)	36 CFR 800	State Historic Preservation Officer National Advisory Council on Historic Preservation	NM Cultural Properties Act EO 11593
Archaeological Resources Protection Act (ARPA)	43 CFR 7	Not Applicable	
American Indian Religious Freedom Act (AIRFA)	None	Not Applicable	

Table 2-1. Major Environmental Acts under which the Laboratory Operated in 1995 (Cont.)

Legislation	Federal Regulatory Citation	Responsible Agency	Related Legislation and Regulations
Native American Graves Protection and Repatriation Act (NAGPRA)	None	Not Applicable	
Endangered Species Act	50 CFR 402	US Fish and Wildlife/ NM Game and Fish	Fish and Wildlife Coordination Act NM Wildlife Conservation Act NM Endangered Plant Species Act
Floodplain Management	EO 11988	DOE	10 CFR 1022 Clean Water Act, Section 404, Rivers and Harbors Act
Protection of Wetlands	EO 11990	DOE	10 CFR 1022 Clean Water Act, Section 404, Rivers and Harbors Act
Atomic Energy Act		Nuclear Regulatory Commission/DOE/EPA	

Table 2-2. Environmental Permits or Approvals under which the Laboratory Operated in 1995

Category/Agency	Approved Activity	Issue Date	Expiration Date	Administering
RCRA Hazardous waste facility[a]	Hazardous waste storage, treatment, and disposal permit	November 1989	November 1999	NMED
	Postclosure care	Application submitted September 1988		NMED
	RCRA mixed waste	Part A application submitted January 1991		NMED
		Portion of Part B application submitted July 1991 (TA-53 Surface Impoundments [3])		NMED
		Revised Part A application submitted October 1993		NMED
	Two RD&D Permits for Packed Bed Reactor/Silent Discharge Plasma Treatment Unit and Hydrothermal Processing Unit	Both issued on April 21, 1994		
HSWA	RCRA Corrective Activities	March 1990	December 1999	EPA
PCBs[b]	Disposal of PCBs at TA-54, Area G	June 5, 1980	NA[c]	EPA
PCB oil (TSCA)	Incineration of PCB oils[d]	October 9, 1992	October 9, 1997	EPA
NPDES[e], Los Alamos	Discharge of industrial and sanitary liquid effluents	August 1, 1994	October 31, 1998	EPA
	Storm water associated with industrial activity	General permit August 25, 1993	October 1, 1997	EPA
NPDES, Fenton Hill	Discharge of industrial liquid effluents	October 15, 1979	June 30, 1983[f]	EPA
Groundwater discharge plan, Fenton Hill	Discharge to groundwater	June 5, 1995	June 5, 2000	NMOCD[g]
Groundwater discharge plan, TA-46 Sanitary Wastewater Treatment Plant	Discharge to groundwater	July 20, 1992	July 20, 1997	NMED
Groundwater discharge plan, Sanitary Sewage Sludge Land Application	Land application of dry sanitary sewage sludge	June 30, 1995	June 30, 2000	NMED

Table 2-2. Environmental Permits or Approvals under which the Laboratory Operated in 1995 (Cont.)

Category/Agency	Approved Activity	Issue Date	Expiration Date	Administering
NMLWD Regulations[h]	Discharge of sanitary effluents[i] from septic tank systems into soil			NMED
Air Quality (NESHAP)[j]	Construction and operation of four beryllium facilities	December 26, 1985; March 19, 1986; September 8, 1987; April 26, 1989		NMED
Open Burning (20 NMAC 2.60)	Burning of jet fuel and wood for ordnance testing, TA-11	September 22, 1995	September 22, 1996	NMED
Open Burning (20 NMAC 2.60)	Burning of HE-contaminated materials, TA-14	January 19, 1995	January 19, 1996	NMED
Open Burning (20 NMAC 2.60)	Burning of HE-contaminated materials, TA-16	January 19, 1995	January 19, 1996	NMED
Open Burning (20 NMAC 2.60)	Burning of scrap wood from experiments, TA-36	November 1995	April 1996	NMED
Open Burning (20 NMAC 2.60)	Burning of HE-contaminated materials, TA-39	August 10, 1995	August 10, 1996	NMED

[a]See Table 2-3 for specific permitted activities.
[b]Polychlorinated biphenyls.
[c]NA = Permit does not have an expiration date.
[d]No incineration occurred during 1995 even though the activity was permitted.
[e]National Pollutant Discharge Elimination System.
[f]Permit administratively extended.
[g]New Mexico Oil Conservation Division.
[h]New Mexico Liquid Waste Disposal Regulations.
[i] Dates vary depending on individual permits.
[j] National Emission Standards for Hazardous Air Pollutants.

Table 2-3. Hazardous Waste Management Facilities at Los Alamos National Laboratory

Technical Area Building	Facility Type	Included in RCRA Permit or Interim Status[a]
3-29[b]	Container (3 Units)	Interim S[c]
3-102-118A	Container	Closed
14-35	OB/OD[d] (2 Units)	Interim T[c]
15-184[b]	OD	Interim T[c]
16, Area P	Landfill	Closure in Progress
16	OB (6 Units)	Interim T[c]
16-88[b]	Container	Interim S[c]
16-1409	Incinerator	Permitted T[e]
21-61[b]	Container	Interim S[c]
22-24	Container	Closed
35-125	Surface Impoundment	Closed
36-8[b]	OB/OD	Interim T[c]
39-6	OB/OD	Interim T[c]
39-57	OB/OD	Interim T[c]
40-2	Container	Closed
50-1	Container	Permitted S[e]
50-1-60A[b]	Container	Interim TS[c]
50-1-60D[b]	Container	Interim S[c]
50-1-BWTP[f]	Aboveground Tank	Closed
50-37-115[b]	Aboveground Tank (2 Units)	Interim S[c]
50-37-115[b]	Container	Interim S[c]
50-37-117	Container	Permitted S[e]
50-37-117[b]	Container	Interim S[c]
50-37-118[b]	Container	Interim S[c]
50-37-CAI[b,g]	Incinerator	Interim T[c]
50-37-CAI	Incinerator	Permitted T[e]
50-69[b]	Container	Interim S[c]
50-69[b]	Container	Interim S[c]
50-114	Container	Permitted S[e]
50-114[b]	Container	Interim S[c]
50-137[h]	Container	Permitted S[e]
50-138[h]	Container	Permitted S[e]
50-139[h]	Container	Permitted S[e]
50-140[h]	Container	Permitted S[e]
53-166[b]	Surface Impoundment	Interim S[i]
53-166[b]	Surface Impoundment	Interim S[i]
53-166[b]	Surface Impoundment	Interim S[i]
54, Area G	Landfill	Interim D[i]
54, Area G Pad 1[b]	Container	Interim S[c]
54, Area G Pad 2[b]	Container	Interim S[c]
54, Area G Pad 4[b]	Container	Interim S[c]
54, Area G Over Pit 30[b]	Container	Interim S[c]
54, Area G Shaft 145[b]	Container	Interim S[c]
54, Area G Shaft 146[b]	Container	Interim S[c]
54, Area G Dome 153[b]	Container	Interim S[c]
54, Area G Dome 224[b]	Container	Interim S[c]

Table 2-3. Hazardous Waste Management Facilities at Los Alamos National Laboratory (Cont.)

Technical Area Building	Facility Type	Included in RCRA Permit or Interim Status[a]
54, Area G Dome 283[b]	Container	Interim S[c]
54, Area H	Landfill	Closure in Progress
54, Area L	Aboveground Tank (4 Tanks)	Permitted[e]
54, Area L	Container	Interim S[c]
54, Area L	Container	Permitted S[e]
54, Area L Shaft 36[b]	Container	Interim S[c]
54, Area L Shaft 37[b]	Container	Interim S[c]
54, Area L Gas Cyl[b]	Container	Interim S[c]
54, Area L Gas Cyl	Container	Permitted S[e]
54-8[b]	Container	Interim S[c]
54-31	Container	Permitted S[e]
54-32	Container	Permitted S[e]
54-33[b]	Container	Interim S[c]
54-48[b]	Container	Interim S[c]
54-49[b]	Container	Interim S[c]
54-68	Container	Permitted S[e]
54-69	Container	Permitted S[e]
55, Near Bldg. 4[b]	Container	Interim S[c]
55-4[b]	Container (4 Units)	Interim S[c]
55-4[b]	Aboveground Tank (13 Tanks)	Interim TS[c]
55-4[b]	Container	Interim S[c]
55-4[b]	Container	Interim S[c]
55-4[b]	Container	Interim TS[c]
55-4[b]	Container	Interim S[c]
55-4[b]	Container	Closure in Progress

[a]S = Storage; T = Treatment; D = Disposal.
[b]Designates mixed waste units.
[c]Part A, January 1991.
[d]OB/OD = open burning/open detonation.
[e]November 1989.
[f]These units have not yet been constructed; BWTP = Batch Waste Treatment Plant.
[g]Revised Part A, October 1993; CAI = Controlled Air Incinerator.

Table 2-4. Johnson Controls World Services, Inc., Fiscal Year 1995 Recycling Volumes

Type	Volume	
	kg	lb
Paper	345,327	759,720
Photographic film	1,000	2,200
Lead w/steel	24,333	53,533
Lead acid batteries	11,530	25,365
Electric cable	7,314	16,091
Aluminum shavings	1,005	2,210
Scrap steel/tin/iron	309,969	681,310
Aluminum solid	32,636	71,800
Copper	729	1,604
Stainless steel	1,632	3,590
Brass	50	110
Tires	7,455	16,400
Waste Oil	97,430	214,345
Flammable liquids	52,653	115,837
Chemicals	16,026	35,257
Mercury light bulbs	1,438	3,164
Gas cylinders	1,259	2,770
Phone books	5,545	12,200

Table 2-5. Environmental Inspections and Audits Conducted at the Laboratory in 1995

Date	Purpose	Performing Agency
January 18, 1995	Asbestos Inspection	NMED
January 18, 1995	General Open Burn	NMED
January 23–24, 1995	UST Inspection	NMED
March 3, 1995	Asbestos Inspection	NMED
March 10, 1995	NPDES Program Overview	Pantex
April 18, 1995	Sandia Canyon Sampling Survey	DOE & NMED/AIP
May 12, 1995	Tour of LANL and Overview of NPDES, Storm Water, SDWA, and Hydrology Team Programs	Cochiti and Santa Clara Environment Departments
May 15–19, 1995	Water Quality Programs Review	DOE/AL & EPA
June 5, 1995	Spill Cleanup Investigations	DOE & NMED/AIP
June 29, 1995	NPDES Permit Program Evaluation	EPA
August 11, 1995	TA-55 Programs Evaluation and Tour	DOE & NMED/AIP
September 12–18, 1995	Hazardous Waste Compliance Inspection	NMED
October 16, 1995	Spill Cleanup Investigations	DOE & NMED/AIP
October 30, 1995	Asbestos Inspection	NMED
November 6–17, 1995	Air Quality Audit–Pilot Oversight	DOE/AL/EPD
December 20, 1995	General Open Burn	NMED
July 9, 1996	General Open Burn	NMED

Table 2-6. Los Alamos National Laboratory National Pollutant Discharge Elimination System Storm Water General Permits Industrial and Construction Activity

Permit #	Location	Submittal	Approval	Type
NMR00A384	LANL Site University of California	09/29/92	08/25/93	Industrial
NMR10A064	TA-53 FM TA-53 Sanitary Pipeline Project University of California	10/01/92	03/04/93	Construction
NMR10A065	US West Communication Ductbank University of California	10/01/92	03/04/93	Construction
NMR10A236	DARHT Facility Construction University of California	05/20/94	12/29/94	Construction
NMR10A277	ER Project Small Arms Firing Range University of California	08/18/94	09/19/94	Construction
NMR10A378	Co-Permittee, TRU Dome Project TWISP Facility Construction University of California	02/28/95	04/07/95	Construction
NMR00A527	ER Project Tar Remnant Remediation University of California	05/26/95	07/07/95	Construction
NMR10A469	TA-9 and TA-16 Steam System Upgrade University of California	09/01/95	10/19/95	Construction

Table 2-7. Types of Discharges and Parameters Monitored at the Laboratory under National Pollutant Discharge Elimination System Permit NM0028355 (Effective August 1, 1994)

EPA Identification No.	Type of Discharge	Number of Outfalls	Monitoring Required	Sampling Frequency
001	Power plant	1	Total suspended solids, free available chlorine, pH, flow	Once per month
02A	Boiler blowdown	2	pH, total suspended solids, flow, total copper, total iron, total phosphorus, sulfite (as SO_3), and total chromium	Once per three months
03A	Treated cooling water	31	Total suspended solids, free available chlorine, flow, total phosphorus, total arsenic, pH	Once per three months
04A	Noncontact cooling water	32	pH, flow, total residual chlorine	Once per three months
051	Radioactive waste treatment plant (TA-21 and TA-50)	1	Ammonia (as N), chemical oxygendemand, total suspended solids, total cadmium, total chromium, total copper, total iron, total lead, total mercury, total nitrogen, total nickel, nitrate-nitrite (as N), total zinc, total toxic organics, radium-226, radium-228, pH, flow	Variable frequency from once per week to once per month
05A	High explosives wastewater	15	Chemical oxygen demand, pH, flow, total suspended solids, oil and grease	Once per three months
06A	Photo waste water	13	Total silver, pH, flow	Once per three months
S	Sanitary wastewater (05S & 13S)	2	Biochemical oxygen demand, flow, pH, total suspended solids, fecal coliform bacteria	Variable frequency, from three per month to once per three months
001, 02A 03A, 04A 051, 05A 06A, 05S 13S	All discharge categories	97	Total aluminum, total arsenic, total boron total cadmium, total chromium, total cobalt, total copper, total lead, total mercury, total, selenium, total vanadium, total zinc, radium-226 + radium-228, accelerator-produced tritium	Once per year

Table 2-8. Limits Established by National Pollutant Discharge Elimination System Permit NM0028355 for Sanitary Outfall Discharges

Discharge Category	Permit Parameter	Daily Average	Daily Maximum	Unit of Measurement
13S TA-46 SWSC	BOD[a]	30.0	45.0	mg/L
		100.0	N/A[b]	lb/day
	TSS[c]	30.0	45.0	mg/L
		100.0	N/A	lb/day
	Fecal coliform bacteria	500.0	500.0	org/100 mL
	pH	6–9	6–9	standard unit
05S TA-21 Package Plant	BOD	30.0	45.0	mg/L
		0.5	N/A	lb/day
	TSS	30.0	45.0	mg/L
		0.5	N/A	lb/day
	COD[d]	125.0	125.0	mg/L
		2.1	N/A	lb/day
	pH	6–9	6–9	standard unit

[a]Biochemical oxygen demand.
[b]N/A means not required by permit.
[c]Total suspended solids.
[d]Chemical oxygen demand.

Table 2-9. National Pollutant Discharge Elimination System Permit Monitoring of Effluent Quality at Sanitary Sewage Treatment Outfalls

Discharge Location (Outfall)	Permit Parameters	Number of Deviations
TA-21 (05S)[a]	Fecal coliform bacteria	N/A[b]
	COD[c]	N/A
	BOD[d]	N/A
	TSS[e]	N/A
	pH	N/A
TA-46 (13S)	Fecal coliform bacteria	0
	BOD	0
	TSS	0
	pH	0

[a]No discharge from Outfall 05S during 1995.
[b]N/A means analysis not performed.
[c]Chemical oxygen demand.
[d]Biochemical oxygen demand.
[e]Total suspended solids.

Table 2-10. Limits Established by National Pollutant Discharge Elimination System Permit NM0028355 for Industrial Outfall Discharges, August 1, 1994

Discharge Category	Permit Parameter	Daily Average	Daily Maximum	Unit of Measurement
001 Power Plant	TSS[a]	30.0	100.0	mg/L
	Free Cl	0.2	0.5	mg/L
	pH	6–9	6–9	standard unit
02A Boiler Blowdown	TSS	30.0	100.0	mg/L
	Total Fe	10.0	40.0	mg/L
	Total Cu	1.0	1.0	mg/L
	Total P	20.0	40.0	mg/L
	Sulfite	35.0	70.0	mg/L
	Total Cr	1.0	1.0	mg/L
	pH	6–9	6–9	standard unit
03A Treated Cooling Water	TSS	30.0	100.0	mg/L
	Free Cl	0.2	0.5	mg/L
	Total P	20.0	40.0	mg/L
	Total As	0.04	0.04	mg/L
	pH	6–9	6–9	standard unit
04A Noncontact Cooling	pH	6–9	6–9	standard unit
	Total Cl	Report[b]	Report[b]	mg/L
051 Radioactive Liquid Waste Treatment Plant (TA-50)	COD[c]	94.0	156.0	lb/day
	TSS	18.8	62.6	lb/day
	Total Cd	0.06	0.3	lb/day
	Total Cr	0.19	0.38	lb/day
	Total Cu	0.63	0.63	lb/day
	Total Fe	1.0	2.0	lb/day
	Total Pb	0.06	0.15	lb/day
	Total Hg	0.003	0.09	lb/day
	Total Zn	0.62	1.83	lb/day
	TTO[d]	1	1	mg/L
	Total Ni	Report	Report	mg/L
	Total N	Report	Report	mg/L
	NO_3-NO_2	Report	Report	mg/L
	Ammonia (as N)	Report	Report	mg/L
	pH	6–9	6–9	standard unit
	COD	125	125	mg/L
	$^{226,228}Ra$	30.0	30.0	pCi/L
05A High Explosive	Oil & Grease	15.0	15.0	mg/L
	COD	125.0	125.0	mg/L
	TSS	30.0	45.0	mg/L
	pH	6–9	6–9	standard unit
06A Photo Waste	Total Ag	0.5	1.0	mg/L
	pH	6–9	6–9	standard unit

Table 2-10. Limits Established by National Pollutant Discharge Elimination System Permit NM0028355 for Industrial Outfall Discharges, August 1, 1994 (Cont.)

Discharge Category	Permit Parameter	Daily Average	Daily Maximum	Unit of Measurement
All Outfall Categories:	Total Aluminum	5.0	5.0	mg/L
Annual Water Quality	Total Arsenic	0.04	0.04	mg/L
Parameters	Total Boron	5.0	5.0	mg/L
	Total Cadmium	0.2	0.2	mg/L
	Total Chromium	5.1	5.1	mg/L
	Total Cobalt	1.0	1.0	mg/L
	Total Copper	1.6	1.6	mg/L
	Total Lead	0.4	0.4	mg/L
	Total Mercury	0.01	0.01	mg/L
	Total Selenium	0.05	0.05	mg/L
	Total Vanadium	0.1	0.1	mg/L
	Total Zinc	95.4	95.4	mg/L
	$^{226,228}Ra$	30.0	30.0	pCi/L
	Tritium	3,000,000	3,000,000	pCi/L

[a]Total suspended solids.
[b]Effluents are reported to EPA but are not subject to limits.
[c]Chemical oxygen demand.
[d]Total toxic organics.

Table 2-11. National Pollutant Discharge Elimination System Permit Monitoring of Effluent Quality at Industrial Outfalls: Deviation 1995

EPA ID	Technical Area	Date	Parameter		Results/Limits	Units
January—No exceedances during monitoring period.						
February						
128128	TA-22-91	02/22/95	pH	(daily max)	9.1/9.0	standard unit
March						
128128	TA-22-91	03/20/95	pH	(daily max)	9.1/9.0	standard unit
128128	TA-22-91	03/20/95	pH	(daily max)	9.1/9.0	standard unit
128128	TA-22-91	03/20/95	pH	(daily max)	9.1/9.0	standard unit
April						
03A114	TA-53-2	04/12/95	Cl_2	(daily avg)	0.38/0.2	mg/L
03A049	TA-53-64	04/19/95	As	(daily max)	0.084/0.04	mg/L
03A049	TA-53-64	04/19/95	As	(daily avg)	0.084/0.04	mg/L
May						
07A109	TA-03-73	05/10/95	pH	(daily max)	9.3/9.0	standard unit
June						
01A001	TA-03-22	06/09/95	Cl_2	(daily max)	0.58/0.5	mg/L
05A054	TA-16-340	06/14/95	COD[a]	(daily max)	196/125	mg/L
July						
03A045	TA-48-1	07/24/95	Cl_2	(daily max)	9.2/0.5	mg/L
03A045	TA-48-1	07/26/95	Cl_2	(daily avg)	4.6/0.2	mg/L
August—No exceedances during monitoring period.						
September						
05A056	TA-16-260	09/12/95	O & G[b]	(daily max)	17.8/15	mg/L
October						
01A001	TA-03-22	10/04/95	TSS[c]	(daily avg)	34/30	mg/L
November						
03A024	TA-03-187	11/02/95	As	(daily max)	0.055/0.04	mg/L
03A024	TA-03-187	11/06/95	As	(daily max)	0.063/0.04	mg/L
03A024	TA-03-187	11/06/95	As	(daily avg)	0.059/0.04	mg/L
03A027	TA-03-285	11/14/95	As	(daily max)	0.211/0.04	mg/L
03A027	TA-03-285	11/14/95	As	(daily avg)	0.132/0.04	mg/L
03A027	TA-03-285	11/14/95	pH	(daily max)	9.3/9.0	standard unit
03A027	TA-03-285	11/14/95	V[d]	(daily max)	0.13/0.10	mg/L
December						
03A027	TA-03-285	12/15/95	As	(daily max)	0.069/0.04	mg/L
03A027	TA-03-285	12/18/95	As	(daily avg)	0.105/0.04	mg/L

[a]Chemical oxygen demand.
[b]Oil and grease.
[c]Total suspended solids.
[d]Water quality parameter. Effluent limits were exceeded one time out of an estimated 1,060 samples collected for water quality parameters during 1995. These results were not used to calculate the Laboratory's overall compliance ratings for the NPDES Permit Program.

Table 2-12. Summary of Storm Water Flows for the Water Year 1995

	Days w/	Total Volume of Water		Instantaneous Max	
Canyon Sites	Flow	ac-ft	gal.	ft^3/S	GPM
E025 Upper Los Alamos	247	465	151,520,715	10	4,488
E030 Middle Los Alamos	169	492	160,318,692	12	5,386
E042 Lower Los Alamos[a]	110	328	106,879,128	54	24,235
E060 Pueblo[a]	365	874	28,481,038	6.3	2,621
E125 Sandia	6	5	1,629,255	13	5,834
E204 Lower Mortandad	0	0	—	0	—
E200 Middle Mortandad[b]	83	18	5,865,318	9.7	4,353
E225 Upper Cañada del Buey	1	0.4	130,340	17	7,630
E230 Lower Cañada del Buey	15	14	4,561,914	75	33,660
E240 Upper Pajarito	239	106	34,540,206	1.9	853
E245 Middle Pajarito	211	250	81,462,750	24	10,771
E250 Lower Pajarito	210	30	9,775,530	4.6	2,064
E255 Potrillo	3	3.5	1,140,479	63	28,274
E252 Upper Water	74	9.5	3,095,585	0.21	94
E253 Canyon de Valle	0		—		
E265 Lower Water[c]	2		—	21	9,425
E275 Ancho[c]	5		—		—

[a]USGS operated.
[b]Record began 5/10/95.
[c]Gage rating to be established.

Table 2-13. Status of National Environmental Policy Act Documentation as of December 31, 1995

Status	Project
Project for which EA-type document was completed for inclusion in Stockpile Stewardship and Management Programmatic EIS	Atlas
EAs that received FONSI during 1995	Actinide Source-Term Waste Test Program Weapons Component Test Facility Relocation High Explosives Wastewater Treatment Facility Low-Energy Accelerator Laboratory Radioactive Source Recovery Program
EA submitted to DOE before 1994; DOE determined in 1995 that an EIS would be required	Medical Radioisotope Production
Projects for which EA-type document (Specific Project Review) was completed for inclusion in Site-Wide EIS	Expansion of Area G, TA-54 Radioactive Liquid Waste Treatment Facility
EAs in preparation during 1995	Chemical and Metallurgy Research Building Upgrades-Phase II Hazardous Waste Treatment Facility and Mixed Waste Receiving and Storage Facility Low-Energy Demonstration Accelerator TRU Waste Drum Staging Building

E. Figures

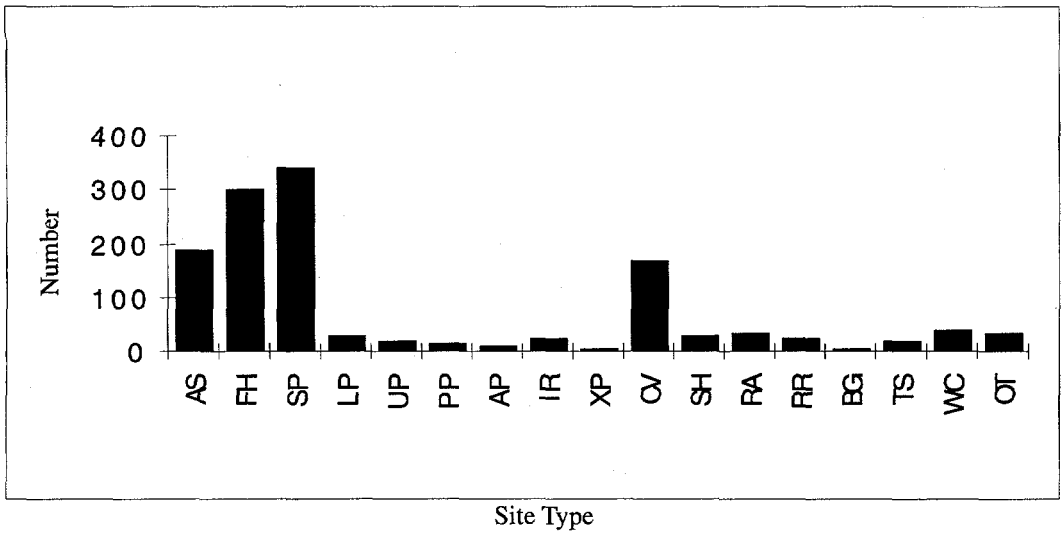


Figure 2-1. Los Alamos National Laboratory prehistoric sites.

SITE TYPE CODES:

AS	artifact scatter
FH	1-3 room structure
SP	single roomblock pueblo
LP	L-shaped pueblo
UP	U-shaped pueblo
PP	enclosed plaza pueblo
AP	highly eroded, indistinct shape pueblo
IR	indeterminate rubble mound
XP	complex shaped pueblo
WC	water control feature
BG	bedrock gametrap
TS	trail or steps
RR	rock ring
RA	rock art
CV	cavate pueblo
SH	rock shelter/overhang
OT	other prehistoric type

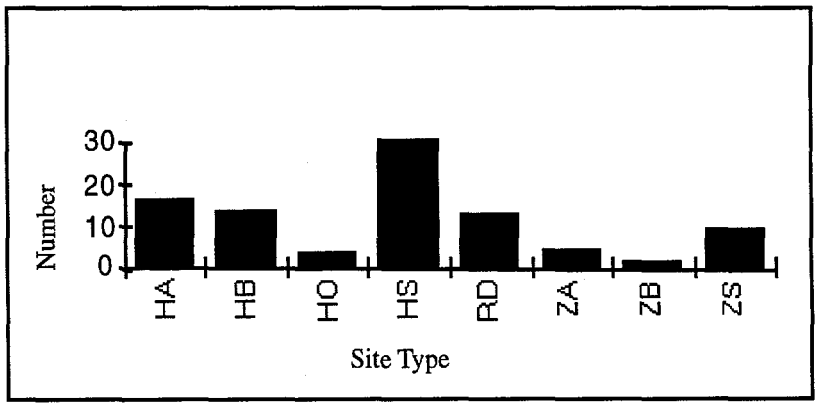


Figure 2-2. Los Alamos National Laboratory historic site types.

SITE TYPE CODES:

HB	homestead building
HS	homestead structure
HA	homestead artifact scatter
HO	homestead other
ZB	Laboratory building
ZS	Laboratory structure
ZA	Laboratory artifact scatter
ZO	Laboratory other

F. References

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3. Environmental Radiological Dose Assessment

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A. Overview of Programs

Radiological dose equivalents show the potential doses received by individuals exposed to radioactivity in the environment. Dose equivalent refers to the quantity of radiation energy absorbed per unit mass (the dose), multiplied by adjustment factors for the type of radiation absorbed. The effective dose equivalent (EDE), or dose, is the principal measurement used in radiation protection. The EDE is a hypothetical whole-body dose equivalent that would equal the same risk of cancer mortality and serious genetic disorder as the sum of the weighted dose equivalents of those organs considered to be most seriously affected by the radionuclide in question. The EDE includes the committed effective dose equivalent (CEDE) from internal deposition of radionuclides and the EDE due to penetrating radiation from sources external to the body.

Federal government standards limit the EDE to the public (DOE Order 5400.5, 40 Code of Federal Regulations [CFR] Part 61) (DOE 1990). The Department of Energy's (DOE's) public dose limit (PDL) is 100 mrem/yr EDE received from all pathways (i.e., ways in which people can be exposed to radiation, such as inhalation, ingestion, and immersion in water or air containing radioactive materials), and the dose received through the air pathway is restricted by the Environmental Protection Agency's (EPA's) effective dose standard of 10 mrem/yr (see Appendix A). These values are in addition to exposures from normal background, consumer products, and medical sources. The standards apply to locations of maximum probable exposure to an individual in an off-site, uncontrolled area.

B. Radiological Dose Equivalents

1. Methods for Dose Calculation

a. Introduction. Annual radiation doses are evaluated for three principal exposure pathways: external exposure (which includes exposure from immersion in air containing photon-emitting radionuclides and direct and scattered penetrating radiation), inhalation, and ingestion.

Two evaluations of potential releases are conducted: one to satisfy 40 CFR Part 61 requirements and one for all pathways. Results of environmental measurements are used as much as possible in assessing doses to individual members of the public. Calculations based on these measurements follow procedures recommended by federal agencies to determine radiation doses (DOE 1991, NRC 1977). If the impact of Laboratory operations is not detected by environmental measurements, individual and population doses attributable to Laboratory activities are estimated through computer modeling of releases.

The dose conversion factors used for inhalation and ingestion calculations are those recommended by the DOE (1988) and are based on factors in Publication 30 of the International Commission on Radiological Protection (ICRP 1979). Dose conversion factors for inhalation assume a particle size of 1-μm-activity median aerodynamic diameter as well as the lung solubility category that will maximize the EDE (for comparison with DOE's 100 mrem/yr PDL). Similarly, the ingestion dose conversion factors are chosen to maximize the EDE for comparison with DOE's 100 mrem/yr PDL for all pathways. These dose conversion factors give the 50-year dose commitment for internal exposure. The 50-year dose commitment is the total dose received by an organ during the 50-year period following the intake of a radionuclide.

External doses from ambient air concentrations are calculated using the dose-rate conversion factors published by DOE (1988). These factors give the photon dose rate in millirem (mrem) per year per unit radionuclide air concentration in microcuries per cubic meter ($\mu Ci/m^3$). If the conversion factor for a specific radionuclide of interest is not published in DOE 1988, it is calculated with the computer program DOSFACTOR II (Kocher 1981).

b. External Radiation. The Laboratory's largest contributor to the penetrating radiation environment is the Los Alamos Neutron Science Center (LANSCE), formerly called the Los Alamos Meson Physics Facility. During experimentation at LANSCE, short-lived positron emitters are released from the stacks and diffuse from the buildings. These emitters release photon radiation as they decay, producing a potential external radiation dose. Most of the emitters decay very quickly, and within a few hundred meters the dose is negligible. However, the dose at East Gate (the Laboratory boundary north-northeast of LANSCE) is elevated by these Laboratory emissions. The Laboratory's contribution to the penetrating radiation dose at East Gate is derived in two ways: in

one method, data from a high-pressure ion chamber are used to develop a direct evaluation of the penetrating radiation exposure rate; in the other method, calculated or measured emissions from the stacks and buildings at LANSCE are input to CAP-88 to model the potential dose at East Gate. The modeling is conservative and generally results in an overestimation of the Laboratory's contribution to the hypothetical maximally exposed individual (MEI) at East Gate. Other locations in the townsite are also modeled to determine potential doses from LANSCE operations.

The other potentially significant contributor to penetrating radiation exposures is the Criticality Facility at TA-18. Criticality experiments produce neutrons and photons, both of which contribute to the external penetrating radiation dose. During experiments that have the potential to produce a dose in excess of 1 mrem per operation, public access is restricted by closing Pajarito Road from White Rock to TA-51.

Environmental thermoluminescent dosimeters (TLD) are used to estimate external penetrating radiation doses. The Laboratory has a network of TLDs (TLDNET) around the Laboratory and townsite. The large variations in the natural background levels of penetrating radiation limit the ability of TLDs to discern the low-level Laboratory releases from natural background fluctuations. However, in the event of releases of penetrating radiation significantly above background, TLDs may be used as an indicator of the magnitude of the exposures. TLDs near the TA-18 facility have shown exposure levels above background as discussed further in Section 4.B.3. The Laboratory's TLDNET is not sensitive enough to reliably distinguish LANSCE emissions from background.

The TLDNET data are used to quantify the exposure from penetrating radiation in the Los Alamos area. The modeled dose contribution from LANSCE is subtracted from the measured TLD exposures to derive the net, nonradon, background dose at a number of locations in the Los Alamos area. The final, individual, nonradon dose is derived by reducing the measured exposure by 20% to account for building shielding and by 30% to account for the self-shielding of the body. The dose from self-irradiation, caused by natural radioactive emitters such as potassium-40 within the body, is about 40 mrem annually and is also factored into the calculation. (Note: these reductions are not used for demonstrating compliance with the EPA standard.) An assumed dose of 200 mrem to account for radon exposure is added to the calculated net dose to determine the total average background dose to a person residing in the Los Alamos area.

c. Inhalation Dose Equivalent. Annual average air concentrations of tritium; plutonium-238; plutonium-239,240; uranium-234; uranium-235; uranium-238; and americium-241, determined by the Laboratory's air monitoring network (AIRNET), are corrected for background by subtracting the average concentrations measured at representative background stations. The net concentration is reduced by 10% to account for indoor occupancy (Kocher 1980). These net concentrations are then multiplied by a standard breathing rate of 8,400 m^3/yr (ICRP 1975) to determine total adjusted intake by inhalation, in microcuries per year, for each radionuclide. Each intake is multiplied by appropriate dose conversion factors to convert radionuclide intake into 50-year committed dose equivalents (CDE). Following ICRP methods, doses are calculated for each organ that contributes more than 10% of the total EDE for each radionuclide. The dose calculated for inhalation of tritium is approximately one-half of the total dose received by being in an environment with tritium; the other half comes from direct absorption of tritium through the skin. The dose conversion factors (DCFs) for inhalation of tritium incorporate the dose received by absorption through the skin.

This procedure for dose calculation assumes conservatively that a hypothetical individual is exposed to the measured air concentration continuously throughout the entire year (8,760 h). This assumption is made for the boundary dose, dose to the MEI, and dose to the population living within 80 km (50 mi) of the site.

d. Ingestion Dose. Radioanalytical data from samples of foodstuffs are used to estimate the annual CDE to various tissues in the body and the total CEDE to the whole body for the average and maximum consumer of food products within the general population. The EPA's model CAP-88 also provides an estimate of the CEDE to the whole body for the air pathway only. The estimated CEDE is included in the total modeled EDE reported in Section 3.B.3.b. However, the CEDE from food products is calculated by multiplying the CDE, representing the total dose which an organ or tissue of the body is expected to receive over the 50-year period following an intake of radioactive material, by the weighting factors for that tissue as given in ICRP 26 (ICRP 1977). The CDE (and thus the CEDE) does not include contributions from exposures external to the body.

To calculate the CEDE, the radionuclide concentration in a particular foodstuff is multiplied by an estimated annual consumption rate to obtain the total adjusted intake for a particular radionuclide. The estimated annual consumption rates used for these calculations are presented in Table 3-1. Multiplication of this annual adjusted

intake by the appropriate radionuclide dose conversion factor for a particular organ gives the estimated CDE to the organ and, similarly the CEDE to the entire body [DOE 1988]. To determine the Laboratory impacts, if any, on a particular foodstuff, the maximum CEDE (i.e., average CEDE + two sigma) at regional stations or other background stations is subtracted from the maximum CEDE at each monitoring location. Since one cannot have a "negative exposure to radiation," all negative values are set to zero leaving only the net positive differences between the sampling location of interest and the background stations. This net positive difference is summed over all the monitored radionuclides to obtain the total net positive difference which is expressed in mrem. The total net positive difference is also reported as a percentage of the DOE's 100 mrem/yr PDL (DOE 1990) and is used to calculate the risk of cancer fatalities from consuming a particular foodstuff.

2. Estimation of Radiation Dose Equivalents

a. Dose Equivalents from Natural Background. Published EDE values from natural background and from medical and dental uses of radiation are used to provide a comparison with doses resulting from Laboratory operations. Global fallout doses due to atmospheric testing of nuclear weapons are only a small fraction of total background doses (<0.3% [NCRP 1987a]). Natural background radiation dose is due to exposure to the lungs from radon decay products and exposures from nonradon sources which affect the whole body.

External radiation comes from two sources of approximately equal magnitude: the cosmic radiation from space and terrestrial gamma radiation from radionuclides in the environment. Estimates of background radiation are based on a comprehensive report by the National Council on Radiation Protection and Measurements (NCRP 1987b). The 1987 NCRP report uses 20% shielding by structures for high-energy cosmic radiation and 30% self-shielding by the body for terrestrial radiation. The 30% protection factor is also applied to less energetic gamma radiation from LANL sources.

Whole-body external dose is incurred from exposure to cosmic rays, external terrestrial radiation from naturally occurring radioactivity in the earth's surface, and from global fallout. The EDE from internal radiation is due to radionuclides naturally present in the body and inhaled and ingested radionuclides of natural origin.

Annual external background radiation exposures for sources other than radon vary depending on factors such as snow cover and the solar cycle (NCRP 1975b). Estimates of background radiation in 1995 from nonradon sources are based on environmental dosimeter measurements of 109 mrem in Los Alamos and 96 mrem in White Rock using only complete datasets (i.e., measurements for all four quarters). The elevation difference between Los Alamos and White Rock accounts mainly for the difference between the two numbers. These measured doses were adjusted for structural shielding by reducing the cosmic ray component by 20%. The measured doses were also adjusted for self-shielding by the body by reducing the terrestrial component by 30%. The neutron dose from cosmic radiation and the dose from self-irradiation were then included to obtain the whole-body background dose of 149 mrem at Los Alamos and 136 mrem at White Rock from sources other than radon. Uranium decay products occur naturally in soil and building construction materials. Inhalation of radon-222 produced by decay of radium-226, a member of the uranium series, results in a dose to the lung, which also must be considered. The EDE from radon-222 decay products is assumed to be equal to the national average, 200 mrem/yr. This estimate may be revised if a nationwide study of background levels of radon-222 in homes is undertaken. Such a national survey has been recommended by the NCRP (NCRP 1984, 1987a).

In 1995 the EDE to residents was 349 mrem at Los Alamos and 336 mrem at White Rock from all natural sources. The individual components of the background dose for Los Alamos and White Rock, and the average EDE of 53 mrem/yr to members of the US population from medical and dental uses of radiation (NCRP 1987a) are listed in Table 3-2.

b. Summary of Doses to the Public from Laboratory Operations

Inhalation of Airborne Emissions. The net CEDE from the inhalation of airborne emissions as measured by the AIRNET in 1995 for the townsites of Los Alamos and White Rock are 0.05 mrem and 0.06 mrem, respectively. The maximum potential CEDE from TA-54, Area G operations, from explosive testing containing depleted uranium, and from decontamination and decommissioning activities at TA-21 are estimated at 0.002 mrem, 0.04 mrem, and 0.006 mrem, respectively. These potential doses to the public are well below the EPA standard of 10 mrem/yr for airborne emissions [EPA 1989]. Section 4.B.1.c provides further discussions on the CEDE by sampling locations as well as the radionuclides that contributed to this dose estimate.

External Penetrating Radiation from Airborne Emissions and Direct Sources. The annual EDE for airborne emissions was measured near the location of the MEI along the LANL boundary known as East Gate. The above background EDE at this location in 1995 was 2.0 mrem. No direct penetrating radiation dose to the public from Laboratory operations was detected by TLD measurements. Section 4.B.3.e provides further discussions on the EDE by sampling locations.

Ingestion of Drinking Water. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for drinking water samples collected in 1995 from the LANL water distribution system is 0.579 mrem (14.5% of the 4-mrem drinking water standard). The maximum annual CEDE for the average consumption rate decreases to 0.411 mrem (10.3% of the 4-mrem drinking water standard). Section 5.C.4 provides further discussions on the CEDE for Los Alamos and White Rock and the Pueblos of San Ildefonso, Santa Clara, Cochiti, and Jemez.

Exposure to Sediments in Mortandad Canyon. The pathways of exposure evaluated for sediment sampling in Mortandad Canyon include the external gamma pathway from radioactive material deposited in the sediments, the inhalation pathway from materials resuspended by winds, animals, etc.; and the soil ingestion pathway. Using RESRAD v 5.61, the maximum total effective dose equivalent (TEDE) (i.e., the total of the EDEs from all pathways plus twice the error term) is estimated as 36.6 mrem (<37% of the DOE PDL). Cesium-137 from sampling locations GS-1 and MCO-5 contributed to more than 98% of the external gamma pathway which, in turn, contributed more than 84% to the maximum TEDE for the entire canyon system. The inhalation and soil ingestion pathway each contributed approximately 8% to this maximum TEDE. Modeling assumptions and more detail information is found in Section 5.E.6.

Exposure to TA-50 Effluent and Stream Below Outfall. The maximum annual CEDE (i.e., the total CEDE plus two sigma using the maximum consumption rate of 16.1 L/yr) for water samples collected in 1995 directly from the TA-50 effluent and from the stream below the outfall is 20.9 mrem (21% of the DOE PDL) and 7.8 mrem (7.8% of the DOE PDL), respectively. For the average consumption rate of 5.7 L/yr, the annual CEDE decreases to 7.4 mrem and 2.8 mrem, respectively. Section 5.E.7 provides further discussions on the assumptions used in this calculation.

Ingestion of Foodstuffs. Using the maximum consumption rate (see Table 3-1), the maximum difference between the total positive CEDE at all sampling locations and the regional background locations for each food group is as follows: produce, 0.228 mrem; honey, 0.010 mrem; eggs, 0.002 mrem; milk, 0.063 mrem; fish (bottom feeders), 0.027 mrem; fish (higher level feeders), 0.003 mrem; elk muscle, 0.027 mrem; and elk bone, 0.216 mrem. Assuming one individual consumed the total quantity for each food group (except elk bone), the total net positive difference for the CEDE is 0.360 mrem (<0.4 % of the DOE PDL) using the maximum consumption rate and 0.081 mrem (<0.09% of the DOE PDL) using the average consumption rate.

The single factor Analysis of Variance (ANOVA) test shows that, at the 95% level of confidence, there is no significant difference between the maximum CEDE (i.e., average CEDE + two sigma) for consuming food products collected at on-site, perimeter, or off-site locations in 1995. For foodstuffs that had more than one sample per year, the Student's t Test also shows that there is no significant difference, at the 95% level of confidence, between the CEDE for 1995 and the CEDE for 1994 (or a previous collection period). For foodstuffs that had only one sample per year, the confidence interval for each dataset overlapped, also indicating there is no difference between the CEDEs for 1994 and 1995. Section 6.B.2 provides further discussions on the CEDE by the food type and sampling locations as well as the radionuclides that contributed to this total net positive difference.

3. Total Maximum Individual Dose to a Member of the Public from 1995 Laboratory Operations

a. Measured Maximum Individual Dose. The maximum individual EDE to a member of the public from 1995 Laboratory operations is estimated to be 2.3 mrem. This is the total EDE from all potential pathways of radiation exposure and is based entirely on environmental measurements. This dose is 2.3% of the DOE's annual public dose limit of 100 mrem EDE from all pathways and 1% of the total annual dose contribution from all sources of radiation (Figure 3-1). The maximum individual dose occurred at East Gate and was primarily due to exposure to external penetrating radiation from air activation products released by the LANSCE accelerator. The contribution to the maximum individual off-site dose via each pathway is presented in Figure 3-2.

b. Modeled Maximum Individual Dose. As required by the EPA, compliance with regulation 40 CFR 61, Subpart H must be demonstrated with the CAP-88 version of the computer codes PREPAR2, AIRDOS2, DARTAB2, and RADRISK (EPA 1990). These codes use measured radionuclide release rates and meteorological

information to calculate airborne concentrations of radionuclides released to the atmosphere. The programs estimate radiation exposures from inhalation of radioactive materials; external exposure to the radionuclides present in the atmosphere and deposited on the ground; and ingestion of radionuclides in drinking water, produce, meat, and dairy products. The source term, the amount of a particular matter, for these calculations was based on measured emissions during 1995. Wind speed, wind direction, and stability class are continuously measured at meteorology towers located at TA-54, TA-49, TA-6, and TA-53. Emissions were modeled with the wind information most representative of the release point. The maximum individual EDE from 1995 airborne emissions, as determined by CAP-88, was 5.05 mrem. The maximum dose, which would occur in the area just north-northeast of LANSCE, is 50.5% of the EPA's air pathway standard of 10 mrem/yr EDE.

c. Comparison of Department of Energy and Environmental Protection Agency Dose Methodologies. The effects of increased dispersion of LANL's radioactive air effluents caused by the rugged topography of the Pajarito Plateau are not well incorporated by EPA's atmospheric dispersion model CAP-88. As such, the measured exposure rate at East Gate is typically less than the predicted exposure rate using CAP-88 (Figure 3-3). This is just one example of the many differences which contribute to the contrast between the dose measured for compliance to DOE standards and the dose modeled for compliance to EPA regulations presented above.

4. Population Distribution

The population distribution is used to calculate the collective dose resulting from 1995 Laboratory operations. In 1995, the estimated population of Los Alamos County was approximately 18,000 (BBER 1995). Two residential and a few commercial areas exist in the county (Figure 1-1). The Los Alamos townsite (the original area of development) now includes residential areas known as Eastern Area, Western Area, North Community, Barranca Mesa, and North Mesa. The townsite had an estimated population of 12,000 residents. The White Rock area includes the residential areas of White Rock, La Senda, and Pajarito Acres. The area had about 6,000 residents in mid-1995. It is estimated that over 241,000 persons lived within an 80-km (50-mi) radius of the Laboratory in mid-1995 (Table 3-3).

5. Collective Dose

The collective EDE from 1995 Laboratory operations is the sum of the estimated dose received by each member of the population within an 80-km (50-mi) radius of LANL. Over 99% of this dose is expected to have resulted from airborne radioactive emissions from Laboratory programs. As a result, the collective dose was estimated by modeling 1995 radioactive air emissions, their transport off site, and the resulting radiation exposures that could occur. The distribution given in Table 3-3 was used in the dose calculation. The collective dose was calculated with the CAP-88 collection of computer programs. These programs were also used to calculate the maximum EDE to a member of the public as required by the EPA regulations in 40 CFR Part 61. Airborne radioactive emissions from all types of releases were included in the analysis. The same exposure pathways that were evaluated for the maximum individual dose were also evaluated for the collective dose; these pathways include inhalation of radioactive materials, external radiation from materials present in the atmosphere and deposited on the ground, and ingestion of radionuclides in meat, produce, and dairy products. The 1995 population collective EDE attributable to Laboratory operations to persons living within 80 km (50 mi) of the Laboratory was calculated to be 3.2 person-rem. This dose is less than 0.004% of the 82,000 person-rem annual average exposure from natural background radiation and less than 0.03% of the 12,800 person-rem exposure an average person receives annually from medical radiation

C. Risk to an Individual from Laboratory Operations

1. Estimating Risk

Health effects from radiation exposure (primarily cancer) are observed in humans only at doses in excess of 10 rem delivered at high dose rates (HPS 1996). In past environmental surveillance reports, our practice has been to use the risk estimates, also called risk factors, presented in the BEIR documents (most recently, BEIR V 1990) to quantify the cancer risks from exposure to radiation. These risks were presented to provide a perspective on the potential risk of cancer from Laboratory contributions to the radiation environment of northern New Mexico.

Although it is important to address the potential risk from these radiation doses, it is also important not to mislead the reader into concluding that small radiation doses are more hazardous than they actually are.

The risk estimates in BEIR V were developed by the National Academy of Sciences and were based primarily on the dose-risk effects produced in survivors of the Hiroshima and Nagasaki atomic bomb blasts. These calculations, however, overestimate actual risk for low linear energy transfer (low-LET) radiation, which is the source of more than 95% of the dose to the MEI from Laboratory operations. The NCRP (1975a) has warned that "risk estimates for radiogenic cancers at low doses and low dose rates derived on the basis of linear (proportional) extrapolation from the rising portions of the dose incidence curve at high doses and high dose rates . . . cannot be expected to provide realistic estimates of the actual risks from low-level, low-LET radiation and have such a high probability of overestimating the actual risk as to be of only marginal value, if any, for purposes of realistic risk-benefit evaluation." The fundamental shortcoming of the BEIR V risk estimates for determining low-level radiation effects is that they are based, primarily, on the effects of doses of tens or hundreds of rem received over periods of seconds. Extrapolating these data linearly downward to the mrem or fractions of mrem annual doses from Laboratory operations almost certainly results in a great overestimation of risk.

As early as the 1920's, investigators concluded that low levels of radiation could not cause the mutations and other effects assigned to such doses (Muller 1935). More recently, Billen (1990) concluded that radiation-induced DNA damage is a small contributor to the ongoing, spontaneous DNA damage that occurs in mammalian cells. In Billen's discussion, he suggests that an annual dose in the range of less than or equal to 100 mrem can be considered a "negligible dose." In terms of DNA damage, this dose is so small as to provide no effect that could be discerned from other causes. Other researchers conclude that there is no scientific basis for the low-dose risk estimates recommended by the EPA and BEIR V, and instead, propose new risk assessment methodologies that involve defining minimum significant risk (Seiler 1994 and Seiler 1996).

Radiation hormesis (the concept that small radiation doses in the range of a few rem annually may be beneficial) should also be considered when evaluating radiation-induced risk. The following discussion is paraphrased from Gollnick (1994). The descriptor *beneficial* means that a population exposed to small amounts of radiation will experience fewer cancer deaths than a similar, unexposed population. Among the claimed effects of small radiation doses, in addition to the potential for reduced cancer risk, are increased life span, growth, and fertility. Gollnick describes possible biochemical bases for these effects including elevated antibody levels in irradiated animals and differential sensitivity of different types of lymphocytes to radiation which effectively increase the body's ability to attack tumors. Some population studies support the radiation hormesis concept, although there are generally too many potential conflicting or contributing factors to draw indisputable conclusions.

Recently, the Health Physics Society (HPS) published a position statement on the risks of radiation exposures (HPS 1996). They recommended "against quantitative estimation of health risk below an individual dose of 5 rem in one year. . . ." They concluded that below an individual dose of 5 rem in one year "risk estimates should not be used; expressions of risk should only be qualitative emphasizing the inability to detect any increased health detriment (i.e., zero health effects is the most likely outcome)."

Risk estimates range from 5×10^{-7} excess cancer deaths per mrem to members of the public (EPA 1994) to a negative (beneficial), although unquantified risk. We present the range of risk estimates in this section to allow readers to draw their own conclusions regarding the dangers of Laboratory radiation. If one chooses to use the BEIR or EPA risk estimates (factors) to calculate the potential excess cancer rates from a radiation dose, the result will overestimate the actual risk. The potential excess cancer deaths may be calculated according to the following equation:

$$R = D \times RF$$

where

R = incremental (or decremental) risk of cancer death expected from a radiation dose to an individual,

D = effective dose equivalent (mrem), and

RF = risk factor (excess cancer deaths/mrem).

As noted previously, RFs range from 5×10^{-7}/mrem to negative, as yet unquantified values. In the following sections, we do not report the potential risks associated with the reported doses, but the reader may calculate these according to the above equation, using whichever risk factors he/she believes to be appropriate.

2. Risk from Whole-Body Radiation

Radiation exposures considered in this report are of two types: (1) whole-body exposures, and (2) individual organ exposures. The primary doses from nonradon natural background radiation and from Laboratory operations are whole-body exposures. With the exception of natural background radon exposures, discussed below, radiation doses and associated risks from those radionuclides that affect only selected body organs are a small fraction of the dose and are negligible. Risks from whole-body radiation can be estimated using the factors of the BEIR V report.

Risk factors from the BEIR estimate (BEIR V 1990) are based on the risk from a single, instantaneous, high-dose-rate exposure of 10 rem. The BEIR V report states that this estimate should be reduced for an exposure distributed over time that would occur at a substantially lower dose rate. The National Academy of Sciences committee discussed dose rate effectiveness factors (DREFs) ranging from 2 to 10 that should be applied to the nonleukemia part of the risk estimate. Using the DREF value of 2 the total risk estimate from BEIR V is 440 cancer (nonleukemia and leukemia) fatalities per 10^{-7} person-mrem. The EPA recently recommended using a risk factor of 5×10^{-7} per person-mrem (EPA 1994) for estimating risks from whole-body radiation.

3. Risk from Exposure to Radon

Radon and radon-decay products are the largest contributors to natural background radiation exposures. These exposures differ from the whole-body radiation discussed above in that they principally involve only the localized exposure of the lung and not other organs in any significant way. Consequently, the risks from radon exposure are calculated separately. Exposure rates to radon (principally radon-222) and radon-decay products are usually measured with a special unit, the working level (WL); 1 WL corresponds to a liter of air containing short-lived radon decay products that have a total potential alpha energy of 1.3×10^5 MeV. An atmosphere having a 100 pCi/L concentration of radon-222 at equilibrium with its decay products corresponds to 1 WL. Cumulative exposure is measured in working level months (WLMs). A WLM is equal to exposure to 1 WL for 170 hours.

The estimated national-average radon EDE that was given by the NCRP is 200 mrem/yr. The NCRP derived this dose from an estimated national-average radon exposure of 0.2 WLM/yr. Because the risk factors are derived in terms of WLM, for the purposes of risk calculation it is more convenient to use the radon exposure of 0.2 WLM/yr than to use the radon dose of 200 mrem/yr. However, the 0.2 WLM/yr and the 200 mrem/yr EDE correspond to the same radiation exposure. Increased risks of fatal cancer from radon exposure can be estimated using a risk factor of 3.50×10^{-4}/WLM (BEIR IV 1988). Alternatively, on the basis of other data (Gollnick 1994), one may assume a zero or negative risk factor for exposure to radon.

4. Risk from Nonradon Natural Background Radiation

During 1995, persons living in Los Alamos and White Rock received an average EDE of 149 mrem and 136 mrem, respectively, of nonradon radiation (principally to the whole body) from natural sources (including cosmic, terrestrial, and self-irradiation sources, with allowances for shielding and cosmic neutron exposure) (Table 3-2).

The dose from natural background radiation also includes exposure to the lung from radon-222 and its decay products as discussed above.

5. Risk from Laboratory Operations

The risks calculated from natural background radiation and medical and dental radiation can be compared with the incremental risk caused by radiation from Laboratory operations. The average doses to individuals in Los Alamos and White Rock from 1995 Laboratory activities were 0.5 and 0.2 mrem, respectively. Assuming the EPA risk factors, these Laboratory doses would give approximately 0.1% of the risk attributed to exposure to natural background radiation or to medical and dental radiation. The exposure to Los Alamos County residents from Laboratory operations is well within variations in exposure of these people to natural cosmic and terrestrial sources and global fallout. For example, variation in the amount of snow cover and in the solar sunspot cycle can cause a 10-mrem difference from year to year (NCRP 1975b).

For Americans, the average lifetime risk is a 1-in-4 chance of contracting cancer and a 1-in-5 chance of dying of cancer (EPA 1979). Assuming one accepts the most conservative risk estimates (BEIR V 1990 and EPA 1994), the incremental risk from exposure to Laboratory operations is negligible.

D. Tables

Table 3-1. Annual Consumption Rates for Calculating the Committed Effective Dose Equivalent in Foodstuffs

Food Groups	Average Exposed Individuals	Maximum Exposed Individuals
Dairy Products	120 kg (0.3 L/d)[a]	300 kg (0.8 L/d)[a]
(Fresh Cow's Milk)	96 kg (0.25 L/d)[a]	190 kg (0.5 L/d)[a]
Elk		
Meat	9.5 kg (21 lb)[a]	23 kg (50 lb)[c]
Bone	2.4 kg (5 lb)[d]	5.7 kg (13 lb)[d]
Fish (Fresh)	5.7 kg (13 lb)[a]	21 kg (46 lb)[b]
Fruits	17 kg (37 lb)[e]	46 kg (102 lb)[e]
Vegetables	42 kg (91 lb)[e]	114 kg (250 lb)[e]
Beverages[g]	540 kg (1.5 L/d)[a]	760 kg (2.1 L/d)[a]
(Tap Water &		
Water Based Drinks)	421 kg (1.1 L/d)[a]	557 kg (1.5 L/d)[a]
Eggs	12 kg (34 g/d)[a]	20 kg (55 g/d)[f]
Honey	1.4 kg (3 lb)[h]	5 kg (11 lb)[h]

[a]EPA 1984.
[b]NRC 1977.
[c]Based on the consumption of one 233 kg elk (Meadows 1982) per year per 4.5 persons family.
[d]Based on the meat consumption rate and the weight distribution of elk tissue groups (Meadows 1982).
[e]Based on values from the NRC Regulatory Guide 1.109 (NRC 1977) with 22% fruit and 54% vegetables. The homegrown fraction is estimated at 40% (EPA 1989).
[f]EPA 1991.
[g]Modified to reflect the percent of water that a particular well contributed to the total amount of drinking water pumped in a year.
[h]Value used in previous years and/or based on professional judgment.

Table 3-2. Calculation of Total Effective Dose Equivalent (mrem/yr) from Natural or Man-Made Sources

	Los Alamos	White Rock
Radon	200	200
Self-irradiation	40	40
Total External[a]	109	96
Total Effective Background Dose	349	336
Medical	53	53

[a]Includes correction for shielding.

Table 3-3. Estimated 1995/1996 Population within 80 km of Los Alamos National Laboratory[a]

	Distance from TA-53 (km)									
Direction	**0-1**	**1-2**	**2-4**	**4-8**	**8-15**	**15-20**	**20-30**	**30-40**	**40-60**	**60-80**
N	7	69	241	134	0	13	89	932	797	577
NNE	7	65	95	23	2	10	2,301	386	660	307
NE	4	11	0	0	1	1,163	14,508	2,495	2,415	3,527
ENE	1	0	0	0	550	1,468	4,480	3,525	1,392	1,564
E	0	0	0	1	311	1,310	4,034	381	21	402
ESE	0	0	0	0	9	10	658	7,890	721	2,222
SE	0	2	0	4,576	577	0	967	71,531	7,371	661
SSE	3	3	0	523	350	0	288	5,565	2,541	106
S	2	2	0	0	22	0	16	143	390	3,028
SSW	3	3	0	0	30	1	764	1,263	6,708	51,824
SW	3	10	0	1	4	1	0	0	2,158	181
WSW	1	16	27	0	7	0	29	373	2,379	4
W	0	4	121	178	0	6	64	277	59	68
WNW	2	14	1,029	5,976	0	0	25	30	61	2,519
NW	5	30	907	1,466	0	2	23	48	0	568
NNW	6	60	696	288	0	6	19	255	157	27
Total	44	289	3,116	13,166	1,863	3,990	28,265	95,094	27,830	67,837

[a]Total population within an 80-km radius of Los Alamos National Laboratory is more than 241,000.

E. Figures

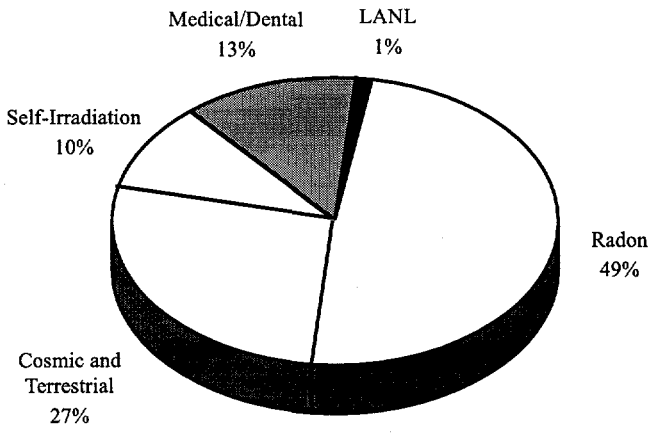


Figure 3-1. Total contributions to 1995 dose at the Laboratory's maximum exposed individual location.

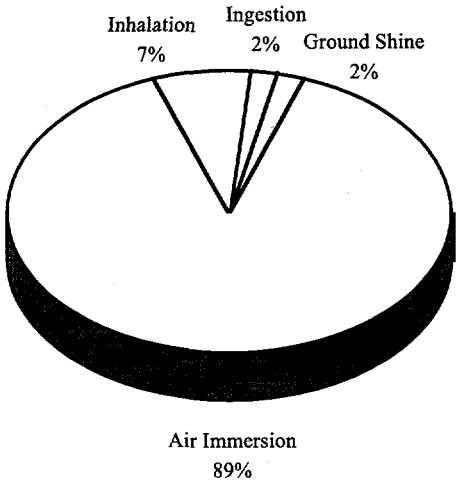


Figure 3-2. The Laboratory's contribution to dose by pathway at the maximum exposed individual location.

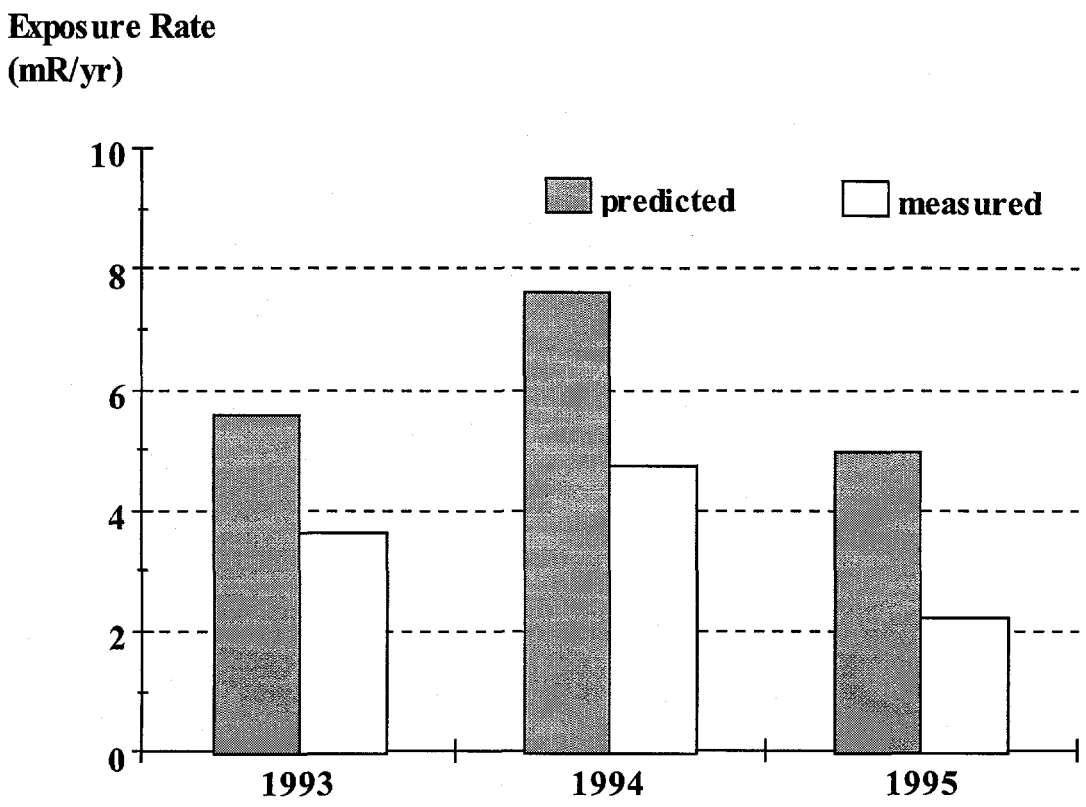


Figure 3-3. A comparison of predicted and measured radiation exposure at East Gate.

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A. Overview of Programs

1. Ambient Air Sampling Program

Natural atmospheric and fallout radioactivity levels fluctuate and affect measurements made using Los Alamos National Laboratory's (LANL or the Laboratory) air sampling program. Worldwide background airborne radioactivity is largely composed of fallout from past atmospheric nuclear weapons tests by several countries, natural radioactive constituents from the decay of thorium and uranium attached to dust particles, and materials resulting from interactions with cosmic radiation (for example, natural tritiated water vapor produced by interactions of cosmic radiation and stable water). Levels of background radioactivity in the atmosphere, which are useful in interpreting air sampling data, are summarized in Table 4-1. Note that the measurements taken in Santa Fe by the US Environmental Protection Agency (EPA) are similar to those taken by the Laboratory as regional background values and are significantly lower than EPA concentration limits for the general public.

The radiological air sampling network at the Laboratory is designed to measure environmental levels of airborne radionuclides that may be released from Laboratory operations. Laboratory emissions include microcurie (μCi) quantities of plutonium and americium, millicurie (mCi) quantities of uranium, and curie (Ci) quantities of tritium and activation products.

Particulate matter in the atmosphere is primarily caused by the resuspension of soil, which is dependent on current meteorological conditions. Windy, dry days can increase the soil resuspension, whereas precipitation (rain or snow) can wash particulate matter out of the air. Consequently, there are often large daily and seasonal fluctuations in airborne radioactivity concentrations caused by changing meteorological conditions. The measured airborne concentrations (Table 4-1) are less than the EPA concentration limit for the general public. The EPA limit represents a concentration that would result in an annual dose of 10 mrem.

2. Stack Sampling Program

Radioactive materials are an integral part of many activities at the Laboratory. Some operations involving these materials may be vented to the environment through a stack. These operations are evaluated to determine impacts on the public and the environment. If this evaluation shows that emissions from a stack may potentially result in a member of the public receiving 0.1 mrem in a year, this stack must be sampled in accordance with 40 Code of Federal Regulations (CFR) 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities" (EPA 1989). As of the end of 1995, 27 stacks were identified as meeting this criterion. An additional five sampling systems are in place to meet Department of Energy (DOE) requirements for nuclear facilities prescribed in DOE Order 6430.1a, "General Design Criteria." (DOE 1989) Where sampling is not required, emissions are estimated using engineering calculations and radionuclide inventory information.

3. Cosmic and Gamma Radiation Monitoring Program

Naturally occurring external penetrating radiation originates from terrestrial and cosmic sources. The terrestrial component results primarily from naturally occurring potassium-40, thorium, and uranium decay chains. Terrestrial radiation varies diurnally, seasonally, and geographically. External penetrating radiation levels can vary from 15% to 25% at a given location because of changes in soil moisture and snow cover (NCRP 1975). There is also spatial variation due to topographical and geological variations (ESG 1978).

Naturally occurring ionizing radiation from cosmic sources increases with elevation because of reduced atmospheric shielding. At sea level, cosmic sources yield between 25 and 30 mrem/yr. Los Alamos, with a mean elevation of about 2.2 km (1.4 mi), receives about 75 mrem/yr (unshielded) from cosmic sources. However, different locations in the region range in elevation from about 1.7 km (1.1 mi) at Española to 2.7 km (1.7 mi) at Fenton Hill, resulting in a corresponding range of 45 to 90 mrem/yr from cosmic sources. This component can

also vary ±10% because of solar modulations (NCRP 1987). These fluctuations along with those from terrestrial sources make it difficult to detect an increase in radiation levels from man-made sources, especially when the increase is small relative to the magnitude of natural fluctuations (see Appendix C for the locations of man-made sources of radiation at the Laboratory).

To evaluate natural and man-made radiation, including x-rays and gamma rays and charged-particle contributions from cosmic, terrestrial, and man-made sources, LANL's environmental monitoring program uses thermoluminescent dosimeters (TLDs) and a high-pressure ion chamber (HPIC). LANL's environmental monitoring of external penetrating radiation is made up of three TLD networks described in Section 4.B.3.a.

4. Meteorology Program

Meteorological data obtained from the meteorological monitoring network support many Laboratory activities, including emergency management and response, regulatory monitoring, safety analysis, and engineering studies. To accommodate the broad demands for weather data at the Laboratory, a wide variety of meteorological variables are measured across the network, including wind, temperature, pressure, relative humidity and dew point, and solar and terrestrial radiation. Details of the meteorological monitoring program are available through the Internet at http://weather.lanl.gov/monplan/mmp96.html and are discussed in Stone (1995).

5. Quality Assurance Program in the Air Quality Group

a. Quality Assurance Program Development. Quality assurance (QA) includes all the planned and systematic activities necessary to provide adequate confidence that a process will perform satisfactorily. The Air Quality Group (ESH-17) made significant programmatic improvements during 1995 by continuing the development of quality plans and procedures which document and formalize its operations. Six plans were developed or revised during 1995:

Quality Management Plan for the Air Quality Group (ESH-17-QMP, R0) (Dewart 1995)

QA Project Plan for Unmonitored Point Source Radioactive Air Emissions (ESH-17-UMS, R0) (Lochamy 1995)

QA Project Plan for Radioactive Particulate and Vapor Stack Emissions Monitoring (ESH-17-PARTIC, R0) (Merkey 1995a)

QA Project Plan for Tritium Stack Emissions Monitoring (ESH-17-TRIT, R0) (Merkey 1995b)

QA Project Plan for Radiological Air Sampling Network (ESH-17-AIRNET, R3) (Morgan 1995)

QA Project Plan for Thermoluminescent Dosimeter Project (ESH-17-TLDNET, R4) (Durrer 1995)

ESH-17's Quality Management Plan was written and approved during 1995. This document was written in the format described in DOE Order 5700.6C (DOE 1991a) and describes the overall group management structure, defines and describes general quality processes applicable to all projects and all group members, and defines the lower-tier project-level plans. Project plans were developed to document and describe the essential elements of each project. Because most ESH-17 projects are required by EPA for compliance with Clean Air Act regulations, the writing of these project plans followed EPA requirements and guidance. The format for the Unmonitored Point Source plan was based on the order of the required elements of a quality plan specified in 40 CFR 61, Appendix B, Method 114, Section 4.0 (EPA 1989). For the other four projects, EPA's guidance QA/R-5 (EPA Requirements For Quality Assurance Project Plans for Environmental Data Operations) (EPA 1994a) was followed. As part of the plan development process described in QA/R-5, the data quality objectives process described in EPA QA/G-4 (Guidance for the Data Quality Objectives Process) (EPA 1994b) was used to develop the necessary data accuracy, precision, and completeness objectives. The QA Project Plan for Meteorology was not modified in 1995 (Olsen 1993). ESH-17 staff also took the lead role in development of the QA Project Plan for the Los Alamos Neutron Science Center (LANSCE, formerly Los Alamos Meson Physics Facility) Radioactive Air Emissions Monitoring (Lochamy 1996).

More than 40 procedures were written, reviewed, and approved during 1995. Procedures were written as necessary to document and describe the specific steps used to accomplish essential work. Procedures describe processes such as records management, procedure writing and revision, training, deficiency documentation and

correction, sample collection, sample shipment, data handling, data entry, calculation of dose, calibration of equipment, maintenance of equipment, internal assessments, and numerous other activities.

b. Analytical Laboratory Assessments. During 1995, prompt-turnaround analytical chemistry services were supplied by the Laboratory's Health Physics Analytical Laboratory (HPAL), which is part of the Health Physics Measurements Group (ESH-4). Quarterly analytical chemistry services were provided by Analytical Technologies, Inc. (ATI) of Fort Collins, Colorado, and the Grand Junction Rust-GeoTech Project Office (GJPO) of Grand Junction, Colorado. Application of the data quality objective (DQO) process led to definition of analytical chemistry DQOs. These DQOs were summarized as purchase requirements in statements of work (SOWs) used for procurement of chemical analyses from the commercial laboratories. Before awarding the purchases, ESH-17 evaluated the lab procedures, quality plans, and interlaboratory comparison program results of these suppliers and found that they met purchase requirements. ESH-17 also performed formal on-site assessments at the ATI and HPAL laboratories during 1995. Quality control aspects of the analytical chemistry will be presented in later sections of this document.

The three analytical laboratories participated in intercomparison studies during 1995. Two federal agencies, EPA and DOE, sponsor intercomparison studies: the EPA Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, and the DOE Environmental Measurements Laboratory in New York, New York. The DOE laboratory sends spiked air filters twice a year to the participating laboratories. The EPA laboratory sends one type of spiked media from one to three times a year. The three laboratories' intercomparison program results on relevant test samples for 1995 are summarized in Table 4-2.

Both the EPA and DOE programs rate the results either "accept," "accept with warning," or "not acceptable," based on the value and the associated uncertainty. As indicated in Table 4-2, only two analytical results were rated "not acceptable" and one was rated "accept with warning;" all involved test samples analyzed by ATI in June. ATI performed acceptably on the test samples submitted in December and obtained consistent results on blanks and spikes throughout the year (see later sections on laboratory quality control); therefore, ESH-17 believed no corrective action was warranted.

B. Description of Programs and Monitoring Results

1. Ambient Air Sampling

a. Air Monitoring Network. During 1995, ambient air sampling for airborne radioactivity was conducted at more than 50 locations, with 6 stations added and 4 stations discontinued in 1995. Stations are categorized as regional, perimeter, or on site. Three regional monitoring stations, 28 to 44 km (18 to 28 mi) from the Laboratory, are located in Española, Pojoaque, and Santa Fe. The data from these stations are used as reference points for determining regional background and fallout levels of atmospheric radioactivity. There are now more than 20 perimeter stations located within 4 km (2.5 mi) of the Laboratory boundary.

Over 30 stations are within the Laboratory boundary. For quality assurance purposes, two samplers are co-located as duplicate samplers, one at Station #27 at Technical Area (TA) 54 and one at Station #26 at TA-49. In addition to the three categories mentioned previously, stations can also be classified as being inside or outside a controlled area. A controlled area is where radioactive materials or elevated radiation fields may be present and are clearly posted as such (DOE 1988). The active waste site TA-54 Area G is an example of a controlled area.

History of Changes in Sampling Stations. In addition to Station #27, four site-specific stations were located at the active radioactive waste disposal site at TA-54, Area G in October 1984. In August 1992, five stations for sampling iodine-131 in air were added to the air monitoring network, with an additional station being added in January 1993. These iodine-131 stations were co-located with other stations, but were discontinued in 1995. In October 1992, five new stations were established at TA-21 to monitor potential emissions resulting from the demolition and removal of a decommissioned nuclear facility, which is part of the DOE's Environmental Restoration (ER) Project. In May 1993, five additional stations were established at TA-54, Area G to monitor potential emissions from the waste remediation project known as the Transuranic Waste Inspectable Storage Project (TWISP). Also during 1993, the Laboratory installed stations at the northern New Mexico Pueblos of Jemez, San Ildefonso, and Taos at the request of the respective tribal governments. In 1994, three stations were installed to monitor potential emissions from the pulsed high-energy radiographic machine emitting x-rays (PHERMEX) and R-306 firing sites. The station located on the roof of the TA-59, Occupational Health Laboratory

was discontinued in 1994, and at the request of residents the Pajarito Acres subdivision, Station #14 (Pajarito Acres) was discontinued in 1994. Station #1 (Española) was moved to an alternate location in Española during 1994 because of a change in property ownership.

In 1995, Stations #29 (TA-2 Omega), #33 (Area AB), #44 (Area G, South Perimeter), and #46 (Area G, East Perimeter) were discontinued. Station #14 was relocated to another location in Pajarito Acres and restarted in 1995. The four new perimeter stations added in 1995 were #60 (LA Canyon), #61 (Los Alamos Hospital), #62 (Trinity Bible Church), and #63 (WR Monte Rey South). Two new stations were also added at TA-54, Area G.

b. Sampling Procedures, Data Management, and Quality Assurance

Sampling Procedures. The Laboratory operates a network of more than 50 environmental air stations (called AIRNET) to sample radionuclides in ambient air (Figure 4-1). Each sampler is equipped with a filter to collect a particulate matter sample (for gross alpha/beta and radiochemical determinations) and a silica gel cartridge to collect a water sample (for tritium determination). A pump pulls ambient air into the housing that protects the sampling apparatus and through the filter and cartridge. Instrumentation within the housing records the total time the pump ran during the two-week sample period and the flow in the particle and the tritium sampling trains. During a two-week period, the filter will collect particulate material from approximately 2,280 m^3 of air, and the silica gel cartridge will collect the moisture from approximately 4 m^3 of air. The particulate filter and the gel cartridge are collected and are generally analyzed biweekly. The particulate filters are accumulated for three months, composited, split, and then sent to commercial analytical laboratories for radiochemical analyses. Details about the sample collection, sample management, chemical analysis, and data management activities are provided in the project plan (Morgan 1995) and in the numerous procedures through which the plan is implemented. Descriptions of activities in 1995 are summarized in the following sections.

Data Management. The 1995 field data including timer readings, readings for the flow in the sampling trains at the start and stop of the sampling period, and comments pertaining to these data were recorded by hand on field sheets. These data were later transferred to spreadsheets in electronic format. Similarly, data from weighing silica gel cartridges and distilling the tritium were hand recorded and then transferred to spreadsheets. All the data were then compiled in a Microsoft Access database. At the end of 1995, an automated field data recording method was developed to eliminate the need for transcribing field data, to reduce errors in field data, and to streamline the quality assurance process. This system replaced the hand recording for field data collected in 1996 but was not ready for deployment in 1995. In 1995, all field and analytical data from previous years were transferred to tables in the Microsoft Access database. As 1995 data were received from the analytical laboratories, the data were transferred to the database. These field and chemistry data tables are relationally linked to allow reporting.

Analytical Chemistry. For 1995, ESH-17 embarked on a program to improve the quality of data packaging and the timeliness of the reporting of chemical analyses. The decision was made to subcontract the analyses to new internal and external laboratory vendors. The vendors were chosen based on prior assessments of their capabilities.

The 1995 particulate filters were analyzed biweekly by the ESH-4 HPAL, using analytical procedures that meet the requirements of 40 CFR 61, Appendix B, Method 114. Gross alpha, beta, and tritium measurements were generally performed biweekly. A composite was prepared quarterly for each station by combining the filters from the six or seven sampling periods during the quarter. The composites (one for each station) were split, and the first half submitted to commercial laboratories for analysis. During 1995, analyses were performed at ATI of Fort Collins, CO or at GJPO of Grand Junction, CO. The second half of each composite was temporarily retained for reanalysis, if needed. Because of apparent sample contamination, reanalyses were required for 2 first-quarter and 12 second-quarter samples. At these laboratories, chemical analyses consisted of complex radiochemical separations followed by instrument determinations which conformed to EPA requirements.

Every two weeks, ESH-17 staff distilled the moisture from the silica gel cartridges and submitted the distillate to the ESH-4 HPAL for tritium determination by liquid scintillation spectrometry. Summary data for the biweekly and quarterly analyses are provided in Table 4-3.

Minimum detectable amounts (MDAs) for upcoming 1996 analyses were established early in 1995 by application of the DQO process. These MDAs were defined, in a manner consistent with EPA guidelines, as functions of the standard deviations (sigma) of background count rates for radioisotopes. These 1996 MDA targets were considered advisory for 1995 samples. As experience was gained during 1995, laboratories increased count times where necessary to meet these MDAs. The tritium results in Table 4-4 provide an example. In the first half

of the year, the MDA was 1.0 pCi/L; in the second half of the year, the MDA improved to 0.6 pCi/L as a result of increasing count time. Target MDAs (as three sigma values) may be found in Table 4-3.

Laboratory Quality Control Samples. For 1995, ESH-17 maintained a program of blank, spike, duplicate, and replicate analyses, which was designed to provide information on the quality of the data received from analytical chemistry suppliers. Overall, the chemistry program was sufficiently in control and capable of providing results suitable for use in the air quality programs.

Analyses of blank samples (i.e., with no added radioisotopes) were used to assess the ability of the laboratories to detect very low levels of radionuclides. Blank samples were of three types: reagent, filter, and field blanks. Each commercial laboratory maintained a program of reagent blanks (chemicals used in the analytical process) alongside the ESH-17 radiochemical analyses. At the request of ESH-17, each laboratory also maintained a program of filter blank analyses (filters never in the field, plus the chemicals used in the analytical process), using filter material supplied by ESH-17. In addition, ESH-17 maintained a program of field blank samples (unused filters which were submitted for analysis as blind samples) during 1995. Two field blank samples were submitted with each biweekly batch. These field blanks were also composited and analyzed as blind samples with the quarterly radioisotopic analyses. Concentrations for blank samples were expected to be near the detection limits. Conversely, MDAs reported for these blanks were expected to conform to the target detection limits referenced above. For tritium, average blank values for the second half of 1995 met 1996 DQOs. For most other categories of blanks (representing more than 90% of all spikes), blank results for all of 1995 were consistently near 1996 DQOs. More detailed average values and actual MDA performance are listed in Table 4-4.

Analyses of spiked samples (i.e., samples with deliberately added radioisotopes) were used to assess the ability of the laboratories to accurately quantify radionuclides. For 1995, each commercial laboratory maintained a program of reagent spikes. At the request of ESH-17, each commercial lab also maintained a program of filter spikes, using filter material supplied by ESH-17. In all, a total of more than 175 analyses of spikes were performed in 1995. For most categories (representing more than 90% of the spikes analyzed), spike recoveries were consistently very near 100% of the actual, which meets or exceeds DQOs. An exception proved to be low (50%) spike recovery of relatively small amounts (approximately 0.75 pCi) of uranium-235 in the presence of relatively large amounts (approximately 20 pCi total) of both uranium-234 and uranium-238. This difficult situation is not applicable to, and is not believed to represent a quality control problem for, real samples. More detailed values can be found in Table 4-5.

During 1995, ESH-17 maintained a program of analyses of duplicate field samples (i.e., samples collected from a second sampling station co-located at a site). There were two such dual sites. These were used to assess the overall ability of the ESH-17 pumps and filters and laboratory analysis systems to provide precise results for real samples. A control chart was set up in mid-1995 to track replication of the biweekly analyses (alpha, beta, and tritium) for the paired stations. Only a single tritium data pair exceeded three sigma and required review. The cause could not be determined. It is important to note that the level of tritium was well below any real level of concern. See Section 4.B.1.c for more detail. For gross alpha and gross beta duplicates, all 1995 data were well within control limits. Duplicate analyses which were within control limits represented more than 90% of the biweekly duplicate data sets.

In most programs which it regulates, EPA recommends duplicate analyses of 5% of the sample load as a DQO. For radiochemical analyses of air filters, only later (i.e., replicate) analyses of the retained portions of filters can be done because the air filters are small, and, with the very low detection limit requirements, the laboratory uses the entire sample and cannot take duplicate portions at the time of analysis. During 1995, ESH-17 required replicate radiochemical analyses of the retained portion of 14 samples for plutonium and americium. For these analytes, this portion was slightly greater than 5% of the annual sample load. To further test the overall system, these replicates were scheduled for analysis at a laboratory different from the laboratory providing the first analyses. Four fresh blanks were also scheduled for analyses. The 14 samples chosen for the replicate analyses were first and second quarter 1995 samples for which contamination was suspected, based on comparisons of the first analyses with historical values. Replicate analyses were completed in January 1996. All laboratory quality controls (blanks and spikes) were in the control range during both the original and the replicate analyses. The blanks which accompanied both the original and the replicate samples all gave appropriate results. The replicate results for analyses of the 14 samples were mixed. For only 4 of the 14 replicate samples results were the same (i.e., 85% to 145% of the first results). However, for 10 of the 14 samples, results were lower (i.e., 15% to 35% of the first results). When results for blanks, spikes, samples, and replicates were considered in total, these results indicated

the probability that contamination occurred in the processes up to and including the first shipment for analysis. Other results for first and second quarter must therefore also be considered suspect.

c. Radiochemical Analytical Results

Gross Alpha and Beta Radioactivity. Gross alpha and beta analyses are used primarily to evaluate general radiological air quality and to identify potential trends in the data. The total gross alpha or beta concentration found on a filter defines the upper limit of alpha or beta activity for any single radionuclide. If gross activity in a sample is consistent with past observations and background, immediate special analyses for specific radionuclides are not necessary. If the gross analytical results appear to be elevated, then immediate analyses for specific radionuclides may be performed to confirm or deny a problem, such as an unplanned release. Gross alpha and beta activity in air exhibit considerable environmental, especially seasonal, variability, as shown in Figures 4-2 and 4-3. The National Council on Radiation Protection and Measurements (NCRP) estimated the average concentration of long-lived gross alpha activity in air to be 2.0 fCi/m^3. The primary alpha activity is due to polonium-210 (a decay product of radon gas) and other naturally occurring radionuclides (NCRP 1987). The NCRP also estimated average concentration levels of long-lived gross beta activity in air to be 20.0 fCi/m^3. This activity is primarily due to the presence of lead-210 and bismuth-210 (decay products of radon) and other naturally occurring radionuclides.

There were more than 1,000 air samples collected in 1995 and analyzed for gross alpha and gross beta activity. As shown in Table 4-6, all of the stations were within two standard deviations of the NCRP's estimated average (2 fCi/m^3) for gross alpha concentrations with one exception. The annual means of Station #52 at TA-54, Area G shows an annual mean below 2.0 fCi/m^3 for gross beta concentrations. The lowest group mean annual concentrations occurred at the regional stations and the pueblo stations. These groups show averages slightly below the NCRP estimated average. Gross alpha activity is almost entirely from the decay of natural radionuclides, primarily radon, and is dependent on variations in natural conditions such as atmospheric pressure, temperature, and soil moisture. The differences among the groups are most likely attributable to these factors.

Table 4-7 shows gross beta concentrations within and around the Laboratory. These data show variability similar to the gross alpha. All group averages are below 20 fCi/m^3, the NCRP estimated national average for gross beta concentrations.

Comment on Data Significance for All AIRNET Data. Individual data values (concentrations) are generally above zero but are equal to or less than the uncertainty in the analytical process. However, calculating the annual concentration for a monitoring site or group of sites usually results in an estimated number that is still close to, but greater than, zero.

Tritium. Tritium is released by the Laboratory in curie amounts. In addition, tritium is present in the environment as the result of nuclear weapons tests and is also produced naturally by the cosmogenic process (Kathern 1984). Sampling results are presented in Table 4-8. Eleven of the off-site mean annual concentrations were above the upper limit background (ULB), which is calculated as the mean of the regional samplers plus two standard deviations) value of 1.8 pCi/m^3. The maximum off-site mean annual concentration of 8.0 pCi/m^3 was recorded at Station #9, Los Alamos Airport. The calculated gross tritium dose (no background subtraction) based on local mean air concentration at Station #9 was 0.53% of the EPA's public dose limit (PDL) of 10 mrem per year. Elevated concentrations were observed at a number of on-site stations, with the highest maximum concentrations at Stations #25, #35, and #36 and the highest annual mean concentration at Station #35. Stations #35 and #36 are located at Area G in the TA-54 waste site near shafts where tritium-contaminated waste is disposed, and Station #25 is located among tritium facilities. However, the maximum annual mean gross (no background subtraction) concentration, which was observed at Station #35, is approximately 0.0019% of the DOE Derived Air Concentration (DAC) for controlled areas (20×10^6 pCi/m^3). All annual mean concentrations were well below the applicable EPA and DOE guidelines.

Plutonium. Plutonium is released by the Laboratory in microcurie amounts. In addition, plutonium is present in the environment because of fallout from past nuclear weapons testing and, in some isolated cases, from natural sources (Kathern 1984).

Sampling results for plutonium-238 are presented in Table 4-9. The table shows that the highest group summary mean was for the category Off-Site Regional Stations (28-44 km). These stations provide regional, baseline concentration levels, and are presumably unaffected by Laboratory emissions because of their location. Assuming there were some contribution from Laboratory emissions to the local/regional radiation environment, we would

expect the regional group mean to be among the lowest of the group concentrations. The high regional group mean is caused largely by a high value for the second quarter for the Española station, although the Santa Fe mean also appears to be somewhat elevated. As discussed further below, we believe that the second-quarter Española sample was contaminated after it was taken from the air station and that the high values are the result of that contamination. The remaining discussion of plutonium-238; plutonium-239,240; and americium-241 disregards the second-quarter Española values, because including those values would bias the results in a nonconservative manner. Using an erroneously high regional number to compare with other monitoring stations would give the impression that ambient air concentrations near the Laboratory and, presumably, Laboratory emissions were less than they actually were.

The annual mean concentration is 12.3 ± 29.1 aCi/m^3 of plutonium-238. This annual mean concentration of 12.3 aCi/m^3 corresponds to approximately 0.59% of the EPA's public dose limit, or about 0.059 mrem. After eliminating the questionable second-quarter plutonium-238 results for Española, the corrected plutonium-238 regional group mean and two standard deviations is 4.3 ± 7.2 aCi/m^3. None of the on- or off-site annual means were above the ULB value of 11.5 aCi/m^3 in 1995.

Sampling results for plutonium-239,240 are presented in Table 4-10. The annual mean concentration is 107.3 ± 343.6 aCi/m^3 of plutonium-239,240. This annual mean concentration of 107.3 aCi/m^3 corresponds to approximately 5.6% of the EPA's public dose limit, or about 0.6 mrem. After eliminating the questionable second-quarter results for Española (second-quarter results are included in the table but not in the calculated values below), the corrected plutonium-239,240 group mean and two standard deviations is 7.5 ± 18.8 aCi/m^3. None of the mean annual concentrations for the off-site stations was above the ULB of 26.3 aCi/m^3. The calculated plutonium-239,240 dose (gross dose, no background subtraction) based on local mean air concentration at Station #13, the highest off-site station, was 1.2 % of the EPA's public dose limit (PDL) of 10 mrem per year. The maximum on-site station mean (108 aCi/m^3) was recorded at Station #27, TA-54, Area G. The gross mean concentration observed at Station #27 was approximately 0.0005% of the DOE DAC guide for controlled areas (2 × 10^6 aCi/m^3). All annual mean concentrations were below the applicable EPA and DOE guidelines.

Americium. Because americium often occurs along with plutonium, a subset of plutonium samples is submitted for americium analysis. Results are presented in Table 4-11. The mean annual concentration is 46.4 ± 139.8 aCi/m^3 for americium-241. This annual mean concentration of 46.4 aCi/m^3 corresponds to approximately 2.4% of the EPA's public dose limit, or about 0.2 mrem. Three on-site stations had annual mean concentration levels above the ULB value of 11.6 aCi/m^3 (5.7 ± 5.9 aCi/m^3 after removal of second-quarter Española values from the regional group summary). The highest on-site concentration (82.6 aCi/m^3) occurred at Station #27 at TA-54, Area G. The highest off-site concentration (11.4 aCi/m^3) occurred at Station #13, Piñon School. The gross (not corrected for background) americium-241 dose at Station #13 was 0.6% of the EPA's PDL of 10 mrem/year. All annual mean concentrations were well below the applicable EPA and DOE guidelines.

Discussion of Validity of Second-Quarter Plutonium and Americium Results for Española. As mentioned above, the second-quarter values for the Española station appear to be anomolously high, by two to three orders of magnitude. One possibility is that the reported values are correct and indicate an elevated concentration of plutonium-238; plutonium-239,240; and americium-241 in the Española area. The other possibility is that the values are incorrect and should not be used. Comparing plutonium-239 activity at the Española station for 1991-1995 (Figure 4-4) indicates that a concentration of this magnitude is unprecedented. In fact, the plutonium-239 filter activity for all other years cannot be distinguished from zero in the figure, whereas the second-quarter value is nearly 16 pCi.

The Laboratory has a number of operations with potential sources for airborne plutonium and americium. Most of the sources are within facilities that have monitored stacks. Emissions records for 1995 do not show an increase in emissions that could account for the magnitude of the elevated Española results. The Laboratory also has several diffuse emissions sources that are evaluated by on-site and perimeter AIRNET stations. The AIRNET results from on-site and perimeter stations also do not show any significantly increased plutonium or americium air concentrations during the second-quarter. Figure 4-5 compares the Española results with those of Santa Fe and Station #27 at Area G. Station #27 was chosen for comparison because it has the highest annual mean concentration (by almost two orders of magnitude) of any Area G station. Station #27 normally has higher radioactive particulate concentrations than other Area G stations or other on-site stations. If there had been a very large release from Area G, the Area G monitoring stations, along with other stations in AIRNET, would have shown significantly increased concentrations.

Partially to provide short-term indication of a problem or unexpected emissions, AIRNET samples are analyzed for gross alpha activity on a biweekly basis. A very large plutonium release should show up as increased gross alpha activity. Figure 4-2 shows the gross alpha activity at Española, Santa Fe, and East Gate during 1995. The Española values are consistent with the other two stations and show no increase during the second quarter. This is further indication that there were not elevated radioactive particulate concentrations in Española during 1995.

In addition to the discussion above, which argues against elevated plutonium-238 air concentrations near Española, we have reason to suspect the analytical data during the second quarter (see Section 4.B.1.b). We believe that contamination of the Española sample after it left the air monitoring station caused the anomalous values.

Uranium. Uranium is released from the Laboratory in microcurie amounts and occurs naturally in rocks and soil (please refer to a general discussion regarding uranium in the environment in a previous annual report [EARE 1995a]). Tables 4-12 through 4-14, present radioisotopic results for uranium-234, uranium-235, and uranium-238 respectively. None of the annual mean concentrations for the off-site or on-site samples for uranium-234 were greater than the ULB value of 56.1 aCi/m^3. The maximum off-site concentration was recorded at Station #61; Los Alamos Hospital. The gross (not corrected for background) uranium-234 dose at Station #61 was 0.22% of the EPA's PDL.

Of the off-site stations, Barranca School (Station #4) exceeded the ULB value of 2.5 aCi/m^3 for uranium-235. This maximum off-site value was 3.4 ± 3.2 aCi/m^3. The gross, uncorrected for background, dose was 0.048% of the EPA's PDL.

None of the annual mean concentrations for the off-site stations for uranium-238 were above the ULB value of 55.7 aCi/m^3. The only station exceeding the ULB was Station #77, IJ Site, with a reported concentration of 120.7 ± 279.2 aCi/m^3. This and all other annual mean concentrations were well below the applicable EPA and DOE guidelines.

Total uranium concentrations, in terms of mass, can be calculated using the conversion factors provided in Table 4-15 for comparison with uranium data from previous environmental surveillance reports.

In addition to releases of uranium from some Laboratory facilities, depleted uranium (consisting primarily of uranium-238) is dispersed by experiments that use conventional high explosives. About 144 kg of depleted uranium containing about 0.0535 Ci of radioactivity was used in such experiments in 1995 (Table 4-16). Most of the debris from these experiments was deposited on the ground in the vicinity of the firing sites. Limited experimental data show that no more than about 10% of the uranium becomes airborne in a high-explosive test (Dahl 1977). Dispersion calculations indicate that the resultant maximum airborne concentrations would be greater than concentrations attributable to the natural abundance of uranium that is resuspended in dust particles; however, the predicted values were not detected at on-site stations or off-site stations. The actual amount released is likely to be smaller than the values given in Table 4-16. Air sampling conducted near the active firing sites supports this conclusion.

Iodine. With the shutdown of the Omega West research reactor in December 1992, the potential for radioiodine emissions from LANL was essentially eliminated. As previously noted, the Laboratory discontinued sampling for radioiodine. Therefore, no results are reported here for 1995.

d. Investigation of Elevated Air Concentration. In 1995, a number of air sampling values exceeded investigation levels established by ESH-17. A discussion of how investigation levels are determined can be found in the Environmental Monitoring Plan (EARE 1995b). When an measured air concentration exceeds an investigation level, the following steps are taken:

determine if the result exceeds its three sigma value,

resubmit the sample for analysis,

review field data for errors and interview field personnel, and

investigate the possible causes such as operational activities, unplanned releases, etc.

Elevated tritium results observed at the TA-16-450 sampler are believed to be related to increased tritium activities (stack and nonstack emissions) by the Weapons Engineering Tritium Facility at TA-16, which became fully operational during 1995. Stack effluents from TA-16 totaled 89 Ci, with 85% as tritium oxide. Diffuse

emissions were estimated using the air sampler data at 35 Ci of tritium oxide. The maximum off-site dose that could have occurred to a member of the public from the release of these effluents was calculated to be 0.01 mrem.

Tritium concentration values exceeding an investigation level were also observed at the following stations: Los Alamos Airport (#9), TA-21-DP Site (#19), and TA-21-03 (#73). These concentrations could be attributed to increased tritium operations in the TA-21 area. In 1995, about 410 Ci of tritium oxide was released from TA-21 (compared to about 170 Ci in 1994). In addition, tritium values exceeding the investigation level were observed at the Pueblo of San Ildefonso (#41) and TA-15-NNE, or IJ-Site (#77). These values could not be reconciled with any specific facility or activity at LANL.

Concentrations of transuranic radionuclides exceeding the investigation level(s) have been observed at TA-21 (Stations #19 and #71 through #75) in the past and have been attributed to operations occurring at that site (see also Section 4.D.7). Elevated concentrations of isotopes of uranium observed at Station #77 are attributed to open air explosive testing at TA-15-PHERMEX. The amount of uranium released to the air by such tests is provided in Table 4-16.

More than 85% of the americium-241 results obtained in 1995 exceeded the investigation level previously established in the Environmental Monitoring Plan. This is most likely an indication of an improvement in analysis sensitivity over previous years. A new radiochemical-analytical lab (located off site) was employed beginning with AIRNET samples collected in 1995. When the appropriate background value for americium-241 was subtracted from the air-concentration values, results were more consistent with what has been observed for americium-241 results in the past, and not due to any Laboratory release.

Although it could not be proved conclusively, the remaining elevated particulate sample readings were thought to be from contamination of the samples after they were collected but before they were shipped off site. Although these concentrations may not represent actual air concentrations that had occurred, LANL is publishing these results. Some of the elevated results included samples from stations normally used to calculate air concentrations for background subtraction; for the purposes of estimating doses resulting from airborne radionuclides, those stations with the lowest concentration of airborne radioactivity (naturally occurring and fallout sources) were used to represent the background concentration (see Table 4-1). For further discussion of anomalous results at regional stations, see Sections 4.B.1.b and 4.B.1.c above.

e. Long-Term Trends. Air samples collected from perimeter stations (0 to 4 km from LANL) and analyzed for tritium during 1971 through 1995 were subjected to a Mann-Kendal nonparametric test for trends. Air concentrations of tritium showed a significantly decreasing ($p < 0.01$) trend over time for perimeter air samples (Figure 4-6). Also shown Figure 4-6 is a linear regression analysis of the data; however, since the correlation coefficient is low (that is, $r^2 = 34\%$), it is not appropriate to presume a linear decrease as presented. A number of factors must be considered. There have been some 36 atmospheric tests (France and China) conducted between 1970 and 1980 (Shapiro 1990). In contrast, the global inventory of tritium has been decreasing since the end of large-scale atmospheric nuclear weapons testing, which reached a peak in 1962 (Kathern 1984). Since tritium has a physical half-life of 12.3 years, it decays at the rate of 5.5% a year. Another regression analysis was performed, applying the decay curve for tritium, and demonstrated at least partially that the decreasing trend could be attributed to physical decay.

Also presented for comparison are the annual stack releases of tritium from the Laboratory for the same time period (Figure 4-7). There is a weak correlation (27%) between perimeter concentrations of tritium in air with past stack releases. Many factors need to be considered in correlating the data, such as tritium releases at individual facilities, tritium concentration at individual samplers, and the chemical form of tritium released.

Although there is no clear indication as to the cause of this decreasing trend, it is obvious that current tritium in air concentrations are 10 times lower than those observed in the 70's and early 80's. Factors contributing to the reduction in tritium concentration in air over time are likely to include physical decay, the cessation of atmospheric testing, weathering, and a reduction in LANL emissions to the environment. A more in-depth trend analysis of tritium and other radionuclides sampled by the AIRNET system will be provided in future reports.

f. Dose Equivalents to Individuals from Inhalation of Airborne Emissions. The maximum individual effective dose equivalents (EDEs) attributable from exposure to airborne emissions were below the EPA air pathway standard of 10 mrem/yr. Emissions of air activation products from LANSCE resulted in negligible inhalation exposures, with the majority of the dose resulting from external penetrating radiation, as measured by an HPIC located at East Gate (Figure 3-2).

Inhalation dose resulting from exposure to airborne tritium (as tritiated water vapor); plutonium-238; plutonium-239,240; americium-241; uranium-234; uranium-235; and uranium-238 was determined from samples collected by the AIRNET program. The background concentration values of these radionuclides, which includes natural radioactivity and worldwide fallout, were measured at selected locations and subtracted from the annual average concentrations values given in Tables 4-8 and 4-14 to determine net dose from LANL airborne effluents. The net dose measured by AIRNET in the townsites of Los Alamos and White Rock were 0.05 mrem and 0.06 mrem, respectively.

Airborne emissions were calculated for the active low-level waste disposal area (TA-54, Area G). The total EDE to a member of the public from Area G airborne emissions during 1995 was estimated to be 0.002 mrem, or about 5,000 times less than the applicable standard. For explosive tests containing depleted uranium conducted in 1995, the maximum potential dose to a member of the public from these operations was 0.04 mrem. For tritium released as liquid effluent to holding lagoons at LANSCE and to an outfall in Mortandad Canyon, the maximum potential dose from these emissions was estimated to be 0.006 mrem. Airborne emissions and subsequent dose for decontamination and decommissioning (D&D) activities at TA-21 are given in Section 4.D.7.

2. Stack Air Sampling for Radionuclides

a. Sampling Methodology. During 1995, LANL continuously sampled approximately 75 stacks for the emission of radioactive material to the ambient air. LANL has identified four types of radioactive stack emissions: (1) particulate matter, (2) vaporous activation products (VAP), (3) tritium, and (4) gaseous/mixed air activation products (G/MAP). For each of these emission types, the Laboratory employs an appropriate sampling method, as described below.

Emissions of radioactive particulate matter, generated by operations at the Chemistry and Metallurgy Research Building (CMR), TA-55, and other facilities around the Laboratory, are sampled using a glass-fiber filter. A continuous sample of stack air is pulled through the filter, where small particles of radioactive material are captured. These samples are analyzed using gross alpha/beta counting and/or gamma spectroscopy. Radiochemical methods are employed for the determination of radionuclides that cannot be identified using gamma spectroscopy.

VAP emissions, generated by LANSCE operations and by hot cell activities at CMR and TA-48, are sampled using a charcoal filter or canister. A continuous sample of stack air is pulled through a charcoal filter where vaporous emissions of radionuclides are adsorbed. The amount and identity of the radionuclide(s) present on the filter are determined through the use of gamma spectroscopy.

Tritium emissions from the Laboratory's tritium facilities are measured using a collection device known as a bubbler. This device enables the Laboratory to determine not only the total amount of tritium released but also whether it is in the elemental (HT) or oxide (HTO) form. The bubbler operates by pulling a continuous sample of air from the stack, which is then "bubbled" through three sequential vials containing ethylene glycol. The ethylene glycol, with its high affinity for water, collects the water vapor from the sample of air, including any tritium that may be part of a water molecule (HTO). After "bubbling" through these three vials, essentially all HTO is removed from the air, leaving only elemental tritium. The sample, containing the elemental tritium, is then passed through a palladium catalyst which converts the elemental tritium to HTO. The sample is then pulled through three additional vials containing ethylene glycol, which collects the newly formed HTO. The amount of HTO and HT is determined by analyzing the ethylene glycol for the presence of tritium using liquid scintillation counting (LSC).

Tritium emissions from LANSCE are determined using a silica gel sampler. A sample of stack air is pulled through a cartridge containing silica gel. The silica gel collects the water vapor from the air, including any HTO. The water is distilled from the sample, and the amount of HTO is determined by analyzing the water using LSC. Since the primary source for tritium is activated water, sampling for only HTO is appropriate.

G/MAP emissions, resulting from activities at LANSCE, are measured using real-time monitoring data. A sample of stack air is pulled through an ionization chamber which measures the total amount of radioactivity in the sample. Specific radioisotopes are identified through the use of gamma spectroscopy and decay curves.

b. Sampling Procedures, Analysis, and Quality Assurance

Sampling and Analysis. Analytical methods, which were chosen for compliance with EPA requirements (40 CFR 61, Appendix B, [EPA 19] Method 114), are summarized in Table 4-17. These requirements were derived during 1995, as part of the development of quality assurance project plans for tritium, particulate, and vapor sampling. Analytical methods for G/MAP are described below.

Particulate Matter Emissions. Glass-fiber filters, used to sample facilities with significant radioactive particulate emissions, were removed and replaced once a week and transported to the HPAL. Before screening the samples for the presence of alpha and beta activity, the HPAL allowed approximately 72 hours for the short-lived progeny of radon to decay. These initial screening analyses were used to ensure that potential emissions were within normal values. Final analyses were performed after the sample had been allowed to decay for approximately one week. After completion of alpha and beta analyses, the HPAL, using gamma spectroscopy, identified gamma-emitting isotopes in the samples by determining the energy of the gamma photon(s) emitted during radioactive decay. Since the energy of decay is specific to a given radioactive isotope, the HPAL could determine the identity of any isotopes detected by the gamma spectroscopy. The amount, or activity, of an isotope could then be found by noting the number of photons detected during analysis. Glass-fiber filters from LANSCE were analyzed using only gamma spectroscopy.

Since gross alpha/beta counting cannot identify specific radionuclides, the glass-fiber filters were periodically composited for radiochemical analysis at a commercial laboratory. This program was added in 1995. During 1995, samples were analyzed by ATI of Fort Collins, CO. The composites were analyzed for the presence of radioisotopes, such as plutonium-238, plutonium-239, uranium-234, uranium-235, uranium-238, americium-241, strontium-90, and lead-210. ESH-17 used these results to identify the source of the activity found during the initial gross alpha/beta counting. The composite solutions were also analyzed for gross alpha and beta to account for any changes in concentrations of the natural radon decay products since the initial count, which was performed as much as several months earlier.

VAP Emissions. Charcoal canisters, used to sample facilities with the potential for significant VAP emissions, were generally removed and replaced weekly. These samples were transported to the HPAL where gamma spectroscopy, as described above, was used to identify and quantify the presence of vaporous radioactive isotopes.

Tritium Emissions. Tritium bubbler samples, used to sample facilities with the potential for significant gaseous and oxide form tritium emissions, were generally collected and transported to the HPAL on a weekly basis. The HPAL added an aliquot of each sample to the appropriate amount of liquid scintillation cocktail and determined the amount of tritium in each vial by LSC.

Silica gel samples were used to sample facilities with the potential for significant tritium emissions in the vapor form only. These samples were transported to the Inorganic Trace Analysis Group (CST-9), where the water was distilled from the silica gel, and the amount of tritium in the sample was determined using LSC.

G/MAP Emissions. Continuous monitoring was used to record and report G/MAP emissions for two reasons. First, the nature of the emissions is such that standard filter paper and charcoal filters will not collect the radionuclides of interest. Second, the half-lives of these radionuclides are so short that the activity would decay away before any sample could be analyzed off line. The G/MAP monitoring system includes a flow-through ionization chamber in series with a gamma spectroscopy system. Total G/MAP emissions were measured with the ionization chamber. The real-time current measured by this ionization chamber was recorded on a strip chart, and the total amount of charge collected in the chamber over the entire beam operating cycle was integrated on a daily basis. The composition of these G/MAP emissions was analyzed with the gamma spectroscopy system. Using decay curves and energy spectra to identify the various radionuclides, LANSCE personnel determined the relative composition of the emissions. Decay curves were typically taken one to three times per week based on accelerator operational parameters. When major ventilation configuration changes were made at LANSCE, new decay curves and energy spectra were recorded.

Data Management. Analysis results were reported to ESH-17 and to the appropriate operating groups when necessary. Upon receipt of these data, ESH-17 calculated non-LANSCE emissions. LANSCE personnel calculated the emissions values for the sampled TA-53 stacks. These emissions values were forwarded to the ESH-17 for review and reporting.

Radioactive air emissions data for sampled LANL stacks were maintained by ESH-17 in the Radioactive Air Emissions (RAEM) database. During 1995, a new relational database (using Microsoft Access) was initiated for these data. ESH-17 used these data to perform dose assessments, emissions evaluations, and compliance assessments. These data also served as the official source for emissions values for Laboratory stacks.

Laboratory Quality Control Performance. Groups of discrete samples were submitted to a commercial laboratory for radiochemical analyses. For these analyses, the laboratory maintained a program of blanks and spikes consistent with EPA guidelines (EPA 1991). These EPA guidelines call for a frequency of 1 blank and 1

duplicate for every 20 samples. For the instrumental gross alpha/beta and tritium analyses for the stack program, the HPAL maintained a program of blanks and duplicates analyses that was more frequent than EPA guidelines. The distinctions are discussed below.

For tritium bubblers, a blank vial of the ethylene glycol was submitted with each bubbler sample set, at a frequency of 1 blank vial per 6 sample vials. This high (1 to 6) rate of blank samples exceeded general EPA guidelines (1 to 20). All tritium samples and blanks were analyzed in duplicate, and results were averaged for final reporting. This high (100%) rate of duplicates greatly exceeded general EPA guidelines (5%).

For gross alpha and beta analyses, the ESH-4 HPAL maintained a supply of new filters to count as blanks. Sample results were reported as a function of the count rate above the count rate for a blank. Since 10 blanks were counted for a batch of approximately 40 samples, the high blank frequency of 1 to 4 greatly exceeded general EPA guidelines.

For on-line LANSCE gamma analyses, the dual instrument system described above (gamma spectrometer and ion chamber), calibrated with National Institute of Standards and Technology (NIST) traceable standards, provided two different sources of independent, accurate data for emissions during operations. This dual instrument system is analogous to 100% duplicate analysis rate.

Radiochemical analyses of composited samples were initiated in 1995 for the stack program. These samples were submitted in batches, and quality control samples typical of commercial environmental labs were run alongside the ESH-17 samples. For the 1995 samples, three types of blanks were analyzed: reagent blanks, filter blanks, and field blanks. Two types of spikes were analyzed: reagent spikes and filter spikes. The types and frequencies of analyses are summarized in Table 4-18 and Table 4-19.

Analyses of composited fiberglass filters proved to be technically challenging. The results for analyses of blank samples are indicative of the problems that were encountered. The need for multiple analytes limited the portion of the sample mass that could be analyzed for each. This requirement placed limits on the detection limits for all analytes. The large amount of dissolved fiberglass-derived solids placed additional limits on the MDA. Presence in the fiberglass of either traces of the analytes themselves, or of inseparable traces of interfering analytes, placed similarly severe limits on MDAs for the individual radioisotopes. Despite these limitations, data quality objectives for low blank levels and for low MDAs were met for most of the analytes tabulated.

Analyses of spiked samples (i.e., samples with deliberately added radioisotopes) were used to assess the ability of the laboratories to accurately quantify radionuclides. For 1995, each commercial laboratory maintained a program of reagent spikes. At the request of ESH-17, each commercial laboratory also maintained a program of filter spikes and used filter material supplied by ESH-17. In all, more than 290 analyses of spikes were performed for the stack program in 1995, and the results were satisfactory. Two filters spiked with high activity levels of strontium-90 shared the lowest recovery (83%).

Overall, the 1995 program of blanks and spikes demonstrated the Stacks Chemistry Program was sufficiently in control and was capable of providing results suitable for use in the air quality programs.

c. Analytical Results. Measurements of Laboratory stack emissions during 1995 totaled 45,380 Ci. Of this total, tritium emissions comprised 1,010 Ci, and air activation products from LANSCE contributed 44,370 Ci. Combined airborne emissions of materials such as plutonium, uranium, americium, and particulate/vapor activation products were less than 0.5 Ci. Detailed emissions data for Laboratory buildings with sampled stacks are provided in Table 4-20. Table 4-21 provides a detailed listing of the constituent radionuclides in the groupings G/MAP and particulate/vapor activation and fission products (P/VAFP).

Radioactive particulate source terms were developed differently for 1995 than in past years. Specifically, radionuclide identification was historically based on process knowledge. In an effort to provide better data, the identities of radionuclides emitted from Laboratory stacks were determined through the use of radioanalytical chemistry in 1995. For this reason, emissions of americium-241 are now presented separately from emissions of plutonium. Where sampling was discontinued or analyses were added during the year, calculated emissions are not representative of annual emissions. To account for this, incomplete emissions were scaled to reflect an entire year.

d. Long-Term Trends. Radioactive emissions from sampled Laboratory stacks are presented in Figures 4-8 through 4-11. These figures illustrate trends in emissions for plutonium, uranium, tritium, and G/MAP emissions, respectively. As Figure 4-8 shows, plutonium emissions for 1995 were higher than in recent years. This was due primarily to a release from the FE-24 stack of the CMR facility during the first part of 1994. The total release was

approximately 120 μCi, consisting primarily of enriched uranium; however, approximately 30 μCi of plutonium was also released. Figures 4-9 through 4-11 show that total stack emissions of uranium, tritium, and G/MAP were either consistent with past years or were slightly decreased.

Figure 4-12 shows the total contribution of each of these emission types to the total Laboratory emissions. It clearly shows that G/MAP emissions and tritium emissions comprise the vast majority of radioactive stack emissions.

Since G/MAP emissions account for most of the airborne radioactivity, and since the FE-3 stack at LANSCE is the primary source of G/MAP isotopes, LANSCE operating personnel have developed and implemented a delay line to reduce these emissions. The delay line operates by removing a large part of the concentrated activated air from the production point at the LANSCE beam stop. This air is passed through a 1,200-m tube, allowing approximately 100 minutes of additional decay time (Fuehne 1996). Due to the short half-lives of the G/MAP isotopes, carbon-10 (19.5 s), carbon-11 (20 min), nitrogen-13 (10 min), nitrogen-16 (7 s), oxygen-14 (71 s), oxygen-15 (123 s), and argon-41(1.8 h), this delay is sufficient to significantly reduce the total activity prior to returning the air to the stack. A recent study shows that, with the delay line operating, G/MAP emissions were reduced by 28.8%, as compared to similar operations without the benefit of the delay line (Fuehne 1996). Through such efforts, emissions of airborne radioactivity can be reduced while limiting the impact on the operating schedule.

3. Cosmic and Gamma Radiation Monitoring

a. Monitoring Network

Laboratory and Regional Areas (TLDNET). This environmental network consists of 55 stations divided into three groups. The off-site regional group has seven locations ranging 28 to 117 km (17 to 73 mi) from the Laboratory boundary. The regional stations are located at Fenton Hill and in the neighboring communities of Española, Pojoaque, and Santa Fe. The Pueblos of San Ildefonso, Jemez, and Taos are also part of this network. The off-site perimeter group consists of 25 stations within 4 km (2.5 mi) of the Laboratory boundary; a new perimeter station was added at State Road 4 and Monte Rey South in the third quarter of 1995. The on-site group includes 23 locations within Laboratory boundaries (Figure 4-13).

Technical Area (TA) 53 Network (LANSCENET) (Formerly referred to as LAMPFNET). This network monitors external penetrating radiation from airborne gases, particles, and vapors resulting from LANSCE operations at TA-53. Air emissions from the LANSCE linear accelerator operation constitute the largest Laboratory source of off-site external penetrating radiation exposure. The network consists of 24 TLD stations. Twelve monitoring TLD stations are located approximately 800 m (0.5 mi) north of and downwind from LANSCE to measure emissions. The other 12 TLDs are background sites and are located about 9 km (5.5 mi) from LANSCE, near the southern boundary of the Laboratory (Figure 4-14). Both monitoring and background TLD stations are placed at approximately the same elevations.

The network of three high-purity germanium detector systems installed on the north side of Los Alamos Canyon was discontinued in 1995. However, an HPIC is still active at the center north-northeast station. Figure 4-14 presents an example of the hourly dose rate measured by the HPIC during a typical month of the 1995 LANSCE facility operating cycle.

Low-Level Radioactive Waste Management Areas Network (WASTENET). Environmental TLDs are placed at 86 locations to monitor external penetrating radiation at 11 active or inactive low-level radioactive waste management areas. TA-54, Area G was the only active low-level radioactive waste management area in 1995. The waste management areas are controlled-access areas and are not accessible to the general public. The average annual dose at each location is calculated from a set of TLDs located at each site.

b. Sampling Procedures, Data Management, and Quality Assurance. TLDs used at the Laboratory are composed of natural lithium fluoride (LiF) crystals containing 7.4% lithium-6 in the form of 6.4-mm-square by 0.9-mm-thick chips, referred to as TLD-100s. After exposure to external penetrating radiation, TLDs emit light when heated under laboratory conditions. The amount of light released is proportional to the amount of radiation absorbed by the TLD. The TLD-100s used in the Laboratory's environmental monitoring program are insensitive to fast, energetic neutrons. As a result, the contribution of energetic cosmic neutrons to natural background radiation is not included in the exposure determined with LANL TLDs.

To ensure similar responses to radiation exposure, TLD chips are selected from the same production batch so that the measured standard deviation in thermoluminescent sensitivity is between 2.0% and 4.0% of the mean at a 10 R exposure. These chips are annealed at 400°C (752°F) for 1 hour and then cooled rapidly to room temperature. This process is followed by another annealing at 100°C (212°F) for 1 hour and another rapid cooling to room temperature. For the annealing conditions to be repeatable, chips are put into rectangular borosilicate glass vials that each hold 48 LiF chips. These vials are placed in a borosilicate glass rack so that all vials in a batch can be simultaneously placed in the annealing ovens.

Each dosimeter is made up of four LiF chips and a two-part threaded assembly made of an opaque yellow acetate plastic. A calibration set of TLDs is prepared each time chips are annealed and is read at the start of the dosimetry cycle. Each calibration set contains up to 150 chips, which are irradiated at levels between 0 and 80 mR, the expected range of environmental dose in a quarter, using a cesium-137 source traceable to the NIST at the ESH-4 calibration facility.

Exposure in air (mR) is converted to dose in tissue (mrem) by multiplying by the conversion factor 1.05. This factor is derived as the reciprocal of the product of the roentgen-to-rad conversion factor (0.958) for muscle tissue of the 661-KeV decay photon of cesium-137, and 0.994, which is the attenuation factor at the electronic equilibrium thickness. A rad-to-rem conversion factor of 1.0 for gamma rays is used, as recommended by the International Commission on Radiation Protection (ICRP 1970). A weighted least-squares linear regression is used to determine the relationship between TLD reader response and calculated dose, the weighting factor being the variance of the sample set (Bevington 1969).

Field data including the date of collection, the condition of TLDs and any observed anomalies are recorded by hand on field sheets which are compiled in a field file. During the read cycle, control blanks (unirradiated dosimeters) and control irradiated dosimeters (i.e. dosimeters irradiated at 20 mR) are interspersed among field dosimeters as a quality check of the system performance. All chips are read and stored as raw data files. These are converted and read by a dose-conversion program to calculate doses at each monitoring location. These results are validated and statistically evaluated before being reported. At the end of each field cycle, the dose at each location in the network is estimated from the regression line, along with the upper and lower confidence limits at the estimated value (Natrella 1963). These individual field cycle doses are summed for each location at the end of the calendar year. The uncertainty is calculated as the summation in quadrature of the individual uncertainties (Bevington 1969).

c. Analytical Results

Laboratory and Regional Areas (TLDNET). Results from the environmental monitoring networks are presented in Table 4-22. TLDs from station #52 at Taos Pueblo were not collected in the fourth quarter of 1993 through the second quarter of 1995 because of the repeated loss of TLDs from the station. TLDs were collected from this location beginning the third quarter of 1995. Some of the other TLD stations are lacking one or more quarters of data as a result of vandalism, animal damage, processing error, or removal requests by the public. A new station, #55, was placed at Monte Rey South and State Road 4 in the third quarter of 1995.

In general, the TLD measurements indicate no detectable radiological impact to the public due to external penetrating radiation from LANL operations. The ranges of values observed within each network are consistent with the expected variability in natural background radiation and are also consistent with the range of results observed in 1994. The Student's t-Test and a single factor analysis of variance (ANOVA), both at a 95% level of confidence, revealed no statistical difference between 1994 and 1995 TLD measurements. Among stations having a complete set of data, the 1995 annual dose at off-site regional stations ranged from 100 to 114 mrem, whereas the annual measurements at off-site perimeter stations ranged from 93 to 156 mrem. Annual measurements at on-site stations ranged from 102 to 168 mrem. The Student's t-Test at a 95% level of confidence, shows no significant difference when comparing on-site TLD measurements to off-site perimeter TLD measurements; however, there is a significant difference at the 95% level of confidence when comparing the on-site and perimeter measurements to the regional measurements. This statistical difference is attributed to differences in elevation and/or geology at each location. Efforts to improve the characterization of background radiation levels at each location are currently being evaluated.

The second-quarter measurement of 255 mrem at Station #28 is included in the total annual dose of 378 mrem for that station; however, this measurement is not considered a public dose. TA-18 administrative controls requires operations to be conducted after hours with minimum site occupation and the closure of Pajarito Road from TA-51 to White Rock whenever the potential dose to a member of the public exceeds 1 mrem. For example, in the second

quarter of 1995, 13 of 17 TA-18 operations had road closures. The 255-mrem measurement at Station #28 includes measurements during times when these administrative controls were being utilized and does not reflect a potential dose to a member of the public. TLD measurements at Station #22 also reflect TA-18 operations and do not represent a public dose for the above reasons.

Technical Area (TA) 53 Network (LANSCENET). The TLD measurements collected at the 12 stations located directly to the north of LANSCE were statistically compared to the 12 background stations located at TA-49. The Student's t-Test at a 95% level of confidence shows no statistical difference between the TLD results observed at LANSCE and those observed at the background locations.

Low-Level Radioactive Waste Management Areas Network (WASTENET). Annual doses at the waste management areas are presented in Table 4-23. Among the sites with a complete data set, the annual average doses at all waste management areas during 1995 ranged from 125 to 161 mrem. Exposure data for TA-6, Area F are not available for first and second quarters of 1995. Extensive and detailed geophysical sampling and characterization of the site disrupted the monitoring program. Monitoring of Area F resumed in the third quarter of 1995 upon completion of the site characterization study. The annual dose for TA-50, Area C does not include second quarter measurements because the data were lost due to an equipment malfunction.

The highest WASTENET annual average dose for 1995 was measured at TA-54, Area G, LANL's only active low-level radioactive waste area. The 25 environmental surveillance TLDs of TA-54, Area G are located within the waste site and along the perimeter fence. The highest dose was measured close to the transuranic (TRU) waste storage areas. In 1995, these areas were uncovered in preparation for retrieval of the contents in conjunction with a plan to build new domes for the temporary storage of TRU waste materials. Since the other TLDs placed around Area G received exposures similar to those observed at the regional stations, any exposure due to waste management activities is localized within Area G.

d. Future Efforts. In an effort to improve the precision and accuracy of the TLD system and its measurements, the ESH-17 will be deploying, in the second quarter of 1996, new environmental TLDs to measure external penetrating radiation. These dosimeters consist of five 3.2-mm-square LiF chips enclosed in the same two-part threaded assembly currently in use. Each dosimeter will have its own correction factor allowing for greater accuracy, rather than a batch correction factor. In addition, the new automatic Harshaw 5500 TLD chip reader will replace the manual Harshaw 4000 reader.

e. Dose Equivalents to Individuals from External Penetrating Radiation from Airborne Emissions and Direct Sources. The major source of external penetrating radiation from LANL operations has been airborne emissions from LANSCE. Nuclear reactions with air in the beam target areas at LANSCE (TA-53) cause the formation of air activation products, principally carbon-10, carbon-11, nitrogen-13, oxygen-14, and oxygen-15. These radioisotopes are positron emitters and have 19-s, 20-min, 10-min, 71-s, and 122-s half-lives, respectively. These radioisotopes are sources of penetrating radiation due to the formation of two 0.511-MeV photons through positron-electron annihilation (oxygen-14 also emits a 2.4-MeV gamma ray). These air activation products are primarily released from a 30-m-tall stack, while an additional small percentage of the releases occur as diffuse emissions from LANSCE. An HPIC is used to record the total external penetrating dose. The HPIC is near the location of the maximum exposed individual (MEI) along the Laboratory boundary known as East Gate. Typical readings recorded during LANSCE operation by the East Gate Station are shown in Figure 4-14. The above background dose measured at this location in 1995 was 2.0 mrem. Doses from LANSCE emissions are currently not detectable by the TLDNET located in the Los Alamos townsite or White Rock.

No direct penetrating radiation dose equivalents to the public from Laboratory operations were detected by TLD monitoring at off-site locations. There was no statistical significant difference between on-site TLD measurements and perimeter TLD measurements. The significantly lower measurements collected at the regional stations are attributed to differences in elevation and geology. On-site TLD measurements of external penetrating radiation reflect Laboratory operations; however, they do not represent any significant public exposure since these were in controlled areas or along roads with restricted public access during operations. Specifically, measurements from stations #22 and #28 reflect operations at TA-18 but do not represent a potential dose to the public, because all personnel, including the public, are excluded from an enlarged operational area from Pajarito Road between TA-51 and the White Rock interchange on State Road 4.

4. Air Surveillance

4. Meteorological Monitoring

a. Monitoring Network. A meteorological network of five towers was used to gather data at the Laboratory during 1995 (see Fig. 13.1 in the Environmental Monitoring Plan [Stone 1995] or access through the Internet at http://weather.lanl.gov/monplan/mmp96.html). A sodar (SOnic Detection And Ranging) device and three precipitation measurement sites also supplemented the data collected. The towers are located at TA-6 (the official meteorological measurement site of the Laboratory), TA-49, TA-53, TA-54, and TA-41 (located in Los Alamos Canyon). The sodar is located at TA-6, and the precipitation measurement sites are located at TA-74, North Community in the Los Alamos townsite, and TA-16.

b. Sampling Procedures, Data Management, and Quality Assurance. Instruments in the meteorological network are located in areas where there is adequate exposure to the elements being measured and in open fields to avoid the wake effects of trees and buildings on measurements of wind and precipitation. The open fields also provide an unobstructed view of the sky for the upward-directed radiometers, a device that measures solar radiation.

Temperature and wind are measured at multiple levels on open-lattice towers, with instruments positioned on west-pointing booms having a length of two times the tower width. The length of the boom helps to decrease wake effects from the tower, as do the west-pointing direction of the booms, since winds from the east are uncommon. The multiple levels give duplicate measurements for quality assurance. Temperature sensors are white in color and aspirated with small fans to minimize radiative heating of the sensor housing.

Most of the meteorological variables are sampled every 3 s, and the results are averaged every 15 min to give a sample size of 300 (for each of the 15-min periods). The data are stored by dataloggers located at the tower sites and then fed to a Hewlett Packard workstation through telephone lines. At the workstation, automatic range checking is performed on the data, and data edits are automatically performed on variables falling outside of preset ranges. Next, time series plots are constructed. These plots are used by a meteorologist to perform quality checking on the data. Daily statistical quantities are included on the time series plots (such as daily maximum and minimum temperature, total solar radiation, maximum wind gust, etc.) and are also checked for quality.

All meteorological instruments are audited twice a year. An internal audit is performed in the winter, and an external audit is conducted during the summer. All instrument calibrations are traceable to NIST standards. No significant problems were found during either audit in 1995 (Oviatt 1995).

c. Analytical Results. A graphical summary of the 1995 Los Alamos weather recorded at TA-6, the official meteorological measurement site of the Laboratory, can be seen in Figure 4-15. This figure shows the average temperature ranges and precipitation by month compared with the normals, which are averages based on a 30-yr record (1961–1990). February was significantly warmer than usual in 1995. Also, October experienced a large diurnal temperature range, on average, due to the lack of clouds during the month. The other months saw near normal variations in temperature. For the entire year temperatures were only slightly above normal.

The year 1995 was slightly drier than normal with 95% of normal precipitation being recorded. After a wet first half of the year, when all months were above normal except for March, a dry second half of the year was observed. From July through December all of the months were drier than normal except for September, and in October no precipitation was recorded. The rainy season, which usually runs from July through September, started late in 1995. Near normal precipitation was recorded in August and September, while July was unusually dry. Snowfall was abundant, compared to normal, due to a snowy January and April. January received 21.3 in. of snow, which is 75% greater than normal. Over 20 in. of snow fell during April, a month which normally receives 4.6 in. of snow. For the remainder of the year, all months received less than normal snowfall. Precipitation data for 1995 for all recording sites are listed in Table 4-24.

Wind statistics based on observations at the four towers on the Pajarito Plateau, shown in the form of wind roses, can be seen in Figures 4-16 through 4-18. Wind roses show the percentage of the time the wind blows from each of 16 different wind directions. Also shown in the wind roses are the distributions of wind speed for each of the 16 directions; these are displayed by the shading of the wind rose barbs, as shown in the legend. For example, at TA-6 (Figure 4-16), the most common daytime wind direction is southerly, which occurs almost 14% of the time. The wind speed for that direction is most often in the 2.5 to 5.0 m/s category, and least often in the 7.5 + m/s category. Winds were calm 1.7% of the time at TA-6 during the daytime in 1995.

During the daytime (Figure 4-16), winds were predominately southerly at all four towers. The nighttime wind roses (Figure 4-17), indicate that the winds were more westerly and northwesterly and generally weaker. Wind roses for all times are given in Figure 4-18.

5. Nonradioactive Emissions and Effluent Monitoring

a. Introduction. Criteria pollutants were monitored for several years without any detected increases above typical regional background levels; therefore, ambient monitoring for these pollutants was discontinued. However, the emissions from nonresearch sources are calculated annually because these sources are responsible for nearly half of all the nonradiological air pollutant emissions at the Laboratory. Research sources vary continuously and have very low emissions. As such, they are not calculated annually; instead, each new or modified research source is addressed in the new source review process.

b. Detonation and Burning of Explosives. The Laboratory conducts explosive testing by detonating explosives at firing sites operated by the Dynamic Testing Division. The Laboratory maintains monthly shot records, including the type of explosive and weight fired at each mound to track emissions from this activity. Table 4-25 summarizes the explosives detonations conducted at the Laboratory during 1994 and 1995. The Laboratory also burns scrap and waste explosives when burning proves to be the safest disposal option. In 1994 and 1995 the Laboratory burned 3,450 and 5,090 kg (7,590 and 11,198 lb) of high explosives, respectively.

c. Asbestos. Under the National Emission Standards for Hazardous Waste Pollutants (NESHAP) for asbestos, the Laboratory must ensure that no visible asbestos emissions to the atmosphere are produced by asbestos removal operations at the Laboratory. During 1994 and 1995, no visible emissions were observed during periodic inspections.

The Laboratory is also required to notify the New Mexico Environment Department (NMED) of asbestos removal activities and disposal quantities. Such activities involving less than 80 m (263 linear ft) on pipes, or 15 m^2 (160 ft^2) of friable asbestos, are covered by an annual small job notification to the NMED. For projects involving greater amounts of friable asbestos, separate notification to the NMED is required in advance of each project. Nonfriable materials are also included in a large job special notice. The NMED is notified of asbestos wastes containing nonfriable as well as friable materials from both small and large jobs on a quarterly basis, which includes any material contaminated or potentially contaminated with radionuclides. Radioactively contaminated material is disposed of on site in a designated radioactive asbestos burial area. Nonradioactive asbestos is transported off site to designated asbestos disposal areas.

During 1994, the Laboratory's off-site shipments of small job waste material totaled approximately 36.62 m^3 (1,293 ft^3). Johnson Controls Inc. (JCI) disposed of approximately 16.85 m^3 (1,293 ft^3) of potentially radioactively contaminated material from small job activity. One large D&D job that was begun in 1993 accounted for an additional 83.6 m^3 (2,951 ft^3) of potentially radioactive, friable or non friable, asbestos waste during the year.

During 1995, LANL shipped 52.27 m^3 (1,846 ft^3) of material from small job activities off site. One Environmental Restoration project generated an additional 66.9 m^3 (2,362 ft^3) of nonfriable asbestos waste. A total of 107.6 m^3 (3,799 ft^3) of potentially radioactively contaminated asbestos and asbestos wastes known to have low-level contamination were disposed of on site.

d. Emissions Calculations. The 1995 estimated emissions are shown in Table 4-26. These are typical industrial-type sources. LANL nonradiological emissions from research operations are small when compared with these listed sources.

The NO_x emissions from the TA-3 power plant were calculated using an emissions factor of 163 lb/million cubic feet (MMCF), which was obtained from the 1995 TA-3 stack test and is adjusted for 20% uncertainty. The particulate matter emission factor of 5 lb/MMCF for the asphalt plant represents the maximum emission factor listed in AP-42 (EPA 1995). For volatile organic compounds, an emission factor of 1.4 was used, which is corrected for 17% methane as specified in AP-42. The emission factor for SO_x is 0.6 lb/MMCF, as specified in AP-42.

The three power plants, the largest sources of nonradioactive emissions, are used to supply steam for heating. The steam plant at TA-3 also produces electricity when sufficient power from outside sources is not available; approximately one-third of the emissions from this steam plant results from electricity production. The plants are primarily operated on natural gas but can use fuel oil as a backup.

C. Unplanned Radiochemical Airborne Release

There was one unplanned release during 1995. During the period from December 28, 1994, to January 6, 1995, an estimated 116 μCi of uranium-235 was released from the FE-24 stack at the CMR facility (Miller 1995). The dose from this release calculated at the nearest off-site location was estimated to be 5.1×10^{-3} mrem, which is less than 0.1% of the applicable standard.

In addition, there were four instances of higher-than-normal stack readings observed in 1995 at TA-3-29, TA-3-35, TA-21-209, and TA-53-3M. However, the annual total emissions were within the normal release rates for LANL (AQG 1996).

D. Special Studies

1. Air Monitoring at Technical Area 54, Area G

In addition to the routine air monitoring performed for the environmental surveillance program, 12 air samplers are operated within TA-54, Area G, or along its perimeter. Area G is the Laboratory's active low-level waste management area. During 1993, 5 new stations (included in the 12 described above) were established to monitor potential emissions resulting from the uncovering and repackaging of 16,500 barrels of TRU waste at the far eastern edge of Area G. This recovery effort is expected to last through FY 2002.

Samplers are located near active and past-waste handling and disposal operations to ensure that the air sampled is representative of worst-case potential emissions. Filters within the samplers collect ambient air and are then analyzed to determine air concentrations of tritium; uranium-234; uranium-235; uranium-238; plutonium-238; plutonium-239,240; and americium-241. The measured air concentrations reflecting operations for 1995 are given in Tables 4-8 through 4-14.

Some of the mean annual air concentrations are above background but are well below the DOE's DAC guides for controlled and uncontrolled areas and are also well below the EPA's 40 CFR 61 concentration guide.

Tritium air concentrations at Stations #35 and #36 were observed to be higher than readings from the other samplers in Area G (Table 4-8). The mean annual air concentrations at Stations #35 and #36 for 1995 were 370 and 49 pCi/m^3, respectively. All other air samplers at TA-54, Area G measured tritium concentrations within the range of those observed elsewhere. Air samplers #35 and #36 are located in the proximity of shafts used to dispose of higher-activity waste containing tritium, and these results indicate the elevated tritium air concentrations close to these shafts.

2. Los Alamos Neutron Scattering Center Diffuse Emissions

Buildings along the high-intensity beam line at LANSCE are sources of diffuse emissions. Air around the various targets at LANSCE becomes activated through various beam interactions and migrates into the surrounding buildings. From the buildings, this slightly radioactive air can escape to the environment.

Potential diffuse emission sources are evaluated by the LANSCE staff to determine if a source meets certain monitoring criteria. Each diffuse source meeting these criteria is continuously monitored throughout the LANSCE operational cycle to determine the radioactive air concentration within each building. Air flow from the building is measured and combined with this activity concentration to determine released radioactivity. Off-site dose from diffuse releases is determined by using the released activity from each source as an input into the CAP-88 computer modeling program, in a manner similar to the stack emissions program.

Throughout the beam operation period, activity concentrations of each monitored source are recorded continuously on strip charts. Each instrument is checked daily to ensure proper operation is maintained. Strip charts are changed each month and analyzed at the end of the run cycle. The instruments are calibrated before each run cycle and again after each cycle. The radiological composition of each source is determined by gamma ray spectroscopy.

Over the past several years, diffuse emissions have decreased as shown in Table 4-27. The decreases in diffuse emissions are the result of sealing, controlling operating environments, and the installation of engineering controls, all of which reduce air migration from target cells into surrounding facilities.

3. Evaluation of Site-Specific Acceptability of AIRNET Stations

The AIRNET program evaluated site-specific characteristics of all ambient air sampling stations to assess whether airflow around the stations' locations was being affected by nearby obstacles or topography. The stations were compared with the criteria from applicable sections in DOE/EH-0173T (DOE 1991b) and 40 CFR 58 App. E (EPA 1992).

The primary site-specific criteria were favorable surface characteristics, airflow obstructions, and topography. A favorable surface is one that is stabilized by vegetation or other cover such that the local generation of wind-borne dusts and dust-loading of the air filters is minimized. The criteria applied to trees, buildings, and other potential obstructions are intended to ensure that airflow from a source or sources toward the sampler is not obstructed. Likewise, topographic depressions and edges of canyons are to be avoided as AIRNET station locations.

As a result of the study, several stations were relocated to better sites and some sites were modified, primarily by trimming or removing nearby vegetation. LANL periodically reviews the AIRNET stations to ensure optimal airflow and representative sampling.

4. Comparison of Thermoluminescent Dosimeters

In addition to the Laboratory's external penetrating radiation monitoring program described in Section 4.B.3, special studies were conducted during 1995. One such study is a continuation of work initiated in 1990 to compare results of LANL TLDs with those of TLDs obtained from a commercial vendor.

The study involves placing vendor TLDs next to Laboratory TLDs. There are a total of 40 vendor TLDs co-located with LANL TLDs at TLDNET locations. The vendor's TLDs are set out and collected following the vendor's specifications and in conjunction with the LANL TLD quarterly change-out schedule. No information is provided to the vendor regarding the TLD locations and possible environmental radiation fields. The vendor TLDs are analyzed and processed by the commercial vendor, and the analytical results are later provided to LANL.

Statistical analyses are applied to the LANL and vendor data sets for normality of distribution. First, the data distribution is determined. If the data are normally distributed, the comparison is made by using a paired t-test, which is very sensitive to systematic differences in sample sets. The data from 1995 were not normally distributed, so the Wilcox Signed Rank test for differences was applied. To ensure that the full power of the statistical test is achieved, only the TLD results from each program that are spatially and temporally comparable are used. Individual quarterly data were evaluated instead of the summed annual results used in previous years. For the second year in a row, there was a statistical and systematic difference in the two data sets. Considering 150 paired data values, the median quarterly value of the LANL TLDs was 6.7 mrem higher than that of the co-located vendor TLDs (34.7 mrem for the LANL TLDs, 28.0 mrem for the vendor TLDs). This result is the opposite of the findings from 1994, when the vendor's TLDs were found to be an average of 5 mrem higher per quarter than the LANL TLD values (EG 1996).

5. Highly Sensitive Dosimeters

A new dosimeter was tested in 1995 containing aluminum oxide, which is nearly 30 times more sensitive than the presently used lithium fluoride crystals. The test dosimeters were located next to those normally used at the northern boundary of LANSCE to monitor the emissions from the facility during the annual run cycle. Preliminary data from this study indicated that the dosimeters were not as sensitive as desired and produced results with higher variability than desired. The cause of this poor dosimeter performance appeared to be the substandard quality of the aluminum oxide material.

6. Neighborhood Environmental Watch Network Community Monitoring Stations

The Neighborhood Environmental Watch Network (NEWNET) is a LANL Dynamic Experiment Division program focused on establishing a partnership with communities, state and tribal governments, and the DOE to address concerns about radiological monitoring in local communities. It establishes meteorological and external penetrating radiation monitoring stations in local communities and around radiological sources. These stations are the responsibility of a station manager from the local community. The stations have a local readout, and the data can be downloaded into a personal computer at the station if this process is coordinated with the station manager.

The data from these stations are transmitted via satellite communications to a downlink station at Los Alamos National Laboratory. The data are converted to engineering units, checked and annotated for transmission errors or station problems, and stored in a public access database. The data from all the stations are available to the public with, at most, a 24-hr delay. Methods to decrease this period to near real time are being developed.

Station measurements include wind speed and wind direction, ambient temperature, relative humidity, barometric temperature, and gross gamma radiation using a pressurized ion chamber. The station can be adapted to monitor other sensors of interest with electrical outputs. The radiation sensors are sampled at 5-s intervals and averaged every 15 min. These values are transmitted every 4 hr.

More information about NEWNET and the data is available on the Internet at http://newnet.jdola.lanl.gov/newnet.html.

7. Technical Area 21 Decommissioning and Decontamination Project

Five environmental air monitoring stations were established in October 1992 to monitor potential diffuse emissions during decommissioning of TA-21; stack emissions were also monitored. The environmental sampling results were analyzed using an atmospheric dispersion equation along with local meteorological data to estimate the potential airborne releases during 1995. Conservative assumptions were used in the calculation to place an upper limit on the possible emissions; actual emissions may have been many times less than the results shown in Table 4-28. The maximum off-site dose from these estimated emissions is less than 0.1 mrem.

E. Tables

Table 4-1. Average Background Concentrations of Radioactivity in the Regional Atmosphere

	Units	Santa Fe (EPA)[a] 1990–1993	Northern New Mexico (LANL)[b] 1995	EPA Concentration Limit[c]
Gross Beta	fCi/m^3	10	12.5	NA
^{234}U	aCi/m^3	17	29.1	7,700
^{235}U	aCi/m^3	0.7	1.9	7,100
^{238}U	aCi/m^3	15	27.9	8,300
^{238}Pu	aCi/m^3	0.2	1.8	2,100
$^{239,240}Pu$	aCi/m^3	0.3	2.3	2,000
Tritium	pCi/m^3	NA	0.8	1,500
^{241}Am	aCi/m^3	NA	3.8	1,900

[a]EPA (1991–1994), Reports 63 through 75. Data are from the EPA Santa Fe, New Mexico, sampling location and were taken from July 1990 through July 1993. Data for 1994 and 1995 were not available at time of publication.
[b]LANL data explained in the footnote.
[c]Each EPA limit equals 10 mrem/yr.
NA = not available.

Table 4-2. Analytical Laboratory Intercomparison Program Results

Test and Testing Agency	Units[a]	True Value Acceptable Range	Analytical Laboratory Results		
			HPAL[b]	ATI[c]	GJPO Rust GeoTech[d]
In Water					
Tritium (Mar. EPA)	pCi/L	6,144.2–8,725.8	7,708.0 ± 346.41	N/A[e]	N/A
Tritium (Aug. EPA)	pCi/L	4,027.1–5,716.9	4,856.67 ± 225.9	N/A	N/A
On Filter					
^{234}U (Jun. DOE)	Bq/F	0.059	N/A	0.104 ± 0.010[f]	0.067 ± 0.003
^{234}U (Dec. DOE)	Bq/F	0.052	N/A	0.063 ± 0.009	0.056 ± 0.010
^{238}U (Jun. DOE)	Bq/F	0.002	N/A	0.045 ± 0.005[f]	DNP[g]
^{238}U (Dec. DOE)	Bq/F	0.053	N/A	0.054 ± 0.007	0.056 ± 0.010
^{238}Pu (Jun. DOE)	Bq/F	0.122	N/A	0.104 ± 0.010	0.119 ± 0.005
^{238}Pu (Dec. DOE)	Bq/F	0.096	N/A	0.078 ± 0.010	0.094 ± 0.009
^{239}Pu (Jun. DOE)	Bq/F	0.062	N/A	0.060 ± 0.009	0.068 ± 0.004
^{239}Pu (Dec. DOE)	Bq/F	0.093	N/A	0.081 ± 0.011	0.094 ± 0.009
^{241}Am (Jun. DOE)	Bq/F	0.177	N/A	0.156 ± 0.016	0.177 ± 0.005
^{241}Am (Dec. DOE)	Bq/F	0.189	N/A	0.174 ± 0.023	0.186 ± 0.013
Alpha (Aug. EPA)	pCi/F	14.1–35.9	27.20 ± 0.87	32.87 ± 1.33	N/A
Alpha (Jun. DOE)	Bq/F	3.220	DNP	3.680 ± 0.400	N/A
Alpha (Dec. DOE)	Bq/F	3.30	DNP	3.720 ± 0.490	N/A
Beta (Aug. EPA)	pCi/F	69.3–103.9	84.70 ± 3.48	84.57 ± 1.72	N/A
Beta (Jun. DOE)	Bq/F	1.850	DNP	2.360 ± 0.240[h]	N/A
Beta (Dec. DOE)	Bq/F	1.060	DNP	1.060 ± 0.130	N/A
^{90}Sr (Aug. EPA)	pCi/F	21.3–38.7	DNP	31.0 ± 0.00	N/A
^{90}Sr (Jun. DOE)	Bq/F	0.739	DNP	0.737 ± 0.074	N/A
^{90}Sr (Dec. DOE)	Bq/F	1.060	DNP	1.130 ± 0.210	N/A
^{137}Cs (Aug. EPA)	pCi/F	16.3–33.7	31.67 ± 3.06	27.33 ± 1.53	N/A

[a]Data units reported here are the same as given in the source reports. Note: pCi = Bq × 27.
[b]HPAL = Health Physics Analytical Laboratory.
[c]ATI is now known as Paragon Laboratory, Inc.
[d]GJPO = Grand Junction Project Office.
[e]N/A indicates laboratory did not perform relevant analyses for any ESH-17 Air Quality projects during 1995.
[f]Indicates not acceptable. Because the laboratory obtained consistent results on blanks and spikes throughout the year and performed acceptably on the test samples submitted in December, ESH-17 felt no correction action was warranted.
[g]DNP indicates laboratory did not participate in this test during 1995.
[h]Indicates acceptable with warning.

Table 4-3. Analytical Chemistry Requirements for 1995 Ambient Air Samples

Analysis Required	No. of Samples Analyzed	Technique or Instrument	Typical Count Time	Target MDA (3 sigma)
Biweekly:				
Alpha	1,299	Proportional Counter	30 min	1 pCi
Beta	1,299	Proportional Counter	30 min	2 pCi
Tritium	1,321	Distillation and Liquid Scintillation	60 min	0.75 pCi/L[b]
Quarterly:				
^{241}Am	196	Radiochemistry and Alpha Spec.	1,000 s	0.04 pCi
^{238}Pu	229	Radiochemistry and Alpha Spec.	1,000 min	0.04 pCi
^{239,240}Pu	229	Radiochemistry and Alpha Spec.	1,000 min	0.04 pCi
^{234}U	230	Radiochemistry and Alpha Spec.	1,000 min	0.04 pCi
^{235}U	230	Radiochemistry and Alpha Spec.	1,000 min	0.04 pCi
^{238}U	230	Radiochemistry and Alpha Spec.	1,000 min	0.04 pCi

[a]MDA = minimum detectable amount.
[b]L refers to the volume (liters) of distillate.

Table 4-4. Blank Sample Performance for 1995 Ambient Air Samples

Analyte	Type of Blank	No. of Samples	Expected Result	Average Result[a]	Average MDA[a,b] Reported
Alpha	Field Blank	46	0	0.06 pCi	0.62 pCi
^{241}Am	Reagent Blank	12	0	0.03 pCi	0.02 pCi
	Filter Blank	18	0	0.02 pCi	0.03 pCi
	Field Blank	8	0	0.02 pCi	0.04 pCi
Beta	Field Blank	46	0	0.6 pCi	1.5 pCi
Tritium	Field Blank	26 (Jan.–June)	0	1.2 pCi/L[c,d]	1.0 pCi/L[c,d]
Tritium	Field Blank	23 (Jul.–Dec.)	0	0.6 pCi/L[c,d]	0.6 pCi/L[c,d]
^{238}Pu	Reagent Blank	11	0	0.02 pCi	0.02 pCi
	Filter Blank	18	0	0.01 pCi	0.02 pCi
	Field Blank	8	0	0.02 pCi	0.03 pCi
^{239}Pu	Reagent Blank	11	0	0.003 pCi	0.015 pCi
	Filter Blank	18	0	0.006 pCi	0.016 pCi
	Field Blank	8	0	0.01 pCi	0.03 pCi
^{234}U	Reagent Blank	10	0	0.01 pCi	0.03 pCi
	Filter Blank	17	0	0.05 pCi	0.03 pCi
	Field Blank	8	0	0.04 pCi	0.03 pCi
^{235}U	Reagent Blank	10	0	0.00 pCi	0.031 pCi
	Filter Blank	17	0	0.010 pCi	0.024 pCi
	Field Blank	8	0	0.001 pCi	0.028 pCi
^{238}U	Reagent Blank	10	0	0.01 pCi	0.03 pCi
	Filter Blank	17	0	0.03 pCi	0.03 pCi
	Field Blank	8	0	0.06 pCi	0.03 pCi

[a]Significant figures vary by isotope, but each is reported to the level justified by the repeatability (standard deviation) of the replicate analyses.
[b]MDA = minimum detectable amount.
[c]See text for discussion of temporal difference.
[d]L refers to the volume (liters) of distillate.

Table 4-5. Spiked Sample Performance for 1995 Ambient Air Samples

Analyte	Type of Spike	No. of Samples	Spike Added (pCi)	Average Spike[a] Recovery (pCi)	Percent Spike[a] Recovery Average% ±1 Sigma%
^{241}Am	Reagent Spike	8	4.7	4.5	96 ± 5%
	Filter Spike	8	2.37	2.24	95 ± 3%
	Filter Spike	10	7.5	7.5	99 ± 3%
	Filter Spike	6	8.3	8.2	98 ± 2%
^{238}Pu	Reagent Spike	1	10.5	10.3	98 single[b]
	Reagent Spike	7	10.7	10.3	96 ± 2%
	Reagent Spike	1	5.4	4.9	91 single
	Filter Spike	7	5.3	5.3	98 ± 3%
^{239}Pu	Reagent Spike	8	10.5	10.5	100 ± 3%
	Filter Spike	8	5.3	5.3	100 ± 3%
	Filter Spike	13	6.5	7.1	109 ± 4%
	Filter Spike	9	7.2	7.8	108 ± 3%
^{234}U	Reagent Spike	7	17	17	99 ± 7%
	Filter Spike	7	8.3	8.7	104 ± 7%
	Filter Spike	16	10.3	10.4	101 ± 7%
	Filter Spike	6	12	13	111 ± 9%
^{235}U	Reagent Spike	7	1.51	0.72	47 ± 11%[c]
	Filter Spike	6	0.40	0.37	92 ± 18%
	Filter Spike	1	0.76	0.35	46 single[c]
	Filter Spike	1	10.3	9.5	92 single
^{238}U	Reagent Spike	7	16.6	15.7	95 ± 2%
	Filter Spike	7	8.3	7.8	94 ± 5%
	Filter Spike	15	10.3	10.8	105 ± 6%
	Filter Spike	6	11.5	12.3	107 ± 6%

[a]Significant figures vary by isotope, but each is reported to the level justified by the repeatability (standard deviation) of the replicate analyses.
[b]Single sample does not allow for calculation of standard deviation.
[c]See text for discussion of spike recovery.

Table 4-6. Airborne Long-Lived Gross Alpha Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (fCi/m^3)	Minimum (fCi/m^3)	Mean (fCi/m^3)	2s
Regional Stations						
01 Española	22	0	3.3	0.6	1.3	1.4
02 Pojoaque	24	1	3.8	0.5	1.4	1.8
03 Santa Fe	21	0	5.7	0.4	1.5	2.6
Group Summary	67	1	5.7	0.4	1.4	0.2
Pueblo Stations						
41 Pueblo of San Ildefonso	24	1	3.1	0.4	1.3	1.6
42 Taos Pueblo	14	1	5.5	0.3	1.6	3.2
48 Jemez Pueblo	20	2	14.4	0.2	1.9	6.2
Group Summary	58	4	14.4	0.2	1.6	0.6
Perimeter Stations						
04 Barranca School	22	1	5.7	0.6	1.9	2.7
05 Urban Park	23	0	5.4	0.4	1.8	2.5
06 48th Street	25	0	5.3	0.6	1.7	2.2
07 Los Alamos Shell Station	24	0	5.1	0.4	1.8	2.3
08 McDonald's Restaurant	25	0	4.9	0.5	1.7	2.0
09 Los Alamos Airport	25	0	5.9	0.3	1.9	2.6
10 East Gate	25	2	5.8	0.1	1.6	2.7
11 Well PM-1	25	0	4.3	0.2	1.7	2.0
12 Royal Crest Trailer Court	20	0	8.1	0.6	2.1	3.6
13 Piñon School	24	0	7.1	0.5	1.9	3.3
14 Pajarito Acres	8	0	5.1	0.7	2.3	3.1
15 White Rock Fire Station	25	0	5.4	0.3	1.6	2.3
16 Nazarene Church	24	1	4.2	0.5	1.8	2.1
17 Bandelier National Monument	25	0	6.5	0.4	1.9	2.8
60 LA Canyon	9	0	4.9	1.1	2.5	2.7
61 LA Hospital	15	0	8.3	0.5	2.1	4.1
62 Trinity Bible Church	14	0	5.5	1.0	2.2	2.9
63 Monte Rey South	13	0	7.2	0.6	2.1	3.8
Group Summary	371	4	8.3	0.1	1.9	0.5
On-Site Stations						
19 TA-21 DP Site	25	0	7.9	0.7	2.0	3.3
20 TA-21 Area B	25	0	5.1	0.6	2.0	2.2
21 TA-6	25	1	4.5	0.1	1.6	2.0
22 TA-53, LANSCE (formerly LAMPF)	24	0	5.9	0.5	2.0	2.5
23 TA-52, Beta Site	25	1	18.5	0.5	2.4	7.2
25 TA-16-450	22	0	5.8	0.6	1.9	2.2
26 TA-49	25	0	5.5	0.5	1.7	2.3
28 TA-33, HP Site	24	0	5.6	0.7	1.9	2.3
29 TA-2, Omega Site	14	0	2.5	0.5	1.3	1.3
30 Booster P-2	25	0	9.2	0.3	2.2	3.6
31 TA-3	19	1	4.2	0.1	1.9	2.0
32 TA-48	25	0	4.9	0.4	1.3	2.2
33 Area AB	6	0	2.8	0.8	1.9	1.4
49 TA-36 Sludge Pond	18	2	6.2	0.2	1.9	3.3
Group Summary	302	5	18.5	0.1	1.9	0.6

Table 4-6. Airborne Long-Lived Gross Alpha Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (fCi/m^3)	Minimum (fCi/m^3)	Mean (fCi/m^3)	2s
Area G Stations						
27 TA-54, Area G	24	1	7.0	0.6	1.5	2.6
34 Area G-1, NE Corner	25	0	6.4	0.7	2.0	2.9
35 Area G-2, South Fence	25	0	7.6	0.7	2.1	3.2
36 Area G-3, Gate	25	0	5.4	0.8	2.0	2.5
37 Area G-4, Water Tank	23	1	8.0	0.2	2.1	3.9
44 Area G (S Perimeter)	18	0	2.4	0.2	1.2	1.2
45 Area G (SE Perimeter)	25	0	7.9	0.7	1.9	3.2
46 Area G (E Perimeter)	20	0	12.7	0.6	1.9	5.2
47 Area G (N Perimeter)	25	0	6.8	0.8	1.9	3.0
50 Area G	21	0	12.1	0.5	2.1	5.6
51 Area G	21	0	6.0	0.5	1.6	2.8
52 Area G	16	0	1.6	0.5	1.0	0.8
Group Summary	268	2	12.7	0.2	1.8	0.8
Decontamination and Decommissioning						
71 TA-21.01	25	0	5.5	0.4	1.7	2.3
72 TA-21.02	25	0	4.8	0.5	1.9	2.2
73 TA-21.03	24	0	4.9	0.5	1.9	2.3
74 TA-21.04	23	0	6.2	0.7	2.2	2.9
75 TA-21.05	25	1	7.1	0.6	2.1	3.0
Group Summary	122	1	7.1	0.4	2.0	0.4
TA-15 Firing Sites						
76 TA-15-41	23	1	3.4	0.0	1.7	1.9
77 IJ Site	23	0	5.3	0.4	2.0	2.6
78 TA-15-vacant	24	1	5.1	0.5	1.7	2.3
Group Summary	70	2	5.3	0.0	1.8	0.3

Concentration Guidelines are not available for gross alpha concentrations.

Table 4-7. Airborne Long-Lived Gross Beta Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (fCi/m^3)	Minimum (fCi/m^3)	Mean (fCi/m^3)	2s
Regional Stations						
01 Española	22	0	30.5	6.5	13.4	11.2
02 Pojoaque	24	0	29.0	8.1	12.6	10.8
03 Santa Fe	21	0	31.4	5.7	11.5	13.3
Group Summary	67	0	31.4	5.7	12.5	1.9
Pueblo Stations						
41 Pueblo of San Ildefonso	24	0	26.3	7.1	12.4	9.2
42 Taos Pueblo	14	0	29.5	8.8	14.1	11.6
48 Jemez Pueblo	20	0	29.2	3.2	12.6	13.3
Group Summary	58	0	29.5	3.2	13.0	2.0
Perimeter Stations						
04 Barranca School	22	0	37.7	7.6	13.7	14.2
05 Urban Park	23	0	32.8	8.1	13.4	11.9
06 48th Street	25	0	37.6	4.8	12.5	13.9
07 Los Alamos Shell Station	24	0	27.6	4.1	12.8	11.4
08 McDonald's Restaurant	25	0	23.1	6.2	12.3	8.5
09 Los Alamos Airport	25	0	30.9	6.7	14.6	11.7
10 East Gate	25	0	34.8	5.0	13.0	15.1
11 Well PM-1	25	0	36.5	5.3	13.3	14.2
12 Royal Crest Trailer Court	20	0	45.0	7.4	16.7	17.6
13 Piñon School	24	0	36.1	6.9	15.1	16.8
14 Pajarito Acres	8	0	30.6	12.1	17.2	14.5
15 White Rock Fire Station	25	0	27.3	5.1	11.5	11.0
16 Nazarene Church	24	0	26.7	7.1	13.6	9.0
17 Bandelier National Monument	25	0	31.5	7.3	14.6	11.2
60 LA Canyon	9	0	23.4	11.4	16.5	9.2
61 LA Hospital	15	0	37.2	8.9	16.5	14.4
62 Trinity Bible Church	14	0	25.3	9.2	17.6	9.9
63 Monte Rey South	13	0	27.8	9.7	16.6	9.4
Group Summary	371	0	45.0	4.1	14.5	3.8
On-Site Stations						
19 TA-21 DP Site	25	0	35.2	7.6	14.6	13.2
20 TA-21 Area B	25	0	32.7	9.4	15.3	10.4
21 TA-6	25	0	23.7	2.7	13.3	9.5
22 TA-53, LANSCE (formerly LAMPF)	24	0	32.7	5.8	14.7	11.4
23 TA-52, Beta Site	25	0	133.6	7.1	17.4	49.1
25 TA-16-450	22	0	22.2	7.6	13.3	9.5
26 TA-49	25	0	26.9	6.5	13.7	10.7
28 TA-33, HP Site	24	0	27.3	6.5	13.7	9.0
29 TA-2, Omega Site	14	0	24.2	6.8	10.8	8.8
30 Booster P-2	25	0	45.4	4.7	16.9	18.8
31 TA-3	19	0	27.4	1.6	16.5	13.5
32 TA-48	25	0	31.4	3.9	11.6	12.3
33 Area AB	6	0	14.5	7.1	11.8	6.0
49 TA-36 Sludge Pond	18	0	37.7	3.8	15.2	16.5
Group Summary	302	0	133.6	1.6	14.2	4.0

Table 4-7. Airborne Long-Lived Gross Beta Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (fCi/m^3)	Minimum (fCi/m^3)	Mean (fCi/m^3)	2s
Area G Stations						
27 TA-54, Area G	24	0	27.4	3.7	13.0	10.9
34 Area G-1, NE Corner	25	0	40.9	3.4	15.5	16.8
35 Area G-2, South Fence	25	0	33.0	7.5	14.1	11.3
36 Area G-3, Gate	25	0	44.8	8.2	15.7	14.8
37 Area G-4, Water Tank	23	0	53.6	6.3	15.0	18.8
44 Area G (S Perimeter)	18	0	20.0	3.4	10.7	9.5
45 Area G (SE Perimeter)	25	0	40.4	4.5	14.8	14.8
46 Area G (E Perimeter)	20	0	29.7	4.0	13.1	12.4
47 Area G (N Perimeter)	25	0	43.8	4.9	14.8	16.5
50 Area G	21	0	35.5	3.8	14.3	15.5
51 Area G	21	0	43.8	6.7	13.7	16.4
52 Area G	16	0	17.7	8.4	11.2	5.4
Group Summary	268	0	53.6	3.4	13.8	3.2
Decontamination and Decommissioning						
71 TA-21.01	25	0	31.2	5.7	13.6	12.9
72 TA-21.02	25	0	30.3	5.4	13.7	11.5
73 TA-21.03	24	0	29.6	6.1	13.2	10.9
74 TA-21.04	23	0	36.1	7.3	14.9	13.0
75 TA-21.05	25	0	35.3	6.9	14.3	12.7
Group Summary	122	0	36.1	5.4	14.0	1.3
TA-15 Firing Sites						
76 TA-15-41	23	0	29.1	8.4	14.3	9.8
77 IJ Site	23	0	31.2	8.9	14.2	11.3
78 TA-15-vacant	24	0	25.0	8.3	13.2	8.6
Group Summary	70	0	31.2	8.3	13.9	1.2

Concentration Guidelines are not available for gross beta concentrations.

Table 4-8. Airborne Tritium as Tritiated Water Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (pCi/m^3)	Minimum (pCi/m^3)	Mean (pCi/m^3)	2s
Regional Stations						
01 Española	18	9	8.6	−1.4[a]	1.4	4.9
02 Pojoaque	24	17	4.5	−1.5	0.7	3.1
03 Santa Fe	21	15	3.5	−0.9	0.4	2.0
Group Summary	63	41	8.6	−1.5	0.8	1.0
Pueblo Stations						
41 Pueblo of San Ildefonso	23	13	70.4	−2.6	5.1	30.5
42 Taos Pueblo	14	9	7.0	−0.7	0.9	3.8
48 Jemez Pueblo	22	15	9.8	−1.6	1.4	5.8
Group Summary	59	37	70.4	−2.6	2.4	4.6
Perimeter Stations						
04 Barranca School	22	9	9.6	−1.2	1.5	5.1
05 Urban Park	22	10	22.5	−1.3	2.2	9.8
06 48th Street	25	13	22.9	−3.2	1.5	9.4
07 Los Alamos Shell Station	24	11	2.7	−1.1	0.8	1.9
08 McDonald's Restaurant	23	8	43.8	−1.4	6.0	20.7
09 Los Alamos Airport	21	5	59.0	−2.2	8.0	28.9
10 East Gate	21	5	33.1	−1.0	5.3	14.9
11 Well PM-1	25	10	23.1	−0.6	2.4	9.4
12 Royal Crest Trailer Court	23	10	11.6	−1.1	2.0	5.6
13 Piñon School	20	7	9.4	−2.1	2.8	6.5
14 Pajarito Acres	9	1	12.6	0.9	3.7	7.4
15 White Rock Fire Station	24	13	7.4	−1.0	1.4	3.9
16 Nazarene Church	19	7	12.2	−0.5	2.3	6.7
17 Bandelier National Monument	22	11	6.1	−1.3	1.4	3.7
60 LA Canyon	8	3	3.0	−0.1	1.3	2.0
61 LA Hospital	15	9	38.3	−2.2	3.1	19.8
62 Trinity Bible Church	13	7	5.4	0.0	1.8	2.9
63 Monte Rey South	12	6	3.2	0.0	1.1	2.1
Group Summary	348	145	59.0	−3.2	2.7	3.9
On-Site Stations						
19 TA-21 DP Site	24	0	58.1	2.5	17.9	31.3
20 TA-21 Area B	23	4	12.8	−0.7	3.8	7.8
21 TA-6	23	15	58.4	−1.9	3.6	24.8
22 TA-53, LANSCE (formerly LAMPF)	24	7	13.4	0.0	2.7	5.8
23 TA-52, Beta Site	23	10	8.9	−1.0	2.4	5.3
25 TA-16-450	21	1	820.5	0.0	178.8	525.1
26 TA-49	23	6	17.9	0.0	3.4	8.8
28 TA-33, HP Site	22	9	19.8	0.0	3.5	9.2
29 TA-2, Omega Site	12	3	13.9	−1.1	3.4	8.2
30 Booster P-2	25	10	7.8	0.0	1.9	3.9
31 TA-3	19	8	45.8	−1.4	6.0	21.1
32 TA-48	23	10	14.7	−0.5	1.8	6.2
33 Area AB	6	3	4.0	−3.2	0.9	4.9
49 TA-36 Sludge Pond	18	12	7.3	−1.0	1.3	4.7
Group Summary	286	98	820.5	−3.2	16.5	93.8

Table 4-8. Airborne Tritium as Tritiated Water Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (pCi/m^3)	Minimum (pCi/m^3)	Mean (pCi/m^3)	2s
TA-54, Area G	21	1	57.6	1.7	18.4	31.2
34 Area G-1, NE Corner	24	0	94.1	1.2	12.7	38.7
35 Area G-2, South Fence	25	0	1,889.8	4.7	370.5	974.8
36 Area G-3, Gate	25	5	1,136.1	–0.4	49.3	453.0
37 Area G-4, Water Tank	20	2	32.1	0.0	8.8	16.5
44 Area G (S Perimeter)	17	0	44.5	1.5	12.8	26.8
45 Area G (SE Perimeter)	24	1	134.7	0.7	15.5	53.1
46 Area G (E Perimeter)	20	3	24.8	0.0	7.0	13.4
47 Area G (N Perimeter)	23	1	54.5	1.4	17.2	27.3
50 Area G	20	1	52.7	1.3	6.9	22.8
51 Area G	20	6	9.9	–0.7	3.2	5.5
52 Area G	15	10	3.6	–0.6	1.3	2.8
Group Summary	254	30	1,889.8	–0.7	43.6	207.3
Decontamination and Decommissioning						
71 TA-21.01	23	3	10.6	–0.7	2.6	5.3
72 TA-21.02	24	4	12.2	–0.5	2.7	5.6
73 TA-21.03	25	1	68.2	0.5	11.7	27.4
74 TA-21.04	22	3	51.8	0.0	11.0	26.4
75 TA-21.05	23	3	16.7	0.0	6.2	9.7
Group Summary	117	14	68.2	–0.7	6.8	8.8
TA-15 Firing Sites						
76 TA-15-41	23	14	32.0	–0.8	2.2	13.2
77 IJ Site	23	12	118.9	–0.6	6.0	49.2
78 TA-15-vacant	21	10	9.9	–0.8	1.3	4.4
Group Summary	67	36	118.9	–0.8	3.2	5.0

Concentration Guidelines.
Controlled Area DOE Derived Air Concentration Guide 20,000,000 pCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 100,000 pCi/m^3.
EPA 40 CFR 61 *Concentration Guide* 1,500 pCi/m^3.

[a]See Appendix B for a discussion of negative values.

Table 4-9. Airborne Plutonium-238 Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Regional Stations						
01 Española	4	2	109.1	1.7	28.9	106.8
02 Pojoaque	4	3	5.4	–1.4[a]	1.8	5.8
03 Santa Fe	4	1	28.4	0.0	6.3	13.3
Group Summary	12	6	109.1	–1.4	12.3	29.1
Pueblo Stations						
41 Pueblo of San Ildefonso	4	3	2.7	0.0	1.4	2.2
42 Taos Pueblo	3	2	2.2	–2.3	0.7	5.2
48 Jemez Pueblo	3	3	2.2	0.0	1.3	2.3
Group Summary	10	8	2.7	–2.3	1.1	0.8
Perimeter Stations						
04 Barranca School	4	2	7.9	1.2	3.4	6.2
05 Urban Park	4	2	13.2	0.6	4.7	11.6
06 48th Street	4	3	2.6	1.2	1.6	1.4
07 Los Alamos Shell Station	4	2	3.9	0.0	2.7	3.7
08 McDonald's Restaurant	4	4	2.1	–1.3	0.6	3.2
09 Los Alamos Airport	4	3	3.5	1.2	2.5	1.9
10 East Gate	4	2	4.0	0.0	1.9	3.3
11 Well PM-1	4	3	6.1	0.0	1.8	5.8
12 Royal Crest Trailer Court	3	3	3.0	1.8	2.3	1.2
13 Piñon School	4	3	10.2	1.0	4.2	8.2
14 Pajarito Acres	1	1	1.4	1.4	1.4	
15 White Rock Fire Station	4	0	5.1	1.8	3.1	2.9
16 Nazarene Church	4	2	3.5	1.5	2.2	1.9
17 Bandelier National Monument	4	3	2.8	0.7	1.7	1.8
60 LA Canyon	1	0	2.1	2.1	2.1	
61 LA Hospital	2	1	2.2	1.2	1.7	1.5
62 Trinity Bible Church	2	0	4.9	2.3	3.6	3.7
63 Monte Rey South	2	2	3.4	1.7	2.5	2.3
Group Summary	59	36	13.2	–1.3	2.4	2.1
On-Site Stations						
19 TA-21 DP Site	4	2	5.2	0.0	2.6	4.2
20 TA-21 Area B	4	2	4.5	1.7	2.8	2.7
21 TA-6	4	4	7.2	0.9	3.3	5.4
22 TA-53, LANSCE (formerly LAMPF)	4	2	6.9	1.3	3.2	5.1
23 TA-52, Beta Site	4	3	2.6	1.4	2.0	1.3
25 TA-16-450	4	3	3.6	0.0	2.1	3.5
26 TA-49	4	2	5.1	0.0	2.8	4.5
28 TA-33, HP Site	4	3	6.4	0.0	2.0	5.9
29 TA-2, Omega Site	3	3	3.1	1.6	2.2	1.6
30 Booster P-2	4	3	4.0	–2.6	0.9	5.8
31 TA-3	2	1	2.4	1.5	2.0	1.3
32 TA-48	4	1	5.3	0.0	2.6	4.3
33 Area AB	1	1	0.0	0.0	0.0	
49 TA-36 Sludge Pond	3	2	4.3	0.0	2.1	4.3
Group Summary	49	32	7.2	–2.6	2.2	1.7

Table 4-9. Airborne Plutonium-238 Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Area G Stations						
27 TA-54, Area G	4	1	9.1	5.0	6.8	3.5
34 Area G-1, NE Corner	4	0	7.1	2.9	5.4	3.8
35 Area G-2, South Fence	4	2	5.5	1.9	3.3	3.2
36 Area G-3, Gate	4	3	4.3	1.0	2.9	2.8
37 Area G-4, Water Tank	4	3	4.3	0.7	2.7	3.2
44 Area G (S Perimeter)	3	3	4.5	1.6	2.7	3.3
45 Area G (SE Perimeter)	4	2	6.0	–1.3	1.8	6.5
46 Area G (E Perimeter)	3	1	14.8	0.0	7.5	14.8
47 Area G (N Perimeter)	4	2	4.7	0.0	2.7	4.7
50 Area G	3	2	2.1	–2.5	0.4	5.5
51 Area G	3	1	3.8	2.3	3.0	1.5
52 Area G	2	2	2.6	1.4	2.0	1.7
Group Summary	42	22	14.8	–2.5	3.4	4.2
Decontamination and Decommissioning						
71 TA-21.01	4	3	2.4	1.2	1.7	1.1
72 TA-21.02	4	2	5.2	1.3	2.6	3.6
73 TA-21.03	4	2	6.2	1.3	3.3	4.2
74 TA-21.04	4	2	6.4	1.4	4.0	4.4
75 TA-21.05	4	1	7.4	2.5	4.2	4.6
Group Summary	20	10	7.4	1.2	3.2	2.1
TA-15 Firing Sites						
76 TA-15-41	4	3	4.5	0.0	2.1	3.9
77 IJ Site	4	2	4.7	0.0	2.6	4.0
78 TA-15-vacant	4	3	5.8	–5.0	0.9	9.2
Group Summary	12	8	5.8	–5.0	1.9	1.7

Concentration Guidelines.
Controlled Area DOE Derived Air Concentration Guide 3,000,000 aCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 30,000 aCi/m^3.
EPA 40 CFR 61 Concentration Guide 2,100 aCi/m^3.

[a]See Appendix B for a discussion of negative values.

Table 4-10. Airborne Plutonium-239,-240 Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Regional Stations						
01 Española	4	2	1,219.3	–0.3[a]	305.6	1218.3
02 Pojoaque	4	2	7.3	–1.4	2.3	7.4
03 Santa Fe	4	2	41.7	0.2	14.0	38.7
Group Summary	12	6	1,219.3	–1.4	107.3	343.6
Pueblo Stations						
41 Pueblo of San Ildefonso	4	2	15.0	–0.3	5.9	14.5
42 Taos Pueblo	3	2	7.0	–0.1	2.3	8.1
48 Jemez Pueblo	3	2	3.7	0.9	1.9	3.1
Group Summary	10	6	15.0	–0.3	3.4	4.4
Perimeter Stations						
04 Barranca School	4	2	39.5	0.4	11.4	37.6
05 Urban Park	4	3	4.2	0.1	2.0	3.4
06 48th Street	4	2	8.1	0.0	2.4	7.7
07 Los Alamos Shell Station	4	2	4.7	–1.4	1.6	5.3
08 McDonald's Restaurant	4	3	10.5	0.0	3.4	9.7
09 Los Alamos Airport	4	2	5.0	1.4	2.8	3.2
10 East Gate	4	4	0.7	0.0	0.2	0.7
11 Well PM-1	4	3	10.4	1.2	3.5	9.2
12 Royal Crest Trailer Court	3	2	3.7	0.0	1.8	3.7
13 Piñon School	4	2	88.0	–0.8	22.3	87.7
14 Pajarito Acres	1	1	0.0	0.0	0.0	
15 White Rock Fire Station	4	3	27.7	–1.0	7.2	27.5
16 Nazarene Church	4	4	2.2	0.3	1.3	1.6
17 Bandelier National Monument	4	3	4.8	0.0	1.8	4.3
60 LA Canyon	1	1	0.3	0.3	0.3	
61 LA Hospital	2	2	2.4	0.3	1.3	3.0
62 Trinity Bible Church	2	0	4.7	2.8	3.7	2.8
63 Monte Rey South	2	2	1.8	1.2	1.5	0.9
Group Summary	59	41	88.0	–1.4	3.8	10.7
On-Site Stations						
19 TA-21 DP Site	4	2	8.2	0.0	2.7	7.7
20 TA-21 Area B	4	1	4.7	0.0	3.1	4.3
21 TA-6	4	3	33.1	0.2	8.9	32.3
22 TA-53, LANSCE (formerly LAMPF)	4	2	24.2	0.9	7.6	22.3
23 TA-52, Beta Site	4	3	10.5	–1.5	2.4	11.0
25 TA-16-450	4	3	3.5	0.0	1.2	3.2
26 TA-49	4	4	1.5	0.4	1.1	1.0
28 TA-33, HP Site	4	2	43.6	0.8	13.3	40.9
29 TA-2, Omega Site	3	2	9.4	0.6	4.0	9.4
30 Booster P-2	4	4	1.7	–1.3	0.2	2.5
31 TA-3	2	2	1.1	0.6	0.9	0.7
32 TA-48	4	1	36.1	1.1	10.6	34.1
33 Area AB	1	1	2.3	2.3	2.3	
49 TA-36 Sludge Pond	3	3	1.3	0.3	0.9	1.1
Group Summary	49	33	43.6	–1.5	4.2	8.3

Table 4-10. Airborne Plutonium-239 Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Area G Stations						
27 TA-54, Area G	4	0	151.9	51.3	108.0	84.3
34 Area G-1, NE Corner	4	3	9.7	0.4	4.0	8.1
35 Area G-2, South Fence	4	3	3.0	0.0	1.2	2.6
36 Area G-3, Gate	4	3	11.0	0.8	4.1	9.5
37 Area G-4, Water Tank	4	3	6.2	–0.2	2.1	5.6
44 Area G (S Perimeter)	3	1	7.1	1.5	5.1	6.3
45 Area G (SE Perimeter)	4	0	32.6	10.7	17.8	20.1
46 Area G (E Perimeter)	3	1	7.4	0.0	4.8	8.3
47 Area G (N Perimeter)	4	0	11.0	2.7	6.5	8.9
50 Area G	3	0	6.4	3.7	5.2	2.7
51 Area G	3	2	15.4	0.6	6.3	16.0
52 Area G	2	1	7.7	0.4	4.0	10.3
Group Summary	42	16	151.9	–0.2	14.1	59.8
Decontamination and Decommissioning						
71 TA-21.01	4	2	3.6	0.0	2.1	3.1
72 TA-21.02	4	0	14.1	2.6	6.0	10.9
73 TA-21.03	4	0	21.5	8.2	13.4	12.4
74 TA-21.04	4	0	37.7	7.0	20.1	25.7
75 TA-21.05	4	1	43.0	1.5	16.3	36.6
Group Summary	20	3	43.0	0.0	11.6	14.8
TA-15 Firing Sites						
76 TA-15-41	4	2	11.9	–1.9	3.3	12.2
77 IJ Site	4	3	69.5	0.3	17.0	64.8
78 TA-15-vacant	4	3	1.6	0.4	1.1	1.0
Group Summary	12	8	69.5	–1.9	7.1	17.2

Concentration Guidelines.
Controlled Area DOE Derived Air Concentration Guide 2,000,000 aCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 20,000 aCi/m^3.
EPA 40 CFR 61 Concentration Guide 1,900 aCi/m^3.

[a] See Appendix B for a discussion of negative values.

Table 4-11. Airborne Americium-241 Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Regional Stations						
01 Española	3	0	373.1	3.3	127.1	426.1
02 Pojoaque	2	0	3.9	3.7	3.8	0.3
03 Santa Fe	4	0	13.6	5.5	8.3	7.5
Group Summary	9	0	373.1	3.3	46.4	139.8
Pueblo Stations						
41 Pueblo of San Ildefonso	4	1	6.7	2.7	4.7	3.8
42 Taos Pueblo	3	1	7.0	3.5	4.9	3.7
48 Jemez Pueblo	3	1	6.5	0.0	3.6	6.6
Group Summary	10	3	7.0	0.0	4.4	1.4
Perimeter Stations						
04 Barranca School	2	0	3.8	3.2	3.5	0.9
05 Urban Park	2	0	4.9	3.0	4.0	2.7
06 48th Street	2	0	2.8	2.7	2.8	0.3
07 Los Alamos Shell Station	2	0	5.6	4.4	5.0	1.7
08 McDonald's Restaurant	2	0	5.4	5.2	5.3	0.2
09 Los Alamos Airport	4	1	5.2	1.4	3.4	3.1
10 East Gate	4	0	5.2	3.5	4.0	1.6
11 Well PM-1	2	1	6.7	4.2	5.5	3.5
12 Royal Crest Trailer Court	3	0	4.0	2.7	3.5	1.4
13 Piñon School	4	1	32.1	3.3	11.4	27.7
14 Pajarito Acres	1	0	2.0	2.0	2.0	
15 White Rock Fire Station	4	0	11.3	3.0	5.7	7.6
16 Nazarene Church	4	2	4.9	0.0	3.4	4.5
17 Bandelier National Monument	3	1	4.3	2.8	3.7	1.5
60 LA Canyon	1	0	4.3	4.3	4.3	
61 LA Hospital	2	0	6.3	3.0	4.7	4.6
62 Trinity Bible Church	2	0	4.7	4.6	4.7	0.2
63 Monte Rey South	2	0	5.1	4.8	4.9	0.5
Group Summary	46	5	32.1	0.0	4.5	3.9
On-Site Stations						
19 TA-21 DP Site	4	1	11.0	2.6	6.0	7.2
20 TA-21 Area B	4	1	6.7	0.0	3.9	5.6
21 TA-6	4	1	14.4	1.4	5.7	11.8
22 TA-53, LANSCE (formerly LAMPF)	4	0	12.5	3.7	6.1	8.6
23 TA-52, Beta Site	2	0	4.8	2.0	3.4	3.9
25 TA-16-450	3	1	5.5	2.9	4.6	2.9
26 TA-49	4	1	5.1	0.0	3.4	4.7
28 TA-33, HP Site	2	0	4.0	3.8	3.9	0.2
29 TA-2, Omega Site	1	0	5.2	5.2	5.2	
30 Booster P-2	4	1	8.4	1.3	5.4	6.9
31 TA-3	3	0	33.3	4.8	14.4	32.8
32 TA-48	2	0	6.2	4.4	5.3	2.5
49 TA-36 Sludge Pond	3	0	7.8	3.7	5.3	4.5
Group Summary	40	6	33.3	0.0	5.6	5.6

Table 4-11. Airborne Americium-241 Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Area G Stations						
27 TA-54, Area G	4	0	127.5	31.4	82.6	78.8
34 Area G-1, NE Corner	4	0	7.3	3.4	5.6	3.3
35 Area G-2, South Fence	4	2	5.5	0.0	3.7	5.0
36 Area G-3, Gate	4	0	11.0	4.8	7.5	5.5
37 Area G-4, Water Tank	4	2	13.0	3.4	6.8	8.5
44 Area G (S Perimeter)	3	3	7.1	6.0	6.5	1.1
45 Area G (SE Perimeter)	4	1	9.3	2.7	5.7	6.3
46 Area G (E Perimeter)	3	2	7.4	3.4	5.0	4.3
47 Area G (N Perimeter)	4	2	10.1	4.1	6.6	5.5
50 Area G	3	0	6.4	4.5	5.9	2.8
51 Area G	3	0	9.0	4.8	7.1	5.8
52 Area G	2	0	3.7	3.7	3.8	0.2
Group Summary	42	12	127.5	0.0	12.2	44.4
Decontamination and Decommissioning						
71 TA-21.01	4	0	6.9	4.2	5.4	2.4
72 TA-21.02	4	1	8.5	0.0	4.5	7.0
73 TA-21.03	4	0	33.6	5.0	12.9	27.6
74 TA-21.04	4	1	13.9	4.2	7.9	8.3
75 TA-21.05	4	1	14.8	0.0	6.0	12.6
Group Summary	20	3	33.6	0.0	7.3	6.7
TA-15 Firing Sites						
76 TA-15-41	2	0	5.8	5.1	5.4	1.0
77 IJ Site	2	0	4.2	3.6	3.9	0.8
78 TA-15-vacant	2	0	5.5	3.8	4.7	2.5
Group Summary	6	0	5.8	3.6	4.7	1.6

Concentration Guidelines.
Controlled Area DOE Derived Air Concentration Guide 2,000,000 aCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 20,000 aCi/m^3.
EPA 40 CFR 61 Concentration Guide 1,900 aCi/m^3.

Table 4-12. Airborne Uranium-234 Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Regional Stations						
01 Española	4	0	23.6	8.1	15.7	12.7
02 Pojoaque	4	0	72.1	18.3	42.7	46.8
03 Santa Fe	4	0	41.6	13.0	28.8	23.6
Group Summary	12	0	72.1	8.1	29.1	27.0
Pueblo Stations						
41 Pueblo of San Ildefonso	4	0	25.1	16.4	21.2	27.0
42 Taos Pueblo	3	0	35.1	19.6	25.8	16.4
48 Jemez Pueblo	3	0	37.0	31.2	34.1	5.8
Group Summary	10	0	37.0	16.4	27.0	13.0
Perimeter Stations						
04 Barranca School	4	0	12.5	8.4	10.5	4.0
05 Urban Park	4	0	21.2	7.3	13.6	13.0
06 48th Street	4	1	8.1	3.0	5.2	4.8
07 Los Alamos Shell Station	4	1	14.3	4.3	9.6	9.2
08 McDonald's Restaurant	4	2	13.2	2.6	8.2	10.6
09 Los Alamos Airport	4	0	14.4	5.8	9.4	8.3
10 East Gate	4	0	19.4	5.2	9.8	13.0
11 Well PM-1	4	1	10.8	6.0	7.7	4.5
12 Royal Crest Trailer Court	3	0	21.7	6.1	11.7	17.2
13 Piñon School	4	1	20.2	4.4	9.9	14.1
14 Pajarito Acres	1	0	8.8	8.8	8.8	
15 White Rock Fire Station	4	1	14.4	2.0	7.7	10.7
16 Nazarene Church	4	2	20.7	2.5	8.8	16.3
17 Bandelier National Monument	4	1	13.6	2.9	7.4	8.9
60 LA Canyon	1	0	7.4	7.4	7.4	
61 LA Hospital	2	0	21.0	13.0	17.0	11.3
62 Trinity Bible Church	2	0	9.5	8.1	8.8	1.9
63 Monte Rey South	2	1	8.6	3.9	6.3	6.7
Group Summary	59	11	21.7	2.0	9.3	5.4
On-Site Stations						
19 TA-21 DP Site	4	1	22.0	2.6	10.9	16.2
20 TA-21 Area B	4	0	25.2	6.4	14.2	18.3
21 TA-6	4	0	13.0	6.2	9.0	6.1
22 TA-53, LANSCE (formerly LAMPF)	4	0	10.4	4.2	7.0	6.3
23 TA-52, Beta Site	4	0	24.8	4.1	15.0	18.0
25 TA-16-450	4	1	19.3	5.0	10.7	13.3
26 TA-49	4	2	22.7	1.4	8.0	19.8
28 TA-33, HP Site	4	1	11.5	1.3	6.6	8.4
29 TA-2, Omega Site	3	0	42.2	3.9	19.4	40.4
30 Booster P-2	4	1	11.9	5.6	9.2	6.3
31 TA-3	3	0	14.3	7.7	10.5	6.8
32 TA-48	4	0	63.6	5.3	29.8	51.6
33 Area AB	1	0	11.4	11.4	11.4	
49 TA-36 Sludge Pond	3	0	33.4	8.9	20.2	24.7
Group Summary	50	6	63.6	1.3	13.0	12.8

Table 4-12. Airborne Uranium-234 Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Area G Stations						
27 TA-54, Area G	4	0	48.2	19.8	36.3	28.2
34 Area G-1, NE Corner	4	0	50.7	13.6	27.7	32.1
35 Area G-2, South Fence	4	0	21.1	6.9	12.4	12.6
36 Area G-3, Gate	4	0	50.4	20.0	35.2	30.8
37 Area G-4, Water Tank	4	0	21.7	5.4	11.0	14.6
44 Area G (S Perimeter)	3	0	42.5	21.8	29.0	23.4
45 Area G (SE Perimeter)	4	0	58.2	5.3	30.7	46.8
46 Area G (E Perimeter)	3	0	50.0	27.1	35.5	25.2
47 Area G (N Perimeter)	4	0	55.0	10.9	27.4	40.7
50 Area G	3	0	42.0	26.6	35.8	16.2
51 Area G	3	0	54.0	27.7	37.3	28.5
52 Area G	2	0	13.2	6.4	9.8	9.6
Group Summary	42	0	58.2	5.3	27.4	20.9
Decontamination and Decommissioning						
71 TA-21.01	4	0	10.8	4.3	8.8	6.1
72 TA-21.02	4	1	80.5	1.7	28.1	71.2
73 TA-21.03	4	0	33.2	15.0	22.4	17.2
74 TA-21.04	4	0	34.0	15.9	26.5	15.8
75 TA-21.05	4	0	29.7	10.2	20.7	16.5
Group Summary	20	1	80.5	1.7	21.3	15.2
TA-15 Firing Sites						
76 TA-15-41	4	1	6.6	5.6	6.0	1.0
77 IJ Site	4	0	49.4	12.8	22.3	36.1
78 TA-15-vacant	4	0	8.7	5.4	7.6	2.9
Group Summary	12	1	49.4	5.4	11.9	18.0

Concentration Guidelines.
Controlled Area DOE Derived Air Concentration Guide 20,000,000 aCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 90,000 aCi/m^3.
EPA 40 CFR 61 Concentration Guide 7,700 aCi/m^3.

Table 4-13. Airborne Uranium-235 Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Regional Stations						
01 Española	4	3	2.4	1.3	1.7	1.0
02 Pojoaque	4	1	3.8	1.4	2.2	2.2
03 Santa Fe	4	3	5.8	0.0	1.8	5.6
Group Summary	12	7	5.8	0.0	1.9	0.6
Pueblo Stations						
41 Pueblo of San Ildefopnso	4	3	2.9	0.0	1.4	2.4
42 Taos Pueblo	3	2	2.6	0.0	1.4	2.6
48 Jemez Pueblo	3	3	1.8	0.0	1.2	2.1
Group Summary	10	8	2.9	0.0	1.3	0.2
Perimeter Stations						
04 Barranca School	4	3	5.5	2.0	3.4	3.2
05 Urban Park	4	3	2.8	0.0	0.7	2.8
06 48th Street	4	4	1.4	0.0	0.6	1.5
07 Los Alamos Shell Station	4	3	1.5	0.0	1.0	1.4
08 McDonald's Restaurant	4	4	1.6	0.0	0.7	1.7
09 Los Alamos Airport	4	4	2.5	0.0	0.6	2.5
10 East Gate	4	2	2.8	0.0	1.7	2.6
11 Well PM-1	4	4	1.3	0.0	0.9	1.3
12 Royal Crest Trailer Court	3	3	1.3	0.0	0.4	1.5
13 Piñon School	4	3	2.8	0.0	1.4	2.3
14 Pajarito Acres	1	1	0.0	0.0	0.0	
15 White Rock Fire Station	4	3	1.2	0.0	0.6	1.3
16 Nazarene Church	4	3	2.5	0.0	1.4	2.1
17 Bandelier National Monument	4	4	1.2	0.0	0.3	1.2
60 LA Canyon	1	1	1.5	1.5	1.5	
61 LA Hospital	2	1	3.0	1.4	2.2	2.2
62 Trinity Bible Church	2	2	2.7	0.0	1.4	3.8
63 Monte Rey South	2	2	0.0	0.0	0.0	0.0
Group Summary	59	50	5.5	0.0	1.0	1.7
On-Site Stations						
19 TA-21 DP Site	4	2	4.4	0.0	2.1	3.7
20 TA-21 Area B	4	3	3.4	0.0	1.6	2.8
21 TA-6	4	3	2.9	0.0	1.1	2.8
22 TA-53, LANSCE (formerly LAMPF)	4	3	3.0	0.0	1.4	3.3
23 TA-52, Beta Site	4	4	3.0	1.3	1.8	1.6
25 TA-16-450	4	4	2.5	0.0	1.4	2.1
26 TA-49	4	3	3.8	0.0	1.6	3.1
28 TA-33, HP Site	4	4	1.5	0.0	1.0	1.4
29 TA-2, Omega Site	3	2	3.1	0.0	1.0	3.6
30 Booster P-2	4	3	1.8	0.0	0.9	2.0
31 TA-3	3	2	1.5	0.0	0.5	1.8
32 TA-48	4	4	3.5	0.0	1.5	3.0
33 Area AB	1	1	0.0	0.0	0.0	
49 TA-36 Sludge Pond	3	2	3.9	0.0	1.8	4.0
Group Summary	50	40	4.4	0.0	1.3	1.1

Table 4-13. Airborne Uranium-235 Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Area G Stations						
27 TA-54, Area G	4	2	3.1	1.3	2.2	1.7
34 Area G-1, NE Corner	4	3	2.0	1.4	1.8	0.7
35 Area G-2, South Fence	4	3	2.9	0.0	1.5	2.4
36 Area G-3, Gate	4	3	3.2	1.5	2.0	1.6
37 Area G-4, Water Tank	4	4	2.2	1.5	1.9	0.5
44 Area G (S Perimeter)	3	1	4.7	1.5	3.0	3.2
45 Area G (SE Perimeter)	4	3	4.5	0.0	2.0	3.7
46 Area G (E Perimeter)	3	3	1.9	1.6	1.7	0.2
47 Area G (N Perimeter)	4	3	3.1	0.0	1.6	2.6
50 Area G	3	2	2.5	1.4	1.8	1.3
51 Area G	3	1	2.8	1.3	1.9	1.7
52 Area G	2	1	1.3	1.1	1.2	0.3
Group Summary	42	29	4.7	0.0	1.9	0.9
Decontamination and Decommissioning						
71 TA-21.01	4	4	1.5	0.0	1.0	1.4
72 TA-21.02	4	2	5.9	1.3	2.5	4.5
73 TA-21.03	4	3	2.7	0.0	1.7	2.5
74 TA-21.04	5	3	4.6	0.0	1.9	4.0
75 TA-21.05	4	1	4.4	1.5	2.9	2.4
Group Summary	21	13	5.9	0.0	2.0	1.5
TA-15 Firing Sites						
76 TA-15-41	4	3	1.5	0.0	1.0	2.6
77 IJ Site	4	2	4.6	0.0	2.1	3.9
78 TA-15-vacant	4	4	2.8	−1.4[a]	1.1	3.5
Group Summary	12	9	4.6	−1.4	1.4	1.2

Concentration Guidelines.
Controlled Area DOE Derived Air Concentration Guide 20,000,000 aCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 100,000 aCi/m^3.
EPA 40 CFR 61 Concentration Guide 7,100 aCi/m^3.

[a] See Appendix B for a discussion of negative values.

Table 4-14. Airborne Uranium-238 Concentrations for 1995

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Regional Stations						
01 Española	4	0	22.0	13.0	16.2	8.0
02 Pojoaque	4	0	80.9	15.5	43.3	56.8
03 Santa Fe	4	0	43.7	5.9	24.3	31.5
Group Summary	12	0	80.9	5.9	27.9	27.8
Pueblo Stations						
41 Pueblo of San Ildefonso	4	0	24.7	13.7	17.8	10.1
42 Taos Pueblo	3	0	37.5	19.8	27.4	18.2
48 Jemez Pueblo	3	0	38.8	30.7	34.8	8.1
Group Summary	10	0	38.8	13.7	26.7	27.1
Perimeter Stations						
04 Barranca School	4	1	16.6	3.6	11.7	11.3
05 Urban Park	4	1	19.8	5.9	12.9	15.6
06 48th Street	4	2	7.4	1.2	4.5	6.2
07 Los Alamos Shell Station	4	0	11.1	7.2	9.1	3.2
08 McDonald's Restaurant	4	0	9.2	4.7	7.1	3.8
09 Los Alamos Airport	4	0	17.3	4.6	10.5	10.7
10 East Gate	4	0	28.1	8.4	13.9	19.1
11 Well PM-1	4	0	13.2	3.7	7.7	8.9
12 Royal Crest Trailer Court	3	0	14.0	6.1	9.7	8.0
13 Piñon School	4	1	14.8	5.4	10.2	7.8
14 Pajarito Acres	1	0	7.5	7.5	7.5	
15 White Rock Fire Station	4	0	14.4	5.1	9.7	9.4
16 Nazarene Church	4	0	12.7	5.9	9.1	6.9
17 Bandelier National Monument	4	1	11.1	3.7	6.2	6.8
60 LA Canyon	1	0	5.9	5.9	5.9	
61 LA Hospital	2	0	22.4	18.8	20.6	5.2
62 Trinity Bible Church	2	0	13.5	11.4	12.4	3.0
63 Monte Rey South	2	0	11.8	7.2	9.5	6.5
Group Summary	59	6	28.1	1.2	9.9	7.4
On-Site Stations						
19 TA-21 DP Site	4	0	16.5	6.5	11.2	8.3
20 TA-21 Area B	4	0	15.1	8.4	10.9	5.9
21 TA-6	4	0	14.1	7.1	10.5	6.0
22 TA-53, LANSCE (formerly LAMPF)	4	0	13.5	6.9	10.0	5.6
23 TA-52, Beta Site	4	0	98.3	3.9	30.7	90.9
25 TA-16-450	4	0	11.2	4.2	6.6	6.4
26 TA-49	4	1	8.8	2.6	5.0	5.9
28 TA-33, HP Site	4	0	12.2	5.2	9.4	6.4
29 TA-2, Omega Site	3	1	51.6	6.1	21.8	51.7
30 Booster P-2	4	0	16.9	8.4	11.9	7.8
31 TA-3	3	0	11.9	7.5	9.0	4.9
32 TA-48	4	0	56.5	2.1	19.0	51.1
33 Area AB	1	0	11.4	11.4	11.4	
49 TA-36 Sludge Pond	3	0	22.3	2.6	12.2	19.7
Group Summary	50	2	98.3	2.1	12.8	13.4

Table 4-14. Airborne Uranium-238 Concentrations for 1995 (Cont.)

Station Location	Number of Results	Number of Results <MDA	Maximum (aCi/m^3)	Minimum (aCi/m^3)	Mean (aCi/m^3)	2s
Area G Stations						
27 TA-54, Area G	4	0	54.2	11.6	36.2	36.4
34 Area G-1, NE Corner	4	0	36.5	19.0	28.1	14.8
35 Area G-2, South Fence	4	1	15.9	2.8	11.3	12.0
36 Area G-3, Gate	4	0	42.6	18.0	30.3	20.5
37 Area G-4, Water Tank	4	1	19.5	4.3	11.7	13.0
44 Area G (S Perimeter)	3	0	42.5	22.7	30.3	21.3
45 Area G (SE Perimeter)	4	0	54.6	14.7	41.9	37.3
46 Area G (E Perimeter)	3	0	59.2	20.4	37.9	39.4
47 Area G (N Perimeter)	4	0	62.8	20.5	32.7	40.6
50 Area G	3	0	38.1	29.4	33.5	8.8
51 Area G	3	0	56.5	24.6	39.4	32.2
52 Area G	2	0	12.1	3.9	8.0	11.7
Group Summary	42	2	62.8	2.8	28.4	23.3
Decontamination and Decommissioning						
71 TA-21.01	4	0	10.8	5.5	7.4	4.8
72 TA-21.02	4	0	14.5	6.1	10.2	7.4
73 TA-21.03	4	0	22.3	5.8	11.7	14.6
74 TA-21.04	4	0	19.7	9.2	13.7	9.5
75 TA-21.05	4	0	21.9	10.4	13.8	10.9
Group Summary	20	0	22.3	5.5	11.0	5.4
TA-15 Firing Sites						
76 TA-15-41	4	1	9.9	5.6	7.3	4.0
77 IJ Site	4	0	328.6	28.1	120.7	279.2
78 TA-15-vacant	4	1	10.0	3.1	5.7	6.0
Group Summary	12	2	328.6	3.1	44.6	131.9

Concentration Guidelines.
Controlled Area DOE Derived Air Concentration Guide 20,000,000 aCi/m^3.
Uncontrolled Area DOE Derived Air Concentration Guide 100,000 aCi/m^3.
EPA 40 CFR 61 Concentration Guide 8,300 aCi/m^3.

Table 4-15. Airborne Uranium Concentration Conversion Factors

Multiply # of	by	to obtain # of
mCi/mL ^{234}U	1.60×10^{14}	pg/m^3 ^{234}U
mCi/mL ^{235}U	4.63×10^{17}	pg/m^3 ^{235}U
mCi/mL ^{238}U	2.98×10^{18}	pg/m^3 ^{238}U

Table 4-16. Estimated Air Concentrations of Depleted Uranium Resulting from Dynamic Experiments

Element	1995 Total Usage (Ci)	Fraction Released (%)	Annual Average Concentration (aCi/m^3) (4 km)	(8 km)	EPA Concentration Limit (aCi/m^3)
^{234}U	4.5×10^{-3}	10	5.2	1.8	7,700
^{235}U	7.8×10^{-4}	10	0.84	0.29	7,100
^{238}U	4.8×10^{-2}	10	49	17	8,300

Table 4-17. Analytical Chemistry Requirements for 1995 Stack Air Sampling

Analysis Required	1995 Samples Analyzed	Technique or Instrument	Typical Count Time	Target MDA[a]
Weekly Samples:				
Alpha	3,275	Proportional Counter	10 min	3 pCi
Beta	2,700	Proportional Counter	10 min	5 pCi
Tritium	2,550	Distillation and Liquid Scintillation	10 min	0.04 Ci/L[b]
Gamma Spec.	2,900	High-Purity Germanium	1,000 s	varies by isotope
Composites Samples:				
^{241}Am	125	Radiochemistry and Alpha Spec.	1,000 min	1 pCi
^{210}Pb	125	Radiochemistry and Proportional Counter	100–800 min	1 pCi
^{238}Pu	125	Radiochemistry and Alpha Spec.	1,000 min	0.5 pCi
$^{239,240}Pu$	125	Radiochemistry and Alpha Spec.	1,000 min	0.5pCi
^{90}Sr	125	Radiochemistry and Proportional Counter	100–800 min	0.5pCi
^{234}U	125	Radiochemistry and Alpha Spec.	1,000 min	1 pCi
^{235}U	125	Radiochemistry and Alpha Spec.	1,000 min	1 pCi
^{238}U	125	Radiochemistry and Alpha Spec.	1,000 min	1 pCi
Alpha	125	Radiochemistry and Proportional Counter	400 min	15 pCi
Beta	125	Radiochemistry and Proportional Counter	400 min	10 pCi

[a]MDA = minimum detectable activity.
[b]L refers to the volume (Liters) of ethylene glycol.

Table 4-18. Blank Sample Performance for 1995 Stack Composites

Analyte	Type of Blank	Number in 1995	Expected[a] Result	Average[a] Result (pCi)	Average MDA[b] Reported (pCi)
Alpha	Reagent Blank	14	0	–1	3
	Filter Blank	15	0	2	11
	Field Blank	2	0	9	17
Beta	Reagent Blank	14	0	–3	5
	Filter Blank	15	0	12	6
	Field Blank	2	0	37	4
^{241}Am	Reagent Blank	12	0	0.2	0.7
	Filter Blank	13	0	0.2	1.1
	Field Blank	2	0	0.3	0.5
^{210}Pb	Reagent Blank	13	0	0.1	0.4
	Filter Blank	14	0	0.4	0.7
	Field Blank	2	0	0.5	0.5
^{238}Pu	Reagent Blank	12	0	0.09	0.42
	Filter Blank	13	0	0.15	0.34
	Field Blank	2	0	0.30	0.54
^{239}Pu	Reagent Blank	12	0	0.02	0.19
	Filter Blank	13	0	0.05	0.25
	Field Blank	2	0	0.2	0.3
^{90}Sr	Reagent Blank	13	0	0.0	0.2
	Filter Blank	14	0	0.1	0.2
	Field Blank	2	0	0.1	0.2
^{234}U	Reagent Blank	12	0	0.7	0.4
	Filter Blank	12	0	1.0	0.3
	Field Blank	2	0	0.7	0.3
^{235}U	Reagent Blank	12	0	0.2	0.3
	Filter Blank	12	0	0.2	0.3
	Field Blank	2	0	0.1	0.2
^{238}U	Reagent Blank	12	0	0.2	0.4
	Filter Blank	12	0	0.4	0.4
	Field Blank	2	0	0.8	0.3

[a]Significant figures vary by isotope, but each is reported to the level justified by the repeatability (standard deviation) of the replicate analyses.
[b]MDA = minimum detectable activity.

Table 4-19. Percent Spike Recovery for 1995 Stack Air Emissions

Analyte[a]	Type of Spike	Number in 1995	Spike Added (pCi)	Average Spike[b] Recovery (pCi)	Percent Spike Recovery[b] Average% ± 1 Sigma%
Alpha	Reagent Spike	4	1,200	1,100	99 ± 9%
	Filter Spike	24	1,200	1,100	95 ± 15%
Beta	Reagent Spike	4	1,100	1,100	99 ± 4%
	Filter Spike	3	550	560	101 ± 2%
	Filter Spike	24	1,100	1,000	94 ± 7%
^{241}Am	Reagent Spike	4	75	73	97 ± 4%
	Filter Spike	8	72	72	101 ± 4%
	Filter Spike	37	75	75	100 ± 15%
^{210}Pb	Reagent Spike	4	24	27	110 ± 5%
	Filter Spike	24	24	26	105 ± 10%
	Filter Spike	10	29	30	102 ± 6%
	Filter Spike	2	49	49	99 ± 4%
^{239}Pu	Reagent Spike	4	65	72	112 ± 10%
	Filter Spike	26	65	71	109 ± 9%
^{234}U	Reagent Spike	4	103	109	106 ± 7%
	Filter Spike	32	103	104	101 ± 5%
^{238}U	Reagent Spike	5	103	110	107 ± 3%
	Filter Spike	31	103	108	104 ± 4%
^{90}Sr	Reagent Spike	5	29	28	99 ± 1%
	Filter Spike	33	30	30	101 ± 6%
	Filter Spike	2	59	49	83 ± 5%

[a]This laboratory does not spike with ^{238}Pu or ^{235}U because performance of the chemistry is believed to be adequtely characterized by use of any isotope of the particular element.

[b]Significant figures vary by isotope, but each is reported to the level justified by the repeatability (standard deviation) of the replicate analyses.

Table 4-20. Airborne Radioactive Emissions from Laboratory Buildings with Sampled Stacks in 1995 (Ci)[a]

TA-Bldg.	^{3}H[b]	^{241}Am	Total Pu[c]	Total U[d]	^{90}Sr	P/VAFP[e]	G/MAP[f]
TA-03-016	2.25 E + 00						
TA-03-029		4.01 E – 06	5.35 E – 05	1.30 E – 04	6.75 E – 06	9.38 E – 04	
TA-03-035				4.08 E – 07	1.46 E – 08		
TA-03-066				2.19 E – 05	2.55 E – 07		
TA-03-102			7.67 E – 11	1.56 E – 07	6.49 E – 10		
TA-03-141		6.65 E – 09	4.81 E – 08	4.21 E – 07	3.01 E – 08		
TA-16-205	8.90 E + 01						
TA-21-004				1.01 E – 06			
TA-21-005					5.36 E – 07		
TA-21-150				8.12 E – 08			
TA-21-155	4.75 E + 01						
TA-21-209	6.64 E + 02						
TA-21-257		7.72 E – 09	8.24 E – 09	3.57 E – 07	3.58 E – 09		
TA-21-313			3.63 E – 08	2.17 E – 07			
TA-21-314			6.91 E – 08		1.25 E – 07		
TA-21-315			5.27 E – 07	2.22 E – 08	3.18 E – 07		
TA-21-324			9.35 E – 11	2.11 E – 08	2.19 E – 09		
TA-33-086	1.09 E + 02						
TA-35-007		3.55 E – 08	2.97 E – 07	6.93 E – 07	9.73 E – 06	1.63 E – 06	
TA-41-001	4.05 E – 01		1.56 E – 08	9.02 E – 09	3.96 E – 08		
TA-41-004	7.81 E + 01						
TA-43-001		2.69 E – 07	5.72 E – 07	1.12 E – 06	1.72 E – 06		
TA-48-001		1.71 E – 06	3.10 E – 06	5.37 E – 07	4.06 E – 07	2.64 E – 02	
TA-50-001		6.26 E – 08	6.45 E – 07		3.09 E – 07		
TA-50-037					1.05 E – 08		
TA-50-066			6.29 E – 09		7.69 E – 09		
TA-50-069			6.99 E – 08		1.81 E – 08		
TA-53-003	1.98 E + 00					2.52 E – 01	4.26 E + 04
TA-53-007	1.19 E + 00					3.54 E – 02	1.02 E + 03
TA-54-002			8.48 E – 10				
TA-55-004	1.56 E + 01	5.45 E – 09	1.63 E – 08		8.79 E – 08		

[a]When a complete year of analysis data was not available, the measured emissions were adjusted to reflect a complete year of sampling.
[b]Includes both gaseous and oxide forms of tritium.
[c]Includes ^{238}Pu, ^{239}Pu and ^{240}Pu.
[d]Includes ^{234}U, ^{235}U and ^{238}U.
[e]P/VAFP—Particulate/vapor activation and fission products, excluding ^{90}Sr.
[f]G/MAP—Gaseous/mixed activation product.

Table 4-21. Detailed Listing of Fission/Activation Products from Laboratory Operations in 1995 (Ci)[a]

TA-Bldg.	Radionuclide	Emission
TA-03-029	^{72}As	2.13 E – 04
	^{7}Be	1.07 E – 04
	^{75}Se	6.18 E – 04
TA-35-007	^{137}Cs	1.63 E – 06
TA-48-001	^{72}As	2.34 E – 04
	^{73}As	1.01 E – 03
	^{74}As	2.55 E – 04
	^{7}Be	1.93 E – 05
	^{77}Br	1.91 E – 05
	^{68}Ge	3.09 E – 04
	^{86}Rb	2.76 E – 05
	^{75}Se	2.45 E – 02
TA-53-003	^{41}Ar	1.90 E + 02
	^{7}B	1.75 E – 02
	^{77}Br	7.70 E – 03
	^{82}Br	2.22 E – 01
	^{10}C	1.35 E + 03
	^{11}C	1.10 E + 04
	^{56}Co	1.02 E – 04
	^{57}Co	3.80 E – 04
	^{58}Co	4.36 E – 04
	^{60}Co	6.95 E – 05
	^{54}Mn	1.32 E – 04
	^{13}N	6.48 E + 03
	^{16}N	2.45 E + 02
	^{14}O	2.75 E + 02
	^{15}O	2.31 E + 04
	^{75}Se	1.61 E – 03
	^{182}Ta	2.15 E – 03
TA-53-007	^{41}Ar	1.58 E + 01
	^{82}Br	3.54 E – 02
	^{10}C	3.92 E – 01
	^{11}C	6.00 E + 02
	^{13}N	2.85 E + 02
	^{14}O	1.48 E + 00
	^{15}O	1.13 E + 02

[a]Excluding ^{90}Sr.

Table 4-22. Thermoluminscent Dosimeter (TLD) Measurements of External Radiation 1993–1995

	TLD Station ID #	Location	1995 Annual Dose (mrem)	1994 Annual Dose (mrem)	1993 Annual Dose (mrem)
Regional	1	Española	100 ± 12[a]	76 ± 13[a,b]	105 ± 12[a]
	2	Pojoaque	114 ± 10	118 ± 13	82 ± 10[b]
	3	Santa Fe	105 ± 10[b]	122 ± 13	109 ± 12
	4	Fenton Hill (TA-57)	51 ± 9[c]	152 ± 13	157 ± 12
	52	West Taos Pueblo	30 ± 10[d]	Out of Service	27 ± 6[d]
	53	Pueblo of San Ildefonso	104 ± 12	113 ± 13	50 ± 10[c]
	54	Jemez Pueblo	114 ± 12	110 ± 13	66 ± 8[c]
Perimeter	5	Barranca School, Los Alamos	139 ± 10	118 ± 13	112 ± 12
	6	Arkansas Avenue, Los Alamos	Discontinued 4th Quarter of 1992		
	7	Cumbres School, Los Alamos	131 ± 10	125 ± 10	124 ± 9
	8	48th Street, Los Alamos	135 ± 8	132 ± 10	126 ± 9
	9	Los Alamos Airport	114 ± 9	110 ± 10	79 ± 7[b]
	10	Bayo Canyon, Los Alamos	149 ± 11	145 ± 13	148 ± 12
	11	Shell Station, Los Alamos	137 ± 9	140 ± 10	174 ± 9
	12	Royal Crest Trailer Court, Los Alamos	127 ± 11	133 ± 13	117 ± 12
	13	White Rock	118 ± 9	124 ± 10	113 ± 11
	14	Pajarito Acres, White Rock	127 ± 11	122 ± 14	126 ± 12
	15	Bandelier National Monument Lookout Station	131 ± 9	143 ± 11	138 ± 9
	16	Pajarito Ski Area	122 ± 12	118 ± 13	120 ± 12
	20	Well PM-1 (SR4 and Truck Rt.)	157 ± 12	148 ± 13	154 ± 12
	41	McDonald's Restaurant, Los Alamos	134 ± 9	128 ± 10	121 ± 9
	42	Los Alamos Airport-South	125 ± 12	123 ± 13	116 ± 12
	43	East Gate Business Park, Los Alamos	126 ± 12	114 ± 13	104 ± 12
	44	Big Rock Loop, Los Alamos	142 ± 10	165 ± 13	147 ± 12
	45	Cheyenne Street, Los Alamos	83 ± 9[c]	160 ± 13	139 ± 12
	46	Los Pueblos Street, Los Alamos	156 ± 12	139 ± 13	82 ± 11[b]
	47	Urban Park, Los Alamos	130 ± 11	135 ± 13	82 ± 10[b]
	48	Los Alamos County Landfill	130 ± 12	122 ± 13	116 ± 12
	49	Piñon School, White Rock	132 ± 12	124 ± 13	103 ± 12
	50	White Rock Church of the Nazarene	93 ± 12	101 ± 13	81 ± 12
	51	Bayo Canyon Well, Los Alamos	155 ± 10	103 ± 12	112 ± 13
	55	Monte Rey South[e]	73 ± 8[c]	No Data	No Data
On-Site	17	TA-21 (DP West)	142 ± 11	153 ± 10	139 ± 9
	18	TA-6 (Two Mile Mesa)	128 ± 9	134 ± 10	82 ± 11
	19	TA-53 (LANSCE)	142 ± 9	152 ± 12	142 ± 12
	21	TA-16 (S-Site)	140 ± 12	99 ± 12[b]	129 ± 11
	22	Booster P-2	185 ± 12	144 ± 13	117 ± 12
	23	TA-3 East Gate of SM 43	105 ± 12	132 ± 13	109 ± 12
	24	State Highway 4	135 ± 11	98 ± 11[b]	147 ± 12
	25	TA-49 (Frijoles Mesa)	135 ± 9	119 ± 10	113 ± 9
	26	TA-2 (Omega Stack)	168 ± 12	135 ± 13	121 ± 11
	27	TA-2 (Omega Canyon)	157 ± 12	159 ± 13	201 ± 12
	28	TA-18 (Pajarito Site)	378 ± 13[f]	127 ± 13	128 ± 12
	29	TA-35 (Ten Site A)	128 ± 12	114 ± 13	91 ± 11[b]

Table 4-22. Thermoluminscent Dosimeter (TLD) Measurements of External Radiation 1993–1995 (Cont.)

	TLD Station ID #	Location	1995 Annual Dose (mrem)	1994 Annual Dose (mrem)	1993 Annual Dose (mrem)
On-Site (Cont.)	30	TA-35 (Ten Site B)	98 ± 11[b]	140 ± 13	119 ± 12
	31	TA-59 (Occupational Health Lab)	128 ± 12	138 ± 13	119 ± 9
	32	TA-3-16 (Van de Graaff)	137 ± 12	145 ± 13	123 ± 12
	33	TA-3-316 (Ion Beam Bldg.)	118 ± 12	142 ± 13	130 ± 12
	34	TA-3-440 (CAS)	104 ± 11[b]	129 ± 13	110 ± 12
	35	TA-3-420 (CMR Bldg. West Fence)	123 ± 12	115 ± 13	109 ± 12
	36	TA-3-102 (Shop)	131 ± 12	119 ± 13	116 ± 12
	37	TA-72 (Pistol Range)	151 ± 12	146 ± 13	135 ± 12
	38	TA-55 (Plutonium Facility South)	107 ± 11[b]	133 ± 13	143 ± 12
	39	TA-55 (Plutonium Facility West)	160 ± 12	140 ± 14	107 ± 10
	40	TA-55 (Plutonium Facility North)	119 ± 11	135 ± 13	150 ± 12

[a]The uncertainty of each measurement is the propagated error of the quarterly measurements.
[b]Annual doses is the sum of three quarters.
[c]Annual dose is the sum of two quarters.
[d]Data only available for one quarter.
[e]New station placed into operation quarter 3, 1995.
[f]Operational measurements from quarter 2 were included in annual dose and does not reflect potential public dose due to controlled access.

Table 4-23. Waste Disposal Area Measured Dose

		Annual Dose (mrem)					
Waste Disposal Area	Number of TLD Locations	1995 Maximum	1995 Minimum	1995 Mean	1995 Uncertainty[a]	1994 Mean	1994 Uncertainty[a]
TA-21, Area A	5	140	124	133	11	129	13
TA-21, Area B	14	171	140	153	11	135	13
TA-50, Area C	10	129[b]	108[b]	118[b]	11	113	13
TA-33, Area E	4	154	139	147	11	139	13
TA-6, Area F	4	77[c]	68[c]	72[c]	9	N/A[d]	—
TA-54, Area G	25	199	144	161	12	160	13
TA-21, Area T	7	273	132	159	12	159	14
TA-21, Area U	4	137	117	128	11	131	14
TA-21, Area V	4	142	129	134	11	105	12
TA-35, Area W	3	145	111	125	11	110	13
TA-49, Area AB	10	147	128	141	12	126	13

[a]Uncertainty is the propagated error of the quarterly measurements.
[b]Annual Doses for only three quarters, second quarter data not available due to equipment malfunction.
[c]Only monitored 3rd & 4th quarter because of geophysical study.
[d]N/A = not available.

Table 4-24. 1995 Precipitation (in.)

	North Community	TA-16	TA-6	TA-49	TA-53	TA-54	TA-74
January	1.00	1.41	1.34	1.22	1.11	0.80	0.89
February	1.05	1.26	1.01	0.85	0.79	0.49	0.55
March	1.05	1.40	1.11	0.93	0.74	0.47	0.36
April	2.13	1.91	1.82	1.44	1.63	1.29	1.42
May	2.08	1.97	2.68	2.64	2.33	1.61	1.66
June	2.56	2.92	1.67	1.69	1.46	1.10	0.96
July	1.85	1.28	1.28	0.95	1.32	0.73	0.67
August	4.83	7.10	3.53	3.57	2.26	3.21	1.57
September	1.56	2.78	2.36	2.11	2.64	2.72	2.24
October	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November	0.38	0.47	0.35	0.19	0.27	0.10	0.17
December	0.66	0.78	0.61	0.44	0.44	0.27	0.33
TOTAL	19.15	23.28	17.76	16.03	14.99	12.79	10.82

Table 4-25. Estimated Concentrations of Toxic Elements Released by Dynamic Experiments

Element	Total Usage (kg)	Fraction Released (%)	Annual Concentration (1,500 m)[a]	Average ($\mu g/m^3$) (3,800 m)[b]	Applicable Standard ($\mu g/m^3$)
Beryllium (1994)[c]	4.4	2	3.8×10^{-6}	1.3×10^{-6}	0.01[d]
Lead (1994)[c]	11.8	100[e]	5.0×10^{-4}	1.7×10^{-4}	1.5[f]
Heavy Metals (1994)[g]	5,769	100[e]	2.4×10^{-1}	8.2×10^{-2}	10[d]
Heavy Metals (1995)[g]	3,345	100[e]	1.4×10^{-1}	4.8×10^{-2}	10[d]

[a]Distance downwind to nearest public access point.
[b]Distance downwind to nearest off-site receptor.
[c]No usage was reported for 1995.
[d]Standard for 30-day average, NM ACQR 201.
[e]No data is available; estimate was done assuming that a worst-case percentage was released into the air.
[f]Standard for 3-month average (40 CFR 50.12).
[g]Although lead is a heavy metal, it is listed separately because there is an air standard applicable to lead.

Table 4-26. Emissions by Source in 1995 (MMCF)

Source	PM	CO	NO_X	SO_X	VOC
TA-3 Power Plant	1.4	11.18	45.55	.17	.39
TA-16 Power Plant	2.2	5.63	22.51	.1	.45
TA-21 Power Plant	.46	1.17	4.67	.02	.09
Asphalt Plant	.13	.65	.05	.01	.03
Total	4.19	18.63	72.78	0.3	0.96

[a]MMCF: million cubic feet.

Table 4-27. Nonpoint Emissions from LANSCE

Year	Emissions (Ci)	Off-Site Dose (mrem)
1993	1420	1.0
1994	1000	0.8
1995	720	0.5

Table 4-28. 1995 Airborne Emmission From TA-21

Radionuclide	Stack Emissions (μCi)	Upper-bound Estimate for Diffuse Emissions (μCi)
^{234}U	0.5	50
^{235}U	0.009	5
^{239}Pu	0.2	30
^{241}Am	0.007	10

F. Figures

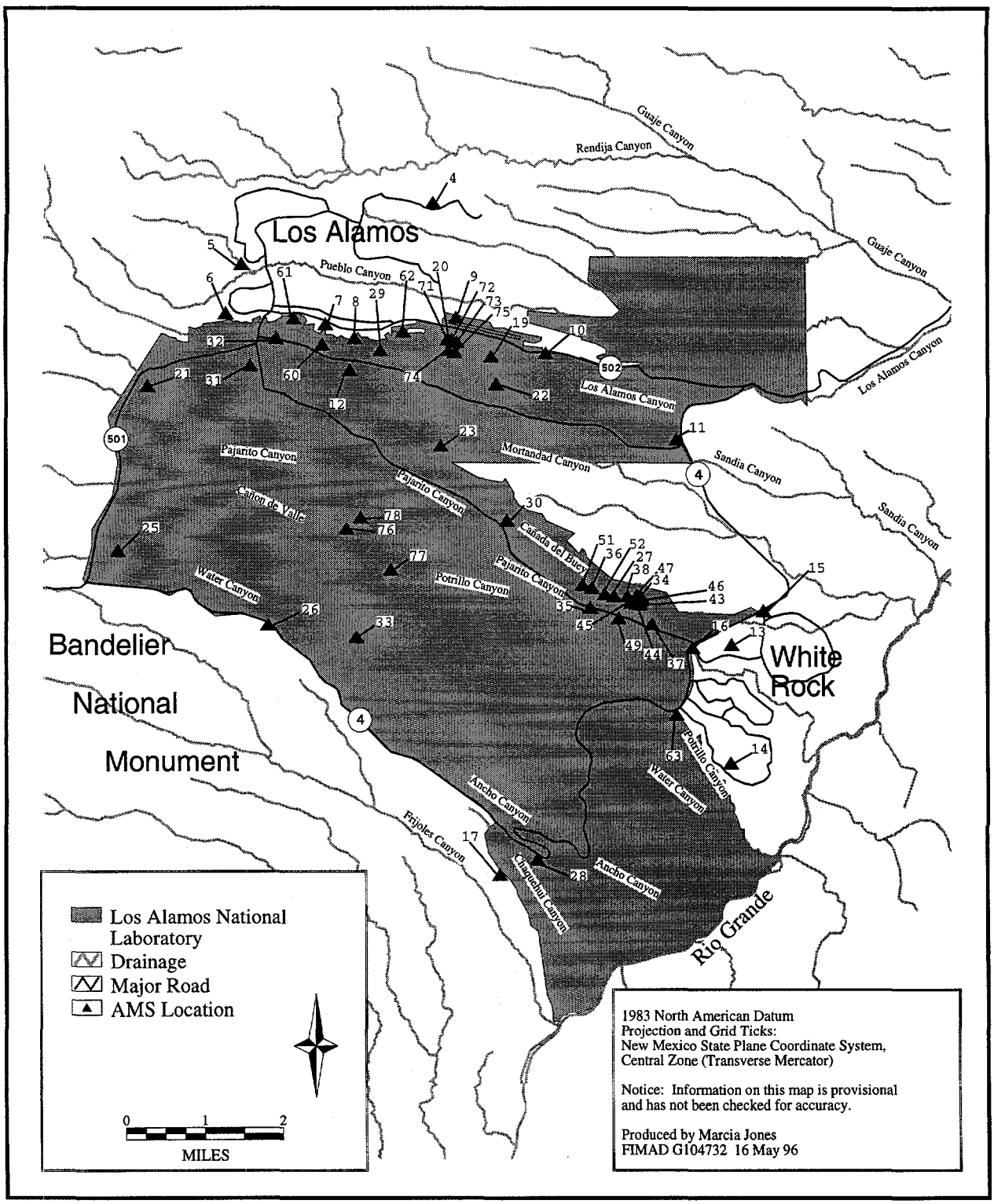


Figure 4-1. Off-site perimeter and on-site Laboratory AIRNET locations (does not show off-site regional stations).

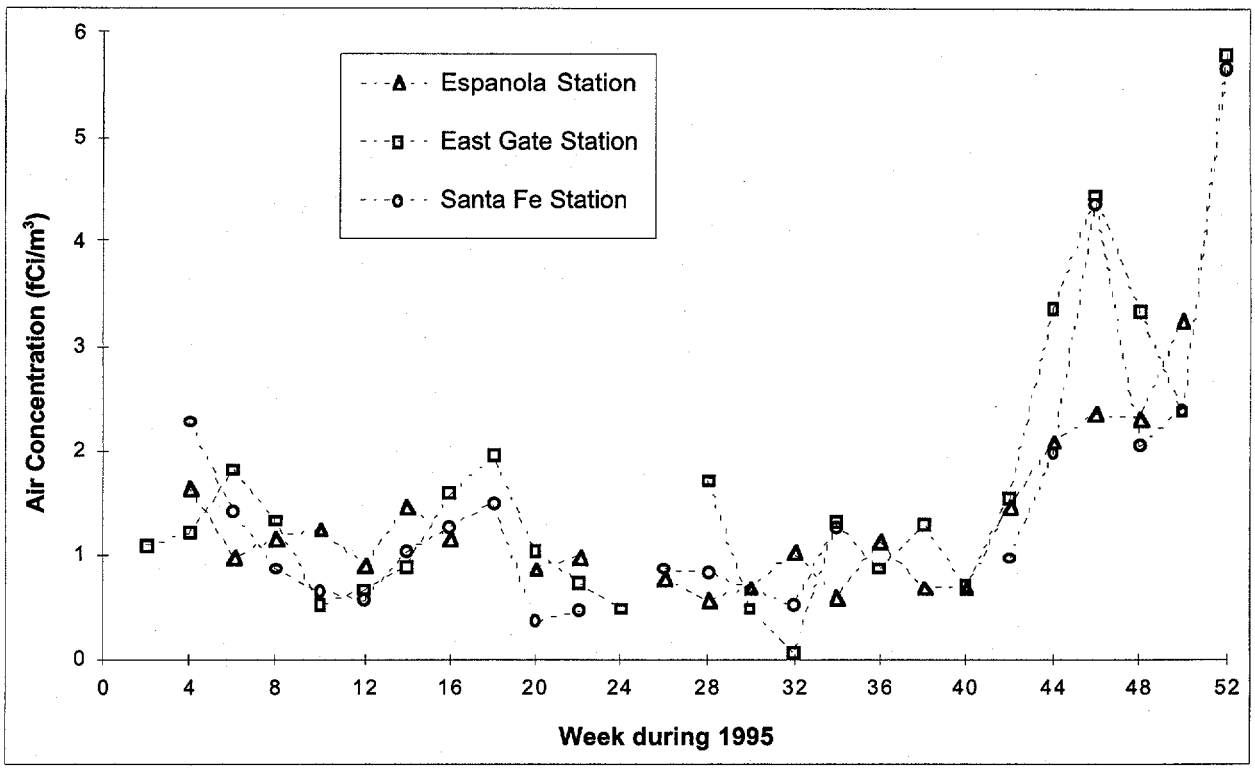


Figure 4-2. Gross alpha activity concentrations in air at two regional and one perimeter station.

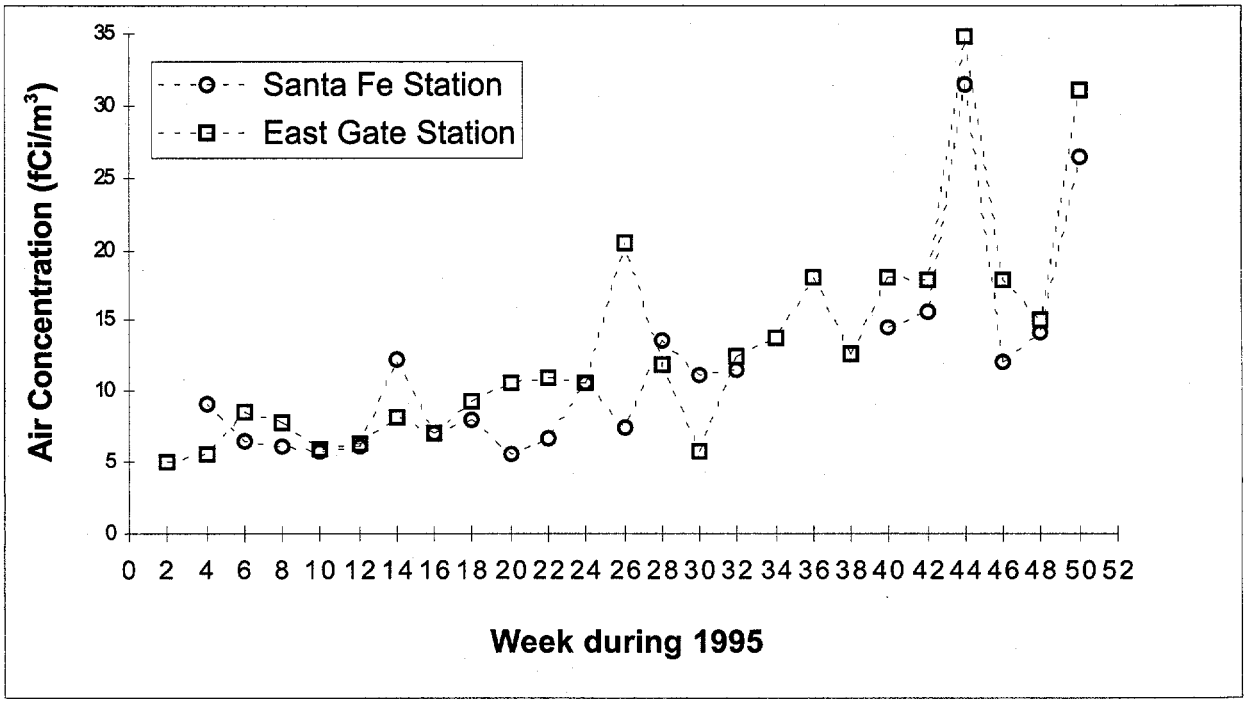


Figure 4-3. Gross beta activity concentrations in air at one regional and one perimeter station.

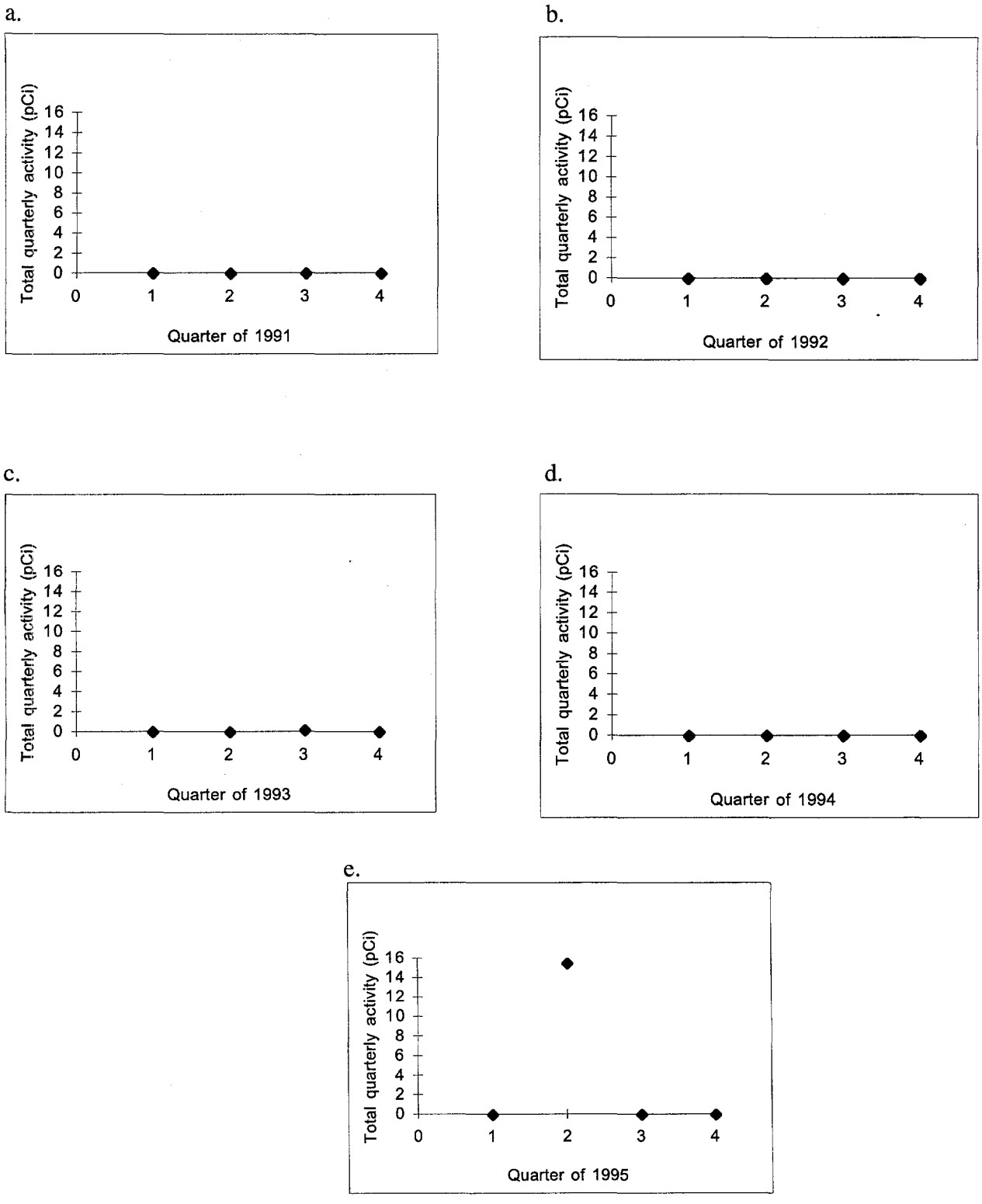
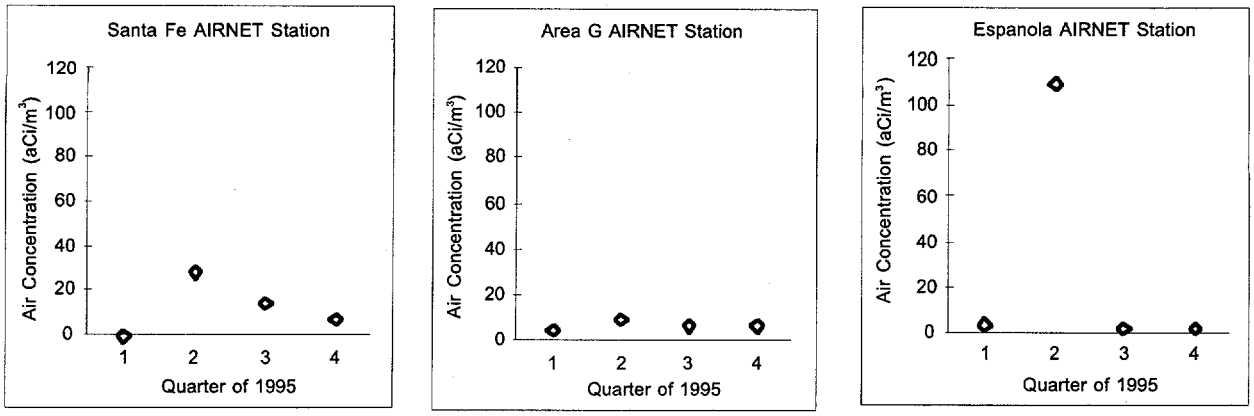
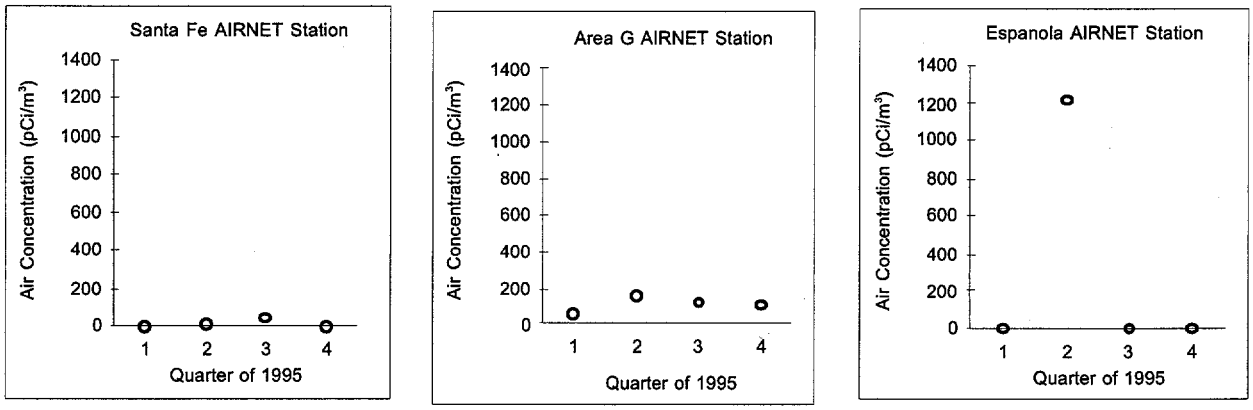


Figure 4-4. Comparison for 1991–1995 of plutonium-239 in samples from Española AIRNET.

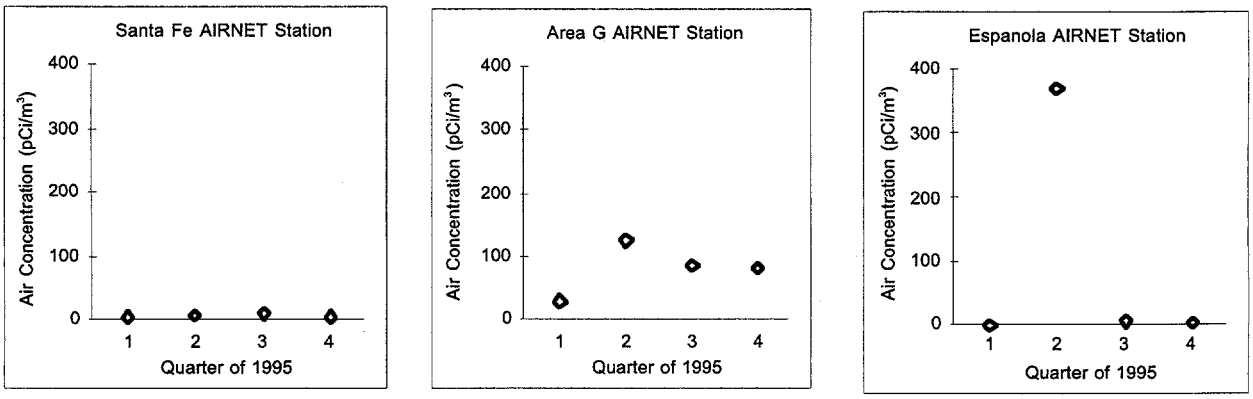
Note: For an explanation of the data spike shown in graph e. above, refer to Section 4.B.1.c. "Discussion of Validity of Second Quarter Plutonium and Americium Results for Española."



a. Plutonium-238



b. Plutonium-239



c. Americium-241

Figure 4-5. Plutonium-238, plutonium-239, and americium-241 in quarterly samples from three AIRNET stations.

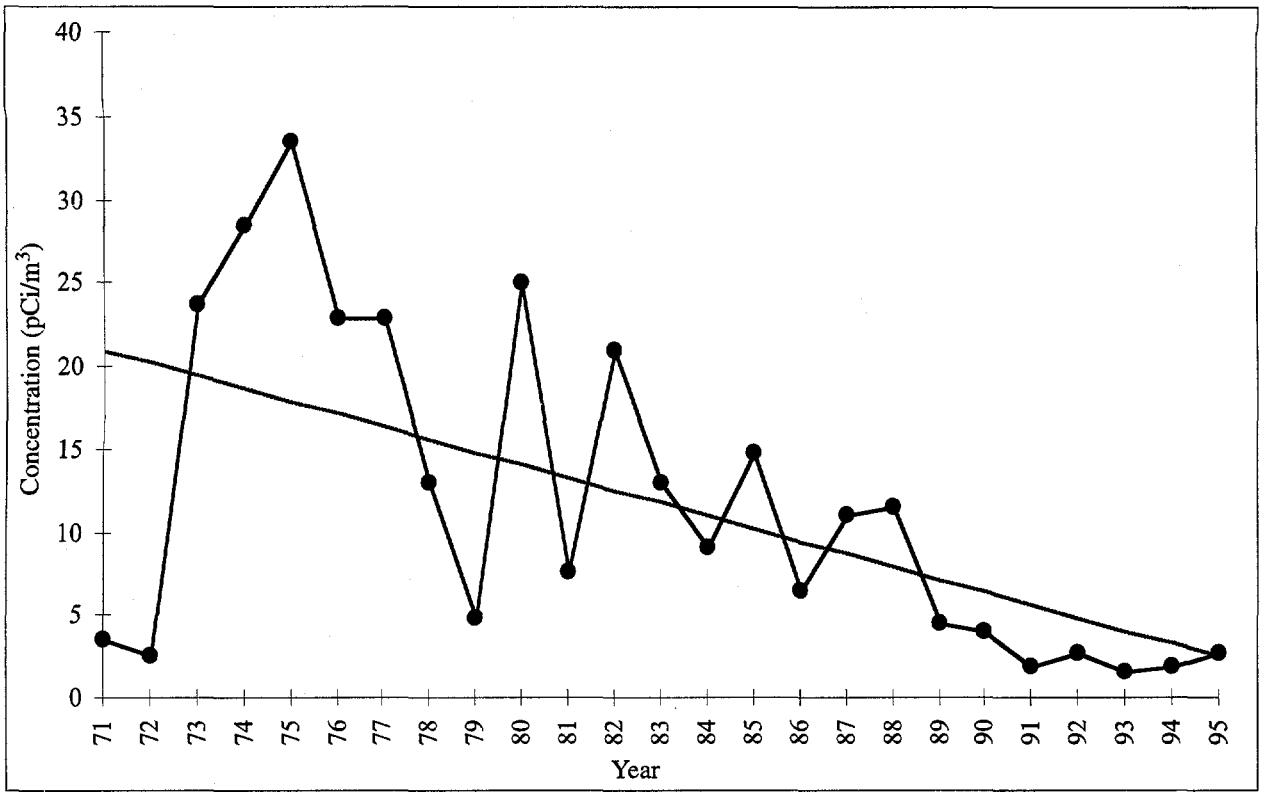


Figure 4-6. Annual mean concentration of tritium at Los Alamos National Laboratory perimeter sampling stations.

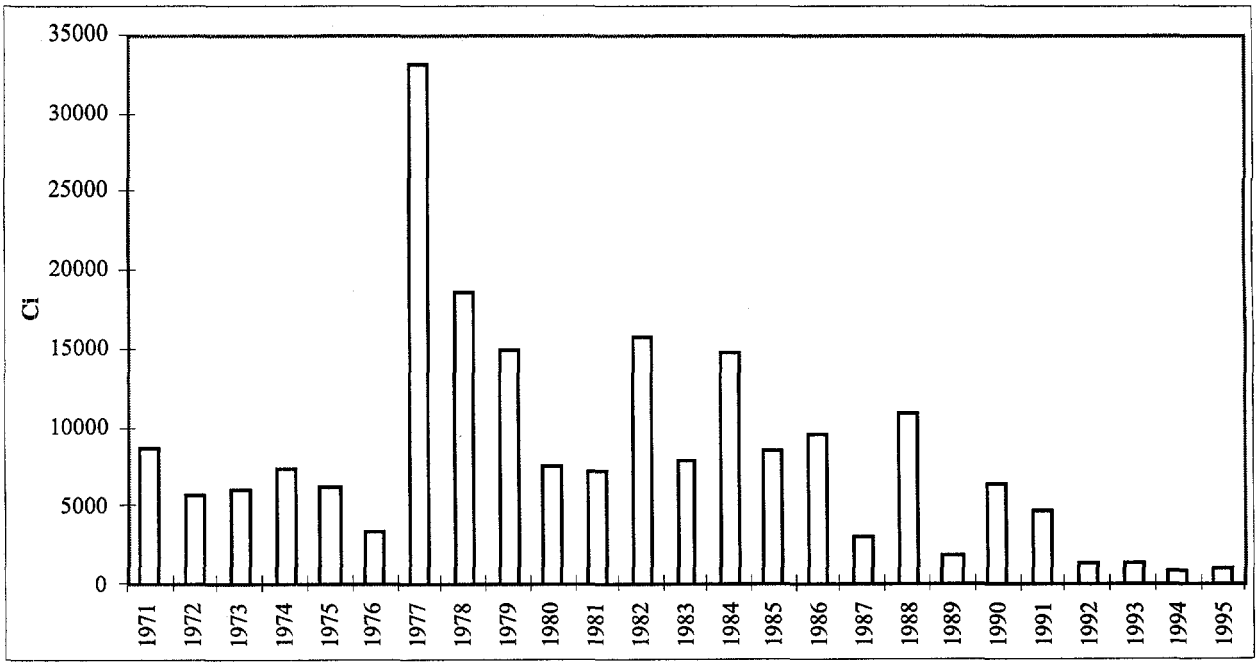


Figure 4-7. Tritium in Los Alamos National Laboratory air effluents from 1971 to 1995.

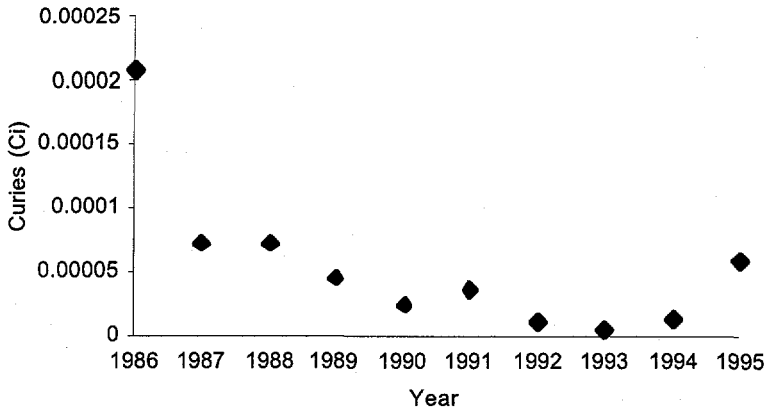


Figure 4-8. Plutonium emissions from sampled Laboratory stacks since 1986.

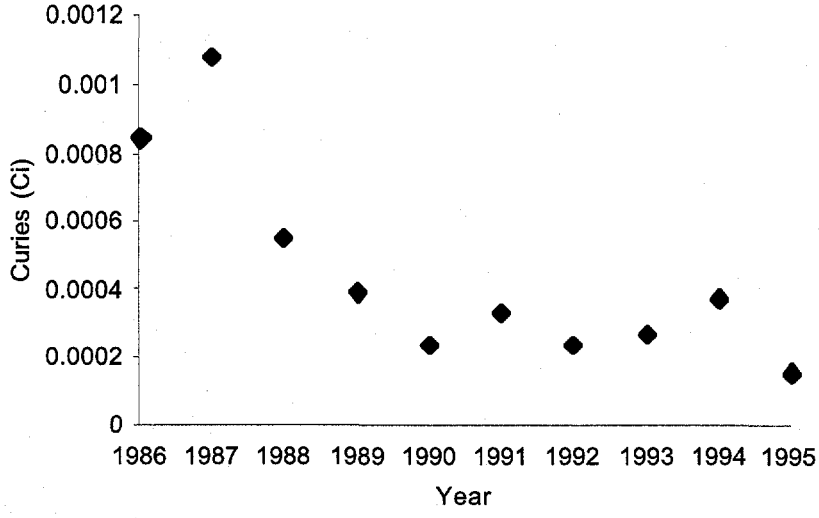


Figure 4-9. Uranium emissions from sampled Laboratory stacks since 1986.

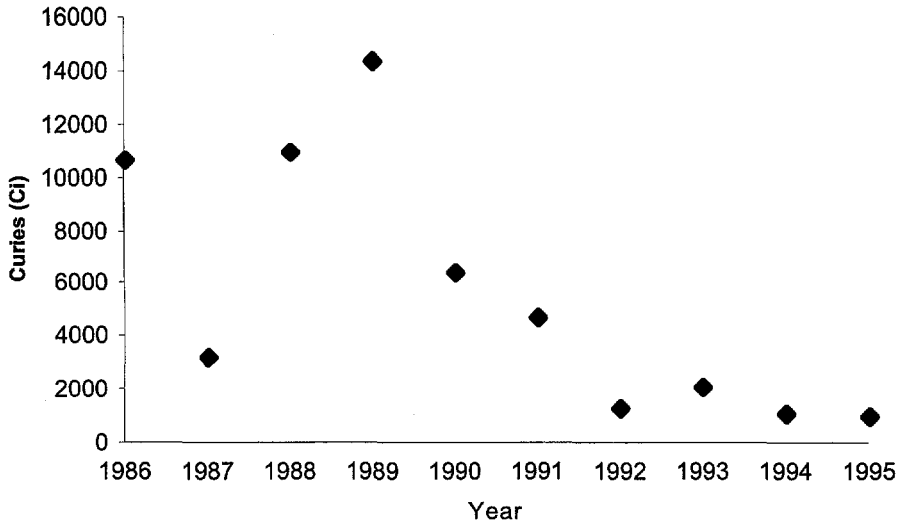


Figure 4-10. Tritium emissions from sampled Laboratory stacks since 1986.

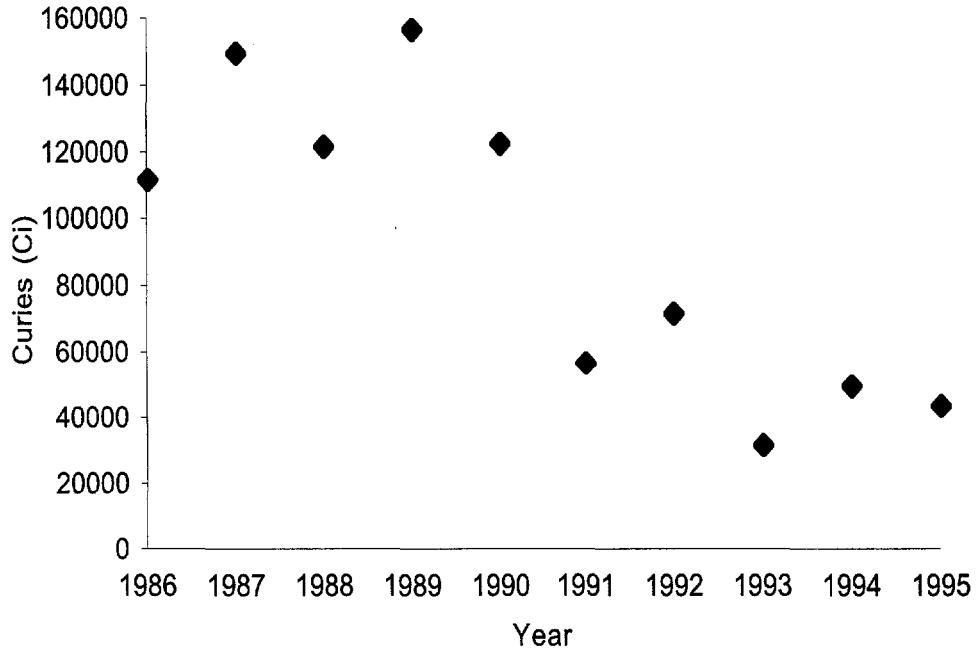


Figure 4-11. Gaseous mixed-action product emissions from sampled Laboratory stacks since 1986.

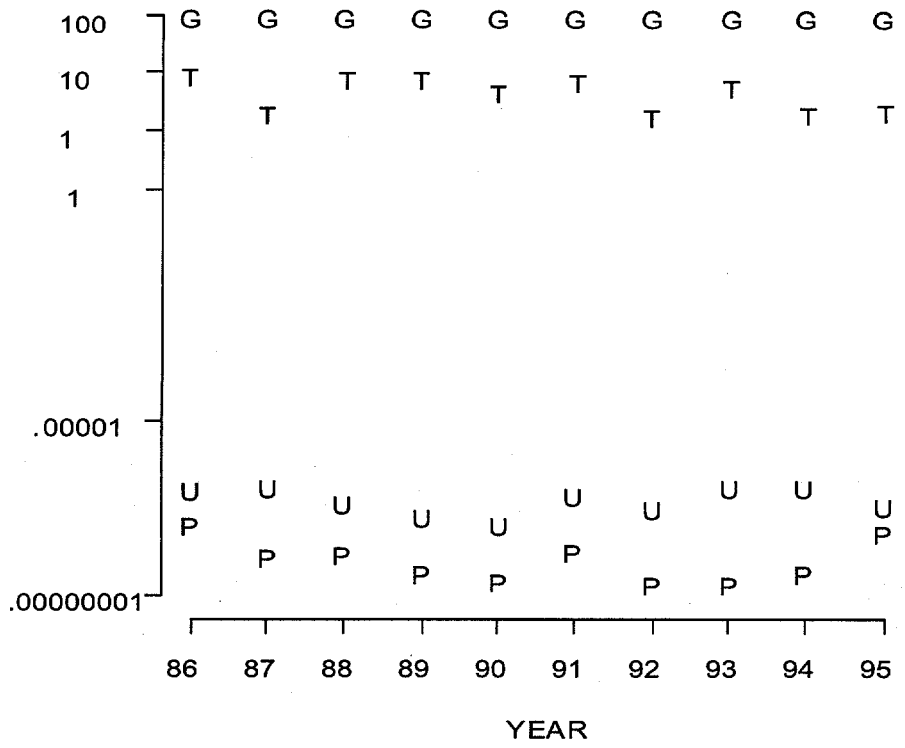


Figure 4-12. Percent of total emissions resulting from plutonium, uranium, tritium, and gaseous/mixed-fission activation products.

Note:
G = gaseous/mixed-fission activation products
T = tritium
U = uranium
P = plutonium

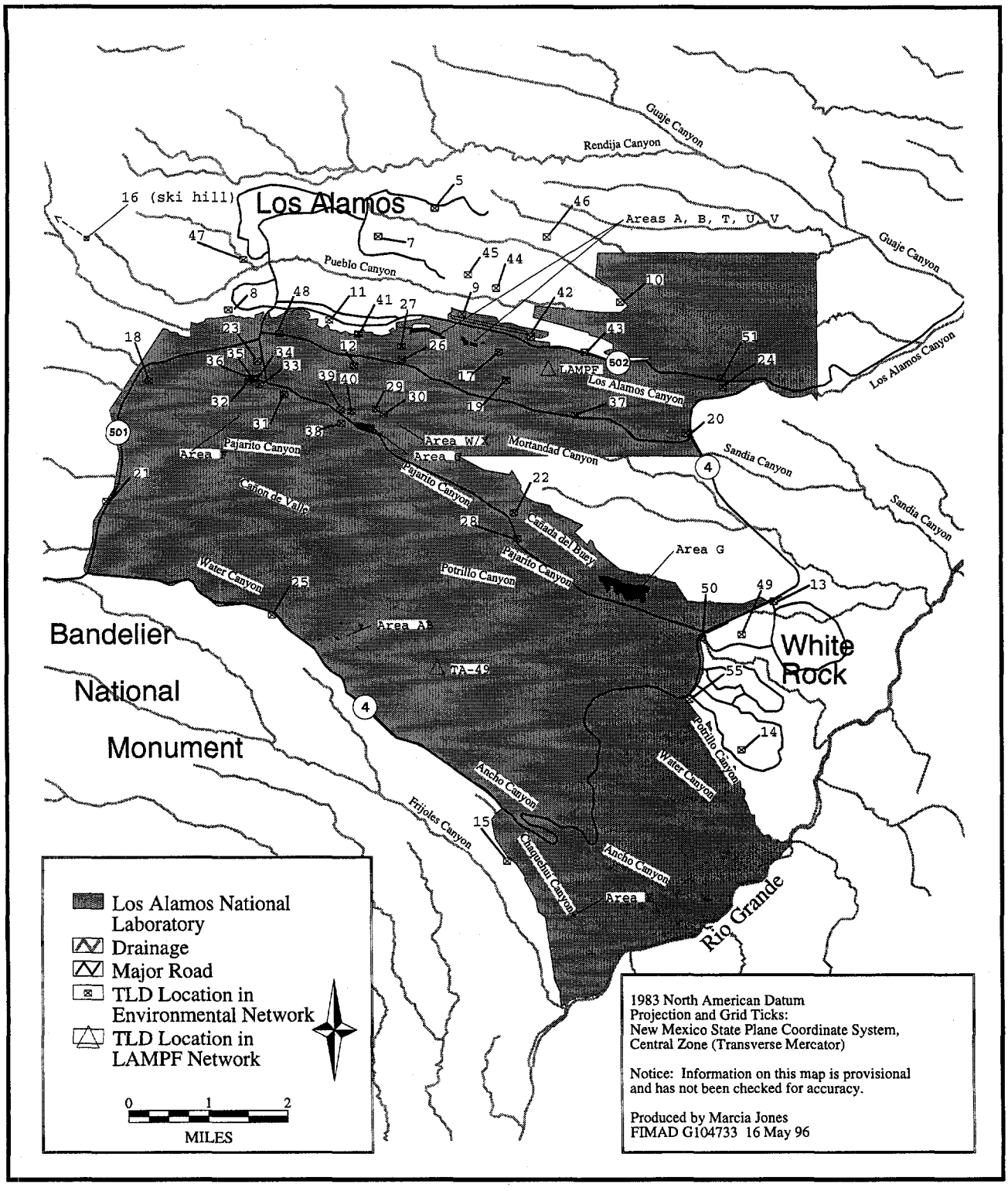


Figure 4-13. Off-site perimeter and on-site Laboratory TLD locations (does not show off-site regional stations).

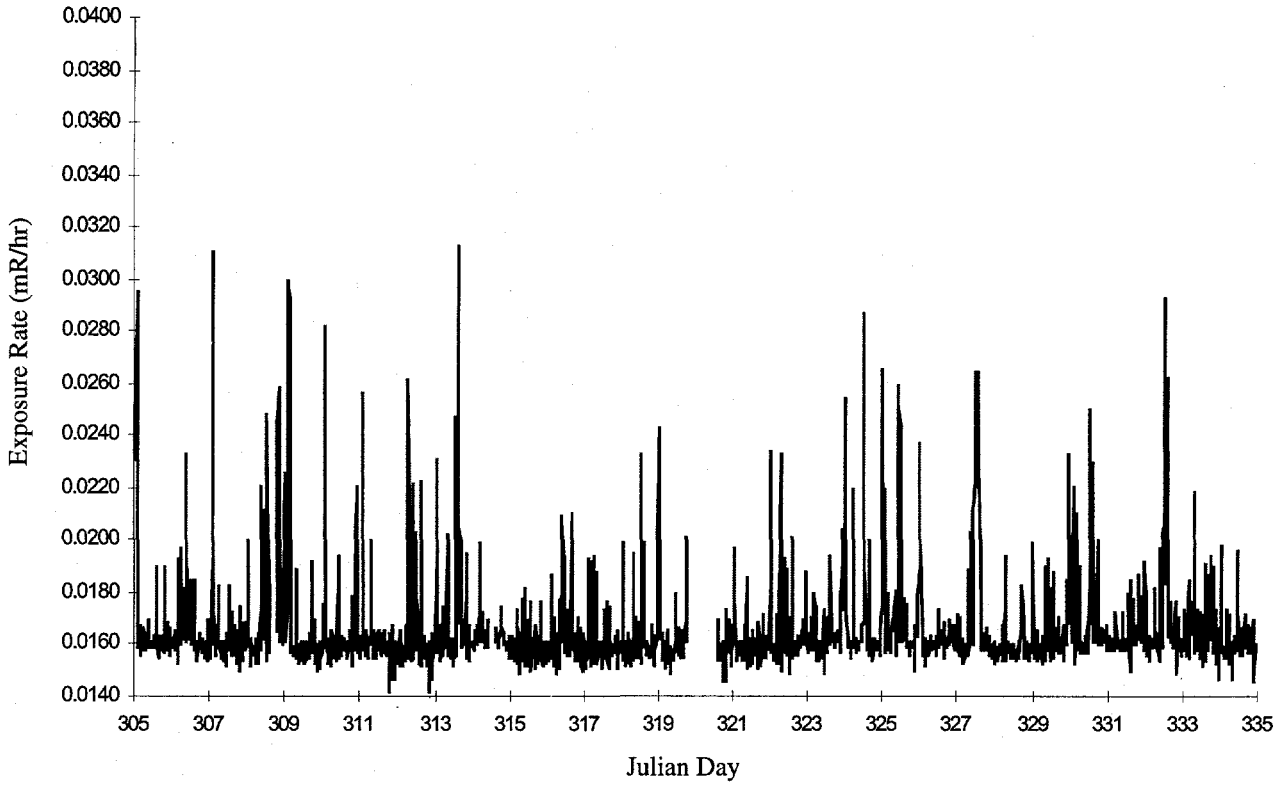


Figure 4-14. Typical TA-53 hourly radiation exposure rate at East Gate with Los Alamos Neutron Scattering Center in operation.

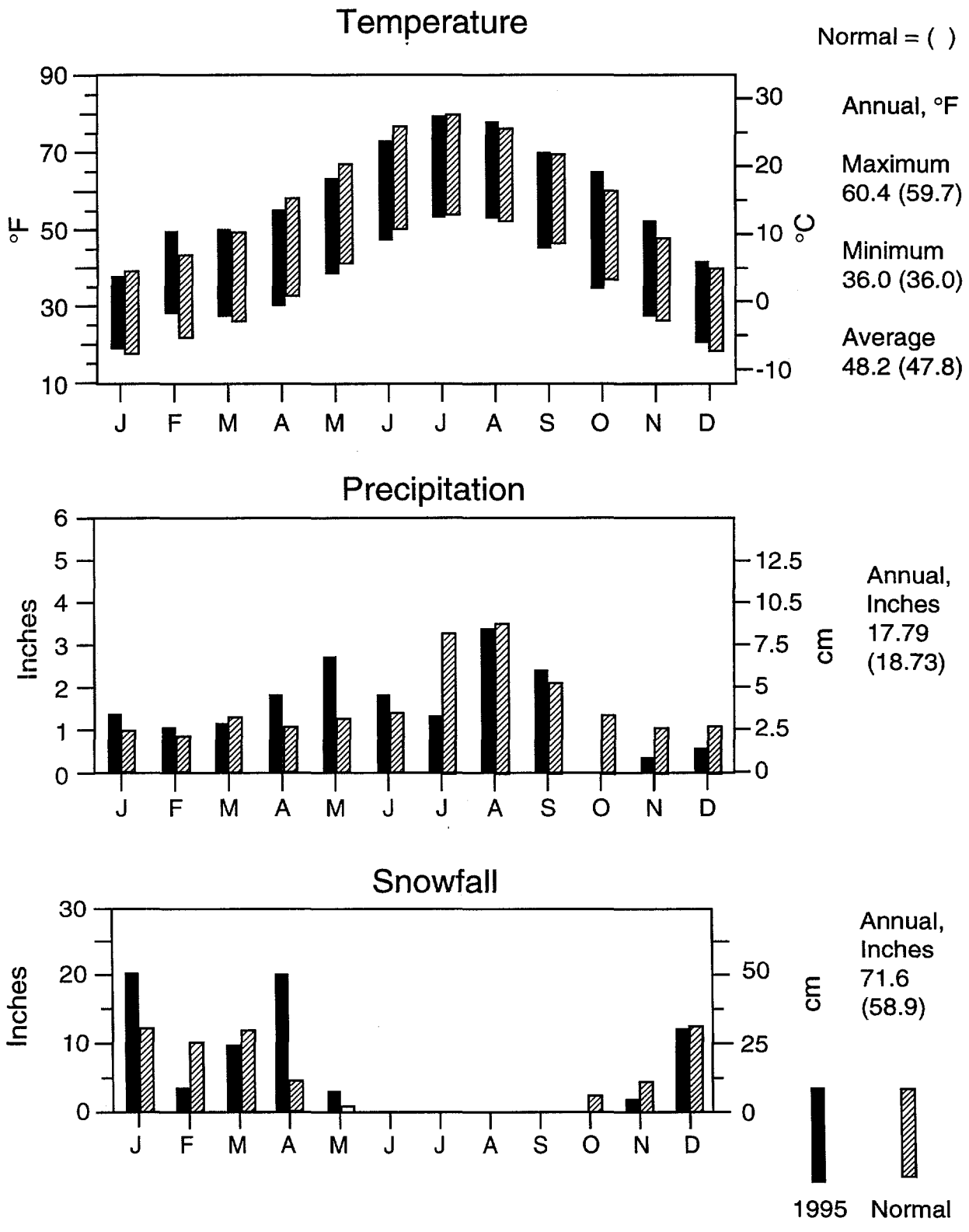


Figure 4-15. 1995 weather summary for Los Alamos.

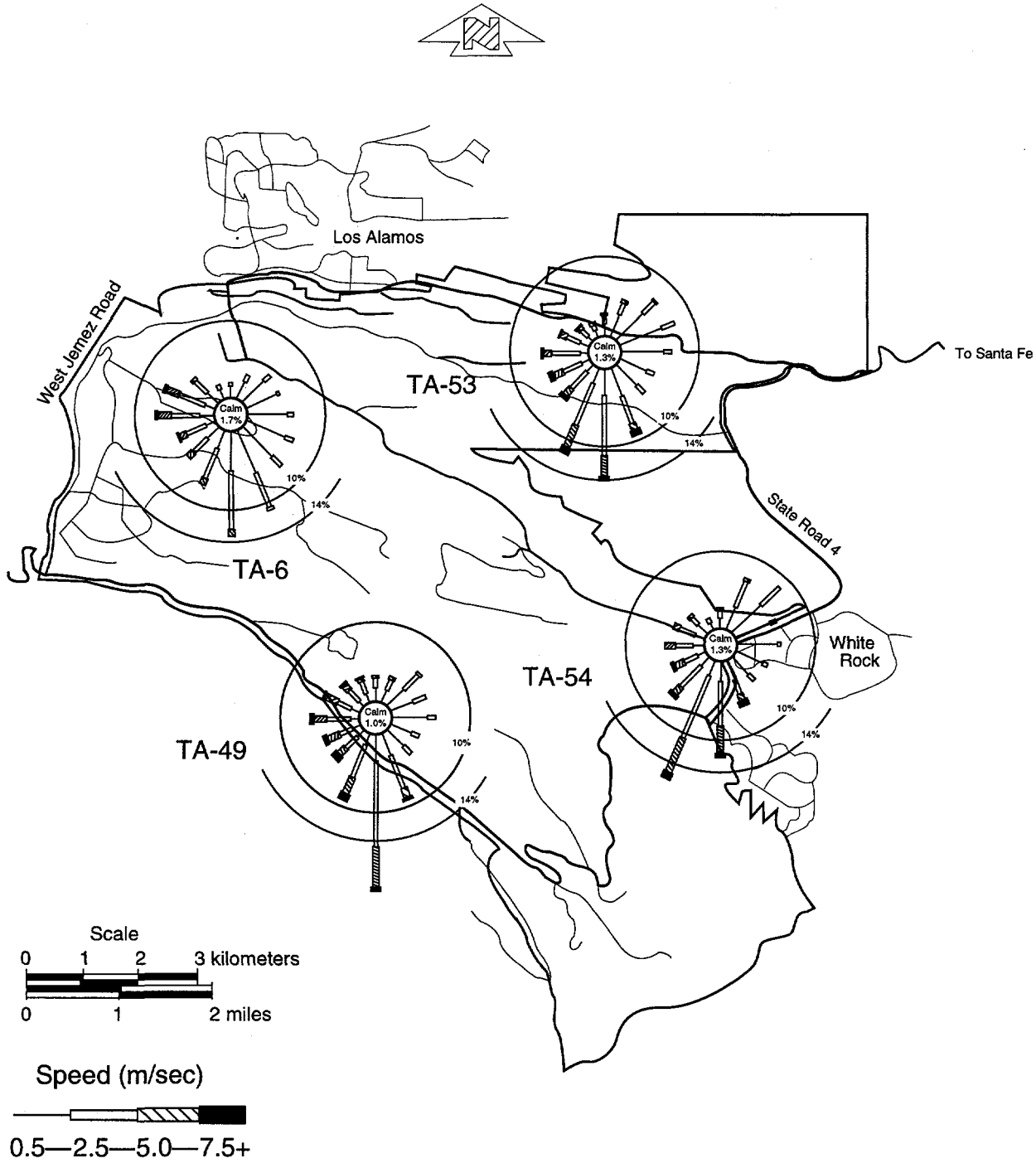


Figure 4-16. Wind roses for daytime winds observed at 11 m (36 ft) at TA-6, TA-49, TA-53, and TA-54.

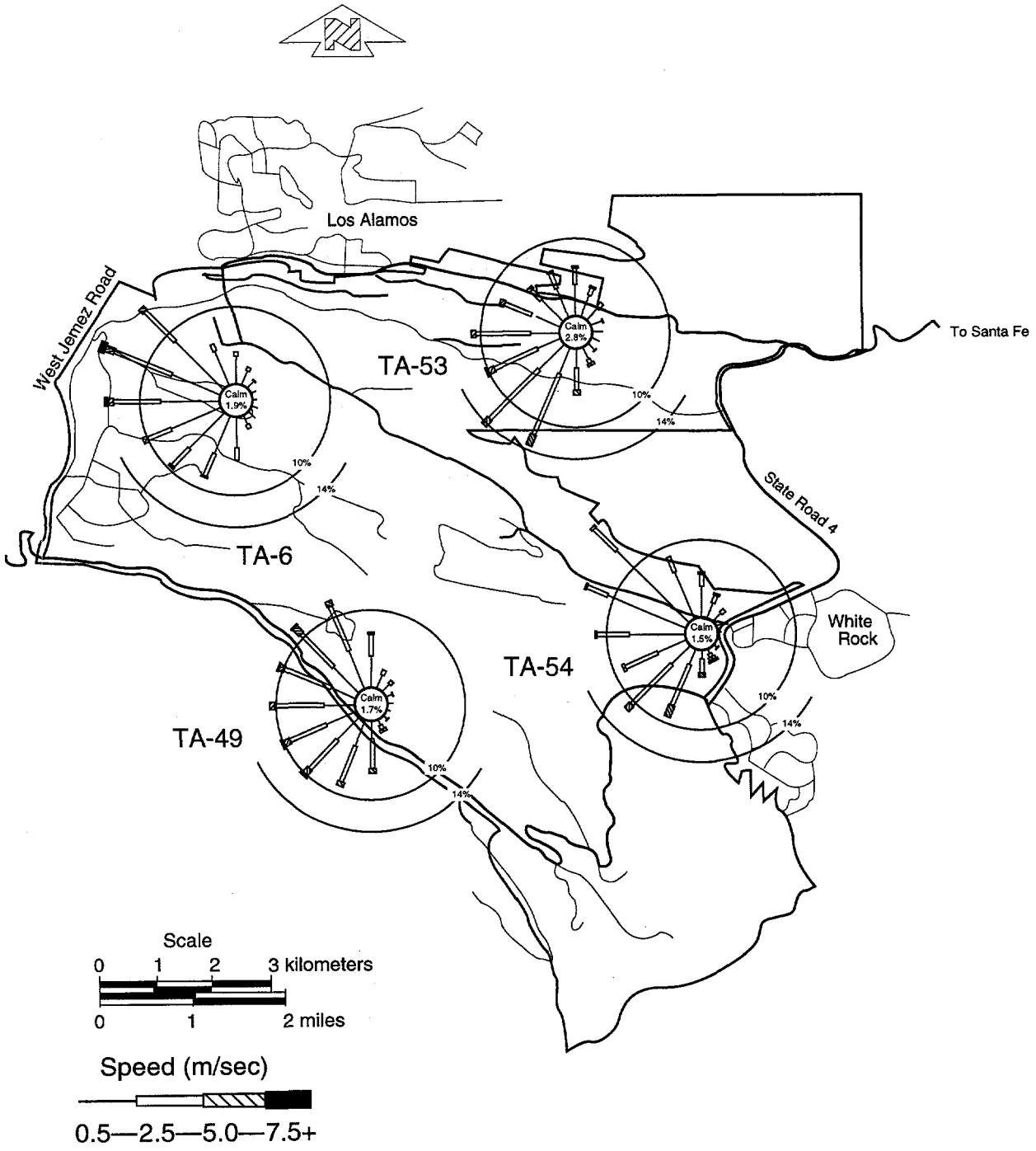


Figure 4-17. Wind roses for nighttime winds observed at 11 m (36 ft) at TA-6, TA-49, TA-53, and TA-54.

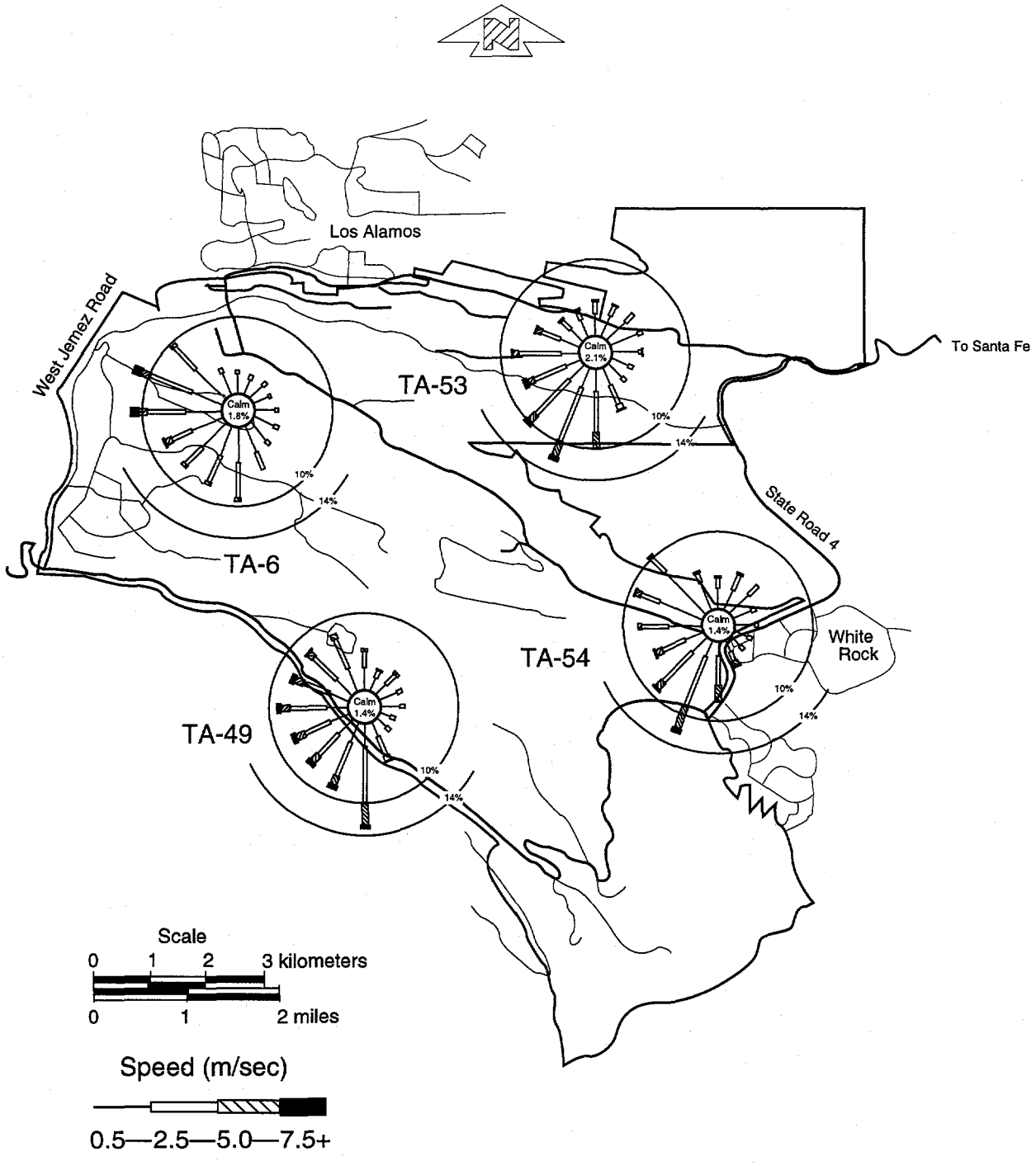


Figure 4-18. Total wind roses for daytime and nighttime winds observed at 11 m (36 ft) at TA-6, TA-49, TA-53, and TA-54.

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5. Surface Water, Groundwater, and Sediments

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A. Overview of Programs

1. Surface Water Program

Surface waters from regional and Pajarito Plateau stations are monitored to survey the environmental effects of Los Alamos National Laboratory (LANL or the Laboratory) operations. There are no perennial surface water flows that extend completely across the Laboratory in any of the canyons. Periodic natural surface runoff occurs in two modes: (1) spring snowmelt runoff that occurs over highly variable periods of time (days to weeks) at a low discharge rate and sediment load, and (2) summer runoff from thunderstorms that occurs over a short period of time (hours) at a high discharge rate and sediment load. None of the surface waters within the Laboratory are a source of municipal, industrial, or irrigation water. The waters are used by wildlife. Concentrations of radionuclides in surface water samples may be compared to either the Department of Energy (DOE) Derived Concentration Guides (DCGs) or the New Mexico Water Quality Control Commission (NMWQCC) stream standard, which reference the NM Health and Environment Department Environmental Improvement Division's NM Radiation Protection Regulations (part 4, Appendix A). However, NM radiation levels are in general two orders of magnitude greater than DOE's DCGs for public dose, so only the DCGs will be discussed here. The concentrations of nonradioactive constituents may be compared with the NMWQCC General, Livestock Watering, and Wildlife Habitat stream standards. The NMWQCC groundwater standards can also be applied in cases where groundwater discharge may affect stream water quality.

The analysis results for the Surface Water Program were generally consistent with past findings. The most notable finding for 1995 was a significant level of strontium-90 found in a runoff sample from Ancho Canyon near Bandelier National Monument. The concentration of strontium-90 in the sample was 50.9 ± 3.5 pCi/L. This is the highest concentration of strontium-90 observed outside the known contaminated areas in Pueblo, Los Alamos, and Mortandad Canyons for the period of record since 1981. This level is slightly above the DOE Drinking Water System DCG (40 pCi/L).

An elevated level of americium-241 (0.17 ± 0.035 pCi/L) was measured in Frijoles Canyon at the Bandelier National Monument Headquarters on June 2, 1995. While this level is above what is usually observed outside known contaminated areas, the concentration is nearly an order of magnitude lower than the DOE Drinking Water System DCG (1.2 pCi/L). A second sample was collected on July 27. The concentration of americium-241 measured in this sample was below the detection limit (0.04 pCi/L) and reported as 0.033 ± 0.018 pCi/L.

2. Groundwater Protection Management Program

Groundwater resource management and protection at the Laboratory are focused on the main (or regional) aquifer underlying the region (see section 1.A.3). The aquifer has been of paramount importance to Los Alamos since the period following the World War II Manhattan Engineer District days, when the Atomic Energy Commission (AEC) needed to develop a reliable water supply to support Laboratory operations. The US Geological Survey (USGS) was extensively involved in overseeing and conducting various studies for development of groundwater supplies beginning in 1945 and 1946. Studies specifically aimed at protecting and monitoring groundwater quality were initiated as joint efforts between the AEC, the Laboratory, and the USGS in about 1949.

The monitoring data indicate that DOE operations at the Laboratory have resulted in some contamination of the main aquifer, particularly beneath Los Alamos and Pueblo Canyons. Note that the term "contamination" refers to the presence of substances whose concentrations exceed background values because of human actions, whether or not these substances significantly affect potential uses of water. Another term, "pollution" applies to levels of contamination which are undesirable, for example because of possible adverse health effects (Freeze 1979). In Los Alamos and Pueblo Canyons, signs of effluent from sewage treatment and past radioactive industrial releases have appeared in the upper part of the main aquifer. In the lower reaches of these canyons, the streams have cut down through the Bandelier Tuff into the more permeable basalts and conglomerates directly overlying the main aquifer, facilitating seepage of contaminants into the aquifer formations.

The radioactive contamination is generally restricted to trace amounts of tritium, an isotope of hydrogen, which moves through rocks much more readily than do other radionuclides because it is a component of some water molecules.

Tritium contamination within the main aquifer has been found at four locations in Los Alamos and Pueblo Canyons, and one location in Mortandad Canyon (EARE 1995, EG 1996). The tritium contamination was discovered in four test wells that penetrate only a short distance into the top of the main aquifer (EARE 1995), and in a former water supply well in lower Los Alamos Canyon. Some of these wells (in Pueblo and Los Alamos Canyons) draw water from formations a relatively short distance below shallow alluvium, known to have past tritium contamination. The casing of other wells was probably not cemented during construction, and leakage down the well bore is possible. The wells are all located downstream of present or former sites of discharge of treated radioactive liquid industrial waste into Acid/Pueblo, DP/Los Alamos, or Mortandad Canyons.

The presence of tritium does not pose a risk to public health, as the highest level detected was about 2% of the federal drinking water limit for tritium. Confirmed evidence of tritium contamination has not been discovered in samples taken from any of the current Los Alamos public water supply wells. The US Department of Health & Human Services Agency for Toxic Substances and Disease Registry (ATSDR) evaluated the trace levels of tritium that were found in Los Alamos and the Pueblo of San Ildefonso water supply wells, and reported, "ATSDR considers water at these drinking water levels to be safe for human consumption" (EG 1996).

The development and production of the water supply has resulted in overall nonpumping water level declines ranging from 3 to 30 m (10 to 100 ft) in some production wells, but has not resulted in major depletion of the resource. Water level recoveries of roughly 90% are observed when wells are shut down for short periods for maintenance purposes.

The early groundwater management efforts evolved with the growth of the Laboratory's current Groundwater Protection Management Program, which addresses environmental monitoring, resource management, aquifer protection, and geohydrologic investigations. Essentially all of the action elements required by DOE Order 5400.1 (DOE 1988a) as part of the Groundwater Protection Management Program have been functioning at the Laboratory for varying lengths of time before the DOE order was issued. Formal documentation for the program, the "Groundwater Protection Management Program Plan," was issued in April 1990 and revised in 1995 (LANL 1995). Several hundred reports and articles documenting studies and data germane to groundwater and the environmental setting of Los Alamos are listed in a bibliography (Bennett 1990).

Groundwater resource monitoring routinely documents conditions of the water supply wells and the hydrologic conditions of the main aquifer as part of the overall Groundwater Protection Management Program. This information is documented in a series of annual reports providing detailed records of pumping and water level measurements. The most recent report in this series is entitled "Water Supply at Los Alamos during 1995" (McLin 1996).

Concentrations of radionuclides in environmental water samples from the main aquifer, the alluvial perched groundwater in the canyons, and the intermediate-depth perched systems may be evaluated by comparison with DCGs for ingested water calculated from DOE's public dose limits. The NMWQCC has established standards for groundwater quality (NMWQCC 1993). Concentrations of radioactivity in samples of water from the water supply wells completed in the Los Alamos main aquifer are also compared to New Mexico Environmental Improvement Board (NMEIB) and EPA drinking water standards or to the DOE DCGs applicable to radioactivity in DOE drinking water systems, which are more restrictive in a few cases.

The concentrations of nonradioactive chemical quality parameters may be evaluated by comparing them to NMWQCC groundwater standards and to the NMEIB and EPA drinking water standards (maximum contaminant levels [MCLs]), even though these latter standards are only directly applicable to the public water supply. The supply wells in the main aquifer are the source of the Los Alamos public water supply. Although it is not a source of municipal or industrial water, the shallow alluvial groundwater results in return flow to surface water and springs used by livestock and wildlife, and may be compared to the Standards for Groundwater or the Livestock and Wildlife Watering stream standards established by the NMWQCC (NMWQCC 1993, NMWQCC 1994).

Groundwater analysis results were generally in keeping with values reported in previous years. Groundwater in some canyons shows the effects of industrial radioactive and other wastes from the Laboratory. For the most part the quality of groundwater within the main aquifer, which is the source of water supply for the Laboratory and Los Alamos County, has not been impacted by Laboratory operations.

The 1994 surveillance sampling of three test wells, TW-3, TW-4 and TW-8, showed unexpected levels of strontium-90 (EG 1996). Special time-series sampling of these wells was carried out in 1995 to evaluate possible aquifer contamination near these wells. Results of these tests indicate no trace of strontium in any of these test wells. The time-series sampling results for tritium suggest that it is present in the aquifer at TW-3 and 8, but not at TW-4. The presence of tritium in TW-3 is a new discovery, as tritium was not noted in this well during sampling in 1993. The tritium in TW-3 is at trace levels, which are far below the MCL established under the Safe Drinking Water Act (SDWA).

During 1995 cooperative efforts between the Laboratory and the Pueblos of San Ildefonso, Santa Clara, Cochiti, and Jemez and the Pueblo Office of Environmental Protection resulted in sampling of water for trace-level tritium analysis in the four Indian Pueblo communities. Baseline water quality data were collected at Cochiti, Santa Clara, and Jemez Pueblos. Also, the Laboratory continued environmental monitoring at the Pueblo of San Ildefonso.

The most notable finding was that the Westside Artesian well at the Pueblo of San Ildefonso had a strontium-90 value of 8.4 pCi/L. This value exceeded the EPA proposed MCL of 8 pCi/L and is inconsistent with prior sampling results. Water supply well G-1A also had an apparent strontium-90 detection, which was just above the detection limit. No prior data on strontium-90 are available for this well. A possible explanation for strontium-90 in these cases and those of TW-3, TW-4, and TW-8 in 1994 lies with the analytical technique used to detect strontium-90, which has a relatively high detection limit.

The tritium results show that tritium in pueblo surface and groundwaters occurs at concentrations either similar to regional precipitation or at lower levels due to radioactive decay in water long isolated from the surface. Exceptions occur in lower Los Alamos Canyon, probably as a result of past disposal of tritium by the Laboratory in Los Alamos/DP Canyon and Pueblo Canyon.

3. Sediment Program

Sediment samples are collected from regional stations and Pajarito Plateau stations surrounding the Laboratory. Regional sediment sampling stations are located within northern New Mexico and southern Colorado at distances up to 200 km (124 mi) from the Laboratory. Sediment transport associated with surface water runoff is a significant mechanism of contaminant movement. Contaminants originating from airborne deposition, effluent discharges, or unplanned releases can become attached to soils or sediments by adsorption or ion exchange. Accordingly, sediments are sampled in all canyons, including those with either perennial or ephemeral flows, that cross the Laboratory. Furthermore, sediments from five regional reservoirs are sampled annually.

Routine laboratory analyses for sediment samples include measurements for radioactivity, trace metals, organic compounds, and high-explosive (HE) residuals.

There are no federal or state regulatory standards for soil or sediment contaminants that can be used for direct comparison with surveillance results. Instead, contaminant levels in sediments may be interpreted in terms of toxicity to humans assuming the contaminated particles are either ingested or inhaled. The results can also be compared to levels attributable to worldwide fallout or natural background levels. Results of radionuclide analyses of soil and sediment samples from regional stations collected from 1974 through 1986 were used to establish statistical limits for worldwide fallout levels for tritium, strontium-90, cesium-137, plutonium-238, plutonium-239,240, and natural background levels of total uranium in northern New Mexico (Purtymun 1987a). The average concentration level for each analyte in these samples, plus twice its standard deviation, was adopted as an indicator of the approximate upper limit for worldwide fallout or natural background concentration. If an individual sample analysis exceeds the background level reported in Purtymun (1987a), we assume that Laboratory contamination is a possible source.

Screening action levels (SALs) are used by the Laboratory's Environmental Restoration (ER) Project to identify the presence of contaminants at levels of concern. Both background concentrations and SAL values for sediments are listed in tables summarizing analytical results for sediments. SAL values are derived from toxicity values and exposure parameters using data from the EPA.

Portions of Pueblo, Los Alamos, and Mortandad Canyons have been affected to varying degrees by contaminant releases from the Laboratory. These canyons have concentrations of radioactivity in sediments at levels that are higher than levels attributable to worldwide fallout or natural sources. Elevated concentration levels of tritium, strontium-90, cesium-137, plutonium, and americium-241 are found in sediments in the upper reaches of Mortandad Canyon. These contaminated sediments have not moved off site because three sediment traps prevented

sediments from moving towards the eastern Laboratory boundary in Mortandad Canyon. Some radioactivity associated with sediments from Pueblo and Los Alamos Canyons has moved into the Rio Grande (Section 5.E.4). Some of these contaminated sediments have been deposited in Cochiti Reservoir since its completion in 1973. No sediment samples collected in 1995 contained levels of trace metals above background or detectable levels of regulated organic compounds or HE residuals.

4. Drinking Water Program

The SDWA program routinely collects drinking water samples from various points in the Laboratory, Los Alamos County, and Bandelier National Monument water distribution systems and from the Laboratory's water supply well heads to demonstrate compliance with the federal SDWA (40 CFR 141) (EPA 1989) and the State of NM Drinking Water Regulations (NMEIB 1995). The EPA has established MCLs for microbiological organisms, organic and inorganic constituents, and radioactivity in drinking water. These standards have been adopted by the State of NM and are included in the NM Drinking Water Regulations. The NM Environment Department (NMED) has been authorized by the EPA to administer and enforce the SDWA in NM.

B. Description of Surface Water, Groundwater, and Sediment Programs and Monitoring Results

The USGS was involved in overseeing and conducting various studies for development of groundwater supplies beginning in 1945 and 1946. Studies specifically aimed at environmental monitoring and at protecting groundwater quality were initiated as joint efforts between the AEC, the Los Alamos Scientific Laboratory, and the USGS in about 1949. These initial efforts were focused on Pueblo and DP/Los Alamos Canyons, which were the main disposal sites for radioactive industrial wastes in the early days of the Laboratory.

The current network of annual sampling stations for surface water, groundwater, and sediment surveillance includes a set of regional (or background) stations and a group of stations near or within the Laboratory boundary. The on-site stations are for the most part focused on areas of present or former waste disposal operations, particularly canyons (Figure 1-4). To provide context for discussion of monitoring results, the setting and operational history of currently monitored canyons that have received radioactive or other liquid discharges are briefly summarized below. These canyons have been the subject of numerous studies to evaluate environmental and health effects of Laboratory operations, as well as continual surveillance monitoring since the early days of the Laboratory and are a high priority for remedial work by the ER Project (Pratt 1996). These descriptions are not intended as a complete inventory of past Laboratory discharges.

Acid Canyon, Pueblo Canyon, and Lower Los Alamos Canyon

Acid Canyon, a small tributary of Pueblo Canyon, was the original disposal site for liquid wastes generated by research on nuclear materials for the World War II Manhattan Engineer District atomic bomb project. Acid Canyon received untreated radioactive industrial effluent from 1943 to 1951. The Technical Area (TA) 45 treatment plant was completed in 1951, and from 1951 to 1964 discharged treated effluents that contained residual radionuclides. Most of the residual radioactivity from these releases is now associated with the sediments in Pueblo Canyon, with an estimated total plutonium inventory of about 630 ± 300 mCi (ESG 1981). The estimated plutonium releases were about 177 mCi. About two-thirds of this total are in the DOE-owned portion of lower Pueblo Canyon.

Pueblo Canyon currently receives treated sanitary effluent from the Los Alamos County Bayo Sewage Treatment Plant in the middle reach of Pueblo Canyon. Water occurs seasonally in the alluvium, depending on the volume of surface flow from snowmelt, thunderstorm runoff, and sanitary effluents. Tritium, nitrate, and chloride from these industrial and municipal disposal operations have infiltrated to the intermediate perched groundwater (at depths of 37 m to 58 m [120 to 190 ft]) and the main aquifer (at a depth of 180 m [590 ft]) beneath the lower reach of Pueblo Canyon. Except for occasional nitrate values, levels of these constituents are a small fraction of EPA drinking water standards.

Increased discharge of sanitary effluent from the county treatment plant, starting in 1990, resulted in nearly continual flow during most months, except June and July, in the lower reach of Pueblo Canyon and across DOE land into the lower reach of Los Alamos Canyon on Pueblo of San Ildefonso land. From mid-June through early August, higher evapotranspiration and the diversion of sanitary effluent for golf course irrigation eliminate flow from Pueblo Canyon into Los Alamos Canyon. One spring, which in the past discharged from alluvium in the

lower reach of Pueblo Canyon, has been dry since 1990, probably because there was no discharge from the older, abandoned Los Alamos County Pueblo Sewage Treatment Plant. Further east the alluvium is continuously saturated, mainly because of infiltration of effluent from the Los Alamos County Bayo Sewage Treatment Plant. Effluent flow from Pueblo Canyon into Los Alamos Canyon generally extends to somewhere between the DOE/ San Ildefonso boundary and the confluence of Guaje and Los Alamos Canyons.

DP Canyon and Los Alamos Canyon

In the past, Los Alamos Canyon received treated and untreated industrial effluents containing some radionuclides. In the upper reach of Los Alamos Canyon there were releases of treated and untreated radioactive effluents during the earliest Manhattan Project operations at TA-1 (late 1940s) and some release of water and radionuclides from the research reactors at TA-2. Los Alamos Canyon also received discharges containing radionuclides from the sanitary sewage lagoon system at the Los Alamos Neutron Science Center (LANSCE [formerly Los Alamos Meson Physics Facility]) (TA-53). The low-level radioactive waste stream was separated from the sanitary system at TA-53 in 1989 and directed into a total retention evaporation lagoon. An industrial liquid waste treatment plant that served the old plutonium processing facility at TA-21 discharged effluent containing radionuclides into DP Canyon, a tributary to Los Alamos Canyon, from 1952 to 1986.

The reach of Los Alamos Canyon within the Laboratory boundary presently carries flow from the Los Alamos Reservoir (west of the Laboratory), as well as National Pollutant Discharge Elimination System (NPDES) - permitted effluents from TA-2, TA-53, and TA-21. Infiltration of NPDES-permitted effluents and natural runoff from the stream channel maintains a shallow body of groundwater in the alluvium of Los Alamos Canyon within the Laboratory boundary west of State Road 4. Groundwater levels are highest in late spring from snowmelt runoff and in late summer from thundershowers. Water levels decline during the winter and early summer when runoff is at a minimum. Depth to water is typically in the range of 1.2 m to 4.6 m (4 to 15 ft). Alluvial perched groundwater also occurs in the lower portion of Los Alamos Canyon on the Pueblo of San Ildefonso lands. This alluvium is not continuous with the alluvium within the Laboratory, and can be sampled utilizing wells installed by the Bureau of Indian Affairs (BIA).

Sandia Canyon

Sandia Canyon has a small drainage area that heads at TA-3. The canyon receives water from the cooling tower at the TA-3 power plant and treated effluents from the TA-46 Sanitary Wastewater Systems Consolidation (SWSC) Plant. These effluents support a continuous flow in a short reach of the upper part of the canyon, but only during summer thundershowers does stream flow reach the Laboratory boundary at State Road 4 and only during periods of heavy thunderstorms or snowmelt does surface flow from Sandia Canyon extend beyond the Laboratory boundary.

Mortandad Canyon

Mortandad Canyon has a small drainage area that heads at TA-3. Its drainage area presently receives inflow from natural precipitation and a number of NPDES-permitted effluents including one from the existing Radioactive Liquid Waste Treatment Facility at TA-50. The TA-50 facility began operations in 1963. Cumulative discharge of radionuclides between 1963 and 1977 and data for 1993 through 1995 are given in Table 5-1. In addition to total annual activity released for 1993 through 1995, Table 5-1 also shows mean concentrations in effluent for each radionuclide, and the ratio of this concentration to the DCG. In six cases the DCG was exceeded: for americium-241 in 1993; for americium-241 and plutonium-238 in 1994; and for plutonium-238; plutonium-239,240; and americium-241 in 1995. For each of these years, the effluent nitrate concentrations exceeded the New Mexico groundwater standard of 10 mg/L (nitrate as nitrogen). The groundwater standard applies because the TA-50 effluent infiltrates the alluvium in the canyon. In order to address these problems the Laboratory is working to upgrade the TA-50 treatment process. These effluents infiltrate the stream channel and maintain a saturated zone in the alluvium extending about 3.5 km (2.2 mi) downstream from the TA-50 NPDES-permitted outfall. The easternmost extent of saturation is on site, about 1.6 km (1 mi) west of the Laboratory boundary with the Pueblo of San Ildefonso.

Surface flow in the drainage has not reached the Pueblo of San Ildefonso boundary since observations began in the early 1960s (Stoker 1991). Three sediment traps are located about 3 km (2 mi) downstream from the effluent discharge in Mortandad Canyon to dissipate the energy of major thunderstorm runoff events and settle out transported sediments. From the sediment traps, it is approximately another 2.3 km (1.4 mi) downstream to the Laboratory boundary with the Pueblo of San Ildefonso.

The alluvium is less than 1.5 m (5 ft) thick in the upper reach of Mortandad Canyon and thickens to about 23 m (75 ft) at the easternmost extent of saturation. The saturated portion of the alluvium is perched on weathered and unweathered tuff and is generally no more than 3 m (10 ft) thick. There is considerable seasonal variation in saturated thickness, depending on the amount of runoff experienced in any given year (Stoker 1991). Velocity of water movement in the perched alluvial groundwater ranges from 18 m/day (59 ft/day) in the upper reach to about 2 m/day (7 ft/day) in the lower reach of the canyon (Purtymun 1974, 1983). The top of the main aquifer is about 290 m (950 ft) below the perched alluvial groundwater.

Pajarito Canyon

In Pajarito Canyon, water in the alluvium is perched on the underlying tuff and is recharged mainly through snowmelt, thunderstorm runoff, and some NPDES-permitted effluents. Three shallow observation wells were constructed in 1985 as part of a compliance agreement with the State of New Mexico to determine if technical areas in the canyon or solid waste disposal activities on the adjacent mesa were affecting the quality of shallow groundwater. No effects were observed; the alluvial perched groundwater was found to be contained in the canyon bottom and did not extend under the mesa (Devaurs 1985).

Cañada del Buey

Cañada del Buey contains a shallow alluvial perched groundwater system of limited extent. The thickness of the alluvium ranges from 1.2 to 5 m (4 to 17 ft), while the underlying weathered tuff ranges in thickness from 3.7 to 12 m (12 to 40 ft). In 1992, saturation was found within only a 0.8-km (0.5-mi) long segment, and only two observation wells have ever contained water (EPG 1994). The apparent source of the saturation is purge water from nearby municipal water supply well PM-4, as the alluvium is dry upstream of the purge water entry point. Because treated effluent from the Laboratory's SWSC project may at some time be discharged into the Cañada del Buey drainage system, a network of five shallow groundwater monitoring wells and two moisture monitoring holes was installed during the early summer of 1992 within the upper and middle reaches of the drainage (EPG 1994). Construction of the SWSC project was completed in late 1992.

1. Sampling and Analytical Procedures, Data Management, and Quality Assurance

a. Sampling and Analytical Procedures. Stoker (1990a) is the basic document covering sampling procedures and quality assurance (QA). Detailed container and preservation requirements are documented in a handbook by Williams (1990). More focused guidance is provided in formal procedures developed to address sampling procedures for each sample matrix (Mullen 1996). All sampling is conducted using strict chain-of-custody procedures, as described in Gallaher (1993). The completed chain-of-custody form serves as an analytical request form and includes the requester or owner, sample barcode number, program code, date and time of sample collection, total number of bottles, the list of analytes to be measured, and the bottle sizes and preservatives for each analysis required. LANL's samples are submitted to the Chemical Science and Technology (CST) analytical laboratory. Detailed analytical methods are published in Gautier (1995a). Beginning in 1995, samples were submitted using blind sample numbers to prevent possible bias by the analyst through a knowledge of the sampled location.

Metals and general inorganics have been analyzed using EPA SW-846 methods. Filtering and digestion methods have changed over time. Before 1993, water samples were preserved in the field and filtered in the lab before digestion. From 1993 forward, water samples have not been filtered in the field or in the laboratory. The results reported have been for total concentrations. As described in "Environmental Surveillance at Los Alamos during 1994" (EG 1996), from September of 1992 through the spring of 1994, SW-846 digestion method 3050 was used for sediments, and 3005 was used for waters. After the spring of 1994, digestion method 3051 was used for

sediments, and 3015 was used for waters. The methods are considered equivalent. Methods 3015 and 3051 use microwave digestion, while 3005 and 3050 use a steam bath.

Radiochemical analysis has been performed using the methods as updated in Gautier (1995a). Sediment samples are screened through a Number 12 US Standard Testing sieve before digestion. This sieve screens out materials larger than 1.7 mm (0.066 in.). One hundred gram samples are collected from stream channels; 1,000 gram samples are collected from reservoirs. This results in a 10-fold decrease in detection limits of plutonium-238 and plutonium-239,240 for reservoir samples.

Negative values are reported for some radiological measurements. Negative numbers occur because measurements of radiochemical samples require that analytical or instrumental backgrounds be subtracted to obtain net values. Thus, net values are sometimes obtained that are lower than the minimum detection limit of the analytical technique. Consequently, individual measurements can result in values of positive or negative numbers. Although negative values do not represent a physical reality they are reported here as they are received from the analytical laboratory. Valid long-term averages can be obtained only if the very small and negative values are included in the analytical results.

Water samples submitted for radiochemical analyses are preserved in the field by adding nitric acid to lower the pH of the sample to two or less. Water samples are filtered shortly after they are received by the analytical laboratory. After filtering, the sample is digested before analysis. Both water and sediment radiochemical samples are completely digested in a mixture of nitric and hydrofluoric acids.

When very accurate trace level tritium analyses are required, samples are shipped to the University of Miami Tritium Laboratory. These samples are collected and analyzed according to procedures described in University of Miami Tritium Laboratory (1996).

Organics are analyzed for using SW-846 methods as shown on Table 5-2. This table shows the number of analytes included in each analytical suite. The specific compounds analyzed for in each suite are listed in Tables 5-3 through 5-6. All organic samples are collected in glass bottles and the volatile organics sample is preserved with hydrochloric acid. A trip blank always accompanies the volatile organic sample.

b. Data Management and Quality Assurance. Historically, as analytical data is generated by the analysts in CST, it is transferred to the Analytical Services Group (CST-3), the sample management group. CST-3 transfers the data to the Water Quality and Hydrology Group (ESH-18) as a hardcopy. In 1995 a new procedure was initiated whereby CST-3 also makes weekly electronic data transfers to the Facility for Information Management, Analysis, and Display (FIMAD). The electronic data is screened by FIMAD and stored in an Oracle database table. The table contains all the analytical data generated by CST for the current year. Data is extracted from the table and downloaded to ESH-18 using commercially available software. The sample location name, the sample barcode number, and the field data are stored in a separate table on ESH-18 personal computers and on FIMAD. This table provides the link for associating a blind sample barcode number with a location name.

Each analytical batch (20 samples or less) contains at least one blank, matrix spike, and duplicate as dictated by SW-846 protocols. These samples are provided by CST-3 and submitted along with environmental surveillance samples. ESH-18 also submits blanks and field-prepared duplicates. These samples are submitted blind and are identical to all other samples. CST participates in numerous interlaboratory quality assurance programs. The programs, laboratory results, and expected results are summarized quarterly in Gautier (1995b).

c. Evaluation of Radiochemical Detection Limits. Uncertainties are reported in the tables for radiological data. These uncertainties are reported by the CST analyst for each radiological measurement. These numbers are referred to as counting uncertainties and represent the uncertainty associated with counting photon emissions from a blank and the sample. Counting uncertainties vary with time and from one instrument to another. One standard deviation (one sigma) counting uncertainties are typically reported; three sigma uncertainties are reported for tritium. Counting uncertainties do not include the other sources of error in an analytical measurement.

CST has determined detection limits for each analytical method. Radiological detection limits are based on Currie's formula (Currie 1968). Detection limits are reported, in this section, at the bottom of the tables summarizing the analytical results. The CST detection limits include uncertainties associated with the entire analytical method and include counting uncertainties, sample preparation, digestion, dilutions, and spike recoveries. The CST detection limits, reported in this document, have been changed from those reported in recent years. These changes reflect changes in aliquot sizes, recent evaluations of detector backgrounds and efficiencies, and evaluations of recoveries.

As part of our QA program we compared the CST detection limits to the counting uncertainties. For an unbiased analytical method, a value of three sigma above zero can be regarded as the method detection limit (MDL) (Keith 1991). Three sigma is chosen to calculate a detection limit with a false positive rate of less than 1%. A false positive, or type I error, occurs when the concentration in the sample is incorrectly identified as being above the detection limit. In other words, a type I error is when the "true" concentration in the sample is below the detection limit, and the analytical result shows the concentration in the sample to be above the detection limit.

To evaluate the reported detection limits, we calculated three times the average reported counting uncertainty for sample values at or below the detection limits provided by CST. Because counting uncertainties do not include the other sources of analytical errors, a three sigma detection limit based on counting uncertainties is the best case detection limit. The "true" detection limit will be higher. The results are summarized in Table 5-7. The CST detection limit for cesium-137 in water appears to be optimistic. There were too few uranium analyses measured below or near the CST detection limit to make an accurate evaluation of the detection limit for uranium. This comparison generally validates the detection limits reported by CST.

Except as noted, the detection limits listed in Table 5-7 were calculated based on the counting uncertainties and represent a best case detection limit. The overall MDL may be significantly higher, as suggested by the additional analysis of tritium data described below.

In evaluating our surveillance data, the following methodology is used to determine if a radionuclide was measured above the detection limit. The measured value is compared to the detection limit listed at the bottom of the tables. If the value is above the detection limit, it is compared to the uncertainty reported with the value. If the value is above the detection limit and greater than twice the uncertainty, it is regarded as a detection. The value of twice the uncertainty is used, rather than three times the uncertainty, to identify all cases where an analyte is present with a reasonable degree of certainty. If the analysis result is above the detection limit but less than two times the uncertainty associated with the measurement, it is considered a nondetection.

Tritium Detection Limits. The detection limit for tritium has been reported as 400 pCi/L in past surveillance reports. The uncertainties associated with tritium values at or near the detection limit have usually been reported as 300 to 400 pCi/L. In the past, the uncertainties reported for tritium in the tables have been identified as representing one standard deviation (one sigma). Recent communications with CST show that this value has been reported incorrectly. The value reported as the one sigma uncertainty should have been reported as a three sigma uncertainty.

Table 5-7 suggests a three sigma detection limit for tritium, using liquid scintillation techniques, of about 300 pCi/L. As discussed in Section 5.B.3, low detection level tritium analyses using electrolytic enrichment techniques have been made on numerous water samples from Los Alamos by the University of Miami Tritium Laboratory since 1992. Comparison of the University of Miami data with the CST data suggested that the detection limits historically reported by CST for tritium should be reevaluated. We determined tritium detection limits by two additional methods. These methods are based on analytical results, rather than CST reported uncertainties, as described below.

ESH-18 and CST-3 submit blanks to CST for tritium analysis. There were 17 blanks associated with ESH-18 samples submitted in 1995. The average tritium value reported for this data set is 6 pCi/L with a standard deviation (one sigma) of 275 pCi/L. This suggests that the CST analytical results are centered around zero with a three sigma detection limit of 825 pCi/L. The detection limit has previously been stated to be 400 pCi/L. Based on this limited data set, we suggest that a more accurate detection limit for tritium would be 800 to 900 pCi/L. Tritium values below 800 pCi/L would be regarded as nondetections.

The second method for evaluating tritium detection limits was based on estimating the standard deviation from duplicate measurements of tritium samples (Taylor 1987). To ensure that the samples used for this calculation were similar and measured at the same level of precision, only duplicates with uncertainties less than 500 pCi/L were used for this analysis. Laboratory replicates, duplicates, and field duplicates were all used with equal weight. A total of 17 duplicate measurements from the 1995 data set were used. This method gave a standard deviation of 635 pCi/L for a three sigma detection limit of 1,900 pCi/L. This suggests that tritium values reported by the CST analytical laboratory should be considered nondetections below about 2,000 pCi/L. This result offers an explanation for the widely diverging results reported by University of Miami and CST for duplicate samples.

d. Chromium Results. Analyses for groundwater sampled March 29, 1995, from wells APCO-1 and LAO-3 showed extremely high levels of chromium. We suspected that potassium dichromate, typically added to preserve the mercury sample, was erroneously added to the metals sample bottle. Samples collected for mercury analysis are preserved with nitric acid and 5 drops of a 50 mg/mL solution of potassium dichromate. This quantity of preservative, if added to the one liter metals sample bottle would result in a chromium concentration of about 4,400 µg/L. The values reported for chromium in the March 29 samples were 5,300 and 7,700 µg/L in APCO-1, 4,700 and 7,000 µg/L in LAO-3. These values are well within the range that would be realized if the potassium dichromate preservative were added to the metals sample bottle instead of the mercury sample bottle. Further confirmation that the potassium dichromate preservative was added to the wrong sample bottle is found in elevated potassium levels that were measured in the March 29 samples when compared to the samples collected from the same wells three months later on June 23, 1995.

2. Surface Water Sampling

a. Monitoring Network. Two types of surface water samples are collected. Surface water grab samples are collected annually from locations where surface flows are typically maintained by effluent discharges or spring flows. Runoff samples are collected during or shortly after significant precipitation events. These samples are generally collected from locations where precipitation or snowmelt runoff is the only source of water.

Regional Stations. Regional surface water samples (Figure 5-1) were collected within 75 km (47 mi) of the Laboratory from seven stations on the Rio Grande, the Rio Chama, and the Jemez River. These waters provide baseline data from areas beyond the Laboratory boundary. Stations on the Rio Grande are at Embudo, Otowi, Frijoles Canyon, Cochiti, and Bernalillo. All the regional stations, except the Rio Grande at Frijoles, are located at current or former USGS stations. All these stations except the Rio Grande at Bernalillo station are currently maintained by the USGS. The Rio Grande at Bernalillo station was operated by the USGS from 1941 to 1969. Stream flows are reported annually in the USGS Water Data Report, Water Resources Data New Mexico.

Pajarito Plateau Stations. Surface water monitoring stations located on the Pajarito Plateau are shown in Figure 5-2. The station in Guaje Canyon is below Guaje Reservoir. Guaje Reservoir is located in upper Guaje Canyon and has a capacity of 871 m^3 (0.7 ac-ft) and a drainage area above the intake of about 14.5 km^2 (5.6 mi^2). Flow into the reservoir is maintained by perennial springs. The stream and reservoir are used for recreation and storing water for landscape irrigation in the Los Alamos townsite.

Surface water sampling stations in Acid/Pueblo Canyon are at Acid Weir (where Acid Canyon joins the main channel of Pueblo Canyon), Pueblo 1, and Pueblo 2. Flow is irregular at these locations and depends mainly on snowmelt, thunderstorm runoff, and return flow from the shallow alluvium. Treated sanitary effluent is discharged from the Los Alamos County Bayo Sewage Treatment Plant below Pueblo 2. Surface water in Pueblo Canyon is sampled within the Laboratory boundaries below the treatment plant at Pueblo 3. Pueblo 3 is sampled at the lowest point in Pueblo Canyon where flowing water can be found on the day the sample is collected. During the summer months much of the discharge from the Bayo treatment plant is diverted for irrigation, and there are no flows at Pueblo 3. Pueblo Canyon discharges into Los Alamos Canyon at State Road 502 near the eastern Laboratory boundary.

Runoff samples are collected in three locations in Pueblo Canyon. The Pueblo at Land Fill station is located west of the Laboratory boundary across from the Pueblo School Complex. Pueblo at GS is located below the Pueblo 3 station. Runoff is also sampled where Pueblo Canyon intersects State Road 502.

Los Alamos Reservoir, in upper Los Alamos Canyon on the flanks of the mountains west of Los Alamos, has a capacity of 51,000 m^3 (41 ac-ft) and a drainage area of 16.6 km^2 (6.4 mi^2). The reservoir is used for recreation and limited storage of water for irrigation of landscaping in the Los Alamos townsite. The sampling location at the reservoir outlet is the uppermost station in Los Alamos Canyon. In the fall of 1991, the Laboratory had the USGS resume operation of a stream flow gaging station a short distance upstream from State Road 4. This station was discontinued at the end of the 1995 water year. A LANL operated station, Pueblo Canyon near LA, replaces it. In lower Los Alamos Canyon, surface water samples are collected at the confluence with the Rio Grande.

DP Canyon is a small tributary of Los Alamos Canyon. There are two surface water sampling stations in DP Canyon, DPS-1 and DPS-4. Runoff samples are collected in DP Canyon above the confluence with Los Alamos Canyon. In Los Alamos Canyon, runoff is sampled at four stations. The furthest upstream station is Los Alamos at Upper Gaging Station (GS) just above the confluence with DP Canyon. Los Alamos at GS-1 is sampled about 1/2

mile above State Road 4. Los Alamos at State Road 4 is sampled where Los Alamos Canyon crosses State Road 4. Los Alamos Canyon is also sampled just upstream of the confluence with the Rio Grande.

Three Sandia Canyon surface water sampling stations, SCS-1, SCS-2, and SCS-3, are located in the reach of the canyon where flows are maintained by effluent discharges. A surface water station, GS-1, is located in Mortandad Canyon a short distance downstream from the TA-50 effluent release point. Treated sanitary effluent (from the community of White Rock) often provides flow in Mortandad Canyon from White Rock to the confluence with the Rio Grande. This is sampled at the confluence with the Rio Grande. Surface water samples are collected from Cañada del Buey below TA-46. The waters sampled are primarily from effluents. There are two surface water stations in Pajarito Canyon. The uppermost station is below TA-18. This station samples effluent from TA-18, and the surface flows from Pajarito Canyon and Three Mile Canyon. Pajarito Canyon is also sampled at its confluence with the Rio Grande just east of the Laboratory. This location samples the perennial reach of the stream in Pajarito Canyon fed from springs. Runoff is sampled at two locations in Pajarito Canyon. Pajarito at State Road 501 is sampled above the highway. Pajarito at State Road 4 is sampled below the highway, south of the intersection of State Road 4 and Pajarito Road in White Rock. Spring-supplemented flows are sampled below the firing sites at TA-16 in Water Canyon at Beta Station. Spring-supported perennial flows in Ancho Canyon are sampled at the confluence with the Rio Grande. Runoff is sampled at Ancho Canyon near Bandelier where Ancho Canyon crosses State Road 4. Surface water flow in Frijoles Canyon is sampled at Bandelier National Monument Headquarters. Flow in the canyon is from spring discharge in the upper reach of the canyon. The drainage area above the monument headquarters is about 44 km^2 (17 mi^2) (Purtymun 1980). Surface flow in Frijoles Canyon is also sampled at the confluence with the Rio Grande.

b. Radiochemical Analytical Results. The results of radiochemical analyses for surface water samples, excluding runoff, for 1995 are listed in Table 5-8. All of these analytical results are below the DOE DCGs for public exposure. The majority of the results are near or below the detection limits of the analytical methods used and below the DOE DCGs for drinking water systems (Appendix A) except for samples from DP Canyon (strontium-90) and Mortandad Canyon (plutonium-238 and americium-241). Most of the measurements at or above detection limits are from locations with previously known contamination: Pueblo Canyon, DP/Los Alamos Canyon, and Mortandad Canyon.

A few of the measurements at or above detection limits were from locations that do not typically show detectable activity. Table 5-9 summarizes radionuclide detections at locations outside the known contaminated areas in Pueblo, DP/Los Alamos, and Mortandad Canyons (See Section 5.B.1 for criteria for determining if a radionuclide is detected). Uranium values are not included in this table as it was unambiguously detected at nearly all locations due either to Laboratory activities or natural occurrence.

In 1995, samples collected at the Rio Grande at Otowi and the Rio Grande at Frijoles were collected from both the bank and as a width integrated sample collected from a transect perpendicular to the stream flow. Historically, samples have only been collected from the bank. The samples have been collected from the western bank of the river to look for possible Laboratory influence on water quality. The Rio Grande at Otowi station is upstream from possible Laboratory influence and is classified as a background station.

The analytical result from a previous sample collected at Rio Grande at Otowi showed americium-241 levels of -0.004 ± 0.03 pCi/L in 1993. A sample collected on September 15, 1995, at the Rio Grande at Otowi contained americium-241 at 0.05 ± 0.03 pCi/L, which is considered a nondetection because the sample value is less than twice the uncertainty. This station is monitored to provide a measure of background values. The sample is taken upstream of Los Alamos Canyon and should show no Laboratory-derived contamination. The apparent detection of americium-241 at this location emphasizes that the detection limits should be used as a guide.

Regarding the 1995 measurements of plutonium-238 and americium-241 for Rio Grande at Bernalillo, previous results were 0.036 ± 0.03 pCi/L and 0.011 ± 0.03 pCi/L for 1993 and 1994 respectively, both nondetections.

Americium-241 was detected in surface water at Cañada del Buey. One other americium-241 analysis is available for Cañada del Buey. This sample was collected in 1994 with a concentration of 0.023 ± 0.03 pCi/L and is considered a nondetection.

An elevated level of americium-241 (0.17 ± 0.035 pCi/L) was measured from a sample collected in Frijoles Canyon at the Bandelier National Monument Headquarters on June 2, 1995. While this level is above what is usually observed outside known contaminated areas, the concentration is nearly an order of magnitude lower than

the DOE Drinking Water System DCG (1.2 pCi/L). A second sample was collected on July 27, 1995, and was regarded as a nondetection.

Measurements of radioactivity in surface water runoff are presented in Table 5-10. Detectable levels of plutonium-239,240 were observed in runoff in Los Alamos Canyon, and detectable levels of americium-241 were found in Pueblo and Los Alamos Canyons, consistent with earlier findings. Strontium-90 was measured in Los Alamos Canyon at State Road 4 and in Ancho Canyon near Bandelier National Monument. The concentration of strontium-90 (50.9 pCi/L) measured in the sample collected at Ancho Canyon near Bandelier was above the EPA Primary Drinking Water standard and the DOE Drinking Water DCG; this is unusual because this location is outside the known contaminated areas. The gross beta measurement (73 pCi/L) for this station supports the strontium-90 value. An elevated level of uranium was also observed in this sample. The runoff event in Ancho Canyon had an estimated peak flow of 1.1 m^3/s (40 ft^3/s). The sample was collected at a flow of approximately 0.2 m^3/s (6 ft^3/s).

The concentrations of plutonium in solution and in the suspended sediments are summarized in Table 5-11. (Radioactivity in solution refers to the filtrate that passes through a 0.45-micron filter; radioactivity in suspended sediments refers to the residue retained by the filter.) These are analyzed separately to estimate the fraction of plutonium associated with the liquid and suspended solid fractions. Results are consistent with past findings with elevated levels of plutonium, especially plutonium-239,240 in Los Alamos Canyon sediments. The highest concentrations are about an order of magnitude below the SALs for sediments (see Sediment Sampling section). Several samples showed dissolved concentrations of plutonium-239,240 just above detection limits.

c. Nonradiochemical Analytical Results.

Major Chemical Constituents. The results of major chemical constituents in surface water samples for 1995 are listed in Table 5-12. The results are generally consistent with those observed in previous years, with some variability. The measurements in waters from areas receiving effluents show the effects of these effluents. The concentration of nitrates in the sample collected at Water Canyon at Beta was 9.6 mg/L (nitrate as nitrogen). This is only slightly below the EPA Drinking Water Standard of 10 mg/L.

Trace Metals. The results of trace metal analyses on surface water samples for 1995 are listed in Table 5-13. The levels are generally consistent with previous observations. As with the radiochemical samples, samples were collected from the bank and as width integrated samples at the Rio Grande at Otowi and the Rio Grande at Frijoles. The EPA action level was exceeded for lead at the Rio Grande at Frijoles for the width integrated sample. The sample collected from the bank showed a lead concentration a factor of three lower than the width integrated sample.

A beryllium concentration above the detection limit levels was measured in samples collected at the Rio Grande at Embudo (3 µg/L), the Rio Grande at Otowi (4 µg/L), and the Jemez River (4 µg/L). The EPA Drinking Water standard for beryllium is 4 µg/L.

A barium concentration of 520 µg/L was measured in the sample collected at Water Canyon at Beta, compared to NMWQCC Groundwater Limit of 1,000 µg/L. This sample also had an elevated level of nitrates as noted above. The presence of these contaminants and the proximity of the sample location to TA-16 suggests HE contamination. The sample collected in 1996 will be analyzed for HE.

The NMWQCC Groundwater Limit was exceeded for silver at all three stations in Sandia Canyon (SCS-1, SCS-2, and SCS-3) with concentrations of 63, 66, and 67 µg/L respectively. The uncertainty associated with these measurements was 40 µg/L. The measured values are less than two sigma and should be regarded as nondetections. Previous data from this location shows that the highest value observed in the period of record since 1981 for these stations was at SCS-1 in 1990 when silver was measured at 19 µg/L.

Our analytical detection limit (0.2 µg/L) is not adequate to determine if mercury is present in excess of the NM Wildlife Habitat stream standard of 0.012 µg/L. In 1995 mercury was observed above the detection limit of 0.2 µg/L at the station in Cañada del Buey.

Aluminum, iron, and manganese concentrations exceed EPA Secondary Drinking Water Standards at most locations. The results reflect the presence of suspended solids in the water samples. Because the metals analyses are performed on unfiltered water samples, the results will be high due to naturally occurring metals (e.g., aluminum, iron, manganese) associated with the suspended solids.

In 1994, cadmium values (150 µg/L) larger than the NM Wildlife Watering Standard (50 µg/L) were detected at Pajarito at the Rio Grande and at SCS-2 (EG 1996). Sampling or analytical inaccuracies were suspected as the cause of the SCS-2 value, as none of the other stations upstream or downstream of SCS-2 within Sandia Canyon

showed elevated levels on the same day. The cadmium concentration at both these stations was below the detection limit in 1995.

Organics. The locations where organics analyses were performed in 1995 are summarized in Table 5-14. Table 5-15 summarizes the organic constituents detected in 1995. The only organic constituent detected in surface waters above the Limit of Quantitation (LOQ) was acetone found at Ancho at Rio Grande and Frijoles at Rio Grande. The presence of acetone in the laboratory method blank and the trip blank discounts these results.

d. Long-Term Trends. Long-term trends of the concentrations of tritium and dissolved total plutonium (the portion of the sample that passes through a 0.45-micron membrane filter) in surface water in Mortandad Canyon are depicted in Figure 5-3. These measurements were made on samples collected at the station Mortandad at GS-1, which is a short distance downstream of the TA-50 effluent discharge into Mortandad Canyon. In general, there has been a decrease in the combined levels of plutonium-238 and plutonium-239,240 (in solution) since 1981. All plutonium values exceed the detection limit of 0.04 pCi/L; all tritium concentrations exceed the detection limit of 2 nCi/L except for a sample collected in April 1988.

3. Groundwater Sampling

a. Monitoring Network. There are three principal groups of groundwater sampling locations, related to the three modes of occurrence of groundwater in the Los Alamos area: main (or regional) aquifer, alluvial perched groundwater in the canyons, and the localized intermediate-depth perched groundwater systems. The sampling locations for the main aquifer, the intermediate-depth perched groundwater systems, and for springs interpreted to be discharging from either the main aquifer (Purtymun 1980) or from the perched intermediate systems are shown in Figure 5-4. The sampling locations for the canyon alluvial perched groundwater systems are shown in Figure 5-5.

Some water for drinking and industrial use has been obtained from a well at the Laboratory's experimental geothermal site (Fenton Hill, TA-57) about 45 km (28 mi) west of Los Alamos on Forest Service land. Due to cessation of operations and impending closure of this site by the DOE, environmental surveillance there has been discontinued.

As a result of budget constraints, approximately half of the White Rock Canyon springs were sampled in 1995. The remainder are scheduled for 1996.

Main Aquifer. Sampling locations for the main aquifer include test wells, supply wells, and springs. The sampling locations, including geologic sections, well construction details, and water depths, are described by Purtymun (1995a). Eight deep test wells, completed into the main aquifer, are routinely sampled. These test wells were drilled by the USGS between 1949 and 1960 using the cable tool method. The wells penetrate only a few hundred feet into the upper part of the main aquifer, and the casings are not cemented.

Three of the test wells are located in the Los Alamos and Pueblo Canyons' drainages. TW-4, drilled in 1950 on the mesa above Acid Canyon, is near the former outfall of the decommissioned TA-45 Radioactive Liquid Waste Treatment Plant. TW-2, drilled in 1949, is in the middle reach of Pueblo Canyon, downstream from the confluence with Acid Canyon, on Los Alamos County land. TW-1, drilled in 1950, is in the lower reach of Pueblo Canyon, near the boundary with the Pueblo of San Ildefonso.

One test well is located in Los Alamos Canyon and one in Mortandad Canyon. TW-3, drilled in 1949, is in the middle reach of Los Alamos Canyon just upstream from the confluence with DP Canyon. TW-8, drilled in 1960, is in the middle reach of Mortandad Canyon, downstream from the TA-50 Radioactive Liquid Waste Treatment Plant NPDES-permitted outfall. Three test wells are located on the mesa at the southern edge of the Laboratory at TA-49, the site of the hydronuclear tests that were conducted in 1960 and 1961. Test wells DT-5A, DT-9, and DT-10 all were drilled in 1960.

Samples were also collected from nine deep water supply wells in three well fields that produce water for the Laboratory and community. The well fields include the Guaje Well Field, located off site in Guaje Canyon on US Forest Service lands northeast of the Laboratory and the on-site Pajarito and Otowi fields. The Guaje Well Field contains seven wells, five of which had significant production during 1994. The five wells of the Pajarito Well Field are located in Sandia and Pajarito Canyons and on mesa tops between those canyons. Two new water supply wells were completed in 1990. These are the first wells in a new field designated as the Otowi Well Field, and the wells were designated Otowi-1 and Otowi-4. Otowi-4 was connected to the distribution system and began production during 1993, but was shut down due to pump failure during 1995.

Additional samples were taken from 13 other wells located in the Santa Fe Group of sedimentary deposits. These wells were sampled as part of the special sampling on the Pueblo of San Ildefonso (Section 5.E.3.a).

Numerous springs near the Rio Grande were sampled because they are interpreted to be representative of natural discharge from the main aquifer (Purtymun 1980). Based on their chemistry, the springs in White Rock Canyon are divided into four groups. Three groups (I, II, and III) have similar, aquifer-related chemical quality. The chemical quality of springs in Group IV reflects local conditions in the aquifer, which are probably related to waters discharging through faults in volcanics. Two additional springs, Indian and Sacred Springs, are west of the river in lower Los Alamos Canyon. These two springs discharge from faults in the siltstones and sandstones of the Tesuque Formation.

Perched Groundwater in Canyon Alluvium. The alluvial perched groundwater in five canyons was sampled by means of shallow observation wells as part of the routine monitoring program. As described above, Pueblo and Los Alamos Canyons are former radioactive effluent release areas, and Mortandad Canyon presently receives treated radioactive effluents. The fourth is Pajarito Canyon, immediately south of the existing solid and liquid waste management areas at TA-54 on Mesita del Buey. The fifth is Cañada del Buey, immediately north of TA-54 and downstream of the Laboratory's SWSC project. The extent of saturation in the alluvial groundwater systems varies seasonally, in response to variations in runoff from snowmelt, summer thunderstorms, and discharges from the Laboratory's NPDES-permitted outfalls. In any given year, some of these alluvial observations wells may be dry, and thus no water samples can be obtained. Observation wells in Water, Fence, and Sandia Canyons have been dry since their installation in 1989. Most of the wells in Cañada del Buey are dry, except for CDBO-6 and CDBO-7.

Intermediate-Depth Perched Groundwater. Perched groundwater of limited extent occurs in the conglomerates and basalts beneath the alluvium in portions of Pueblo, Los Alamos, and Sandia Canyons. Samples are obtained from two test wells and one spring. TW-2A (drilled in 1949) is located in the middle reach of Pueblo Canyon. TW-1A (drilled in 1950) is located in the lower reach of Pueblo Canyon. Perched water in the basaltic rocks is also sampled from Basalt Spring, which is in lower Los Alamos Canyon on the Pueblo of San Ildefonso.

Perched groundwater was observed during the drilling of water supply wells Otowi-4 in Los Alamos Canyon and Otowi-1 in Pueblo Canyon and in the basalts in water supply well PM-1 in Sandia Canyon. It was also observed during the drilling of borehole LADP-3 and borehole LAOI-1.1 in Los Alamos Canyon in the Guaje Pumice at the base of the Bandelier Tuff.

Some perched water occurs in volcanics on the flanks of the Jemez Mountains off site to the west of the Laboratory. This water discharges at several springs (Armstead and American) and yields a significant flow from a gallery in Water Canyon. The gallery contributed to the Los Alamos water supply for 41 years, producing 23 to 96 million gal./yr. Since 1988 it has only been used for makeup water for the steam plant at TA-16, producing 1.6 million gal. in 1995.

b. Radiochemical Analytical Results. The results of radiochemical analyses of groundwater samples for 1995 are listed in Table 5-16. Discussion of the results will address the main aquifer, the canyon alluvial groundwater, and finally the intermediate perched groundwater system.

Radiochemical Constituents in the Main Aquifer. For samples from wells or springs in the main aquifer, most of the results for tritium; strontium-90; uranium; plutonium-238; plutonium-239,240; americium-241; and gross beta were below the DOE DCGs or the EPA or NM standards applicable to a drinking water system. The exceptions are discussed below. In addition, most of the results were near or below the detection limits of the analytical methods used.

Some samples from wells and springs contained levels of plutonium or americium slightly above analytical method detection limits. For several reasons, none of the findings are interpreted to represent contamination of the main aquifer by plutonium or americium. One reason to suspect the validity of a radiochemical analysis is inconsistencies between the types of analyses, (such as apparent plutonium-238 without any corresponding plutonium-239,240 or vice versa). Large counting uncertainties in the measurements at the low levels near average detection limits (often 50% or more of the value) are another issue that makes the validity of very low reported radionuclide concentrations questionable (see Section 5.B.1). In the case of springs, the fact that such samples often must be collected in contact with surface rocks or channel sediments, which might have been contaminated by global fallout, means that sample concentrations reflect radionuclides in these sediments rather than the

groundwater. One example of a suspect analysis was an apparent detection of americium-241 in PM-4 (.109 ± .028 pCi/L), which was contradicted by a lower value (.023 ± .009 pCi/L) on reanalysis.

La Mesita Spring and Sandia Spring have high uranium concentrations. Samples from springs in this area have always contained a relatively high concentration of natural uranium (Purtymun 1980), although the value for Sandia Spring is higher than previously noted. The uranium concentrations for these springs are both below the proposed EPA primary drinking water MCL of 20 µg/L, however. These two springs also have high gross alpha values, at or above the EPA primary drinking water standard of 15 pCi/L.

Water supply well G-1A had an apparent strontium-90 detection of 3.9 ± 0.7 pCi/L. This value is just above the strontium-90 detection limit of 3 pCi/L. Another analysis gave a result of 7.4 ± 3.5 pCi/L, which has a very high uncertainty making interpretation of this result difficult. No prior strontium-90 data are available for this well for comparison. Preliminary results of 1996 samples indicate no trace of strontium-90 in samples from this well. Spring 9B also had a possible strontium-90 detection of 5.1 ± 0.7 pCi/L.

All cesium-137 measurements of samples from the main aquifer wells and springs for 1994 are less than 5% of the DCG applicable to DOE Drinking Water Systems and less than the detection limit of 4 pCi/L.

Tritium measurements of samples from main aquifer wells and springs were near or below the detection limit for the EPA-specified liquid scintillation analytical method. These results are for the most part consistent with additional special tritium measurements made as part of a study utilizing trace-level measurements of tritium to estimate the age of water in the main aquifer (see Section 5.E.2). A notable exception is the tritium value for test well DT-10 which was 2,100 ± 400 pCi/L. This differs with a low-detection-limit value determined by the University of Miami of 3.16 ± 0.29 pCi/L. Another discrepancy is the value for Sacred Spring which was 3,800 ± 600 pCi/L. This compares to a low-detection-limit value determined by the University of Miami of 3.42 ± 0.35 pCi/L. The difference between these results suggests that the detection limit for the liquid scintillation method is at times much higher, perhaps 2,000 to 4,000 pCi/L, than the stated 400 pCi/L detection limit. Other similar discrepancies between the methods are discussed in Section 5.E.3.

Radiochemical Constituents in Alluvial Groundwater. Additional data for alluvial groundwaters are presented in Section 5.E.1. Both filtered and unfiltered samples were analyzed as part of this study, to evaluate the role of suspended sediment particles on observed concentrations.

For some of the alluvial groundwater samples the americium-241 analysis was done initially by direct counting on a germanium lithium detector. This method has typical counting uncertainties of 20 to 40 pCi/L. The samples were rerun by the usual radiochemistry alpha spectroscopy (RAS) method which has a detection limit of about 0.04 pCi/L and counting uncertainties of about 0.02 pCi/L.

None of the alluvial groundwater concentrations are above the DOE DCGs for Public Dose for Ingestion of Environmental Water. Except for strontium-90 values in some samples from Los Alamos and Mortandad Canyons, none of the concentrations exceed DOE DCGs applicable to a drinking water system. (See Section 5.E.1) Levels of tritium; cesium-137; uranium; plutonium-238; plutonium-239,240; strontium-90; and gross alpha, beta, and gamma are all within the range of values observed in recent years.

The samples of the alluvial groundwater in Los Alamos Canyon show residual contamination, as has been seen since the original installation of the monitoring wells in the 1960s. In particular, for LAO-2 and LAO-3, the concentration of strontium-90 exceeds the EPA Primary Drinking Water Standard MCL of 8 pCi/L. No low-detection-limit tritium data were collected for alluvial groundwaters in Los Alamos Canyon in 1995. These data were used in 1994 (EG 1996) to show that residual tritium contamination resulting from the Omega West Reactor leak was still present. This residual tritium contamination was found at levels below the detection limit of the EPA-specified liquid scintillation counting method, and far below the present EPA tritium drinking water standard of 20,000 pCi/L.

Well LAO-0.7 had an unusual uranium value of 15.4 ± 1.5 µg/L. Uranium values in Los Alamos Canyon alluvial groundwater have ranged from the detection limit up to a few values of 5 to 8 µg/L since 1990. As in prior years, detections of americium-241 were ubiquitous in the canyon, and plutonium-238 and plutonium-239,240 detections occurred in some of the wells.

The alluvial groundwater samples from Mortandad Canyon showed levels of radionuclides within the ranges observed previously. Tritium; strontium-90; plutonium-238; plutonium-239,240; americium-241; gross alpha; and gross beta are clearly detected in many of the wells. Well MCO-4 was not in service, so samples from nearby well MCO-4B are used in its place. The radionuclide levels tend to be highest at well MCO-4B, which is nearest to the TA-50 outfall, and are lower further down the canyon. The levels of tritium, strontium-90, gross alpha, and gross

beta exceed EPA drinking water criteria in many of the wells; the levels (except for tritium) exceed the DOE Drinking Water System DCGs; but the levels do not exceed the DOE DCGs for Public Dose for Ingestion of Environmental Water. There are no EPA drinking water criteria for plutonium-238; plutonium-239,240; or americium-241. The DOE Drinking Water System DCGs for these radionuclides were not exceeded in Mortandad Canyon alluvial groundwater.

As observed in 1994, Pueblo Canyon well APCO-1 had a plutonium-239,240 level (.105 ± 0.021 pCi/L) above the detection limit. This well also had a americium-241 level (0.076 ± 0.02 pCi/L) above the detection limit. Pajarito Canyon wells PCO-2 and PCO-2 had americium-241 values above the detection limit.

Radiochemical Constituents in Intermediate-Depth Perched Groundwater. The radioactivity measurements in samples from TW-1A, 2A, and Basalt Spring in the intermediate-depth perched zones in Pueblo Canyon indicate a connection with surface water and alluvial groundwaters in Pueblo Canyon. Intermediate-depth perched zone waters have long been known to be influenced by contaminated surface water in the canyon based on measurements of major inorganic ions. TW-2A, furthest upstream and closest to the historical discharge area in Acid Canyon, showed the highest levels. The tritium measurement obtained by conventional methods was 2,100 pCi/L. In previous years this has been confirmed by the low detection limit measurements of about 2,300 pCi/L (EG 1996). In contrast to 1994, 1991, and 1990, TW-1A showed no traces of cesium-137. Both TW-1A and TW 2A had plutonium-239,240 levels (both about 0.06 ± 0.02 pCi/L) slightly above the detection limit.

The sample from the Water Canyon gallery was consistent with previous results, showing no evidence of contamination from Los Alamos operations.

c. Nonradiochemical Analytical Results. The results of general chemical parameter analyses of groundwater samples for 1995 are listed in Table 5-17, and results of total recoverable metal analyses are listed in Table 5-18. Discussion of the results will address the main aquifer, the canyon alluvial groundwaters, and the intermediate perched groundwater system. Finally, results of organic analyses will be discussed.

Nonradioactive Constituents in the Main Aquifer. Values for all parameters measured in the water supply wells were within drinking water limits, with the following exceptions. A nitrate value of 9.9 mg/L was found in well G-1A; values of this size have never been observed previously in this well and no such values were found in the regular SDWA sampling (see Section 5.C). Preliminary 1996 results show a nitrate concentration of 0.49 mg/L, or background levels. Reported silver values were in the range of 40 to 60 µg/L, compared to the NMWQCC groundwater limit of 50 µg/L. However, the analytical uncertainty for these measurements is ± 40 µg/L so the resolution of the measurements is insufficient to define these low levels of silver. The arsenic level in well G-2 was about 96% of the standard of 50 µg/L and was similar to previous measurements. The vanadium level in well G-2 of 91 µg/L is within the EPA health advisory range of 80 to 110 µg/L but is lower than the 1993 value of 260 µg/L.

The test wells in the main aquifer showed levels of several constituents that exceed standards for drinking water distribution systems. However, the test wells are used for monitoring purposes only and are not part of the water supply system. TW-1 had a nitrate value above the primary drinking water standard of 10 mg/L (nitrate as nitrogen). This test well has shown nitrate levels in the range of about 5 to 20 mg/L (nitrate as nitrogen) since the early 1980s. The source of the nitrate is apparently infiltration from sewage treatment effluent in Pueblo Canyon.

Levels of trace metals that approach water quality standards in some of the test wells are believed to be associated with the more than 40-yr-old steel casings and pump columns. Iron, manganese, cadmium, nickel, antimony, and zinc were high in several of the main aquifer test wells. These trace metal values must be regarded as total, rather than dissolved concentrations, in that they include the composition of any suspended sediment contained in the water samples. Lead levels exceeded the EPA action level in TW-1, 2, 3 and 4. Several of the test wells have occasionally had elevated lead levels in previous years, and unusually high lead values were reported for 1993 (EARE 1995). The lead levels appear to be due to flaking from piping installed in the test wells and do not represent lead in solution in the water (EG 1996). There are no known sources of lead near these wells, and dissolved lead levels in natural waters of near neutral pH (pH ~7) are commonly extremely low (Hem 1989). Trace metal levels in both filtered and unfiltered samples for test well DT-5A were low. This well had the highest lead levels in 1993.

Overall, trace metal levels in the White Rock Canyon springs were much lower than for 1993 and 1994. Samples from a few springs in White Rock Canyon showed aluminum levels that exceed NMWQCC Livestock and Wildlife Watering Standards. These levels are not dissolved concentrations, but reflect the composition of

suspended sediments. Many of the springs have very low flow rates and samples are collected in small pools in contact with the surrounding soils. Samples from several of the springs showed levels of iron and, in some cases, manganese that would exceed secondary standards for drinking water systems. However, these elements are also associated with suspended sediment particles. Unlike 1994, none of the springs exceeded standards for silver or arsenic. Several springs had cadmium levels above the drinking water MCL. Indian Spring exceeded the standard for beryllium, and Sandia Spring had high lead and vanadium values.

Nonradioactive Constituents in Alluvial Groundwater. Alluvial canyon groundwater in Pueblo, Los Alamos, and Mortandad Canyons, which receive effluents, showed the effects of those effluents, in that levels of some parameters were elevated. Mortandad Canyon alluvial groundwater exceeds the NMWQCC groundwater standard for fluoride and nitrate. Nitric acid is used in plutonium processing at TA-55 and enters the TA-50 waste stream. Mortandad Canyon alluvial groundwater is also high in sodium. Nitrate levels in Pajarito Canyon wells PCO-2 and PCO-3 and Cañada del Buey well CDBO-6 also approached or exceeded the NMWQCC groundwater standard.

Overall, trace metal levels in alluvial groundwater samples were much lower than for 1993 and 1994. Well LAO-0.7 again showed levels of beryllium and barium approaching or exceeding water quality standards. Cañada del Buey wells CDBO-6 and CDBO-7 had high lead values. Cadmium, nickel, molybdenum, manganese, lead, and thallium levels were exceeded in some of the Los Alamos Canyon alluvial wells.

Nonradioactive Constituents in Intermediate-Depth Perched Groundwater. The nitrate value for TW-1A approached the NMWQCC groundwater and EPA drinking water standard. In previous years, the nitrate values for TW-1A, 2A, and Basalt Spring exceeded these standards. The presence of nitrate is probably related to infiltration of sewage treatment effluent beneath Pueblo Canyon.

TW-2A had levels of cadmium, lead, and zinc approaching or exceeding water quality standards. Again, the detection of these metals in TW-2A probably reflects flaking of metals from pump hardware and the well casing rather than the existence of dissolved metals in the groundwater. Otherwise, the intermediate perched groundwater and the Water Canyon Gallery did not show any concentrations of trace metals that are of concern.

Organic Constituents in Groundwater. Analyses for organic constituents were performed on selected springs and alluvial observation wells in 1995. The stations sampled are listed in Table 5-19. Other organic results are discussed in Section 5.E. Samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and polychlorinated byphenyls (PCBs). Three springs were analyzed for HE constituents. The samples where organics were detected above the analytical LOQ are listed in Table 5-20.

HE constituents were detected in Ancho Spring. The detection of these HE constituents in Ancho Spring may reflect surface soil contamination rather than groundwater contamination by HE. This spring is below the explosives testing sites in the southern portion of the Laboratory. Trinitrotoluene detections in Ancho Spring and Spring 9 were discounted by the presence of this substance in the laboratory method blanks. As a result of this discovery, ESH-18 will conduct additional analyses for HE in this area. The only other organic detection not explained by possible contamination during laboratory analysis was chloroethane in Basalt Spring. Numerous tentatively identified compounds were listed for Basalt Spring. These later identifications reflect analytical measurements which do not correspond to cataloged organic compounds.

d. Long-Term Trends.

Main Aquifer. The long-term trends of the water quality in the main aquifer have shown little impact resulting from Laboratory operations. Except for low levels of tritium contamination found at four locations in Los Alamos and Pueblo Canyons and one location in Mortandad Canyon, no concentrations of radionuclides above detection limits have been measured on water samples from the production wells or test wells that reach the main aquifer other than an occasional analytical outlier not confirmed by analysis of subsequent samples. The apparent detection of strontium-90 in TW-3 in 1994 (EG 1996) presently appears to be due to analytical error, because the gross beta measurement does not support the strontium result. The apparent detection of strontium-90 in TW-4 in 1994 (EG 1996) has not been substantiated by prior or subsequent measurements.

Measurements of tritium by extremely low detection limit analytical methods (EARE 1995; EG 1996) show the presence of some recent recharge (meaning within the last four decades) in water samples from six wells into the main aquifer at Los Alamos. The levels measured range from less than 2% to less than a 0.01% of current drinking water standards, and are all less than levels that could be detected by the EPA-specified analytical methods normally used to determine compliance with drinking water regulations. Recent detection of lead in the main

aquifer test wells appears to have resulted from contamination by well casings, pumps, and monitoring devices (EARE 1995).

The long-term trends of water levels in the water supply and test wells in the main aquifer indicate that there is no major depletion of the resource as a result of pumping for the Los Alamos water supply (Purtymun 1995b).

Alluvial Perched Groundwater in Mortandad Canyon. Long-term trends of radionuclide concentrations in shallow alluvial perched groundwater in Mortandad Canyon (downstream from the NPDES-permitted outfall for the radioactive waste treatment facility at TA-50) are depicted in Figure 5-6. The samples are from Observation well MCO-6 in the middle reach of the canyon. The combined total of plutonium-238 and plutonium-239,240 concentrations are relatively constant, fluctuating up and down in response to variations in the treatment plant effluent and storm runoff that cause some dilution in the shallow alluvial water. Note that the current plutonium detection limit of 0.04 pCi/L applies to the separate analyses of plutonium-238 and plutonium-239,240, and might be doubled for the addition of these values, since results are often at or near the detection limit. The tritium concentration has fluctuated almost in direct response (with a time lag of about one year) to the average annual concentration of tritium in the TA-50 effluent.

4. Sediment Sampling

a. Monitoring Network. Sediment samples are collected from regional stations and Pajarito Plateau stations surrounding the Laboratory. Regional sediment sampling stations are located within northern New Mexico and southern Colorado at distances up to 200 km (124 mi) from the Laboratory. Samples from these regional stations provide a basis for determining conditions (such as radionuclide concentrations resulting from fallout) beyond the range of potential influence from normal Laboratory operations. Stations on the Pajarito Plateau are located within about 4 km (2.5 mi) of the Laboratory boundary. They document conditions in areas potentially affected by Laboratory operations. The majority of Pajarito Plateau stations are located within the Laboratory boundary.

Sample stations are located to provide background data and to detect potential contaminant releases from Laboratory operations. The locations of many stations have not changed since they were first sampled in the mid-1960s to early 1980s, hence long-term trends at individual stations are available. Additional sediment sampling may also be periodically conducted in special areas for special studies.

During 1995, sediment samples were collected from 93 regional and Pajarito Plateau stations to evaluate impacts of Laboratory operations on the environment. Of 25 regional samples, 9 are from rivers and 16 from reservoirs; of the 68 Pajarito Plateau samples, 21 are specifically related to waste storage sites. Fifteen of the samples were collected at either San Ildefonso or Santa Clara Pueblos. Locations of individual sampling stations are shown in Figures 5-2, 5-7, and 5-8. The sediment stations are organized according to drainages. Several of the Pajarito Plateau stream channel locations may be perennial over short stretches (often in response to Laboratory discharges, thunderstorm runoff, or snowmelt activity); however, most of these streams are intermittent or ephemeral. Reservoir samples are collected from regional and local reservoirs in northern New Mexico and southern Colorado.

Regional Stations. As seen in Figure 5-1, seven regional stations for stream channel sediments are located in drainages surrounding the Laboratory. These drainages include the Rio Chama, the Rio Grande, and the Jemez River. During 1995, 15 reservoir sediment samples were also collected from the upper, middle, and lower portions of 5 regional reservoirs, and from the middle of 2 small lakes. The regional reservoirs include El Vado, Heron, and Abiquiu Reservoirs on the Rio Chama; Cochiti Reservoir on the Rio Grande; and Rio Grande Reservoir in southern Colorado. A lake sediment sample was collected from Love Lake, a small 5 acre tributary lake located in the San Juan National Forest about 24 km (15 mi) south of Creede, Colorado, near the Rio Grande Reservoir. A second special lake sediment sample was collected from 4th Pond in Santa Clara Canyon on Santa Clara Pueblo (the uppermost reservoir on Santa Clara Creek).

Pajarito Plateau Stations. Many of the sediment sampling stations on the Pajarito Plateau are located to monitor contaminated sediment transport from past effluent release sites. As seen in Figure 5-7, one sampling station is located in Acid Canyon at Acid Weir just above the confluence with Pueblo Canyon, and two stations are downstream in Pueblo Canyon at stations Pueblo 1 and Pueblo 2. Pueblo Canyon then flows onto Laboratory land where three additional downstream sediment stations are located: Hamilton Bend Spring, Pueblo 3, and Pueblo at State Route 502.

Eight sediment sampling stations are located in DP and Los Alamos Canyons above the confluence with Pueblo Canyon at State Route 4. An additional six stations are located in lower Los Alamos Canyon above its confluence with the Rio Grande at Otowi Bridge.

Seven sediment samples are collected in Mortandad Canyon below the TA-50 NPDES-permitted outfall. An additional six sediment samples have been collected in the off-site portion of Mortandad Canyon on Pueblo of San Ildefonso land to document conditions there, as discussed in Section 5.E.3.

Seven other canyons around the Laboratory are also sampled along channel segments that cross State Route 4 between White Rock and Bandelier National Monument. All Laboratory facilities near these canyons are located upstream of this highway. An additional seven sediment samples have also been taken from these same canyons just above their confluence with the Rio Grande. One sediment sample is collected in Frijoles Canyon at the Bandelier National Monument Headquarters.

Sediments from drainages around two radioactive solid waste management areas are sampled to monitor transport of radioactivity from surface contamination. Nine sampling stations were established in 1982 outside the perimeter fence at Area G, TA-54 (Figure 5-8a), to monitor possible transport of radionuclides by sheet erosion from the active waste storage and disposal area.

From 1959 to 1961, hydronuclear experiments were conducted in underground shafts beneath the surface of the mesa at TA-49. The experiments involved a combination of conventional (chemical) high explosives and radionuclides. The residuals of the experiments were confined within the shafts. The site is designated Solid Waste Management Area AB. In 1960 a surface contamination incident occurred when an old shaft was accidentally breached during the excavation of a new shaft (Purtymun 1987b, ESG 1988). Eleven stations were established in 1972 to monitor surface sediments in drainages surrounding the experimental area. Another station (AB-4A) was added in 1981 as the surface drainage changed (Figure 5-8b).

b. Radiochemical Analytical Results. The results of radiochemical analyses of sediment samples collected during 1995 are listed in Table 5-21. All of the 1995 sediment samples appeared to be consistent with previous years' results. The majority of the sediment samples collected outside known radioactive effluent release areas were within the background levels that reflect worldwide fallout (Purtymun 1987a). A majority of sediment samples from the known radioactive effluent release areas, including Acid/Pueblo, DP/Los Alamos, and Mortandad Canyons, exceeded worldwide fallout levels for numerous constituents. These observed levels are consistent with historical data. Two sediment samples from stations GS-1 and MCO-5 in Mortandad Canyon showed a cesium-137 concentration level that exceeded the SAL value. No other sediment samples showed any values that exceeded respective SAL values, although reported values from stations GS-1 and MCO-5 were relatively high for plutonium-238; plutonium-239,240; and americium-241 (that is, more than 100 times background levels). These elevated values for radionuclides are consistent with historical values and reflect TA-50 effluent discharges into Mortandad Canyon since 1963. Samples taken on Pueblo of San Ildefonso land in Mortandad Canyon are discussed in detail in Section 5.E.3.

In the samples from the regional stations, the sample from Chamita showed a strontium-90 value above background. This reported value is questionable, however, because the laboratory QA values were unsatisfactory. Previous samples at Chamita have not exceeded the background levels for any radionuclide. The sample from the Rio Grande at Otowi showed slightly elevated plutonium-238 and plutonium-239,240 values when compared to background values. The sample from Rio Grande at Frijoles also showed a slightly elevated plutonium-238 value. However, all of these variations are consistent with data from previous years.

Ten Pajarito Plateau stations showed plutonium-238 values slightly above background. These stations included Bayo at State Road 502, Guaje at State Road 502, Sandia at the Rio Grande, MCO-13 (A-5) in Mortandad Canyon, Pajarito at State Road 4, Fence at State Road 4, Ancho at State Road 4 and at the Rio Grande, Chaquehui at the Rio Grande, and Frijoles at the Rio Grande. However, only three of these same stations also showed plutonium-239,240 values above background; these stations included Pajarito at State Road 4, MCO-13 (A-5) in Mortandad Canyon, and Chaquehui at the Rio Grande. Potrillo at State Road 4, Indio at State Road 4, and Chaquehui at the Rio Grande showed slightly above background levels of strontium-90. Station A-6 in Mortandad Canyon and Chaquehui at the Rio Grande also showed above-background levels of cesium-137. All of these somewhat elevated values may be related to multiple sources, including atmospheric fallout, surface deposition from stack emissions, or surface transport from various Laboratory sources.

At TA-54, Area G a number of stations exceeded background levels for tritium; plutonium-238; plutonium-239,240; americium-241; and gross gamma. At TA-49, Area AB, station AB-4 exceeded the background level for cesium-137, while AB-3 showed a value slightly above background for americium-241. Furthermore, stations AB-1, AB-2, AB-3, AB-4A, AB-7, and AB-8 showed values slightly above-background for plutonium-238. Values at stations AB-2, AB-3, AB-4, and AB-6 were also slightly above-background levels with respect to plutonium-239,240. All of these values are consistent with earlier observations from these same stations.

Results of the radiochemical analyses of the large 1 kg samples collected in 1995 from El Vado, Heron, Abiquiu, Cochiti, and Rio Grande Reservoirs, and Love Lake and Santa Clara Pond Number 4, are similar to those from previous years. Unfortunately, most of these 1-kg reservoir samples collected during 1995 were analyzed as if they were 100 g samples. Hence, higher detection limits might apply as seen in Table 5-21. Levels of plutonium-238 in the samples from the upper stations in Abiquiu and Cochiti Reservoirs, and the middle and lower stations at Heron Reservoir, exceeded the background level (Purtymun 1987a). None of the other sediment samples exceeded background levels for other radionuclides listed in Table 5-21.

The results of the reservoir analyses are best interpreted in conjunction with information from a special study by Purtymun (1990b), which provides a regional context for analyses of reservoir sediments. The conclusions of greatest significance to interpreting the current samples from the five reservoirs are (1) the mean plutonium concentrations in Cochiti Reservoir are almost identical to the mean plutonium concentrations found in the Rio Grande Reservoir in Colorado; (2) reservoirs on the Rio Chama exhibit lower plutonium concentrations in sediments than those found in Rio Grande reservoirs; and (3) the isotopic ratios of plutonium-239,240 to plutonium-238 from these reservoir sediments suggest that plutonium deposition from fallout is not homogeneous but varies with differences in weather, altitude, erosion, and sediment transport conditions.

The data from the 1995 plutonium analyses are shown in a long-term context in Table 5-22. Abiquiu Reservoir historically has had some of the lowest plutonium concentration ranges and isotopic ratios observed, while Cochiti Reservoir has some of the highest. However, sediments from Cochiti Reservoir contain a higher fraction of fine-grained materials and organic matter than sediments from Abiquiu Reservoir. These features enhance the capacity of the sediments to adsorb plutonium. The isotope ratios of plutonium-239,240 to plutonium-238 from these reservoirs are nearly identical, averaging about 15, and are typical of worldwide fallout in northern New Mexico. However, sediments from Acid/Pueblo Canyon exhibit ratios of plutonium-239,240 to plutonium-238 that are typically 20 times larger than worldwide fallout values as can be seen from data in Table 5-21. These observations suggest that contributions of radionuclides from Los Alamos Canyon to Cochiti Reservoir average less than 10% of the total inventory carried in Rio Grande sediments (see Section 5.E.4).

c. Nonradiochemical Analytical Results.

Trace Metals. Beginning in 1992, sediments were analyzed for trace metals. Trace metal results for the sediment samples collected in 1995 are presented in Table 5-23. None of the results show any significant accumulations of metals above background concentrations. Laboratory procedures for metals analyses changed in 1993 (see Section 5.B.1). The 1992 sediment metals data should not be compared to the 1993–1995 metals data due to differences in laboratory preparation methods.

Reported detection limits for antimony, mercury, and molybdenum increased from 1992 to 1995 (that is, from about 0.05 mg/kg, 0.01 mg/kg, and 0.30 mg/kg, respectively, to about 0.20 mg/kg, 0.10 mg/kg, and 2.0 mg/kg, respectively). These differences probably resulted from a decrease in the typical sediment sample size from 250 mg in 1992 to 125 mg in 1995. The reported 1992 iron values were two to three times higher than their counterparts in 1995, and 1992 aluminum values were about 10 times larger than their 1995 counterparts. Reported 1992 values for aluminum and iron in Table IV-22 of the "Environmental Surveillance at Los Alamos during 1992" (EPG 1994) should each be multiplied by a factor of 10; this omission resulted from a unit conversion error.

Organic Analyses. Beginning in 1993, sediments were analyzed for VOCs and SVOCs, and PCBs. In 1995, some samples were analyzed for residuals from HE. Lists of individual compounds that were analyzed in the laboratory during 1995 are given in Tables 5-3 through 5-5.

Because of budgetary constrains in 1995, sediment samples for VOCs, SVOCs, and HE residues were analyzed from about one-sixth of the regional and local stations. The analytical results confirmed that there were no VOC, SVOC, and HE residues detected above the respective LOQ in any of the sediment samples collected during 1995. The stations sampled are listed in Table 5-24.

d. Long-Term Trends. The concentrations of radioactivity in sediments from Acid, Pueblo, and lower Los Alamos Canyons that may be transported off-site are fully documented (ESG 1981). The data indicate that concentrations of radionuclides in sediments from Acid, Pueblo, and lower Los Alamos Canyons have been relatively constant at each location since 1980, given some degree of yearly fluctuation in the data. The total plutonium concentrations (plutonium-238 plus plutonium-239,240) observed since 1980 in sediments at four indicator locations are shown in Figure 5-9.

Figure 5-9 also depicts total plutonium concentrations at four sediment stations in Mortandad Canyon from 1980 to 1995. The first two stations shown on this plot are MCO-5 and MCO-7, located downstream of the TA-50 discharge point, and upstream of the sediment traps. MCO-9 and MCO-13 are between the sediment traps and the Pueblo of San Ildefonso boundary. The data indicate that total plutonium concentrations decreased over this period at stations MCO-5 and MCO-7. Values of plutonium at MCO-5 and MCO-7 are elevated due to Laboratory discharges at TA-50, while values from stations MCO-9 and MCO-13, located near the Laboratory-Pueblo of San Ildefonso boundary, are at atmospheric fallout levels. Apparently there has been no transport of plutonium from TA-50 below the sediment traps in Mortandad Canyon.

C. Drinking Water Program

1. Monitoring Network

The Laboratory routinely collects drinking water samples from the Laboratory, Los Alamos County, and Bandelier National Monument's water distribution systems and from the Laboratory's water supply well heads in order to demonstrate compliance with the SDWA's MCLs for microbiological organisms, organic and inorganic constituents, and radioactivity in drinking water. The particular locations within the water system where SDWA compliance samples are collected is specified in the regulations for each contaminant or group of contaminants. In 1995, the monitoring network for SDWA compliance sampling consisted of four location groups within the water system:

(1) well head sampling from the four operating water supply wells in the Guaje Well Field (G-1, G-1A, G-2, G-6) and the four operating water supply wells in the Pajarito Well Field operating at the time of sampling (PM-1, PM-2, PM-3, PM-5);

(2) the four entry points into the distribution system (Pajarito Booster Station #2, Guaje Booster Station #2, PM-1 and PM-3 well heads);

(3) the six total trihalomethane (TTHM) sampling locations within the distribution system (see Table 5-25); and

(4) the 41 microbiological sampling sites located throughout the Laboratory, Los Alamos County, and Bandelier National Monument.

2. Sampling Procedures, Data Management, and Quality Assurance

The sampling program for drinking water quality is designed to meet or exceed regulatory requirements under the federal SDWA and the NM Environmental Improvement Act. Sampling locations, frequencies, preservation, handling, and analyses follow the requirements specified in federal and state regulations. Chemical and radiological sampling is performed by LANL staff and submitted for analysis to laboratories certified by the EPA and the NMED. Microbiological sampling and analysis are performed by the Johnson Controls, Inc., Environmental (JENV) laboratory. The JENV laboratory is certified by the NMED for microbiological compliance analysis. Certification requirements include proficiency samples, maintenance of an approved QA/quality control program, and periodic audits by the NMED. LANL and JENV staff are certified by the NMED to perform drinking water compliance sampling.

All data collected from SDWA compliance testing is submitted to the Drinking Water Bureau of the NMED for review and filing. The NM Health Department's Scientific Laboratory Division (SLD) laboratory reports the analytical results directly to NMED. Triangle Laboratories reports the analytical results to ESH-18 who, in turn, transmits to NMED. The JENV laboratory reports the analytical results directly to NMED. ESH-18 maintains both electronic and hard-copy files of all data collected from SDWA compliance testing at their TA-59 offices and reports the complete data record annually in the Laboratory's Environmental Surveillance Report.

3. Radiochemical Analytical Results

As required by the SDWA, in 1995 the Laboratory collected drinking water samples at the four entry points into the distribution system to determine the radiological quality of the drinking water. As is shown in Table 5-26, the concentrations of gross alpha activity were less than the screening level of 5 pCi/L, and the concentrations of gross beta activity were less than the screening limit of 50 pCi/L. When gross alpha and beta activity measurements are below the screening limits, the Laboratory does not need to perform further isotopic analyses or perform dose calculations under the SDWA program. However, it should be noted that comprehensive monitoring of the water supply wells for radiochemical constituents is conducted by ESH-18 annually (see Table 5-16).

Radon is a naturally occurring radionuclide produced during the decay of geological sources of uranium. In 1995, radon sampling was performed at the eight operating water supply well heads and the four entry points into the distribution system. This sampling was done to collect information before the issuance of final EPA regulations governing radon in drinking water. As shown in Table 5-27, the radon concentrations ranged from 227 to 629 pCi/L. If the MCL is finalized at the proposed 300 pCi/L level, waters from some well fields may need radon treatment by extended storage to allow radioactive decay or adsorption removal. Radon has a half-life of about 12 days; residence time in storage tanks will reduce radon concentrations before the water reaches consumers.

4. Dose Equivalents to Individuals from Ingestion of Drinking Water

The maximum annual committed effective dose equivalent (CEDE) (i.e., the total CEDE plus two sigma for the maximum consumption rate) for drinking water samples collected in 1995 is 0.579 mrem (14.5% of the 4 mrem drinking water standard). The maximum annual CEDE for the average consumption rate decreases to 0.411 mrem (10.3% of the 4 mrem drinking water standard). The radionuclides that contributed to more than 5% of the total CEDE in 1995 are strontium-90; uranium; plutonium-239,240; and americium-241. These CEDEs equate to a risk of excess cancer fatalities of 2.9×10^{-7} (0.3 in a million) and 2.1×10^{-7} (0.2 in a million), respectively. Since drinking water aquifers are regional, there is no "background" drinking water source available to determine the total net positive difference between Los Alamos water and a background source.

Table 5-28 presents the summary of the CEDE from the ingestion of drinking water collected in 1995. This is the first year a CEDE has been calculated for drinking water so there are no previous results for comparison.

Table 5-29 presents the total CEDE, also described as the whole body effective dose equivalent, from the ingestion of drinking water collected in 1995. The general methodology used to calculate these dose equivalents is found in Section 3.B.1.d. Since the Federal Guidance Report (FGR) #11 is "intended for general use in assessing average individual committed doses in any population..." (EPA 1988), the dose conversion factors (DCFs) listed in this report are used in assessing drinking water from non-DOE sources, whereas DOE DCFs (DOE 1988b) are used for assessing drinking water from DOE sources (i.e., the Los Alamos and White Rock distribution system). The DOE DCFs utilize 12 major tissue groups (as opposed to only seven major tissue groups in FGR #11) and are slightly more conservative than FGR #11.

Table 5-30 presents the maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) and the estimated risk of excess cancer fatalities from consuming drinking water collected in 1995. Included in this table, in the bottom row, is a summary of the CEDE based on the analytical detection limits for each radionuclide. This value is the lower limit possible for calculated doses, reflecting the minimum resolution of the radiochemical analyses and is not representative of a positive dose value.

Los Alamos and White Rock. The total annual CEDEs (i.e., the annual CEDE, without any error term, summed over all radionuclides) for all drinking water samples collected from Los Alamos and White Rock water distribution wells are below 4 mrem. No samples collected exceeded the radioactive MCLs for drinking water systems (EPA 1989). The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for drinking water samples collected in 1995 is 0.555 mrem as modified by the percent contribution to the distribution system for each monitored well. The maximum annual CEDE for the average consumption rate decreases to 0.411 mrem. The radionuclides that contributed to more than 5% of the total CEDE in 1995 are strontium-90; uranium; plutonium-239,240; and americium-241.

The Pueblo of San Ildefonso. The total annual CEDEs for all drinking water samples collected from the Pueblo of San Ildefonso are below 4 mrem. A sample collected from the Westside Artesian well exceeded the MCL for strontium-90 and total uranium, and a sample collected from the New Community well exceeded the MCL for total uranium (EPA 1989). These uranium levels are common in the Pojoaque area and similar levels

have been previously observed in some Pueblo of San Ildefonso wells. The Laboratory and the Pueblo will resample to verify the strontium-90 result. The total annual CEDE using the maximum consumption rate (2.0 L/day) is 3.86 mrem for the Westside Artesian well and 3.74 mrem for the New Community well. For all samples collected at the Pueblo, the uranium contribution to the total CEDE ranged from 46.9% from the Otowi House sample to 80.6% from the New Community well sample. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for all the drinking water samples collected in 1995 ranged from 1.34 mrem from the Otowi House sample to 5.38 mrem from the New Community well sample. The total committed dose equivalent to individual tissue groups ranged from 0.008 mrem in the Otowi House sample to 56.2 mrem in the New Community well sample. For the average consumption rate, the maximum annual CEDEs ranged from 0.99 mrem to 3.98 mrem for these same locations.

Santa Clara Pueblo. The total annual CEDEs for all drinking water samples collected from Santa Clara Pueblo are below 4 mrem. No samples collected exceeded the radioactive MCLs for drinking water systems (EPA 1989). The highest total CEDE using the maximum consumption rate (2.1 L/day) is 1.65 mrem from the Community Above Village well sample. For all samples collected at the Pueblo, the uranium contribution to the total CEDE ranged from 3.1% from the Community New Subdivision sample to 73.4% from the Community Above Village sample. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for all the drinking water samples collected in 1995 ranged from 0.68 mrem from the Community New Subdivision sample to 2.07 mrem from the Community Above Village sample. For the average consumption rate, the range extends from 0.50 mrem to 1.53 mrem for these same locations.

Cochiti Pueblo. The total annual CEDEs from all drinking water samples collected from Cochiti Pueblo are well below 4 mrem. No samples collected exceeded the radioactive MCLs for drinking water systems (EPA 1989). The highest total CEDE using the maximum consumption rate (2.0 L/day) is 0.98 mrem from the Tetilla Peak sample. The contribution of uranium to the total CEDE ranged from 6.5% from the Cochiti Lake 1 sample to 49.6% from the Tetilla Peak sample. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for all the drinking water samples collected in 1995 ranged from 0.69 mrem from the Cochiti Lake 1 sample to 1.55 mrem from the Tetilla Peak sample. For the average consumption rate, the range extends from 0.54 mrem to 1.14 mrem for these same locations.

Jemez Pueblo. The total annual CEDE from consuming drinking water collected from Jemez Pueblo is 0.14 mrem. Uranium contributed less than 5% to the total CEDE in the sample. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for the drinking water sample collected in 1995 is 0.54 mrem. The maximum annual CEDE for the average consumption rate decreases to 0.40 mrem.

5. Nonradiochemical Analytical Results

In 1995, the analytical results for TTHMs (Table 5-25), inorganic constituents (Table 5-31), lead and copper (Table 5-32), VOCs (Table 5-33), and synthetic organic compounds (SOCs) (Table 5-34) in drinking water were all below the SDWA MCLs.

In 1995, inorganic constituents in drinking water were sampled at the four entry points to the distribution system with the exception of nitrates (NO_3-N [nitrate as nitrogen]) which were sampled at the eight operating water supply well heads. All inorganic constituents were analyzed by SLD. Both well head and entry point taps are flushed for several minutes so that the samples collected represent water that is freshly drawn from the water main. As shown in Table 5-31, all locations and all constituents were below the MCLs.

In 1995, TTHM samples were collected during each quarter from six locations in the Laboratory and Los Alamos County water distribution systems. All TTHM samples were analyzed by SLD. Sample taps are flushed for several minutes so that samples represent water that is freshly drawn from the water main. As is shown in Table 5-25, the annual average for TTHM samples in 1995 was 3.84 µg/L, well below the SDWA MCL of 100 µg/L.

In accordance with the requirements of the SDWA, the sampling program for lead and copper at residential taps that was initiated in 1992, continued in 1995. There is currently no set MCL for lead or copper in drinking water. Instead an action level has been set for each metal. SDWA regulations specify that if more than 10% of the samples from selected residential sites exceed the action level then water suppliers must take prescribed actions to monitor and control the corrosivity of the water supplied to the customers. Additionally, if 90% of the sample sites are below the action levels for lead and copper then the water system is in compliance without the need to implement corrosion control. As is shown in Table 5-32, all 36 samples collected during 1995 were below the EPA action

levels for lead and copper. Since the 90th percentile values for lead and copper were below the EPA action levels, the Laboratory was in compliance with the SDWA regulations for lead and copper in drinking water for 1995.

In 1995, VOC samples were collected from each of the eight operating water supply well heads and analyzed by SLD. As shown in Table 5-33, during the initial sampling phase (February 27, 1995) the presence of a regulated VOC, methylene chloride, was detected in four of the samples (PM-3, G-1A, G-1, and G-2) at concentrations below the SDWA MCL. Confirmation samples collected at PM-3, G-1A, G-1, and G-2 on March 21, 1995, were negative for methylene chloride. Analysts from the SLD laboratory have reported to LANL's ESH-18 that the presence of methylene chloride in the initial samples was most probably due to sample contamination at their laboratory since methylene chloride is routinely used during the preparation of VOC samples.

In the first and second quarters of 1995, SOC samples were collected at the eight operating water supply well heads and analyzed by SLD and Triangle laboratories. Table 5-34 presents the analytical results for SOC sampling in 1995. SOC concentrations at each of the eight well heads sampled were below the laboratory's practical quantitation limit (PQL) and the SDWA MCLs. Dioxin samples were collected only during the first quarter of 1995 because the water system qualified for a waiver from second quarter sampling from the District II Office of the NMED. Sampling for SOCs will resume during the first quarter of 1997.

Microbiological Analyses of Drinking Water. Each month during 1995, an average of 46 samples was collected from the Laboratory, Los Alamos County, and Bandelier National Monument water distribution systems to determine the free chlorine residual available for disinfection and the microbiological quality of the drinking water. Of the 555 samples analyzed during 1995, 2 indicated the presence of total coliforms, and 1 indicated the presence of fecal coliforms. Noncoliform bacteria were present in 14 of the microbiological samples. A summary of the monthly analytical data is found in Table 5-35. Noncoliform bacteria are not regulated, but their presence in repeated samples may serve as indicators of biofilm growth in water pipes. Microbiological samples are collected and analyzed for microbiological quality by the JENV laboratory.

6. Long-Term Trends

Historically, the Los Alamos water system has never incurred a violation for a SDWA regulated chemical or radiological contaminant. The water supply wells have, on occasion, exceeded proposed SDWA MCLs for arsenic and radon due to their natural occurrence in the main aquifer. Violations of the SDWA MCL for microbiological contamination occurred in 1993 and 1994. Both of these violations were attributed to localized contamination in the distribution system and not microbiological contamination of the main aquifer.

D. Unplanned Releases

1. Radiochemical Liquid Materials

There were three unplanned potentially radioactive liquid releases reported during 1995.

- On October 6, 1995, at TA-53, approximately 0.237 L (0.0625 gal.) of potentially contaminated water was spilled on the ground during routine sampling of a radioactive liquid waste (RLW) holding tank. The spilled water was cleaned up immediately and monitoring of the area after clean up indicated no presence of radioactivity.
- On December 1, 1995, at TA-10 in Bayo Canyon, approximately 75.7 L (20 gal.) of decontamination water used for washing drill rigs was discovered to have leaked from a storage drum. The leaking was stopped and swipe samples and readings taken to test for the presence of radiological materials showed no presence of radioactivity.
- On December 5, 1995, at TA-21, a brick-lined industrial/radioactive waste manhole was discovered. All sources which discharge to the manhole have been eliminated.

2. Nonradiochemical Liquid Materials

The following is a summary of these 29 unplanned releases during 1995:

- twelve releases of untreated sanitary sewage (all but one were less than 1,135.5 L (300.0 gal.) from the Laboratory's sanitary wastewater treatment plant collection systems;

- four releases of oil: <3.8 L (<1.0 gal.) at TA-21-149 outfall 04A-142 on February 27, 1995; 17.4 L (4.6 gal.) at TA-22-91 outfall 128-128 on May 12, 1995; 7.6 L (2.0 gal.) at TA-54-MDA-J on June 14, 1995; and 3.8 L (1.0 gal.) at TA-35-31 on July 18, 1995;
- two releases of boiler water: 1892.5 L (500.0 gal.) at TA-2-1 on April 10, 1995; and <3785.0 L (<1000.0 gal.) at TA-53-28 on April 24, 1995;
- one release of propane: 427.0 N (96.0 lb.) at TA-15-183 on December 12, 1995;
- two releases of treated cooling water: < 3785.0 L (<1000.0 gal.) at TA-53-294 cooling tower on April 27, 1995; and 113,550.0 L (30,000.0 gal.) at TA-53-62 cooling tower on December 8, 1995;
- one release of acid water mixture: 189.25 L (50.0 gal.) 1 part sulfuric acid to 32.3 parts water mixture at TA-46-25 on December 11, 1995;
- one release of diesel: 83.3 L (22.0 gal.) at TA-16-218 on September 21, 1995;
- three potable water releases from line breaks in excess of 378.500.0 L (100,000.0 gal.): 492,050.0 L (130,000.0 gal.) at TA-21-4 on July 17, 1995; 1,324,750.0 L (350,000.0 gal.) at TA-54-Area G on July 28, 1995; and 946,250.0 L (250,000.0 gal.) at TA-54-Area G on August 2, 1995;
- one release of battery acid: 37.9 L (10.0 gal.) at TA-35-128 on November 22, 1995;
- two historical releases: unknown amount of PCB from SWMU 3-056 at TA-3-223 reported on May 9, 1995; and unknown amount of suspected diesel at TA-61-16 reported on June 15, 1995.

All spills were investigated by ESH-18. Upon cleanup, personnel from NMED/DOE Oversight Bureau inspected the spill sites to ensure adequate cleanup. NMED administratively closed 18 of the 29 spills which occurred in 1995.

ESH-18 prepared a generalized Notice of Intent (NOI) for the discharge of potable water from the Los Alamos water supply system, including production wells, transmission lines, storage tanks, booster pump stations, and other related facilities. The generalized NOI provides the Laboratory with regulatory coverage for releases of potable water from the water supply system that are not considered hazardous to public health and are not covered by the NPDES permit. ESH-18 also prepared a generalized NOI for the release of steam condensate and line disinfection from the Laboratory's steam distribution and condensate return systems. ESH-18 provides an annual summary of discharges to the NMED Surface Water Quality Bureau.

E. Special Studies

1. Special Sampling of Alluvial Groundwaters

The Laboratory's Hazardous Waste Permit (issued under the 1984 Hazardous and Solid Waste Amendments [HSWA] to the Resource Conservation and Recovery Act [RCRA]) contains several special conditions in Module VIII, Section C. The first condition required the installation of several additional monitoring wells in the principal canyons on the Laboratory property and chemical analyses of the waters. The new HSWA monitoring wells were constructed according to EPA's RCRA standards. This work was completed in 1990 (Purtymun 1990a, Stoker 1990b, EPG 1992).

The 1990 chemical analyses compared results from the new wells with adjacent older wells used in routine surveillance. For the most part, analytical results for the paired wells were similar. An exception was that lower levels of plutonium were found in the new wells in Mortandad Canyon. This was attributed to higher plutonium adsorption in the vicinity of the newer wells as a result of new sediment surfaces made available for adsorption through disturbance during well installation.

The EPA completed a Comprehensive Groundwater Monitoring Evaluation Report for the Laboratory in March 1993 which contained several recommendations. One of these was that additional sampling of the 1990 HSWA permit wells should be conducted. The EPA maintained that preliminary results from the 1990 sampling indicated

that concentrations of some constituents were higher in the new HSWA wells than the older wells in Los Alamos Canyon.

In response to this request, the Laboratory sampled these wells on a quarterly basis during 1995. Only the first two quarters (sampling done on March 29 and June 23, 1995) of data are available at the time of this report preparation. A complete presentation of the 1995 and 1990 data will be presented in a forthcoming report.

Results for three canyons (Acid/Pueblo, Los Alamos, and Mortandad) are represented in the 1995 sampling series. The wells drilled in other canyons as a result of the HSWA permit Module VIII special conditions have remained dry. The sampling results are presented in Tables 5-36 through 5-38. Groundwater samples drawn from the canyon bottom alluvium can be quite turbid, containing a significant quantity of suspended sediment which has entered the well casings. Both filtered and unfiltered samples were collected at each of the stations, in order to evaluate the quantity of metals and radionuclides associated with the suspended sediment portion of the water samples. Due to a miscommunication, however, all samples for radiochemical analysis were filtered in the laboratory.

Several preliminary observations can be made regarding the radiochemical results (Table 5-36). Strontium-90 is clearly detected in all three of the canyons. In Los Alamos and Mortandad Canyons strontium-90 concentrations are largest at the upstream stations and decrease downstream. Americium-241 and plutonium-239,240 were detected in Acid/Pueblo Canyon. Americium-241, plutonium-238, and possibly cesium-137 were found in Los Alamos Canyon. Tritium; strontium-90; plutonium-238; plutonium-239,240; and americium-241 are present in Mortandad Canyon. The levels of uranium in Mortandad Canyon are generally about 2 μg/L, compared to about 0.5 μg/L in Acid/Pueblo Canyon and 0.1 to 0.4 μg/L in Los Alamos Canyon.

An important observation that comes from these data is that there is significant variability in radionuclide concentrations at the same station at different times. Strontium-90 concentrations at LAO-3 and nearby LAO-3A decreased by a factor of two between March 29 and June 23, 1995. A similar conclusion applies to APCO-1.

There also appears to be variability in concentrations between some adjacent wells. The strontium-90 concentrations at LAO-3A are consistently higher than at nearby LAO-3. Americium-241 was apparently detected in LAO-3A but not in LAO-3. Tritium concentrations are higher at MCO-6 than at MCO-6B, while strontium-90 concentrations are lower. Comparisons at other paired wells show that concentrations of particular radionuclides at the two wells are similar. The differences in concentrations between adjacent wells may indicate that concentrations vary as much in space as in time in a given part of the canyon alluvium.

The general chemistry (Table 5-37) results from the sampling show trends similar to those discussed for radionuclides. Concentrations of several constituents show significant variability between sampling periods. One observation needs to be qualified: the high chromium values discovered in the results for wells APCO-1 and LAO-3 in the March 29 sampling appear to be due to a sample bottle switch (see Section 5.B.1).

Organic results from the special alluvial sampling (Tables 5-39 and 5-40) show four possible detections. Two of these are discounted as the compounds were also detected in the laboratory method blanks and are probably the result of contamination during analysis. Acetone (a common laboratory chemical and probably the result of contamination during analysis) and chloromethane were detected in samples from wells MCO-7A and MT-4.

2. Special Sampling of Test Wells 3, 4, and 8.

The 1994 surveillance sampling of three test wells, TW-3, TW-4 and TW-8, showed unexpected levels of strontium-90 (EG 1996). For TW-4 (6.2 ± 3.4 pCi/L) and TW-8 (2.1 ± 0.7 pCi/L), the values were near 0, within 2 to 3 times the analytical uncertainty and are regarded as nondetections. (See Section 5.B.1 for a discussion of evaluation of radiochemical results near the detection limit). However, an analysis of a split sample from TW-4 by the NMED/DOE Oversight Bureau staff showed a strontium-90 level of 6.6 ± 2.0 pCi/L, supporting a detection in that well.

The value of strontium-90 found in TW-3 (35.1 ± 2.2 pCi/L) was well above the limits of analytical uncertainty and also above the EPA proposed primary drinking water standard MCL of 8 pCi/L. However, this strontium-90 value was questionable because of the very low gross beta measurements for the sample, of 2.2 ± 0.4 pCi/L. Strontium-90 is a beta emitter, and the values for strontium-90 and gross beta should be about the same. Chloride and tritium were not found in the TW-3 sample. These substances should also be present, as they are also found in the alluvial groundwater (the likely source of the strontium-90) and are transported more readily than strontium-90.

Nonetheless, the apparent detection of strontium-90 in TW-3 is plausible, as high levels of strontium-90 are present in the overlying Los Alamos Canyon alluvial groundwater.

In most uncontaminated regional aquifer waters in the Los Alamos area, chloride and nitrate occur at levels of about 1 to 3 mg/L for chloride and less than 1 mg/L NO_3-N (nitrate as nitrogen). These ions are useful indicators of contamination because their transport is generally conservative (concentrations are unaffected by adsorption or other chemical reactions and reflect the general movement of water) and because their presence at levels above background is usually from man-made sources.

In 1994 TW-8 in Mortandad Canyon also showed a large increase in nitrate, from values of about 0.2 mg/L in prior years, to 5.1 mg/L. Nitrate is a common contaminant found in Mortandad Canyon alluvial groundwater, as a result of effluent disposal from the TA-50 Radioactive Liquid Waste Treatment Plant. Trace levels of tritium found earlier in TW-8 in Mortandad Canyon indicate the presence of recent recharge at that location. Therefore, the presence of elevated nitrate levels is not surprising, but tends to confirm the initial interpretation of the trace level tritium discoveries in this well.

In response to these 1994 findings, ESH-18 conducted a time series sampling study on test wells TW-3, TW-4, and TW-8 in July 1995. The normal sampling procedure for wells is to collect a water sample after pumping at least three well bore volumes, in order to ensure that stagnant water in the well casing and the surrounding aquifer formation has been removed and that the sample represents water from the formation surrounding the well screen. The July 1995 water samples were collected at nearly every well bore volume for 10 to 15 bore volumes and analyzed for strontium-90, tritium (using low-detection limit techniques at the University of Miami), chloride, and nitrate. The results of this study are given in Table 5-41, and shown in Figures 5-10 through 5-12.

The volumes for each well were determined from the depth of water in the bottom of the casing and the casing diameter. These volumes are, in gal. per well bore: 206.5 gal. for TW-3, 78 gal. for TW-4, and 220 gal. for TW-8.

In addition to the July 1995 time series tests, quarterly sampling of TW-TW-3, TW-4, and TW-8 is being carried out in 1996. These samples are being analyzed for trace-level amounts of tritium, general inorganic chemistry, and radionuclides.

The intent of the July 1995 tests was to see whether there were changes in the concentration of any of the constituents with volume pumped. Unfortunately, such results are not definitive regarding the source of any contamination found. In the case of a steady concentration over the series, aquifer contamination is indicated or ruled out depending on the concentration. A declining concentration with time might suggest limited aquifer contamination due to either flow of some contaminants down the well bore or limited contamination present in only the upper portion of the aquifer.

Results of the 1995 sampling indicate no trace of strontium in any of these test wells (Figure 5-10). The detection limit for strontium-90 is about 3 pCi/L. All of the strontium-90 values were near 0, within 2 to 3 times the analytical uncertainty and are regarded as nondetections. (See Section 5.B.1 for a discussion of evaluation of radiochemical results near the detection limit).

The results for tritium (Figure 5-11) suggest that it is present in the aquifer at TW-3 and 8, but not at TW-4. Tritium has previously been observed in TW-8 in a 1993 sample at 89 pCi/L. The presence of tritium and gradual drop off in concentration after prolonged pumping of this well suggests that recharge to the main aquifer of some water from the overlying alluvium has occurred. An alternative hypothesis of leakage of water down the well bore cannot be ruled out but seems unlikely because of the high volume of contaminated water which would be required to produce the tritium concentrations observed while sampling TW-8.

The presence of tritium in TW-3 is a new discovery, as tritium was not noted in this well during sampling in 1993. Possible sources of the tritium are infiltration or vapor movement from the overlying alluvium or leakage along the well casing. The sharp drop off in concentration after a few well bores could indicate that tritium contamination in the aquifer is not pervasive here. Results of the 1996 quarterly sampling may clarify this matter.

The time-series tritium results for TW-4 show that tritium is not present in the aquifer at this location. TW-4 was not sampled from 1962 to 1992, as it had no pump. A sample collected from this well in 1993 showed 11 pCi/L of tritium, but contaminated water introduced during pump priming was suspected as the source of tritium. Other chemical irregularities noted in samples from TW-4 including the 1994 detection of strontium-90 may also be related to the contaminated water. The fact that the depth of water in the well was only 10 ft prevented adequate purging of the well during collection of the 1993 and 1994 samples.

Time-series plots for chloride and nitrate (Figure 5-12) show that for all three test wells, chloride is fairly constant during the sampling. If water were leaking down the borehole from above and carrying higher amounts of

chloride, the chloride concentration would be expected to drop off during pumping, as water with less chloride was drawn into the well from the surrounding aquifer. For all three of the test wells, the nitrate concentrations increase at about well bore 5, at which point it stabilizes. This effect may be due to differences in the oxidation state of nitrogen, to biological depletion of nitrate, or to volatilization of nitrogen in water near the well bore compared to farther back in the formation.

Several other test well samples were analyzed for tritium by low-detection limit methods. Table 5-41 shows these results. Prior analytical results for tritium were published in EARE (1995). The 1995 results for TW-1, 1A, and 2A are in the ranges previously observed, although these values are all lower than earlier results. TW-2 had a 1995 value of about 16.8 pCi/L compared to values of 0.71 and 2.8 pCi/L in 1992 and 1993.

Before atmospheric testing of nuclear weapons began, tritium levels in precipitation were about 20 pCi/L (Adams 1995). This is 5 to 10 times the tritium levels detected in the Los Alamos public water supply wells. By the mid-1960s, tritium in atmospheric water in northern New Mexico reached a peak level of about 6,500 pCi/L. At present, general atmospheric levels in northern New Mexico are about 30 pCi/L, and those in the Los Alamos vicinity range from 20 to 450 pCi/L (Adams 1995). Groundwaters that contain between 16 and 65 pCi/L of tritium are most likely the result of recent recharge, that is within the last four decades (Blake 1995). Waters with tritium concentrations below about 1.6 pCi/L are likely to be old: the ages of these waters are more than 3,000 years, but there may be large errors associated with small tritium concentrations. With a tritium concentration below 0.5 pCi/L, modeled ages are more than 10,000 years, but this is at the limit of tritium age determinations. Waters with tritium concentrations more than 1,000 pCi/L and collected after 1990 cannot have their ages modeled, and can only be the result of contamination (Blake 1995).

Thus, the tritium levels in TW-1, 1A, and 2A are the result of infiltration of recent precipitation, with a possible contribution of a component of radioactive industrial effluent. This latter conclusion is supported by high levels of chloride and nitrate, supporting an anthropogenic source for part of this water (Blake 1995). For TW-2, the tritium levels are also the result of infiltration, perhaps of recent precipitation.

Test wells DT-9 and DT-10 also both showed higher tritium values in 1995 than in prior years. The 1993 values for Test wells DT-9 and DT-10 were 0.45 and 1.3 pCi/L, compared to 1995 values of 1.5 and 3.2 pCi/L. These tritium values fall into a possible age range between 40 and 3,000 years.

3. Environmental Surveillance at Accord Pueblos

During 1995, cooperative efforts between the Laboratory and the Pueblos of San Ildefonso, Santa Clara, Cochiti, and Jemez and the Pueblo Office of Environmental Protection resulted in sampling of water for tritium in the four Indian Pueblo communities. The locations of the four Accord Pueblos are shown in Figure 5-13. A Laboratory/Tribal-developed sampling plan was the basis for testing of community and private wells, streams, and springs on pueblo lands. General chemical and organic analysis results for pueblo waters are discussed for each pueblo below, as well as results for sediments collected at the Pueblo of San Ildefonso. These results are presented in Tables 5-42 through 5-48. Following these discussions, the results of low-detection limit tritium analyses for the pueblos are discussed as a group.

a. Pueblo of San Ildefonso. To document the potential impact of Laboratory operations on lands belonging to Pueblo of San Ildefonso, DOE entered into a memorandum of understanding (MOU) with the Pueblo and the BIA to conduct environmental sampling on pueblo land. The agreement, entitled "Memorandum of Understanding Among the Bureau of Indian Affairs, the Department of Energy, and the Pueblo of San Ildefonso Regarding Testing for Radioactive and Chemical Contamination of Lands and Natural Resources Belonging to the Pueblo of San Ildefonso," No. DE-GM32-87AL37160, was concluded in June 1987. The MOU calls for hydrologic pathway sampling (including water and sediments), and air, soils, and foodstuff sampling. This section deals with the hydrologic pathway. From 1987 to 1994, water, soil, and sediment samples were collected in accord with the MOU, and the results were reported in Purtymun (1988) and the annual environmental surveillance reports, the latest of which is EG (1996).

The groundwater, surface water, and sediment stations sampled on the Pueblo of San Ildefonso are shown in Figures 5-14 and 5-15. Aside from stations listed in the accompanying tables, the MOU also specifies collection and analysis of additional water and sediment samples from sites that have long been included in the routine environmental sampling program, as well as special sampling of storm runoff in Los Alamos Canyon. These

locations are shown in Figures 5-16 and 5-17 and results of analysis were discussed in Sections 5.B.2., 5.B.3, and 5.B.4.

Groundwater. Radiochemical analyses of the 1995 groundwater samples are shown in Table 5-42. As in previous years, the data indicate the widespread presence of naturally occurring uranium at levels approaching or in excess of proposed EPA drinking water limits. Naturally occurring uranium concentrations approaching or many times above the proposed MCL are prevalent in well water throughout the Pojoaque area. The data also suggest the occasional detection of trace levels of plutonium and americium. (See Section 5.B.1 for a discussion of evaluation of radiochemical results near the detection limit). In 1992 (EPG 1994), analyses of several of the samples for plutonium and americium indicated that they contained levels exceeding the average detection limits of the analytical method. Those for Pajarito Pump 1, Pajarito Pump 2, Otowi House, Sanchez House, and Martinez House were as much as 2 to 3 times the detection limit, and those for the New Community well and the Halladay House were up to 15 times the detection limit. The sampling or the analytical method were suspected of inaccuracies for two principal reasons: (1) none of the previously sampled locations had shown the presence of these isotopes, (2) results of BIA duplicate samples for 1992 by an independent laboratory did not confirm the results. The 1994 data appear to confirm the 1992 result that samples for the Martinez House, Otowi House, and Pajarito Pump 1 Wells contained levels of plutonium exceeding the average detection limits.

For 1995, detection limits of 0.04 pCi/L for plutonium-238 were exceeded in LA-1B, New Community, and Sanchez House wells; and of 0.04 pCi/L for americium-241 in LA-1A, Pajarito Pump 2, Martinez House, Otowi House, and New Community Wells. Two considerations suggest that these observations are not a cause for concern, however. First, the americium-241 value in the trip blank also exceeded the detection limit, and second, the plutonium-238 and americium-241 values for the New Community well sample and a duplicate sample differed widely. These two observations call into question the precision of the laboratory analyses at these extremely low detection levels.

Large tritium levels were apparently detected in New Community and Sanchez House Wells and in Sacred Spring. These three results are contradicted by analyses of duplicate samples by low-detection limit methods at the University of Miami, as discussed in Section 5.E.3.e. These observations call into question the precision of the EPA-specified liquid scintillation counting analyses at these low tritium levels (see Section 5.B.1).

The Westside Artesian well had a strontium-90 value of 8.4 pCi/L. This value exceeded the EPA MCL of 8 pCi/L. This analysis should be viewed with caution: first, because of the possibility of analytical error, in light of the relatively high detection limit for strontium-90; and second, because strontium-90 has not been previously found in any of these wells.

The Westside Artesian and New Community Wells had uranium concentrations near or exceeding the proposed EPA primary drinking water standard of 20 µg/L. Uranium concentrations at the Pajarito Pump 1 and Sanchez House Wells were about half of the proposed EPA standard. These measurements are consistent with the levels in previous samples and with relatively high levels of naturally occurring uranium in other wells and springs in the area.

The gross alpha level in samples from the Pajarito Pump 2, New Community, and Sanchez House Wells approached or exceeded the EPA primary drinking water standard of 15 pCi/L.

The levels of plutonium and americium in the BIA wellpoints are well below both the DOE DCGs for public dose and the DOE drinking water system DCG.

The chemical quality of the groundwater, shown in Table 5-43, is consistent with previous observations. The samples from the Westside Artesian, Pajarito Pump 1, Pajarito Pump 2, Sanchez House, Martinez House, Otowi House, and LA-1B Wells exceeded or were near the drinking water standard for total dissolved solids (TDS); these levels are similar to those previously measured. The TDS values for the BIA wellpoints reflect the high total suspended solids (TSS) of the samples. The TDS value reported for BIA wellpoint 1 of 8,637 mg/L is inconsistent with the electrical conductance value and is a laboratory error.

The fluoride values for these four wells (Westside Artesian, Pajarito Pump 2, Sanchez House, and LA-1B) are near or (for Westside Artesian and LA-1B) greatly exceed the NMWQCC groundwater standard of 1.6 mg/L, again similar to previous values. Several of the wells have alkaline pH values, above the EPA secondary standard range of 6.8–8.5; again, these values do not represent a change from those previously observed in the area. The Martinez House well had a nitrate value of 8.6 mg/L, approaching drinking water limits of 10 mg/L (nitrate as nitrogen), as observed in previous years. Unlike 1994, high nitrate values were not widespread.

Trace metal analyses are shown in Table 5-44. As was reported for 1993 and 1994 (EARE 1995, EG 1996), several wells and springs show high values for trace metals, exceeding values previously reported (EPG 1994). The

higher values are due to a change in analytical procedure. Before late 1992, all samples were filtered in the laboratory prior to analysis, while subsequent samples are not filtered. In particular, aluminum, iron, and manganese values for some of the samples were high.

Well LA-1B and Pajarito Pump 1 had much lower arsenic values in 1995, compared to prior values of about 40 μg/L, just below the EPA drinking water standard of 50 μg/L. A similar value was reported for LA-1B in 1993 (EARE 1995).

Boron values in two wells, Westside Artesian and Pajarito Pump 1, exceeded the NMWQCC groundwater limit of 750 μg/L. These values are similar to those of past years. Cadmium, chromium, and cobalt in the Martinez House well and beryllium in the Otowi House well exceeded standards. Silver levels in all wells were below 0.5 μg/L probably reflecting a lower detection limit for the analysis, and in contrast to much higher levels for the Martinez House, Old Community, and Sanchez House Wells in 1994.

Levels for a number of trace metals were high in the BIA wellpoints. These values probably reflect the high TSS values for these two samples.

Samples from Pajarito Pumps 1 and 2, and the Martinez House, Sanchez House, and New Community Wells were analyzed for VOCs, SVOCs, and PCBs (Table 5-45). The only sample in which there was a trace detection was New Community well (Table 5-46). The compound detected is a phthalate, a constituent of plastics, and a common contaminant inadvertently introduced during laboratory analysis.

Sediments. Sediments from Mortandad Canyon were collected on May 31, 1995, from seven permanent sampling stations, as seen in Figure 5-17. The results of these and other sediment sample analyses for radiochemicals and trace metals are shown in Table 5-47 and Table 5-48. Related information is presented in Section 5.B.4. Results are comparable to sediment data collected from these same stations in previous years.

Data discussed in Section 5.B.4 suggest that radionuclide concentrations in sediments on Laboratory land just upstream of the Pueblo of San Ildefonso boundary are the result of worldwide fallout rather than of Laboratory operations. None of the Pueblo of San Ildefonso sediment stations in Mortandad Canyon showed levels of strontium-90, total uranium, americium-241, gross alpha, gross beta, or gross gamma that exceeded the background values attributed to fallout (or naturally occurring uranium) in northern New Mexico (Purtymun 1987a). The sample at Station A-6 (located on Pueblo of San Ildefonso land adjacent to the boundary with the Laboratory) showed a cesium-137 value slightly higher than background, and a level of plutonium-239,240 about 1.6 times the background value for fallout. The plutonium-238 value for Station A-6 was only slightly higher than the background value. In sediment samples dominated by worldwide fallout at low concentration levels, considerable variability is expected (Purtymun 1990b).

Sediment sampling stations located on Pueblo of San Ildefonso lands in Los Alamos Canyon showed levels of cesium-137; plutonium-238; plutonium-239,240; and americium-241 above background. All of these levels are consistent with previous samples collected from these same stations (see Section 5.E.4).

Analytical results from the sediment sampling locations in Guaje, Bayo, and Sandia Canyons are all within the range of values expected from worldwide fallout. These findings are consistent with current and previous measurements of sediments from these canyons where they exit the Laboratory at State Road 502. Sediment samples collected from the Pueblo of San Ildefonso in 1995 were also analyzed for trace metals, as reported in Table 5-48. These results, which are all within the general ranges found in geologic materials from Pajarito Plateau, suggest natural origins for all trace metals, including total uranium (reported in Table 5-47).

b. Santa Clara Pueblo. The stations sampled at Santa Clara Pueblo in 1995 are shown in Figure 5-16. A sediment sample collected at 4th Pond is discussed in Section 5.B.4. Results of radiochemical analyses of the 1995 water samples are given in Table 5-42. Americium-241 was near the detection limit in several of the samples. The most notable finding is that uranium is at about 10 μg/L, or half of the proposed MCL, in two water supply wells. Naturally occurring uranium concentrations approaching or many times above the proposed MCL are prevalent in well water throughout the Pojoaque area.

Data on the chemical quality of the groundwater are shown in Table 5-43. Two wells (Enos House and Community New Subdivision) have fluoride levels that are about half the NMWQCC groundwater limit of 1.6 mg/L. The Community New Subdivision Well also has high chloride and TDS values, relative to water quality standards. Several surface water samples had measurable TSS values, common in surface waters.

Trace metal analyses are shown in Table 5-44. The Enos House Well had an arsenic concentration above the EPA MCL and a vanadium value in the range of the EPA health advisory. The surface water samples with measurable TSS had values of aluminum, iron, and manganese comparable to the water quality standards, probably related to dissolution of the suspended particulates during sample analysis.

Samples from Community New Subdivision and Community Above Village Wells were analyzed for VOCs and SVOCs and PCBs (Table 5-45), and none were detected.

c. Cochiti Pueblo. The stations sampled at Cochiti Pueblo in 1995 are shown in Figure 5-17. Results of radiochemical analyses of the 1995 water samples are given in Table 5-42. Sediment data are discussed in Section 5.B.4. Americium-241 was near the detection limit in several of the samples; however, the americium-241 value in the trip blank also exceeded the detection limit, discounting these observations. A small amount of uranium was found in Cochiti well 1, at a level only one-tenth of the EPA MCL.

Data regarding the chemical quality of the groundwater are shown in Table 5-43. The only chemical quality observation of note was the finding of a nitrate level of about 4 mg/L (nitrate as nitrogen) in Cochiti well 1, which is 40 percent of the EPA MCL.

Trace metal analyses are shown in Table 5-44. No trace metal detections of note occurred in these water samples. The apparently high silver level (40 µg/L, relative to the NMWQCC groundwater limit of 50 µg/L) reflects a detection limit and analytical uncertainty of 40 µg/L.

The sample from Cochiti well 1 was analyzed for VOCs, SVOCs, and PCBs (Table 5-45). The only compound detected was Di-n-butyl phthalate (Table 5-46). This compound was found in the method blank indicating the source was laboratory contamination. The compound detected is a phthalate, a common constituent of plastics.

d. Jemez Pueblo. The stations sampled at Jemez Pueblo in 1995 are shown in Figure 5-18. Results of radiochemical analyses of the 1995 water samples are given in Table 5-42. No radiochemical detections of note occurred in the North Tank water sample.

The chemical quality of the North Tank water sample is shown in Table 5-43. A fluoride value of 1.3 mg/L, compared to the NMWQCC groundwater limit of 1.6 mg/L, is the only notable observation.

Trace metal analyses are shown in Table 5-44. The boron level of 620 µg/L is nearly at the NMWQCC groundwater limit of 750 µg/L. Boron and fluoride are common constituents of water in volcanic areas (Hem 1989). The thermal waters discharging from the Valles Caldera have been shown to discharge through the Jemez River drainage, and other wells and springs in the area have far higher boron and fluoride levels (Goff 1988). The apparently high silver level (40 µg/L relative to the NMWQCC groundwater limit of 50 µg/L) reflects a detection limit and analytical uncertainty of 40 µg/L.

The North Tank water sample was analyzed for VOCs, SVOCs, and PCBs (Table 5-45). The only compound detected was chlorodibromomethane (Table 5-46). The significance of this finding is doubtful as the sample was collected from a chlorinated water system, and chloromethane compounds are commonly formed in such a case.

e. Trace-Level Tritium Analyses of Pueblo Waters. Fifty water samples were collected at the four Accord Pueblos and sent to the University of Miami Tritium Laboratory for analysis using their low-detection limit methodology. The accuracy of this analytical technique far exceeds that of the liquid scintillation method, which is the EPA-specified method for determining compliance with drinking water standards. The University of Miami Tritium Laboratory analyses are used by geochemists and hydrologists for the purposes of groundwater age dating and pathway determination. Table 5-49 gives the analytical results. Also included in the table are the liquid scintillation results for some of the samples. The very large difference between the liquid scintillation and University of Miami results suggests that the detection limit for the liquid scintillation method is at times much higher, perhaps 2,000 to 4,000 pCi/L, than the stated 400 pCi/L detection limit (see Section 5.B.1). Note that the EPA MCL for tritium (20,000 pCi/L) far exceeds any of the values discussed here.

The tritium results from pueblo waters fall into several groups. Santa Clara Pueblo surface waters (Santa Clara Creek) and the Rio Grande have values in the range of 28 to 42 pCi/L. At present, general atmospheric levels reflected in precipitation in northern New Mexico are about 30 pCi/L, and those in the Los Alamos vicinity range from 20 to 450 pCi/L (Adams 1995). Thus the surface water values are similar to those of regional precipitation. A number of well waters have tritium values in this range, suggesting that a significant component of their groundwater is of meteoric origin and has been recharged at least within the last four to five decades (Blake 1995, Shevenell 1995). Examples of such waters are Sanchez House, Basalt Spring, Otowi House, the BIA wellpoints, New Community, Tetilla Peak, and all of the Jemez Pueblo waters. It is possible, however, that Los Alamos Canyon waters (Basalt Spring, Otowi House, and the BIA wellpoints) have tritium levels which reflect a component of Laboratory-generated tritium.

A second group of waters, mostly wells, have tritium values from as low as 0.4 pCi/L to about 9 pCi/L. Waters with tritium concentrations below about 1.6 pCi/L are likely to be old: the ages of these waters are more than 3,000 years, but there may be large errors associated with small tritium concentrations (Blake 1995, Shevenell 1995). This implies that these waters do not contain a significant component of recent recharge and are therefore probably isolated from surface contamination. Note, however, that the nitrate level for the Martinez House well does indicate that there is recent recharge of water to this well, possibly from a septic system or fertilizers. The tritium level for this well is about 7.8 pCi/L. This apparent conflict highlights the assumptions which must be made when inferring groundwater ages and the desirability of supporting the conclusions with additional information.

A final topic related to low-detection limit tritium analyses is a discussion of the results of blanks associated with this testing. The blank results are tabulated in Table 5-50. Three types of blanks were used for quality control with the University of Miami tritium analyses. Two of the blanks (A and B) were prepared by the Environmental Isotope Lab at the University of Waterloo, Ontario, Canada. Decay-corrected values for the blanks are given in Table 5-50. The University of Miami values for blanks A and B are well within the expected values ± the uncertainty given by the University of Waterloo. The mean of the blank A values was 8.9 pCi/L, compared to an expected value of 8.2 ± 1.5 pCi/L. The mean of the blank B values was 0.77 pCi/L, compared to an expected value of 0.12 ± 0.89 pCi/L. PM-2 well water was used as a third blank. PM-2 water has consistently shown tritium concentrations near the University of Miami detection limit. Table 5-50 presents a summary of all prior analyses of PM-2 well water, which have a mean and standard deviation that are both about 0.5 pCi/L.

4. Sediment Studies in the Northern Rio Grande Drainage System

Recently two studies were completed that address plutonium deposition, sediment transport, and redistribution in Los Alamos Canyon and the Rio Grande below Otowi Bridge. The first study (Graf 1993, 1994) uses a historical perspective to evaluate the contributions of plutonium to the Rio Grande watershed, accounting for both worldwide fallout and input from Los Alamos Canyon. This study uses aerial photography and hydrologic data to evaluate movement and deposition of sediments. An important objective of this effort was to locate sediment deposits along the Rio Grande between Otowi Bridge and San Marcial that have the highest probability of containing plutonium. This objective was deemed important because sample analyses are costly, and plutonium concentration levels are typically at or below minimum detection levels.

Using aerial photographs, Graf (1993, 1994) identified locations where sediments had been deposited during specific periods. Subsequent aerial photographs identified deposits that had been preserved. A sample of sediment deposited sometime between 1941 and 1968 was collected from the Rio Grande floodplain near Buckman (just north of Cañada Ancha on Figure 5-8). This sample was subjected to a very sensitive analysis of plutonium isotopes. The ratio of plutonium-239 to plutonium-240 was consistent with approximately an equal contribution of plutonium from worldwide fallout and from the Acid/Pueblo-Los Alamos Canyon system. The total level of plutonium-239 and plutonium-240 in the sample (0.017 pCi/g) was near the statistically derived worldwide fallout level (0.023 pCi/g). Among the study's conclusions regarding a regional plutonium budget for the 1948 to 1985 period are the following:

1) The distribution of sediment and plutonium in the Rio Grande system is highly variable geographically, with plutonium detected in some locations but not in others.

2) Worldwide fallout accounts for more than 90% of plutonium in the Rio Grande system; slightly less than 10% originates from the Laboratory.

3) About half of the total plutonium (from both worldwide fallout and the Laboratory) is stored along the river, and the remainder has been carried to Elephant Butte Reservoir.

4) Most of the plutonium originating from the Laboratory is found along the river between Otowi and Peña Blanca (just downstream from Cochiti Dam); since 1973, the downstream transport of plutonium contributions from the Laboratory and from worldwide fallout have terminated in Cochiti Reservoir.

The second study (Graf 1995) explored the connection between plutonium disposal sites located in Acid/Pueblo and DP/Los Alamos Canyons and the Rio Grande. Fifteen years of empirical data from annual sediment sampling throughout this canyon system have produced 458 observations of plutonium concentrations in sediments. These data show that mean plutonium concentrations in fluvial sediments decline from about 10,000 fCi/g near the Acid/

Pueblo sampling site, to less than 100 fCi/g at the confluence of Los Alamos Canyon and the Rio Grande. Temporal data from sites repeatedly sampled show the passage of waves of contaminated and uncontaminated sediments through this canyon system. Field mapping identified 108 deposits of potentially contaminated sediments, including active floodplains, bars, channel fills, and slack water deposits. Graf (1995) estimated that about 957 mCi of total plutonium is distributed in the Pueblo/Los Alamos Canyon system. This compares to earlier estimates (ESG 1981) of about 246 mCi using geometric mean concentrations from sampling data, or about 631 ± 298 mCi using arithmetic means. This earlier study also estimated that approximately 177 mCi of total plutonium was originally discharged into Acid and DP Canyons between 1943 and 1964. These discrepancies in estimated total plutonium inventory result from differences in estimated total sediment volume present in the canyon system, high spatial and temporal variability in plutonium concentration values, and an insufficient number of samples to adequately characterize this variability.

According to Graf (1995), approximately 78% of the original plutonium inventory is still trapped in lower Pueblo Canyon, 18% in lower Los Alamos Canyon, and the remainder (4%) is in the upper reaches of the system. Computer simulations of water, sediment, and plutonium transport suggest that flood-related discharges up to the 25-yr runoff event fail to develop sufficient transport capacity to completely flush all plutonium contamination from the system. Lesser flows tend to move some contaminated materials toward the Rio Grande by remobilizing previously stored sediments.

5. Main Aquifer Hydrologic Properties Studies

a. Water Production Records. Monthly water production records are provided to the State Engineer's Office under State of New Mexico requirements specified in the water rights permit held by DOE for the Los Alamos municipal water supply system. During 1995, total water production from 12 wells in the Guaje and Pajarito municipal well fields, the Water Canyon Gallery, and Los Alamos Reservoir was 5.15 million m^3 (1,359 million gal., or 4,172 ac-ft). The two wells in the Otowi field were not pumped during 1995. This total production amounts to 75% of the total diversion right of 6.8 million m^3 (5,541 ac-ft) that is available to DOE under its permit. Details of the performance of the water supply wells (pumpage, water levels, drawdown, and specific yield) and their operation are published in a series of separate reports. The most recent report is entitled "Water Supply at Los Alamos during 1995" (McLin 1996).

b. Measurement of Main Aquifer Water Levels. In October 1992, the Laboratory began measuring and recording water level fluctuations in test wells completed into the main aquifer below Pajarito Plateau and in various other monitoring wells completed within intermediate and alluvial groundwaters located throughout the facility. These data are automatically recorded at hourly intervals using calibrated pressure transducers. Table 5-51 summarizes the locations, start and end dates for data collection, and final water levels recorded during 1995. These same data are also presented in greater detail in the Laboratory report entitled "Water Supply at Los Alamos during 1995" (McLin 1996).

6. Dose Equivalents from Exposure to Sediments in Mortandad Canyon

Radioanalytical results for sediments collected from Mortandad Canyon in 1995 were modeled using the RESRAD model, version 5.61 (ANL 1995). The pathways evaluated are the external gamma pathway from radioactive material deposited in the sediments, the inhalation pathway from materials resuspended by winds, and the soil ingestion pathway. Since water in the canyon is not used for drinking water or irrigation and there are no cattle grazing in the canyon or gardens in the canyon, the drinking water, meat ingestion, and fruit/vegetable ingestion pathways were not considered.

The RESRAD model was run for three areas of concern: (1) the entire canyon with 13-21 samples per analyte collected throughout the canyon, (2) the sampling location labeled GS-1, and (3) the sampling location labeled MCO-5. To model the entire canyon, the average and standard deviation of the analytical results were input into RESRAD. For the individual monitoring locations, the analytical result and the counting uncertainty were used. If more than one sample was collected or a replicate sample was submitted to the laboratory, the average and standard deviation of analytical results were used in the model. Tritium analytical data are normally provided in the amount of radioactivity per liquid volume (i.e., pCi/mL) whereas RESRAD requires the amount of radioactivity per dry gram of soil (i.e., pCi/gm). A value of 30% soil moisture for sediments in Mortandad Canyon (Stoker 1991) was

used in a data conversion algorithm (Fresquez 1996) to calculate the required input data. Uranium data were converted into isotope-specific concentrations by assuming that the total uranium analytical result contained a natural abundance of each of the principal uranium isotopes (i.e., uranium-234, uranium-235, and uranium-238). Using the relative mass abundance and the specific activity, the concentration for each of the uranium radioisotopes was calculated. The input parameters for the RESRAD model are summarized in Table 5-52 and the initial radionuclide concentrations used in the model are summarized in Table 5-53. RESRAD calculates the daughter radionuclides based on the initial radionuclide concentrations and time since placement of material.

The total effective dose equivalent (TEDE) (i.e., the sum of the effective dose equivalents from the external gamma, the inhalation and soil ingestion pathways) is presented for the three areas of concern (Table 5-54). The TEDE using the average concentration of all monitoring locations in Mortandad Canyon and using the RESRAD input parameters in Table 5-52 is 6.75 mrem (<7% of the 100 mrem DOE PDL). The error term associated with this average value is extremely large indicating a high degree of variability in the concentrations at individual monitoring site. As can be seen from Table 5-55, the maximum TEDE, using the average TEDE as above plus twice the error term, is 36.6 mrem (<37% of the DOE PDL). The majority of this TEDE is from sediment samples collected at GS-1 and MCO-5 that have higher cesium-137 concentrations than other monitoring locations in the canyon. This radionuclide contributed more than 98% to the external gamma pathway which, in turn, contributed more than 84% to the maximum TEDE for the entire canyon system. The inhalation and soil ingestion pathways each contributed approximately 8% to this maximum TEDE. The maximum TEDEs for GS-1 and MCO-5 using the same input parameters as for the entire canyon system are 43.4 mrem and 22.1 mrem, respectively.

7. Dose Equivalents from Ingestion of Water from the TA-50 Effluent and the Stream Below the Outfall

Table 5-56 presents the summary of the CEDE from the ingestion of water collected in 1995 from the TA-50 effluent. To estimate the CEDE for someone consuming water from the stream below the outfall, the effluent concentration was mixed with the average annual storm runoff into Mortandad Canyon (Purtymun 1983). Since no water is derived from Mortandad Canyon for drinking, industrial, or agricultural purposes (Penrose 1990), comparisons with the standards for drinking water are inappropriate and were not made. The CEDEs provided below are based on a per liter of water intake and an exercise scenario where a jogger or hiker drinks from the TA-50 effluent or the stream directly below the outfall.

By providing the CEDE on a per liter basis, the reader is enabled to determine his or her own level of intake of water from these sources and multiply this intake by the CEDE figures provided in the table. The total CEDE on a per liter intake bases for these sources are 1.30 mrem and 0.49 mrem per liter of water consumed from the TA-50 effluent and the stream directly below the outfall, respectively.

Any exercise scenario is highly unlikely to occur because most individuals will most likely bring bottled water along for an extended hike or jog in the canyon. However, the modeled exercise scenario has a jogger or hiker going into Mortandad Canyon, becoming thirsty, and drinking from the TA-50 effluent or stream directly below the TA-50 permitted outfall. The hourly intake of water for an individual with a high activity level and ambient temperatures of 90°F is estimated at 0.286 ± 0.260 L/hr (McNall 1974) for members in the US Army performing heavy, strenuous training (assumed to be a similar level of activity as exercise). Since the majority of persons exercise less than one hour per session, the maximum intake was estimated using the average + two sigma, and the average intake is estimated using only the average value above for each exercise event. The modeled exercise scenario assumes an individual exercises 4 times a week for 50 weeks and drinks from the TA-50 effluent and stream only 10% of the time. The total water consumed per year from each source with this scenario is 16.1 L for the maximum consumption rate, whereas for the average consumption rate, the total water consumed per year from each source is 5.7 L. The total CEDE for this scenario using the maximum consumption rate is 20.9 mrem and 7.8 mrem for the TA-50 effluent and the stream directly below the outfall, respectively. For the average consumption rate, these values drop to 7.4 mrem and 2.8 mrem for these two sources, respectively.

Table 5-1. Summary of TA-50 Radionuclide and Nitrate Discharges[a]

	1963–1977	1993			1994			1995		
Radionuclide	Total Activity Released (mCi)[b]	Total Annual Activity (mCi)	Mean Concentration (pCi/L)	Ratio of Concentration to DCG[c]	Total Annual Activity (mCi)	Mean Concentration (pCi/L)	Ratio of Concentration to DCG	Total Annual Activity (mCi)	Mean Concentration (pCi/L)	Ratio of Concentration to DCG
^{3}H	25,150	2,660	123,000	0.06	2,230	107,000	0.05	731	41,400	0.02
^{241}Am	7	11.2	522	17.40	3.1	147	4.9	1.4	79.4	2.65
^{137}Cs	848	8.2	375	0.13	8.5	408	0.14	6.6	375	0.13
^{238}Pu	51	0.6	26.8	0.67	2.8	135	3.38	3.4	195	4.88
^{239}Pu	39	0.5	23.1	0.77	0.4	21.4	0.71	0.6	35.6	1.19
^{90}Sr	295	3.4	155	0.16	0.3	13.7	0.01	0.6	36.9	0.04
Constituent		Total Annual Mass (kg)	Mean Concentration (mg/L)	Ratio of Concentration to MCL[d]	Total Annual Mass (kg)	Mean Concentration (mg/L)	Ratio of Concentration to MCL	Total Annual Mass (kg)	Mean Concentration (mg/L)	Ratio of Concentration to MCL
NO_3-N		1,440	81.6	8.1	947	45.5	4.5	718	35.6	3.5
Total effluent volume ($\times 10^7$ liters)		2.17			2.08			1.76		

[a]Compiled from Radioactive & Industrial Wastewater Science Group (CST-13) Annual Reports.
[b]DOE, 1979; decay corrected through 12/77.
[c]DOE Derived Concentration Guide.
[d]Maximum contaminant level.

Table 5-2. Organic Analytical Methods

Test	SW-846 Method	Extraction Water	Extraction Sediments	Number of Analytes
Volatiles	8260A	E0730	E0720	59
Semivolatiles	8270B[a]	E0530	E0510	69
PCB[b]	8080A, 8081	E0430	E0410	4
HE[c]	8330			14

[a]Direct injection used for method 8270B.
[b]PCB = polychlorinated biphenyls.
[c]HE = high-explosive.

Table 5-3. Volatile Organic Compounds (VOCs)

Analytes	Limit of Quantitation Water (µg/L)	Limit of Quantitation Sediments (mg/kg)
Acetone	20	0.02
Benzene	5	0.005
Bromobenzene	5	0.005
Bromochloromethane	5	0.005
Bromodichloromethane	5	0.005
Bromoform	5	0.005
Bromomethane	10	0.01
Butanone [2-]	20	0.02
Butylbenzene [n-]	5	0.005
Butylbenzene [sec-]	5	0.005
Butylbenzene [tert-]	5	0.005
Carbon disulfide	5	0.005
Carbon tetrachloride	5	0.005
Chlorobenzene	5	0.005
Chlorodibromomethane	5	0.005
Chloroethane	10	0.01
Chloroform	5	0.005
Chloromethane	10	0.01
Chlorotoluene [o-]	5	0.005
Chlorotoluene [p-]	5	0.005
Dibromoethane [1,2-]	5	0.005
Dichlorobenzene [o-] (1,2)	5	0.005
Dichlorobenzene [m-] (1,3)	5	0.005
Dichlorobenzene [p-] (1,4)	5	0.005
Dichlorodifluoromethane	10	0.01
Dichloroethane [1,1-]	5	0.005
Dichloroethane [1,2-]	5	0.005
Dichloroethene [1,1-]	5	0.005
Dichloroethene [trans-1,2-]	5	0.005
Dichloroethylene [cis-1,2-]	5	0.005
Dichloropropane [1,2-]	5	0.005
Dichloropropane [1,3-]	5	0.005

Table 5-3. Volatile Organic Compounds (VOCs) (Cont.)

Analytes	Limit of Quantitation Water (µg/L)	Sediments (mg/kg)
Dichloropropane [2,2-]	5	0.005
Dichloropropene [1,1-]	5	0.005
Dichloropropene [cis-1,3-]	5	0.005
Dichloropropene [trans-1,3-]	5	0.005
Ethylbenzene	5	0.005
Hexanone [2-]	20	0.02
Isopropylbenzene	5	0.005
Isopropyltoluene [4-]	5	0.005
Methyl iodide	5	0.005
Methyl-2-pentanone [4-]	20	0.02
Methylene chloride	5	0.005
Propylbenzene	5	0.005
Styrene	5	0.005
Tetrachloroethane [1,1,1,2-]	5	0.005
Tetrachloroethane [1,1,2,2-]	5	0.005
Tetrachloroethylene	5	0.005
Toluene	5	0.005
Trichloro-1,2,2-trifluoroethane [1,1,2-]	5	0.005
Trichloroethane [1,1,1-]	5	0.005
Trichloroethane [1,1,2-]	5	0.005
Trichloroethene	5	0.005
Trichlorofluoromethane	5	0.005
Trichloropropane [1,2,3]	5	0.005
Trimethylbenzene [1,2,4-]	5	0.005
Trimethylbenzene [1,3,5-]	5	0.005
Vinyl chloride	10	0.01
Xylenes (o + m + p) [Mixed-]	5	0.005

Table 5-4. Semivolatile Organic Compounds (SVOCs)

Analytes	Limit of Quantitation Water (µg/L)	Sediments (mg/kg)
Acenaphthene	10	0.33
Acenaphthylene	10	0.33
Aniline	10	0.33
Anthracene	10	0.33
Azobenzene	10	0.33
Benzidine [m-]	10	0.33
Benzo[a]anthracene	10	0.33
Benzo[a]pyrene	10	0.33
Benzo[b]fluoranthene	10	0.33
Benzo[g,h,i]perylene	10	0.33
Benzo[k]fluoranthene	10	0.33
Benzoic acid	50	1.65
Benzyl alcohol	10	0.33
Bis(2-chloroethoxy)methane	10	0.33
Bis(2-chloroethyl)ether	10	0.33
Bis(2-chloroisopropyl)ether	10	0.33
Bis(2-ethylhexyl)phthalate	10	0.33
Bromophenylphenyl ether [4-]	10	0.33
Butyl benzyl phthalate	10	0.33
Chloro-3-methylphenol [4-]	10	0.33
Chloroaniline [4-]	10	0.33
Chloronaphthalene [2-]	10	0.33
Chlorophenol [o-]	10	0.33
Chlorophenylphenyl ether [4-]	10	0.33
Chrysene	10	0.33
Di-n-butyl phthalate	10	0.33
Di-n-octyl phthalate	10	0.33
Dibenzo[a,h]anthracene	10	0.33
Dibenzofuran	10	0.33
Dichlorobenzene (1,2) [o-]	10	0.33
Dichlorobenzene (1,3) [m-]	10	0.33
Dichlorobenzene (1,4) [p-]	10	0.33
Dichlorobenzidine [3,3'-]	20	0.66
Dichlorophenol [2,4-]	10	0.33
Diethyl phthalate	10	0.33
Dimethyl phthalate	10	0.33
Dimethylphenol [2,4-]	10	0.33
Dinitrophenol [2,4-]	10	0.33
Dinitrotoluene [2,4-]	50	1.65
Dinitrotoluene [2,6-]	10	0.33
Fluoranthene	10	0.33
Fluorene	10	0.33
Hexachlorobenzene	10	0.33
Hexachlorobutadiene	50	1.65
Hexachlorocyclopentadiene	10	0.33
Hexachloroethane	10	0.33

Table 5-4. Semivolatile Organic Compounds (SVOCs) (Cont.)

Analytes	Limit of Quantitation Water (µg/L)	Sediments (mg/kg)
Indeno[1,2,3-cd]pyrene	10	0.33
Isophorone	10	0.33
Methyl-4,6-dinitrophenol [2-]	50	1.65
Methylnaphthalene [2-]	10	0.33
Methylphenol [2-]	10	0.33
Methylphenol [4-]	10	0.33
Naphthalene	10	0.33
Nitroaniline [2-]	20	0.66
Nitroaniline [3-]	20	0.66
Nitroaniline [4-]	20	0.66
Nitrobenzene	10	0.33
Nitrophenol [2-]	10	0.33
Nitrophenol [4-]	50	1.65
Nitrosodi-n-propylamine [N-]	10	0.33
Nitrosodimethylamine [N-]	10	0.33
Nitrosodiphenylamine [N-]	10	0.33
Pentachlorophenol	50	1.65
Phenanthrene	10	0.33
Phenol	10	0.33
Pyrene	50	1.65
Trichlorobenzene [1,2,4-]	10	0.33
Trichlorophenol [2,4,5-]	10	0.33
Trichlorophenol [2,4,6-]	10	0.33

Table 5-5. Polychlorinated Biphenyls (PCB) Analytes

Analytes	Detection Limits Water (µg/L)	Sediments (mg/kg)
Aroclor [Mixed-]	0.05	0.06
Aroclor 1242	0.05	0.06
Aroclor 1254	0.05	0.06
Aroclor 1260	0.05	0.06

Table 5-6. High Explosives Analytes

Analytes	Limit of Quantitation Water (µg/L)	Sediments (mg/kg)
HMX	0.21	2.20
RDX	0.27	1.00
1,3,5-TNB	0.042	0.25
1,3-DNB	0.032	0.25
Tetryl	0.24	0.65
Nitrobenzene	0.13	0.26
2,4,6-TNT	0.068	0.25
4-A-2,6-DNT	0.046	0.25
2-A-4,6-DNT	0.046	0.25
2,6-DNT	0.085	0.25
2,4-DNT	0.085	0.25
2-NT	0.10	0.25
4-NT	0.12	0.25
3-NT	0.13	0.25

Table 5-7. Calculated Detection Limits (DL) Based on Reported Uncertainties

Analyte	Units	CST Reported DL	Calculated DL (3 times average one sigma uncertainty)
		Water Analysis	
^{3}H	pCi/L	300	324.0
^{3}H	pCi/L	300	825[a]
^{3}H	pCi/L	300	1900[b]
^{90}Sr	pCi/L	3.0	3.1
^{137}Cs	pCi/L	2.0	4.4
U	µg/L	0.1	0.03
^{238}Pu and $^{239,240}Pu$	pCi/L	0.04	0.03
^{241}Am	pCi/L	0.04	0.06
Gross Alpha	pCi/L	3.0	5.4
Gross Beta	pCi/L	3.0	1.1
Gross Gamma	pCi/L		130[c]
		Sediments Analysis	
^{90}Sr	pCi/g	1.0	0.95
^{137}Cs	pCi/g	0.05	0.067
U	µg/g	0.02	0.24[d]
^{238}Pu and $^{239,240}Pu$	pCi/g	0.002	0.005
^{241}Am	pCi/g	0.002	0.005
Gross Alpha	pCi/g	1.5	0.78
Gross Beta	pCi/g	1.5	0.53
Gross Gamma	pCi/g		0.85[e]

[a]Minimum detection limit calculated from blanks as described in text.
[b]Minimum detection limit calculated from duplicates as described in text.
[c]From uncertainties associated with sample values less than 50 pCi/L.
[d]From uncertainties associated with sample values less than 1 µg/g.
[e]From uncertainties associated with sample values less than 3 pCi/g.

Table 5-8. Radiochemical Analysis of Surface Waters for 1995

Station Name	Date	Code[a]	^{3}H (pCi/L)	^{90}Sr (pCi/L)	^{137}Cs (pCi/L)	U (µg/L)	^{238}Pu (pCi/L)	$^{239,240}Pu$ (pCi/L)	^{241}Am (pCi/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Gross Gamma (pCi/L)
Regional Stations												
Rio Chama at Chamita	05/09	1	−200 (300)[b]	.4 (.8)	< .61[c]	1.04 (.1)	−.017 (.003)	.003 (.007)	.004 (.015)	−.4 (.7)	2.4 (.4)	100 (50)
Rio Grande at Embudo	05/09	1	−200 (300)	.2 (.8)	< .47	1.18 (.12)	.025 (.014)	.006 (.013)	.035 (.015)	.6 (.7)	2.1 (.4)	110 (50)
Rio Grande at Otowi (bank)	05/09	1	0 (300)	.5 (.8)	< .88	1.26 (.13)	.004 (.008)	.003 (.008)	.054 (.017)	1 (.8)	2.5 (.4)	100 (50)
Rio Grande at Otowi (bank)	09/15	1	0 (300)	.2 (.9)	1.13 (.57)	2.52 (.33)	−.02 (.009)	−.004 (.01)	.050 (.030)	1 (.9)	5 (.7)	10 (40)
Rio Grande at Otowi (wdth intgrt)	09/15	1	−300 (300)	.6 (.9)	−.21 (.8)	2.63 (.34)	.023 (.016)	.015 (.019)	.031 (.017)	4 (1)	4 (.6)	50 (50)
Rio Grande at Frijoles (bank)	09/13	1	500 (300)	.5 (.7)	.86 (.34)	2.53 (.25)	.016 (.01)	.001 (.008)	.025 (.013)	3 (1)	5 (.7)	50 (50)
Rio Grande at Frijoles (wdth intgrt)	09/13	1	100 (300)	0 (1)	.21 (.32)	2.46 (.27)	.003 (.008)	−.018 (.01)	.026 (.018)	.4 (1)	5 (.7)	20 (40)
Rio Grande at Cochiti	05/11	1	100 (300)	.6 (1)	.76 (.44)	1.46 (.15)	.021 (.012)	.032 (.012)	.028 (.016)	.9 (.8)	2.3 (.4)	120 (50)
Rio Grande at Bernalillo	05/11	1	−100 (300)	1.3 (1)	1.75 (.57)	1.6 (.19)	.049 (.017)	.024 (.014)	.057 (.018)	.5 (.8)	3.4 (.5)	80 (50)
Rio Grande at Bernalillo	05/11	D1				1.62 (.18)						
Rio Grande at Bernalillo	05/11	R1					.032 (.01)	.01 (.01)	.057 (.0176)			
Jemez River	05/11	1	0 (300)	−.2 (1.1)	1.29 (.46)	.53 (.05)	−.007 (.005)	.005 (.009)	.032 (.015)	4 (1)	5.8 (.7)	40 (40)
Jemez River	05/11	D1		− .4 (1.3)								
Pajarito Plateau												
Guaje Canyon:												
Guaje Canyon	06/06	1	0 (300)	−.4 (.9)	< .91	.36 (.04)	.002 (.008)	.012 (.01)	.043 (.025)	.2 (.4)	3.3 (.5)	−10 (40)
Pueblo Canyon:												
Acid Weir	07/28	1	−100 (300)	6.9 (1)	.49 (.73)	.42 (.07)	−.002 (.013)	.517 (.058)	.115 (.025)	1 (1)	22 (2)	20 (40)
Pueblo 1	07/28	1	−100 (300)	−.3 (.9)	.52 (.79)	.06 (.01)	−.015 (.006)	.024 (.016)	.12 (.029)	−212 (70)	141 (10)	30 (40)
Pueblo 2	07/28	Dry-No Sample										
Pueblo 3	07/28	Dry-No Sample										
Pueblo at SR-502		see Table 5-10										
DP/Los Alamos Canyon:												
Los Alamos Canyon Reservoir	06/02	1	200 (300)	.1 (.9)	.65 (.4)	.1 (.01)	−.012 (.003)	.012 (.012)	.019 (.014)	−.3 (.3)	2.5 (.4)	250 (50)
DPS-1	06/21	1	−100 (300)	84.5 (4.9)	1.56(2.33)	.45 (.05)	.032 (.016)	.026 (.014)	.065 (.019)	−5.9 (4.9)	189.7 (22.3)	30 (40)
DPS-1	06/21	R1								−13.5 (5.5)	212 (22.3)	
DPS-4	06/21	1	0 (300)	47.2 (2.8)	.84 (.41)	.11 (.01)	.025 (.012)	.068 (.019)	.119 (.026)	−2.4 (2.4)	102.6 (10)	40 (40)
DPS-4	06/21	D1		45.6 (2.7)								
Los Alamos at Rio Grande		see Table 5-10										
Sandia Canyon:												
SCS-1	06/07	1	−300 (300)	.6 (.8)	< .74	.33 (.03)	.002 (.006)	.015 (.011)	.029 (.015)	−.1 (1.2)	8.9 (1.1)	0 (40)
SCS-2	06/07	1	−200 (300)	1.1 (.7)	.52 (.29)	.51 (.05)	.003 (.007)	.024 (.012)	.063 (.019)	0 (1.2)	11.1 (1.1)	30 (40)
SCS-3	06/07	1	0 (400)	.3 (.7)	< .87	.55 (.06)	−.008 (.005)	.018 (.011)	.031 (.014)	0 (1.2)	11 (1.1)	20 (40)
Mortandad Canyon:												
Mortandad at GS-1	07/28	1	18,000 (1300)	30.8 (2)	49.6 (5.8)	2.24 (.29)	4.694 (.269)	.732 (.069)	1.76 (.26)	49 (12)	346 (33)	40 (40)
Mortandad at GS-1	07/28	D1				2.04 (.2)						
Mortandad at Rio Grande	09/11	1	200 (300)	.5 (.7)	.24 (.37)	.54 (.05)	−.016 (.011)	−.01 (.012)	.022 (.013)	0 (1)	15 (1)	20 (40)

Table 5-8. Radiochemical Analysis of Surface Waters for 1995 (Cont.)

Station Name	Date	Code[a]	^{3}H (pCi/L)	^{90}Sr (pCi/L)	^{137}Cs (pCi/L)	U (µg/L)	^{238}Pu (pCi/L)	$^{239,240}Pu$ (pCi/L)	^{241}Am (pCi/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Gross Gamma (pCi/L)
Cañada del Buey:												
Cañada del Buey	06/05	1	–200 (300)	1.1 (.9)	< .82	.92 (.09)	.006 (.009)	.008 (.013)	.055 (.017)	2.9 (1.8)	5 (.6)	0 (40)
Pajarito Canyon:												
Pajarito Canyon	07/27	1	100 (300)	.4 (.7)	–.61 (.8)	.17 (.02)	.007 (.015)	.018 (.014)	.036 (.017)	.2 (.6)	1 (.3)	50 (40)
Pajarito at Rio Grande	09/11	1	–200 (300)	1.2 (.8)	.21 (.32)	1.08 (.15)	.016 (.016)	.026 (.015)	.033 (.02)	.6 (.6)	3 (.5)	180 (50)
Pajarito at Rio Grande	09/11	D1			.81 (.39)							
Pajarito at Rio Grande	09/11	R1	100 (400)							.2 (.6)	3 (.5)	100 (50)
Water Canyon:												
Water Canyon at Beta	08/04	1	0 (300)	0 (2.9)	.71 (.33)	.62 (.06)	.011 (.011)	–.002 (.016)	.013 (.011)	0 (.8)	9 (1)	–40 (50)
Ancho Canyon:												
Ancho at Rio Grande	09/12	1	–100 (300)	3.9 (1)	.71 (.3)	.22 (.04)	.005 (.014)	.002 (.011)	.04 (.022)	–.4 (.5)	2 (.5)	160 (50)
Ancho at Rio Grande	09/12	R1	100 (400)						– .051 (.05)			
Ancho at Rio Grande	09/12 d	1	0 (300)	1.1 (.9)	.91 (1.37)	.23 (.03)	–.012 (.013)	–.005 (.013)		–.1 (.5)	3 (.5)	30 (40)
Ancho at Rio Grande	09/12 d	D1				.21 (.03)						
Frijoles Canyon:												
Frijoles at Monument HQ	06/02	1	–200 (300)	.3 (.8)	< 1.33	.18 (.03)	.007 (.009)	.008 (.013)	.172 (.035)	–.2 (.4)	2.5 (.4)	340 (60)
Frijoles at Monument HQ	07/27	1	200 (300)	.3 (.8)	–.16 (.8)	.4 (.05)	.003 (.015)	.01 (.014)	.033 (.018)	0 (.6)	2 (.5)	50 (40)
Frijoles at Rio Grande	09/13	1	–100 (300)	.2 (.9)	.78 (1.17)	.12 (.02)	–.028 (.014)	.003 (.017)	.035 (.02)	–.2 (.5)	3 (.5)	40 (50)
Frijoles at Rio Grande	09/13	D1		0 (.9)								
Detection Limits			2,000	3	4	0.1	0.04	0.04	0.04	3	3	
Water Quality Standards[d]												
DOE DCG for Public Dose			2,000,000	1,000	3,000	800	40	60	30			
DOE Drinking Water System DCG			80,000	40	120	30	1.6	1.2	1.2			
EPA Primary Drinking Water Standard			20,000	8		20				15		
EPA Screening Level											50	
NMWQCC Livestock Watering Standards			20,000							15		
NMWQCC Groundwater Limit						5,000						

[a] Codes: d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.

[b] Radioactivity counting uncertainties (1 standard deviation, except ^{3}H—3 standard deviations) are shown in parenthesis. Values less than twice the radioactivity counting uncertainty are considered a nondetection.

[c] Less than symbol (<) means measurement was below the specified detection limit for the analytical method.

[d] Standards given here for comparison only; see Appendix A.

Table 5-9. Apparent Detections of Radiochemical Constituents in Surface Waters for 1995[a] (pCi/L)

Station Name	Date	Code[b]	^{238}Pu	^{241}Am
Rio Grande at Otowi (bank)	5/9	1		.054 (.017)
Rio Grande at Bernalillo	5/11	1	.049 (.017)[c]	.057 (.018)
Rio Grande at Bernalillo	5/11	R1		.057 (.018)
Cañada del Buey	6/5	1		.055 (.017)
Frijoles at Monument HQ	6/2	1		.172 (.035)
Detection Limits			0.04	0.04

[a]Outside of known contaminated areas.
[b]Codes: Primary analysis; R1— lab replicate.
[c]Radioactivity counting uncertainties (1 standard deviation) are shown in parenthesis. Values less than twice the radioactivity counting uncertainty are considered a nondetection.

Table 5-10. Radiochemical Analysis of Runoff Samples in 1995

Station Name	Date	Code[a]	^{3}H (pCi/L)	^{90}Sr (pCi/L)	^{137}Cs (pCi/L)	U (µg/L)	^{238}Pu (pCi/L)	$^{239,240}Pu$ (pCi/L)	^{241}Am (pCi/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Gross Gamma (pCi/L)
Pajarito Plateau												
Pueblo Canyon:												
Pueblo at Land Fill	5/25	1					.008 (.015)[b]	0 (.008)				
Pueblo at Land Fill	7/18	1	200 (300)	.7 (.8)	.83 (1.26)	.22 (.03)	−.023 (.009)	.027 (.017)	.044 (.015)	.2 (.4)	2 (.5)	50 (50)
Pueblo at GS	5/25	1					.009 (.01)	.007 (.011)				
Pueblo at GS	7/18	1	0 (300)	1.5 (.9)	1.68 (.67)	.28 (.03)	−.013 (.011)	−.004 (.01)	.045 (.053)	−.1 (1)	12 (1)	20 (50)
Pueblo at GS	7/18	R1										−10 (50)
Pueblo at SR-502	5/25	1					−.023 (.008)	.012 (.015)				
DP/Los Alamos Canyon:												
Los Alamos at Upper GS	5/25	1					.02 (.013)	.048 (.016)				
DP Canyon Above Confluence	7/18	1	−100 (300)		.71 (1.07)	.17 (.02)	−.005 (.01)	.026 (.018)	.074 (.021)	−.1 (.5)	28 (3)	30 (50)
DP Canyon Above Confluence	7/18	D1				.13 (.02)						
Los Alamos at GS-1	5/1	1	200 (300)	1.9 (.9)	.7 (.36)	.08 (.01)	.008 (.019)	.032 (.02)	.035 (.016)	−.4 (.7)	7.5 (.9)	120 (50)
Los Alamos at GS-1	5/5	1	−100 (300)	.5 (1.1)	.48 (.23)	1 (.1)	−.011 (.006)	.02 (.011)	.042 (.016)	−1 (1)	5.4 (.7)	90 (50)
Los Alamos at GS-1	5/8	1	200 (300)	1.8 (1)	.64 (.3)	.13 (.01)	.018 (.01)	.029 (.014)	.147 (.028)	.5 (.7)	7.5 (.9)	10 (40)
Los Alamos at GS-1	5/8	R1	200 (400)									
Los Alamos at GS-1	7/18	1	−100 (300)	1.5 (.8)	.54 (.81)	.67 (.07)	.019 (.018)	.084 (.031)	.014 (.013)	.4 (.4)	3 (.5)	50 (50)
Los Alamos at GS-1	7/18	D1		1.7 (.7)								
Los Alamos at SR-4	5/19	1					0 (.006)	.021 (.01)				
Los Alamos at SR-4	5/25	1					.02 (.013)	.057 (.018)				
Los Alamos at SR-4	7/18	1	0 (300)	6.1 (.8)	1.27 (.63)	.29 (.03)	.005 (.03)	.048 (.029)	.117 (.026)	0 (.5)	13 (1)	20 (50)
Los Alamos at SR-4	7/18	R1								.1 (.5)	12 (1)	
Los Alamos at Rio Grande	5/19	1					.013 (.011)	.032 (.015)				
Los Alamos at Rio Grande	5/25	1					−.006 (.01)	.006 (.01)				
Pajarito Canyon:												
Pajarito at SR-501	5/25	1					.016 (.011)	.011 (.011)				
Pajarito at SR-4	7/18	1	300 (300)	.3 (.8)	1.06 (.54)	1.16 (.12)	.002 (.01)	−.016 (.009)	.028 (.012)	3 (1)	7 (.9)	10 (50)
Ancho Canyon:												
Ancho Canyon near Bandelier	6/29	1	300 (300)	50.9 (3.5)	.11 (.17)	9.47 (.95)	−.011 (.033)	−.008 (.022)	.003 (.001)	23 (9)	73 (8)	460 (70)
Detection Limits			2,000	3	4	0.1	.04	.04	.04	3	3	
Water Quality Standards[c]												
DOE DCG for Public Dose			2,000,000	1,000	3,000	800	40	30	30			
DOE Drinking Water System DCG			80,000	40	120	30	1.6	1.2	1.2			
EPA Primary Drinking Water Standard			20,000	8		20					15	
NMWQCC Groundwater Limit					5,000							

[a] Codes: d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.

[b] Radioactivity counting uncertainties (1 standard deviation, except ^{3}H—3 standard deviation) are shown in parenthesis. Values less than two standard deviations are considered a nondetection.

[c] Standards given here for comparison only; see Appendix A.

Table 5-11. Plutonium in Runoff Samples in 1995

Station Name	Date	Code[a]	Concentration in Solution ^{238}Pu (pCi/L)		Concentration in Solution $^{239,240}Pu$ (pCi/L)		Concentration in Suspended Sediment ^{238}Pu (pCi/g)		Concentration in Suspended Sediment $^{239,240}Pu$ (pCi/g)		Suspended Sediment (µg/L)
Pajarito Plateau											
Pueblo Canyon:											
Pueblo at Land Fill	5/25	1	.008	(.015)	0	(.008)					
Pueblo at Land Fill	7/18	1	–.023	(.009)	.027	(.017)	.01	(.005)	.009	(.006)	
Pueblo at GS	5/25	1	.009	(.01)	.007	(.011)					
Pueblo at GS	7/18	1	–.013	(.011)	–.004	(.01)					
Pueblo at SR-502	5/25	1	–.023	(.008)	.012	(.015)					
DP/Los Alamos Canyon:											
Los Alamos at Upper GS	5/25	1	.02	(.013)	.048	(.016)					
DP Canyon Above Confluence	7/18	1	–.005	(.01)	.026	(.018)	.249	(.022)	1.21	(.056)	
Los Alamos at GS-1	5/1	1	.008	(.019)	.032	(.02)					10,000
Los Alamos at GS-1	5/5	1	–.011	(.006)	.02	(.011)					1,800
Los Alamos at GS-1	5/8	1	.018	(.01)	.029	(.014)					45,500
Los Alamos at GS-1	7/18	1	.019	(.018)	.084	(.031)	.013	(.014)	2.429	(.125)	
Los Alamos at SR-4	5/19	1	0	(.006)	.021	(.01)					
Los Alamos at SR-4	5/25	1	.02	(.013)	.057	(.018)					
Los Alamos at SR-4	6/1	1	–.013	(.007)	.023	(.018)	.191	(.067)	1.448	(.169)	38,000
Los Alamos at SR-4	7/18	1	.005	(.03)	.048	(.029)	.217	(.025)	1.806	(.094)	
Los Alamos at Rio Grande	5/19	1	.013	(.011)	.032	(.015)					
Los Alamos at Rio Grande	5/25	1	–.006	(.01)	.006	(.01)					
Los Alamos at Rio Grande	6/1	1	.013	(.011)	.022	(.012)	.031	(.024)	1.298	(.101)	173,000
Pajarito Canyon:											
Pajarito at SR-501	5/25	1	.016	(.011)	.011	(.011)					
Pajarito at SR-4	7/18	1	.002	(.01)	–.016	(.009)	–.036	(.032)	.036	(.064)	
Ancho Canyon:											
Ancho Canyon near Bandelier	6/29	1	–.011	(.033)	–.008	(.022)	.002	(.001)	.039	(.003)	
Ancho Canyon near Bandelier	6/29	R1					.036	(.009)	.061	(.012)	

[a] Codes: 1—primary analysis; R1—lab replicate.

Table 5-12. Chemical Quality of Surface Waters for 1995 (mg/L[a])

Station Name	Date	Code[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Regional Stations																				
Rio Chama at Chamita	05/09	1	22	33	7.6	2.5	13	2	58	0	74	0.1	<.02	0.01	<.01	389	61	113	7.85	281
Rio Grande at Embudo	05/09	1	31	24	5.2	2.6	9	2	21	0	72	0.3	<.02	0.11	0.01	323	66	82	7.96	199
Rio Grande at Otowi (bank)	05/09	1	32	33	7.1	2.8	13	3	42	0	79	0.2	<.02	0.07	0.01	412	83	112	7.91	257
Rio Grande at Otowi (bank)	09/15	1	21	37	7.2	3.0	17	8	41	<5[f]	108	0.4	0.03	0.59	<.01	252	<1	121	7.38	323
Rio Grande at Otowi (bank)	09/15	R1										0.4								
Rio Grande at Otowi (wdth intgrt)	09/15	1	18	37	7.7	3.3	17	7	42	<5	110	0.4	0.05	<.04	<.01	232	<1	123	7.09	325
Rio Grande at Otowi (wdth intgrt)	09/15	R1		38	7.9	3.4	18											126		
Rio Grande at Frijoles (bank)	09/13	1	19	44	10.0	2.9	18	7	42	<5	103	0.4	0.04	5.10	<.01	246	<1	150	7.96	324
Rio Grande at Frijoles (wdth intgrt)	09/13	1	19	43	9.5	4.6	17	7	43	<5	99	0.4	0.07	0.08	<.01	212	<1	145	7.96	307
Rio Grande at Frijoles (wdth intgrt)	09/13	R1	19																	
Rio Grande at Cochiti	05/11	1	29	29	6.6	2.7	12	3	43	0	81	0.2	0.09	0.03	0.01	398	86	100	7.18	265
Rio Grande at Bernalillo	05/11	1	29	32	6.7	3.0	17	6	46	0	84	0.2	<.02	0.06	<.01	397	60	108	8.04	285
Jemez River	05/11	1	36	21	3.1	3.1	17	17	10	0	70	0.3	<.02	0.02	<.01	275	30	65	8.04	219
Pajarito Plateau																				
Guaje Canyon:																				
Guaje Canyon	06/06	1	51	7	3.3	2.8	6	1	5	0	34	0.1	0.04	0.00	0.01	174	28	32	7.6	85
Pueblo Canyon:																				
Acid Weir	07/28	1	20	10	1.2	5.0	45	49	6	<5	54	0.3	0.37	0.92	0.02	212	<1	34	6.74	299
Acid Weir	07/28	R1												0.92						
Pueblo 1	07/28	1	23	12	2.5	6.5	36	35	6	<5	68	0.3	0.75	0.25	<.01	188	2	40	7.17	259
Pueblo 1	07/28	R1										0.2								
Pueblo 2		Dry-No Sample																		
Pueblo 3		Dry-No Sample																		
Pueblo at SR-502		Runoff Sample-Only Radiological Data Available																		
DP/Los Alamos Canyon:																				
Los Alamos Canyon Reservoir	06/02	1	32	6	2.5	1.7	5	6	5	0	28	0.1	<.02	0.80	<.01	128	10	26	7.28	84
DPS-1	06/21	1	20	35	2.4	5.5	68	51	11	<5	110	0.5	0.04	<.04	<.01	540	<1	150	7.75	519
DPS-1	06/21	R1										0.5								
DPS-4	06/21	1	19	17	1.7	7.2	41	49	7	<5	72	1.0	0.05	0.18	<.01	224	<1	49	7.66	295
Los Alamos at Rio Grande		Runoff Sample-Only Radiological Data Available																		
Sandia Canyon:																				
SCS-1	06/07	1	96	21	5.2	8.9	58	33	13	<5	119	2.5	2.35	4.47	<.01	338	4	61	8.39	352
SCS-2	06/07	1	83	25	5.5	11.0	90	48	72	<5	117	2.1	2.28	2.99	<.01	220	5	82	8.53	517
SCS-3	06/07	1	83	24	5.4	12.0	94	45	71	<15	106	2.1	2.39	3.00	<.01	478	4	82	8.65	480
SCS-3	06/07	R1	84							<11	120	2.1								
Mortandad Canyon:																				
Mortandad at GS-1	07/28	1	50	51	3.5	7.2	87	13	41	<5	208	1.0	0.22	14.97	0.01	514	2	140	7.59	614
Mortandad at Rio Grande	09/11	1	85	27	5.8	13.0	67	44	26	<5	122	0.8	5.70	4.08	<.01	402	<1	91	7.64	500

Table 5-12. Chemical Quality of Surface Waters for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Code[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Cañada del Buey:																				
Cañada del Buey	06/05	1	28	11	5.5	7.3	21	14	7	<5	45	0.5	0.08	<.04	0.02	296	35	50	6.55	128
Pajarito Canyon:																				
Pajarito Canyon	07/27	1	37	15	4.5	4.1	19	20	8	<5	62	0.2	0.25	0.31	<.01	136	<1	56	7.44	194
Pajarito at Rio Grande	09/11	1	68	20	4.3	2.8	12	7	8	<5	84	0.4	<.02	0.70	<.01	222	<1	67	8.2	191
Water Canyon:																				
Water Canyon at Beta	08/04	1	38	16	4.8	5.2	19	29	6	<5	66	0.2	0.22	9.61	<.01	182	3	59	6.84	243
Ancho Canyon:																				
Ancho at Rio Grande	09/12	1	76	14	3.4	2.4	11	5	6	<14	66	0.4	0.03	<.04	<.01	190	<1	49	9.21	139
Ancho at Rio Grande	09/12	R1		14	3.3	2.7	10			<12	71							48		
Ancho at Rio Grande	09/12	1	76	13	3.1	2.4	10	5	6	<12	75	0.4	<.02	0.04	<.01	188	2	45	9.33	135
Frijoles Canyon:																				
Frijoles at Monument HQ	06/02	1	54	9	3.3	1.9	8	5	3	0	43	0.1	<.02	0.01	<.01	182	19	35	7.38	108
Frijoles at Monument HQ	07/27	1	90	13	3.5	<5	12	3	4	<5	76	0.3	0.1	0.30	<.01	176	2	47	8.31	147
Frijoles at Monument HQ	07/27	R1		13	3.3	<4	11											46		
Frijoles at Rio Grande	09/13	1	60	9	3.0	2.6	9	6	6	<5	48	0.2	<.02	0.05	<.01	162	<1	35	7.68	115
Water Quality Standards[g]																				
EPA Primary Drinking Water Standard									500			4		10	0.2					
EPA Secondary Drinking Water Standard								250	250			2				500			6.8–8.5	
NMWQCC Groundwater Limit								250	600			1.6		10	0.2	1,000			6–9	

[a] Except where noted.
[b] Codes: d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.
[c] Total dissolved solids.
[d] Total suspended solids.
[e] Standard units.
[f] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[g] Standards given here for comparison only; see Appendix A.

Table 5-13. Total Recoverable Trace Metals in Surface Waters for 1995 (µg/L)

Station Name	Date	Code[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Regional Stations														
Rio Chama at Chamita	05/09	1	<1[b]	1,730	<2	<10	80	<2	<1	<2	2	<2	1,160	<.2
Rio Grande at Embudo	05/09	1	<1	2,890	<2	20	60	3	<1	<2	3	<2	2,710	<.2
Rio Grande at Otowi (bank)	05/09	1	<1	3,140	<2	10	90	4	<1	<2	3	3	2,620	<.2
Rio Grande at Otowi (bank)	09/15	1	<10	3,400	3	50	99	<1	<3	<4	4	<4	1,800	<.2
Rio Grande at Otowi (wdth intgrt)	09/15	1	<10	4,000	4	40	100	<1	<3	<4	<4	8	2,100	<.2
Rio Grande at Otowi (wdth intgrt)	09/15	R1	<10	5,300	3	50	110	<1	<3	<4	4	8	2,700	<.2
Rio Grande at Frijoles (bank)	09/13	1	<10	11,000	5	35	160	<3	3	7	14	36	4,600	<.2
Rio Grande at Frijoles (wdth intgrt)	09/13	1	<10	9,100	5	40	150	<3	<3	<7	7	9	4,000	<.2
Rio Grande at Cochiti	05/11	1	<1	2,580	2	10	70	<2	<1	<2	3	<2	1,620	<.2
Rio Grande at Bernalillo	05/11	1	<1	2,490	8	40	80	<2	<1	<2	3	2	1,720	<.2
Jemez River	05/11	1	<1	1,890	18	120	60	4	<1	<2	2	<2	1,060	<.2
Pajarito Plateau														
Guaje Canyon:														
Guaje Canyon	06/06	1	<.5	2,280	2	<10	30	<2	<2	<2	<2	4	1,230	<.2
Pueblo Canyon:														
Acid Weir	07/28	1	<10	1,300	2	<40	26	<3	<3	<4	<4	<4	660	<.2
Pueblo 1	07/28	1	<10	3,200	4	25	29	<3	<3	<4	7	<4	1,800	<.2
Pueblo 2		Dry-No Sample												
Pueblo 3		Dry-No Sample												
Pueblo at SR-502		Runoff Sample-Only Radiological Data Available												
DP/Los Alamos Canyon:														
Los Alamos Canyon Reservoir	06/02	1	<.5	1,530	<2	<10	20	<2	<2	<2	<2	11	700	<.2
DPS-1	06/21	1	<10	100	<3	35	110	<3	<3	<4	<4	<10	130	<.2
DPS-4	06/21	1	<10	880	<3	48	66	<3	<3	<4	<4	<10	430	<.2
Los Alamos at Rio Grande		Runoff Sample-Only Radiological Data Available												
Sandia Canyon:														
SCS-1	06/07	1	63	130	4	48	24	<3	<4	<4	<6	5	120	<.2
SCS-2	06/07	1	66	950	9	47	35	<3	<4	<5	17	11	780	<.2
SCS-2	06/07	R1												<.2
SCS-3	06/07	1	67	750	4	58	32	<3	<3	<4	18	17	630	<.2

Table 5-13. Total Recoverable Trace Metals in Surface Waters for 1995 (µg/L) (Cont.)

Station Name	Date	Code[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Mortandad Canyon:														
Mortandad at GS-1	07/28	1	<10	<100	4	60	43	<3	<3	<4	<4	26	160	<.2
Mortandad at Rio Grande	09/11	1	<10	790	5	340	84	<3	<3	<7	<4	15	440	<.2
Cañada del Buey:														
Cañada del Buey	06/05	1	<10	35,000	4	60	160	1	<3	<4	27	39	18,000	0.4
Cañada del Buey	06/05	R1												0.3
Pajarito Canyon:														
Pajarito Canyon	07/27	1	<10	3,800	9	29	180	<3	<5	14	<4	7	18,000	<.2
Pajarito at Rio Grande	09/11	1	<10	310	2	24	41	<3	<3	<7	9	<4	180	<.2
Water Canyon:														
Water Canyon at Beta	08/04	1	<10	600	2	30	520	1	<3	<4	<4	<4	400	<.2
Ancho Canyon:														
Ancho at Rio Grande	09/12	1	<10	270	3	20	32	<3	<3	<7	7	6	210	<.2
Ancho at Rio Grande	09/12	R1	<10	440	3	15	32	<3	<3	<7	4	4	230	<.2
Ancho at Rio Grande	09/12	d 1	<10	140	2	<10	28	<3	4	<7	7	<4	120	<.2
Frijoles Canyon:														
Frijoles at Monument HQ	06/02	1	<.5	1,230	<2	<10	20	<2	<2	<2	<2	13	730	<.2
Frijoles at Monument HQ	07/27	1	<10	<100	2	17	28	<3	<5	<4	6	<4	<100	<.2
Frijoles at Monument HQ	07/27	R1	<10	<100	2	12	27	<3	<5	<4	<5	<4	<100	
Frijoles at Rio Grande	09/13	1	<10	150	<2	<10	18	<3	3	<7	4	<4	180	<.2
Water Quality Standards[c]														
EPA Primary Drinking Water Standard					50		2,000	4	5		100			2
EPA Secondary Drinking Water Standard			100	50-1200								1,000	300	
EPA Action Level												1,300		
NM Wildlife Habitat Standards														0.012
NMWQCC Livestock Watering Standards				5,000	200	5,000			50	1,000	1,000	500		10
NMWQCC Groundwater Limit			50	5,000	100	750	1,000		10	50	50	1,000	1,000	2

Table 5-13. Total Recoverable Trace Metals in Surface Waters for 1995 (µg/L) (Cont.)

Station Name	Date	Code[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Regional Stations													
Rio Chama at Chamita	05/09	1	40	2	<2	<2	<2	<2	<2	280	<2	<2	<10
Rio Grande at Embudo	05/09	1	190	3	<2	<2	<2	<2	<2	180	<2	6	20
Rio Grande at Otowi (bank)	05/09	1	130	2	2	<2	<2	<2	<2	260	<2	8	20
Rio Grande at Otowi (bank)	09/15	1	120	<8	<10	2	<2	<2	<30	310	<2	7	20
Rio Grande at Otowi (wdth intgrt)	09/15	1	130	8	<10	5	<2	<2	<30	310	<2	7	20
Rio Grande at Otowi (wdth intgrt)	09/15	R1	130	<8	<10	5	<2	<2	<30	310	<2	8	30
Rio Grande at Frijoles (bank)	09/13	1	180	<8	<10	6	<2	<1	<30	360	<2	27	31
Rio Grande at Frijoles (wdth intgrt)	09/13	1	170	<8	<10	19	<2	<1	<30	350	<2	11	26
Rio Grande at Cochiti	05/11	1	80	2	2	<2	<2	<2	<2	240	<2	<2	20
Rio Grande at Bernalillo	05/11	1	80	2	2	<2	<2	<2	<2	260	<2	2	<10
Jemez River	05/11	1	40	<2	2	<2	<2	<2	<2	100	<2	2	10
Pajarito Plateau													
Guaje Canyon:													
Guaje Canyon	06/06	1	20	<2	<2	<2	<2	<2	<5	70	<2	3	<10
Pueblo Canyon:													
Acid Weir	07/28	1	4	<8	<10	<30	<2	<1	<30	51	<2	<10	<20
Pueblo 1	07/28	1	66	<8	<10	<80	<2	<1	<30	69	<2	<10	29
Pueblo 2		Dry-No Sample											
Pueblo 3		Dry-No Sample											
Pueblo at SR-502		Runoff Sample-Only Radiological Data Available											
DP/Los Alamos Canyon:													
Los Alamos Canyon Reservoir	06/02	1	<10	<2	<2	<2	<2	<2	<5	50	<2	<2	<10
DPS-1	06/21	1	520	<20	<20	4	<2	<1	<30	160	<2	<4	27
DPS-4	06/21	1	4	<15	<20	<2	<2	<1	<30	100	<2	<4	<20
Los Alamos at Rio Grande		Runoff Sample-Only Radiological Data Available											
Sandia Canyon:													
SCS-1	06/07	1	<3	270	<10	<2	<2	<2	<30	79	<2	20	130
SCS-2	06/07	1	12	230	<10	2	<2	2	<30	110	<2	21	82
SCS-2	06/07	R1											
SCS-3	06/07	1	12	220	<10	2	<2	<2	<30	110	<2	18	54

Table 5-13. Total Recoverable Trace Metals in Surface Waters for 1995 (µg/L) (Cont.)

Station Name	Date	Code[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Mortandad Canyon:													
Mortandad at GS-1	07/28	1	30	330	<10	<30	<2	<1	<30	110	<2	<4	39
Mortandad at Rio Grande	09/11	1	30	<8	<10	<2	<2	<1	45	130	<2	11	25
Cañada del Buey:													
Cañada del Buey	06/05	1	170	500	<10	13	<2	<2	40	72	<2	37	120
Cañada del Buey	06/05	R1											
Pajarito Canyon:													
Pajarito Canyon	07/27	1	2,100	<8	<10	<30	<2	<1	<30	110	<2	<4	<20
Pajarito at Rio Grande	09/11	1	<20	<8	<10	<2	<2	<1	63	120	<2	<4	<20
Water Canyon:													
Water Canyon at Beta	08/04	1	29	<8	10	2	<2	<1	30	120	<2	<4	20
Ancho Canyon:													
Ancho at Rio Grande	09/12	1	32	10	<10	<2	<2	<2	38	71	<2	8	24
Ancho at Rio Grande	09/12	R1	<20	8	20	<2	<2	<.2	<30	69	<2	7	<20
Ancho at Rio Grande	09/12[d]	1	<20	16	<10	<2	<2	1	<30	65	<2	11	<20
Frijoles Canyon:													
Frijoles at Monument HQ	06/02	1	20	<2	<2	<2	<2	<2	<5	50	<2	<2	<10
Frijoles at Monument HQ	07/27	1	<3	<8	<10	<40	<2	<1	<3	60	<2	13	42
Frijoles at Monument HQ	07/27	R1	<3	<20	<10	<40	<2	<1	<3	57	<2	14	39
Frijoles at Rio Grande	09/13	1	<20	13	<10	<2	<2	<1	<30	59	<2	11	<20
Water Quality Standards[c]													
EPA Primary Drinking Water Standard					100		6	50			2		
EPA Secondary Drinking Water Standard			50										5,000
EPA Action Level						15							
NM Wildlife Habitat Standards								2					
NMWQCC Livestock Watering Standards						100		50				100	25,000
NMWQCC Groundwater Limit			200	1,000	200	50		50					1,000

[a]Codes: d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.

[b]Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[c]Standards given here for comparison only, see Appendix A. Note that New Mexico Livestock and Groundwater limits (except mercury) are based on dissolved concentrations, while these analyses are of unfiltered samples—thus, concentrations may include metals assciated with the suspended sediments.

Table 5-14. Number of Results Above the Analytical Limit of Quantitation for Organic Compounds in Surface Waters in 1995

Station Name	Date	Code[a]	Volatile	Semivolatile	PCB	High Explosives
Number of Compounds Analyzed			59	69	4	14
Acid Weir	7/28		0	0	0	
DPS-1	6/21		0	0	0	
Los Alamos Canyon Reservoir	6/2		0	0	0	
SCS-2	6/7		0	0	0	
Cañada del Buey	6/5		0	0	0	
Pajarito Canyon	7/27		0	0	0	
Pajarito at Rio Grande	9/11		0	0	0	
Water Canyon at Beta	8/4		0	0	0	
Ancho at Rio Grande	9/12		1	0	0	0
Ancho at Rio Grande	9/12	d	0	0	0	0
Frijoles at Bandelier National Monument HQ	6/2		0	0	0	
Frijoles at Rio Grande	9/13		1	0	0	

[a]Codes: d—field duplicate.

Table 5-15. Organics Found in Surface Waters in 1995 above the Limit of Quantitation

Station Name	Date	Analyte	Sample Value (µg/L)	Uncertainty (µg/L)	Limit of Quantitation (µg/L)	Analyte[a] Suite	CST-12 Comments
Ancho at Rio Grande	9/12	Acetone	25	7.5	20	voa	found in method blank
Frijoles at Rio Grande	9/13	Acetone	25	7.5	20	voa	found in method blank
Trip Blank	9/13	Acetone	20	9.3	31	voa	found in method blank

[a]volatile organics.

Table 5-16. Radiochemical Analyses of Groundwater for 1995 (pCi/L[a])

Station Name	Date	Codes[b]		^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Main Aquifer													
Test Wells:													
Test Well 1	06/19		1	−100 ± 300[c]	−.5 ± 1	<.97[d]	2.1 ± .5	.041 ± .014	.026 ± .012	.034 ± .021	−.3 ± 1.1	4.7 ± .7	110 ± 50
Test Well 1	06/19		R1	0 ± 400									
Test Well 2	08/01		1	100 ± 300	−.2 ± 1.9	.45 ± .25	.19 ± .03	.043 ± .023	−.007 ± .018	.032 ± .015	−.1 ± .7	4 ± .6	−20 ± 50
Test Well 3	07/18		1	0 ± 300	.4 ± .8	.31 ± .47	.41 ± .04	.003 ± .019	.002 ± .013	.009 ± .017	−.1 ± .4	2 ± .5	−40 ± 40
Test Well 4	07/19		1	400 ± 300	.7 ± .7	1.1 ± .59	.8 ± .08	.001 ± .009	.01 ± .013	.007 ± .014	.5 ± .7	2 ± .4	30 ± 40
Test Well 8	07/17		1	−100 ± 300	.3 ± .8	.63 ± .96	.04 ± .01	−.001 ± .014	−.007 ± .016	.033 ± .019	.2 ± .5	1.3 ± .3	30 ± 40
Test Well DT-5A	11/13	uf	1	100 ± 300	1.7 ± 1.1	.24 ± .37	.45 ± .05	−.007 ± .004	.025 ± .012	.05 ± .05	.4 ± .4	2 ± .3	80 ± 50
Test Well DT-5A	11/13	f	1	−200 ± 300	.5 ± 1.3	.48 ± .71	.4 ± .07	−.002 ± .006	.016 ± .013	.028 ± .016	.5 ± .4	2 ± .3	70 ± 50
Test Well DT-9	05/31		1	500 ± 300	.4 ± .8	<1.22	.41 ± .04	0 ± .005	.01 ± .012	.017 ± .013	−.6 ± .5	1.3 ± .3	100 ± 50
Test Well DT-10	05/30		1	2,100 ± 400	.1 ± 1.1	1.69 ± .64	.58 ± .06	.003 ± .031	.061 ± .037	.032 ± .015	0 ± .4	1.11 ± .3	130 ± 50
Test Well DT-10	05/30		R1					.0053 ± .0143	.0266 ± .0166				
Test Well DT-10	12/21		1	400 ± 300	−.5 ± 6.1	−.01 ± .8	.43 ± .04	.001 ± .004	.056 ± .015	.047 ± .013	2 ± .6	9 ± 1	30 ± 40
Water Supply Wells:													
PM-1	06/12		1	0 ± 500	4.6 ± 10.8	−.14 ± .8	2.09 ± .21	.009 ± .015	−.017 ± .009	.052 ± .03	.5 ± .9	4.3 ± .5	100 ± 40
PM-2	06/12		1	0 ± 500	0 ± .9	.08 ± .12	.15 ± .04	−.009 ± .01	.013 ± .011	.028 ± .017	−.6 ± .6	2.4 ± .4	40 ± 40
PM-2	06/12		D1		−.1 ± .8		.14 ± .03						
PM-2	06/12	d	1	−200 ± 500	6.6 ± 18.2	.04 ± .08	.16 ± .04	−.013 ± .005	.024 ± .013	.029 ± .018	−1.4 ± .5	1.7 ± .3	70 ± 40
PM-3	06/12		1	−100 ± 500	−.1 ± .8	.67 ± 1	1 ± .12	−.005 ± .009	.023 ± .02	.064 ± .019	−.5 ± .9	3.9 ± .5	110 ± 40
PM-4	06/12		1	−100 ± 500	.5 ± 1.1	.31 ± .47	.4 ± .06	.013 ± .022	.052 ± .025	.109 ± .028	−.6 ± .6	3 ± .4	80 ± 40
PM-4	06/12		R1					.017 ± .006	.025 ± .006	.023 ± .009			
PM-5	06/12		1	0 ± 500	−.1 ± .8	.2 ± .3	.59 ± .1	−.02 ± .013	.012 ± .017	.067 ± .021	−1.3 ± .6	2.7 ± .4	120 ± 50
PM-5	06/12		R1								−.5 ± .6	2.7 ± .4	
G-1	06/12		1	−300 ± 500	.2 ± .8	.08 ± .12	.97 ± .1	.007 ± .009	.011 ± .011	.099 ± .031	−.6 ± .8	4.3 ± .5	80 ± 40
G-1A	06/12		1	100 ± 500	3.9 ± .7	−.01 ± .8	.49 ± .06	.008 ± .017	−.005 ± .011	.076 ± .027	−1.4 ± .7	2.9 ± .4	50 ± 40
G-1A	06/12		R1										50 ± 40
G-1A	06/12	d	1	0 ± 500	7.4 ± 3.5	.03 ± .04	.47 ± .05	−.005 ± .007	.028 ± .016	.096 ± .023	−.4 ± .6	2.8 ± .4	60 ± 40
G-2	06/12		1	300 ± 500	−.2 ± .8	−.04 ± .8	.86 ± .09	.009 ± .008	.025 ± .013	.077 ± .022	−.4 ± .8	2.7 ± .4	80 ± 40
G-6	06/12		1	−100 ± 500	1.1 ± 3.7	.2 ± .3	.54 ± .08	−.005 ± .002	.008 ± .009	.049 ± .017	−.4 ± .6	2 ± .4	30 ± 40

Table 5-16. Radiochemical Analyses of Groundwater for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]	^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Main Aquifer Springs												
White Rock Canyon Group I:												
Sandia Spring	09/11	1	300 ± 300	2.9 ± .9	.6 ± .3	7.62 ± .99	.026 ± .027	.01 ± .018	–.048 ± .187	15 ± 4	17 ± 2	90 ± 50
Spring 3	09/11	1	300 ± 300	–.1 ± 1	.58 ± .87	1.75 ± .18	.044 ± .018	.038 ± .017	.027 ± .02	1 ± .7	3.1 ± .6	50 ± 50
Spring 3AA	09/11	1	300 ± 300	1 ± 1	.01 ± .8	1.23 ± .13	.004 ± .011	–.003 ± .015	.069 ± .02	.9 ± .6	3 ± .6	60 ± 50
Spring 4A	09/11	1	300 ± 300	.7 ± .9	.79 ± 1.19	1.02 ± .13	–.026 ± .01	.011 ± .016	.044 ± .017	–4 ± .6	3 ± .4	50 ± 50
Spring 4A	09/11	D1			–1.1 ± .8							
Spring 4A	09/11	R1								.3 ± .6	2 ± .5	
Spring 4A	09/11 d	1	0 ± 300	0 ± .9	–.04 ± .8	.96 ± .1	.005 ± .008	.02 ± .013	.014 ± .014	0 ± .5	2 ± .3	60 ± 50
Spring 5	09/12	1	0 ± 300	.5 ± .7	2.18 ± .73	2.44 ± .24	.022 ± .016	.004 ± .013	.071 ± .02	3 ± 1	8 ± .9	60 ± 50
Ancho Spring	09/12	1	–100 ± 300	.1 ± .9	–.3 ± .8	.5 ± .05	–.015 ± .004	.014 ± .018	.015 ± .014	.1 ± .6	3 ± .5	10 ± 40
White Rock Canyon Group II:												
Spring 5B	09/12	1	–300 ± 300	.2 ± 1	–.16 ± .8	1.02 ± .1	–.004 ± .011	–.004 ± .01	.01 ± .013	1 ± .7	3 ± .5	60 ± 50
Spring 6A	09/12	1	100 ± 300	–.7 ± 1.1	–.42 ± .8	.31 ± .05	–.004 ± .013	–.002 ± .009	.031 ± .013	–.4 ± .4	2 ± .3	20 ± 40
Spring 7	09/12	1	300 ± 300	0 ± .9	.22 ± .33	.58 ± .08	–.006 ± .003	.01 ± .011	.074 ± .022	–.2 ± .5	3 ± .5	80 ± 50
Spring 8B	09/12	1	800 ± 300	.1 ± .8	.39 ± .21	.12 ± .01	–.01 ± .014	.002 ± .013	.024 ± .017	–.2 ± .5	2 ± .5	40 ± 50
Spring 8B	09/12	D1				.11 ± .02						
Spring 9	09/12	1	100 ± 300	0 ± .8	.3 ± .45	1.1 ± .11	–.006 ± .015	.002 ± .014	.02 ± .016	1 ± .6	2 ± .5	50 ± 50
Spring 9	09/12	R1					.026 ± .015	.02 ± .013				0 ± 40
Spring 9B	09/12	1	300 ± 300	5.1 ± .7	.09 ± .14	.49 ± .06	.016 ± .009	.017 ± .01	.041 ± .015	–.1 ± .5	2 ± .3	100 ± 50
White Rock Canyon Blanks:												
Trip Blank	09/13	1	200 ± 300	.4 ± .8	–.08 ± .8	0 ± .01	–.006 ± .008	0 ± .008	.024 ± .015	0 ± .2	6 ± .7	40 ± 50
Trip Blank	09/13	D1		.2 ± .9								
Trip Blank	09/13	1	–200 ± 300	.1 ± 1	1.78 ± 2.67	0 ± .01	–.011 ± .007	.028 ± .016		–.2 ± .3	–.2 ± .2	90 ± 50
White Rock Canyon Group III:												
Spring 1	06/05	1	–100 ± 300	–.1 ± .9	<.47	2.33 ± .23	–.012 ± .008	.012 ± .012	.024 ± .016	.2 ± .6	2 ± .4	50 ± 40
Spring 2	06/05	1	0 ± 300	.1 ± .8	<.61	2.8 ± .36	–.01 ± .009	.003 ± .006	.013 ± .02	1.2 ± .8	3.1 ± .5	100 ± 50
White Rock Canyon Group IV:												
La Mesita Spring	05/24	1	–100 ± 300	.5 ± .9	<.78	12.41 ± 1.2	.006 ± .011	.007 ± .007	.022 ± .013	17 ± 3.7	8 ± .8	70 ± 50

Table 5-16. Radiochemical Analyses of Groundwater for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]		^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Other Springs:													
Sacred Spring	05/24		1	3,800 ± 600	0 ± 1	<.86	1.2 ± .12	–.003 ± .009	.01 ± .012	.057 ± .017	1 ± .8	2.6 ± .4	20 ± 50
Indian Spring	05/25		1	–100 ± 300	2.1 ± 1.1	<.48	2.2 ± .33	–.01 ± .007	.002 ± .008	.035 ± .017	2.2 ± 1	3.3 ± .4	60 ± 50
Alluvial Canyon Groundwater Systems													
Acid/Pueblo Canyons:													
APCO-1	06/23	uf	1	–200 ± 300	3.2 ± 2.7	6.6 ± 9.9	.39 ± .05	.02 ± .011	.105 ± .021	14 ± 21[e]	2 ± 1	17 ± 1	180 ± 50
APCO-1	06/23	uf	2							.076 ± .02			
APCO-1	06/23	uf	R1	1,200 ± 400									
Cañada del Buey:													
CDBO-6	08/14		1	200 ± 300	1.1 ± 1.1	–.37 ± .8	2.29 ± .23	.002 ± .008	.003 ± .012	.026 ± .042	3 ± 1	7 ± .8	–20 ± 50
CDBO-7	08/14		1	500 ± 300	.3 ± 1.3	–.23 ± .8	3.13 ± .31	–.027 ± .009	.014 ± .018	.019 ± .037	12 ± 2	21 ± 2	40 ± 50
DP/Los Alamos Canyons:													
LAO-C	06/21		1	300 ± 300	1.2 ± 1.2	–.02 ± .09	.08 ± .02	–.005 ± .006	.011 ± .014	.056 ± .019	.4 ± .1	3.5 ± .5	40 ± 40
LAO-C	06/21		D1				.09 ± .01						
LAO-0.7	06/21		1	0 ± 300	–.4 ± 1.1	.51 ± .77	15.42 ± 1.5	.152 ± .03	.904 ± .082	.1 ± .05	74.1 ± 12	53.5 ± 5.5	80 ± 40
LAO-1	06/21		1	–200 ± 300	6 ± .9	–.26 ± .09	.23 ± .03	.007 ± .011	.004 ± .014	.054 ± .018	2.1 ± .9	14.5 ± 1.2	70 ± 40
LAO-1	06/21		R1					.012 ± .006	.044 ± .009	.094 ± .026			
LAO-2	06/21		1	0 ± 300	24.7 ± 1.7	1.56 ± 2.3	.15 ± .02	.043 ± .017	.054 ± .018	.056 ± .02	–1.2 ± 1.2	53.5 ± 5.5	50 ± 40
LAO-2	06/21		R1										40 ± 40
LAO-3	06/23	uf	1	0 ± 300	27.1 ± 4.8	14 ± 21	.16 ± .02	.009 ± .01	.025 ± .014	–26 ± 39[e]	0 ± 2	88 ± 9	130 ± 50
LAO-3	06/23	uf	2							.012 ± .01			
LAO-4.	12/21			400 ± 300	–.5 ± 6.1	–.01 ± .8	.43 ± .04	.001 ± .004	.056 ± .015	.047 ± .013	2 ± .6	9 ± 1	30 ± 40
LAO-4.5	06/29	uf	1	100 ± 300	1.4 ± 1.3	1.3 ± 1.8	.17 ± .02	.006 ± .014	.058 ± .019	–28 ± 45[e]	.2 ± 1	8 ± .9	40 ± 40
LAO-4.5	06/29	uf	2							.041 ± .012			
LAO-4.5	06/29	uf	R1					–.0047 ± .0037	–.0039 ± .0045				
Mortandad Canyon:													
MCO-4B	06/27	uf	1	16,700 ± 1,200	42.4 ± 2.8	1.4 ± 2.2	1.59 ± .16	.022 ± .018	.075 ± .023	66 ± 21[e]	12 ± 6	156 ± 11	210 ± 50
MCO-4B	06/27	uf	1							.38 ± .09			
MCO-5	08/01		1	17,100 ± 1,300	29.6 ± 1.9	–.4 ± .8	1.44 ± .14	.065 ± .023	.118 ± .029	.432 ± .056	11 ± 4	123 ± 11	210 ± 50
MCO-6	06/27	ufd	1	20,200 ± 1,400	31.5 ± 1.9	–2.6 ± 18	1.83 ± .18	.042 ± .016	.026 ± .016	–30 ± 40[e]	6 ± 5	123 ± 11	120 ± 50
MCO-6	06/27	ufd	2							.23 ± .037			
MCO-6	06/27	uf	1	19,500 ± 1,300	23.3 ± 1.4	–3.2 ± 4.8	1.84 ± .18	.044 ± .016	.031 ± .017	–26 ± 39[e]	12 ± 5	123 ± 11	130 ± 50

Table 5-16. Radiochemical Analyses of Groundwater for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]	^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Mortandad Canyon (Cont.):												
MCO-6	06/27	uf 1							.303 ± .04			
MCO-7	08/10	uf 1	19,200 ± 1,300	.9 ± .9	.55 ± .83	2.4 ± .24	.019 ± .011	.026 ± .014	.208 ± .034	9 ± 4	58 ± 6	−60 ± 50
MCO-7	08/10	uf R1	19,300 ± 600									
MCO-7.5	08/01	1	19,800 ± 1,400	.1 ± .8	.84 ± 1.26	1.48 ± .15	.008 ± .01	.023 ± .016	.226 ± .036	9 ± 2	41 ± 4	140 ± 50
Pajarito Canyon:												
PCO-1	05/20	1	−200 ± 300	.2 ± .7	<.71	.08 ± .01	−.012 ± .004	.01 ± .009	.063 ± .019	−1.4 ± .6	4.5 ± .5	60 ± 40
PCO-2	05/20	1	−100 ± 300	.4 ± .7	<1.09	.1 ± .01	−.003 ± .001	.016 ± .01	.038 ± .02	0 ± .8	11.1 ± 1	40 ± 40
PCO-3	05/20	1	−100 ± 300	.7 ± .7	<.91	.45 ± .05	.002 ± .008	.025 ± .013	.06 ± .024	−2.4 ± 2	2.7 ± .5	40 ± 40
Intermediate Perched Groundwater Systems												
Pueblo/Los Alamos Area Perched System in Conglomerates and Basalt:												
Test Well 1A	06/19	1	500 ± 400	.6 ± .8	<.47	.36 ± .05	.008 ± .014	.024 ± .016	.062 ± .019	−2.5 ± 1.2	8 ± .9	150 ± 50
Test Well 2A	08/01	1	2,100 ± 400	−.1 ± 2.1	.4 ± .6	.56 ± .07	.004 ± .017	.036 ± .021	.065 ± .02	−2 ± 1	3 ± .5	−30 ± 50
Basalt Spring	05/25	1	600 ± 300	.5 ± .8	1.21 ± .52	.72 ± .07	−.002 ± .006	.037 ± .017	−.004 ± .009	−1 ± .7	7.9 ± .8	50 ± 50
Basalt Spring	05/25	R1	800 ± 400									
Perched Groundwater System in Volcanics:												
Water Canyon Gallery	07/27	1	0 ± 300	.1 ± .7	.22 ± .33	.1 ± .01	.007 ± .013	.022 ± .014	.003 ± .014	1 ± .5	5 ± .7	30 ± 40
Detection Limits			2,000	3	4	0.1	0.04	0.04	0.04	3	3	
Water Quality Standards[f]												
DOE DCG for Public Dose			2,000,000	1,000	3,000	800	40	30	30	30	1,000	
DOE Drinking Water System DCG			80,000	40	120	30	1.6	1.2	1.2	1.2	40	
EPA Primary Drinking Water Standard			20,000	8		20				15		
EPA Screening Level											50	
NMWQCC Groundwater Limit						5,000						

[a]Except where noted.

[b]Codes: uf—unfiltered; f—filtered; d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.

[c]Radioactivity counting uncertainties (1 standard deviation, except ^{3}H—3 standard deviations) follow the ± sign. Radioactivity counting uncertainties are less than analytical method uncertainties. Values less than two standard deviations are considered a nondetection.

[d]Less than symbol (<) means measurement was below the specified detection limit for the analytical method.

[e]Result from ^{241}Am G method (direct counting GeLi detector). Other ^{241}Am measurements by the RAS (radiochemistry alpha spectroscopy) method.

[f]Standards given here for comparison only; see Appendix A.

Table 5-17. Chemical Quality of Groundwater for 1995 (mg/L[a])

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Main Aquifer																				
Test Wells:																				
Test Well 1	06/19	1	48	40	8	2.8	15	31	21	<5[f]	106	.39	.03	12.9	<.01	294	<1	132	8.26	346
Test Well 1	06/19	R1	48	40	8.1	2.9	15			<5	99							130		
Test Well 2	08/01	1	22	9.1	2.6	2.1	21	2.7	2.9	<5	72	.39	.1	<.04	<.01	1876	7	33	8.03	137
Test Well 3	07/18	1		12	3.5	1.9	10						.02	<.04	<.01					
Test Well 4	07/19	1	38	9.3	4.9	2.3	8.6	2.6	2.7	<5	72	.21	.09	.36	<.01	120	1	43	8.08	143
Test Well 4	07/19	R1										.21								
Test Well 8	07/17	1	67	12	4.3	1.5	10	2.5	2.9	<5	69	.17	<.02	.25	<.01	148	<1	47	8.03	136
Test Well 8	07/17	R1		12	4.3	1.4	10											47		
Test Well DT-5A																				
	11/13	uf 1	79	8.1	2.4	<2	9.9	3	3	<5	54	.23	.05	.42	<.01	18	<1	29	7.91	112
Test Well DT-5A																				
	11/13	uf R1		8.1	2.4	1.4	9.9											29		
Test Well DT-5A																				
	11/13	f 1	78	8.7	2.6	1.6	11	3	3	<5	52	.24	<.02	.4	<.01	8	<1	32	7.89	112
Test Well DT-5A																				
	11/13	f R1									50									
Test Well DT-9																				
	05/31	1	67.0	10	3.07	.88	9.77	1.43	1.41	0	54.8	.25	.016	.35	<.01	188.4	<1	37.6	7.27	119
Test Well DT-10																				
	12/21	1	42	12	4.3	5.2	29	26.8	8.3	<5	62	.72	.17	.44	<.01	152	199	47.3	8.04	234
Test Well DT-10																				
	12/21	R1		12	4.2	6.6	31							.48				46.9		
Water Supply Wells:																				
PM-1	06/12	1	87	26	6.4	3.6	17	6.2	5.8	<5	115	.25	<.02	1.4	<.01	206	<1	90	8.05	243
PM-2	06/12	1	98	10	3.4	3	12	2.9	3.5	<5	55	.26	<.02	.42	<.01	114	<1	39	8.02	119
PM-2	06/12	d 1	101	8	3.1	2.2	11	2.9	3.5	<5	53	.26	<.02	.49	<.01	112	<1	33	7.99	113
PM-2	07/14	1												.43		176	1			
PM-3	06/12	1	89	21	7.1	3	15	6.7	5.9	<5	107	.3	<.02	.59	<.01	190	<1	81	8.01	178
PM-3	06/12	R1	90																	
PM-3	07/14	1												.54		254	<1			
PM-4	06/12	1	91	11	4.1	3.1	14	3.1	3.7	<5	66	.28	<.02	.49	<.01	132	<1	44	7.94	138
PM-5	06/12	1	93	11	4.5	2	12	3.6	3.9	<5	67	.26	.02	.4	<.01	146	2	46	8.02	144

Table 5-17. Chemical Quality of Groundwater for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Water Supply Wells (Cont.):																				
G-1	06/12	1	86	11	.51	2.2	22	3.9	5.4	<5	82	.83	<.02	9.9	<.01	180	<1	29	8.29	423
G-1A	06/12	1	76	9	.44	2.7	26	3.9	5.2	<5	78	.61	<.02	1	<.01	166	<1	24	8.28	175
G-1A	06/12	d 1	74	11	.49	3	28	3.9	5.2	<5	82	.61	<.02	1	<.01	218	<1	29	8.22	170
G-1A	07/14	1												.48		294	<1			
G-2	06/12	1	76	10	.53	2.9	31	3.5	5	<5	96	.81	<.02	3.1	<.01	164	<1	27	8.24	190
G-6	06/12	1	56	12	2	1.9	13	3.1	4.3	<5	73	.29	<.02	.49	<.01	90	<1	38	7.92	146
G-6	06/12	R1	56							<5	71	.29								
G-6	07/14	1												.54		162	<1			
Main Aquifer Springs																				
White Rock Canyon Group I:																				
Sandia Spring	09/11	1	46	51	16	6.4	8.4	5.82	8.55	<5	118	.51	5.1	<.04	<.01	226	<1	192.2	7.7	234
Sandia Spring	09/11	R1										.52								
Spring 3	09/11	1	50	22	2.1	3.6	16	6.21	7.73	<5	89	.43	<.02	1.23	<.01	210	<1	63	7.7	191
Spring 3AA	09/11	1	52	21	2	3.5	14	5.88	7.65	<5	77	.41	<.02	.71	<.01	180	<1	60	7.43	178
Spring 4A	09/11	1	69	19	4.5	2.5	12	6.72	7.96	<5	72	.44	<.02	.9	<.01	222	<1	65	8.08	175
Spring 4A	09/11	d 1	69	17	4.1	2.1	10	6.77	7.98	<5	76	.43	<.02	.89	<.01	238	<1	59	8.49	179
Spring 5	09/12	1	69	17	4.4	2.5	11	6.49	7.58	<5	70	.39	<.02	.69	<.01	198	<1	60	8.25	169
Ancho Spring	09/12	1	76	12	3	2.5	9.5	5.04	5.94	<5	58	.33	.02	.44	<.01	178	<1	42	7.85	133
White Rock Canyon Group II:																				
Spring 5B	09/12	1	63	17	4.1	2.5	12	6.27	8.2	<5	71	.44	<.02	1.99	<.01	208	<1	59	7.49	184
Spring 6A	09/12	1	76	10	2.8	2.1	9.2	5	5.79	<5	53	.29	<.02	.12	<.01	162	<1	36	7.39	122
Spring 6A	09/12	R1										.29								
Spring 7	09/12	1	77	12	3.1	3.2	12	4.98	6.79	<5	58	.3	<.02	.44	<.01	208	<1	42	6.83	136
Spring 8B	09/12	1	85	12	2.9	2.4	11	4.94	5.66	<5	60	.48	<.02	.48	<.01	224	<1	42	7.75	137
Spring 9	09/12	1	74	11	3.1	2.3	10	4.98	5.75	<5	60	.42	<.02	.3	<.01	188	<1	40	7.72	126
Spring 9B	09/12	1	74	9.4	3	2	9.8	5.06	5.76	<5	44	.45	<.02	.17	<.01	190	<1	36	7.28	127
White Rock Canyon Blanks:																				
Trip Blank	09/13	1	<10	<.4	.17	<.6	.18	<.5	<1	<5	<5	<.1	<.02	<.04	<.01	36	<1	<1	6.19	3
Trip Blank	09/13	R1		<.4	<.04	<.6	<.1											<1		
Trip Blank	09/13	1	<10	<.4	<.045	.67	<.1	<.5	4.54	<5	6	<.1	<.02	.15	<.01	22	<1	<1	6.19	3
Trip Blank	09/13	R1	<10							<5	<5			.14						
White Rock Canyon Group III:																				
Spring 1	06/05	1	31.4	15.9	1.48	2.13	29.5	2.8	6.94	0	99.1	.57	<.02	.36	<.01	241	2.4	45.8	7.88	216
Spring 2	06/05	1	30.4	14.8	1.26	1.79	40.2	2.73	5.71	0	116	.55	<.02	.17	<.01	274.7	17.8	42.1	8.12	243

Table 5-17. Chemical Quality of Groundwater for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
White Rock Canyon Group IV:																				
La Mesita Spring																				
	05/24	1	36.6	34.4	1.52	3.03	25.8	7.1	15.1	0	123	.22	<.02	1.29	.01	375.5	26.2	92.2	7.77	312
Other Springs:																				
Sacred Spring	05/24	1	27.6	24.4	.57	2.4	21.8	1.55	5.41	0	109	.5	<.02	.02	.06	259.3	1.3	63.3	6.98	230
Indian Spring	05/25	1	45.6	31.9	2.81	2.27	25.2	28.7	7.17	0	103	.42	<.02	.78	<.01	344.9	2.3	91.2	7.71	315
Three Mile Spring																				
	08/18	1	35	11	3.9	3.2	10	6.3	5.1	<5	57	.15	.04	<.04		152		43.2	6.56	140
Three Mile Spring																				
	08/18	R1								<5	57									
Alluvial Canyon Groundwater Systems																				
Acid/Pueblo Canyons:																				
APCO-1	06/23	uf 1		18.9	<3.89	14.4	64.4		10.1			.62	2.21	1.07	<.01					
APCO-1	06/23	uf D1		20	4	15.6	66.7													
Cañada del Buey:																				
CDBO-6	08/14	1	57	17	6.5	8.4	23	10	7.7	<5	70	.14	.38	17	.05	178	3	68.8	6.92	160
CDBO-6	08/14	R1		15	8.4	12	23					.13						71.6		
CDBO-7	08/14	1	67	21	11	19	24	8.9	6.7	<5	75	.15	.57	3.67	.06	196	4	97.2	6.97	176
CDBO-7	08/14	1												.23						
CDBO-7	08/14	R1	67																	
CDBO-7	08/14	R1												.31						
DP/Los Alamos Canyons:																				
LAO-C	06/21	1	35	10	2.5	2.5	17	21.4	5.2	<5	39	.12	.05	.04	<.01	632	<1	35	7.52	151
LAO-0.7	06/21	1	34	35	8.3	12	32	33	6.4	<5	41	.28	3.29	<.04	<.01	606	286	120	7.24	194
LAO-1	06/21	1	36	9.1	2.2	2.7	27	30.8	5.9	<5	46	.3	.09	<.04	<.01	180	5	32	7.41	189
LAO-1	06/21	R1	36																	
LAO-2	06/21	1	59	17	4.5	4.8	28	29.4	8.3	<5	76	.7	.14	.1	<.01	242	4	60	7.73	246
LAO-2	06/21	R1										.69								
LAO-3	06/23	uf 1		16.7	<3.67	8	34.4		8.2			.91	<3.8	.06	<.01					
LAO-4	12/21		42	12	4.3	5.2	29	26.8	8.3	<5	62	.72	.17	.44	<.01	152	199	47.3	8.04	234
LAO-4	12/21			12	4.2	6.6	31							.48				46.9		
LAO-4.5	06/29	uf 1		13.3	<3.89	5.89	30		6.7			.92	.12	.07	<.01					

Table 5-17. Chemical Quality of Groundwater for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Mortandad Canyon:																				
MCO-4B	06/27	uf 1		26.7	<2.67	20	70		16.6			1.49	.08	13.1	<.01					
MCO-4B	06/27	uf D1		26.7	2.7	18.9	71.1													
MCO-5	08/01	1	30	23	2.7	22	70	18	16	<5	163	1.5	.18	9.1	<.01	406	<1	68	7.27	496
MCO-5	08/01	2																68		
MCO-6	06/27	ufd 1		23.3	<2.67	23.3	85.6		18.8			1.88	.12	16.3	<.01					
MCO-6	06/27	uf 1		22.2	<2.56	22.2	83.3		18.8			1.86	.14	18.1	<.01					
MCO-7	08/10	uf 1	41	16	5.6	20	85	15	19	<5	160	1.88	.52	13.6	<.01	434	7	62.6	7.3	430
MCO-7	08/10	uf R1												13.3						
Pajarito Canyon:																				
PCO-1	05/20	1	35	12	3.7	3.1	19	24.7	8.3	<5	54	.14	.03	3.42	<.01	164	<1	45	7.54	
PCO-2	05/20	1	29	16	4.5	2.7	21	27.9	6.8	<5	70	.16	.02	7.6	<.01	160	<1	70.5	7.54	
PCO-3	05/20	1	46	56	11	1.7	55	54.5	3.3	<5	233	.44	.16	17.4	<.01	296	<1	183.3	7.06	
PCO-3	05/20	R1									229									
Intermediate Perched Groundwater Systems																				
Pueblo/Los Alamos Canyon Perched System in Conglomerates and Basalt:																				
Test Well 1A	06/19	1	48	22	6.9	5.8	46	38	18	<5	126	.59	1.15	7.7	<.01	268	<1	54	8.18	389
Test Well 2A	08/01	1	57	37	6.8	2.7	19	45	21	<5	85	.2	.1	2.16	<.01	276	<1	120	7.6	346
Basalt Spring	05/25	1	52.6	12	3.11	6.41	26.6	27.6	8.74	0	53.1	.37	1.86	1.35	<.01	253.1	3.7	42.8	6.73	250
Perched Groundwater System in Volcanics:																				
Water Canyon Gallery	07/27	1	45	6.8	3.3	2.3	5.1	1.5	2.9	<5	67	<.1	.04	.29	<.01	68	2	30	7.78	85
Water Canyon Gallery	07/27	R1	46																	
Fenton Hill (TA-57):																				
FH-1	06/13	1	66.5	72.9	9.6	6.32	23.9	43.6	10.5	0	217	<.02	<.02	.29	<.01	677.6	<1	222	7.57	560

Table 5-17. Chemical Quality of Groundwater for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Water Quality Standards[g]																				
EPA Primary Drinking Water Standard									500			4		10	0.2					
EPA Secondary Drinking Water Standard								250	250							500			6.8–8.5	
EPA Health Advisory							20													
NMWQCC Groundwater Limit								250	600			1.6		10	0.2	1,000			6–9	

[a] Except where noted.
[b] Codes: uf—unfiltered; f—filtered; d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.
[c] Total dissolved solids.
[d] Total suspended solids.
[e] Standard units.
[f] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[g] Standards given here for comparison only; see Appendix A.

Table 5-18. Total Recoverable Trace Metals in Groundwater for 1995 (µg/L)

Station Name	Date	Codes[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Main Aquifer														
Test Wells:														
Test Well 1	06/19	1	<10[b]	<100	<2	60	70	<1	<3	<4	<4	<4	300	<.2
Test Well 1	06/19	R1	<10	<100	<2	60	71	<1	<3	<4	<4	<4	300	<.2
Test Well 2	08/01	1	<10	630	2	22	43	<3	<3	<4	12	<30	20,000	<.2
Test Well 3	07/18	1	<10	<100	3	36	29	<3	5	<4	7	10	10,000	<.2
Test Well 4	07/19	1	<10	100	<2	10	81	<1	<3	<4	15	64	9,200	<.2
Test Well 8	07/17	1	<10	<100	<3	17	6	<3	<.6	<4	<10	4	<100	<.2
Test Well 8	07/17	R1	<10	<100	<3	13	5	<3	<3	<4	7	<4	160	
Test Well DT-5A	11/13	uf 1	<10	<100	3	<20	22	<3	<4	<4	<4	<4	<100	<.2
Test Well DT-5A	11/13	uf R1	<10	<100	3	13	22	<3	<5	<4	<5	<4	<100	
Test Well DT-5A	11/13	f 1	<10	<100	3	16	25	<3	<4	<4	11	<4	<100	<.2
Test Well DT-9	05/31	1	<.5	60	4	<10	10	<2	<2	<2	<2	20	130	<.2
Test Well DT-10	12/21	1	<10	8,000	<2	30	61	<3	36	<4	6	11	2,900	<.2
Test Well DT-10	12/21	R1	<10	8,500	<2	<10	59	<3	6	<4	13	8	2,900	<.2
Water Supply Wells:														
PM-1	06/12	1	58	<100	<3	47	69	<3	<3	<4	<4	<4	<100	<.2
PM-2	06/12	1	48	<100	<3	<10	25	<3	<3	<4	6	6	<100	<.2
PM-2	06/12	d 1	<40	<100	<3	<10	23	<3	<3	<4	<20	12	<100	<.2
PM-3	06/12	1	<40	<100	<3	38	40	<3	<3	<4	6	4	<100	<.2
PM-4	06/12	1	49	<100	<3	<10	28	<3	<3	<4	8	<4	<100	<.2
PM-5	06/12	1	<40	<100	<3	<10	29	<3	<3	<4	8	<4	<100	<.2
G-1	06/12	1	<40	<100	13	38	51	<3	<3	<4	<4	<4	<100	<.2
G-1A	06/12	1	<40	<100	16	25	34	<3	<3	<4	<8	<4	<100	<.2
G-1A	06/12	d 1	53	<100	18	22	36	<3	<3	<4	<10	<4	<100	<.2
G-2	06/12	1	56	<100	48	35	63	<3	<4	<4	<10	<4	<100	<.2
G-6	06/12	1	<10	<100	3	<10	5	<3	<3	<4	<8	6	<100	<.2

Table 5-18. Total Recoverable Trace Metals in Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Main Aquifer Springs														
White Rock Canyon Group I:														
Sandia Spring	09/11	1	<10	41,000	20	22	690	3	<3	19	13	250	18,000	<.2
Spring 3	09/11	1	<10	1,200	4	31	51	<3	<3	<7	6	<4	770	<.2
Spring 3AA	09/11	1	<10	510	4	22	56	<3	4	<7	7	6	760	<.2
Spring 4A	09/11	1	<10	<100	2	22	40	<3	3	<7	8	<4	<100	<.2
Spring 4A	09/11	d 1	<10	<100	2	15	37	<3	<3	<7	8	<4	<100	<.2
Spring 5	09/12	1	<10	<100	2	15	25	<3	5	<7	8	<4	<100	<.2
Ancho Spring	09/12	1	<10	820	2	<10	41	<3	<3	<7	7	<4	330	<.2
White Rock Canyon Group II:														
Spring 5B	09/12	1	<10	160	2	16	37	<3	4	<7	8	<4	180	<.2
Spring 6A	09/12	1	<10	370	2	18	28	<3	5	<7	5	<4	180	<.2
Spring 7	09/12	1	<10	330	2	12	30	<3	<3	<7	5	<4	190	<.2
Spring 8B	09/12	1	<10	300	3	<10	27	<3	5	<7	6	<4	150	<.2
Spring 9	09/12	1	<10	150	2	<10	21	<3	<3	<7	6	<4	<100	<.2
Spring 9B	09/12	1	<10	230	3	11	7	<3	<3	<7	8	<4	170	<.2
White Rock Canyon Blanks:														
Trip Blank	09/13	1	<10	210	<2	14	10	10	10	12	13	22	<100	<.2
Trip Blank	09/13	R1	<10	120	<2	<10	<4	<3	<3	<5	<4	<4	<100	
Trip Blank	09/13	1	<10	<100	<2	<10	<4	<3	<3	<7	4	<4	<100	<.2
White Rock Canyon Group III:														
Spring 1	06/05	1	<.5	580	4	40	30	<2	<2	<2	8	9	400	<.2
Spring 2	06/05	1	<.5	170	9	40	30	<2	<2	<2	<2	<2	80	<.2
White Rock Canyon Group IV:														
La Mesita Spring	05/24	1	.5	1,560	2	50	130	<2	<2	3	<2	8	1,820	<.2
Other Springs:														
Sacred Spring	05/24	1	<.5	190	5	40	110	2	17	3	3	<2	350	<.2
Indian Spring	05/25	1	<.5	100	3	30	90	13	<2	<2	<2	14	<10	<.2

Table 5-18. Total Recoverable Trace Metals in Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]		Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Alluvial Canyon Groundwater															
Acid/Pueblo Canyons:															
APCO-1	06/23	uf	1	<11.1	578	<9.3	278	<44.4	<3.3	<3.3	<4.4	<5.6	<4.4	300	<.2
APCO-1	06/23	uf	D1	<11.1	489	9.2	278	45.6	<3.3	<3.3	5.6	4.4	<4.4	267	
Cañada del Buey:															
CDBO-6	08/14		1	<10	36,000	11	90	400	3	<3	4	25	21	23,000	<.2
CDBO-6	08/14		R1	10	62,000	17	50	430	4	<3	6	38	24	37,000	
CDBO-7	08/14		1	<10	90,000	22	70	930	5	3	5	38	25	42,000	<.2
DP/Los Alamos Canyons:															
LAO-C	06/21		1	<10	2,900	<3	<30	44	<3	<3	<4	<4	<10	1,500	<.2
LAO-0.7	06/21		1	<10	70,000	13	31	2900	16	<3	32	30	51	36,000	.4
LAO-1	06/21		1	<10	5,200	<3	<30	35	<3	<4	<4	11	9	2,400	<.2
LAO-2	06/21		1	<10	370	<3	38	43	<3	<3	<4	<4	<10	210	<.2
LAO-3	06/23	uf	1	<11.1	356	<2.2	37.8	<51.1	<3.3	<3.3	<4.4	<4.4	<4.4	178	<.2
LAO-4	12/21			<10	8,000	<2	30	61	<3	36	<4	6	11	2,900	<0.2
LAO-4	12/21		R1	<10	8,500	<2	<10	59	<3	6	<4	13	8	2,900	<0.2
LAO-4.5	06/29	uf	1	<10	2,220	<2.2	30	<43.3	<3.3	<3.3	<4.4	<4.4	<4.4	1,110	<.2
Mortandad Canyon:															
MCO-4B	06/27	uf	1	<11.1	1,670	<2.2	46.7	<84.4	<3.3	<3.3	<4.4	<6.7	<4.4	800	<.2
MCO-4B	06/27	uf	D1	<11.1	1,444	<2.2	46.7	84.4	<3.3	<3.3	<4.4	<4.4	4.4	756	<.2
MCO-5	08/01		1	<10	380	6	54	78	<3	<4	<4	<4	<4	250	<.2
MCO-6	06/27	ufd	1	<11.1	389	<2.2	58.9	<84.4	<3.3	<3.3	<4.4	<4.4	<4.4	189	<.2
MCO-6	06/27	uf	1	<11.1	444	<2.2	58.9	<82.2	<3.3	<3.3	<4.4	<6.7	<4.4	200	<.2
MCO-7	08/10	uf	1	<10	13,000	7	80	240	1	<3	<4	9	19	6,700	<.2
MCO-7.5	08/01		1	11	1,000	<2	70	140	<3	<10	<10	<4	<4	550	<.2
Pajarito Canyon:															
PCO-1	05/20		1	<10	2,100	<2	30	80	<1	<3	<4	<4	<4	1,000	<.2
PCO-2	05/20		1	<10	500	<2	30	66	<1	<3	<4	<4	<4	300	<.2
PCO-3	05/20		1	<10	100	6	30	140	<1	<3	4	<4	<4	4,100	<.2

Table 5-18. Total Recoverable Trace Metals in Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Intermediate Perched Groundwater														
Pueblo/Los Alamos Canyon Perched Groundwater in Conglomerates and Basalt:														
Test Well 1A	06/19	1	<10	<100	3	190	67	<1	<3	<4	<4	8	1,700	<.2
Test Well 2A	08/01	1	<10	<100	2	75	58	<3	7	<4	<4	<4	18,000	<.2
Basalt Spring	05/25	1	<.5	510	4	80	50	<2	<2	<2	<2	17	300	<.2
Perched Groundwater in Volcanics:														
Water Canyon Gallery	07/27	1	<10	110	<2	<10	13	<3	<5	<4	<4	<4	<100	<.2
Fenton Hill (TA-57):														
FH-1	06/13	1	<.5	160	<2	700	160	<2	<2	<2	<2	7	120	<.2
Water Quality Standards[c]														
EPA Primary Drinking Water Standard					50		2,000	4	5		100			2
EPA Secondary Drinking Water Standard				50–200									300	
EPA Action Level												1,300		
NMWQCC Livestock Watering Standards				5,000	200	5,000			50	1,000	1,000	500		10
NMWQCC Groundwater Limit			50	5,000	100	750	1,000		10	50	50	1,000	1,000	2

[a]Codes: uf—unfiltered; f—filtered; d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.

[b]Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[c]Standards given here for comparison only, see Appendix A. Note that New Mexico Livestock and Groundwater limits (except for mercury) are based on dissolved concentrations, while many of these analyses are of unfiltered samples—thus concentrations may include suspended sediment quantities.

Table 5-18. Total Recoverable Trace Metals in Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]		Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Main Aquifer														
Test Wells:														
Test Well 1	06/19		1	21	<8[b]	<10	49	6	<1	<30	240	<2	<4	570
Test Well 1	06/19		R1	21	<8	<10	42	6	1	<30	240	<2	<4	620
Test Well 2	08/01		1	480	<8	<10	170	<2		<30	47	<2	<10	3,000
Test Well 3	07/18		1	75	<8	<10	24	<2	<2	<30	54	<1	<8	940
Test Well 4	07/19		1	100	<8	<10	150	<2	1	<30	54	<2	<4	4,600
Test Well 8	07/17		1	<3	<8	<10	4	<2	<2	<30	57	<1	<4	330
Test Well 8	07/17		R1	<3	<8	<10	4	<2	<2	<30	57	<1	<4	340
Test Well DT-5A	11/13	uf	1	<3	<8	<10	2	<2	<2	<33	46	<2	<4	230
Test Well DT-5A	11/13	uf	R1	<3	<8	<10	2	<2	<2	<70	46	<2	<4	220
Test Well DT-5A	11/13	f	1	<3	<8	<10	2	<2	<2	61	50	<2	<10	210
Test Well DT-9	05/31		1	<10	<2	<2	11	<2	<2	<5	50	<2	6	230
Test Well DT-10	12/21		1	150	34	110	3	<2	<1	70	91	<2	<4	30
Test Well DT-10	12/21		R1	38	42	130	2	<2	<1	<30	89	2	<4	70
Water Supply Wells:														
PM-1	06/12		1	<3	<8	<10	<2	<2	<2	<30	140	<2	10	<20
PM-2	06/12		1	<3	<10	<10	<2	<2	<2	<30	50	<2	12	<20
PM-2	06/12	d	1	<3	<8	<10	<2	<2	<2	<30	47	<2	11	<20
PM-3	06/12		1	<3	<8	<10	<2	<2	<2	<30	120	<2	16	<20
PM-4	06/12		1	<3	<8	<10	<2	<2	<2	<30	55	<2	10	46
PM-5	06/12		1	<3	<8	<10	<2	<2	<2	<30	56	<2	22	<20
G-1	06/12		1	<3	<8	<10	<2	<2	<2	<30	93	<2	39	<20
G-1A	06/12		1	<3	<8	<10	<2	<2	<2	<20	74	<2	45	<20
G-1A	06/12	d	1	<3	<8	<10	<2	<2	<2	<30	77	<2	60	34
G-2	06/12		1	<3	<20	<10	<2	<2	<2	<30	84	<2	91	<20
G-6	06/12		1	<3	<8	<10	<2	<2	<2	<30	66	<2	27	<20

Table 5-18. Total Recoverable Trace Metals in Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Main Aquifer Springs													
White Rock Canyon Group I:													
Sandia Spring	09/11	1	1,400	<8	22	57	<2	6	<30	530	<2	90	69
Spring 3	09/11	1	45	<8	<10	<2	<2	1	42	250	<2	14	22
Spring 3AA	09/11	1	100	12	<10	2	<2	<1	<30	240	<2	24	<20
Spring 4A	09/11	1	<20	<8	<10	<2	<2	<1	35	98	<2	11	20
Spring 4A	09/11	d 1	<20	<8	<10	<2	<2	<1	<30	89	<2	11	<20
Spring 5	09/12	1	<20	<8	<10	<2	<2	<1	37	85	<2	11	<20
Ancho Spring	09/12	1	44	<8	<10	2	<2	<1	59	61	<2	7	<20
White Rock Canyon Group II:													
Spring 5B	09/12	1	<20	<8	<10	<2	<2	<1	54	98	<2	11	<20
Spring 6A	09/12	1	<20	15	11	<2	<2	<1	<300	51	<2	11	<20
Spring 7	09/12	1	<20	<8	<10	<2	<2	<1	<30	65	<2	11	<20
Spring 8B	09/12	1	<20	16	<10	<2	<2	1	38	57	<2	7	<20
Spring 9	09/12	1	<20	<8	<10	<2	<2	<1	48	54	<2	7	<20
Spring 9B	09/12	1	<20	<8	<10	<2	<2	<1	<30	51	<2	<4	<20
White Rock Canyon Trip Blanks:													
Trip Blank	09/13	1	9	14	<10	<2	<2	<1	<30	9	<2	<4	<20
Trip Blank	09/13	R1	<3	<8	<10	<2	<2	<1	<30	<3	<2	<4	23
Trip Blank	09/13	1	<20	<8	<10	<2	<2	1	<30	<3	<2	<4	<20
White Rock Canyon Group III:													
Spring 1	06/05	1	20	<2	<2	<2	<2	<2	8	190	<2	20	<10
Spring 2	06/05	1	<10	<2	<2	<2	<2	<2	<5	180	<2	19	<10
White Rock Canyon Group IV:													
La Mesita Spring	05/24	1	20	3	<2	2	<2	<2	<5	810	<2	7	30
Other Springs:													
Sacred Spring	05/24	1	20	3	13	<2	<2	<2	<5	500	<2	13	<10
Indian Spring	05/25	1	<10	<2	<2	2	<2	<2	<5	360	<2	11	150

Table 5-18. Total Recoverable Trace Metals in Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Alluvial Canyon Groundwater Systems													
Acid/Pueblo Canyon:													
APCO-1	06/23	uf 1	678	<13.3	<11.1	<2.2	<2.2	<1.1	<33.3	111	<2.2	<17.8	<22.2
APCO-1	06/23	uf D1	689	22.2	<11.1	2.2	<2.2	<1.1	<33.3	111	<2.2	18.9	<22.2
Cañada del Buey:													
CDBO-6	08/14	1	490	<8	10	54	<2	1	30	130	<2	40	150
CDBO-6	08/14	R1	650	<8	20	55	<2	4	<30	130	<2	60	200
CDBO-7	08/14	1	1,100	<8	30	62	<2	4	50	190	<2	63	230
DP/Los Alamos Canyons:													
LAO-C	06/21	1	40	<8	<10	<2	<2	<1	<30	70	<2	<4	22
LAO-0.7	06/21	1	13,000	30	<90	77	<2	<1	<3	400	<2	58	270
LAO-1	06/21	1	15	56	<10	<2	<2	<1	<30	69	<2	<4	<20
LAO-2	06/21	1	<3	1,000	<10	<2	<2	<1	<30	120	<2	<4	81
LAO-3	06/23	uf 1	<3.3	622	<11.1	<2.2	<2.2	<1.1	<33.3	108	<2.2	<4.4	<22.2
LAO-4	12/21		150	34	110	3	<2	<1	70	91	<2	<4	30
LAO-4	12/21		38	42	130	2	<2	<1	<30	89	2	<4	70
LAO-4.5	06/29	uf 1	23.3	<11.1	<11.1	<4.4	<2.2	<1.3	<33.3	80	<2.2	<5.6	<22.2
Mortandad Canyon:													
MCO-4B	06/27	uf 1	20	156	<11.1	<2.2	<2.2	<1.1	<33.3	110	<2.2	<4.4	<22.2
MCO-4B	06/27	uf D1	18.9	167	<11.1	2.2	<2.2	<1.1	<33.3	110	<2.2	<4.4	<22.2
MCO-5	08/01	1	4	130	<10	<2	<2	2	<30	110	<2	<4	<20
MCO-6	06/27	ufd 1	<3.3	156	<11.1	<2.2	<2.2	<1.1	<33.3	110	<2.2	<4.4	<22.2
MCO-6	06/27	uf 1	<3.3	156	<11.1	<2.2	<2.2	<1.1	<33.3	108	<2.2	<4.4	<22.2
MCO-7	08/10	uf 1	150	150	10	10	<1	1	30	130	<1	16	40
MCO-7.5	08/01	1	16	40	<10	<2	3	1	<30	130	<2	<4	<20
Pajarito Canyon:													
PCO-1	05/20	1	11	<8	<10	<2	<2	<1	<30	98	<2	<4	<20
PCO-2	05/20	1	3	<8	<10	<2	2	<1	<30	120	<2	<4	<20
PCO-3	05/20	1	2,900	<8	<10	<2	2	1	<30	330	2	<4	20

Table 5-18. Total Recoverable Trace Metals in Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Intermediate Perched Groundwater Systems													
Pueblo/Los Alamos Canyon Area Perched System in Conglomerates and Basalt:													
Test Well 1A	06/19	1	130	9	<10	5	2	<1	<30	140	<2	<4	2,300
Test Well 2A	08/01	1	150	<8	<10	91	<2	<1	<30	210	<2	11	9,500
Basalt Spring	05/25	1	120	69	<15	2	<2	<2	<5	60	<2	7	<10
Perched Groundwater System in Volcanics:													
Water Canyon Gallery	07/27	1	<3	<8	<10	<30	<2	<1	<30	51	<2	11	<20
Fenton Hill (TA-57):													
FH-1	06/13	1	<10	<2	9	3	<2	<2	<5	260	<2	<2	2,580
Water Quality Standards[c]													
EPA Primary Drinking Water Standard					100		6	50			2		
EPA Secondary Drinking Water Standard			50										5,000
EPA Action Level						15							
EPA Health Advisory												80–110	
NMWQCC Livestock Watering Standards							100	50		25,000–90,000		100	25,000
NMWQCC Groundwater Limit			200	1,000	200	50		50					10,000

[a]Codes: uf—unfiltered; f—filtered; d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.

[b]Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[c]Standards given here for comparison only, see Appendix A. Note that New Mexico Livestock and Groundwater limits are based on dissolved concentrations, while many of these analyses are of unfiltered samples—thus concentrations may include suspended sediment quantities.

Table 5-19. Number of Results Above the Analytical Limit of Quantitation for Organic Compounds in Groundwater for 1995

Station	Date	Type of Organic Compound			
		Volatile	Semivolatile	PCB	HE[a]
Number of Compounds Analyzed		59	69	4	14
Ancho Spring	09/12	0	0	0	5
Spring 9	09/12	0	0	0	1
Spring 9B	09/12	0	0	0	0
Sacred Spring	05/24	0	0	0	
APCO-1	03/29	0	0	0	
APCO-1	06/23	0	0	0	
APCO-1	08/07	0	0	0	
APCO-1	12/14	0	0	0	
LAO-3	03/29	0	0	0	
LAO-3	06/23	0	0	0	
LAO-3	08/07	0	0	0	
LAO-3	08/07	0	0	0	
LAO-3	12/14	0	0	0	
MCO-4B	03/31	0	0	0	
MCO-4B	06/27	0	0	0	
MCO-4B	08/09	0	0	0	
MCO-4B	12/18	0	0	0	
MCO-6	03/31	0	0	0	
MCO-6	06/27	0	0	0	
MCO-6	08/09	0	0	0	
MCO-6	12/19	0	0	0	
MCO-7	03/30	0	1	0	
MCO-7	06/28	0	0	0	
PCO-3	05/20	0	0	0	
Basalt Spring	07/21	2	0	0	

[a]High explosive.

Table 5-20. Results Above the Analytical Limit of Quantitation for Organic Compounds in Groundwater for 1995 (µg/L)

Station	Date	Analyte	Sample Value	Uncertainty	Limit of Quantitation	Analyte Suite[a]	Symbol[b]	CST-12 Comments on Analytical Results
Ancho Spring	09/12	Dinitrotoluene [2,4-]	.18	.054		HE		
Ancho Spring	09/12	HMX	4.9	1.47		HE		
Ancho Spring	09/12	RDX	23	6.9		HE		
Ancho Spring	09/12	Tetryl(methyl-2,4,6-trinitrophenylnitramine)	.61	.183		HE		
Ancho Spring	09/12	Trinitrotoluene [2,4,6-]	4.8	1.44		HE		found in method blank
Spring 9	09/12	Trinitrotoluene [2,4,6-]	.2	.06		HE		found in method blank
MCO-7	03/30	Pentachlorophenol	11	3.3	50	svoa		found in method blank
Basalt Spring	07/21	Chloroethane	21	6.3	10	voa		
Basalt Spring	07/21	Oxygenated Hydrocarbon	48				TI	
Basalt Spring	07/21	Oxygenated Hydrocarbon	19				TI	
Basalt Spring	07/21	Toluene	37			voa	TI	possible analytical artifact
Basalt Spring	07/21	Unknown alkanes	73				TI	
Basalt Spring	07/21	Unknown alkanes	39				TI	
Basalt Spring	07/21	Unknown organic compound	120				TI	
Basalt Spring	07/21	Unknown organic compound	18				TI	
Basalt Spring	07/21	Unknown organic compound	24				TI	
Basalt Spring	07/21	Unknown organic compound	33				TI	
Basalt Spring	07/21	Unknown organic compound	150				TI	
Basalt Spring	07/21	Unknown organic compound	17				TI	
Basalt Spring	07/21	Unknown organic compound	54				TI	
Basalt Spring	07/21	Unknown organic compound	150				TI	
Basalt Spring	07/21	Unknown organic compound	37				TI	
Basalt Spring	07/21	Unknown organic compound	110				TI	
Basalt Spring	07/21	Unknown organic compound	190				TI	
Basalt Spring	07/21	Unknown organic compound	16				TI	
Basalt Spring	07/21	Unknown organic compound	28				TI	
Basalt Spring	07/21	Unknown organic compound	36				TI	
Basalt Spring	07/21	Unknown organic compound	22				TI	

[a]HE—high explosives; voa—volatile organics; svoa—semivolatile organics.
[b]TI—tentatively identified compound.

Table 5-21. Radiochemical Analysis of Sediments in 1995

Station Name	Date	Code[a]	^{3}H (nCi/L)	^{90}Sr (pCi/g)	^{137}Cs (pCi/g)	Total U (mg/kg)	^{238}Pu (pCi/g)	$^{239,240}Pu$ (pCi/g)	^{241}Am (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Gross Gamma (pCi/g)
Regional Stations												
Chamita	03/23	1[b]	.0 (0.4)[c]	10.8 (0.7)[d]	.05 (.02)	.61 (.10)	.004 (.001)	.002 (.001)	.003 (.001)	0.8 (0.2)	.5 (0.1)	1.4 (0.2)
Chamita	03/23	R	.3 (0.3)									
Embudo	03/23	1	.0 (0.3)	.1 (0.2)	.05 (.02)	1.39 (.26)	.001 (.001)	.002 (.001)	.003 (.003)	1.9 (0.5)	1.6 (0.2)	1.8 (0.3)
Embudo	03/23	R							.001 (.001)			
Rio Grande at Otowi (bank)	03/23	1	.2 .(0.4)	.0 (0.2)	.03 (.02)	1.57 (.28)	.009 (.002)	.024 (.003)	.004 (.001)	1.3 (0.3)	1.4 (0.2)	1.7 (0.2)
Rio Grande at Otowi (bank)	09/15	1	.0 (0.3)	.2 (0.2)	.07 (.02)		.002 (.001)	.003 (.001)		3.0 (0.6)	1.4 (0.2)	3.0 (0.3)
Rio Grande at Otowi (wdth intgrt)	09/15	1	.2 (0.4)	.0 (0.2)	.01 (.02)		.005 (.001)	.002 (.001)		2.0 (0.4)	.8 (0.2)	3.1 (0.4)
Rio Grande at Frijoles (bank)	09/13	1	–.1 (0.3)		.03 (.01)	1.11 (.11)	.002 (.001)	.004 (.001)	.001 (.001)	1.0 (0.2)	.5 (0.1)	2.0 (0.3)
Rio Grande at Frijoles (wdth intgrt)	09/13	1	.1 (0.4)		.04 (.01)	1.03 (.10)	.003 (.002)	.002 (.001)	.002 (.001)	1.0 (0.2)	.3 (0.1)	2.3 (0.3)
Rio Grande at Frijoles (wdth intgrt)	09/13	R	–.1 (0.3)		.02 (.01)	1.20 (.12)			.003 (.001)	2.0 (0.4)	1.0 (0.2)	2.9 (0.3)
Rio Grande at Cochiti Spillway	03/23	1	.2 (0.3)	.3 (0.2)	.08 (.03)	1.81 (.25)	.007 (.001)	.008 (.001)	.001 (.001)	2.0 (0.5)	2.3 (0.3)	2.2 (0.3)
Rio Grande at Bernalillo	03/23	1	.2 (0.3)	.2 (0.2)	.05 (.02)	1.28 (.23)	.002 (.001)	.004 (.002)	.002 (.001)	1.7 (0.5)	1.7 (0.2)	1.7 (0.2)
Jemez River	03/23	1	.2 (0.3)	.2 (0.2)	.05 (.03)	1.18 (.22)	.001 (.001)	.002 (.001)	.002 (.001)	1.4 (0.5)	1.7 (0.2)	3.0 (0.3)
Guaje Canyon:												
Guaje at SR-502	03/21	1		.2 (0.2)	.04 (.02)	1.69 (.44)	.012 (.001)	.002 (.001)	.002 (.001)	1.7 (0.4)	1.4 (0.2)	2.2 (0.3)
Bayo Canyon:												
Bayo at SR-502	03/21	1		–.1 (0.3)	<.04[e]	1.30 (.13)	.010 (.002)	.002 (.001)	.002 (.001)	1.0 (0.3)	1.0 (0.2)	2.6 (0.3)
Acid/Pueblo Canyons:												
Acid Weir	05/02	1	–.1 (0.3)	.2 (0.2)	.20 (.04)	1.46 (.15)	.046 (.005)	7.320 (.274)	.252 (.014)	14.0 (2.0)	2.0 (0.3)	2.1 (0.3)
Acid Weir	05/02	R					.023 (.007)	6.521 (.165)				
Pueblo 1	05/02	1	–.4 (0.3)	.1 (0.2)	.02 (.02)	.77 (.08)	.000 (.002)	.005 (.002)	.005 (.002)	2.0 (0.5)	4.0 (0.5)	1.9 (0.2)
Pueblo 1	05/02	R					.036 (.009)	.051 (.008)				
Pueblo 2	05/02	1		.1 (0.2)	.04 (.01)	1.72 (.17)	.011 (.003)	3.317 (.128)	.053 (.005)	3.0 (0.6)	.3 (0.1)	2.3 (0.3)
Pueblo 2	05/02	R					.015 (.006)	1.148 (.039)	.025 (.003)			
Hamilton Bend Spring	05/02	1		.4 (0.2)	.01 (.02)	1.70 (.17)	.018 (.003)	.814 (.033)	.030 (.003)	3.0 (0.6)	.8 (0.2)	2.1 (0.3)
Hamilton Bend Spring	05/02	R					.004 (.001)	.566 (.019)	.024 (.003)			
Pueblo 3	05/03	1	–.1 (0.3)	.0 (0.2)	.06 (.02)	3.25 (.33)	.018 (.002)	.607 (.017)	.026 (.003)	3.0 (0.7)	1.0 (0.2)	3.9 (0.4)
Pueblo 3	05/03	R					.020 (.002)	.671 (.021)	.025 (.003)			
Pueblo at SR-502	05/02	1		.1 (0.2)	.03 (.01)	1.64 (.16)	.009 (.004)	1.057 (.053)	.030 (.003)	2.0 (0.5)	.8 (0.2)	2.4 (0.3)
Pueblo at SR-502	05/02	R					.012 (.002)	.407 (.017)	.016 (.002)			
DP/Los Alamos Canyons:												
Los Alamos at Bridge	05/02	1	–.2 (0.3)	.2 (0.2)	.02 (.03)	1.69 (.17)	.005 (.001)	.006 (.001)	.002 (.001)	2.0 (0.4)	.8 (0.2)	2.0 (0.3)
Los Alamos at LAO-1	05/02	1	–.1 (0.3)	.1 (0.2)	.29 (.05)	2.85 (.29)	.008 (.003)	1.277 (.057)	.019 (.002)	5.0 (0.9)	2.0 (0.3)	3.1 (0.4)
Los Alamos at LAO-1	05/02	R					.007 (.002)	.917 (.037)	.016 (.002)			
Los Alamos at GS-1	05/03	1	.0 (0.3)	.2 (0.2)	1.32 (.14)	1.89 (.19)	.041 (.005)	.222 (.013)	.222 (.010)	2.0 (0.5)	2.0 (0.3)	3.4 (0.4)

Table 5-21. Radiochemical Analysis of Sediments in 1995 (Cont.)

Station Name	Date	Code[a]	^{3}H (nCi/L)	^{90}Sr (pCi/g)	^{137}Cs (pCi/g)	Total U (mg/kg)	^{238}Pu (pCi/g)	$^{239,240}Pu$ (pCi/g)	^{241}Am (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Gross Gamma (pCi/g)
DP/Los Alamos Canyons (Cont.):												
Los Alamos at GS-1	05/03	R					.020 (.002)	.147 (.007)	.137 (.007)			
DPS-1	07/13	1		.3 (0.2)	.11 (.02)	1.06 (.11)	.007 (.001)	.009 (.001)	.009 (.002)	1.0 (0.2)	1.0 (0.2)	2.2 (0.3)
DPS-1	07/13	R					.005 (.001)	.008 (.002)	.017 (.002)			
DPS-4	05/03	1	.0 (0.3)	.8 (0.2)	2.06 (.21)	1.60 (.16)	.038 (.005)	.149 (.011)	.244 (.011)	3.0 (0.6)	6.0 (0.7)	3.8 (0.4)
DPS-4	05/03	R					.050 (.010)	.166 (.008)	.219 (.009)			
Los Alamos at LAO-3	05/03	1	–.2 (0.3)	.3 (0.2)	.34 (.05)	2.66 (.27)	.061 (.012)	.433 (.023)	.061 (.004)	3.0 (0.7)	2.0 (0.2)	3.3 (0.4)
Los Alamos at LAO-3	05/03	R					.022 (.008)	.133 (.023)	.062 (.004)			
Los Alamos at LAO-4.5	05/02	1	.2 (0.3)	.6 (0.2)	1.01 (.11)	1.90 (.19)	.023 (.002)	.164 (.007)	.136 (.008)	2.0 (0.5)	2.0 (0.2)	2.9 (0.3)
Los Alamos at LAO-4.5	05/02	R					.018 (.002)	.126 (.006)	.118 (.006)			
Los Alamos at SR-4	05/03	1	.0 (0.3)	.2 (0.6)	1.45 (.15)	1.47 (.15)	.064 (.008)	.364 (.021)	.282 (.011)	3.0 (0.6)	3.0 (0.3)	4.1 (0.4)
Los Alamos at SR-4	05/03	R					.037 (.005)	.180 (.012)	.191 (.008)			
Los Alamos at Totavi	05/04	1	–.1 (0.3)	.1 (0.2)	.12 (.02)	2.64 (.26)	.002 (.001)	.103 (.005)	.073 (.012)	2.0 (0.4)	1.0 (0.2)	2.8 (0.3)
Los Alamos at Totavi	05/04	R					.003 (.001)	.120 (.006)	.016 (.003)			
Los Alamos at LA-2	05/04	1	–.3 (0.3)	.0 (0.2)	.08 (.02)	1.54 (.15)	.006 (.002)	.125 (.010)	.011 (.002)	2.0 (0.5)	1.0 (0.2)	1.7 (0.2)
Los Alamos at LA-2	05/04	R					.002 (.001)	.099 (.006)				
Los Alamos at Otowi	05/04	1	–.1 (0.3)	.4 (0.4)	–.01 (.09)	1.93 (.19)	.005 (.002)	.204 (.011)	.016 (.002)	2.0 (0.5)	.5 (0.1)	2.0 (0.3)
Los Alamos at Otowi	05/04	R					.002 (.001)	.138 (.007)	.012 (.002)			
Sandia Canyon:												
Sandia at SR-4	03/21	1	.0 (0.3)	.0 (0.2)	<.02	1.25 (.13)	.001 (.001)	.004 (.001)	.002 (.001)	2.0 (0.4)	1.3 (0.2)	2.6 (0.3)
Sandia at Rio Grande	09/11	1	–.3 (0.3)		.08 (.03)	1.85 (.19)	.013 (.002)	.002 (.001)	.002 (.002)	3.0 (0.6)	2.0 (0.2)	2.7 (0.3)
Mortandad Canyon:												
Mortandad near CMR Building	05/04	1	.3 (0.3)	.2 (0.2)	.03 (.04)	1.45 (.15)	.009 (.003)	.004 (.002)	.001 (.001)	2.0 (0.5)	1.0 (0.2)	2.5 (0.3)
Mortandad near CMR Building	05/04	R					.020 (.010)	.010 (.010)	.004 (.001)			
Mortandad west of GS-1	05/22	1	–.3 (0.3)	.1 (0.2)	.07 (.02)	.95 (.10)	.029 (.003)	.024 (.002)	.019 (.003)	2.0 (0.5)	1.0 (0.2)	1.9 (0.3)
Mortandad west of GS-1	05/22	R					.020 (.002)	.029 (.003)	.008 (.001)			
Mortandad at GS-1	05/22	1	11.5 (1.0)	.3 (0.3)	25.70 (1.9)	1.33 (.13)	6.177 (.131)	6.903 (.146)	11.700 (.500)	52.0 (11.0)	30.0 (3.0)	24.0 (2.0)
Mortandad at GS-1	05/22	R					7.667 (.220)	8.510 (.244)	15.000 (2.00)			
Mortandad at MCO-5	05/04	1	3.7 (0.4)	1.3 (0.7)	12.80 (1.0)	1.25 (.13)	2.410 (.095)	7.525 (.281)	6.200 (.300)	32.0 (6.0)	21.0 (2.0)	13.0 (1.0)
Mortandad at MCO-5	05/04	R1	3.8 (0.6)				2.200 (.100)	6.000 (.300)	9.600 (.900)	27.0 (6.0)	22.0 (2.0)	18.0 (2.0)
Mortandad at MCO-5	05/04	R2					2.800 (.200)	8.100 (.400)	5.700 (.500)			
Mortandad at MCO-7	05/04	1		.6 (0.2)	2.93 (.27)	.88 (.09)	.366 (.012)	.747 (.020)	2.530 (.140)	11.0 (2.0)	9.0 (1.0)	5.5 (0.6)
Mortandad at MCO-7	05/04	R					.318 (.012)	.951 (.029)	.950 (.050)			
Mortandad at MCO-9	05/04	1	.2 (0.3)	.4 (0.2)	.39 (.06)	2.28 (.23)	.001 (.001)	.016 (.002)	.004 (.001)	5.0 (1.0)	4.0 (0.5)	3.4 (0.4)
Mortandad at MCO-9	05/04	R					.003 (.001)	.013 (.002)	.004 (.001)			
Mortandad at MCO-13 (A-5)	05/04	1	.5 (0.3)	.2 (0.2)	.26 (.04)	1.79 (.18)	.001 (.001)	.027 (.003)	.009 (.002)	5.0 (1.0)	4.0 (0.5)	2.4 (0.3)
Mortandad at MCO-13 (A-5)	05/04	R					.001 (.001)	.013 (.002)	.005 (.001)			
Mortandad A-6	05/31	1	.3 (0.3)	.5 (0.3)	.50 (.08)	2.50 (.43)	.008 (.001)	.036 (.003)	.013 (.003)	6.1 (1.2)	5.0 (0.5)	3.4 (0.4)

Table 5-21. Radiochemical Analysis of Sediments in 1995 (Cont.)

Station Name	Date	Code[a]	^{3}H (nCi/L)	^{90}Sr (pCi/g)	^{137}Cs (pCi/g)	Total U (mg/kg)	^{238}Pu (pCi/g)	$^{239,240}Pu$ (pCi/g)	^{241}Am (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Gross Gamma (pCi/g)
Mortandad Canyon (Cont.):												
Mortandad A-6	05/31	R										
Mortandad A-7	05/31	1	–.1 (0.3)	.2 (0.2)	.13 (.03)	.32 (.04)	.004 (.002)	.011 (.002)	.003 (.002)	3.3 (0.7)	2.3 (0.3)	1.8 (0.2)
Mortandad A-8	05/31	1	–.1 (0.3)	.2 (0.2)	.15 (.04)	2.74 (.27)	.002 (.001)	.012 (.002)	.003 (.002)	4.2 (0.9)	3.2 (0.3)	2.7 (0.3)
Mortandad at SR-4 (A-9)	05/31	1	.3 (0.3)	.0 (0.2)	.06 (.02)	2.33 (.23)	.002 (.001)	.003 (.001)	.002 (.002)	3.5 (0.7)	2.4 (0.3)	2.2 (0.3)
Mortandad A-10	05/31	1	.2 (0.3)	.1 (0.5)	<.03	.39 (.04)	.004 (.001)	.002 (.001)	.001 (.001)	2.1 (0.5)	1.4 (0.2)	2.4 (0.3)
Mortandad at Rio Grande (A-11)	09/11	1	–.1 (0.3)		.03 (.01)	1.78 (.21)	.003 (.001)	.005 (.001)	.002 (.001)	2.0 (0.6)	1.2 (0.2)	2.6 (0.3)
Cañada del Buey:												
Cañada del Buey at SR-4	03/21	1	.5 (0.5)	.3 (0.2)	.04 (.02)	1.53 (.15)	.004 (.001)	.007 (.001)	.002 (.001)	2.6 (0.6)	2.1 (0.3)	2.7 (0.3)
Cañada Ancha:												
Cañada Ancha at Rio Grande	09/11	1	.2 (0.3)		.06 (.02)	1.22 (.12)	.000 (.001)	.002 (.001)	.000 (.001)	2.0 (0.5)	.9 (0.2)	1.3 (0.2)
Area G, TA-54:												
G-1	05/05	1	–.2 (0.3)	.0 (0.3)	.08 (.03)	.84 (.15)	.001 (.001)	.004 (.001)	.004 (.001)	2.2 (0.5)	1.4 (0.2)	5.2 (0.6)
G-2	05/05	1	–.1 (0.3)	.0 (0.3)	.06 (.02)	1.25 (.13)	.012 (.002)	.002 (.001)	.002 (.002)	2.1 (0.5)	2.0 (0.3)	4.2 (0.5)
G-3	05/05	1	.4 (0.3)	.1 (0.3)	.36 (.06)	1.98 (.22)	.003 (.001)	.021 (.002)	.008 (.001)	4.5 (1.0)	4.0 (0.5)	5.0 (0.5)
G-4	05/05	1	.1 (0.3)	.0 (0.3)	.35 (.06)	2.32 (.46)	.016 (.002)	.026 (.002)	.005 (.001)	6.0 (1.0)	4.3 (0.5)	4.9 (0.5)
G-5	05/05	1	1.6 (0.4)	.3 (0.3)	.11 (.03)	1.06 (.11)	.015 (.002)	.009 (.002)	.004 (.001)	2.3 (0.5)	2.2 (0.3)	2.8 (0.3)
G-6	05/05	1	2.5 (0.5)	.3 (0.2)	.27 (.05)	1.85 (.26)	.007 (.001)	.072 (.004)	.025 (.003)	6.0 (1.0)	4.7 (0.5)	9.0 (0.9)
G-7	05/05	1	.4 (0.3)	.1 (0.4)	.23 (.05)	1.31 (.20)	.028 (.002)	.038 (.003)	.016 (.006)	5.0 (1.0)	4.4 (0.5)	7.9 (0.8)
G-8	05/05	1	.7 (0.3)	.1 (0.3)	.09 (.03)	1.58 (.16)	.176 (.007)	.147 (.006)	.033 (.007)	2.6 (0.6)	1.6 (0.2)	6.7 (0.7)
G-9	05/05	1	.3 (0.3)	.3 (0.2)	.31 (.06)	1.18 (.13)	.022 (.002)	.048 (.003)	.015 (.002)	5.0 (1.0)	3.5 (0.4)	6.8 (0.7)
Pajarito Canyon:												
Pajarito at SR-4	03/21	1	.2 (0.3)	.2 (0.2)	.29 (.06)	2.25 (.23)	.025 (.002)	.072 (.004)	.013 (.002)	5.0 (1.0)	4.9 (0.5)	3.6 (0.4)
Pajarito at Rio Grande	09/11	1	–.2 (0.3)	.0 (0.5)	.03 (.04)	.94 (.09)	.004 (.001)	.003 (.001)	.003 (.001)	1.0 (0.2)	.7 (0.1)	1.7 (0.2)
Potrillo Canyon:												
Potrillo at SR-4	03/21	1	.3 (0.4)	.9 (3.8)	.13 (.04)	1.72 (.21)	.006 (.001)	.006 (.001)	.002 (.001)	2.6 (0.6)	3.1 (0.4)	2.8 (0.3)
Fence Canyon:												
Fence at SR-4	03/21	1	1.3 (0.5)	.2 (0.2)	.12 (.04)	3.16 (.35)	.029 (.003)	.010 (.002)	.002 (.001)	4.5 (1.0)	3.9 (0.4)	4.7 (0.5)
Water Canyon:												
Water at SR-4	03/21	1		.1 (0.2)	.08 (.03)	1.56 (.16)	.003 (.001)	.008 (.002)	.004 (.002)	2.8 (0.6)	3.1 (0.4)	3.8 (0.4)
Water at Rio Grande	09/12	1	.1 (0.3)	.3 (0.2)	.15 (.04)	2.90 (.35)	.001 (.001)	.010 (.002)	.004 (.003)	6.0 (1.0)	4.0 (0.5)	2.9 (0.3)
Indio Canyon:												
Indio at SR-4	03/21	1	.7 (0.6)	.9 (2.1)	.13 (.04)	1.12 (.11)	.001 (.001)	.004 (.001)	.001 (.001)	1.4 (0.3)	1.4 (0.2)	2.9 (0.3)

Table 5-21. Radiochemical Analysis of Sediments in 1995 (Cont.)

Station Name	Date	Code[a]	^{3}H (nCi/L)	^{90}Sr (pCi/g)	^{137}Cs (pCi/g)	Total U (mg/kg)	^{238}Pu (pCi/g)	$^{239,240}Pu$ (pCi/g)	^{241}Am (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Gross Gamma (pCi/g)
Ancho Canyon:												
Ancho at SR-4	03/21	1		.4 (0.2)	.04 (.02)	1.57 (.16)	.018 (.003)	.006 (.002)	.003 (.001)	2.0 (0.4)	2.1 (0.3)	4.1 (0.5)
Ancho at Rio Grande	09/12	1	.1 (0.3)	.1 (0.3)	.25 (.05)	2.39 (.35)	.007 (.002)	.018 (.002)	.006 (.003)	6.0 (1.0)	4.0 (0.5)	3.4 (0.4)
Chaquehui Canyon:												
Chaquehui at Rio Grande	09/13	1	–.1 (0.3)	1.0 (0.4)	.61 (.07)	2.87 (.52)	.018 (.002)	.028 (.002)	.010 (.004)	9.0 (1.0)	6.0 (0.7)	4.3 (0.5)
Area AB, TA-49:												
AB-1	05/04	1	–.1 (0.3)	.4 (0.3)	.19 (.05)	2.99 (.60)	.012 (.010)	.013 (.002)	.004 (.001)	6.1 (1.0)	5.4 (0.5)	3.7 (0.4)
AB-2	05/04	1	–.1 (0.3)	.5 (0.2)	.34 (.07)	3.74 (.90)	.012 (.002)	.033 (.003)	.010 (.002)	11.1 (2.0)	8.1 (0.8)	3.5 (0.4)
AB-3	05/04	1	–.2 (0.3)	.8 (0.3)	.25 (.06)	3.40 (.61)	.022 (.002)	1.181 (.028)	.306 (.011)	11.1 (2.0)	5.9 (0.6)	3.6 (0.4)
AB-4	05/04	1	.3 (0.3)	.5 (0.2)	.50 (.09)	3.63 (.62)	.002 (.001)	.026 (.003)	.011 (.002)	9.8 (2.0)	7.0 (0.7)	4.2 (0.5)
AB-4A	05/04	1	–.4 (0.3)	.2 (0.3)	.18 (.04)	2.62 (.26)	.007 (.001)	.014 (.002)	.006 (.001)	6.1 (1.0)	6.0 (0.6)	3.4 (0.4)
AB-5	05/04	1	.0 (0.3)	.0 (0.2)	.07 (.03)	2.15 (.28)	.002 (.001)	.006 (.001)	.003 (.001)	8.6 (1.0)	5.4 (0.5)	3.4 (0.4)
AB-6	05/04	1	.1 (0.3)	.7 (0.4)	.78 (.11)	1.89 (.28)	.001 (.001)	.033 (.003)	.011 (.002)	5.3 (0.9)	6.3 (0.6)	3.3 (0.4)
AB-7	05/04	1	.1 (0.3)	.5 (0.2)	.29 (.06)	2.39 (.45)	.011 (.010)	.015 (.002)	.008 (.002)	7.4 (1.0)	5.1 (0.5)	3.2 (0.4)
AB-8	05/04	1	–.4 (0.3)	.2 (0.2)	.05 (.02)	1.27 (.13)	.014 (.002)	.003 (.001)	.002 (.001)	2.7 (0.5)	2.4 (0.3)	2.7 (0.3)
AB-9	05/04	1	.0 (0.3)	.4 (0.2)	.42 (.08)	1.84 (.26)	.001 (.001)	.019 (.002)	.008 (.002)	4.5 (0.8)	5.0 (0.4)	3.3 (0.4)
AB-9	05/04	R					.001 (.001)	.016 (.002)				
AB-10	05/04	1		.1 (0.3)	.10 (.03)	1.21 (.15)	.000 (.001)	.003 (.001)	.005 (.001)	2.9 (0.5)	2.4 (0.3)	2.4 (0.3)
AB-10	05/04	R				1.26 (.13)						
AB-11	05/04	1	.0 (0.3)	.2 (0.3)	.06 (.03)	1.03 (.10)	.001 (.001)	.006 (.002)	.007 (.001)	7.4 (1.0)	5.0 (0.5)	2.2 (0.3)
AB-11	05/04	R								5.0 (0.5)	6.1 (1.0)	
Frijoles Canyon:												
Frijoles at Rio Grande	09/14	1	.2 (0.3)		.26 (.04)	2.77 (.36)	.016 (.002)	.006 (.001)	.003 (.002)	4.0 (0.9)	2.0 (0.3)	3.7 (0.4)
Reservoirs on Rio Chama:												
El Vado Upper	07/05	1	.0 (0.3)	.1 (0.3)	.12 (.03)	2.02 (.24)	.001 (.001)	.006 (.001)	.003 (.001)	5.0 (1.0)	2.1 (0.3)	2.1 (0.3)
El Vado Upper	07/05	R		.2 (0.2)	.10 (.03)		.0003 (.0031)	.0065 (.0122)	.002 (.001)	6.0 (1.0)	3.0 (0.3)	
El Vado Middle	07/05	1	–.2 (0.3)	.1 (0.2)	.13 (.03)	1.88 (.21)	.002 (.003)	.005 (.001)	.000 (.001)	5.0 (1.0)	3.0 (0.3)	2.2 (0.3)
El Vado Lower	07/05	1	–.1 (0.3)	.1 (0.2)	.16 (.03)	2.46 (.25)	.001 (.001)	.006 (.001)	.003 (.001)	7.0 (1.0)	4.0 (0.4)	2.4 (0.3)
El Vado Lower	07/05	R				2.07 (.21)						
Heron Upper	07/05	1	.4 (0.3)	.8 (0.3)	.28 (.05)	3.42 (.44)	.003 (.001)	.012 (.002)	.007 (.001)	10.0 (2.0)	5.0 (0.5)	3.2 (0.4)
Heron Middle	07/05	1	.5 (0.3)	.3 (0.2)	.29 (.05)	3.46 (.35)	.021 (.002)	.009 (.001)	.003 (.001)	10.0 (2.0)	5.0 (0.7)	3.3 (0.4)
Heron Lower	07/05	1	.0 (0.3)	.2 (0.2)	.37 (.06)	3.29 (.33)	.019 (.002)	.011 (.002)	.005 (.001)	12.0 (2.0)	5.0 (0.5)	3.4 (0.4)
Abiquiu Upper	06/30	1	.0 (0.3)	.3 (0.3)	.02 (.03)	2.32 (.26)	.036 (.003)	.003 (.001)	.002 (.001)	9.0 (2.0)	2.0 (0.3)	2.3 (0.3)
Abiquiu Middle	06/30	1	.0 (0.3)	.4 (0.2)	.44 (.06)	3.30 (.40)	.002 (.001)	.012 (.002)	.007 (.003)	14.0 (2.0)	7.0 (0.8)	4.0 (0.4)
Abiquiu Lower	06/30	1	–.3 (0.3)	.3 (0.3)	.35 (.05)	3.72 (.60)	.003 (.001)	.009 (.001)	.005 (.003)	10.0 (2.0)	6.0 (0.7)	3.3 (0.4)

Table 5-21. Radiochemical Analysis of Sediments in 1995 (Cont.)

Station Name	Date	Code[a]	^{3}H (nCi/L)	^{90}Sr (pCi/g)	^{137}Cs (pCi/g)	Total U (mg/kg)	^{238}Pu (pCi/g)	$^{239,240}Pu$ (pCi/g)	^{241}Am (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Gross Gamma (pCi/g)
Reservoirs and Lakes on Rio Grande (Colorado):												
Rio Grande Upper	07/28	1	.2 (0.4)	.7 (0.4)	.12 (.02)	2.85 (.48)			.004 (.002)	5.0 (1.0)	3.0 (0.4)	2.9 (0.3)
Rio Grande Upper	07/28	R			.15 (.03)					6.0 (1.0)	4.0 (0.4)	
Rio Grande Middle	07/28	1	.3 (0.4)	.4 (0.5)	.26 (.04)	2.82 (.28)			.004 (.001)	7.0 (1.0)	5.0 (0.5)	2.8 (0.3)
Rio Grande Lower	07/28	1	–.1 (0.4)	.4 (0.4)	.23 (.04)	2.84 (.28)			.001 (.001)	6.0 (1.0)	4.0 (0.4)	3.3 (0.4)
Rio Grande Lower	07/28	R				2.27 (.23)						
Love Lake	07/28	1	.2 (0.4)	.5 (0.3)	.53 (.07)	4.18 (.48)	.003 (.001)	.016 (.003)	.015 (.002)	11.0 (2.0)	8.0 (0.9)	4.0 (0.4)
Reservoirs and Lakes on Rio Grande (New Mexico):												
Cochiti Upper	06/09	1	–.2 (0.4)	.1 (0.3)	.09 (.03)	2.29 (.27)	.0150 (.0019)	.0065 (.0012)	.003 (.001)	2.0 (1.0)	4.0 (0.5)	2.2 (0.3)
Cochiti Middle	06/09	1	–.1 (0.4)	.1 (0.4)	.20 (.04)	.09 (.03)	.0052 (.0013)	.0196 (.0023)	.002 (.001)	7.0 (2.0)	8.0 (0.9)	2.0 (0.3)
Cochiti Lower	06/09	1	–.1 (0.4)	.2 (0.4)	.23 (.04)	2.37 (.24)	.0025 (.0009)	.0114 (.0018)	.005 (.001)	4.0 (1.0)	5.0 (0.5)	4.8 (0.6)
Santa Clara Pond 4	05/19	1	.2 (0.3)	.2 (0.4)	.23 (.04)	2.37 (.24)	.0025 (.0009)	.0114 (.0018)	.005 (.001)	4.0 (1.0)	5.0 (0.5)	4.8 (0.6)
Detection Limits			2.0	1.0	0.05	0.25	0.005[f]	0.005[f]	0.005	1.5	1.5	0.8
Background (x+2s)[g]				0.87	0.44	4.40	0.006	0.023				7.9
SAL[h]			20.0	5.9	4.0	95.0	20.0	18.0	17.0			

[a] Code: 1—primary analysis; R—lab replicate.

[b] Sample sizes: stream channels—100 g; reservoirs—1000 g.

[c] Radioactivity counting uncertainties are shown in parentheses (1 standard deviation, 3 except ^{3}H—3 standard deviations). Radioactivity counting uncertainties are less than analytical uncertainties. Values less than two standard deviations are considered nondetections.

[d] Questionable value; laboratory QA not within control specifications.

[e] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[f] Limits of Detection for 1000 g ^{238}Pu and $^{239,240}Pu$ reservoir samples are 0.0001 pCi/g.

[g] Purtymun 1987a; background defined as mean plus two times standard deviation (x+2s).

[h] SAL—Screening Action Level; Environmental Restoration, 1995; see text for details.

Table 5-22. Plutonium Analyses of Sediments in Reservoirs on the Rio Chama and Rio Grande[a]

		^{238}Pu (fCi/g)		^{239,240}Pu (fCi/g)		Ratio (^{239,240}Pu/^{238}Pu)
Abiquiu Reservoir (Rio Chama)						
1984	Mean(s)	0.7	(0.2)[b]	12.7	(1.1)	18.1
1985	Mean(s)	0.7	(0.2)	8.8	(0.8)	12.6
1986	Mean(s)	0.3	(0.1)	7.5	(0.3)	25.0
1987	Mean(s)	0.2	(0.0)	3.7	(0.2)	18.5
1988	Mean(s)	0.3	(0.1)	7.4	(0.3)	24.7
1989	Mean(s)	0.4	(0.1)	3.7	(0.2)	9.2
1990	Mean(s)	0.1	(0.1)	2.6	(0.2)	26.0
1991	Mean(s)	0.3	(0.2)	7.2	(0.4)	24.0
1992	Mean(s)	0.1	(0.0)	0.8	(0.0)	8.0
1993	Mean(s)	0.2	(0.1)	5.1	(0.4)	25.5
1994	Mean(s)	0.2	(0.1)	0.5	(0.2)	2.5
1995	Upper	36.0	(3.0)	3.0	(1.0)	0.1
	Middle	2.0	(1.0)	12.0	(2.0)	6.0
	Lower	3.0	(1.0)	9.0	(1.0)	3.0
	Mean(s)	13.7	(1.7)	8.0	(1.3)	0.6
Cochiti Reservoir (Rio Chama)						
1984	Mean(s)	0.7	(0.1)	19.7	(1.1)	28.1
1985	Mean(s)	1.6	(0.3)	24.1	(0.8)	15.1
1986	Mean(s)	1.3	(0.1)	21.6	(0.3)	16.6
1987	Mean(s)	0.8	(0.1)	17.5	(0.2)	21.9
1988	Mean(s)	1.7	(0.2)	12.1	(0.3)	7.1
1989	Mean(s)	2.5	(0.2)	49.3	(0.2)	19.7
1990	Mean(s)	3.2	(0.1)	17.6	(0.2)	5.5
1991	Mean(s)	0.2	(0.1)	4.1	(0.4)	20.1
1992	Mean(s)	1.9	(0.2)	13.4	(0.0)	7.1
1993	Mean(s)	4.1	(0.4)	30.5	(0.4)	7.4
1994	Mean(s)	0.4	(0.1)	9.3	(0.4)	23.3
1995	Upper	15.0	(1.9)	6.5	(1.2)	0.4
	Middle	5.2	(1.3)	19.6	(2.3)	3.8
	Lower	2.5	(0.9)	11.4	(1.8)	4.6
	Mean(s)	7.6	(1.4)	12.5	(1.8)	1.6
Background						
(1974–1986)[c]		6.0		23.0		

[a]Samples were collected June 30, 1995, at Abiquiu Reservoir and June 9, 1995, at Cochiti Reservoir.
[b]Counting uncertainties (±1 standard deviation) are in parentheses.
[c]Purtymun (1987a).

Table 5-23. Total Recoverable Trace Metals in Sediments for 1995 (mg/kg)

Station Name	Date	Code[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Regional Stations														
Rio Grande at Otowi (bank)	09/15	1	1.0[b]	4,300	3.0	2.0	140.0	0.13	<0.4[c]	3.30	7.0	6.7	7,800	<0.03
Rio Grande at Otowi (bank)	09/15	R												<0.03
Rio Grande at Otowi (wdth intgrt)	09/15	1	<1.0	780	0.9	<1.0	25.0	<0.08	<0.4	0.62	1.7	3.9	2,300	0.03
Rio Grande at Otowi (wdth intgrt)	09/15	R												<0.03
Rio Grande at Frijoles (bank)	09/13	1	<1.2	680	0.6	<1.2	11.0	<0.17	<0.4	<0.50	1.4	<1.4	1,400	0.03
Rio Grande at Frijoles (bank)	09/13	R												0.03
Rio Grande at Frijoles (wdth intgrt)	09/13	1	<1.0	970	0.8	<1.0	11.0	<0.17	<0.4	1.00	2.0	1.6	2,800	<0.03
Rio Grande at Frijoles (wdth intgrt)	09/13	R	<1.0	540	1.0	1.0	8.6	<0.17	<0.4	<0.50	1.3	1.5	1,500	<0.03
Acid/Pueblo Canyons:														
Acid Weir	05/02	1	<1.0	1,600	1.0	<1.0	18.0	0.22	<0.4	2.40	2.3	1.7	4,000	
Pueblo 1	05/02	1	<1.0	1,700	1.0	<1.0	19.0	0.20	<0.4	2.00	1.5	1.1	4,900	
Pueblo 2	05/02	1	<5.0	1,100	<0.5	6.6	12.0	<0.08	<0.4	<1.50	1.7	<0.5	11,000	
Hamilton Bend Spring	05/02	1	<5.0	2,700	0.9	4.6	35.0	0.57	<0.4	1.20	3.7	2.3	5,500	
Pueblo 3	05/03	1	<5.0	2,900	0.8	3.6	21.0	0.18	<0.4	1.20	2.7	12.0	3,700	
Pueblo at SR-502	05/02	1	<5.0	5,500	0.8	7.6	46.0	0.55	<0.4	0.94	3.6	2.4	9,300	
DP/Los Alamos Canyons:														
Los Alamos at Bridge	05/02	1	<1.0	2,200	0.6	<1.0	25.0	0.19	<0.4	2.20	3.6	7.3	4,400	
Los Alamos at LAO-1	05/02	1	<5.0	5,300	1.0	4.6	43.0	0.34	<0.4	1.70	7.5	6.2	5,700	
Los Alamos at GS-1	05/03	1	<5.0	610	<0.5	1.2	7.2	<0.08	<0.4	<0.50	<1.0	<1.0	1,200	
DPS-1	07/13	1	<5.0	1,600	1.0	3.6	16.0	0.12	<0.4	<1.00	1.3	1.6	3,600	
DPS-4	05/03	1	<1.0	2,300	0.9	1.1	24.0	0.37	<0.4	0.77	1.5	1.0	4,200	
Los Alamos at LAO-3	05/03	1	<5.0	3,700	0.8	3.3	28.0	0.20	<0.4	1.30	3.7	3.2	4,700	
Los Alamos at LAO-4.5	05/02	1	<5.0	1,100	0.5	2.0	12.0	<0.08	<0.4	<1.60	1.4	1.3	2,000	
Los Alamos at SR-4	05/03	1	<5.0	2,300	0.8	3.2	17.0	0.12	<0.4	0.87	1.9	1.2	4,600	
Sandia Canyon:														
Sandia at Rio Grande	09/11	1	2.0	7,100	0.9	1.7	92.0	0.57	<0.4	4.00	10.0	5.6	12,000	<0.03
Sandia at Rio Grande	09/11	R												0.03
Mortandad Canyon:														
Mortandad near CMR Building	05/04	1	<1.0	2,600	1.0	<1.0	29.0	0.31	<0.4	2.50	2.8	<2.0	5,900	
Mortandad near CMR Building	05/04	R	<1.0	2,300	2.0	0.2	40.0	0.30	<0.4	2.10	2.0	1.1	5,900	
Mortandad west of GS-1	05/22	1	<5.0	1,600	2.0	3.6	21.0	0.15	<0.4	1.20	1.6	0.8	4,500	
Mortandad at GS-1	05/22	1	<5.0	1,400	0.7	2.5	12.0	0.11	<0.4	0.74	1.5	2.3	3,100	
Mortandad at MCO-5	05/04	1	<5.0	1,400	0.8	3.3	11.0	0.11	<0.4	0.59	1.7	2.1	3,100	

Table 5-23. Total Recoverable Trace Metals in Sediments for 1995 (mg/kg) (Cont.)

Station Name	Date	Code[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Mortandad Canyon (Cont.):														
Mortandad at MCO-5	05/04	R	<5.0	1,500	<0.5	2.9	11.0	0.09	<0.4	0.50	1.4	2.5	3,300	
Mortandad at MCO-7	05/04	1	<5.0	1,900	1.0	3.6	21.0	0.15	<0.4	0.76	1.8	2.2	3,200	
Mortandad at MCO-9	05/04	1	<5.0	3,100	0.8	4.0	32.0	0.27	<0.4	1.50	2.1	2.8	4,400	
Mortandad at MCO-13 (A-5)	05/04	1	<1.0	4,400	1.0	5.6	68.0	0.43	0.4	4.10	2.6	3.2	5,500	
Mortandad A-6	05/31	1	<1.0	6,800	1.0	4.0	58.0	0.53	0.9	2.60	4.9	3.6	7,800	0.01
Mortandad A-6	05/31	R												<0.01
Mortandad A-7	05/31	1	<1.0	3,100	<0.5	3.0	19.0	0.29	0.8	1.30	2.5	<0.5	3,900	<0.01
Mortandad A-7	05/31	R												<0.01
Mortandad A-8	05/31	1	<1.0	5,500	1.0	4.0	52.0	0.53	0.7	2.60	4.5	1.9	7,300	<0.01
Mortandad A-8	05/31	R												<0.01
Mortandad at SR-4 (A-9)	05/31	1	<1.0	6,600	1.0	4.0	84.0	0.54	1.2	4.30	6.0	1.2	8,100	<0.01
Mortandad at SR-4 (A-9)	05/31	R												<0.01
Mortandad A-10	05/31	1	<1.0	6,500	0.9	3.4	70.0	0.40	1.1	3.70	6.1	<0.5	8,900	<0.01
Mortandad A-10	05/31	R												<0.01
Mortandad at Rio Grande (A-11)	09/11	1	1.9	8,900	2.0	<1.2	140.0	0.55	<0.4	6.00	9.2	7.9	12,000	0.03
Mortandad at Rio Grande (A-11)	09/11	R												0.03
Cañada Ancha:														
Cañada Ancha at Rio Grande	09/11	1	1.2	3,300	2.0	<1.2	72.0	<0.17	<0.4	2.50	4.7	4.1	6,100	0.03
Cañada Ancha at Rio Grande	09/11	R												0.03
Pajarito Canyon:														
Pajarito at Rio Grande	09/11	1	<1.3	1,400	0.4	<1.3	12.0	<0.17	<0.4	<0.50	2.9	1.5	3,000	<0.03
Pajarito at Rio Grande	09/11	R												<0.03
Water Canyon:														
Water at Rio Grande	09/12	1	1.7	13,000	2.0	<1.3	150.0	0.83	<0.4	5.10	9.9	7.7	12,000	0.03
Water at Rio Grande	09/12	R												0.04
Ancho Canyon:														
Ancho at Rio Grande	09/12	1	1.7	9,500	2.0	2.9	140.0	0.57	0.4	5.10	7.6	7.7	9,700	0.05
Ancho at Rio Grande	09/12	R												0.05
Chaquehui Canyon:														
Chaquehui at Rio Grande	09/13	1	1.8	12,000	3.0	3.0	140.0	0.89	<0.4	4.30	9.1	13.0	12,000	0.05
Chaquehui at Rio Grande	09/13	R												0.05
Frijoles Canyon:														
Frijoles at Rio Grande	09/14	1	2.4	11,000	2.0	<1.3	170.0	0.67	<0.4	6.70	13.0	14.0	16,000	0.04
Frijoles at Rio Grande	09/14	R												0.03

Table 5-23. Total Recoverable Trace Metals in Sediments for 1995 (mg/kg) (Cont.)

Station Name	Date	Code[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Reservoirs and Lakes on Rio Chama:														
El Vado Upper	07/05	1	3.0	11,000	6.0	2.0	99.0	0.45	<0.4	6.80	13.0	9.0	19,000	
El Vado Upper	07/05	R	3.0	11,000	7.0	<1.0	100.0	0.54	<0.4	7.50	14.0	9.3	20,000	
El Vado Middle	07/05	1	3.0	7,900	6.0	1.0	80.0	0.45	<0.4	6.10	12.0	8.0	17,000	
El Vado Lower	07/05	1	3.0	7,600	6.0	<1.0	89.0	0.33	<0.4	6.40	10.0	9.0	17,000	
Heron Upper	07/05	1	3.0	20,000	34.0	1.0	130.0	0.89	<0.4	7.90	16.0	21.0	20,000	
Heron Middle	07/05	1	3.0	14,000	9.0	<1.0	130.0	0.73	<0.4	7.90	12.0	22.0	19,000	
Heron Lower	07/05	1	3.0	21,000	9.0	5.0	140.0	0.93	<0.4	8.40	18.0	23.0	21,000	
Abiquiu Upper	06/30	1	1.0	4,800	6.0	1.0	140.0	0.27	<0.4	3.60	6.5	8.0	8,700	
Abiquiu Middle	06/30	1	3.0	25,000	5.0	1.0	270.0	1.40	<0.4	9.40	22.0	22.0	22,000	
Abiquiu Lower	07/05	1	3.0	16,000	8.0	1.0	130.0	0.86	<0.4	8.00	13.0	22.0	19,000	
Reservoirs and Lakes on Rio Grande (Colorado):														
Rio Grande Upper	07/28	1	<1.0	8,900	5.0	<1.0	210.0	0.60	<0.4	9.30	4.1	13.0	20,000	0.05
Rio Grande Upper	07/28	R	<1.0	9,500	5.0	<1.0	220.0	0.67	<0.4	9.70	3.8	13.0	21,000	0.05
Rio Grande Middle	07/28	1	<1.0	12,000	4.0	<1.0	210.0	0.67	<0.4	8.50	5.0	11.0	22,000	0.04
Rio Grande Middle	07/28	R												0.06
Rio Grande Lower	07/28	1	<1.0	12,000	3.0	<1.0	200.0	0.70	<0.5	7.70	5.5	12.0	20,000	0.05
Rio Grande Lower	07/28	R												0.05
Love Lake	07/28	1	<1.0	18,000	4.0	3.3	250.0	1.30	<0.7	4.60	9.6	7.5	14,000	0.05
Love Lake	07/28	R												0.05
Reservoirs and Lakes on Rio Grande (New Mexico):														
Cochiti Upper	06/09	1	<1.0	9,000	4.0	1.0	210.0	<0.08	<0.4	7.00	14.0	15.0	13,000	
Cochiti Upper	06/09	R	<1.0	8,600	4.0	5.0	210.0	<0.08	<0.4	5.80	12.0	14.0	12,000	
Cochiti Middle	06/09	1	<1.0	24,000	6.0	2.4	330.0	0.93	<0.4	11.00	22.0	23.0	22,000	
Cochiti Lower	06/09	1	2.0	13,000	5.0	3.0	170.0	0.35	<0.4	7.80	15.0	17.0	16,000	
Santa Clara Pond 4	05/19	1	<1.0	18,000	4.0		180.0	2.70	<0.4	4.00	14.0	8.6	15,000	0.02
Santa Clara Pond 4	05/19	R												0.02
Detection Limits			1.0	17	0.5	1.0	0.14	0.08	0.4	0.50	0.5	0.5	14	0.01
SAL[d]			380	78,000			5,300		38	4,600	30.0[e]	2,800		23

Table 5-23. Total Recoverable Trace Metals in Sediments for 1995 (mg/kg) (Cont.)

Station Name	Date	Code[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Regional Stations													
Rio Grande at Otowi (bank)	09/15	1	230	<0.9	3.8	<4.1	<0.25	0.3	<4.0	71.0	<0.25	14.0	20.0
Rio Grande at Otowi (bank)	09/15	R											
Rio Grande at Otowi (wdth intgrt)	09/15	1	91	1.3	<1.2	<4.1	<0.25	<0.3	<4.0	8.1	<0.25	3.3	8.0
Rio Grande at Otowi (wdth intgrt)	09/15	R											
Rio Grande at Frijoles (bank)	09/13	1	58	1.7	<2.0	<4.0	<0.25	<0.1	<4.0	7.7	<0.25	2.0	6.1
Rio Grande at Frijoles (bank)	09/13	R											
Rio Grande at Frijoles (wdth intgrt)	09/13	1	63	<0.9	3.0	<4.0	<0.25	0.1	<4.0	8.3	<0.25	4.8	11.0
Rio Grande at Frijoles (wdth intgrt)	09/13	R	43	1.5	<2.0	<4.0	<0.25	0.1	<4.0	5.8	<0.25	2.5	7.9
Acid/Pueblo Canyons:													
Acid Weir	05/02	1	170	<0.9	<2.0	25.0	<0.40	<0.3	<3.0	3.1	<0.40	6.0	35.0
Pueblo 1	05/02	1	260	<2.0	<2.0	14.0	<0.40	<0.3	<3.0	3.1	<0.40	6.0	35.0
Pueblo 2	05/02	1	210	<0.9	<2.0	4.1	<0.40	0.3	<10.0	2.3	<0.40	6.3	55.0
Hamilton Bend Spring	05/02	1	330	<0.9	<2.0	9.0	<0.40	<0.3	8.5	8.1	<0.40	4.0	41.0
Pueblo 3	05/03	1	55	<0.9	<2.0	<4.0	<0.40	0.5	8.0	5.2	<0.40	3.8	39.0
Pueblo at SR-502	05/02	1	210	<0.9	<2.0	11.0	<0.40	0.3	<3.0	8.1	<0.40	8.6	57.0
DP/Los Alamos Canyons:													
Los Alamos at Bridge	05/02	1	120	<0.9	<5.0	14.0	<0.40	<0.3	<3.0	6.6	<0.40	7.3	21.0
Los Alamos at LAO-1	05/02	1	180	<0.9	<5.0	17.0	<0.40	0.3	<3.0	9.9	<0.40	6.8	40.0
Los Alamos at GS-1	05/03	1	54	<0.9	<2.0	4.8	<0.40	<0.3	<8.0	1.8	<0.40	<2.0	9.7
DPS-1	07/13	1	120	<0.9	2.1	8.8	<0.40	0.3	6.5	2.7	<0.40	3.7	30.0
DPS-4	05/03	1	160	<3.0	<2.0	12.0	<0.40	<0.3	<3.0	4.1	<0.40	4.4	29.0
Los Alamos at LAO-3	05/03	1	150	<0.9	2.1	<10.0	<0.40	0.3	<3.0	6.5	<0.40	5.4	27.0
Los Alamos at LAO-4.5	05/02	1	98	<0.9	<2.0	<4.0	<0.40	<0.3	<7.0	2.7	<0.40	1.6	13.0
Los Alamos at SR-4	05/03	1	120	<0.9	<2.0	10.0	<0.40	0.3	<3.0	3.7	<0.40	3.9	26.0
Sandia Canyon:													
Sandia at Rio Grande	09/11	1	350	1.8	8.9	13.0	<0.25	0.3	<4.0	29.0	<0.25	20.0	77.0
Sandia at Rio Grande	09/11	R											
Mortandad Canyon:													
Mortandad near CMR Building	05/04	1	190	5.0	2.0	<5.0	<0.40	<0.3	<3.0	7.1	<0.40	7.1	48.0
Mortandad near CMR Building	05/04	R	260	1.9	1.7	10.0	<0.40	<0.3	<3.0	6.7	<0.40	6.5	37.0
Mortandad west of GS-1	05/22	1	270	<2.0	<2.0	<9.0	<0.40	<0.3	<3.0	3.0	<0.40	4.8	16.0
Mortandad at GS-1	05/22	1	150	2.0	<2.0	<10.0	<0.40	<0.3	<8.0	1.8	<0.40	2.6	19.0

Table 5-23. Total Recoverable Trace Metals in Sediments for 1995 (mg/kg) (Cont.)

Station Name	Date	Code[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Mortandad Canyon (Cont.):													
Mortandad at MCO-5	05/04	1	110	<2.0	<2.0	<4.0	<0.40	<0.3	<7.0	2.2	<0.40	2.3	18.0
Mortandad at MCO-5	05/04	R	110	<2.0	<2.0	<8.0	<0.40	<0.3	<8.0	2.5	<0.40	2.3	21.0
Mortandad at MCO-7	05/04	1	130	<2.0	<2.0	<8.0	<0.40	<0.3	<6.0	3.4	<0.40	3.0	18.0
Mortandad at MCO-9	05/04	1	210	<2.0	<2.0	<8.0	<0.40	<0.3	<3.0	4.7	<0.40	3.7	27.0
Mortandad at MCO-13 (A-5)	05/04	1	550	<2.0	<2.0	<10.0	<0.40	0.3	<6.0	6.0	<0.40	6.3	30.0
Mortandad A-6	05/31	1	300	<0.9	<2.0	11.6	<0.25	0.3	<4.0	8.1	<0.25	9.4	56.0
Mortandad A-6	05/31	R											
Mortandad A-7	05/31	1	140	<0.9	<2.0	4.1	<0.25	0.2	<4.0	<0.3	<0.25	4.4	20.0
Mortandad A-7	05/31	R											
Mortandad A-8	05/31	1	280	<0.9	<2.0	7.6	<0.25	0.2	<4.0	6.4	<0.25	9.0	33.0
Mortandad A-8	05/31	R											
Mortandad at SR-4 (A-9)	05/31	1	370	<0.9	<2.0	9.2	<0.25	0.3	<4.0	9.4	<0.25	11.0	31.0
Mortandad at SR-4 (A-9)	05/31	R											
Mortandad A-10	05/31	1	300	<0.9	<2.0	6.8	<0.25	0.3	<4.0	8.1	<0.25	13.0	30.0
Mortandad A-10	05/31	R											
Mortandad at Rio Grande (A-11)	09/11	1	410	<0.9	8.2	8.5	<0.25	0.6	<4.0	32.0	<0.25	15.0	40.0
Mortandad at Rio Grande (A-11)	09/11	R											
Cañada Ancha:													
Cañada Ancha at Rio Grande	09/11	1	130	<0.9	5.8	<4.0	<0.25	0.2	<4.0	25.0	<0.25	13.0	15.0
Cañada Ancha at Rio Grande	09/11	R											
Pajarito Canyon:													
Pajarito at Rio Grande	09/11	1	46	<0.9	<2.0	<4.0	<0.25	0.1	<4.0	3.5	<0.25	3.8	13.0
Pajarito at Rio Grande	09/11	R											
Water Canyon:													
Water at Rio Grande	09/12	1	330	<0.9	6.3	13.0	<0.25	0.5	<4.0	27.0	<0.25	13.0	44.0
Water at Rio Grande	09/12	R											
Ancho Canyon:													
Ancho at Rio Grande	09/12	1	480	<0.9	6.2	8.5	<0.25	0.5	<4.0	27.0	<0.25	13.0	35.0
Ancho at Rio Grande	09/12	R											
Chaquehui Canyon:													
Chaquehui at Rio Grande	09/13	1	330	<0.9	7.3	14.0	<0.25	0.6	<4.0	34.0	0.25	14.0	47.0
Chaquehui at Rio Grande	09/13	R											

Table 5-23. Total Recoverable Trace Metals in Sediments for 1995 (mg/kg) (Cont.)

Station Name	Date	Code[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Frijoles Canyon:													
Frijoles at Rio Grande	09/14	1	540	<0.9	11.0	17.0	<0.25	0.6	<4.0	63.0	<0.25	20.0	81.0
Frijoles at Rio Grande	09/14	R											
Reservoirs on Rio Chama:													
El Vado Upper	07/05	1	270		10.0	7.0	<0.16	0.5	<4.0	30.0	0.40	36.0	53.0
El Vado Upper	07/05	R	270		11.0	5.0	<0.16	0.4	<4.0	30.0	0.40	37.0	51.0
El Vado Middle	07/05	1	250		10.0	5.0	<0.16	0.4	<4.0	29.0	0.31	33.0	44.0
El Vado Lower	07/05	1	270		10.0	7.0	<0.16	0.5	<4.0	32.0	0.31	26.0	45.0
Heron Upper	07/05	1	270		19.0	9.0	<0.16	1.0	<4.0	65.0	0.70	30.0	72.0
Heron Middle	07/05	1	460		18.0	11.0	<0.16	1.0	<4.0	69.0	0.58	21.0	71.0
Heron Lower	07/05	1	400		19.0	10.0	<0.16	1.0	<4.0	70.0	0.74	33.0	73.0
Abiquiu Upper	06/30	1	230		8.0	4.0	<0.16	0.5	<4.0	68.0	0.26	14.0	31.0
Abiquiu Middle	06/30	1	470		22.0	13.0	<0.16	0.8	<4.0	97.0	0.50	27.0	68.0
Abiquiu Lower	07/05	1	340		17.0	11.0	<0.16	0.9	<4.0	73.0	0.70	23.0	70.0
Reservoirs and Lakes on Rio Grande (Colorado):													
Rio Grande Upper	07/28	1	830	<0.9	3.7	12.2	<0.25	0.6	<4.0	67.0	0.25	32.0	72.0
Rio Grande Upper	07/28	R	890	<0.9	6.0	11.7	<0.25	0.6	<4.0	70.0	0.25	33.0	78.0
Rio Grande Middle	07/28	1	520	<0.9	5.3	11.7	<0.25	0.8	<4.0	72.0	0.25	38.0	75.0
Rio Grande Middle	07/28	R											
Rio Grande Lower	07/28	1	350	<0.9	7.2	10.9	<0.25	0.8	<4.0	71.0	0.25	31.0	67.0
Rio Grande Lower	07/28	R											
Love Lake	07/28	1	310	<0.9	6.2	11.4	<0.25	2.0	<4.0	70.0	0.25	24.0	53.0
Love Lake	07/28	R											
Reservoirs and Lakes on Rio Grande (New Mexico):													
Cochiti Upper	06/09	1	420	<0.9	11.0	18.0	<0.20	0.6	<4.0	100.0	<0.20	19.0	62.0
Cochiti Upper	06/09	R	340	<0.9	10.0	11.0	<0.20	0.5	<4.0	97.0	<0.20	22.0	50.0
Cochiti Middle	06/09	1	790	0.9	19.0	19.0	<0.20	0.7	<4.0	200.0	<0.20	26.0	90.0
Cochiti Lower	06/09	1	490	<0.9	13.0	20.0	<0.20	0.6	<4.0	78.0	0.20	26.0	66.0
Santa Clara Pond 4	05/19	1	670		7.7	24.0	<0.25	1.7			<0.25	17.0	120.0
Santa Clara Pond 4	05/19	R											

Table 5-23. Total Recoverable Trace Metals in Sediments for 1995 (mg/kg) (Cont.)

Station Name	Date	Code[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Detection Limits			0.2	0.9	2.0	0.2	0.20	0.3	4.0	0.3	0.20	0.5	1.0
SAL[d]			390	380	1,500	400	31	380		46,000	6.4	540	23,000

[a]Code: 1—primary analysis; R—laboratory replicate.
[b]Measurement uncertainty is approximately 10% of reported value.
[c]Less than symbol (<) means measurement was below the specified detection limit on the analytical method.
[d]SAL—Screening Action Level; Environmental Restoration, 1995; see text for details.
[e]SAL value for hexavalent Cr; SAL value for trivalent Cr is 80,000 mg/kg.

Table 5-24. Number of Analyses Above Analytical Limit of Quantitation for Organic Compounds in Sediment Samples for 1995

Station Name	Date	Code[a]	Volatile	Semivolatile	HE[b]
Number of Compounds Analyzed			59	69	14
Area G, TA-54					
G-1	05/05	1	0	0	
G-2	05/05	1	0	0	
G-3	05/05	1	0	0	
G-4	05/05	1	0	0	
G-5	05/05	1	0	0	
G-6	05/05	1	0	0	
G-7	05/05	1	0	0	
G-8	05/05	1	0	0	
G-9	05/05	1	0	0	
Water Canyon					
Water at Rio Grande	09/12	1			0
Ancho Canyon					
Ancho at Rio Grande	09/12	1			0
Chaquehui Canyon					
Chaquehui at Rio Grande	09/13	1			0
Frijoles Canyon					
Frijoles at Rio Grande	09/14	1			0

[a]Code: 1—primary analysis.
[b]High explosive.

Table 5-25. Total Trihalomethanes in Drinking Water (µg/L)

	1995 Quarters			
Sample Location	**First**	**Second**	**Third**	**Fourth**
Distribution Sites:				
LA Airport	4.80	5.90	8.80	8.70
White Rock Fire Station	0.00	0.00	0.00	0.00
North Community Fire Station	1.10	0.00	0.00	3.20
S-Site Fire Station	2.10	0.60	4.50	3.40
Barranca Mesa School	1.10	0.50	3.30	7.80
TA-33, Bldg. 114	4.90	8.60	11.30	11.50
1995 Average	3.84			
EPA MCL (Maximum Contaminant Level)			100.00	
Laboratory PQL (Practical Quantitation Level)			2.00	

Table 5-26. Radioactivity in Drinking Water (pCi/L)

	Gross Alpha			Gross Beta		
Sample Location	**Calibration Std.**	**Value**	**(Uncertainty)**	**Calibration Std.**	**Value**	**(Uncertainty)**
Entry Points to Distribution:						
Pajarito Booster #2	^{241}Am	1.20	(0.50)	^{137}Cs	2.50	(0.90)
	Natural uranium	1.30	(0.50)	$^{90}Sr,^{90}Y$	2.40	(0.80)
Guaje Booster #2	^{241}Am	0.30	(0.40)	^{137}Cs	1.60	(1.10)
	Natural uranium	0.30	(0.40)	$^{90}Sr,^{90}Y$	1.50	(1.10)
Pajarito Well Field-PM1	^{241}Am	2.00	(0.60)	^{137}Cs	3.60	(0.90)
	Natural uranium	2.30	(0.60)	$^{90}Sr,^{90}Y$	3.50	(0.90)
Pajarito Well Field-PM3	^{241}Am	0.60	(0.50)	^{137}Cs	3.80	(1.10)
	Natural uranium	0.70	(0.60)	$^{90}Sr,^{90}Y$	3.60	(1.10)
EPA Maximum Contaminant Level		15.00			NA	
EPA Screening Level		5.00			50.00	

Table 5-27. Radon in Drinking Water (pCi/L)

Sample Location	Value	(Uncertainty)
Entry Points to Distribution:		
Pajarito Booster #2	243	(16)
Guaje Booster #2	507	(29)
Pajarito Well Field-PM1	227	(15)
Pajarito Well Field-PM3	325	(20)
Well Heads:		
Pajarito Well Field-PM1	293	(19)
Pajarito Well Field-PM2	629	(35)
Pajarito Well Field-PM3	318	(20)
Pajarito Well Field-PM5	487	(28)
Guaje Well Field-G1A	360	(21)
Guaje Well Field-G1	358	(21)
Guaje Well Field-G2	263	(17)
Guaje Well Field-G6	479	(27)
Proposed EPA Maximum Contaminant Level	300	

Table 5-28. Summary of Total Committed Effective Dose Equivalent from the Ingestion of Drinking Water Collected during 1995

(mrem/yr)	Committed Effective Dose Equivalent[a]
Average Consumption[b]	0.317 (± 0.095)[c]
Maximum Consumption[b]	0.446 (± 0.133)[c]

[a]Based on DOE dose conversion factors (DOE 1988b).
[b]See Table 3-1 for consumption rates.
[c]±2 sigma in parenthesis; to convert to μSv multiply by 10.

Table 5-29. Total Committed Effective Dose Equivalent from the Ingestion of Drinking Water Collected during 1995

Well or Water System	Maximum Consumption[a] Total Committed Effective Dose Equivalent[b] (mrem/yr)	Average Consumption[a] Total Committed Effective Dose Equivalent[b] (mrem/yr)
Los Alamos & White Rock[c]	0.43 (± 0.12)[d]	0.32 (± 0.10)
Pueblo of San Ildefonso		
Westside Artesian	3.86 (± 1.49)	2.86 (± 1.11)
Halladay House	1.38 (± 0.67)	1.02 (± 0.50)
Pajarito Pump 1	1.61 (± 0.67)	1.19 (± 0.50)
Pajarito Pump 2	1.25 (± 0.76)	0.93 (± 0.56)
Martinez House	1.27 (± 0.62)	0.94 (± 0.46)
Otowi House	0.82 (± 0.52)	0.61 (± 0.39)
New Community	3.74 (± 1.65)	2.76 (± 1.22)
Sanchez House	1.81 (± 1.00)	1.34 (± 0.74)
Santa Clara Pueblo		
Community Above Village	1.65 (± 0.43)	1.22 (± 0.32)
Naranjo House	1.04 (± 0.58)	0.77 (± 0.43)
Enos House	0.82 (± 0.51)	0.61 (± 0.38)
Community New Subdivision	0.32 (± 0.35)	0.24 (± 0.26)
Cochiti Pueblo		
Cochiti Lake 1	0.35 (± 0.34)	0.26 (± 0.25)
Cochiti 1	0.57 (± 0.47)	0.42 (± 0.35)
Cochiti Golf Course	0.23 (± 0.49)	0.17 (± 0.37)
Tetilla Peak	0.98 (± 0.55)	0.74 (± 0.41)
Cochiti Elementary	0.63 (± 0.55)	0.47 (± 0.41)
Jemez Pueblo		
North Tank	0.14 (± 0.41)	0.10 (± 0.30)

[a] See Table 3-1 for consumption rates.

[b] CEDE for consumption of water collected from the Los Alamos/White Rock distribution system are based on DOE dose conversion factors (DOE 1988b); whereas the CEDE for consumption of water collected from non-DOE sources are based on dose conversion factors listed in FGR#11 (EPA1988).

[c] Modified by the contribution of each well to the distribution system.

[d] ±2 sigma in parenthesis; to convert to μSv multiply by 10.

Table 5-30. Summary of the Maximum Committed Effective Dose Equivalent by Radionuclide from Consuming Drinking Water Using the Maximum Consumption Rate[a]

	Maximum CEDE[b] (mrem)							
Well or Water System	**^{90}Sr**	**^{137}Cs**	**Total U**	**^{238}Pu**	**^{239,240}Pu**	**^{3}H**	**^{241}Am**	**Total CEDE**
Los Alamos & White Rock[c]								
Distribution System	0.11	0.011	0.082	0.013	0.095	0.001	0.243	0.56
Pueblo of San Ildefonso								
Westside Artesian	1.08	0.025	4.03	0.005	0.114	<0.001	0.106	5.36
Halladay House	0.249	0.027	1.46	0.077	0.085	<0.001	0.151	2.05
Pajarito Pump 1	0.207	0.034	1.83	0.044	0.078	<0.001	0.090	2.28
Pajarito Pump 2	0.187	0.039	1.29	0.014	0.171	<0.001	0.311	2.01
Martinez House	0.207	0.049	1.27	0.068	0.093	<0.001	0.207	1.89
Otowi House	0.321	0.083	0.628	0.030	0.094	0.005	0.179	1.34
New Community	0.177	0.086	4.34	0.501	0.092	<0.001	0.186	5.38
Sanchez House	0.228	0.102	1.83	0.367	0.119	<0.001	0.159	2.81
Santa Clara Pueblo								
Community Above Village	0.040	0.053	1.52	0.053	0.153	<0.001	0.252	2.07
Naranjo House	0.166	0.017	0.995	0.131	0.191	<0.001	0.116	1.62
Enos House	0.207	0.140	0.533	0.100	0.168	<0.001	0.181	1.33
Community New Subdivision	0.446	0.049	0.021	0.033	0.041	<0.001	0.088	0.68
Cochiti Pueblo								
Cochiti Lake 1	0.321	0.058	0.044	0.009	0.026	<0.001	0.229	0.69
Cochiti 1	0.394	0.107	0.117	0.070	0.127	<0.001	0.229	1.04
Cochiti Golf Course	0.218	0.106	0.004	0.049	0.165	<0.001	0.186	0.73
Tetilla Peak	0.187	0.180	0.767	0.491	0.036	0.002	0.327	1.55
Cochiti Elementary	0.259	0.060	0.509	0.119	0.106	<0.001	0.133	1.19
Jemez Pueblo								
North Tank	0.166	0.006	0.019	0.063	0.142	0.003	0.144	0.54
CEDE from Analytical Detection Limits[d]	0.207	0.049	0.008	0.061	0.067	<0.001	0.069	0.46

[a] See Table 3-1 for consumption rates

[b] CEDE + 2 sigma; CEDE for consumption of water collected from the Los Alamos/White Rock distribution system are based on DOE dose conversion factors (DOE 1988), whereas the CEDE for consumption of water collected from non-DOE sources are based on dose conversion factors listed in FGR #11 (EPA1988); to convert to μSv multiply by 10.

[c] Modified by the contribution of each well to the distribution system.

[d] CEDEs below this detection limit CEDE represent the lower limit possible for calculated doses and are not representative of a positive dose value.

Table 5-31. Inorganic Constituents in Drinking Water (mg/L)

Sample Location	As	Ba	Be	Cd	Cr	F	CN	Hg	Ni	NO_3 (as N)	Se	Sb	Tl
Entry Points:													
Pajarito Booster #2	0.002	<0.1	<0.001	<0.001	0.004	0.3	<0.02	<0.0002	<0.01		<0.005	<0.001	<0.001
Guaje Booster #2	0.014	<0.1	<0.001	<0.001	0.005	0.6	<0.02	<0.0002	<0.01		<0.005	<0.001	<0.001
Pajarito Well Field-PM1	0.002	<0.1	<0.001	<0.001	0.003	0.3	<0.02	<0.0002	<0.01		<0.005	<0.001	<0.001
Pajarito Well Field-PM3	0.002	<0.1	<0.001	<0.001	0.003	0.3	<0.02	<0.0002	<0.01		<0.005	<0.001	<0.001
Wellheads:													
Pajarito Well Field-PM1										0.5			
Pajarito Well Field-PM2										0.3			
Pajarito Well Field-PM3										0.4			
Pajarito Well Field-PM5										0.3			
Guaje Well Field-G1A										0.4			
Guaje Well Field-G1										0.4			
Guaje Well Field-G2										0.4			
Guaje Well Field-G6										0.5			
EPA Maximum Contam. Level	0.05[a]	2.0	0.004	0.005	0.1	4.0	0.2	0.002	0.1	10.0	0.05	0.006	0.002

[a]Proposed SDWA Primary Drinking Water Standard.

Table 5-32. Lead and Copper in Drinking Water at Residential Taps

Values	Lead	Copper
Values less than or equal to detection limit	35 samples	26 samples
Values detectable but less than action level	1 samples	10 samples
Values greater than action level	0 samples	0 samples
Totals	36 samples	36 samples
Detection Limit	5 µg/L	50 µg/L
90th Percentile Value	<5 µg/L	60 µg/L
EPA Action Level	15 µg/L	1300 µg/L

Table 5-33. Volatile Organic Compounds (VOCs) in Drinking Water in 1995 (µg/L)

	VOC Group I (63 Compounds)	
Sample Location	**Initial (2/27/95)**	**Confirmation (4/21/95)**
Pajarito Well Field-PM1	N[a]	
Pajarito Well Field-PM2	N[a]	
Pajarito Well Field-PM3	1.70 ppb[b]	N[a]
Pajarito Well Field-PM5	N[a]	
Guaje Well Field-G1A	0.60 ppb[b]	N[a]
Guaje Well Field-G1	0.50 ppb[b]	N[a]
Guaje Well Field-G2	0.90 ppb[b]	N[a]
Guaje Well Field-G6	N[a]	

[a]N = None detected above the Laboratory's Practical Quantitation Limit (PQL).
[b]Methylene chloride (Dichloromethane), SDWA MCL = 5.0 ppb.

Table 5-34. Synthetic Organic Compounds (SOCs) in Drinking Water (µg/L) in 1995 by EPA Method

Sample Location	EDB 504.0	PCB/Pest 505	Acid Herbicide 515.1	Carbamate Pest 531.1	Glyphosate 547	Endothall 548.1	Diquat 549.1
1st Quarter 1995							
Wellhead Composites:							
PM-3, G-6	N	N	N	N	N	N	N
PM-2, PM-5	N	N	N	N	N	N	N
PM-1, G-1	N	N	N	N	N	N	N
G-2, G-1A	N	N	N	N	N	N	N
2nd Quarter 1995							
Wellhead Composites:							
PM-1, PM-2	N	N	N	N	N	N	N
PM-3, PM-4	N	N	N	N	N	N	N
PM-5, G-1	N	N	N	N	N	N	N
G-2, G-6	N	N	N	N	N	N	N

N: None detected at concentrations greater than the method PQL (Practical Quantitation Limit).

	Dioxin 1613A
1st Quarter 1995	
Wellheads:	
Pajarito Well Field-PM1	N
Pajarito Well Field-PM2	N
Pajarito Well Field-PM3	N
Pajarito Well Field-PM5	N
Guaje Well Field-G1A	N
Guaje Well Field-G1	N
Guaje Well Field-G2	N
Guaje Well Field-G6	N

N: None detected at concentrations greater than the MDL (Method Detection Limit).

Table 5-35. Bacteria in Drinking Water at Distribution System Taps in 1995

Month	No. of Samples Collected	No. of Positive Tests		
		Coliform	Fecal Coliform	Noncoliform
Jan	46	0	0	0
Feb	50	1	0	1
Mar	46	0	0	1
Apr	49	1	1	1
May	47	0	0	2
Jun	46	0	0	1
Jul	45	0	0	2
Aug	46	0	0	1
Sep	44	0	0	1
Oct	46	0	0	2
Nov	45	0	0	1
Dec	45	0	0	1
Total 1995	555	2	1	14
Maximum Contaminant Level (MCL)[a]			[b]	[c]

[a]The MCL for coliforms is positive samples not to exceed 5% of the monthly total.
[b]The MCL for fecal coliforms is no coliform positive repeat samples following a fecal coliform positive sample.
[c]There is no MCL for noncoliforms.

Table 5-36. Radiochemical Analyses of Alluvial Groundwater for 1995 (pCi/L[a])

Station Name	Date	Codes[b]		^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Acid/Pueblo Canyons:													
APCO-1	03/29	uf	1	−200 ± 300[c]	4.2 ± 1	.78 ± 1.17	.68 ± .09	.004 ± .009	.024 ± .016	.06 ± .023	−1 ± 1	12 ± 1	990 ± 50
APCO-1	03/29	f	1		0 ± 1	.82 ± .41	.6 ± .06	.004 ± .012	.034 ± .017	.047 ± .016	0 ± 1	14 ± 1	50 ± 50
APCO-1	06/23	uf	1	−200 ± 300	3.2 ± 2.7	6.6 ± 9.9	.39 ± .05	.02 ± .011	.105 ± .021	14 ± 21[d]	2 ± 1	17 ± 1	180 ± 50
APCO-1	06/23	uf	R1	1,200 ± 400									
APCO-1	06/23	uf	2							.076 ± .02			
APCO-1	06/23	f	1	1,100 ± 300	1.4 ± .9	12.7 ± 7.2	.37 ± .04	.005 ± .006	.025 ± .012	4.2 ± 6.3[d]	0 ± 1	17 ± 1	190 ± 50
APCO-1	06/23	f	2							.018 ± .016			
DP/Los Alamos Canyons:													
LAO-3	03/29	uf	1	400 ± 300	59.6 ± 3.6	1.7 ± 2.55	.21 ± .02	−.006 ± .005	−.005 ± .007	.02 ± .019	2.3 ± 3	120 ± 10	430 ± 60
LAO-3	03/29	f	1	−100 ± 300	57.7 ± 3.5	2.22 ± .77	.2 ± .02	.002 ± .005	.011 ± .011	.017 ± .015	2 ± 3	130 ± 10	30 ± 50
LAO-3	06/23	uf	1	0 ± 300	27.1 ± 4.8	14 ± 21	.16 ± .02	.009 ± .01	.025 ± .014	−26 ± 39[d]	0 ± 2	88 ± 9	130 ± 50
LAO-3	06/23	uf	2							.012 ± .01			
LAO-3	06/23	f	1	300 ± 300	29.6 ± 1.8	13 ± 20	.32 ± .03	.014 ± .01	.03 ± .013	1.1 ± 1.7[d]	−1 ± 2	87 ± 9	150 ± 50
LAO-3	06/23	f	2							.004 ± .007			
LAO-3A	03/28	uf	1	400 ± 300	68.7 ± 4.3	<.47[e]	.38 ± .06	.002 ± .008	.018 ± .012	.098 ± .026	0 ± 3	150 ± 20	60 ± 50
LAO-3A	03/28	f	1	400 ± 300	71.9 ± 4.4	<.73	.18 ± .03	.014 ± .011	.049 ± .018	.043 ± .021	3 ± 3	140 ± 10	60 ± 50
LAO-3A	06/23	uf	1	300 ± 300	47.8 ± 3.3	26 ± 39	.57 ± .06	.002 ± .008	.009 ± .011	4.4 ± 6.6[d]	2 ± 2	99 ± 10	110 ± 40
LAO-3A	06/23	uf	2							.037 ± .019			
LAO-3A	06/23	f	1	100 ± 300	26.1 ± 1.8	18 ± 26	.34 ± .03	−.002 ± .004	−.001 ± .006	8 ± 12[d]	2 ± 2	88 ± 9	80 ± 40
LAO-3A	06/23	f	2							.061 ± .018			
LAO-4.5	06/29	uf	1	100 ± 300	1.4 ± 1.3	1.3 ± 1.8	.17 ± .02	.006 ± .014	.058 ± .019	−28 ± 45[d]	.2 ± 1	8 ± .9	40 ± 40
LAO-4.5	06/29	uf	R1					−.0047 ± .0037	−.0039 ± .0045				
LAO-4.5	06/29	uf	2							.041 ± .012			
LAO-4.5	06/29	f	1	100 ± 300	.8 ± 7.4	28 ± 8	.2 ± .02	−.002 ± .005	.015 ± .01	−20 ± 45[d]	.7 ± .9	7 ± .9	20 ± 40
LAO-4.5	06/29	f	D1			11 ± 5	.17 ± .02			−7 ± 45[d]			
LAO-4.5	06/29	f	R1	200 ± 400									70 ± 40
LAO-4.5	06/29	f	2							.105 ± .021			
LAO-4.5	06/29	f	R1							.079 ± .018			

Table 5-36. Radiochemical Analyses of Alluvial Groundwater for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]		^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
DP/Los Alamos Canyons (Cont.):													
LAO-4.5C	03/28	uf	1	100 ± 300	1.2 ± .8	<.7	.04 ± .01	.019 ± .012	–.002 ± .008	.07 ± .06	.2 ± .6	6.7 ± .8	70 ± 50
LAO-4.5C	03/28	f	1	200 ± 300	1.7 ± 1.3	<1.1	.08 ± .01	–.001 ± .006	.013 ± .008	.05 ± .024	.7 ± .7	6.7 ± .8	40 ± 50
LAO-4.5C	06/26	uf	1	100 ± 300	1.9 ± .6	13 ± 19	.21 ± .02	–.011 ± .005	.017 ± .015	.12 ± .028	3 ± 1	7 ± .9	70 ± 40
LAO-4.5C	06/26	uf	2							5.6 ± 8.4[d]			
LAO-4.5C	06/26	uf	3							.021 ± .017			
LAO-4.5C	06/26	f	1	100 ± 300	1.3 ± 1.9	9.8 ± 4.6	.12 ± .01	.105 ± .025	.04 ± .017	.03 ± .017	2 ± .9	7 ± .8	130 ± 50
LAO-4.5C	06/26	f	2							71 ± 28[d]			
LAO-4.5C	06/26	f	3							.05 ± .02			
LAO-6	03/30	ufd	1	300 ± 300	.7 ± 1	<1.22	.06 ± .01	.018 ± .012	.024 ± .014	.059 ± .029	.4 ± .7	4.9 ± .6	270 ± 60
LAO-6	03/30	ufd	R1					.008 ± .011	.015 ± .01	.075 ± .021			
LAO-6	03/30	uf	1	800 ± 300	1.2 ± .9	1.15 ± .54	.06 ± .01	–.013 ± .014	.023 ± .016	.052 ± .019	–.1 ± .6	5.2 ± .7	240 ± 50
LAO-6	03/30	uf	R1					–.007 ± .009	.019 ± .011	.056 ± .026			
LAO-6	03/30	fd	1	500 ± 300	.3 ± 1	<.83	.06 ± .01	.017 ± .011	.02 ± .012	.027 ± .018	.3 ± .6	5 ± .6	90 ± 50
LAO-6	03/30	fd	R1					.003 ± .01	–.011 ± .007	.048 ± .022			
LAO-6	03/30	f	1	400 ± 300	.9 ± 1.1	<1.09	.05 ± .01	.015 ± .013	.011 ± .014	.047 ± .026	–2.1 ± .5	–1.3 ± .2	160 ± 50
LAO-6	03/30	f	R1					.001 ± .007	.049 ± .016	.073 ± .022			
LAO-6	06/26	uf	1	100 ± 300	.6 ± .8	17 ± 7	.16 ± .02	.006 ± .007	.041 ± .014	.02 ± .014	2 ± .7	5 ± .7	30 ± 40
LAO-6	06/26	uf	2							9 ± 14[d]			
LAO-6	06/26	uf	3							.043 ± .018			
LAO-6	06/26	f	1	200 ± 300	2.4 ± .8	16 ± 7	.09 ± .01	.01 ± .009	.015 ± .011	.037 ± .018	1 ± .7	6 ± .8	90 ± 40
LAO-6	06/26	f	2							94 ± 141[d]			
LAO-6	06/26	f	3							.014 ± .011			
LAO-6A	03/28	uf	1	300 ± 300	1.3 ± .8	1.13 ± .48	.17 ± .02	.038 ± .017	.047 ± .019	.051 ± .02	.8 ± .7	4.9 ± .6	110 ± 50
LAO-6A	03/28	uf	R1					.005 ± .01	.02 ± .013	.038 ± .016			
LAO-6A	03/28	f	1	200 ± 300	1.7 ± 1.1	<.47	.19 ± .02	–.001 ± .011	.024 ± .012	.058 ± .02	–.4 ± .7	6.3 ± .8	80 ± 50
LAO-6A	03/28	f	R1					–.012 ± .006	.003 ± .008	.058 ± .02			
LAO-6A	06/26	uf	1	100 ± 300	1.2 ± .9	14 ± 21	.14 ± .01	.001 ± .011	.018 ± .01	.057 ± .02	1 ± .7	6 ± .8	0 ± 40
LAO-6A	06/26	uf	2							–7.2 ± 45[d]			
LAO-6A	06/26	uf	3							.028 ± .014			
LAO-6A	06/26	f	1	100 ± 300	.8 ± .8	14 ± 7	.14 ± .02	–.008 ± .006	.007 ± .009	.065 ± .021	2 ± .8	5 ± .7	90 ± 40
LAO-6A	06/26	f	2							48 ± 23[d]			
LAO-6A	06/26	f	3							.035 ± .019			

Table 5-36. Radiochemical Analyses of Alluvial Groundwater for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]		^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Mortandad Canyon:													
MCO-4B	03/31	uf	1	23,700 ± 1,500	6.9 ± 1	2.03 ± .69	1.69 ± .17	.127 ± .027	.099 ± .023	.246 ± .039	19 ± 5	54 ± 6	90 ± 50
MCO-4B	03/31	f	1	26,100 ± 1,600	39.8 ± 2.6	<1.33	1.08 ± .11	.114 ± .026	.099 ± .023	.315 ± .043	12 ± 5	130 ± 10	160 ± 50
MCO-4B	06/27	uf	1	16,700 ± 1,200	42.4 ± 2.8	1.4 ± 2.2	1.59 ± .16	.022 ± .018	.075 ± .023	66 ± 21[d]	12 ± 6	156 ± 11	210 ± 50
MCO-4B	06/27	uf	2							.38 ± .09			
MCO-4B	06/27	f	1	15,300 ± 1,200	49.3 ± 3.2	–10 ± 15	1.57 ± .16	.045 ± .019	.04 ± .018	–34 ± 51[d]	0 ± 5	156 ± 11	210 ± 50
MCO-4B	06/27	f	2							.29 ± .09			
MCO-6	03/31	ufd	1	32,200 ± 1,800	25.1 ± 1.7	<1.22	1.49 ± .15	.036 ± .017	.039 ± .016	.253 ± .039	27 ± 7	100 ± 10	60 ± 50
MCO-6	03/31	uf	1	30,800 ± 1,700	21.7 ± 1.4	<.83	1.52 ± .17	.035 ± .016	.106 ± .025	.168 ± .032	14 ± 5	100 ± 10	50 ± 50
MCO-6	03/31	uf	R1	31,500 ± 800									
MCO-6	03/31	fd	1	31,700 ± 1,700	22.2 ± 1.4	<1.44	1.46 ± .15	.037 ± .014	.092 ± .022	.212 ± .035	19 ± 5	98 ± 10	60 ± 50
MCO-6	03/31	f	1	30,900 ± 1,700	22.6 ± 1.5	<1.44	1.49 ± .15	.045 ± .017	.038 ± .016	.186 ± .031	–42 ± 9	110 ± 10	170 ± 50
MCO-6	06/27	ufd	1	20,200 ± 1,400	31.5 ± 1.9	–2.6 ± 18	1.83 ± .18	.042 ± .016	.026 ± .016	–30 ± 40[d]	6 ± 5	123 ± 11	120 ± 50
MCO-6	06/27	ufd	2							.23 ± .037			
MCO-6	06/27	uf	1	19,500 ± 1,300	23.3 ± 1.4	–3.2 ± 4.8	1.84 ± .18	.044 ± .016	.031 ± .017	–26 ± 39[d]	12 ± 5	123 ± 11	130 ± 50
MCO-6	06/27	uf	2							.303 ± .04			
MCO-6	06/27	fd	1	20,100 ± 1,400	30.6 ± 1.8	6 ± 10	1.87 ± .19	.04 ± .017	.035 ± .018	–11 ± 45[d]	17 ± 6	123 ± 11	150 ± 50
MCO-6	06/27	fd	2							.258 ± .019			
MCO-6	06/27	fd	R1							.243 ± .016			
MCO-6	06/27	f	1	21,000 ± 1,400	34.2 ± 2	5 ± 8	2.03 ± .3	.022 ± .011	.035 ± .014	–18 ± 45[d]	12 ± 6	123 ± 11	180 ± 50
MCO-6	06/27	f	2							.217 ± .017			
MCO-6	06/27	f	R1							.207 ± .016			
MCO-6B	03/31	uf	1	25,100 ± 1,500	43.1 ± 2.8	<1.44	1.08 ± .11	.043 ± .017	.022 ± .011	.305 ± .043	15 ± 5	140 ± 10	50 ± 50
MCO-6B	03/31	f	1	25,900 ± 1,600	4.5 ± .7	1.75 ± .72	1.72 ± .17	.062 ± .021	.062 ± .02	.25 ± .042	17 ± 5	57 ± 6	60 ± 50
MCO-7	03/30	ufd	1	20,200 ± 1,400	1 ± .8	<.73	1.22 ± .15	.006 ± .013	.02 ± .014	.292 ± .051	7 ± 3	38 ± 4	360 ± 60
MCO-7	03/30	ufd	R1					–.007 ± .011	.01 ± .012	.196 ± .035			
MCO-7	03/30	uf	1	19,600 ± 1,400	.9 ± .8	<1.07	1.34 ± .16	.022 ± .014	.021 ± .015	.21 ± .036	12 ± 3	40 ± 4	240 ± 50
MCO-7	03/30	uf	R1					.043 ± .017	.033 ± .016	.248 ± .054			
MCO-7	03/30	fd	1	20,800 ± 1,400	1 ± 1	<1.07	1.3 ± .22	.004 ± .007	.012 ± .013	.272 ± .045	17 ± 4	41 ± 4	60 ± 50
MCO-7	03/30	fd	R1					–.011 ± .009	.014 ± .012	.201 ± .034			
MCO-7	03/30	f	1	20,700 ± 1,400	.2 ± 1	<.81	1.26 ± .18	.017 ± .013	.021 ± .012	.176 ± .038	8 ± 3	39 ± 4	200 ± 50
MCO-7	03/30	f	R1					.023 ± .012	.014 ± .013	.185 ± .031			

Table 5-36. Radiochemical Analyses of Alluvial Groundwater for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]	^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Mortandad Canyon: (Cont.)												
MCO-7	06/28	uf 1	19,100 ± 1,300	1.7 ± 3.1	–40 ± 18	2.23 ± .22	.017 ± .021	.025 ± .016	–38 ± 45[d]	18 ± 5	59 ± 5	10 ± 40
MCO-7	06/28	uf R1								11 ± 4	56 ± 5	
MCO-7	06/28	uf 2							.223 ± .034			
MCO-7	06/28	f 1	19,700 ± 1,400	1.5 ± 1.1	–1.7 ± 18.1	1.78 ± .18	.008 ± .011	.058 ± .019	–7.6 ± 45[d]	15 ± 5	53 ± 5	60 ± 40
MCO-7	06/28	f R1					.03 ± .0063	.0192 ± .0057				
MCO-7	06/28	f 2							.228 ± .038			
MCO-7	08/10	uf 1	19,200 ± 1,300	.9 ± .9	.55 ± .83	2.4 ± .24	.019 ± .011	.026 ± .014	.208 ± .034	9 ± 4	58 ± 6	–60 ± 50
MCO-7	08/10	uf R1	19,300 ± 600									
MCO-7	08/10	f 1	19,700 ± 1,400	.4 ± .9	.37 ± .56	1.82 ± .18	.037 ± .019	.02 ± .016	.208 ± .034	6 ± 2	56 ± 6	30 ± 50
MCO-7	08/10	f R1					.0113 ± .0058	.0235 ± .0067	245 ± .036			
MCO-7A	03/31	uf 1	19,100 ± 1,300	1.3 ± .8	<1.33	1.81 ± .2	.021 ± .011	.052 ± .017	.12 ± .027	11 ± 3	45 ± 5	70 ± 50
MCO-7A	03/31	f 1	19,600 ± 1,400	1.5 ± .7	<1.44	1.85 ± .19	.053 ± .018	–.003 ± .01	.268 ± .042	16 ± 4	42 ± 4	70 ± 50
MCO-7A	06/28	uf 1	19,500 ± 1,300	1 ± 1.3	14 ± 5	1.89 ± .19	–.007 ± .009	.045 ± .017	–40 ± 45[d]	14 ± 5	49 ± 5	–10 ± 40
MCO-7A	06/28	uf R1										20 ± 40
MCO-7A	06/28	uf 2							.207 ± .034			
MCO-7A	06/28	uf R1							.18 ± .03			
MCO-7A	06/28	f 1	21,000 ± 1,400	1.1 ± 1.1	16 ± 24	2.53 ± .35	.007 ± .01	.023 ± .015	–9 ± 45[d]	22 ± 6	53 ± 5	40 ± 40
MCO-7A	06/28	f D1		1.2 ± 1.1		2.53 ± .25						
MCO-7A	06/28	f 2							.13 ± .05			
MCO-7A	08/10	uf 1	19,800 ± 1,400	.9 ± 1.1	.36 ± .54	3.13 ± .59	.047 ± .019	.01 ± .019	.207 ± .031	10 ± 4	61 ± 8	–20 ± 50
MCO-7A	08/10	uf D1		1.4 ± 1		3.11 ± .31						
MCO-7A	08/10	f 1	18,500 ± 1,300	1.1 ± 1.4	.63 ± .95	2.06 ± .21	.052 ± .018	–.023 ± .012	.251 ± .035	4 ± 2	54 ± 6	–50 ± 50
MT-4	03/27	uf 1	33,700 ± 1,800	0 ± .9	1.42 ± .69	1.46 ± .15	.014 ± .014	.021 ± .013	.261 ± .042	8 ± 3	20 ± 2	120 ± 50
MT-4	03/27	uf R1					.012 ± .011	.012 ± .016	.257 ± .038			
MT-4	03/27	f 1	36,800 ± 1,900	0 ± .8	<.59	1.64 ± .16	.029 ± .015	.024 ± .012	.367 ± .048	11 ± 4	21 ± 2	50 ± 50
MT-4	03/27	f R1					.044 ± .019	.035 ± .021	.364 ± .047			

Table 5-36. Radiochemical Analyses of Alluvial Groundwater for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]	^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Limits of Detection			2,000	3	4	0.1	0.04	0.04	0.04	3	3	
Water Quality Standards[f]												
DOE DCG for Public Dose			2,000,000	1,000	3,000	800	40	30	30			
DOE Drinking Water System DCG			80,000	40	120	30	1.6	1.2	1.2	30	1,000	
EPA Primary Drinking Water Standard			20,000	8		20				15		
EPA Screening Level											50	
NMWQCC Groundwater Limit						5,000						

[a] Except where noted.

[b] Codes: uf—unfiltered; f—filtered; d—field duplicate; 1—primary analysis; 2—secondary analysis; R1—lab replicate; D1—lab duplicate.

[c] Radioactivity counting uncertainties (1 standard deviation, except ^{3}H-3 standard deviations) follow the ± sign. Radioactivity counting uncertainties are less than analytical method uncertainties. Values less than two standard deviations are considered a nondetection.

[d] Result from ^{241}Am G method (direct counting GeLi detector). Other ^{241}Am measurements by the RAS (radiochemistry alpha spectroscopy) method.

[e] Less than symbol (<) means measurement was below the specified detection limit for the analytical method.

[f] Standards given here for comparison only; see Appendix A.

Table 5-37. Chemical Quality of Alluvial Groundwater for 1995 (mg/L[a])

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Acid/Pueblo Canyons:																				
APCO-1	03/29	uf 1	68	24	5.6	21	63	37.1	6.9	<5[f]	166	.52	3.9	13.8	<.01	240		82	7.58	401
APCO-1	03/29	uf R1						36.4	6.8											
APCO-1	03/29	f 1	70	25	5.8	16	68	36	6.8	<5	155	.51	3.4	4.3	<.01	298		86	7.68	395
APCO-1	06/23	uf 1		18.99	<3.89	14.44	64.44		10.11			.62	2.21	1.07	<.01					
APCO-1	06/23	uf D1		20	4	15.56	66.67													
APCO-1	06/23	f 1		18.99	<3.78	13.33	63.33		10.22			.63	2.22	1.1	<.01					
DP/Los Alamos Canyons:																				
LAO-3	03/29	uf 1	45	31	6.8	13	47	78.4	10.6	<5	71	.66	.09	7.3	<.01	222		105	7.2	391
LAO-3	03/29	f 1	44	32	6.7	12	48	78.3	10.6	<5	71	.63	.1	3.8	<.01	268		108	7.44	366
LAO-3	06/23	uf 1		16.77	<3.67	8	34.44		8.2			.91	<3.8	.058	<.01					
LAO-3	06/23	f 1		16.77	<3.67	7.22	33.33		8.17			.91	.18	.089	<.01					
LAO-3A	03/28	uf 1	43	27	5.7	8.2	45	87	10.8	<5	76	.68	.12	.34	<.01	278		90.2	7.07	403
LAO-3A	03/28	f 1	44	27	5.8	8.5	44	87	10.8	<5	74	.69	.09	.31	<.01	302		90.6	6.93	405
LAO-3A	03/28	f R1								<5	72	.67								
LAO-3A	06/23	uf 1		16.77	<3.78	8.78	34.44		8.29			.95	.16	2.26	<.01					
LAO-3A	06/23	f 1		16.77	<3.56	7.89	33.33		8.33			.95	<.02	.159	<.01					
LAO-3A	06/23	f D1							8.20				<.02	.159						
LAO-4.5	06/29	uf 1		13.33	<3.89	5.89	30		6.7			.92	.12	.066	<.01					
LAO-4.5	06/29	f 1		13.33	<3.78	5.78	30		6.72			.94	.1	.057	<.01					
LAO-4.5	06/29	f D1										.931								
LAO-4.5C	03/28	uf 1	36	11	3.5	4	28	44	7.8	<5	45	.7	.02	<.04	<.01	196		41.6	7.22	222
LAO-4.5C	03/28	f 1	37	12	3.7	4.6	28	43	7.8	<5	44	.71	.03	<.04	<.01	76		44.9	7.37	228
LAO-4.5C	03/28	f R1	38	11	3.7	4.3	28											42.4		
LAO-4.5C	06/26	uf 1		10.33	<3.44	<4.67	26.77		6.16			.84	.06	<.04	<.01					
LAO-4.5C	06/26	f 1		9.89	<3	<4.33	25.66		6.14			.84	.04	<.0	<.01					
LAO-6	03/30	ufd 1	38	12	3.9	2	29	39.6	7.3	<5	34	.42	.03	.57	<.01	140		46	7.39	205
LAO-6	03/30	uf 1	39	13	4.1	2.8	30	39.8	7.4	<5	34	.42	.02	.45	<.01	78		49	7.32	209
LAO-6	03/30	uf R1										.41								
LAO-6	03/30	fd 1	39	13	4.2	2.1	31	40	7.3	<5	35	.43	.03	4.6	<.01	198		49	7.32	214
LAO-6	03/30	f 1	40	12	3.8	2.2	28	39	7.4	<5	42	.35	.02	.28	<.01	122		45	7.43	216
LAO-6	06/26	uf 1		11.11	<3.67	<3.11	27.88		6.75			.54	.03	<.04	<.01					
LAO-6	06/26	f 1		12.22	<3.78	<3.89	27.88		6.6			.54	.03	.041	<.01					

Table 5-37. Chemical Quality of Alluvial Groundwater for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
DP/Los Alamos Canyons (Cont.):																				
LAO-6A	03/28	uf 1		9.7	3.1	2.8	25	40	7.2				.03	<.04	<.01	304		36.7	7.3	207
LAO-6A	03/28	f 1		9.7	3.2	2.7	25	40	7.2				.03	<.04	<.01	800		37.1	7.1	209
LAO-6A	03/28	f R1						39.9	7.1											
LAO-6A	06/26	uf 1		12.22	<3.89	<3.89	27.88		6.71			.53	.05	.051	<.01					
LAO-6A	06/26	f 1		13.33	<3.89	<3.33	27.88		6.63			.53	.03	.047	<.01					
LAO-6A	06/26	f D1							6.63				.02	.044	.01					
Mortandad Canyon:																				
MCO-4B	03/31	uf 1	38	30	2.6	22	70	17.6	19	<5	149	1.57	.08	15	<.01	350		85	7.78	463
MCO-4B	03/31	f 1	39	29	2.6	17	72	17.5	19.1	<5	152	1.58	.08	14.9	<.01	414		82	7.6	477
MCO-4B	03/31	f R1	39							<5	150									
MCO-4B	06/27	uf 1		26.77	<2.67	20	70		16.6			1.49	.08	13.11	<.01					
MCO-4B	06/27	uf D1		26.67	2.67	18.89	71.11													
MCO-4B	06/27	f 1		27.88	<2.56	18.99	72.22		16.66			1.49	.07	13	<.01					
MCO-6	03/31	ufd 1	38	28	2.6	19	83	13.4	15.7	<5	161	2.06	.16	18	<.01	372		80	7.74	464
MCO-6	03/31	uf 1	38	23	2.5	18	83	13.3	15.7	<5	158	1.97	.16	18.5	<.01	302		67	7.77	457
MCO-6	03/31	fd 1	38	22	2.5	19	82	13.1	15.6	<5	157	2.12	.17	17.8	<.01	370		65	7.78	480
MCO-6	03/31	f 1	39	22	2.5	18	81	12.9	15.7	<5	162	2.04	.16	18	<.01	204		65	8.03	495
MCO-6	06/27	ufd 1		23.33	<2.67	23.33	85.66		18.88			1.88	.12	16.33	<.01					
MCO-6	06/27	uf 1		22.22	<2.56	22.22	83.33		18.88			1.86	.14	18.11	<.01					
MCO-6	06/27	fd 1		23.33	<2.67	22.22	85.66		18.88			1.88	.12	17.88	<.01					
MCO-6	06/27	fd D1										1.86	.09		.01					
MCO-6	06/27	f1		23.33	<2.67	22.22	85.66		18.88			1.86	.12	16.77	<.01					
MCO-6B	03/31	uf 1	36	18	3.3	16	79	11.8	12.9	<5	155	2.16	.16	17	<.01	264		58	7.81	448
MCO-6B	03/31	f 1	37	18	3.3	17	79	11.7	13	<5	148	2.23	.17	17.2	<.01	218		58	7.66	440
MCO-7	03/30	ufd 1	38	23	6.5	18	94	11.9	12.8	<5	149	.82	.51	17	<.01	164		84	7.47	457
MCO-7	03/30	ufd R1		20	5.6	14	80											72		
MCO-7	03/30	uf 1	39	20	5.5	13	79	11.7	12.7	<5	149	1.79	.53	16.6	<.01	312		72	7.68	431
MCO-7	03/30	fd 1	40	19	5.3	13	78	11.7	12.6	<5	145	1.83	.52	26.6	<.01	304		69	7.67	454
MCO-7	03/30	f 1	40	19	5.3	14	78	11.7	12.7	<5	151	1.76	.51	19.4	<.01	324		69	7.69	441
MCO-7	06/28	uf 1		23.66	7.27	28.99	79.88		17.44			1.95	.58	23.22	<.01					
MCO-7	06/28	f 1		20.33	<4.8	18.66	77.66		16.66			1.96	.43	17.77	<.01					
MCO-7	08/10	uf 1	41	16	5.6	20	85	15	19	<5	160	1.88	.52	13.6	<.01	434	7	62.66	7.3	430
MCO-7	08/10	uf R1												13.3						
MCO-7	08/10	f 1	41	15	4.1	16	82	16	19	<5	168	1.89	.42	14	<.01	440	<1	53.99	7.45	426

Table 5-37. Chemical Quality of Alluvial Groundwater for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Mortandad Canyon (Cont.):																				
MCO-7A	03/31	uf 1	38	18	4.4	17	75	11.5	12.2	<5	149	1.95	.4	16.5	<.01	220		63	7.98	424
MCO-7A	03/31	f 1	40	18	4.5	16	76	11.1	12.1	<5	148	1.93	.41	16	<.01	300		63	7.81	440
MCO-7A	06/28	uf 1		23.44	8.34	28.66	81.88		16.77			2.05	.53	16	<.01					
MCO-7A	06/28	f 1		20.99	<5.26	21.66	79.66		16.66			2.06	.39	16.22	<.01					
MCO-7A	06/28	f D1													<.01					
MCO-7A	08/10	uf 1	40	17	6.2	23	86	16	19	<5	173	1.94	.49	13.7	<.01	492	21	67.55	7.79	433
MCO-7A	08/10	f 1	39	15	4	18	84	16	19	<5	150	1.94	.41	14	<.01	414	10	53.55	7.41	432
MT-4	03/27	uf 1		14	3.4	3.8	130	16.7	17.5				.12	36	<.01	518		48.6	7.5	591
MT-4	03/27	f 1		14	3.4	3.8	110	16.4	17.7				.12	35	<.01	374		48.6	7.6	586
Water Quality Standards[g]																				
EPA Primary Drinking Water Standard									500			4		10	0.2					
EPA Secondary Drinking Water Standard								250	250							500			6.8–8.5	
EPA Health Advisory							20													
NMWQCC Groundwater Limit								250	600			1.6		10	0.2	1000			6–9	

[a]Except where noted.
[b]Codes: uf—unfiltered; f—filtered; d—field duplicate; 1—primary analysis; R1—lab replicate; D1-lab duplicate.
[c]Total dissolved solids.
[d]Total suspended solids.
[e]Standard units.
[f]Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[g]Standards given here for comparison only; see Appendix A.

Table 5-38. Total Recoverable Trace Metals in Alluvial Groundwater for 1995 (µg/L)

Station Name	Date	Codes[a]		Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Alluvial Canyon Groundwater Systems															
Acid/Pueblo Canyons:															
APCO-1	03/29	uf	1	<100[b]	2,100	9	250	69	<3	<4	8	7,700	<20	1,200	<.2
APCO-1	03/29	f	1	<100	<100	11	250	43	<3	<4	9	5,300	<30	<100	<.2
APCO-1	06/23	uf	1	<11.1	578	<9.3	278	<44.4	<3.3	<3.3	<4.4	<5.6	<4.4	300	<.2
APCO-1	06/23	uf	D1	<11.1	489	9.2	278	45.6	<3.3	<3.3	5.6	4.4	<4.4	267	
APCO-1	06/23	f	1	<11.1	<111	<9.2	267	<40	<3.3	<3.3	<4.4	<4.4	<4.4	<111	<.2
DP/Los Alamos Canyons:															
LAO-3	03/29	uf	1	<70	<300	4	27	80	<3	<4	<10	7,000	<20	<100	<.2
LAO-3	03/29	f	1	<100	<100	<3	40	81	<3	<4	<4	4,700	<4	<100	<.2
LAO-3	06/23	uf	1	<11.1	356	<2.2	37.8	<51.1	<3.3	<3.3	<4.4	<4.4	<4.4	178	<.2
LAO-3	06/23	f	1	<11.1	333	<2.8	32.2	<48.9	<3.3	<3.3	<4.4	<4.4	<4.4	156	<.2
LAO-3A	03/28	uf	1	<10	500	2	40	90	<1	<3	<4	<4	<4	200	<.2
LAO-3A	03/28	f	1	<10	300	2	40	87	<1	<3	<4	<4	<4	100	<.2
LAO-3A	06/23	uf	1	<11.1	3,780	<2.6	35.6	<62.2	<3.3	<3.3	<4.4	<6.7	<4.4	1,330	<.2
LAO-3A	06/23	f	1	<11.1	311	<3.1	33.3	<50	<3.3	<3.3	<4.4	<4.4	<4.4	133	<.2
LAO-4.5	06/29	uf	1	<10	2,220	<2.2	30	<43.3	<3.3	<3.3	<4.4	<4.4	<4.4	1,110	<.2
LAO-4.5	06/29	f	1	<10	1,330	<2.2	34.4	<38.9	<3.3	<3.3	<4.4	<4.4	<4.4	711	<.2
LAO-4.5C	03/28	uf	1	<10	700	<2	30	40	<1	<3	<4	<4	<4	300	<.2
LAO-4.5C	03/28	f	1	<10	2,000	<2	30	47	<1	<3	<4	5	<4	1,000	<.2
LAO-4.5C	03/28	f	R1	<10	2,000	<2	30	50	<1	<3		6	<4	800	
LAO-4.5C	06/26	uf	1	<11.1	4,670	<2.2	24.4	<47.8	<3.3	<3.3	<4.4	14.4	<4.4	2,000	<.2
LAO-4.5C	06/26	f	1	<11.1	1,000	<2.2	23.3	<31.1	<3.3	<3.3	<4.4	<4.4	<4.4	433	<.2
LAO-6	03/30	ufd	1	<80	480	<3	16	32	<3	<3	<4	<4	<7	200	<.2
LAO-6	03/30	uf	1	<80	550	<3	<30	34	<3	<4	7	<10	<7	230	<.2
LAO-6	03/30	f	1	<80	430	<3	<20	30	<3	<4	<4	<6	<7	180	<.2

Table 5-38. Total Recoverable Trace Metals in Alluvial Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]		Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
DP/Los Alamos Canyons (Cont.):															
LAO-6	03/30	fd	1	<80	440	<3	14	33	<3	<4	<4	<20	<7	230	<.2
LAO-6	06/26	uf	1	<11.1	1,560	<2.2	26.7	<32.2	<3.3	<3.3	<4.4	<4.4	<4.4	667	<.2
LAO-6	06/26	f	1	11.1	744	<2.2	24.4	<31.1	<3.3	<3.3	<4.4	<5.6	<4.4	322	<.2
LAO-6A	03/28	uf	1	<10	240	<3	30	28	<1	<3	<4	<4	<4	100	<.2
LAO-6A	03/28	f	1	<10	1,000	<3	30	30	30	3	<4	<4	<4	400	<.2
LAO-6A	06/26	uf	1	17.8	878	<2.2	28.9	<30	<3.3	<3.3	<4.4	<4.4	<4.4	378	<.2
LAO-6A	06/26	f	1	25.6	711	<2.2	31.1	<30	<3.3	<3.3	<4.4	<4.4	<4.4	322	<.2
Mortandad Canyon:															
MCO-4B	03/31	uf	1	170	260	<3	52	76	<3	<4	<4	<4	<4	160	<.2
MCO-4B	03/31	f	1	<90	130	<3	32	78	<3	<4	<4	<7	11	<100	<.2
MCO-4B	06/27	uf	1	<11.1	1,670	<2.2	46.7	<84.4	<3.3	<3.3	<4.4	<6.7	<4.4	800	<.2
MCO-4B	06/27	uf	D1	<11.1	1,444	<2.2	46.7	84.4	<3.3	<3.3	<4.4	<4.4	4.4	756	<.2
MCO-6	03/31	ufd	1	<90	460	<3	52	77	<3	<15	<10	<6	<70	300	<.2
MCO-6	03/31	uf	1	<90	350	<3	48	77	<3	<4	<8	<4	<10	170	<.2
MCO-6	03/31	fd	1	<90	1,300	<3	50	74	<3	<4	<4	<9	<10	<100	<.2
MCO-6	03/31	f	1	<90	170	<3	51	73	<3	<20	<4	<10	11	<100	<.2
MCO-6	06/27	ufd	1	<11.1	389	<2.2	58.9	<84.4	<3.3	<3.3	<4.4	<4.4	<4.4	189	<.2
MCO-6	06/27	uf	1	<11.1	4,444.4	<2.2	58.9	<82.2	<3.3	<3.3	<4.4	<6.7	<4.4	200	<.2
MCO-6	06/27	fd	1	<11.1	256	<2.2	58.9	<82.2	<3.3	<3.3	<4.4	<5.6	<4.4	111	<.2
MCO-6	06/27	f	1	<11.1	267	<2.2	58.9	<83.3	<3.3	<3.3	<4.4	<4.4	<4.4	133	<.2
MCO-6B	03/31	uf	1	<90	590	<3	50	140	<3	<10	<4	<5	<10	250	<.2
MCO-6B	03/31	f	1	<90	430	<3	47	140	<3	<10	<4	<8	<10	230	<.2
MCO-7	03/30	ufd	1	<70	3,000	8	73	200	<3	<4	<4	15	13	1,400	<.2
MCO-7	03/30	ufd	R1	<70	3,100	4	60	170	<3	<4	<4	6	20	1,400	
MCO-7	03/30	uf	1	<70	1,000	3	61	170	<3	<4	<4	<9	<12	580	<.2

Table 5-38. Total Recoverable Trace Metals in Alluvial Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]		Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Mortandad Canyon (Cont.):															
MCO-7	03/30	fd	1	<80	<300	4	58	150	<3	<15	<7	<7	8	150	<.2
MCO-7	03/30	f	1	<80	420	4	56	160	<3	<4	6	6	<7	200	<.2
MCO-7	06/28	uf	1	<10	21,500	<7.3	72.2	268	<3.3	<3.3	<7.1	23.2	33.2	12,000	<.2
MCO-7	06/28	f	1	<10	1,870	<3.4	63.2	<152	<3.3	<3.3	<4.4	<4.9	<4.4	972	<.2
MCO-7	08/10	uf	1	<10	13,000	7	80	240	1	<3	<4	9	19	6,700	<.2
MCO-7	08/10	f	1	<10	100	4	70	150	<1	<3	<4	<4	5	100	.2
MCO-7A	03/31	uf	1	<90	410	3	53	150	<3	<15	<4	7	<10	200	<.2
MCO-7A	03/31	f	1	<90	260	<3	51	150	<3	<4	<6	<4	<10	120	<.2
MCO-7A	06/28	uf	1	<10	36,500	<9.6	74.3	393	<3.3	<3.3	<8.9	20.2	<4.4	21,200	<.2
MCO-7A	06/28	f	1	<10	7,220	<3.8	69.9	<194	<3.3	<3.3	<5.4	<10.6	<4.4	3840	<.2
MCO-7A	08/10	uf	1	<10	23,000	9	80	330	1	<3	6	14	12	14,000	<.2
MCO-7A	08/10	f	1	<10	260	4	70	170	<1	<3	<4	5	<4	1,300	<.2
MT-4	03/27	uf	1	<10	200	<3	90	98	<1	<3	<4	<.004	<4	100	<.2
MT-4	03/27	uf	R1	<10											<.2
MT-4	03/27	f	1	<10	300	<3	90	96	<1	<3	<4	<4	<4	100	<.2
Water Quality Standards[c]															
EPA Primary Drinking Water Standard						50		2,000	4	5		100			2
EPA Secondary Drinking Water Standard				50–200										300	
EPA Action Level													1,300		
NMWQCC Livestock Watering Standards				5,000	200	5,000			50	1,000	1,000	500			10
NMWQCC Groundwater Limit				50	5,000	100	750	1,000		10	50	50	1,000	1,000	2

[a]Codes: uf—unfiltered; f-filtered; d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.

[b]Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[c]Standards given here for comparison only, see Appendix A. Note that New Mexico Livestock and Groundwater limits (except for mercury) are based on dissolved concentrations, while many of these analyses are of unfiltered samples—thus concentrations may include suspended sediment quantities.

Table 5-38. Total Recoverable Trace Metals in Alluvial Groundwater for 1995 (µg/L) (Cont)

Station Name	Date	Codes[a]		Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Acid/Pueblo Canyons:														
APCO-1	03/29	uf	1	880	<8[b]	<10	<2	<2	<2	<30	130	<2	<4	38
APCO-1	03/29	f	1	330	<20	<30	<2	<2	<2	<30	130	<2	<4	<20
APCO-1	06/23	uf	1	678	<13.3	<11.1	<2.2	<2.2	<1.1	<33.3	111	<2.2	<17.8	<22.2
APCO-1	06/23	uf	D1	689	22.2	<11.1	2.2	<2.2	<1.1	<33.3	111	<2.2	18.9	<22.2
APCO-1	06/23	f	1	511	<18.9	<11.1	<2.2	<2.2	<1.1	<33.3	108	<2.2	<13.3	<22.2
DP/Los Alamos Canyons:														
LAO-3	03/29	uf	1	6	250	<20	<2	<2	<2	<30	190	<2	<4	<20
LAO-3	03/29	f	1	<3	280	<10	<2	<2	<2	<30	190	<2	<4	<20
LAO-3	06/23	uf	1	<3.3	622	<11.1	<2.2	<2.2	<1.1	<33.3	108	<2.2	<4.4	<22.2
LAO-3	06/23	f	1	<3.3	611	<11.1	<2.2	<2.2	<1.1	<33.3	106	<2.2	<4.4	<22.2
LAO-3A	03/28	uf	1	46	240	<10	<2	<2	<2	<30	190	<2	<4	<20
LAO-3A	03/28	f	1	<2	250	<10	<2	<2	<2	30	190	<2	<4	<20
LAO-3A	06/23	uf	1	35.6	578	<11.1	<2.2	<2.2	<1.1	<33.3	110	<2.2	<4.4	<22.2
LAO-3A	06/23	f	1	<3.3	567	<11.1	<2.2	<2.2	<1.1	<33.3	106	<2.2	<4.4	<22.2
LAO-4.5	06/29	uf	1	23.3	<11.1	<11.1	<4.4	<2.2	<1.3	<33.3	80	<2.2	<5.6	<22.2
LAO-4.5	06/29	f	1	18.9	<15.6	<11.1	<2.2	<2.2	<1.1	<33.3	77.8	<2.2	<4.4	<22.2
LAO-4.5C	03/28	uf	1	2	8	<10	<2	<2	<2	<30	85	<2	<4	<20
LAO-4.5C	03/28	f	1	20	12	<10	<2	<2	<2	<30	88	<2	<4	<20
LAO-4.5C	03/28	f	R1	20	13	<10	<2	<2		<30	87	<2	<4	<20
LAO-4.5C	06/26	uf	1	41.1	<12.2	<11.1	<2.2	<2.2	<1.1	<33.3	74.4	<2.2	<4.4	<22.2
LAO-4.5C	06/26	f	1	<3.3	<12.2	<11.1	<2.2	<2.2	<1.4	<33.3	67.8	<2.2	<4.4	<22.2
LAO-6	03/30	ufd	1	<3	<20	<10	<2	<2	<2	<30	83	<2	<4	<20
LAO-6	03/30	uf	1	<3	<20	<30	<2	<2	<2	<30	87	<2	<4	<20
LAO-6	03/30	fd	1	4	<20	<30	<2	<2	<2	<30	88	<2	<4	<20
LAO-6	03/30	f	1	<3	<20	<30	<2	<2	<2	<30	81	<2	<4	<20
LAO-6	06/26	uf	1	<5.6	<23.3	<11.1	<4.4	<2.2	<1.1	<33.3	80	<2.2	<5.6	<22.2
LAO-6	06/26	f	1	<3.3	<23.3	<11.1	<2.2	<2.2	<1.1	<33.3	80	<2.2	<4.4	<22.2

Table 5-38. Total Recoverable Trace Metals in Alluvial Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
DP/Los Alamos Canyons (Cont.):													
LAO-6A	03/28	uf 1	3	<8	10	<2	<2	4	<30	78	<2	<4	<20
LAO-6A	03/28	f 1	9	<8	10	<2	<2	<2	<30	77	<2	<4	<20
LAO-6A	06/26	uf 1	<3.3	<24.4	<11.1	<2.2	<2.2	<1.1	<33.3	87.8	<2.2	<4.4	<22.2
LAO-6A	06/26	f 1	<3.3	<25.6	<11.1	<2.2	<2.2	<1.1	<33.3	86.7	<2.2	<4.4	<22.2
Mortandad Canyon:													
MCO-4B	03/31	uf 1	9	170	<20	<2	<2	2	<30	100	<2	<4	20
MCO-4B	03/31	f 1	<3	170	<10	<2	<2	<2	<30	110	<2	<4	<20
MCO-4B	06/27	uf 1	20	156	<11.1	<2.2	<2.2	<1.1	<33.3	110	<2.2	<4.4	<22.2
MCO-4B	06/27	uf D1	18.9	167	<11.1	2.2	<2.2	<1.1	<33.3	110	<2.2	<4.4	<22.2
MCO-6	03/31	ufd 1	33	200	<10	<2	<2	2	<30	100	<2	<4	180
MCO-6	03/31	uf 1	<20	210	<20	<2	<2	3	<30	99	<2	<4	<20
MCO-6	03/31	fd 1	<3	210	<30	<2	<2	2	<30	96	<2	<4	<20
MCO-6	03/31	f 1	<3	190	<10	<2	<2	<2	<30	97	<2	<4	<20
MCO-6	06/27	ufd 1	<3.3	156	<11.1	<2.2	<2.2	<1.1	<33.3	110	<2.2	<4.4	<22.2
MCO-6	06/27	uf 1	<3.3	156	<11.1	<2.2	<2.2	<1.1	<33.3	108	<2.2	<4.4	<22.2
MCO-6	06/27	fd 1	<3.3	156	<11.1	<2.2	<2.2	<1.1	<33.3	110	<2.2	<4.4	<22.2
MCO-6	06/27	f 1	<3.3	144	<11.1	<2.2	<2.2	<1.2	<33.3	110	<2.2	<4.4	<22.2
MCO-6B	03/31	uf 1	6	170	<30	<2	<2	3	<30	100	<2	<4	<20
MCO-6B	03/31	f 1	4	180	<20	<2	<2	<2	<30	100	<2	<4	<20
MCO-7	03/30	ufd 1	33	210	<30	<2	<2	<2	<30	150	<2	<4	<20
MCO-7	03/30	ufd R1	29	190	<30	<2	<2	<2	<30	130	<2	5	<20
MCO-7	03/30	uf 1	32	180	<30	<2	<2	<2	<30	130	<2	<4	<20
MCO-7	03/30	fd 1	<3	160	<30	<2	<2	<2	<30	120	<2	5	<20
MCO-7	03/30	f 1	<3	180	<30	<2	<2	<2	<50	120	<2	<4	<20
MCO-7	06/28	uf 1	209	188	<11.1	15.6	<2.2	<2.7	<33.3	141	<2.2	<23.4	69.9
MCO-7	06/28	f 1	<7	180	<11.1	<2.2	<2.2	<1.1	<33.3	116	<2.2	<4.4	<22.2
MCO-7	08/10	uf 1	150	150	10	10	<1	1	30	130	<1	16	40
MCO-7	08/10	f 1	<2	150	<10	1	<1	<1	<30	110	<1	<4	20

Table 5-38. Total Recoverable Trace Metals in Alluvial Groundwater for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]		Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Mortandad Canyon (Cont.):														
MCO-7A	03/31	uf	1	8	190	<20	<2	<2	<2	<30	110	<2	<4	<20
MCO-7A	03/31	f	1	<3	210	<20	<2	<2	<2	<30	110	<2	<10	<20
MCO-7A	06/28	uf	1	631	180	<22.7	31.1	<2.2	<1.1	<33.3	154	<2.2	<38.7	73
MCO-7A	06/28	f	1	100	180	<11.1	<4.4	<2.2	<1.1	<33.3	122	<2.2	<15.4	<22.2
MCO-7A	08/10	uf	1	410	160	<10	19	2	2	<30	140	1	26	70
MCO-7A	08/10	f	1	40	160	<10	3	1	<1	<30	110	<1	6	<20
MT-4	03/27	uf	1	7	19	10	<2	<2	<2	<30	100	<2	<4	<20
MT-4	03/27	f	1	<2	19	10	<2	<2	<2	<30	100	<2	<4	<20
Water Quality Standards[c]														
EPA Primary Drinking Water Standard						100		6	50	25,000–90,000		2		
EPA Secondary DrinkingWater Standard				50										5,000
EPA Action Level														
EPA Health Advisory													80–110	
NMWQCC Livestock Watering Limit Standards							100		50				100	25,000
NMWQCC Groundwater Limit				200	1,000	200	50		50					10,000

[a]Codes: uf—unfiltered; f—filtered; d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.

[b]Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[c]Standards given here for comparison only, see Appendix A. Note that New Mexico Livestock and Groundwater limits (except for mercury) are based on dissolved concentrations, while many of these analyses are of unfiltered samples—thus concentrations may include suspended sediment quantities.

Table 5-39. Number of Results Above the Analytical Limit of Quantitation for Organic Compounds in Alluvial Groundwater for 1995

Station	Date	Type of Organic Compound		
		Volatile	Semivolatile	PCB
Number of Compounds Analyzed		59	69	4
LAO-3A	03/28	0	0	0
LAO-3A	06/23	0	0	0
LAO-3A	08/07	0	0	0
LAO-4.5C	03/28	0	0	0
LAO-4.5C	06/26	0	1	0
LAO-4.5C	08/08	0	0	0
LAO-4.5C	12/14	0	0	0
LAO-6	03/30	0	0	0
LAO-6	06/26	0	0	0
LAO-6A	03/28	0	0	0
MCO-6B	03/31	0	0	0
MCO-7A	03/31	1	0	0
MCO-7A	06/28	0	1	0
MT-4	03/27	1	0	0

Table 5-40. Results Above the Analytical Limit of Quantitation for Organic Compounds in Alluvial Groundwater for 1995 (µg/L)

Station	Date	Analyte	Sample Value	Uncertainty	Limit of Quantitation	Analyte Suite[a]	Symbol[b]	CST-12 Comments on Analytical Results
LAO-3A	06/23	Dimethyl-3-pentanone [2,4-]	6	0			TI	
LAO-4.5C	06/26	Di-n-butyl phthalate	11	3.3	10	svoa		found in method blank
MCO-7A	03/31	Acetone	21	6.3	20	voa		
MCO-7A	06/28	Di-n-butyl phthalate	12	3.6	10	svoa		found in method blank
MT-4	03/27	Chloromethane	11	3.3	10	voa		

[a]voa: volatile organics; svoa: semivolatile organics.
[b]TI: tentatively identified compound.

Table 5-41. Special Radiochemical and Chemical Analyses of Test Well Groundwater for 1995

Well (or Blank Type)	Date	Codes[a]	Well Bore No.	^{90}Sr (pCi/L)	^{3}H (pCi/L)[b]	Cl (mg/L)	NO_3-N (mg/L)
Test Well 3	07/18	1	0	0.6 ± 0.8[c]	–0.10 ± 0.29[d]	3.6	<.04
	07/18	1	3	0 ± 1	52.7 ± 1.60	3.7	.05
	07/18	d 1	3	0.5 ± 0.8	49.5 ± 1.60	3.6	.05
	07/18	s 1	3	0.4 ± 0.8			<.04
	07/18	1	4	0.5 ± 0.7	28.9 ± 0.96	3.5	.46
	07/18	1	5	0.3 ± 0.8	2.14 ± 0.29	3.6	.65
	07/18	1	7	0.5 ± 0.8	1.18 ± 0.29	3.5	.65
	07/18	1	10	0 ± 0.9	0.19 ± 0.29	3.5	.66
^{90}Sr Blank	07/18	1		0.3 ± 0.9			
^{3}H Blank B	07/18	b			1.28 ± 0.42		
Test Well 4	07/19	1	0	0.1 ± 0.7	0.10 ± 0.29	2.8	<.04
	07/19	1	1	1.1 ± 0.8	0.70 ± 0.29	2.8	<.04
	07/19	1	2	0.3 ± 0.9	0.54 ± 0.29	2.7	<.04
	07/19	d 1	2	–0.2 ± 1.2	0.22 ± 0.29		<.04
	07/19	1	3	2.9 ± 0.8	0.16 ± 0.29	2.8	<.04
	07/19	R1	3	0.5 ± 1.2			
	07/19	1	4	0.5 ± 0.9	0.89 ± 0.29	2.8	<.04
	07/19	R1	4	0.1 ± 1.2			
	07/19	s 1	4	0.7 ± 0.7		2.6	.36
	07/19	1	5	0.1 ± 0.8	1.92 ± 0.29	2.8	.04
	07/19	1	7	0.3 ± 0.9	0.35 ± 0.29	2.7	0.3
	07/19	1	10	–0.5 ± 1.2	0.51 ± 0.29	2.8	.35
	07/1	d 1	10	–1 ± 1.2	0.29 ± 0.29	2.8	.34
^{90}Sr Blank	07/19	1		0.1 ± 0.9			
^{3}H Blank B	07/19	b			0.26 ± 0.29		
Test Well 8	07/17	1	0	0 ± 0.7	13.7 ± 0.54	2.8	<.04
	07/17	d 1	0	0.5 ± 0.9	14.7 ± 0.51	2.5	<.04
	07/17	1	1	0.7 ± 0.6	15.6 ± 0.51	2.5	.23
	07/17	1	2	2.5 ± 0.7	13.8 ± 0.45	2.5	.24
	07/17	R1	2	0.9 ± 0.9			
	07/17	1	3	0.7 ± 0.9	10.7 ± 0.42	2.5	.27
	07/17	s 1	3	0.3 ± 0.8		2.5	.25
	07/17	1	4	0.4 ± 0.7	10.4 ± 0.42	2.5	.27
	07/17	1	5	0.2 ± 0.7	8.53 ± 0.38	2.2	.37
	07/17	1	7	0.9 ± 0.6	7.76 ± 0.38	2.5	.32
	07/17	1	10	1.5 ± 0.7	6.99 ± 0.32	2.5	0.3
	07/17	1	15	0.5 ± 0.9	5.24 ± 0.29	2.5	.44
	07/17	R1	15	0.2 ± 0.9			
^{90}Sr Blank	07/17	b 1		0.5 ± 0.7			
^{3}H Blank B	07/18	b			0.93 ± 0.29		

Table 5-41. Special Radiochemical and Chemical Analyses of Test Well Groundwater for 1995 (Cont.)

Well (or Blank Type)	Date	Codes[a]	Well Bore No.	^{90}Sr (pCi/L)	^{3}H (pCi/L)[b]	Cl (mg/L)	NO_3-N (mg/L)
Test Well 1	06/19				277 ± 9.3		
Test Well 1A	06/19				78.9 ± 2.55		
Test Well 2A	08/01				1807 ± 60.7		
Test Well 2	08/01				16.8 ± 0.57		
Test Well DT-9	05/31				1.50 ± 0.29		
Test Well DT-10	05/30				3.16 ± 0.29		
^{3}H Blank B		b			0.61 ± 0.29		
EPA Primary Drinking Water Standard[e]				8	20,000		10

[a]Codes: b—field blank; s—surveillance sample; d—field duplicate; 1—primary analysis; R1—lab replicate.
[b]Results from University of Miami Tritium Laboratory. Data are reported in tritium units (TU) and converted to pCi/L (1 TU = 3.193 pCi/L).
[c]Radioactivity counting uncertainties (one standard deviation) follow the ± sign. Values less than two standard deviations are considered a nondetection.
[d]Analytical method uncertainties (one standard deviation) follow the ± sign for Miami tritium values.
[e]Standards given here for comparison only; see Appendix A.

Table 5-42. Radiochemical Analyses of Pueblo Groundwater and Surface Water for 1995 (pCi/L[a])

Station Name	Date	Codes[b]	^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
San Ildefonso Pueblo												
Water Supply and Monitoring Wells:												
LA-1A	05/24	1	−300 ± 300	0 ± 1.1[c]	<.47[d]	4.57 ± .45	−.015 ± .015	.015 ± .017	.046 ± .018	3.7 ± 1.2	4.6 ± .7	50 ± 50
LA-1A	05/24	R1								3.7 ± 1.2	4.6 ± .6	
LA-1B	05/24	1	0 ± 300	.1 ± 1	<1.11	.78 ± .08	.047 ± .016	.037 ± .014	.021 ± .012	0 ± 2.4	3.7 ± .5	20 ± 50
Westside Artesian	05/24	1	0 ± 300	8.4 ± 1	<.68	20.73 ± 4.15	−.006 ± .001	.021 ± .012	.014 ± .013	−19.7 ± 6.1	11 ± 1	0 ± 50
Halladay House	05/24	1	−100 ± 300	.2 ± 1.1	<.74	8.75 ± .88	.013 ± .01	.013 ± .01	.019 ± .019	−.2 ± .5	1.6 ± .3	70 ± 50
Pajarito Pump 1	05/24	1	200 ± 300	.4 ± .8	<.92	10.62 ± 1.27	.005 ± .007	.006 ± .012	.012 ± .011	−8.6 ± 3.7	10 ± 1	80 ± 50
Pajarito Pump 2	05/24	1	−100 ± 300	0 ± .9	.49 ± .29	6.84 ± 1.23	−.011 ± .003	.034 ± .016	.075 ± .021	14 ± 3.7	4.5 ± .6	20 ± 50
Martinez House	05/24	1	−100 ± 300	0 ± 1	<1.33	7.61 ± .76	.009 ± .01	.012 ± .012	.044 ± .017	4.9 ± 2.4	6 ± .7	70 ± 50
Martinez House	05/24	D1				7.59 ± .76						
Otowi House	05/24	1	700 ± 300	1.1 ± 1	1.02 ± .63	3.77 ± .38	−.001 ± .007	.016 ± .013	.049 ± .019	2.5 ± 1	5.1 ± .6	40 ± 50
Otowi House	05/24	R1					−.002 ± .006	.015 ± .007	.0274 ± .0077			
New Community	05/24	1	−400 ± 300	0 ± .8	<.69	21.64 ± 5.41	−.003 ± .007	.003 ± .006	.036 ± .014	22 ± 4.9	8.4 ± 1	30 ± 50
New Community	05/24	d 1	2,700 ± 500	−.2 ± .9	1.59 ± .61	24.2 ± 2.42	.317 ± .04	.03 ± .012	.044 ± .016	21 ± 4.9	7.3 ± .8	70 ± 50
Sanchez House	05/24	1	2,100 ± 400	−.2 ± 1.1	1.56 ± .62	10 ± 1.6	.105 ± .026	.016 ± .015	.03 ± .015	14.8 ± 3.7	5.4 ± .6	10 ± 50
Alluvial Observation Wells:												
BIA Wellpoint 1	05/24	1	800 ± 300		<1.44	14.55 ± 1.89	.171 ± .029	.401 ± .046	.117 ± .047	−12 ± 11	14.5 ± 1	0 ± 50
BIA Wellpoint 3	05/25	1	200 ± 300	.7 ± 1.1	<1.44	3.57 ± .36	−.003 ± .012	.744 ± .072	.521 ± .056	2.4 ± 2.4	15.6 ± 1	20 ± 50
Blank:												
San Ildefonso Trip Blank	05/24	1	−200 ± 300	.1 ± .9	<.69	.58 ± .06	.005 ± .014	.029 ± .019	.048 ± .017	−.1 ± .2	0 ± .2	90 ± 50
Santa Clara Pueblo												
Water Supply Wells:												
Community Above Village	05/18	1	−200 ± 300	0 ± 1	<1.44	10.71 ± 1.07	.004 ± .01	−.002 ± .01	.061 ± .019	9.8 ± 2.4	6.2 ± .7	30 ± 5
Community Above Village	05/18	d 1	−400 ± 300	.2 ± .8	1.42 ± .67	10.1 ± 1.31	−.012 ± .009	.03 ± .016	.024 ± .018	9.8 ± 2	3.7 ± .5	100 ± 50
Community Above Village	05/18	D1				10.21 ± 1.12						
Naranjo House	05/18	1	−300 ± 300	−.3 ± .8	<.47	5.97 ± .6	.027 ± .013	.04 ± .014	.04 ± .017	5 ± .6	5 ± .6	50 ± 50
Naranjo House	05/18	R1					−.005 ± .005	.003 ± .004	.042 ± .008			
Enos House	05/18	1	−500 ± 300	.6 ± .7	2.17 ± .83	3.2 ± .32	.019 ± .012	.037 ± .014	.036 ± .016	1.7 ± 1	1 ± .3	20 ± 40
Enos House	05/18	R1								1 ± 1.1	1 ± .3	
Community New Subdivision	05/19	1	−200 ± 300	2.3 ± 1	<1.33	.13 ± .01	0 ± .007	−.005 ± .008	.007 ± .013	3.7 ± 2.4	2.4 ± .6	30 ± 50

Table 5-42. Radiochemical Analyses of Pueblo Groundwater and Surface Water for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]	^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Santa Clara Creek:												
S C Crk @ Rio Grande	5/18	1	0 ± 300	.9 ± .8	<.64	.49 ± .06	–.006 ± .012	–.006 ± .009	.05 ± .017	.05 ± .6	3.5 ± .5	10 ± 40
Blanks:												
Santa Clara Trip Blank	05/18	1	–300 ± 300	–.2 ± .9	<1.33	.01 ± .01	.005 ± .009	.02 ± .013	.022 ± .018	–.2 ± .2	–.2 ± .3	60 ± 50
Santa Clara Trip Blank	05/18	R1	–100 ± 400									
Cochiti Pueblo												
Cochiti Lake 1	06/08	1	–200 ± 300	1.7 ± .7	–.51 ± .8	.26 ± .03	–.005 ± .002	–.003 ± .005	.05 ± .018	.9 ± .5	3 ± .5	40 ± 40
Cochiti 1	06/08	1	–100 ± 300	2.2 ± .8	1.39 ± .77	.7 ± .07	.01 ± .01	.021 ± .014	.044 ± .021	5 ± .6	5 ± .8	80 ± 40
Cochiti Golf Course	06/08	1	0 ± 400	.3 ± .9	.72 ± 1.09	.01 ± .01	.001 ± .01	.032 ± .016	.034 ± .018	.4 ± .1	.5 ± .3	40 ± 40
Tetilla Peak	06/08	1	–100 ± 300	.4 ± .7	2.84 ± 1.04	4.61 ± .46	.005 ± .008	–.004 ± .007	.075 ± .024	6 ± 1.2	6 ± .8	–10 ± 40
Cochiti Elementary	06/08	1	–200 ± 300	.3 ± 1.1	.81 ± .41	3.05 ± .31	.025 ± .013	.015 ± .013	.02 ± .015	4.9 ± 1	4 ± .6	70 ± 40
Blanks:												
Cochiti Trip Blank	06/08	1	100 ± 300	.2 ± .7	–.07 ± .8	.62 ± .06	.039 ± .017	.007 ± .011	.056 ± .019	2 ± .6	4 ± .6	50 ± 40
Jemez Pueblo												
North Tank	07/21	1	–100 ± 300	0 ± .8	.04 ± .06	.12 ± .01	.003 ± .012	.019 ± .018	.022 ± .016	0 ± 4	12 ± 1	10 ± 40
Summary of Blanks												
San Ildefonso Trip Blank	05/24	1	–200 ± 300	.1 ± .9	<.69	.58 ± .06	.005 ± .014	.029 ± .019	.048 ± .017	–.1 ± .2	0 ± .2	90 ± 50
Santa Clara Trip Blank	05/18	1	–300 ± 300	–.2 ± .9	<1.33	.01 ± .01	.005 ± .009	.02 ± .013	.022 ± .018	–.2 ± .2	–.2 ± .3	60 ± 50
Santa Clara Trip Blank	05/18	R1	–100 ± 400									
Cochiti Trip Blank	06/08	1	100 ± 300	.2 ± .7	–.07 ± .8	.62 ± .06	.039 ± .017	.007 ± .011	.056 ± .019	2 ± .6	4 ± .6	50 ± 40

Table 5-42. Radiochemical Analyses of Pueblo Groundwater and Surface Water for 1995 (pCi/L[a]) (Cont.)

Station Name	Date	Codes[b]	^{3}H	^{90}Sr	^{137}Cs	U (µg/L)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Detection Limits			2,000	3	4	0.1	0.04	0.04	0.04	3	3	
Water Quality Standards[e]												
DOE DCG for Public Dose			2,000,000	1,000	3,000	800	40	30	30	30	1,000	
DOE Drinking Water System DCG			80,000	40	120	30	1.6	1.2	1.2			
EPA Primary Drinking Water Standard			20,000	8		20				15		
EPA Screening Level											50	
NMWQCC Groundwater Limit						5,000						

[a]Except where noted.

[b]Codes: d—field duplicate; 1—primary analysis; R1—lab replicate; D1-lab duplicate.

[c]Radioactivity counting uncertainties (1 standard deviation, except ^{3}H-3 standard deviations) follow the ± sign. Radioactivity counting uncertainties are less than analytical method uncertainties. Values less than two standard deviations are considered a non detection.

[d]Less than symbol (<) means measurement was below the specified detection limit for the analytical method.

[e]Standards given here for comparison only; see Appendix A.

Table 5-43. Chemical Quality of Pueblo Groundwater and Surface Water for 1995 (mg/L[a])

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Pueblo of San Ildefonso																				
Water Supply and Monitoring Wells:																				
LA-1A	05/24	1	26.11	13.4	.29	2.08	78.4	14.3	26.7	7.2	160	.49	<.02[f]	.011	.01	413	18.6	34.7	8.56	405
LA-1B	05/24	1	9.26	3.78	.14	2.08	147	17.3	32.8	17.5	289	2.67	<.02	.004	<.01	532	<1	10	8.95	670
Westside Artesian	05/24	1	23.32	13.9	.91	1.45	374	186	80.1	15.5	342	4.47	<.02	.025	.03	1084	<1	38.5	8.34	1977
Halladay House	05/24	1	25.89	4.24	.04	.67	40.5	3.81	13.9	6.5	85.4	.51	<.02	.565	<.01	195	<1	10.8	8.47	217
Pajarito Pump 1	05/24	1	34.67	59.9	6.45	3.77	312	223	51.7	0	571	.46	<.02	.212	<.01	1445	<1	176	7.72	1767
Pajarito Pump 2	05/24	1	34.03	27.1	1.95	2.36	110	52.5	25.4	0	231	.86	<.02	1.33	<.01	568	<1	75.7	7.9	660
Martinez House	05/24	1	39.16	41.5	2.67	2.85	55.6	17.6	34.1	0	155	.55	.049	8.63	<.01	504	<1	115	7.71	493
Otowi House	05/24	1	52.86	66.8	5.59	3.11	39.2	34.7	25.7	0	209	.32	<.02	.576	<.01	632	<1	190	7.08	560
New Community	05/24	1	24.18	16.5	1.09	.83	78.4	8.7	35.2	0	179	.13	<.02	1.45	<.01	397	<1	45.7	8.11	447
New Community	05/24	d 1	24.18	16.4	1.07	.79	77	8.81	35.2	9.2	179	.12	<.02	1.46	.01	404	<1	45.4	8.28	449
Sanchez House	05/24	1	37.24	28.1	2.13	1.69	93.5	45.3	41.3	0	185	1.17	.033	.949	<.01	520	<1	78.9	7.77	597
Alluvial Observation Wells:																				
BIA Wellpoint 1	05/24	1	200.73	232	71.8	28.6	37.5	36.5	23.3	0	181	.57	<.02	.081	1.71	8637	982	875	7.14	477
BIA Wellpoint 3	05/25	1	89.67	25.8	6.66	8.63	34.5	29.2	10.7	0	118	.46	.902	.307	.03	984	520	91.8	6.67	350
Blank:																				
San Ildefonso Trip Blank	05/24	1	1.35	.02	<.01	<.02	.38	.01	<.05	0	<.8	<.02	<.02	.052	<.01	2	<1	<.1	5.08	2

Table 5-43. Chemical Quality of Pueblo Groundwater and Surface Water for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Santa Clara Pueblo																				
Water Supply Wells:																				
Community Above Village																				
	05/18	1	24.40	26.3	.56	1.25	71.2	39.1	40.7	0	122	.3	<.02	.978	<.01	399	<1	68	7.98	460
Community Above Village																				
	05/18 d	1	24.18	25.9	.67	1.22	68.2	40	41.2	5.9	120	.34	<.02	1.00	<.01	404	3.4	67.4	8.17	462
Naranjo House																				
	05/18	1	42.37	25.8	1.62	1.85	53	3.48	17.6	7.1	152	.34	<.02	.206	.01	378	<1	71.1	8.18	338
Enos House	05/18	1	26.32	1.4	.12	.3	89.8	2.65	15.9	22.1	166	.99	<.02	.298	<.01	331	<1	4	9.29	369
Community New Subdivisiom																				
	05/19	1	25.25	37.2	.58	1.9	457	647	39.5	3.4	43.9	.76	<.02	.063	.12	1357	<1	95.3	8.3	2380
Santa Clara Creek:																				
Singer Headgate																				
	5/19	1	46.40	5.6	1.69	1.22	5.5	0.81	6.6	0	24.6	0.33	0.02	0.02	0.01	166	48.7	20.9	7.87	62
S C Crk @ Rio Grande																				
	5/18	1	102.9	16.2	4.38	2.87	6.7	0.72	3.1	0	44.5	0.38	0.03	0.09	0.01	266	5.4	58.5	7.66	100
Rio Grande:																				
Ditch Headgate																				
	5/18	1	44.1	31.6	7.34	2.78	9.9	2.31	37.7	0	74.0	0.20	0.02	0.10	0.01	436	105	109	7.86	234
Rio Grande @ S C Crk																				
	5/18	1	33.6	23.0	3.48	1.62	4.8	1.27	6.3	0	55.6	0.20	0.02	0.05	0.01	275	66	72	7.88	130
Blank:																				
Santa Clara Trip Blank																				
	05/18	1	.19	.09	.03	<.02	<.02	<.02	.24	0	<.7	<.02	<.02	<.01	<.01	.9	<1	.3	4.95	1
Cochiti Pueblo																				
Cochiti Lake 1																				
	06/08	1	62	23	4.1	3	12	3.5	7.2	<5	71	.29	.05	1.1	<.01	144	4	74	8.02	149
Cochiti 1	06/08	1	67	26	3.9	3.6	12	4.3	12	<5	90	.52	<.02	4.2	<.01	184	4	80	8.14	196
Cochiti 1	06/08	R1		27	4.1	3.8	13											84		
Cochiti Golf Course																				
	06/08	1	62	29	5.4	4.1	9.6	5.5	12	<5	68	.28	.04	2.3	<.01	172	5	94	7.73	186
Cochiti Golf Course																				
	06/08	R1										.27								
Tetilla Peak	06/08	1	28	43	7.6	2.6	22	6.8	45	<5	129	.39	<.02	.5	<.01	236	2	138	8.08	320

Table 5-43. Chemical Quality of Pueblo Groundwater and Surface Water for 1995 (mg/L[a]) (Cont.)

Station Name	Date	Codes[b]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[c]	TSS[d]	Hardness as $CaCO_3$	pH[e]	Conductance (µS/cm)
Cochiti Pueblo (Cont.):																				
Cochiti Elementary	06/08	1	33	51	7.2	2.7	18	4.4	15	<5	141	.35	<.02	1.2	<.01	228	4	156	8.04	288
Cochiti Elementary	06/08	R1	30																	
Blank:																				
Cochiti Trip Blank	06/08	1	<10	<.4	<.04	<.6	<.3	<.5	<1	<5	<5	<.1	<.02	<.04	<.01	30	4	<1	5.79	1
Jemez Pueblo																				
North Tank	07/21	1	58	50	11	11	82	75.8	38	10	276	1.32			<.01	538	<1	169	7.84	772
North Tank	07/21	R1		50	11	11	82			11	279							169		
Summary of Blanks																				
San Ildefonso Trip Blank	05/24	1	1.35	.02	<.01	<.02	.38	.01	<.05	0	<.8	<.02	<.02	.052	<.01	2	<1	<.1	5.08	2
Santa Clara Trip Blank	05/18	1	.19	.09	.03	<.02	<.02	<.02	.24	0	<.7	<.02	<.02	<.01	<.01	.9	<1	.3	4.95	1
Cochiti Trip Blank	06/08	1	<10	<.4	<.04	<.6	<.3	<.5	<1	<5	<5	<.1	<.02	<.04	<.01	30	4	<1	5.79	1
Water Quality Standards[g]																				
EPA Primary Drinking Water Standard									500			4		10	0.2					
EPA Secondary Drinking Water Standard								250	250							500			6.8–8.5	
EPA Health Advisory							20													
NMWQCC Groundwater Limit								250	600			1.6		10	0.2	1,000			6–9	

[a] Except where noted.
[b] Codes: uf—unfiltered; f—filtered; d—field duplicate; 1—primary analysis; R1—lab replicate; D1—lab duplicate.
[c] Total dissolved solids.
[d] Total suspended solids.
[e] Standard units.
[f] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[g] Standards given here for comparison only; see Appendix A.

Table 5-44. Total Recoverable Trace Metals in Pueblo Groundwater and Surface Water for 1995 (µg/L)

Station Name	Date	Codes[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Pueblo of San Ildefonso														
Water Supply and Monitoring Wells:														
LA-1A	05/24	1	<.5[b]	390	4	200	290	<2	4	<2	34	10	29,300	<.2
LA-1B	05/24	1	<.5	30	17	310	30	<2	<2	<2	<2	19	90	<.2
Westside Artesian	05/24	1	<.5	50	6	1800	40	<2	<2	6	<2	4	210	<.2
Halladay House	05/24	1	<.5	30	8	60	40	<2	<2	<2	17	15	120	<.2
Pajarito Pump 1	05/24	1	<.5	150	7	1580	90	<2	<2	<2	<2	22	860	<.2
Pajarito Pump 2	05/24	1	<.5	80	12	430	100	<2	<2	<2	<2	<2	30	<.2
Martinez House	05/24	1	<.5	130	8	120	180	2	5	55	55	34	560	<.2
Otowi House	05/24	1	<.5	140	2	60	310	<2	<2	<2	<2	5	280	<.2
New Community	05/24	1	<.5	90	4	40	20	12	<2	<2	<2	19	100	<.2
New Community	05/24	d 1	<.5	60	3	40	10	<2	<2	<2	<2	<2	10	<.2
Sanchez House	05/24	1	<.5	70	14	250	90	<2	<2	<2	<2	13	30	<.2
Alluvial Observation Wells:														
BIA Wellpoint 1	05/24	1	2.6	202,000	820	4,390	3,610	25	200	220	310	700	5,440,000	<.2
BIA Wellpoint 3	05/25	1	.8	7,480	13	130	250	<2	<2	5	24	87	28,800	<.2
Blanks:														
San Ildefonso Trip Blank	05/24	1	<.5	10	<2	<10	<10	<2	<2	<2	<2	<2	20	<.2
Santa Clara Pueblo														
Water Supply Wells:														
Community Above Village	05/18	1	<.5	90	3	120	60	<2	<2	<2	<2	8	60	<.2
Community Above Village	05/18	1	<.5	70	3	110	60	<2	3	<2	2	<2	<10	<.2
Naranjo House	05/18	1	<.5	100	5	50	140	<2	<2	<2	<2	<2	20	<.2
Enos House	05/18	1	<.5	30	54	170	<10	<2	<2	<2	<2	9	40	<.2
Community New Subdivision	05/19	1	<.5	140	7	180	430	<2	<2	<2	<2	7	70	<.2
Santa Clara Creek:														
Singer Headgate	5/19	1	<.5	2,260	<2	<10	30	<2	<2	<2	<2	5	1,500	<.2
S C Crk @ Rio Grande	5/18	1	<.5	11,300	3	10	160	<2	3	<2	7	7	7,780	<.2

Table 5-44. Total Recoverable Trace Metals in Pueblo Groundwater and Surface Water for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Rio Grande:														
Ditch Headgate	5/18	1	<.5	6,160	3	20	110	<2	6	<2	9	13	4,810	<.2
Rio Grande @ S C Crk	5/18	1	<.5	4,180	5	<10	90	<2	2	<2	<2	8	2,670	<.2
Blanks:														
Santa Clara Trip Blank	05/18	1	<.5	10	<2	<10	<10	<2	<2	<2	<2	<2	<10	<.2
Cochiti Pueblo														
Cochiti Lake 1	06/08	1	44	<100	<3	<10	140	<3	<3	<4	<4	24	<100	<.2
Cochiti 1	06/08	1	<40	<100	<3	<10	86	<3	<3	<4	<4	<4	<100	<.2
Cochiti 1	06/08	R1	<40	<100	<3	<10	87	<3	<3	<4	<4	<4	<100	
Cochiti Golf Course	06/08	1	45	<100	<3	<10	66	<3	<3	<4	<4	15	<100	<.2
Tetilla Peak	06/08	1	<40	<100	<3	35	47	<3	<3	<4	<4	<4	<100	<.2
Cochiti Elementary	06/08	1	43	<100	<3	25	180	<3	<3	<4	<4	<4	<100	<.2
Blanks:														
Cochiti Trip Blank	06/08	1	42	<100	<3	<10	<4	<3	<3	<4	<4	<4	<100	<.2
Jemez Pueblo														
North Tank	07/21	1	<10	<100	21	620	320	<1	<3	<4	<4	<4	100	<.2
North Tank	07/21	R1	<10	<10	21	620	320	<1	<3	<4	<4	<4	100	<.2
Summary of Blanks														
San Ildefonso Trip Blank	05/24	1	<.5	10	<2	<10	<10	<2	<2	<2	<2	<2	20	<.2
Santa Clara Trip Blank	05/18	1	<.5	10	<2	<10	<10	<2	<2	<2	<2	<2	<10	<.2
Cochiti Trip Blank	06/08	1	42	<100	<3	<10	<4	<3	<3	<4	<4	<4	<100	<.2

Table 5-44. Total Recoverable Trace Metals in Pueblo Groundwater and Surface Water for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Water Quality Standards[c]														
EPA Primary Drinking Water Standard					50		2,000	4	5		100			2
EPA Secondary Drinking Water Standard				50–200									300	
EPA Action Level												1,300		
NMWQCC Livestock Watering Standards				5,000	200	5,000			50	1,000	1,000	500		10
NMWQCC Groundwater Limit			50	5,000	100	750	1,000		10	50	50	1,000	1,000	2

[a]Codes: d—field duplicate; 1—primary analysis; R1—lab replicate.

[b]Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[c]Standards given here for comparison only, see Appendix A. Note that New Mexico Livestock and Groundwater limits (except for mercury) are based on dissolved concentrations, while many of these analyses are of unfiltered samples—thus concentrations may include suspended sediment quantities.

Table 5-44. Total Recoverable Trace Metals in Pueblo Groundwater and Surface Water for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]		Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Pueblo of San Ildefonso														
Water Supply and Monitoring Wells:														
LA-1A	05/24		1	270	7	5	10	<2[b]	<2	<5	500	<2	5	160
LA-1B	05/24		1	20	14	<2	<2	<2	<2	<5	100	<2	<2	10
Westside Artesian	05/24		1	<10	19	<2	<2	<2	<2	<5	340	<2	5	<10
Halladay House	05/24		1	<10	4	<2	2	<2	<2	<5	120	<2	23	10
Pajarito Pump 1	05/24		1	<10	<2	<2	<2	<2	<2	<5	1,400	<2	16	70
Pajarito Pump 2	05/24		1	<10	8	<2	2	<2	<2	<5	520	<2	31	10
Martinez House	05/24		1	<10	6	<2	2	<2	<2	<5	560	<2	26	400
Otowi House	05/24		1	<10	<2	<2	2	<2	<2	<5	800	<2	7	310
New Community	05/24		1	<10	<2	<2	2	<2	<2	<5	210	<2	18	10
New Community	05/24	d	1	<10	<2	<2	2	<2	<2	<5	200	<2	6	<10
Sanchez House	05/24		1	<10	11	<2	3	<2	<2	<5	290	<2	20	20
Alluvial Observation Wells:														
BIA Wellpoint 1	05/24		1	32,900	19	550	820	<10	<10	<5	1,640	3	2,190	275,000
BIA Wellpoint 3	05/25		1	420	39	26	21	<2	<2	<5	160	<2	26	7,140
Blanks:														
San Ildefonso Trip Blank	05/24		1	<10	<2	<2	<2	<2	<2	<5	<10	<2	<2	<10
Santa Clara Pueblo														
Water Supply Wells:														
Community Above Village	05/18		1	<10	7	5	<2	<2	<2	<5	560	<2	<2	<10
Community Above Village	05/18	d	1	<10	5	2	<2	<2	<2	<5	550	<2	2	<10
Naranjo House	05/18		1	<10	4	<2	<2	<2	<2	<5	350	<2	17	20
Enos House	05/18		1	<10	2	<2	<2	<2	<2	<5	30	<2	170	20
Community New Subdivision	05/19		1	30	78	3	<2	<2	<2	<5	700	<2	<2	370
Santa Clara Creek:														
Singer Headgate	5/19		1	90	2	<2	<2	<2	<2	<5	50	<2	2	<10
S C Crk @ Rio Grande	5/18		1	330	3	8	4	<2	<2	<5	120	<2	14	30

Table 5-44. Total Recoverable Trace Metals in Pueblo Groundwater and Surface Water for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Rio Grande:													
Ditch Headgate	5/18	1	240	5	3	2	<2	<2	<5	240	<2	9	30
Rio Grande @ S C Crk	5/18	1	90	2	2	3	<2	<2	<5	150	<2	6	20
Blanks:													
Santa Clara Trip Blank	05/18	1	<10	<2	<2	<2	<2	<2	<5	<10	<2	<2	<10
Cochiti Pueblo													
Cochiti Lake 1	06/08	1	<3	<8	<10	6	<2	<2	<30	100	<2	10	40
Cochiti 1	06/08	1	<3	<8	<10	<2	<2	<2	<30	170	<2	10	<20
Cochiti 1	06/08	R1	<3	<8	<10	<2	<2	<2	<30	170	<2	7	<20
Cochiti Golf Course	06/08	1	<3	<9	<10	3	<2	<2	<30	140	<2	<4	25
Tetilla Peak	06/08	1	<3	<8	<10	<2	<2	<2	<30	290	<2	8	23
Cochiti Elementary	06/08	1	<3	<8	<10	<2	<2	<2	<30	280	<2	<10	<20
Blanks:													
Cochiti Trip Blank	06/08	1	<3	<8	<10	<2	<2	<2	<30	<3	<2	<10	29
Jemez Pueblo													
North Tank	07/21	1	50	11	<10	<30	<3	1	<30	700	<3	<4	<20
North Tank	07/21	R1	48	14	<10	<30	<3	1	<30	700	<3	<4	20
Summary of Blanks													
San Ildefonso Trip Blank	05/24	1	<10	<2	<2	<2	<2	<2	<5	<10	<2	<2	<10
Santa Clara Trip Blank	05/18	1	<10	<2	<2	<2	<2	<2	<5	<10	<2	<2	<10
Cochiti Trip Blank	06/08	1	<3	<8	<10	<2	<2	<2	<30	<3	<2	<10	29

Table 5-44. Total Recoverable Trace Metals in Pueblo Groundwater and Surface Water for 1995 (µg/L) (Cont.)

Station Name	Date	Codes[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Water Quality Standards[c]													
EPA Primary Drinking Water Standard					100		6	50			2		
EPA Secondary DrinkingWater Standard			50										5,000
EPA Action Level						15							
EPA Health Advisory										25,000–90,000		80–110	
NMWQCC Livestock Watering Standards						100		50				100	25,000
NMWQCC Groundwater Limit			200	1,000	200	50		50					10,000

[a]Codes: d—field duplicate; 1—primary analysis; R1—lab replicate.

[b]Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[c]Standards given here for comparison only, see Appendix A. Note that New Mexico Livestock and Groundwater limits (except for mercury) are based on dissolved concentrations, while many of these analyses are of unfiltered samples—thus concentrations may include suspended sediment quantities.

Table 5-45. Number of Results Above the Analytical Limit of Quantitation for Organic Compounds in Pueblo Groundwater for 1995

Station	Date	Type of Organic Compound		
		Volatile	Semivolatile	PCB
Number of Compounds Analyzed		59	69	4
Pueblo of San Ildefonso				
Pajarito Pump 1	05/24	0	0	0
Pajarito Pump 2	05/24	0	0	0
Martinez House	05/24	0	0	0
New Community	05/24	1	0	0
Sanchez House	05/24	0	0	0
Santa Clara Pueblo				
Community Above Village	05/18	0	0	0
Community New Subdivision	05/19	0	0	0
Cochiti Pueblo				
Cochiti 1	06/08	0	1	0
Jemez Pueblo				
North Tank	07/21	1	0	0

Table 5-46. Results Above the Analytical Limit of Quantitation for Organic Compounds in Pueblo Groundwater for 1995 (µg/L)

Station	Date	Analyte	Sample Value	Uncertainty	Limit of Quantitation	Analyte Suite[a]	Symbol[b]	CST-12 Comments on Analytical Results
San Ildefonso Pueblo:								
New Community Well	05/24	Di-n-butyl phthalate	11	3.3	11	svoa		
Trip Blank	06/08	Dimethyl-3-pentanone [2,4-]	6	0			TI	
Cochiti Pueblo:								
Cochiti Well 1	06/08	Di-n-butyl phthalate	14	4.2		svoa		found in method blank
Jemez Pueblo:								
North Tank	07/21	Chlorodibromomethane	5	1.5	5	voa		
Trip Blank	07/21	Ethyl-1-hexanol [2-]	8	0			TI	
Trip Blank	07/21	Unknown organic acid	12	0			TI	

[a] voa: volatile organics; svoa: semivolatile organics.
[b] TI: tentatively identified compound.

Table 5-47. Radiochemical Analyses of Sediments on Pueblo of San Ildefonso Land for 1995

Station Name	Date	Code[a]	^{3}H (nCi/L)	^{90}Sr (pCi/g)	^{137}Cs (pCi/g)	Total U (µg/L)	^{238}Pu (pCi/g)	$^{239,240}Pu$ (pCi/g)	^{241}Am (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Gross Gamma (pCi/g)
Rio Grande:												
Rio Grande at Otowi (bank)	03/23	1	.2 (0.4)	.0 (0.2)[b]	.03 (.02)	1.57 (.28)	.009 (.002)	.024 (.003)	.004 (.001)	1.3 (0.3)	1.4 (0.2)	1.7 (0.2)
Rio Grande at Otowi (bank)	09/15	1	.0 (0.3)	.2 (0.2)	.07 (.02)		.002 (.001)	.003 (.001)		3.0 (0.6)	1.4 (0.2)	3.0 (0.3)
Rio Grande at Otowi (wdth intgrt)	09/15	1	.2 (0.4)	.0 (0.2)	.01 (.02)		.005 (.001)	.002 (.001)		2.0 (0.4)	.8 (0.2)	3.1 (0.4)
Guaje Canyon:												
Guaje at SR-502	03/21	1		.2 (0.2)	.04 (.02)	1.69 (.44)	.012 (.001)	.002 (.001)	.002 (.001)	1.7 (0.4)	1.4 (0.2)	2.2 (0.3)
Bayo Canyon:												
Bayo at SR-502	03/21	1		–.1 (0.3)	<.04[c]	1.30 (.13)	.010 (.002)	.002 (.001)	.002 (.001)	1.0 (0.3)	1.0 (0.2)	2.6 (0.3)
Pueblo Canyon:												
Pueblo at SR-502	05/02	1		.1 (0.2)	.03 (.01)	1.64 (.16)	.009 (.004)	1.057 (.053)	.030 (.003)	2.0 (0.5)	.8 (0.2)	2.4 (0.3)
Pueblo at SR-502	05/02	R					.012 (.002)	.407 (.017)	.016 (.002)			
Los Alamos Canyon:												
Los Alamos at SR-4	05/03	1	.0 (0.3)	.2 (0.6)	1.45 (.15)	1.47 (.15)	.064 (.008)	.364 (.021)	.282 (.011)	3.0 (0.6)	3.0 (0.3)	4.1 (0.4)
Los Alamos at SR-4	05/03	R					.037 (.005)	.180 (.012)	.191 (.008)			
Los Alamos at Totavi	05/04	1	–.1 (0.3)	.1 (0.2)	.12 (.02)	2.64 (.26)	.002 (.001)	.103 (.005)	.073 (.012)	2.0 (0.4)	1.0 (0.2)	2.8 (0.3)
Los Alamos at Totavi	05/04	R					.003 (.001)	.120 (.006)	.016 (.003)			
Los Alamos at LA-2	05/04	1	–.3 (0.3)	.0 (0.2)	.08 (.02)	1.54 (.15)	.006 (.002)	.125 (.010)	.011 (.002)	2.0 (0.5)	1.0 (0.2)	1.7 (0.2)
Los Alamos at LA-2	05/04	R					.002 (.001)	.099 (.006)				
Los Alamos at Otowi	05/04	1	–.1 (0.3)	.4 (0.4)	–.01 (.09)	1.93 (.19)	.005 (.002)	.204 (.011)	.016 (.002)	2.0 (0.5)	.5 (0.1)	2.0 (0.3)
Los Alamos at Otowi	05/04	R					.002 (.001)	.138 (.007)	.012 (.002)			
Mortandad Canyon:												
MCO-13 (A-5)	05/04	1	.5 (0.3)	.2 (0.2)	.26 (.04)	1.79 (.18)	.001 (.001)	.027 (.003)	.009 (.002)	5.0 (1.0)	4.0 (0.5)	2.4 (0.3)
MCO-13 (A-5)	05/04	R					.001 (.001)	.013 (.002)	.005 (.001)			
A-6	05/31	1	.3 (0.3)	.5 (0.3)	.50 (.08)	2.50 (.43)	.008 (.001)	.036 (.003)	.013 (.003)	6.1 (1.2)	5.0 (0.5)	3.4 (0.4)
A-6	05/31	R										
A-7	05/31	1	–.1 (0.3)	.2 (0.2)	.13 (.03)	.32 (.04)	.004 (.002)	.011 (.002)	.003 (.002)	3.3 (0.7)	2.3 (0.3)	1.8 (0.2)
A-8	05/31	1	–.1 (0.3)	.2 (0.2)	.15 (.04)	2.74 (.27)	.002 (.001)	.012 (.002)	.003 (.002)	4.2 (0.9)	3.2 (0.3)	2.7 (0.3)
Mortandad at SR-4 (A-9)	05/31	1	.3 (0.3)	.0 (0.2)	.06 (.02)	2.33 (.23)	.002 (.001)	.003 (.001)	.002 (.002)	3.5 (0.7)	2.4 (0.3)	2.2 (0.3)
A-10	05/31	1	.2 (0.3)	.1 (0.5)	<.03	.39 (.04)	.004 (.001)	.002 (.001)	.001 (.001)	2.1 (0.5)	1.4 (0.2)	2.4 (0.3)
Mortandad at Rio Grande (A-11)	09/11	1	–.1 (0.3)		.03 (.01)	1.78 (.21)	.003 (.001)	.005 (.001)	.002 (.001)	2.0 (0.6)	1.2 (0.2)	2.6 (0.3)
Detection Limits			0.2	10	0.05	0.25	0.005	0.005	0.005	1.5	1.5	0.8
Sediment Standards												
Historical Background (x+2s)[d]				0.87	0.44	4.4	0.006	0.023				7.9
SAL[e]			20.0	5.9	4.0	95.0	20.0	18.0	17.0			

[a] Code: 1—primary analysis; R—lab replicate.

[b] Radioactivity counting uncertainties are shown in parentheses; these are ±1 standard deviation, except for tritium, which is ±3 standard deviations. These uncertainties are less than analytical uncertainties. Reported values that are less than two standard deviations are considered nondetection.

[c] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.

[d] Purtymun (1987a); for comparison only. Here background is defined as mean plus two times standard deviation (x+2s).

[e] SAL-Screening Action Level; Environmental Restoration, 1995; see text for details.

Table 5-48. Total Recoverable Trace Metals in Sediments at Pueblo of San Ildefonso in 1995 (mg/kg)

Station Name	Date	Code[a]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Rio Grande														
Rio Grande at Otowi (bank)	09/15	1	1.0[b]	4,300	3.0	2.0	140.0	0.13	<0.4[c]	3.30	7.0	6.7	7,800	<0.03
Rio Grande at Otowi (bank)	09/15	R												<0.03
Rio Grande at Otowi (wdth intgrt)	09/15	1	<1.0	780	0.9	<1.0	25.0	<0.08	<0.4	0.62	1.7	3.9	2,300	0.03
Rio Grande at Otowi (wdth intgrt)	09/15	R												<0.03
Pueblo Canyon:														
Pueblo at SR-502	05/02	1	<5.0	5,500	0.8	7.6	46.0	0.55	<0.4	0.94	3.6	2.4	9,300	
Los Alamos Canyon:														
Los Alamos at SR-4	05/03	1	<5.0	2,300	0.8	3.2	17.0	0.12	<0.4	0.87	1.9	1.2	4,600	
Sandia Canyon:														
Sandia at Rio Grande	09/11	1	2.0	7,100	0.9	1.7	92.0	0.57	<0.4	4.00	10.0	5.6	12,000	<0.03
Sandia at Rio Grande	09/11	R												0.03
Mortandad Canyon:														
Mortandad at MCO-13 (A-5)	05/04	1	<1.0	4,400	1.0	5.6	68.0	0.43	0.4	4.10	2.6	3.2	5,500	
Mortandad A-6	05/31	1	<1.0	6,800	1.0	4.0	58.0	0.53	0.9	2.60	4.9	3.6	7,800	0.01
Mortandad A-6	05/31	R												<0.01
Mortandad A-7	05/31	1	<1.0	3,100	<0.5	3.0	19.0	0.29	0.8	1.30	2.5	<0.5	3,900	<0.01
Mortandad A-7	05/31	R												<0.01
Mortandad A-8	05/31	1	<1.0	5,500	1.0	4.0	52.0	0.53	0.7	2.60	4.5	1.9	7,300	<0.01
Mortandad A-8	05/31	R												<0.01
Mortandad at SR-4 (A-9)	05/31	1	<1.0	6,600	1.0	4.0	84.0	0.54	1.2	4.30	6.0	1.2	8,100	<0.01
Mortandad at SR-4 (A-9)	05/31	R												<0.01
Mortandad A-10	05/31	1	<1.0	6,500	0.9	3.4	70.0	0.40	1.1	3.70	6.1	<0.5	8,900	<0.01
Mortandad A-10	05/31	R												<0.01
Mortandad at Rio Grande (A-11)	09/11	1	1.9	8,900	2.0	<1.2	140.0	0.55	<0.4	6.00	9.2	7.9	12,000	0.03
Mortandad at Rio Grande (A-11)	09/11	R												0.03
Detection Limits			1.0	17	0.5	1.0	0.14	0.08	0.4	0.50	0.5	0.5	14	0.01

Table 5-48. Total Recoverable Trace Metals in Sediments at Pueblo of San Ildefonso in 1995 (mg/kg) (Cont.)

Station Name	Date	Code[a]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
Rio Grande													
Rio Grande at Otowi (bank)	09/15	1	230	<0.9	3.8	<4.1	<0.25	0.3	<4.0	71.0	<0.25	14.0	20.0
Rio Grande at Otowi (bank)	09/15	R											
Rio Grande at Otowi (wdth intgrt)	09/15	1	91	1.3	<1.2	<4.1	<0.25	<0.3	<4.0	8.1	<0.25	3.3	8.0
Rio Grande at Otowi (wdth intgrt)	09/15	R											
Pueblo Canyon:													
Pueblo at SR-502	05/02	1	210	<0.9	<2.0	11.0	<0.40	0.3	<3.0	8.1	<0.40	8.6	57.0
Los Alamos Canyon:													
Los Alamos at SR-4	05/03	1	120	<0.9	<2.0	10.0	<0.40	0.3	<3.0	3.7	<0.40	3.9	26.0
Sandia Canyon:													
Sandia at Rio Grande	09/11	1	350	1.8	8.9	13.0	<0.25	0.3	<4.0	29.0	<0.25	20.0	77.0
Sandia at Rio Grande	09/11	R											
Mortandad Canyon:													
Mortandad at MCO-13 (A-5)	05/04	1	550	<2.0	<2.0	<10.0	<0.40	0.3	<6.0	6.0	<0.40	6.3	30.0
Mortandad A-6	05/31	1	300	<0.9	<2.0	11.6	<0.25	0.3	<4.0	8.1	<0.25	9.4	56.0
Mortandad A-6	05/31	R											
Mortandad A-7	05/31	1	140	<0.9	<2.0	4.1	<0.25	0.2	<4.0	<0.3	<0.25	4.4	20.0
Mortandad A-7	05/31	R											
Mortandad A-8	05/31	1	280	<0.9	<2.0	7.6	<0.25	0.2	<4.0	6.4	<0.25	9.0	33.0
Mortandad A-8	05/31	R											
Mortandad at SR-4 (A-9)	05/31	1	370	<0.9	<2.0	9.2	<0.25	0.3	<4.0	9.4	<0.25	11.0	31.0
Mortandad at SR-4 (A-9)	05/31	R											
Mortandad A-10	05/31	1	300	<0.9	<2.0	6.8	<0.25	0.3	<4.0	8.1	<0.25	13.0	30.0
Mortandad A-10	05/31	R											
Mortandad at Rio Grande (A-11)	09/11	1	410	<0.9	8.2	8.5	<0.25	0.6	<4.0	32.0	<0.25	15.0	40.0
Mortandad at Rio Grande (A-11)	09/11	R											
Detection Limits			0.2	0.9	2.0	0.2	0.20	0.3	4.0	0.3	0.20	0.5	1.0

[a]Code: 1—primary analysis; R—laboratory replicate.
[b]Measurement uncertainty is approximately 10% of reported value.
[c]Less than symbol (<) means measurement was below the specified detection limit on the analytical method.

Table 5-49. Tritium Analyses of Pueblo Groundwater and Surface Water for 1995 (pCi/L)

Station Name	Date	Codes[a]	^{3}H (CST-9)	^{3}H (U of Miami)[b]
Pueblo of San Ildefonso				
Water Supply and Monitoring Wells:				
LA-1A	05/24	1	–300 ± 300[c]	8.75 ± 0.38[d]
LA-1B	05/24	1	0 ± 300	1.63 ± 0.29
Westside Artesian	05/24	1	0 ± 300	0.51 ± 0.29
Halladay House	05/24	1	–100 ± 300	0.96 ± 0.29
Pajarito Pump 1	05/24	1	200 ± 300	0.57 ± 0.29
Pajarito Pump 2	05/24	1	–100 ± 300	3.29 ± 0.29
Martinez House	05/24	1	–100 ± 300	7.85 ± 0.38
Otowi House	05/24	1	700 ± 300	100.26 ± 3.19
New Community	05/24	1	–400 ± 300	14.66 ± 0.48
New Community	05/24	d 1	2,700 ± 500	
Sanchez House	05/24	1	2,100 ± 400	15.65 ± 0.48
Springs:				
Basalt Spring	05/25	1	600 ± 300	88.13 ± 2.87
Basalt Spring	05/25	R1	800 ± 400	
La Mesita Spring	05/24	1	–100 ± 300	–0.22 ± 0.29
Sacred Spring	05/24	1	3,800 ± 600	3.42 ± 0.35
Indian Spring	05/25	1	–100 ± 300	4.06 ± 0.35
Alluvial Observation Wells:				
BIA Wellpoint 1	05/24	1	800 ± 300	125.48 ± 3.83
BIA Wellpoint 3	05/25	1	200 ± 300	86.85 ± 2.87
Blanks:				
PM-2 Blank	05/23			0.03 ± 0.29
Blank A				9.80 ± 0.38
Blank A				8.59 ± 0.35
Santa Clara Pueblo				
Water Supply Wells:				
Community Above Village	05/18	1	–200 ± 300	1.82 ± 0.32
Community Above Village	05/18	d 1	–400 ± 300	
Naranjo House	05/18	1	–300 ± 300	2.20 ± 0.42
Enos House	05/18	1	–500 ± 300	0.57 ± 0.29
Community New Subdivision	05/19	1	–200 ± 300	1.56 ± 0.29
Ranger Station	05/18			8.14 ± 0.29
Santa Clara Creek:				
Head Waters	05/19			32.41 ± 0.83
Singer Headgate	05/19			30.05 ± 0.80
Below 3rd Pond	05/19			30.05 ± 0.86
Power Lines	05/19			30.01 ± 0.83
S C Crk @ Rio Grande	05/18			27.52 ± 0.73
Rio Grande:				
Ditch Headgate	05/18			35.44 ± 0.96
Rio Grande @ S C Crk	05/18			41.83 ± 0.96
Blanks:				
PM-2 Blank	05/23			0.51 ± 0.29
Blank A				8.65 ± 0.32
Blank A				9.20 ± 0.35

Table 5-49. Tritium Analyses of Pueblo Groundwater and Surface Water for 1995 (pCi/L) (Cont.)

Station Name	Date	Codes[a]	^{3}H (CST-9)	^{3}H (U of Miami)[b]
Cochiti Pueblo				
Wells:				
Cochiti Lake 1	06/08	1	−200 ± 300	0.45 ± 0.29
Cochiti 1	06/08	1	−100 ± 300	0.73 ± 0.29
Cochiti Golf Course	06/08	1	0 ± 400	5.14 ± 0.29
Tetilla Peak	06/08	1	−100 ± 300	35.12 ± 1.28
Cochiti Elementary	06/08	1	−200 ± 300	0.99 ± 0.29
Blanks:				
Blank PM-2	05/23			0.26 ± 0.29
Blank A				9.71 ± 0.42
Blank A				8.08 ± 0.45
Jemez Pueblo				
Water Supply System:				
Convenience Store	07/21			37.36 ± 1.28
North Tank	07/21	1	−100 ± 300	54.28 ± 1.92
Toya House	07/21			53.32 ± 1.92
Waquie House	07/21			46.62 ± 1.60
Owl Springs	07/21			23.44 ± 0.77
Blanks:				
PM-2 Blank	05/23			0.29 ± 0.29
Blank A				9.00 ± 0.42
Blank A				8.24 ± 0.45
Water Quality Standards[e]				
DOE DCG for Public Dose			2,000,000	2,000,000
EPA Primary Drinking Water Standard			20,000	20,000

[a]Codes: d—field duplicate; 1—primary analysis; R1—lab replicate.
[b]Results from University of Miami Tritium Laboratory. Data are reported in tritium units (TU) and converted to pCi/L (1 TU = 3.193 pCi/L).
[c]Radioactivity counting uncertainties (three standard deviations) follow the ± sign. Values less than two standard deviations are considered a nondetection.
[d]Analytical method uncertainties (one standard deviation) follow the ± sign for Miami tritium values.
[e]Standards given here for comparison only; see Appendix A.

Table 5-50. 1995 Low Detection Limit Tritium Blank Data

Station	Date	TU[a]	±TU[b]	pCi/L	±pCi/L
PM-2 Tritium Values					
Prior PM-2 Values					
PM-2	2/14/1992	0.04	0.09	0.13	0.29
PM-2	8/18/1992	0.15	0.09	0.48	0.29
PM-2	5/19/1993	0.49	0.09	1.56	0.29
1995 Pueblo PM-2 Blanks					
PM-2 Blank	5/23/1995	0.16	0.09	0.51	0.29
PM-2 Blank	5/23/1995	0.01	0.09	0.03	0.29
PM-2 Blank	5/23/1995	0.08	0.09	0.26	0.29
PM-2 Blank	5/23/1995	0.09	0.09	0.29	0.29
Mean		**0.14**	**0.09**	**0.47**	**0.29**
Std. Dev.		0.16	0.00	0.51	0.00
Blank A Values[c]					
Blank A	5/26/1995	2.71	0.10	8.65	0.32
Blank A	5/26/1995	2.88	0.11	9.20	0.35
Blank A		3.07	0.12	9.80	0.38
Blank A		2.69	0.11	8.59	0.35
Blank A		3.04	0.13	9.71	0.42
Blank A		2.53	0.14	8.08	0.45
Blank A		2.82	0.13	9.00	0.42
Blank A		2.58	0.14	8.24	0.45
Mean		**2.79**	**0.12**	**8.91**	**0.39**
Std. Dev.		0.20	0.01	0.64	0.05
Expected[c]		**2.57**	**0.47**	**8.21**	**1.50**
Blank B Values[c]					
LL H3 Blank B		0.19	0.09	0.61	0.29
TW8 H3 Blank B	7/18/1995	0.29	0.09	0.93	0.29
TW4 H3 Blank B	7/18/1995	0.08	0.09	0.26	0.29
TW3 H3 Blank B	7/18/1995	0.40	0.13	1.28	0.42
Mean		**0.24**	**0.10**	**0.77**	**0.32**
Std. Dev.		0.14	0.02	0.44	0.06
Expected[c]		**0.04**	**0.28**	**0.12**	**0.89**

[a] 1 TU = 3.193 pCi/L.

[b] Tritium analytical method uncertainties (one standard deviation).

[c] University of Waterloo Environmental Isotope Laboratory prepared tritium standards. Prepared standard uncertainties are given as ± one standard deviation.

Table 5-51. Wells Equipped with Recording Transducers in 1995

Well	Date Started	Date Ended	Water Depth[a] (ft)	Elevation[b] (ft)
Main Aquifer Test Wells				
TW-1	10-14	12-31	550.15[a]	5,818.03[b]
TW-2	01-01	12-31	796.84	5,851.92
TW-3	10-14	12-31	781.78	5,815.83
TW-4	01-01	12-31	1,177.23	6,069.10
TW-8	01-11	12-31	994.43	5,883.60
DT-5A	10-24	12-31	1,183.47	5,961.16
DT-9	02-24	12-31	1,115.50	5,921.21
DT-10	02-24	12-31	1,097.03	5,922.89
LA-1B	01-01	12-31	artesian	5,635.29[c]
LA-1A	01-01	12-31	artesian	T.O.C.[d]
Municipal Water Supply Wells				
Otowi-1	02-09	12-31	678.25	5,720.50
Intermediate Perched Zone Wells				
TW-1A	01-01	12-31	194.05	6,177.17
TW-2A	10-18	12-31	117.27	6,536.09
LADP-3	10-18	12-31	322.86	6,435.20
Canyon Alluvial Wells				
LAO-3	01-01	11-02	10.67	6,569.68
LAO-4	01-01	12-31	15.45	6,506.16
Other Wells				
CH-2	01-01	12-31	508.31	6,636.14

[a]Depth to water measured below top of casing on end date.
[b]Water elevation relative to mean sea level (MSL) on end date.
[c]Overflow drain-pipe elevation is about 5,616 ft above MSL; top-of-pipe elevation is about 5,622 ft above MSL. Water levels were recorded using a mechanical packer set below the overflow pipe.
[d]T.O.C.: Top of casing reference point.

Table 5-52. RESRAD[a] Input Parameters for Mortandad Canyon Sediments Collected in 1995

Parameter	Value	Comments
Area of contaminated zone	10,000 m^2[b]	RESRAD default value; a larger area maximizes exposure via external gamma, inhalation and ingestion pathways
Thickness of contaminated zone	3 m	Based on mesa top conditions[c]
Time since placement of material	0 yr	Assumes current year (i.e., no radioactive decay) and minimal weathering
Cover depth	0 m	Assumption of no cover maximizes dose
Density of contaminated zone	1.6 g/cm^3	Based on previous models[d] and mesa top conditions[c]
Contaminated zone erosion rate	0.001 m/yr	RESRAD default value
Contaminated zone total porosity	0.5	Average from several samples in Mortandad Canyon[e]
Contaminated zone effective porosity	0.3	Table 3.2 in data handbook[f]
Contaminated zone hydraulic conductivity	440 m/yr	An average value for soil (not tuff)[g]
Contaminated zone b parameter	4.05	Mortandad Canyon consists of two units, the top most unit being sand[h] and Table 13.1 in the data handbook[f]
Humidity in air	4.8 g/cm^3	Average value from Los Alamos Climatology[i]
Evapotranspirations coefficient	0.85	Based on tritium oxide tracers in Mortandad Canyon[j]
Precipitation	0.48 m/yr	Average value from Los Alamos Climatology[i]
Irrigation rate	0 m/yr	Water in Mortandad Canyon is not used
Runoff coefficient	0.52	Based on mesa top conditions[c]
Inhalation rate	8400 m^3/yr	RESRAD default value
Mass loading for inhalation	5.53×10^{-5} g/m^3	Factor used for benchmarking against several codes[k]
Exposure duration	1 year	Assumes current year exposure only
Dilution length for airborne dust	3 m	RESRAD default value
Shielding factor, inhalation	0.4	RESRAD default value
Shielding factor, external gamma	0.7	RESRAD default value
Fraction of time spent indoors each year	0.7	Based on 18 h/d[c]
Fraction of time spent outdoors	0.01	Assumes an industrial scenario where access to site is somewhat limited[l]
Shape factor	1	Corresponds to a contaminated area larger than a circular area of 1200 m^2
Depth of soil mixing layer	0.15 m	RESRAD default value.
Soil ingestion rate	44 g/yr	Calculated based on 100 mg/d for 24 yr (adult) and 200 mg/d for 6 yr (child)[c]

[a]RESRAD is a computer modeling code designed to model radionuclide transport in the environment.
[b]For sampling locations MCO-5 and GS-1, the area of the contaminated zone was assumed to be 100 m^2.
[c]Fresquez 1996.
[d]Buhl 1989.
[e]Stoker 1991.
[f]Yu 1993.
[g]Nyhan 1978.
[h]Purtyman 1983.
[i]Bowen 1990.
[j]Penrose 1990.
kFaillace 1993.
[l]Robinson 1991.

Table 5-53. RESRAD[a] Input for Initial Radionuclide Concentrations (pCi/g)

Location	^{3}H	^{90}Sr	^{137}Cs	^{234}U	^{235}U	^{238}U	^{238}Pu	^{239}Pu	^{241}Am
Mortandad Canyon	588 (1440)[b]	0.342 (0.348)[b]	3.31 (7.59)[b]	0.556 (0.284)[b]	0.0239 (0.0122)[b]	0.511 (0.261)[b]	1.05 (2.15)[b]	1.85 (3.22)[b]	2.47 (4.50)[b]
GS-1	4930 (430)[c]	0.3 (0.3)[c]	25.7 (1.90)[c]	0.481 (0.047)[c]	0.0207 (0.0020)[c]	0.442 (0.043)[c]	6.92 (1.05)[b]	7.71 (1.14)[b]	13.4 (2.33)[b]
MCO-5	1610 (271)[b]	1.3 (0.7)[c]	12.8 (1.00)[c]	0.452 (0.047)[c]	0.0194 (0.0020)[c]	0.416 (0.043)[c]	2.47 (0.304)[b]	7.21 (1.09)[b]	7.17 (2.12)[b]

[a]RESRAD is a computer modeling code designed to model radionuclide transport in the environment.
[b]One standard deviation of analytical results
[c]One counting uncertainty of analytical results.

Table 5-54. Total Effective Dose Equivalent for Mortandad Canyon (mrem)

Location	^{3}H	^{90}Sr	^{137}Cs	^{234}U	^{235}U	^{238}U	^{238}Pu	^{239}Pu	^{241}Am	Total
Mortandad Canyon	0.277 (0.680)[a]	0.006 (0.012)	5.433 (12.44)	0.015 (0.008)	0.009 (0.005)	0.046 (0.024)	0.163 (0.334)	0.317 (0.515)	0.487 (0.890)	6.754 (14.94)
GS-1	0.232 (0.020)	0.004 (0.004)	35.36 (2.614)	0.007 (0.0007)	0.007 (0.0007)	0.031 (0.003)	0.359 (0.055)	0.438 (0.065)	1.032 (0.180)	37.47 (2.942)
MCO-5	0.076 (0.013)	0.016 (0.009)	17.61 (1.376)	0.007 (0.0007)	0.006 (0.0007)	0.029 (0.003)	0.128 (0.016)	0.410 (0.062)	0.554 (0.164)	18.84 (1.643)

[a]One standard deviation in parenthesis.

Table 5-55. Maximum Total Effective Dose Equivalent (Average + 2 Sigma) (mrem)

Location	^{3}H	^{90}Sr	^{137}Cs	^{234}U	^{235}U	^{238}U	^{238}Pu	^{239}Pu	^{241}Am	Total
Mortandad Canyon	1.636	0.018	30.313	0.030	0.019	0.093	0.830	1.419	2.266	36.634
GS-1	0.272	0.012	40.588	0.008	0.008	0.037	0.468	0.567	1.393	43.353
MCO-5	0.102	0.034	20.362	0.008	0.007	0.035	0.160	0.533	0.882	22.123

Table 5-56. Total Committed Effective Dose Equivalent (mrem)[a] from the Consumption of Water from the TA-50 Effluent and the Stream Below the Outfall during 1995

	Per Liter		Exercise Scenario			
			Maximum Consumption[b]		Average Consumption[c]	
Radionuclide	TA-50 Effluent	Stream below Outfall	TA-50 Effluent	Stream below Outfall	TA-50 Effluent	Stream below Outfall
Tritium	2.6×10^{-3}	9.8×10^{-4}	4.2×10^{-2}	1.6×10^{-2}	1.5×10^{-2}	5.6×10^{-3}
^{89}Sr	5.7×10^{-5}	2.1×10^{-5}	9.2×10^{-4}	3.4×10^{-4}	3.3×10^{-4}	1.2×10^{-4}
^{90}Sr	4.8×10^{-3}	1.8×10^{-3}	7.7×10^{-2}	2.9×10^{-2}	2.7×10^{-2}	1.0×10^{-2}
^{137}Cs	1.9×10^{-2}	7.0×10^{-3}	3.0×10^{-1}	1.1×10^{-1}	1.1×10^{-1}	4.0×10^{-2}
^{56}Co	8.4×10^{-3}	3.1×10^{-3}	1.4×10^{-1}	5.1×10^{-2}	4.8×10^{-2}	1.8×10^{-2}
^{57}Co	1.3×10^{-3}	4.9×10^{-4}	2.1×10^{-2}	8.0×10^{-3}	7.6×10^{-3}	2.8×10^{-3}
^{58}Co	5.3×10^{-3}	2.0×10^{-3}	8.5×10^{-2}	3.2×10^{-2}	3.0×10^{-2}	1.1×10^{-2}
^{234}U	3.7×10^{-3}	1.4×10^{-3}	6.0×10^{-2}	2.2×10^{-2}	2.1×10^{-2}	8.0×10^{-3}
^{235}U	1.3×10^{-3}	5.0×10^{-5}	2.2×10^{-3}	8.0×10^{-4}	7.6×10^{-4}	2.9×10^{-4}
^{238}Pu	7.4×10^{-1}	2.8×10^{-1}	$1.2 \times 10^{+1}$	4.5×10^{0}	4.2×10^{0}	1.6×10^{0}
^{239}Pu	1.5×10^{-1}	5.8×10^{-2}	2.5×10^{0}	9.3×10^{-1}	8.8×10^{-1}	3.3×10^{-1}
^{241}Am	3.6×10^{-1}	1.3×10^{-1}	5.8×10^{0}	2.2×10^{0}	2.0×10^{0}	7.7×10^{-1}
Total CEDE	1.3×10^{0}	4.9×10^{-1}	$2.1 \times 10^{+1}$	7.8×10^{0}	7.4×10^{0}	2.8×10^{0}

[a]Based on DOE dose conversion factors (DOE 1988).
[b]Maximum consumption rate is 16.1 L/year (0.8 L/event). See text for assumptions.
[c]Average consumption rate is 5.7 L/year (0.3 L/event). See text for assumptions.

G. Figures

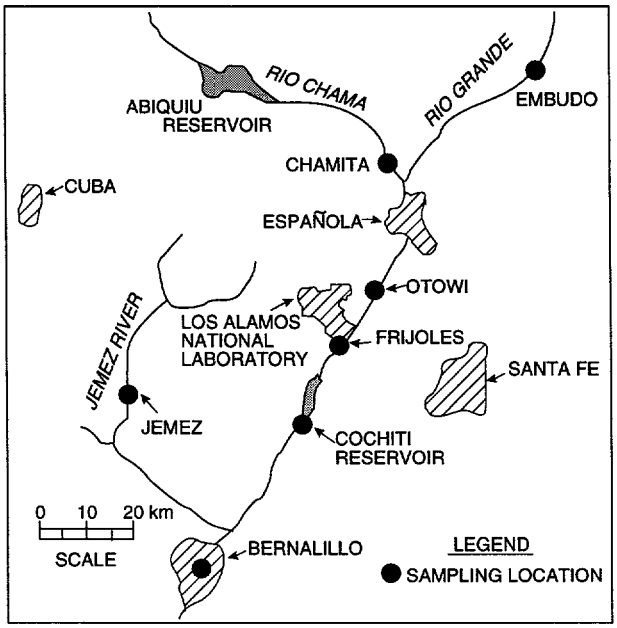


Figure 5-1. Regional surface water and sediment sampling locations.

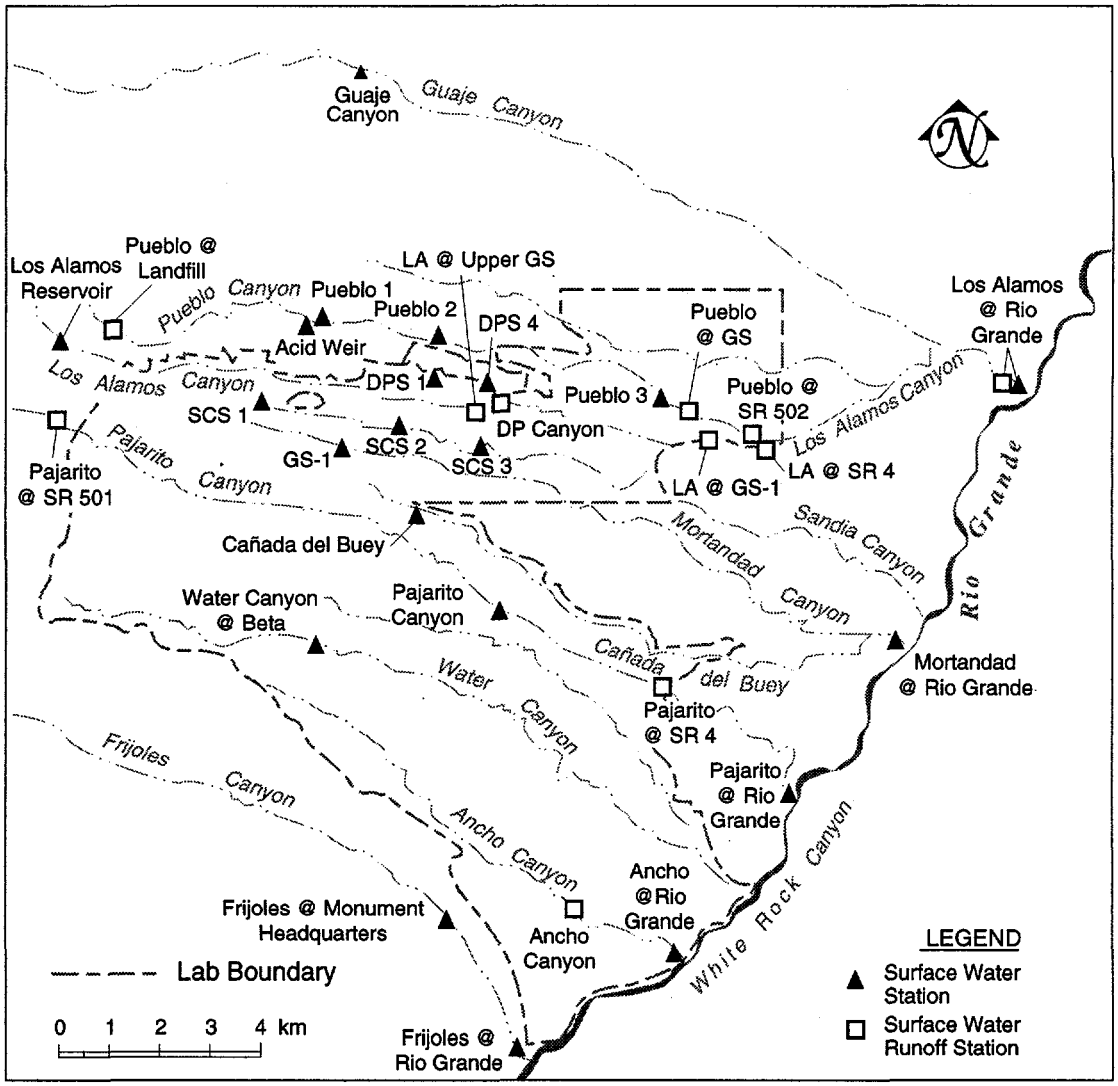


Figure 5-2. Surface water sampling locations in the vicinity of Los Alamos National Laboratory.

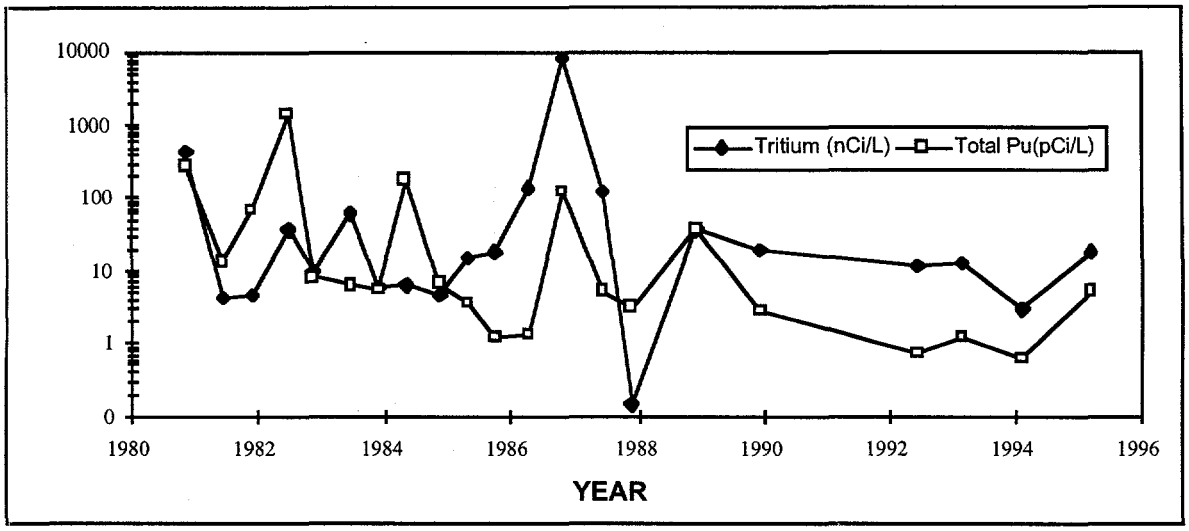


Figure 5-3. Tritium and plutonium concentrations at Mortandad Canyon at Gaging Station 1.

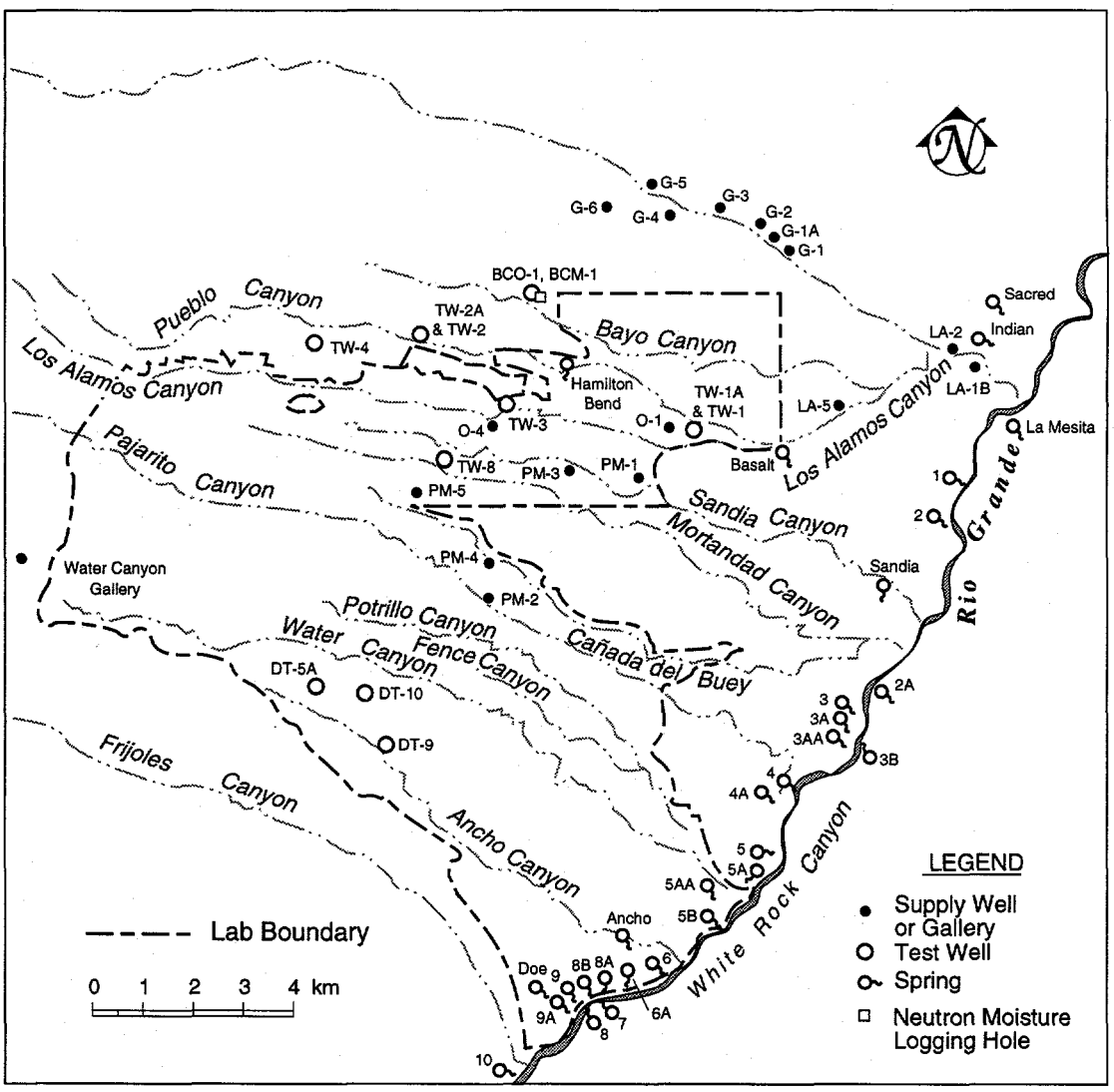


Figure 5-4. Springs and deep and intermediate wells used for groundwater sampling.

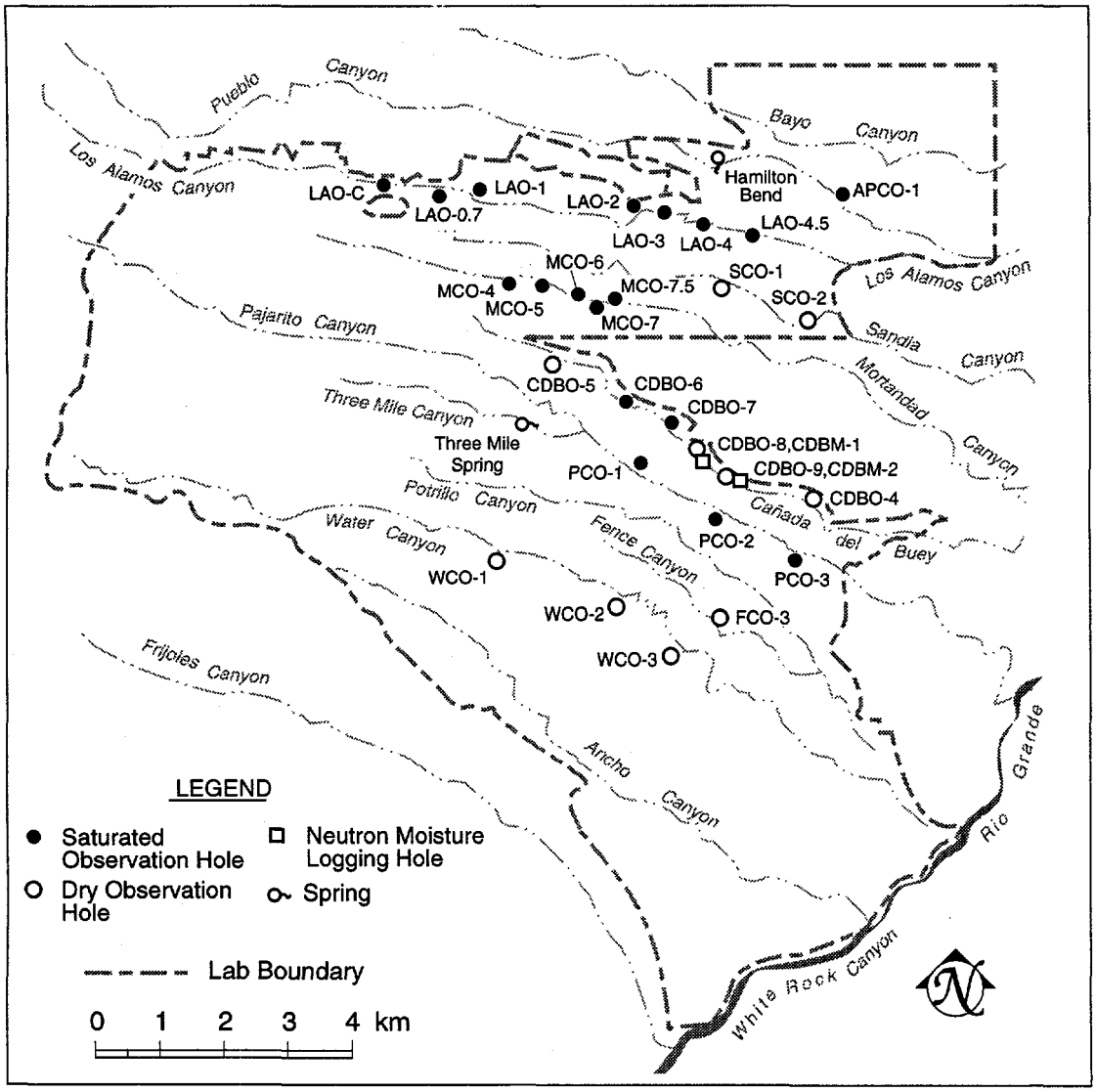


Figure 5-5. Observation wells and springs used for alluvial groundwater sampling and shallow neutron moisture holes.

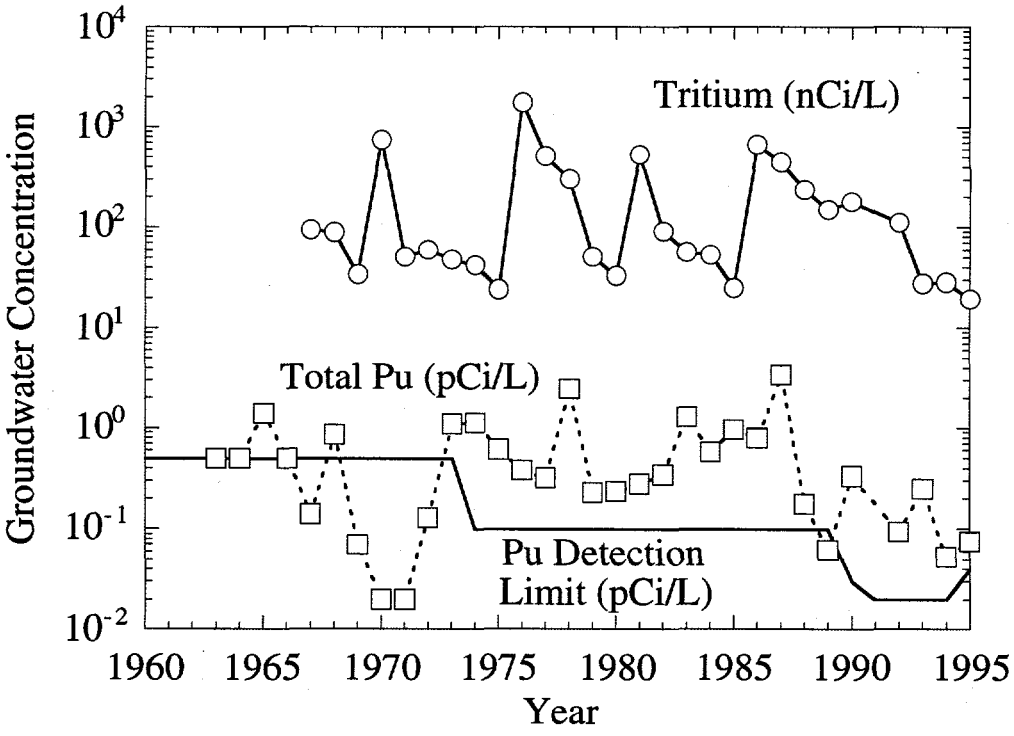


Figure 5-6. Tritium and plutonium concentrations in water samples from Mortandad Canyon Alluvial Observation Well MCO-6.

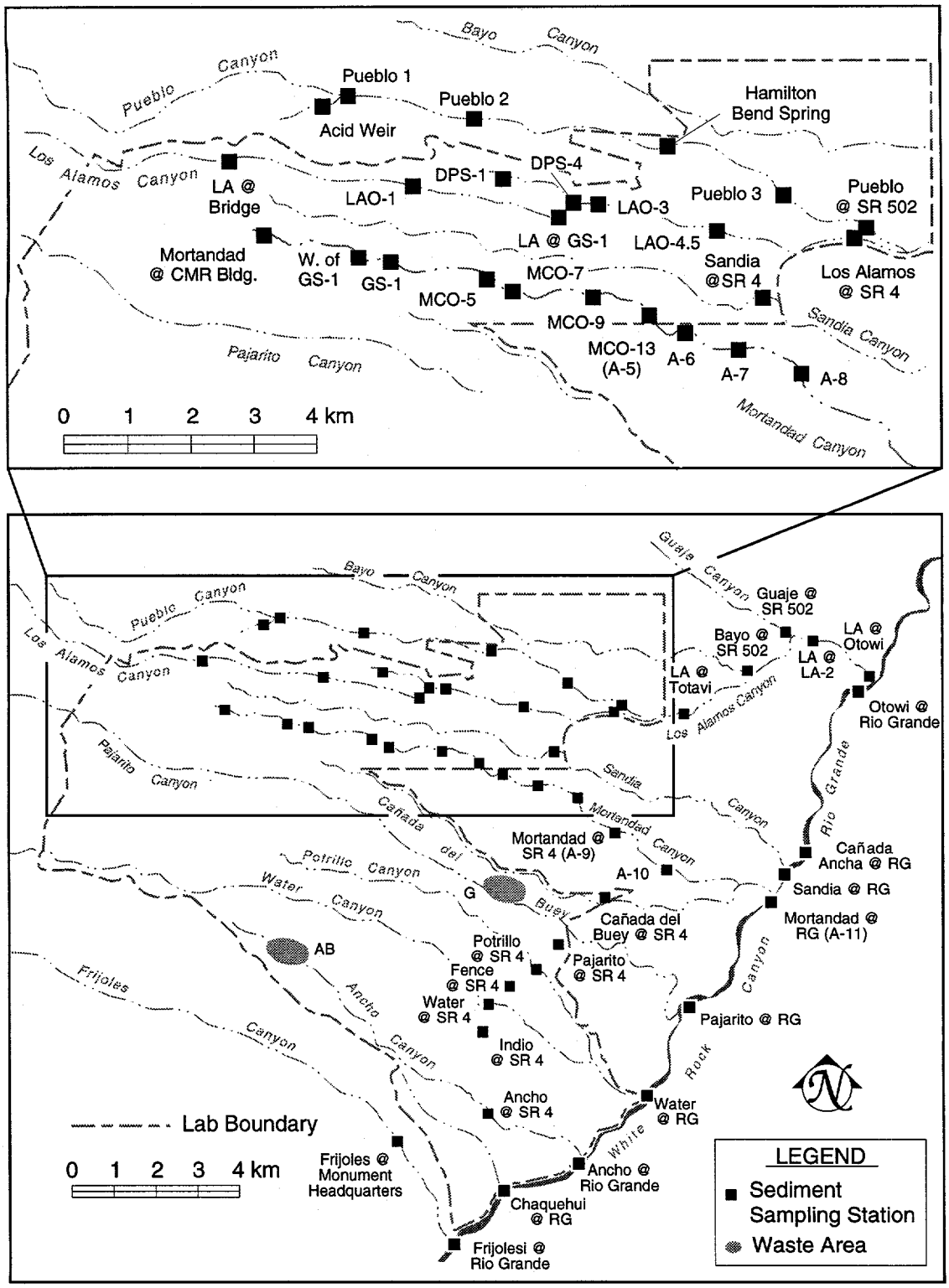
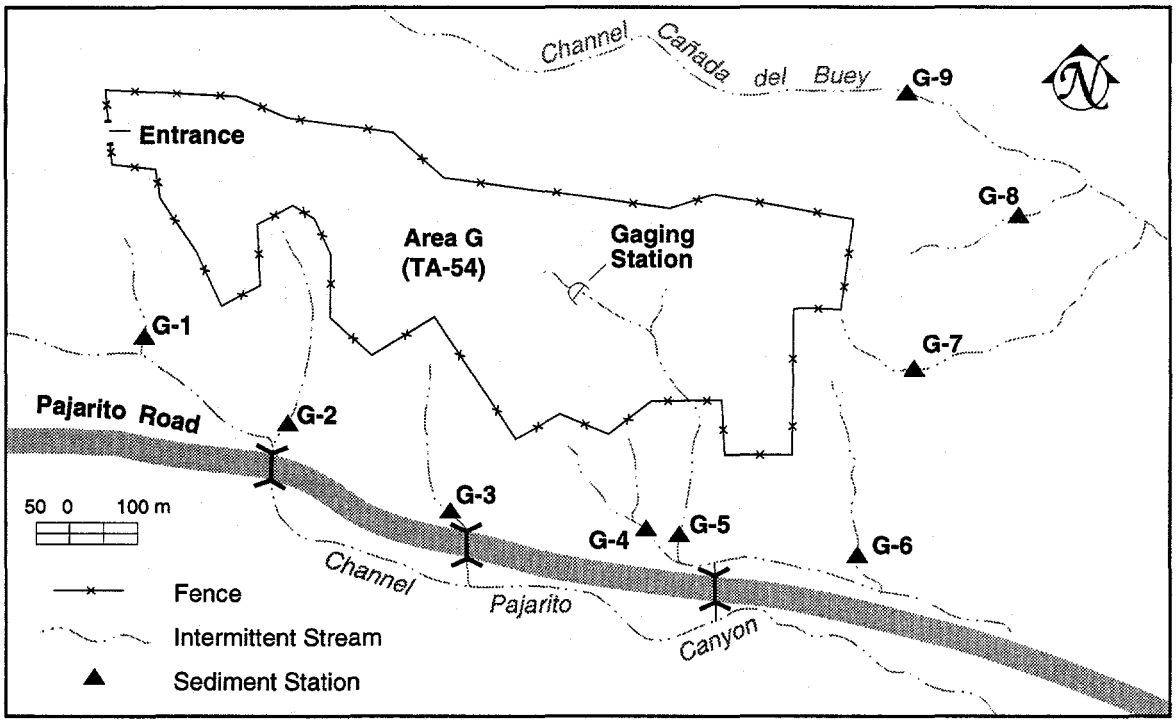


Figure 5-7. Sediment sampling stations on the Pajarito Plateau near Los Alamos National Laboratory. Solid waste management areas with multiple sampling locations are shown in Figure 5-8.

a.



b.

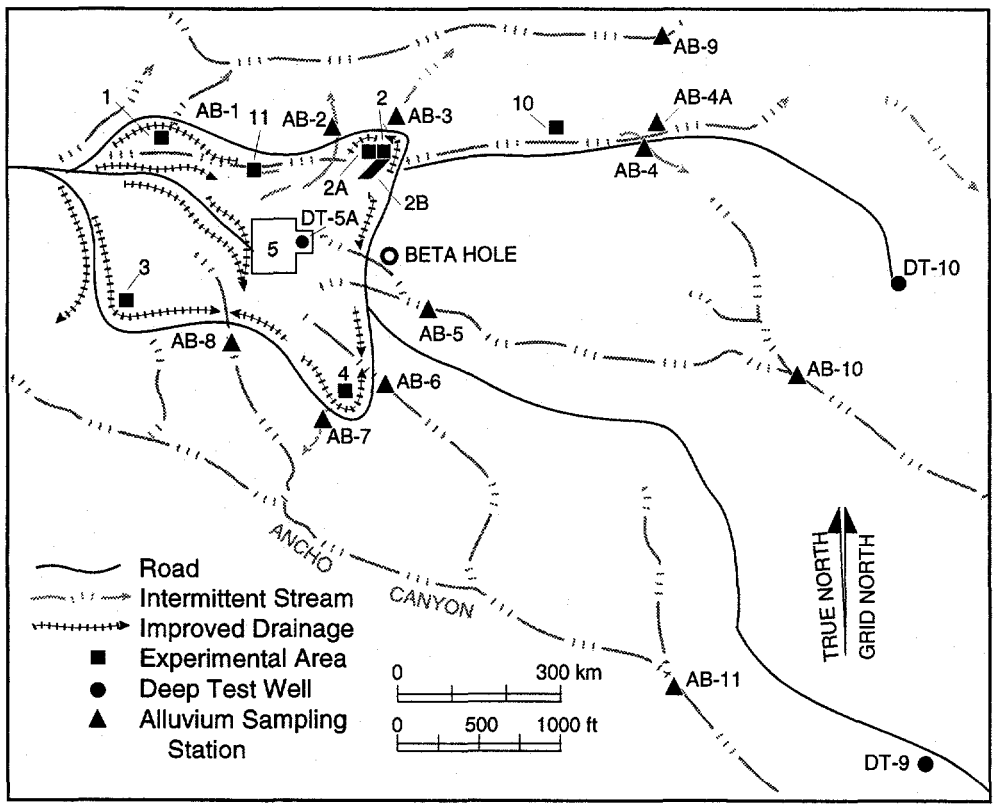


Figure 5-8. Sediment sampling locations at solid waste management areas.
a. Stations at TA-54, Area G.
b. Stations at TA-49, Area AB.

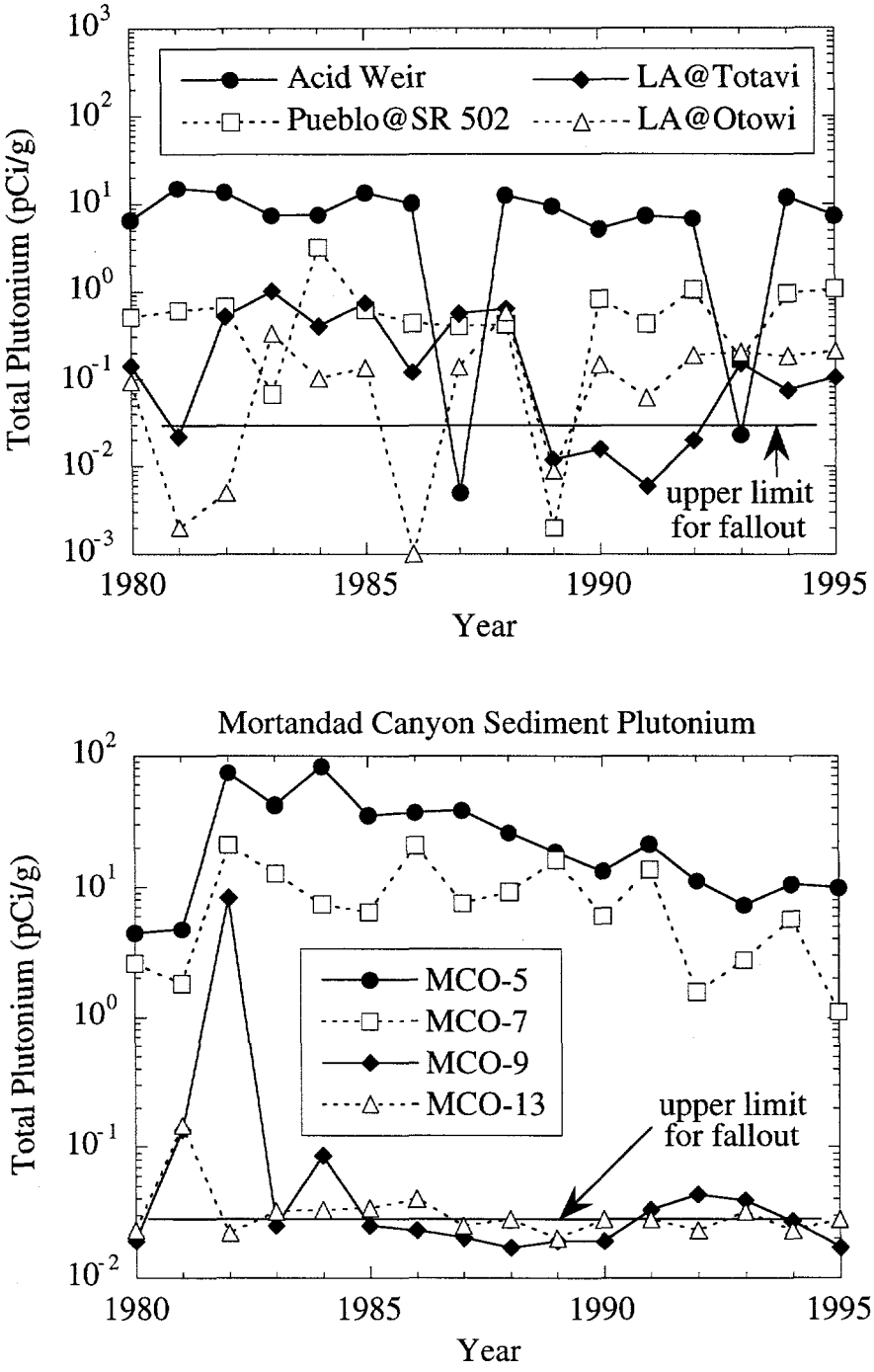


Figure 5-9. Total plutonium concentrations on sediments in Pueblo-Los Alamos Canyons (top) and Mortandad Canyon (bottom).

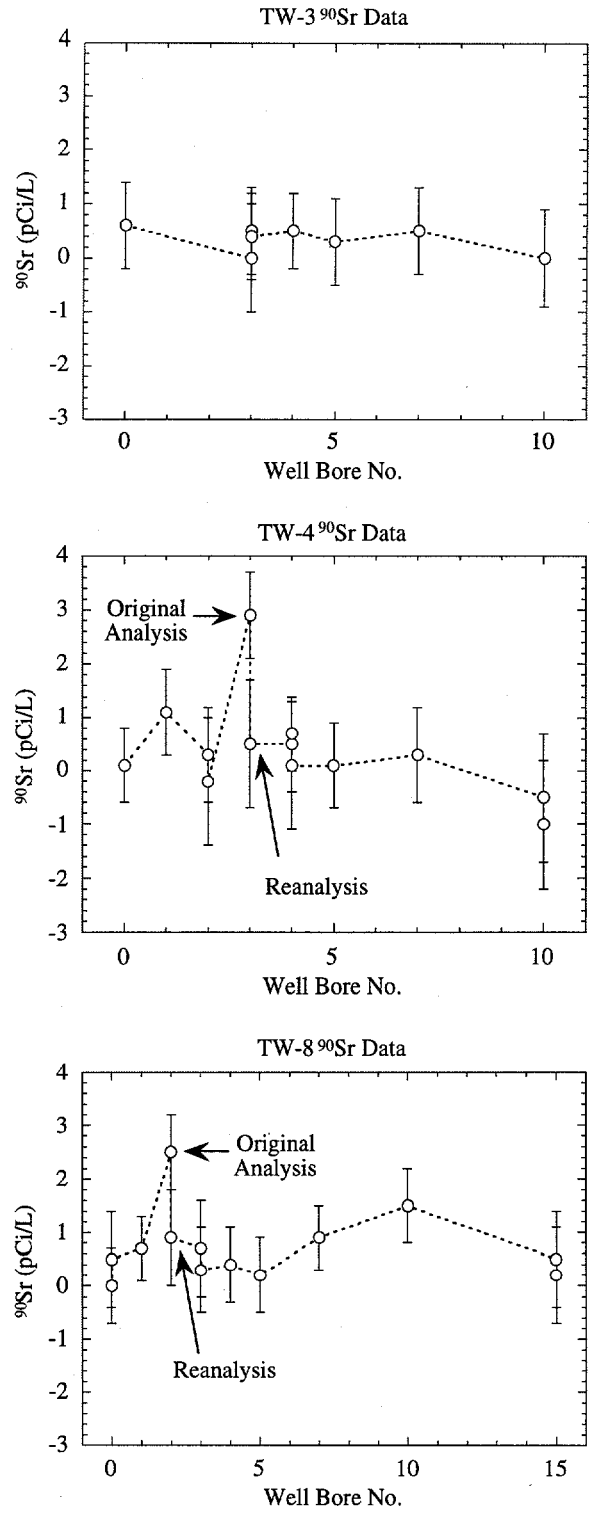


Figure 5-10. Results for strontium-90 in test wells from July 1995 time series sampling.

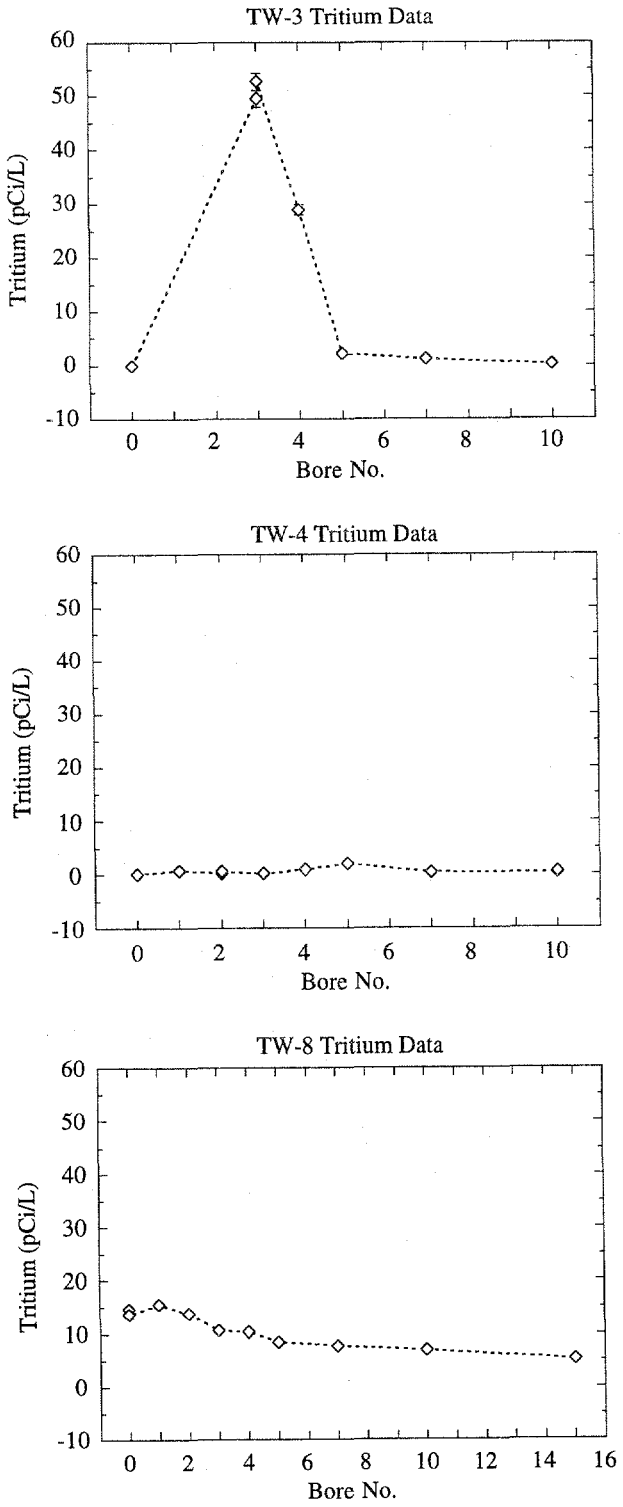


Figure 5-11. Results for tritium in test wells from July 1995 time series sampling.

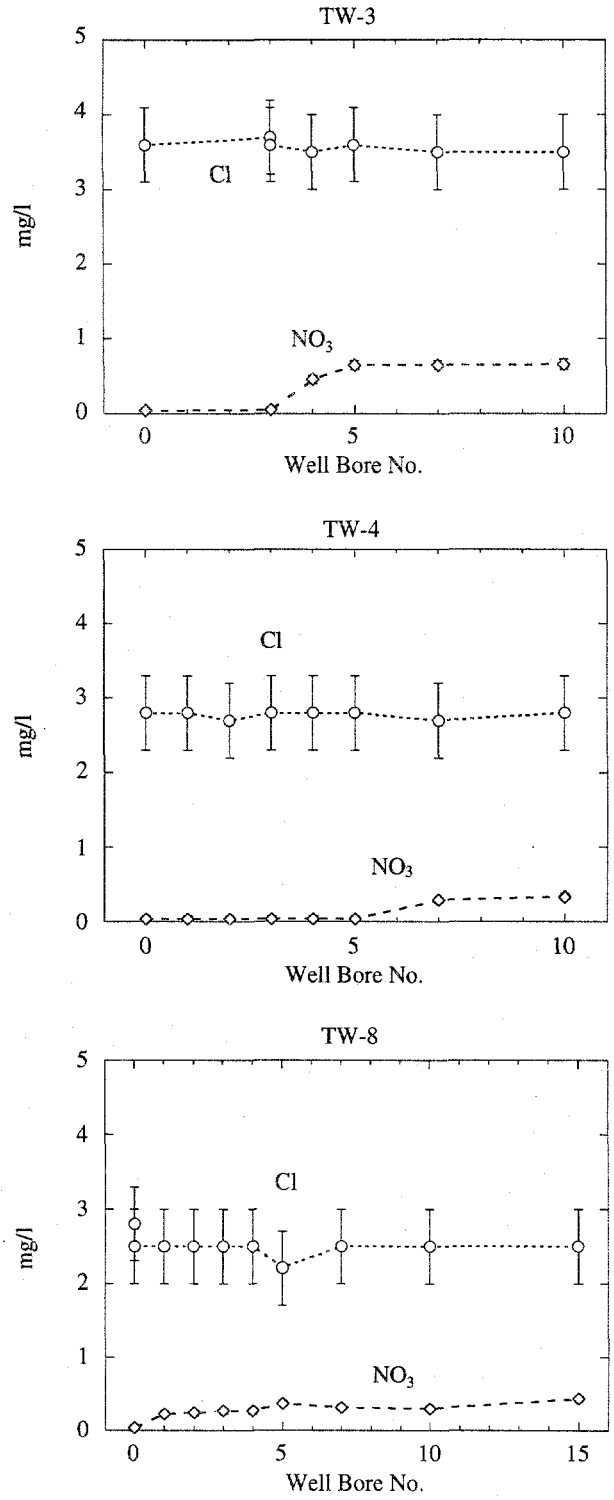


Figure 5-12. Results for chloride and nitrate in test wells from July 1995 time series sampling.

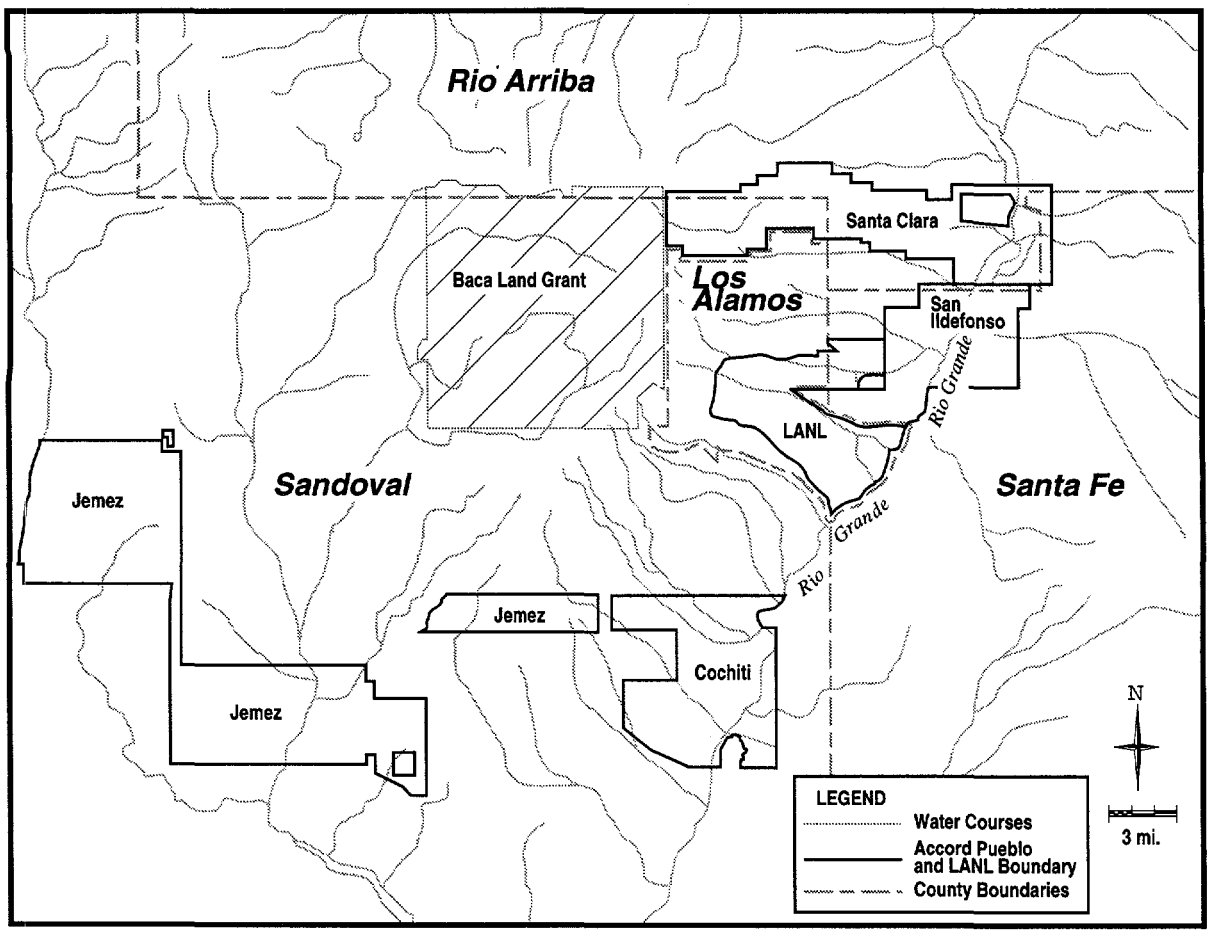


Figure 5-13. Location of Accord Pueblos and Los Alamos National Laboratory.

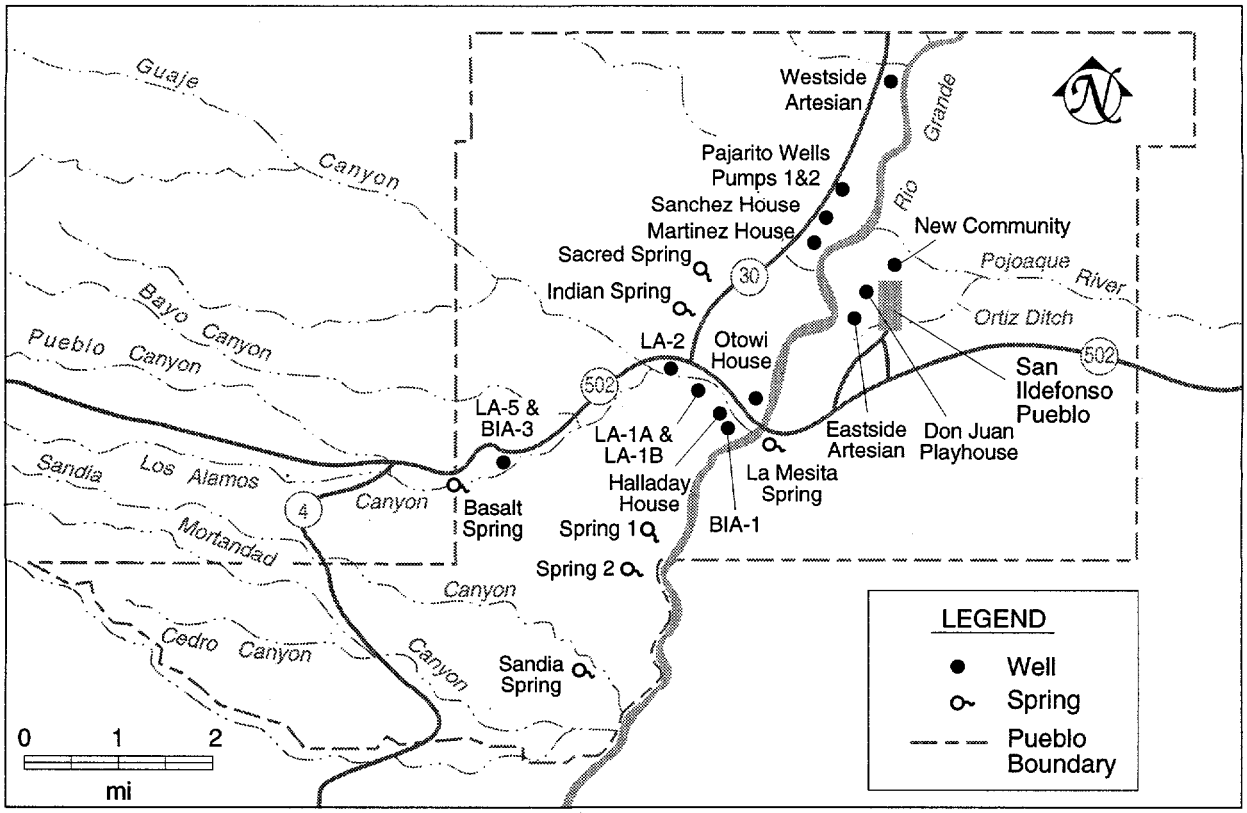


Figure 5-14. Springs and groundwater stations on or adjacent to Pueblo of San Ildefonso land.

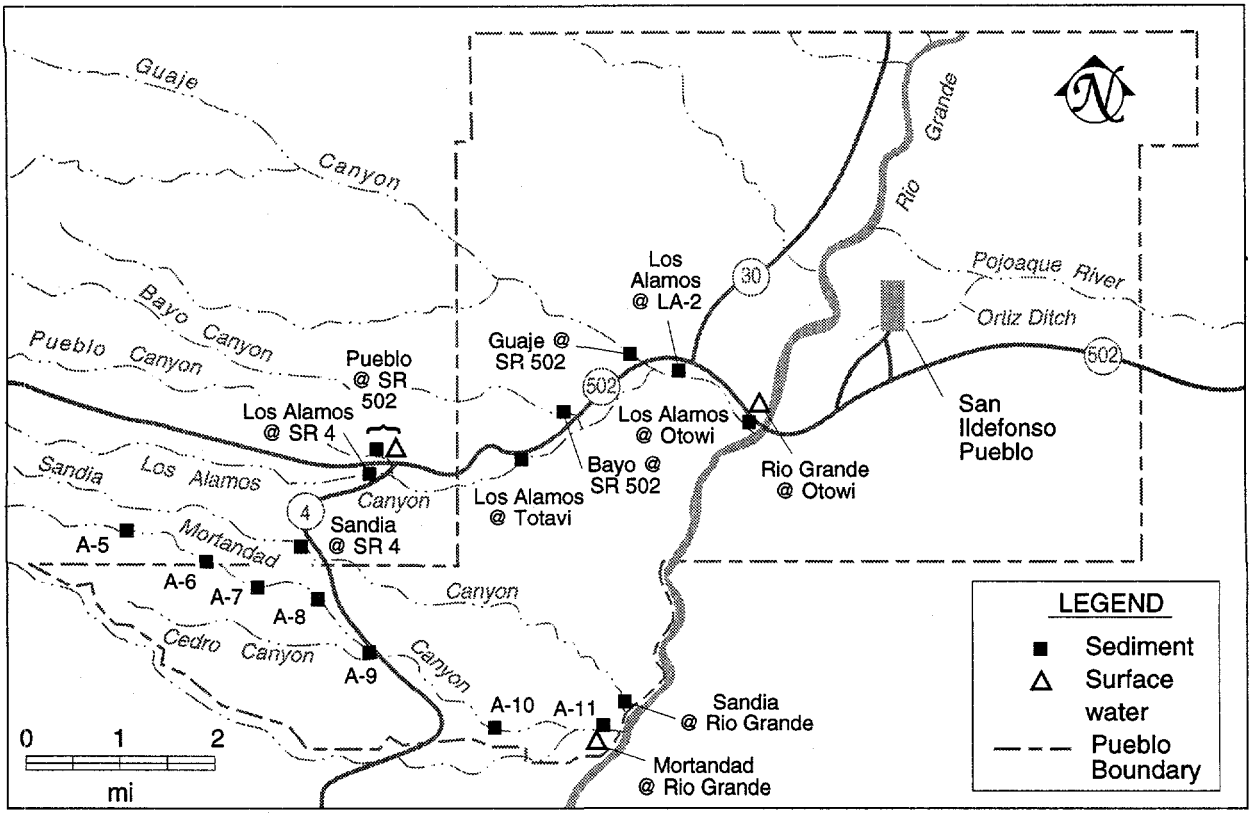


Figure 5-15. Sediment and surface water stations on or adjacent to Pueblo of San Ildefonso land.

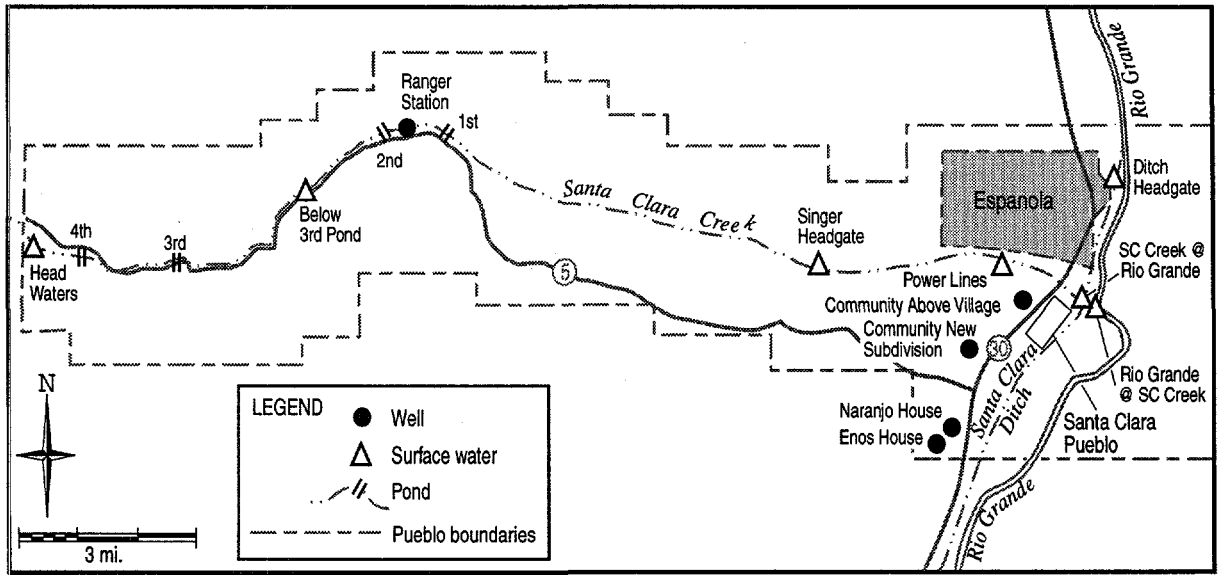


Figure 5-16. Surface water and groundwater stations at Santa Clara Pueblo.

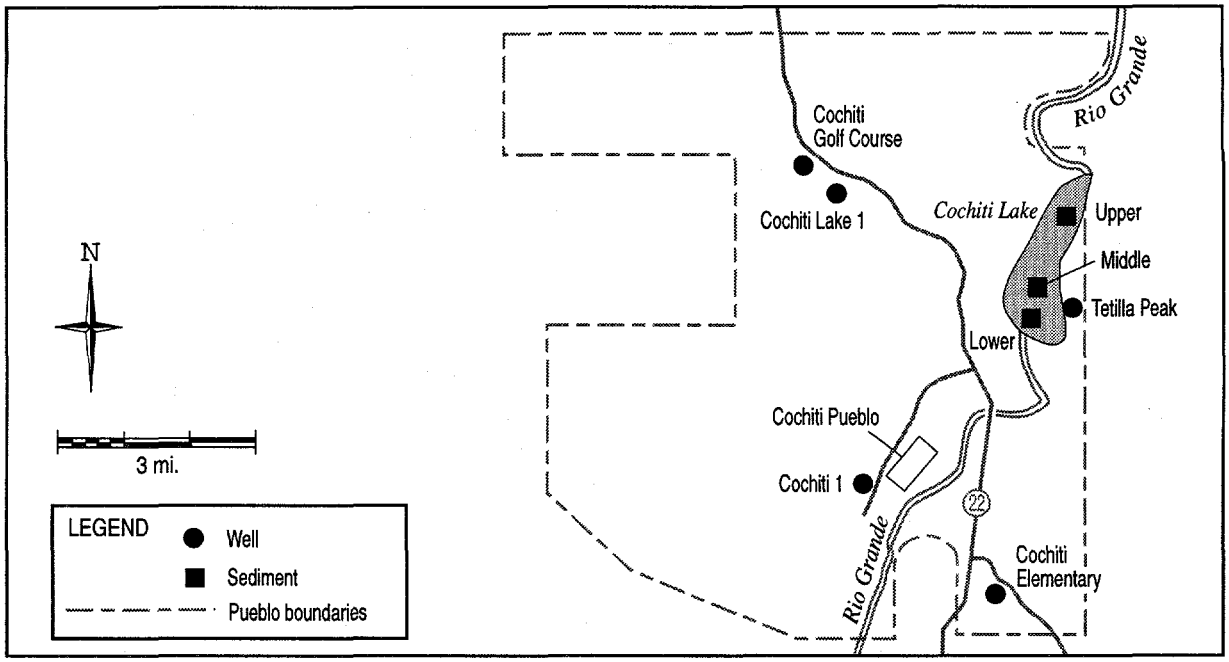


Figure 5-17. Sediment and groundwater stations at Cochiti Pueblo.

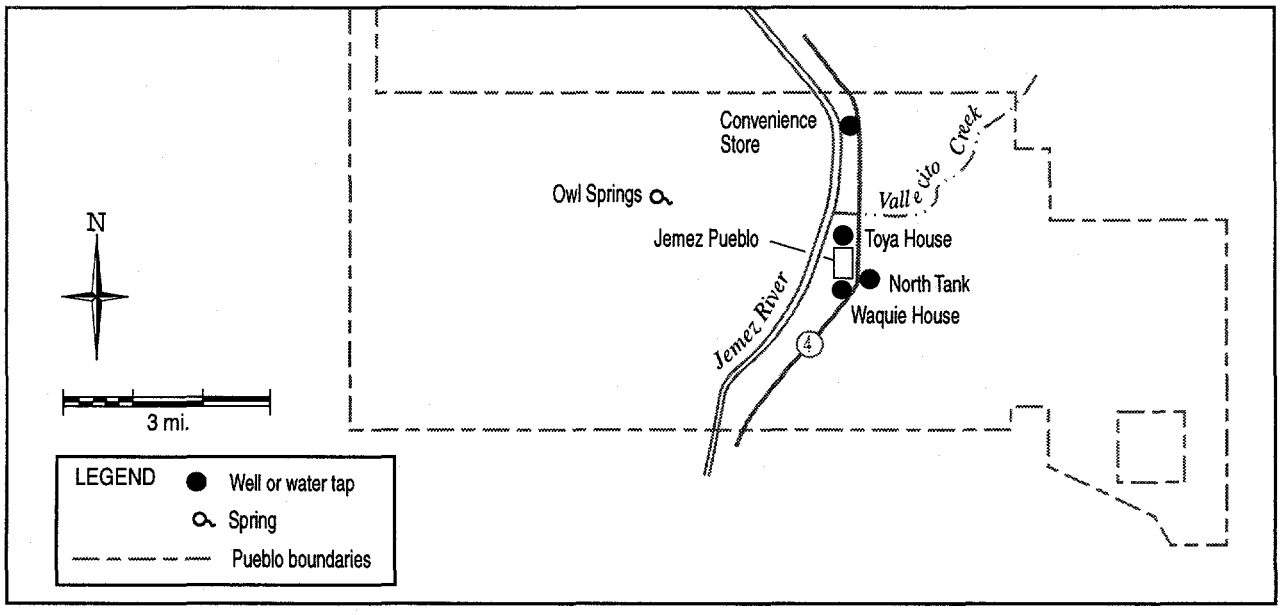


Figure 5-18. Springs, wells, and water taps sampled at Jemez Pueblo.

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6. Soil, Foodstuffs, and Biological Resources

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A. Overview of Programs

1. Soil Program

A soil sampling and analysis program provides the most direct means of determining the concentration, inventory, and distribution of radionuclides and radioactivity around nuclear facilities (DOE 1991). This program is mandated by Department of Energy (DOE) Orders 5400.1 and 5400.5. Soil provides an integrating medium that can account for contaminants released to the atmosphere, either directly in gaseous effluents (e.g., air stack emissions) or indirectly from resuspension of on-site contamination (e.g., fugitive dust from solid waste management units [SWMUs]), or through liquid effluents released to a stream that is subsequently used for irrigation. Subsequently, the knowledge gained from a soil radiological sampling program is critical for providing information about potential pathways (e.g., soil ingestion, food crops, resuspension into the air, and contamination of groundwater) that may result in a radiation dose to humans (Fresquez 1996a). This program evaluates radionuclide, radioactivity, and nonradionuclides (heavy metals) in soils collected from on-site Los Alamos National Laboratory (the Laboratory or LANL), around the perimeter of the Laboratory, and regional (background) locations. On-site and perimeter areas are compared to regional background areas—these background areas are distant from the Laboratory, and their radionuclide and nonradionuclide contents are due to naturally occurring elements and/or to worldwide fallout.

2. Foodstuffs (and Associated Biota) Program

There are many agriculturally important products that are grown and/or are harvested in the area surrounding the Laboratory, and the ingestion of foodstuffs constitutes a critical pathway by which radionuclides can be transferred to humans. Samples of foodstuffs, therefore, are collected on an annual basis from Laboratory and surrounding communities to determine the impact of Laboratory operations on the human food chain. This program is mandated by DOE Orders 5400.1 and 5400.5. The two main objectives of the Foodstuffs Monitoring Program are to (1) determine and compare radioactive and heavy metals constituents in foodstuffs (milk, eggs, honey, produce, fish, and game animals) between on-site LANL and off-site perimeter areas with regional (background) areas; and (2) calculate a maximum total committed effective dose equivalent (CEDE) to surrounding area residents (Los Alamos townsite, White Rock/Pajarito Acres, Pojoaque Valley, Pueblo of San Ildefonso, and Cochiti Pueblo) who may consume such foodstuffs. Radiation doses to individuals from the ingestion of foodstuffs are presented in Section 3.B.2.b.

3. Evaluations of Biological Resources

Because the DOE and the Laboratory must comply with the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald Eagle Protection Act, biological studies are conducted at LANL on all major trophic levels. Diverse studies are done on everything from ants to spotted owls to determine possible influences (positive and negative) that LANL may have on surrounding ecosystems.

The Ecological Studies Team (EST) of the Ecology Group (ESH-20) employs a varied number of study methods to ensure a comprehensive assessment of our biological resources. Baseline data are gathered about the LANL populations of plants, terrestrial and aquatic invertebrates, birds, reptiles, amphibians, and mammals. In order to assess potential LANL impacts on the biota, these population numbers are compared with control site populations. Besides baseline studies, site-specific as well as species-specific studies are also conducted. These studies are done to assure that Laboratory operations are in compliance with federal and state laws. This includes many field studies done on threatened and endangered species.

Plants and animals are also collected and analyzed for the presence of environmental contamination. This includes radionuclide and heavy metal contamination. These contamination data will be used for ecological risk assessments in the future. Likewise, the purpose of these studies is to determine if LANL operations are influencing overall ecosystem health.

B. Description of Programs and Monitoring Results

1. Soil Monitoring

a. Monitoring Network. Soil surface samples are collected from relatively level, open, and undisturbed areas at LANL, its perimeter, and regional (background) locations. The majority of on-site soil-sampling stations are located close to, and downwind from, if possible, major facilities and/or operations at LANL in an effort to assess radionuclide, radioactivity, and heavy metals in soils that may have been contaminated as a result of air stack emissions and fugitive dust. All areas are compared to soils collected from regional background locations where radionuclides, radioactivity, and heavy metals are due to natural and/or to worldwide fallout events.

Off-Site Regional (Background) Stations. The regional background stations for soils are located in the three major drainages in northern New Mexico surrounding the Laboratory: Rio Chama, Embudo, and Otowi; Cochiti and Bernalillo; and Jemez. One additional soil station is located near Santa Cruz Lake, across the Rio Grande valley to the northeast of the Laboratory (Figure 6-1 and Table 6-1). All are over 15 km (6 mi) from the Laboratory and are beyond the range of potential influence from normal Laboratory operations (DOE 1991).

Off-Site Perimeter Stations. A total of six soil sampling stations are located within 4 km (2.5 mi) of the Laboratory (Figure 6-2 and Table 6-1). Four of these stations are located to reflect the soil conditions of the inhabited areas to the north (Los Alamos townsite area) and east (White Rock area) of the Laboratory. The other two stations, one located on Forest Service land to the west and the other located on Park Service land (Bandelier) to the southwest, provide additional coverage.

On-Site Stations. Soil samples from 10 on-site stations are collected; they are located near and downwind of Laboratory facilities that are the principal sources of airborne emissions or that could be potential contaminant sources (Figure 6-2 and Table 6-1).

b. Sampling Procedures, Data Management, and Quality Assurance. Collection of samples for chemical and radiochemical analyses follow a set procedure to ensure proper sample collection, documentation, submittal for chemical analyses, and posting of analytical results. Stations and samples are assigned a unique identifier to provide chain-of-custody control during the transfer of samples from the time of collection through analysis and reporting.

All samples are collected and handled in accordance with the guidelines recommended by the American Society for Testing and Materials (ASTM 1990). To collect soil surface samples, a stainless steel soil ring 10 cm (4.0 in.) in diameter is driven 5 cm (2.0 in.) into the soil. Samples are collected from the center and corners of a square area 10 m (32 ft) per side. The five sub-samples are combined and mixed thoroughly in a 3-gal. reclosable plastic bag to form a composite sample. Samples are poured in pre-labeled 500 mL polypropylene bottles for radionuclide analysis and pre-labeled 125 mL polypropylene bottles for trace and heavy metals analysis. These bottles are fitted with chain-of-custody tape, placed into individual reclosable plastic bags, and then into a locked ice chest cooled to approximately 4°C. Details of container and preservation requirements for radiological and inorganic analyses, and identification of Environmental Protection Agency (EPA) methodology for each analysis are contained in the Inorganic Trace Analysis Group (CST-9) publication "Handbook for Sample Collection, Preservation, and Instrumental Techniques" (Williams 1990). The equipment used for collection of these samples is washed with a soap and water solution, and dried with paper towels. This is done before each sample is taken to reduce the potential for cross-contamination.

All samples are submitted to CST-9 for the analysis of radiological constituents such as gross alpha, beta and gamma activity; tritium; strontium-90; total uranium; cesium-137; plutonium-238; plutonium-239,240; americium-241; and trace and heavy metal elements like silver, arsenic, barium, beryllium, cadmium, chromium, mercury, nickel, lead, antimony, selenium, and thallium. These are the only EPA regulated heavy and trace metals. Procedures for laboratory analyses are documented by CST-9 in LANL report LA-10300-MS (Gautier 1994). These methods are based on EPA methods (EPA 1987) when available, or generally recognized and accepted institutions such as the American Public Health Association or ASTM. Quality controls (QCs) for analytical procedures are addressed in quality assurance (QA) documentation from the Health and Environmental Chemistry Group (Health and Environmental Chemistry Group 1985, Environmental Surveillance Group 1979: Appendix C, 1980; Appendix C, 1986; Appendix C).

Laboratory analytical results (hard copies) are sent directly to ESH-20 with full QA/QC analyses, duplicate sample analyses, and signatures. As results are obtained, they are scanned for any outlier numbers, and replicate

samples are compared with one another. Normally two replicates are submitted with the soil surveillance program samples. Each replicate flows through the processing and analytical procedure in parallel with its partner. Replicate samples may be useful in identifying spurious results or inconsistent procedures. After a visual check of the data, they are entered into a microcomputer EXCEL spreadsheet, tabulated, and large deviations are examined further to ensure their validity. The evaluations are cross-checked with each other to reduce the potential for errors of data transfer, of calculation, and of misinterpretation. Handling and reduction of the analytical results are independently carried out by the program's technician and supervisor.

Data are further analyzed with standard descriptive and comparative statistics. Descriptive statistics (i.e., means and standard deviations) are calculated for each parameter of concern at each sampled location. Mean results from the different (affected) locations (on-site and perimeter areas) are compared against background using a nonparametric Wilcoxon Rank Sum Test at the 0.05 probability level ($p<0.05$) (Gilbert 1987).

c. Radiochemical Analytical Results. Table 6-2 shows data from soils collected in 1995. In general, the average concentrations of tritium; strontium-90; cesium-137; plutonium-239,240; americium-241; and gross alpha and beta activity in soils collected from perimeter stations were not significantly different ($p < 0.05$) than radionuclide concentrations and activity in soil samples collected from regional background locations. In contrast, the average level of uranium (3.12 μg/g), plutonium-238 (0.015 pCi/g) and gross gamma activity (4.1 pCi/g) in perimeter soils was significantly higher ($p < 0.05$) than uranium (1.84 μg/g), plutonium-238 (0.004 pCi/g), and gross gamma (3.4 pCi/g) in background soils. Although the average level of uranium and gross gamma activity in perimeter soils was significantly higher than background, they were still within the long-term regional statistical reference level (RSRL) of 4.05 μg/g and 7.3 pCi/g, respectively. The RSRL is the average background concentration plus twice the standard deviation of the mean from data collected over a 21-yr period; data from 1974 through 1994 from regional background stations were used to establish the upper limit background (ULB) concentration for worldwide fallout of tritium; strontium-90; cesium-137; americium-241; plutonium-238; plutonium-239,240; and total uranium (Fresquez 1996a). Plutonium-238 average concentrations, on the other hand, were just above the RSRL (<0.008 pCi/g); however, these levels were far below LANL screening action levels (SALs) of 27 pCi/g. LANL SALs, developed by the Environmental Restoration Project at the Laboratory, are used to identify the presence of contaminants of concern and are derived from a risk assessment pathway using a 10 mrem/yr dose limit.

The average levels of tritium, strontium-90, cesium-137, plutonium-238, americium-241, and gross alpha, beta, and gamma activity in soils collected from on-site stations were not significantly different ($p < 0.05$) than radionuclide concentrations and activity in soil samples collected from regional background locations. Only plutonium-239,240 (0.059 pCi/g) and total uranium (3.57 μg/g) were detected in significantly higher concentrations in on-site soils as compared to off-site background soils. The average concentrations of total uranium and plutonium-239,240 detected in on-site soils, however, were still within the long-term RSRL and/or were far below LANL SALs. In general, the higher concentrations of radionuclides, particularly uranium and plutonium isotopes, in perimeter soils as compared to background soils may be due in part to Laboratory operations but are mostly due to worldwide fallout and to naturally occurring radioactive minerals, whereas higher radioactivity in soils from on-site areas may be due to worldwide fallout, natural radioactivity, and Laboratory operations (Fresquez 1996a).

Although the average levels of most radionuclides and radioactivity in soils collected from on-site and perimeter areas were not significantly different from background areas, there were some individual sites, mostly from LANL areas, that exhibited detectable radionuclide and/or radioactivity concentrations (where the analytical result was greater than two sigma) above RSRLs. However, all soil samples were below the Laboratory's SAL values (Table 6-2).

d. Nonradiochemical Analytical Results. Soils were also analyzed for trace and heavy metals. These data will ultimately be used to establish a database and are meaningful from a Laboratory operation/effects standpoint as well as for geochemical processes. The results of the 1995 soil sampling program can be found in Table 6-3.

The average concentrations of all heavy metals measured in soils collected from perimeter and on-site areas, with the exception of beryllium and lead, were not significantly higher ($p < 0.05$) than metals in soils collected from regional background stations. Most, in fact, were within the range of metals' concentrations normally encountered in the Los Alamos area (Ferenbaugh 1990) and continental United States (Shacklette 1984). Beryllium and lead concentrations, on the other hand, were significantly higher ($p < 0.05$) in both perimeter and on-site stations than in

background soils. This trend was the same as the last two years (1993 and 1994). Although the average concentrations of beryllium and lead in soils collected from perimeter and on-site stations were significantly higher than background, they were still within the RSRL (<0.90 μg/g and <21.8 μg/g, respectively) and within the range of concentrations for beryllium in the Los Alamos area (1.1 to 3.3 μg/g) (Ferenbaugh 1990) and continental United States (<1 to 15 μg/g) (Shacklette 1984). Also, beryllium and lead levels were below the Laboratory's SALs (0.90 μg/g for beryllium and 500.0 μg/g for lead).

e. Long-Term Trends. All soil results from on-site and perimeter stations during 1974 through 1994 were subjected to a Mann-Kendall test for trend (Fresquez 1996a). Most radionuclides and radioactivity detected in LANL and perimeter soils exhibited generally decreasing trends over time. The exceptions are plutonium-238, which increased at ≈ 96% of the sites, and gross alpha activity, which increased at half of the sites.

Concentrations of tritium, cesium-137 plutonium-239, and uranium showed significantly decreasing ($p < 0.05$) trends over time in many soils collected from on-site and perimeter areas. Their decrease may be due in part to reductions in Laboratory operations, air stack emissions, and to better engineering controls employed by the Laboratory (EG 1996), but is more probably due to (1) the cessation of aboveground nuclear weapons testing in the early 1960s, (2) weathering (wind, water erosion, and leaching), and (3) radioactive decay (half-life) (Wicker 1982). Tritium, which has a half-life of about 12 years, exhibited the greatest decrease in activity over the 21 years in almost all of the soil sites studied, including regional locations.

Plutonium and gross alpha activity generally increased over time in most on-site, perimeter, and even in regional background sites—all sites, however, were far from being statistically significant ($p < 0.05$) and the probability for these sites ranged from 0.167 to 0.997. The source of most plutonium-239 detected in the natural environment is from nuclear weapons testing in the atmosphere (Klement 1965) and from the reentry burn up of satellites containing a plutonium-238 power source (Perkins 1980). Only a few gross alpha readings and a few gross beta readings showed significantly increasing trends ($p < 0.05$) over time. In these cases, however, the measurement period was both early and very short time periods (1978 to 1981). If the same general trend of decreasing radionuclide concentrations observed at most other measurement sites were being followed, especially by the alpha (plutonium and uranium) and beta (strontium-90) emitters, these sites might also have exhibited decreasing gross alpha activity by 1994. To test this hypothesis, soil surface samples from all of these original sites will be collected during the 1996 sampling period.

As for metals in perimeter and on-site soil areas, most were within the range of naturally occurring elements in the Los Alamos area. Only beryllium and lead, both products of firing site activities, exhibit any kind of a trend; that is, both are consistently higher in perimeter and on-site soil areas year after year than in background soils. Concentrations over time show that average beryllium in perimeter soils decreased from 0.97 μg/g in 1992 to 0.62 μg/g in 1995. Lead decreased from 32 μg/g in 1992 to 22.7 μg/g in 1995. Similarly, beryllium in on-site soils averaged 1.17 μg/g in 1992 and decreased to 0.63 μg/g in 1995. Lead in on-site soils, on the other hand, increased slightly in concentration from an average of 16.7 μg/g in 1992 to 20 μg/g in 1995.

2. Foodstuffs and Associated Biota Monitoring

a. Produce.

Monitoring Network. Fruits, vegetables, and grains are collected each year from on-site (Laboratory), perimeter (Los Alamos and White Rock/Pajarito Acres), and off-site regional (background) locations (Figure 6-3). Samples of produce are also collected from the Pueblos of Cochiti and San Ildefonso, which are located in the general vicinity of LANL. Produce from areas within and around the perimeter of LANL are compared to produce collected from regional (background) gardens >16 km (10 mi) from the Laboratory; these areas are located around the Española, Santa Fe, and Jemez areas.

Sampling Procedures, Data Management, and Quality Assurance. Produce samples are collected from local gardens around the perimeter of the Laboratory in the summer and fall of each year (Salazar 1984). Each produce sample is collected and sealed in a labeled plastic bag. Samples are transported in a locked ice chest and refrigerated until prepared for chemical analyses. Produce samples are washed, as if for consumption, quantitative wet, dry, and ash weights are determined, and the samples are submitted to CST-9 for the analysis of tritium; total uranium; strontium-90; plutonium-238; plutonium-239,240; and cesium-137. All results are reported on an oven-dry-weight basis (dry g). A complete sample bank is kept frozen until all radiochemical analyses have been completed. Water is distilled from samples and submitted for tritium analysis. Heavy and trace metals in produce

are processed by first drying at 75°C for 48 hr, then ground in a Wiley Mill using a 20 mm stainless steel screen, and poured into 20 mL polypropylene bottles. All samples are submitted under full chain-of-custody for the analysis of silver, arsenic, barium, beryllium, cadmium, chromium, mercury, nickel, lead, antimony, selenium, and thallium. Variations in the mean radionuclide content in produce are tested using a nonparametric Wilcoxon Rank Sum Test at the 0.05 probability level (Gilbert 1987). All QA/QC protocols, chemical analysis, and data handling, validation, and tabulations are conducted in the same manner as described in the soils section.

Radiochemical Analytical Results. Concentrations of radionuclides in produce collected from on-site, perimeter, and off-site regional (background) locations during the 1995 growing season can be found in Table 6-4. The average concentration of all radionuclides, with the exception of tritium, were not significantly different ($p < 0.05$) in produce collected from on-site and perimeter areas (Los Alamos townsite and White Rock/Pajarito Acres) as compared to background. Most values, in fact, were within concentrations reported for these areas in past years. Tritium, as in past years, was significantly higher in produce collected from LANL lands as compared to produce from background locations.

No significant differences were found in the levels of tritium; uranium; strontium-90; plutonium-238; plutonium-239,240; and cesium-137 between produce collected from gardens at the Pueblos of San Ildefonso and Cochiti with produce collected from the Española, Santa Fe, or Jemez areas. Most radionuclide concentrations in produce from Cochiti Pueblo and the Pueblo of San Ildefonso were similar to concentrations detected in past years (Fresquez 1995d). There were some individual detectable radionuclide concentrations (where the analytical result was higher than two times the counting uncertainty) in some on-site and perimeter produce samples that were higher than RSRLs. Detectable radionuclide concentrations above the RSRL in produce were associated with mostly on-site LANL stations, but strontium-90 and plutonium-239,240 were detected in tea from Pueblo of San Ildefonso lands

Dose Equivalents to Individuals from Ingestion of Produce. Table 6-5 presents 1995 data; the results for the 1994 growing season are also presented for comparison. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) is 1.25 mrem from the regional background sample (Española, Santa Fe, and Jemez). The total net positive difference between the CEDE due to consuming produce, at the maximum consumption rate, from Cochiti Pueblo, White Rock, Los Alamos townsite, and the Pueblo of San Ildefonso and from the regional background locations is 0.228 mrem (<0.3% of the DOE public dose limit [PDL]), 0.001 mrem (<0.002% of the DOE PDL), 0.0002 (<0.001% of the DOE PDL), and 0.121 mrem (<0.2% of the DOE PDL), respectively. The maximum total net positive difference for CEDE using the average consumption rate is 0.008 mrem (<0.009% of the DOE PDL) from the produce collected at Cochiti Pueblo. The only radionuclides contributing more than 5% to this total net positive difference at Cochiti Pueblo and the Pueblo of San Ildefonso are the natural occurring radioisotopes of cesium-137 and strontium-90, respectively. Only tritium contributed to this difference at Los Alamos townsite and White Rock. The total net positive difference from produce grown on site is 1.19 mrem. The radionuclides contributing to more than 5% of this total net positive difference are strontium-90, uranium, and tritium. Since ingestion of produce collected on site is not considered to be a significant pathway because of the small amount of edible material and the limited access to these foodstuffs, comparison to the DOE PDL or calculating a risk factor is not appropriate.

The single factor Analysis of Variance (ANOVA) test shows that there is no significant difference (at the 95% level of confidence) between the maximum CEDE (i.e., average CEDE + two sigma) calculated for produce samples collected from regional, perimeter, or on-site locations. This can be easily seen by noting that the two sigma error term is always higher than the CEDE value. The Student's t-Test also shows that there is no significant difference (at the 95% level of confidence) between the 1994 CEDE and the 1995 CEDE calculated for produce samples collected from these locations.

Nonradiochemical Analytical Results. Most trace and heavy metal elements were below the limit of detection (Table 6-6). In those cases, where produce samples contained some metals above the limit of detection (e.g., silver, barium, cadmium, chromium, nickel, and lead), only the mean concentration for silver in produce collected from the Cochiti area and chromium in White Rock/Pajarito Acres were significantly higher ($p < 0.05$) than background. These results should be viewed with caution, however. The mean concentration of silver in produce collected from the Cochiti area was elevated due to mainly one sample (a tomato had 23 μg/dry g). Also, soil samples collected from the Cochiti area did not contain higher silver concentrations (<3.0 μg/dry g) than other background soil samples (<3.0 μg/dry g) (Table 6-3).

No significant differences in any of the trace and heavy metal mean concentrations were found in produce collected from other on-site, perimeter, or pueblo areas as compared to background.

b. Honey.

Monitoring Network. Bee hives located within perimeter areas, Los Alamos townsite and White Rock/ Pajarito Acres, are sampled on an annual basis for honey (Figure 6-4). Honey from these hives was compared to honey collected from regional background hives located in northern New Mexico.

Sampling Procedures, Data Management, and Quality Assurance. Honey is collected by a professional (contract) bee keeper. The frames of honey are enclosed in large plastic bags, marked for identification, and transported in an ice chest to the Laboratory. At the Laboratory, the honey is separated from the combs by a heat lamp into labeled 500-mL polypropylene bottles. The honey samples are submitted under full chain-of-custody to CST-9 for radiochemical analyses of tritium; total uranium; strontium-90; plutonium-238; plutonium-239,240; and cesium-137. All QA/QC protocols, chemical analysis, and data handling, validation, and tabulation are conducted in the same manner as described in Section 6.B.1.b.

Radiochemical Analytical Results. Results of the analysis of honey collected during the 1995 season are presented in Table 6-7. No detectable radionuclide concentrations were found in honey samples collected from the Los Alamos townsite or White Rock/Pajarito Acres areas. Accordingly, all radionuclide levels in perimeter areas were all well within the RSRL of radionuclides detected from background areas. In past years, tritium was almost always significantly higher in honey collected from on-site LANL hives, especially from hives located at TA-53 and at TA-54. Since honey collected within LANL lands is not distributed to the public, it is not considered a significant pathway to humans. Starting in 1995, the honey surveillance program is limited to sampling in off-site regional and perimeter areas.

Dose Equivalents to Individuals from Ingestion of Honey. Table 6-8 presents the summary of the CEDE from the ingestion of honey collected in 1995. The results for 1994 season are also presented for comparison. It should be noted that americium-241 analyses are included in the 1995 dataset but were not requested in 1994. Because the analyses for the San Pedro honey sample were lost in the analytical laboratory, the regional background average concentrations for 1994 were substituted for the missing strontium-90, plutonium-238, plutonium-239, and uranium results (Table 6-7). The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for all honey samples collected in 1995 is 0.024 mrem for the consumption of honey collected in White Rock. The total net positive difference between the CEDE due to consuming honey from Los Alamos townsite and White Rock and honey collected at a regional background station (i.e., San Pedro), using the maximum consumption rate, is 0.004 mrem (<0.004% of the DOE PDL) and 0.010 mrem (<0.02% of the DOE PDL), respectively. For the average consumption rate, these differences decrease to 0.001 mrem (<0.002% of the DOE PDL) for Los Alamos and to 0.003 mrem (<0.003% of the DOE PDL) for White Rock. The radionuclides that contributed to this total net positive dose are strontium-90 and americium-241 for honey collected in Los Alamos townsite; and strontium-90, plutonium-239, cesium-137 and americium-241 for honey collected in White Rock. Since americium-241 was not requested in 1994, it is questionable whether this radionuclide actually contributed to the total net positive difference or not. Collecting additional honey samples will be necessary to determine whether americium-241 contributes to this difference.

The single factor ANOVA test shows that there is no significant difference (at the 95% level of confidence) between the maximum CEDE (i.e., average CEDE + two sigma) calculated for consuming honey from the background, Los Alamos townsite, or White Rock sampling locations. Since only one sample has been collected each year, statistical tests could not be performed to compare the 1994 results with the 1995 results. However, the confidence interval for these two data sets overlap indicating that there is no difference between the 1994 and the 1995 calculated CEDEs for these sampling locations.

c. Eggs.

Monitoring Network. Fresh eggs are collected from the nearest free-ranging chicken farm in the Pueblo of San Ildefonso. These eggs are compared to eggs from chickens located in the Albuquerque area.

Sampling Procedures, Data Management, and Quality Assurance. Approximately 24 medium-sized eggs from the Pueblo of San Ildefonso plus eggs collected from a background area (Albuquerque) are transported in Styrofoam containers to the Laboratory and submitted to CST-9 for the analysis of tritium; total uranium;

strontium-90; plutonium-238; plutonium-239,240; americium-241; and cesium-137. All QA/QC protocols, chemical analysis, and data handling, validation, and tabulation are conducted in the same manner as described in Section 6.B.1.b.

Radiochemical Analytical Results. Results of radionuclide concentrations detected in eggs collected from the Pueblo of San Ildefonso and Albuquerque can be found in Table 6-9. All radionuclide concentrations, including two detectable isotopes (uranium and cesium-137), in eggs collected from the Pueblo of San Ildefonso were well below the RSRL.

Dose Equivalents to Individuals from Ingestion of Eggs. Table 6-10 presents the summary of the CEDE from the ingestion of eggs collected near the Pueblo of San Ildefonso and a regional background location near Albuquerque in 1995. The maximum annual CEDE (i.e., the total CEDE plus two sigma using the maximum consumption rate) for eggs collected at the Pueblo of San Ildefonso from all locations is 0.041 mrem. The total net positive difference between the CEDE due to consuming eggs, at the maximum consumption rate, from the Pueblo of San Ildefonso and from the regional background location is 0.002 mrem (<0.002% of the DOE PDL). The radionuclides contributing more than 5% to this total net positive difference are strontium-90, cesium-137, and plutonium-239. Since there were no radionuclides detected in all the egg samples, the contribution of these radionuclides to the total net positive dose appears to be from natural variability within the data set as a result of measuring low concentrations (i.e., near the detection limits of the instruments). The single factor ANOVA test shows that there is no significant difference (at the 95% level of confidence) between the maximum CEDE (i.e., average CEDE + two sigma) calculated for eggs collected from the Pueblo of San Ildefonso and the regional background in the Albuquerque area.

d. Milk.

Monitoring Network. There are no milk production facilities within 15 km (9 mi) of the Laboratory—the closest working dairy, located in the Pojoaque Valley, is approximately 40 km (25 mi) away. However, because milk is considered one of the most important and universally consumed foodstuffs, the analysis of milk may yield information as to the deposition of small amounts of radionuclides over a relatively large area. Accordingly, various radionuclides in milk from the Pojoaque Valley dairy were analyzed and compared to milk collected from a dairy located in Albuquerque.

Sampling Procedures, Data Management, and Quality Assurance. Milk is collected directly from the dairies in the Pojoaque Valley and Albuquerque and submitted to CST-9 in the original containers for the analysis of tritium; uranium; strontium-90; plutonium-238; plutonium-239,240; iodine-131; americium-241; and cesium-137. All QA/QC protocols, chemical analysis, and data handling, validation, and tabulation are conducted in the same manner as described in Section 6.B.1.b.

Radiochemical Analytical Results. Analyses of milk collected from the Pojoaque Valley and Albuquerque during June and September of 1995 are given in Table 6-11. All radionuclides concentrations, including detectable levels of uranium, were within RSRLs and were similar to those obtained in previous years; neither increasing nor decreasing trends are evident. Tritium (–0.20 to –0.10 pCi/mL) and strontium-90 (2.6 to 4.7 pCi/L) levels, in particular, compare well with tritium (avg 0.06 pCi/mL) and strontium-90 levels (avg 12.0 pCi/L) in milk from other states around the country. Milk collected from both Pojoaque Valley and Albuquerque dairies contained detectable uranium levels. However, the concentrations were not higher than RSRLs, and not unexpected as uranium is a natural element in all soils and the degree to which it is found in milk depends on many factors including the geology, mineralogy, vegetation, and meteorological (wind and rain) conditions of the area (Wicker 1982).

Dose Equivalents to Individuals from Ingestion of Milk. Table 6-12 presents the summary of the CEDE from the ingestion of milk and milk products collected in the Pojoaque Valley for 1995. The results from 1994 are also presented for comparison. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for milk is 0.875 mrem from the regional background sample (near Albuquerque). The total net positive difference (see Section 3.B.3.d) between the CEDE due to consuming milk at the maximum consumption rate, from the Pojoaque Valley and from the regional background location is 0.063 mrem (<0.07% of the DOE PDL). For the average consumption rate, this difference decreases to 0.025 mrem (<0.03% of the DOE PDL). The radionuclides contributing more than 5% to this total net positive difference are plutonium-239 and iodine-131, and this appears to be due to the natural variability within the data set as a result of measuring low concentrations (i.e., near the detection limits of the instruments).

The single factor ANOVA test shows that there is no significant difference (at the 95% level of confidence) between the maximum CEDE (i.e., average CEDE + two sigma) calculated for milk samples. The confidence intervals for these data sets overlap indicating that there is no difference between the 1994 and the 1995 CEDEs from these two dairies.

e. Fish.

Monitoring Network. Fish are collected annually upstream and downstream of the Laboratory (Figure 6-3). Cochiti Reservoir, a 10,690-ac flood and sediment control project, is located on the Rio Grande approximately 5 mi downstream from the Laboratory. Radionuclides in fish collected from Cochiti Reservoir are compared to fish collected from background reservoirs: Abiquiu, Heron, and/or El Vado. Abiquiu, Heron, and El Vado Reservoirs are located on the Rio Chama, upstream from the confluence of the Rio Grande and intermittent streams that cross Laboratory lands.

Two types of fish were collected: game (surface-feeders) and nongame (bottom-feeders). Game fish include Rainbow Trout (*Salmo gairdneri*), Brown Trout (*Salmo trutta*), Kokanee Salmon (*Oncorhynchus nerka*), Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass (*Micropterus dolomieui*), White Crappie (*Pomixis annularis*), and Walleye (*Stizostedion vitreum*). Nongame fish include the White Sucker (*Catostomus commersone*), Channel Catfish (*Ictalurus penctatus*), Carp (*Cyprinus carpio*), and Carp Sucker (*Carpiodes carpio*).

Sample Procedures, Data Management, and Quality Assurance. Fish are collected by hook and line, trot line, or gill nets (Salazar 1984). Fish samples are transported under ice to the laboratory for preparation. At the laboratory, fish heads and tails are removed, and fish are gutted and washed. Muscle tissue is processed; wet, dry, and ash weights are determined; and ash is submitted for analysis. Concentrations of tritium, total uranium; strontium-90; plutonium-238; plutonium-239,240; americium-241; and cesium-137 are determined. Also, the ratio of uranium-235 to uranium-238 in bottom-feeding fish is determined by thermal ionization mass spectrometry (Efurd 1993). All results are reported on an oven-dry-weight basis (dry g). Variations in the mean radionuclide content in fish collected upstream and downstream of the Laboratory are tested using a nonparametric Wilcoxon Rank Sum Test at the 0.05 probability level (Gilbert 1987). Heavy and trace metals in fish are also analyzed. Fish are submitted under full chain-of-custody directly to CST-9 for metals analysis. Results are reported on a wet basis. All QA/QC protocols, chemical analysis, and data handling, validation, and tabulation are conducted in the same manner as described in Section 6.B.1.b.

Radiochemical Analytical Results. Concentration of radionuclides in game and nongame fish collected upstream and downstream of the Laboratory are presented in Table 6-13. The concentrations of most radionuclides, with the exception of uranium in surface-feeding fish, were not significantly different ($p < 0.05$) in game (surface-feeding) and nongame (bottom-feeding) fish collected from Cochiti Reservoir as compared to fish collected from reservoirs located upstream of the Laboratory. These results compare well with radionuclide contents in crappie, trout, and salmon from comparable (background) reservoirs and lakes in Colorado (Wicker 1972, Nelson 1969).

Although total uranium concentrations were significantly higher in game fish from Cochiti Reservoir as compared to background, concentrations were still within the RSRLs (<6.5 ng/dry g). Using isotopic ratios to determine if the uranium was from LANL illustrated that this was naturally occurring uranium (i.e., ratios indicated no enriched or depleted uranium). In addition, there was no evidence of uranium-236; this isotope does not occur in nature and is indicative of the presence of man-made uranium (Efurd 1993).

These higher than background concentrations of naturally occurring uranium in Cochiti Reservoir game fish samples can be attributed to the following: (1) Cochiti receives greater amounts of sediments than the other reservoirs (EARE 1995), (2) there are more uranium-bearing minerals around the Cochiti area (e.g., uranium in Bandelier Tuff around the Los Alamos area ranges in concentration from 4.0 to 11.4 μg/g [Crowe 1978; Fresquez 1996a]) than in areas upstream of Cochiti (e.g., uranium in soils from northern New Mexico ranges in concentration from 1.3 to 4.05 μg/g [Purtymun 1987; Fresquez 1996a]), and (3) some uranium may be entering Cochiti Reservoir via the Santa Fe River as this river flows past the edge of an abandoned 25-ac uranium mine site (La Bajada Uranium Mine) approximately 9.7 km (6 mi) upstream and northeast of Cochiti Reservoir (Fresquez 1996d).

Bottom-feeders (nongame fish) from both downstream and upstream reservoirs contained higher average uranium contents (9.3 ng/dry g) than the surface feeders (2.5 ng/dry g). The higher concentration of uranium in bottom feeders as compared to surface feeders may be attributed to the ingestion of sediments on the bottom of the

lake (Gallegos 1971). Sediments represent the accumulation or sink compartment for most radionuclides (Wicker 1982).

Dose Equivalents to Individuals from Ingestion of Fish. Table 6-14 presents the summary of the CEDE from the ingestion of fish collected from upstream (Abiquiu, Heron, and/or El Vado Reservoirs) and downstream (Cochiti Reservoir) of the Laboratory. The results from 1994 are also presented for comparison. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for all fish collected is 0.150 mrem from the upstream higher-level feeders. The total net positive difference between the CEDE due to consuming fish, at the maximum consumption rate, from Cochiti Reservoir and from upstream of the Laboratory is 0.027 mrem (<0.03% of the DOE PDL) for the bottom-feeders and 0.003 mrem (<0.003% of the DOE PDL) for the higher-level feeders. For the average consumption rate, this difference decreases to 0.007 mrem (<0.008% of the DOE PDL) for the bottom-feeders and <0.001 mrem (<0.001% of the DOE PDL) for the higher-level feeders. The radionuclides contributing more than 5% to these total net positive differences are strontium-90 (a naturally occurring radionuclide present from radioactive fallout) for the bottom feeders; and uranium, tritium, and plutonium-238 for the higher-level feeders. Since the only radionuclide detected in all the fish samples was strontium-90 and that occurred for only one sample, the contribution of these radionuclides to the total net positive dose appears to be from natural variability within the data set.

The single factor ANOVA test shows that there is no significant difference (at the 95% level of confidence) between the maximum CEDE (i.e., average CEDE + two sigma) calculated for fish collected from upstream of the Laboratory and from Cochiti Reservoir. This can be easily seen by noting that the two sigma error term is always higher than the CEDE value. The Student's t-Test also shows that there is no significant difference ($p<0.05$) between the 1994 CEDE and the 1995 CEDE calculated for the fish collected.

Long-term Trends. A summarization and trend analysis of radionuclide concentrations in game (surface-feeding) and nongame (bottom-feeding) fish collected from reservoirs upstream (Abiquiu, Heron, and El Vado) and downstream (Cochiti) of LANL from 1981 to 1993 was conducted (Fresquez 1994c). In general, the average levels of strontium-90, cesium-137, plutonium-238, and plutonium-239 in game and nongame fish collected from Cochiti Reservoir were not significantly different in fish collected from reservoirs upstream of the Laboratory. Total uranium was the only radionuclide that was significantly higher in both game and nongame fish from Cochiti Reservoir as compared to fish from Abiquiu, Heron, and El Vado Reservoirs. Uranium concentrations in fish collected from Cochiti Reservoir, however, significantly ($p < 0.05$) decreased from 1981 to 1993, and no evidence of depleted uranium was found in fish samples collected from Cochiti Reservoir in 1993. Based on the average concentration of radionuclides over the years, the net positive CEDE, from consuming 46 lb of game fish is 0.005 mrem and nongame fish from Cochiti Reservoir is 0.009 mrem. The highest dose was <0.01% of the International Commission on Radiological Protection (ICRP) permissible dose limit for protecting members of the public.

Nonradiochemical Analytical Results. Most trace and heavy metals in bottom-feeding fish (catfish, suckers, and carp) collected from Cochiti, Abiquiu, Heron, and El Vado Reservoirs were below the limit of detection (Table 6-15). For those elements that were above the limit of detection (e.g., mercury and selenium), the mean levels were statistically ($p < 0.05$) similar in fish from Cochiti Reservoir as compared to fish collected from Abiquiu, Heron, and El Vado Reservoirs (background). In addition, all of these metals, particularly beryllium, mercury, and lead, were similar to values reported in "Environmental Surveillance in Los Alamos during 1991" (EPG 1993) and in "Environmental Surveillance in Los Alamos during 1994" (EG 1996). Mercury concentrations in fish occurring in lakes and reservoirs in NM have been of significant concern to the public for several years. However, based on three years of data, mercury concentrations in fish upstream of LANL have been consistently higher, albeit slightly, than mercury concentrations downstream of the Laboratory, and therefore, are not a reflection of Laboratory operations.

f. Game Animals.

Monitoring Network. Road kills of elk and deer are collected on an annual basis from within Laboratory boundaries and the meat and bone is analyzed for various radionuclides. Four elk (*Cervus elaphus*) were collected during fiscal year (FY) 1995. These data, from muscle and bone samples, were compared to radionuclide concentration in muscle and bone samples from elk collected from regional background locations in 1993 (Fresquez 1994a).

Sampling Procedures, Data Management, and Quality Assurance. Background samples are collected from the New Mexico Department of Game and Fish. Tissue from each elk are sampled (>1,000 g each of leg bone and muscle), and samples are submitted to CST-9 for the determination of tritium; uranium; strontium-90; plutonium-238; plutonium-239,240; and cesium-137. All results are reported on an oven-dry-weight basis (dry g). All QA/QC protocols, chemical analysis, and data handling, validation and tabulation are conducted in the same manner as described in Section 6.B.1.b.

Radiochemical Analytical Results. Results of road kill elk (bone and muscle tissue) collected during the FY95 can be found in Table 6-16. Slightly higher detectable concentrations of tritium, uranium, and plutonium-238 in bone from some on-site elk were observed as compared to similar tissues in elk collected from off-site background areas. Conversely, with the exception of tritium in two muscle samples, no detectable radionuclide concentrations above RSRLs were found in any of the muscle samples from on-site elk, including uranium or plutonium-238. In general, most of these data are within concentrations (± 2 std dev) detected in on-site elk collected during FY93 (Fresquez 1994a). A more thorough trend analysis, including data from deer, will be conducted in the next few years.

Dose Equivalents to Individuals from Ingestion of Game Animals. Table 6-17 presents the summary of the CEDE in elk tissues collected via roadkills during FY95. To compare the CEDE from these elk with a regional background, elk tissues collected in FY93 at off-site locations (Fresquez 1994a) are also presented in this table. It should be noted that the analyses for the 1993 elk tissues do not include tritium, but the 1995 analyses do include tritium. The maximum annual CEDE (i.e., the total CEDE plus two sigma for the maximum consumption rate) for elk collected on-site in 1995 is 1.34 mrem for the consumption of bone tissue and 0.048 mrem for the consumption of muscle tissue. The total net positive difference (see Section 3.B.3.d) between the CEDE due to consuming bone and muscle from elk collected on site and elk collected off site in 1993, using the maximum consumption rate, is 0.216 mrem (<0.3% of the DOE PDL) and 0.027 mrem (<0.03% of the DOE PDL), respectively. For the average consumption rate, these differences decrease to 0.095 mrem (<0.1% of the DOE PDL) for bone and to 0.011 mrem (<0.02% of the DOE PDL) for muscle tissue. The radionuclides that contributed to this total net positive dose are uranium and plutonium-238 for bone; and strontium-90, plutonium-238, plutonium-239, and tritium for muscle. Since elk collected on site had concentrations of strontium and plutonium in the muscle tissues but the off-site elk muscle did not, it is questionable whether these radionuclides actually contributed to the total net positive difference or not. Collecting additional off-site elk will be necessary to determine whether these radionuclides contributed to this difference.

The single factor ANOVA test shows that there is no significant difference (at the 95% level of confidence) between the maximum CEDE (i.e., average CEDE + two sigma) calculated for elk tissues collected from on-site or off-site locations. The Student's t-Test also shows that there is no significant difference (at the 95% level of confidence) between the 1993 CEDE and the 1995 CEDE calculated for the elk sample collected.

3. Biological Resources Monitoring

a. Aquatic Invertebrates. The Biology Team has conducted field studies of stream macroinvertebrate communities within Sandia Canyon since 1990 to assess environmental impacts of Laboratory operations. The team records water quality field parameters simultaneously with taking monthly collections of aquatic invertebrates. Data were collected using standard techniques (Batelle 1977, Schwenneker 1984). Data obtained from the sampling stations indicate that the number and diversity of macroinvertebrates in Sandia Canyon are a function of water quality and physical characteristics of the stream. Macroinvertebrate diversity and community complexity generally increase with increased distance downstream from the National Pollution Discharge Elimination System (NPDES)-permitted outfalls. In 1995, quantitative sampling was initiated, and all collected midges (Family Chironomidae) were sent to a LANL consultant for genus- or species-level identifications. These changes will provide greater accuracy in data analysis of aquatic community diversity and composition.

Aquatic invertebrates and water quality were systematically investigated at six springs and three stream confluences along the Rio Grande in White Rock Canyon for the first time during the fall of 1994 and the spring of 1995. Water quality measurements showed that the pH of both springs and streams decrease between spring and autumn, the springs had more stable temperature regimes than the streams, and that great variations in flow rates existed between individual springs and streams. In terms of aquatic invertebrate communities, the stream habitats

showed high seasonal variances, the dominant taxon frequently changed seasonally in both springs and streams, and most springs and streams appeared capable of supporting well-developed communities.

In 1995, aquatic biological research continued in Guaje and Los Alamos Canyons for the final year of a three-year study. Invertebrate samples were collected seasonally at three permanent stations in each canyon. All recorded field parameters were within ranges set by the New Mexico Water Quality Control Commission's standards for high-quality cold-water fisheries during 1995 (NMWQCC 1995). Increased water temperatures and seasonal drought in lower Los Alamos Canyon were the most significant impacts noted. According to Rapid Biological Protocol metric III analysis comparing stations in Guaje (the control canyon) to stations in Los Alamos (the study canyon), 1995 water quality was slightly impaired at Station LA1, moderately impaired at Station LA2, and severely impaired at LA3. This pattern of increasing downstream impairment was also substantiated by decreasing standing crop numbers and biodiversity values.

b. Terrestrial Invertebrates. EST continued laboratory-wide studies of terrestrial arthropods during 1995. Arthropods were collected using pitfall traps, beating nets, collecting nets, burlese traps, and black light traps (Arnett 1993). All arthropods were identified by a trained entomologist. Arthropod populations are used as indicators of general ecosystem health and are therefore monitored at LANL. Table 6-18 is a list of the insect families that have been collected on LANL property as of December 1995, and Table 6-19 lists the noninsect anthropods collected. The diversity and population numbers of arthropods found on LANL property are not different from those found in control areas outside of LANL. There is no indication that LANL operations are having a negative influence on arthropod diversity or health.

c. Reptiles and Amphibians. During 1995, the populations of reptiles and amphibians were monitored in Pajarito Canyon wetlands to gather baseline information on the number and species of animals that use these wetlands. Animals were collected using standard pitfall traps (Stebbins 1985). These data will eventually be used to perform ecological risk assessments. Captures included among other things: Tiger Salamanders (*Ambystoma tigrinum*), Woodhouse Toads (*Bufo Woodhousei*) Canyon Tree Frogs (*Hyla arenicolor*), Eastern Fence Lizards (*Sceloporus undulatus*) and Many-lined Skinks (*Eumeces multivirgatus*) (Table 6-20). The data indicates that the plateau whiptail lizard (*Cnemidophorus velox*) was the most abundant reptile captured, and the chorus frog (*Pseudacris triseriata*) was the most abundant amphibian. These populations will continue to be monitored in the future and used to assess the overall health of wetland areas. The number and diversity of reptiles and amphibians captured in this study were as expected for this area.

Surveys were also conducted in Mortandad Canyon for the state endangered Jemez Mountains Salamander (*Plethodon neomexicanus*). No salamanders were found during these searches.

d. Birds. During the 1995 field season, six bird surveys were performed in accordance with standard ornithological techniques (Keller 1995a). Each survey covered a total length of approximately 5 km. Surveys were conducted in Los Alamos Canyon, Cañada del Buey, TA-67 Mesa, and Puye Mesa. Approximately 2,000 total individual birds were encountered during the surveys including a total of 78 resident bird species. Table 6-21 lists the more prevalent species identified in these surveys. The populations of birds on LANL lands do not differ from the predicted populations for this type of topography and vegetation zones.

In addition to these surveys, systematic surveys were conducted on LANL lands for the northern goshawk, a candidate under the federal Endangered Species Act. Surveys were begun in suitable habitat to determine the presence of the Mexican spotted owl and the southwestern willow flycatcher, species protected under the federal Endangered Species Act. No nesting goshawks were found on LANL lands, but portions of LANL lands were determined to be northern goshawk post-fledgling management areas. Mexican spotted owls were found to be nesting on LANL property, and southwestern willow flycatcher were not found to be nesting on LANL lands. However, LANL property does contain suitable nesting habitat for these species. All areas of the Laboratory with suitable threatened, endangered, or sensitive species habitat will continue to be monitored and managed.

e. Small Mammals. Small mammal contaminant studies were conducted primarily in two areas of LANL during 1995: Mortandad Canyon and TA-54, Area G.

Mortandad Canyon. Small mammals, plants, and sediments were sampled at one upstream location (Site 1) and two downstream locations (Site 2 and Site 3) from NPDES outfall #051-051 in Mortandad Canyon, Los Alamos County, NM. The purpose of the sampling was to identify radionuclides potentially present, to quantitatively estimate and compare the amount of radionuclide uptake at specific locations (Site 2 and Site 3)

within Mortandad Canyon to an upstream site (Site 1), and to identify the primary mode (inhalation/ingestion, or surface contact) of contamination to small mammals. Samples were analyzed for americium-241, strontium-90, plutonium-238, plutonium-239, and total uranium. Plants were collected at all three sites within the small mammal grid. Three samples of understory (grasses and forbs) and overstory (shrubs and trees) vegetation were taken for each site. At each of the three locations, five subsamples were collected of sediments. Samples were collected across the stream bed channel at the 0-to-5 cm (0-to-2 in.) depth. Samples were submitted to CST-9 on the same day. All methods of radiochemical analyses have been described previously (Salazar 1984).

Radiochemical Analytical Results. Analyses of results from Mortandad Canyon in 1995 have not been completed, pending funding.

Area G. Small mammals were sampled at two waste burial sites (1 and 2) at Area G, TA-54 and a control site on Frijoles Mesa (Site 4) in 1995 to identify radionuclides that are present within surface and subsurface soils at waste burial sites, to compare the amount of radionuclide uptake by small mammals at waste burial sites to a control site, and to identify the primary mode of contamination to small mammals, either through surface contact or ingestion/inhalation. Three composite samples of at least five animals per sample were collected at each site. Pelts and carcasses of each animal were separated and analyzed independently. Samples were analyzed for americium-241, strontium-90, plutonium-238, plutonium-239, total uranium, cesium-137, and tritium.

Radiochemical Analytical Results. Total levels of radionuclides detected in small mammals are reported in Table 6-22. Higher concentrations of uranium, americium-241, plutonium-238, and plutonium-239 in pelts as compared to carcasses suggested that the primary route of contamination was through surface contact. Site 1 had higher mean tritium concentrations in pelts and carcasses than Site 2 or the control (Site 4), and Site 2 had higher mean plutonium-239 concentrations than Site 1 or the control (Site 4).

f. Large Mammals. Large mammal studies were initiated in January 1995 to evaluate the use of the Laboratory by elk and deer. Animals were captured using modified clover traps baited with apple mash and alfalfa. Four elk and one deer were fitted with radio collars. Trapping took place during winter and early spring. Animals were located at least once a week using triangulation with handheld receivers and antennas.

g. Preoperational Studies. Preoperational studies are required by DOE Order 5400.1 for areas where a new facility or process may significantly impact the environment (DOE 1988). The order requires that chemical, physical, and biological characteristics be assessed before the site is disturbed.

Comprehensive ecological studies were conducted for three projects during 1995. These studies included biological assessments for the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility (Keller 1995b), the Los Alamos townsite portions of the Infrastructure Support Facility (ISF) gas line project (Biggs 1996), and the Norton Powerline pole replacement project (Keller 1996).

These assessments include information on floodplains and wetlands; threatened, endangered, and sensitive species; vegetation understory (grass and forbs) and overstory (trees); invertebrates (insects and spiders); and wildlife (reptiles, amphibians, birds, mammals) found within each project area.

Mitigation measures were included in all assessments to minimize the ecological impact of these projects. All assessments concluded that none of the projects is likely to adversely affect the biota of the area if the mitigation measures are strictly followed.

h. Long-Term Trends. Because contaminant monitoring of biological resources began in 1994, it is too early to conclusively define any long-term trends. Monitoring of flora and fauna will continue in order to eventually accumulate enough data to analyze long-term trends.

C. Special Studies

1. Sampling of Perimeter Surface Soils at Technical Area 54, Area G

During FY95, 58 surface soil samples were collected from the perimeter of TA-54, Area G. The locations of these surface soil samples were established so that they could indicate whether contaminants were moving outside the TA-54, Area G perimeter fence under the influence of surface water runoff. That is, each sampling point was located in an obvious (but small) drainage channel just outside the perimeter fence. These sampling locations were thus biased to best determine movement of contaminated soil being carried by surface water runoff from within the confines of TA-54, Area G to beyond the Area G fence (Conrad 1996).

During FY95, the radioactive constituents measured in these surface soil samples included americium-241, cesium-137, isotopic plutonium, total uranium, and tritium. In addition, six soil samples were analyzed for the metals silver, arsenic, barium, beryllium, cadmium, chromium, mercury, nickel, lead, and antimony.

The analytical results of the FY95 surface soil sampling are found in Tables 6-23 and 6-24. Table 6-23 indicates that the perimeter soils at TA-54, Area G are generally elevated above background levels for tritium and plutonium. The most elevated concentrations of tritium in soils are prevalent in the locations that are adjacent to the tritium disposal shafts (sample series G-27-33) and the transuranic (TRU) pads (sample series G-38-50). Isotopic plutonium and americium-241 activity appear to be only slightly elevated in those perimeter locations adjacent to the TRU pads. Cesium-137 and uranium are uniformly distributed in the perimeter locations, and there is no evidence for localized elevated levels of either of these constituents in the perimeter soils sampled.

The concentrations of metals on those soils sampled indicated that there is no elevated distribution of any of the metals on the perimeter soils (Table 6-24).

The results of the perimeter surface soil sampling performed during FY95 indicate that in the areas of the tritium disposal shafts and TRU pads, soils, contaminated to varying degrees by tritium and plutonium, are being moved by surface water runoff from the TA-54, Area G disposal area to outside the perimeter fence. No gross changes in radioactivity in surface soils sampled were observed during FY95, although tritium concentrations in soils were generally lower than in FY94. No new locations where surface soils were elevated with radioactivity were defined by the FY95 sampling. These findings are consistent with analogous measurements taken in FY93 and FY94.

2. Radionuclide Concentrations in and/or on Vegetation at Radioactive Waste Disposal Area G during the 1995 Growing Season

Overstory (piñon pine) and understory (grass and forb) vegetation were collected within and around selected points at TA-54, Area G, a low-level radioactive solid waste disposal facility at LANL, for the analysis of tritium, strontium-90, plutonium-238 and plutonium-239, cesium-137, and total uranium. Also, heavy metals (silver, arsenic, barium, beryllium, cadmium, chromium, mercury, nickel, lead, antimony, selenium, and thallium) in and/or on vegetation were determined. In general, most (unwashed) vegetation collected within and around TA-54, Area G contained tritium, uranium, plutonium-238, and plutonium-239 in higher concentrations than vegetation collected from regional (background) areas. Tritium, in particular, was detected as high as 7,300 pCi/mL in understory vegetation collected from the west side of the TRU pads. The south and west ends of the tritium shaft field also contained elevated levels of tritium in overstory, and especially in understory vegetation, as compared to background; this suggests that tritium may be migrating from this waste repository through surface and subsurface pathways. Also, understory vegetation collected north of the TRU pads (adjacent to the fence line of TA-54, Area G) contained the highest values of plutonium-238 and plutonium-239 as compared to background, and may be a result of surface holding, storage, and/or disposal activities.

With the exception of a few slightly elevated heavy metal elements in and/or on vegetation as compared to background, most heavy metals in and/or on overstory and understory vegetation collected within and around TA-54, Area G were within normal background concentrations. Barium was detected in slightly higher concentrations in vegetation collected at almost all of the sites at TA-54, Area G than upper limit background concentrations. The reasons for the slightly higher values of barium in and/or on vegetation at TA-54, Area G as compared to background are not completely known, as barium in soils within (Conrad 1995) and around TA-54, Area G were within normal background concentrations. Only one site, understory vegetation collected at the south end of the tritium shaft field, exhibited any kind of a trend; that is, concentrations of more than one heavy metal element, namely barium, beryllium, cadmium, chromium, and nickel, were detected at above background concentrations. All data and a more detailed discussion of results can be found in Fresquez 1996b.

3. Strontium Concentrations in Chamisa (*Chrysothamnus nauseosus*) Shrub Plants Growing in a Former Liquid Waste Disposal Area in Bayo Canyon

Chamisa (*Chrysothamnus nauseosus*) shrub plants growing in a former liquid waste disposal site (SWMU 10 003[c]) in Bayo Canyon at LANL were collected and analyzed for strontium-90 and total uranium. Surface soil samples were also collected from below (understory) and between (interspace) shrub canopies. Both chamisa plants growing over SWMU 10-003(c) contained significantly higher concentrations of strontium-90 than a control

plant; one plant, in particular, contained 90,500 pCi strontium-90/g ash in top-growth material. Similarly, soil surface samples collected underneath and between plants contained strontium-90 concentrations above background and LANL SALs; this probably occurred as a result of chamisa plant leaf fall contaminating the soil understory area followed by water and/or winds moving strontium-90 to the soil interspace area. Although some soil surface migration of strontium-90 from SWMU 10-003(c) has occurred, the level of strontium-90 in sediments collected downstream of SWMU 10-003(c) at the Bayo Canyon/State Road 4 intersection was still within regional (background) concentrations. All data and a more detailed discussion of results can be found in Fresquez 1995c.

4. Baseline Radionuclide Concentrations in Soils and Vegetation Around the Proposed Weapons Engineering Tritium Facility and the Weapons Subsystems Laboratory at Technical Area 16

A preoperational environmental survey is required by the DOE for all federally funded research facilities that have the potential to cause adverse impacts on the environment. Therefore, in accordance with DOE Order 5400.1, an environmental survey was conducted over the proposed sites of the Weapons Engineering Tritium Facility (WETF) and the Weapons Subsystems Laboratory (WSL) at TA-16. Baseline concentrations of tritium, plutonium-238, plutonium-239, and total uranium were measured in soils, vegetation (pine needles and oak leaves) and ground litter. Tritium was also measured from air samples, while cesium-137 was measured in soils. The mean concentration of airborne tritiated water during 1987 was 3.9 pCi/m^3. Although the mean annual concentration of tritium in soil moisture at the 0–5 cm (0–2 in.) soil depth was measured at 0.6 pCi/mL, a better background level, based on long-term regional data, was considered to be 2.6 pCi/mL. Mean values for cesium-137, plutonium-238, plutonium-239, and total uranium in soils collected from the 0–5 cm (0–2 in.) depth were 1.08 pCi/g, 0.0014 pCi/g, 0.0325 pCi/g, and 4.01 μg/g, respectively. Ponderosa pine (*Pinus ponderosa*) needles contained higher values of plutonium-238, plutonium-239, and total uranium than did leaves collected from gambel's oak (*Quercus gambelii*). In contrast, leaves collected from gambel's oak contained higher levels of cesium-137 than the pine needles did. All data and a more detailed discussion of results can be found in Fresquez 1995a.

5. Radionuclides and Radioactivity in Soils Within and Around Los Alamos National Laboratory: 1974 to 1994

A soil sampling and analysis program is the most direct means for determining the inventory, concentration, and distribution of radionuclides in the environment within and around nuclear facilities. This report summarizes radionuclide concentrations in soils collected from on-site LANL, perimeter, and regional (background) areas over a 20-year period (1974 to 1994). The upper limit background concentration (mean plus 2 std dev) for tritium, cesium-137, plutonium-238, plutonium-239, americium-241, strontium-90, total uranium, and gross alpha, beta, and gamma activity, was 6.34 pCi/mL, 1.13 pCi/g, 0.008 pCi/g, 0.028 pCi/g, 0.208 pCi/g, 0.82 pCi/g, 4.05 μg/g, 35.24 pCi/g, 13.62 pCi/g, and 7.33 pCi/g, respectively. Most perimeter and on-site soils contained three or more radionuclides, including plutonium-239 and uranium, that were significantly ($p < 0.05$) higher in concentration than regional locations. The higher levels of radionuclides in perimeter soils as compared to regional soils were attributed mostly to worldwide fallout and to naturally occurring radioactivity in Bandelier Tuff soils. Higher concentrations of radionuclides detected in on-site soils as compared to perimeter and regional soils, on the other hand, were attributed to worldwide fallout, natural radioactivity, and to Laboratory operations. All data and a more detailed discussion of results can be found in Fresquez 1995b.

6. Radionuclide and Heavy Metal Concentrations in Soil, Vegetation, and Fish Collected Around and Within Tsicoma Lake in Santa Clara Canyon

Radionuclide (tritium, strontium-90, cesium-137, plutonium-238, plutonium-239, and total uranium) and heavy metal (silver, arsenic, barium, beryllium, cadmium, chromium, mercury, nickel, lead, antimony, selenium, and thallium) concentrations were determined in soil, vegetation (overstory and understory), and fish (rainbow trout) collected around and within Tsicoma Lake in Santa Clara Canyon in 1995. All heavy metal and most radionuclide concentrations around or within Tsicoma Lake, with the exception of uranium in soil, vegetation, and fish, were within or just above RSRLs. Detectable levels (where the analytical result was greater than two times the counting uncertainty) of uranium in soils, vegetation, and fish from Tsicoma Lake were found in slightly higher concentrations than in background samples. Overall, however, the maximum total CEDE (95% confidence

level)—based on the consumption of 46 lb of fish—from Tsicoma Lake (0.066 mrem yr was within the maximum total CEDE from the ingestion of fish from the Mescalero National Fish Hatchery (background) (0.113 mrem/yr). All data and a more detailed discussion of results can be found in Fresquez 1996c.

7. Tritium Concentrations in Bees and Honey at Los Alamos National Laboratory

LANL has maintained a network of honey bee colonies at on-site LANL, perimeter (Los Alamos townsite and White Rock/Pajarito Acres) and regional (background) areas for more than 15 years; the main objective of this honey bee network was to help determine the bioavailability of certain radionuclides in the environment. Of all the radionuclides studied (tritium, cobalt-57, beryllium-7, sodium-22, magnesium-54, rubidium-83, cesium-137, plutonium-238, plutonium-239, strontium-90, and total uranium), tritium was consistently detected in bees and was most readily transferred to the honey. In fact, honey collected from hives located at TA-21, TA-33, TA-35, TA-53, and TA-54 and from White Rock/Pajarito Acres contained significantly higher concentrations of tritium than regional background hives. Based on the average concentration of all radionuclides measured over the years, the net positive CEDE from consuming 5 kg (11 lb) of honey collected from the Los Alamos townsite and White Rock/Pajarito Acres, after regional background has been subtracted, was 0.0036 (± 0.0100) and 0.00084 (± 0.00061) mrem/yr, respectively. The highest net positive CEDE, based on the mean + 2 standard deviation (95% confidence level), was 0.024 mrem/yr (Los Alamos townsite); this was <0.03% of the ICRP permissible dose limit of 100 mrem/yr from all pathways. All data and a more detailed discussion of results can be found in Fresquez 1994b.

8. Native American Involvement in Flora and Fauna Sampling to Support Human Health Risk Evaluations in the Vicinity of Los Alamos National Laboratory

LANL, located in northern New Mexico, is evaluating risks to human health and the environment that may have resulted from development of the atomic bomb and subsequent nuclear weapons development and research activities. The remediation of a number of LANL sites is being carried out under the federal Resource Conservation and Recovery Act, which requires public involvement and acceptance of the remediation plan. Models for assessing past, present, and future risk have been modified to more accurately assess exposure pathways likely to occur at the Native American Pueblos in the vicinity of LANL. To ensure that these models have adequate data to characterize the appropriate input parameters, LANL is involving tribal members in development of sampling plans and collection of samples. This process is being instituted to ensure (1) that the media deemed important as potential exposure sources are adequately sampled: (2) that exposure points of most concern to the pueblos because of either frequency or intensity of contact are sampled; and (3) that bioconcentration factors are obtained that are appropriate for the site in plant and animal species of concern. This process has included involvement of tribal representatives in collecting samples of ecological and dietary concern such as fish, game, and indigenous plant materials. For example, tribal input is used to determine native plant species important to the tribe, identification of potential contamination in these species, and comparison of vegetation patterns with patterns in reference communities. In addition, site-specific uptake factors for contaminants of concern in plants cultivated at the pueblos have been determined. Uptake is known to be dependent on the climatic conditions, soil texture, pH, and moisture level and the specific plant or plant parts being examined. Conditions at the pueblos typically involve alkaline soils, and a growing season with extreme sunlight and arid conditions. Plant species cultivated for dietary consumption typically include a finite set with corn and squash comprising a major portion of the diet. The exposure models developed for the pueblo assessments appear to be most sensitive to these plant uptake values, therefore mandating appropriate values for these parameters to ensure accuracy of risk predictions. Samples are also being collected from fish, elk, and other game whose range includes contaminated regions. Patterns of meat distribution from hunted game within the pueblos increase the number of people likely to ingest potentially contaminated meat, making this an important source term in calculating potential exposure. In addition, data obtained from plant and game samples within contaminated regions will be important in assessing the impact of contamination on the ecosystem.

9. Ecotoxicological Screen of a Mortandad Canyon Area

Potential ecological risk associated with soil contaminants at a Mortandad Canyon site at LANL was assessed by performing an ecotoxicological risk screen. The site is down-channel from US EPA Outfall 051-051, which

discharges treated effluent from the Radioactive Liquid Waste Treatment Facility (RLWTF). Discharge at the outfall is permitted under the Clean Water Act National Pollutant Discharge Elimination System permit. Radionuclide discharge is regulated by DOE Order 5400.5.

Ecotoxicological screening action levels (ESALs) were computed for nonradionuclide constituents in soil, and human risk SALs for radionuclides were used as ESALs. Soil was sampled at three points along each of nine linear transects located at 100 ft intervals down-channel from the outfall. Soil samples from 3 depths for each sampling point were analyzed for the concentrations of 121 constituents. Maximum soil contaminant concentrations were compared to ESALs. Only the results of surface sampling for radionuclide concentrations is reported in full.

The spatial change in radionuclide concentration from the outfall to the down-canyon sample locations was not statistically significant. The average concentration (19.7 pCi/g) of alpha-emitting radionuclides was higher than values reported in a different study for 15 on-site locations for the period 1978–1981 and is 242% of the mean gross alpha concentration measured in the same area between 1975 and 1977. The standard deviation within transect means 3.1 pCi/g. Of 121 screened soil constituents, 42 met the criteria for needed further study; however, for 25 of the 42 were potential contaminants for concern for which the maximum soil concentration was equal to or less than the lowest required analytical limit, which is known as the "contractor required quantitation limit" (crql). Excluding the crql-related contaminants, there were no semivolatiles, 1 volatile, 5 inorganics and 11 radionuclides. There was inadequate data to make a determination for 20 analytes. The heavy metals may be a concern because of their susceptibility to biomagnification. Although the results of subsurface sampling are not reported here, a cursory review of the data revealed that the concentrations of several of the metals are highest at the intermediate sampling depth, 1.5–2.5 ft. The results of this study may present issues related to the Clean Water Act and/or the Comprehensive Environmental Response, Compensation, and Liability Act regarding requirements to conduct ecological risk assessments. At least 17 contaminants should be investigated in an ecological risk assessment.

10. Small Mammal Study in Sandia Canyon

The purpose of this study was to gather data on species richness, diversity, density, biomass, and physical characteristics (weight, length, and lean body mass) of nocturnal small mammal populations in three areas of Sandia Canyon. Sandia Canyon receives outfall effluents from multiple sources, and we compared small mammal population characteristics at increasing distances from the outfall sources to other locations in Los Alamos County. Location 1 was closest to the outfall sources and Location 3 farthest away.

Animals were marked with size #FF rodent ear tags. Location of capture, species name, sex, weight, body length, tail length, ear length, foot length, tag number, and lean body mass (determined using a nondestructive scanner) were recorded. Incidental kills were kept for species confirmation/accuracy rates, food habits analysis of stomach contents, and chemical analysis for percent body fat. Additionally, on the final day of trapping, all or a portion of animals captured at each site were sacrificed for these analyses.

Two locations had relatively greater species richness, primarily due to habitat differences. Locations 1 and 2 contained both cattail marsh and upland areas. These locations had species indicative of wet environment (shrews and voles) as well as upland environments (deer and brush mice). Location 3, however, was centered over a very narrow riparian stream channel, and the majority of the species captured were characteristic of upland environments. Species diversity index values (1.60, 1.65, and 0.67 for Locations 1, 2, and 3, respectively) were very similar to indices calculated at other sites with similar habitat within LANL (Raymer 1994). The differences in species diversity indices appeared to be directly related to habitat type.

Density estimates were calculated for all three webs. Location 1, with the greatest extend of cattail marsh, had the highest density estimate. However, statistical analysis could not be performed on the estimates due to insufficient sample size. Statistical analysis also was not performed on the biomass estimates due to insufficient sample size. However, Location 1 (2,638 g/ha) had a higher biomass estimate than Locations 2 (1,237 g/ha) and 3 (510 g/ha). Voles made up 40% of the animals captured at Location 1, relative to 20% at Location 2 and 3.3% at location 3. Voles have the largest mass of the species captured.

Decreased body weight, body length, and percent body fat (measured as an increase in lean body mass) can indicate reduced health of organisms. These factors were evaluated for rodents captured at each location. There was no evidence of changes in weight, length, or lean body mass with increasing distance from outfall sources. Deer and brush mice captured at the three locations had a mean body weight and body length within the normal range for these species.

D. Tables

Table 6-1. Location of Soil Sampling Stations[a]

Location	Map Denotation	Northing Coordinate[b]	Easting Coordinate[b]
Regional			
Rio Chama		1844693.096	1677875.228
Embudo		1816440.315	1744693.086
Otowi		1777182.637	1668721.670
Near Santa Cruz		1816438.561	1744700.759
Cochiti		1644216.892	1647114.194
Bernalillo		1572864.707	1549601.021
Jemez		1719495.437	1502276.101
Perimeter			
L.A. Sportsman Club	S1	1788136.211	1636493.387
North Mesa	S2	1780072.446	1630330.015
Near TA-8 (GT Site)	S3	1768805.627	1609433.446
Near TA-49	S4	1755456.289	1620318.345
White Rock (East)	S5	1758301.447	1655116.466
Tsankawi	S6	1768110.302	1647985.099
On-Site			
TA-21 (DP Site)	S7	1774989.218	1631266.389
East of TA-53	S8	1772914.010	1629196.631
TA-50	S9	1769548.575	1626390.047
Two-Mile Mesa	S10	1769494.453	1615386.422
East of TA-54	S11	1757882.733	1645162.755
R-Site Road East	S12	1761923.229	1625863.108
Potrillo Drive	S13	1759475.770	1635153.829
S-Site (TA-16)	S14	1759328.803	1618868.688
Near Test Well DT-9	S15	1752337.978	1629594.961
Near TA-33	S16	1740806.015	1638487.987

[a]Soil sampling locations are given in Figures 6-1 and 6-2.
[b]New Mexico State Planar Coordinates, NAD 1983.

Table 6-2. Radiochemical Analyses of Soils Collected in 1995

Location	^{3}H (pCi/mL)	^{90}Sr (pCi/g)	^{137}Cs (pCi/g)	Total Uranium (µg/g)	^{238}Pu (pCi/g)	$^{239,240}Pu$ (pCi/g)	^{241}Am (pCi/g)	Gross Alpha (pCi/g)	Gross Beta (pCi/g)	Gross Gamma (pCi/g)
Off-Site Regional (Background) Stations:										
Rio Chama	0.10 (0.60)[a]	0.10 (0.40)	0.25 (0.10)	0.83 (0.16)	0.000 (0.002)	0.006 (0.002)	0.008 (0.008)	2.5 (1.0)	2.5 (0.6)	2.3 (0.6)
Embudo	0.20 (0.60)	0.10 (0.40)	0.45 (0.14)	1.62 (0.32)	0.004 (0.002)	0.018 (0.004)	0.010 (0.004)	5.6 (4.8)	4.8 (1.2)	3.6 (0.8)
Otowi	0.10 (0.60)	0.50 (0.60)	0.51 (0.14)	1.95 (0.40)	0.002 (0.002)	0.019 (0.006)	0.007 (0.006)	6.7 (6.0)	4.8 (1.2)	3.5 (0.8)
Santa Cruz	0.40 (0.60)	0.40 (0.60)	0.46 (0.14)	1.85 (0.38)	0.003 (0.002)	0.021 (0.004)	0.009 (0.008)	6.4 (9.4)	5.6 (1.6)	4.2 (1.0)
Cochiti	0.20 (0.60)	0.30 (0.40)	0.10 (0.06)	1.31 (0.26)	0.005 (0.004)	0.007 (0.004)	0.002 (0.004)	4.1 (2.6)	3.8 (1.0)	3.0 (0.8)
Bernalillo	0.20 (0.60)	0.10 (0.40)	0.24 (0.08)	2.81 (0.56)	0.002 (0.002)	0.011 (0.004)	0.008 (0.008)	9.1 (12.0)	5.4 (1.4)	3.6 (0.8)
Jemez	0.30 (0.60)	0.30 (0.60)	0.50 (0.14)	2.53 (0.50)	0.012 (0.004)	0.012 (0.004)	0.005 (0.006)	3.8 (4.8)	3.0 (0.8)	3.8 (0.8)
Mean (±2SD)	0.21 (0.21)	0.26 (0.32)	0.36 (0.32)	1.84 (1.36)	0.004 (0.008)	0.013 (0.012)	0.007 (0.006)	5.5 (4.4)	4.3 (2.4)	3.4 (1.2)
RSRL[b]	6.34	0.82	1.13	4.05	0.008	0.028	0.208	35.3	13.6	7.3
SAL[c]	1,900.00[d]	4.40	5.10	29.00	27.000	24.000	22.000			
Off-Site Perimeter Stations:										
LA Sportsman Club	0.20 (0.60)	0.80 (0.40)	0.62 (0.18)	3.32 (0.66)	0.037 (0.006)[e]	0.040 (0.006)[e]	0.007 (0.004)	8.0 (5.6)	6.5 (1.6)	4.2 (1.0)
North Mesa	0.20 (0.60)	0.20 (0.60)	0.32 (0.12)	3.14 (0.62)	0.002 (0.002)	0.018 (0.004)		---	---	---
TA-8/GT Site	-0.10[f] (0.60)	0.50 (0.40)	1.21 (0.28)[e]	2.39 (0.48)	0.024 (0.006)[e]	0.045 (0.008)[e]	0.016 (0.004)	5.0 (2.6)	6.0 (1.4)	4.3 (1.0)
TA-49	0.20 (0.60)	0.30 (0.40)	0.41 (0.12)	3.50 (0.70)	0.008 (0.004)	0.024 (0.006)	0.010 (0.004)	8.0 (5.0)	7.4 (1.8)	3.9 (0.8)
White Rock (East)	0.10 (0.60)	0.40 (0.40)	0.30 (0.10)	2.20 (0.44)	0.013 (0.006)[e]	0.012 (0.008)	0.006 (0.002)	5.5 (3.0)	4.6 (1.2)	3.3 (0.8)
Tsankawi	0.10 (0.60)	0.40 (0.60)	0.13 (0.08)	4.19 (0.84)[e]	0.004 (0.004)	0.006 (0.002)	0.004 (0.002)	5.2 (2.0)	2.9 (0.6)	4.7 (1.0)
Mean (±2SD)	0.12 (0.23)	0.43 (0.41)	0.50 (0.77)	3.12 (1.47)[g]	0.015 (0.027)[g]	0.024 (0.031)	0.009 (0.010)	6.3 (3.1)	5.5 (3.5)	4.1 (1.0)[g]
On-Site Stations:										
TA-21 (DP Site)	0.20 (0.60)	0.10 (0.60)	0.18 (0.06)	2.07 (0.42)	0.005 (0.002)	0.071 (0.008)[e]	0.010 (0.008)	6.7 (3.4)	5.0 (1.2)	3.5 (0.8)
West of TA-53	0.50 (0.60)	0.20 (0.60)	0.33 (0.10)	4.15 (0.84)[e]	0.024 (0.006)[e]	0.030 (0.006)[e]	0.008 (0.004)	6.0 (2.2)	4.1 (1.0)	3.9 (0.8)
TA-50	0.20 (0.60)	0.80 (0.60)	0.62 (0.16)	5.29 (1.06)[e]	0.030 (0.006)[e]	0.351 (0.024)[e]	0.034 (0.006)	9.4 (7.4)	8.7 (2.2)	3.7 (0.8)
Two-Mile Mesa	0.30 (0.60)	0.60 (0.80)	0.47 (0.14)	2.71 (0.54)	0.005 (0.004)	0.021 (0.006)	0.007 (0.004)	5.0 (3.0)	5.5 (1.4)	3.2 (0.8)
East of TA-54	0.00 (0.60)	0.50 (0.80)	0.10 (0.04)	2.43 (0.48)	0.014 (0.004)[e]	0.024 (0.006)	0.006 (0.004)	4.4 (1.8)	3.2 (0.8)	3.4 (0.8)
R-Site Road East	0.40 (0.60)	1.30 (1.20)[e]	0.57 (0.16)	7.83 (1.56)[e]	0.002 (0.002)	0.025 (0.006)		---	---	---
Potrillo Drive	0.30 (0.60)	0.30 (0.80)	0.30 (0.10)	2.53 (0.50)	0.021 (0.004)[e]	0.013 (0.004)	0.007 (0.004)	7.4 (5.0)	5.1 (1.2)	3.3 (0.8)
S-Site (TA-16)	0.30 (0.60)	1.10 (1.00)[e]	0.46 (0.12)	3.95 (0.80)	0.002 (0.002)	0.024 (0.004)	0.008 (0.004)	8.8 (5.4)	9.1 (2.2)	3.6 (0.8)
Near Test Well DT-9	0.20 (0.60)	0.20 (0.40)	0.32 (0.10)	2.29 (0.46)	0.002 (0.006)	0.014 (0.008)	0.008 (0.004)	6.7 (4.8)	5.9 (1.4)	3.5 (0.8)
Near TA-33	0.10 (0.60)	0.20 (0.40)	0.00 (0.18)	2.49 (0.50)	0.008 (0.002)	0.014 (0.004)	0.007 (0.002)	5.2 (3.2)	5.2 (1.2)	---
Mean (±2SD)	0.25 (0.29)	0.53 (0.83)	0.34 (0.40)	3.57 (3.64)[g]	0.011 (0.021)	0.059 (0.208)[g]	0.011 (0.018)	6.6 (3.4)	5.8 (3.9)	3.5 (0.4)

[a](±2 counting uncertainty); values are the uncertainty of the analytical result at the 95% confidence level.

[b]Regional Statistical Reference Level; this is the upper limit background concentration (mean + 2 std dev) from Fresquez (1996a).

[c]SAL (Los Alamos National Laboratory screening action level) from Fresquez (1996a).

[d]Equivalent to 260 pCi/dry g soil at 12% moisture.

[e]Detectable value (where the analytical results was greater than two sigma) and higher than the RSRL.

[f]See Appendix B for an explanation of the presence of negative values.

[g]Statistically significant mean from background mean using a Wilcoxon Rank Sum test at the 0.05 probability level.

Tables 6-3. Total Recoverable Trace and Heavy Metals (μg/g) in Soils Collected in 1995[a]

Location	Ag	As	Ba	Be	Cd	Cr	Hg	Ni	Pb	Sb	Se	Tl
Off-Site Regional (Background) Stations:												
Rio Chama	3.1	0.9	36.0	<0.08[b]	<0.4	2.8	0.04	2.9	<8.0	<0.3	0.2	<0.3
Embudo	<3.0	2.0	120.0	0.44	<0.4	11.0	0.05	7.8	<14.0	<0.3	0.5	<0.3
Otowi	<3.0	2.0	150.0	0.37	<0.4	9.2	0.04	5.1	18.0	<0.3	0.5	<0.3
Santa Cruz	<3.0	4.0	140.0	0.47	<0.4	13.0	0.04	9.0	12.0	<0.3	0.6	<0.3
Cochiti	<3.0	3.0	110.0	0.30	<0.4	8.0	0.04	5.0	9.8	<0.3	0.4	<0.3
Bernalillo	<3.0	4.0	160.0	0.63	<0.4	13.0	0.05	9.9	16.0	<0.3	0.8	<0.3
Jemez	<3.0	3.0	86.0	0.32	<0.4	8.4	0.05	4.0	<14.0	<0.3	0.4	<0.3
Mean (±2SD)	<3.0 (0.1)	2.6 (2.8)	114.6 (85.7)	<0.37 (0.34)	<0.4 (0.0)	9.3 (7.1)	0.04 (0.01)	6.2 (5.3)	<13.1 (6.9)	<0.3 (0.0)	0.5 (0.4)	<0.3 (0.0)
RSRL[c]	<4.4	6.0	220.0	<0.90	<0.5	17.4	<0.05	<14.8	<21.8	<0.4	<2.0	<2.4
SAL[d]	400.0	6.0	5,600.0	0.90	80.0	400.0	24.00	1,600.0	500.0	32.0	400.0	6.4
Off-Site Perimeter Stations:												
Sportsman's Club	<3.0	4.0	120.0	0.56	<0.4	11.0	0.05	6.0	19.0	<0.3	0.5	<0.3
North Mesa	<4.0	4.0	120.0	0.64	<0.4	13.0	0.06[e]	<3.0	26.0[e]	<0.3	0.5	<0.3
TA-8	<3.0	4.0	76.0	0.40	<0.4	10.0	0.06[e]	3.4	25.0[e]	<0.3	0.4	<0.3
TA-49	<3.0	4.0	150.0	0.63	<0.4	12.0	0.04	6.2	22.0[e]	<0.3	0.4	<0.3
White-Rock	<3.0	3.0	120.0	0.79	<0.4	12.0	0.04	6.7	19.0	<0.3	0.5	<0.3
Tsankawi	<3.0	1.0	47.0	0.68	<0.4	5.3	<0.40	<2.0	25.0[e]	<0.3	0.3	<0.3
Mean (±2SD)	<3.2 (0.8)	3.3 (2.4)	105.5 (74.3)	0.62 (0.26)[f]	<0.4 (0.0)	10.6 (5.5)	<0.05 (0.02)	<4.6 (4.0)	22.7 (6.3)[f]	<0.3 (0.0)	0.4 (0.2)	<0.3 (0.0)
On-Site Stations:												
TA-21	<3.0	3.0	91.0	0.74	<0.4	11.0	0.05	5.1	40.0[e]	<0.3	0.4	<0.3
East of TA-53	3.5	1.0	22.0	0.27	<0.4	2.7	0.04	<2.0	19.0	<0.3	0.3	<0.3
TA-50	<3.0	3.0	110.0	0.53	<0.4	8.6	0.07[e]	3.7	15.0	<0.3	0.4	<0.3
2-Mile Mesa	<3.0	4.0	81.0	0.47	<0.4	9.6	0.05	4.6	22.0[e]	<0.3	0.4	<0.3
East of TA-54	<3.0	2.0	92.0	0.65	<0.4	8.4	0.04	2.9	13.0	<0.3	0.4	<0.3
R-Site-RD-E	<4.0	4.0	170.0	0.74	<0.4	11.0	0.05	<6.0	21.0	<0.3	0.4	<0.3
Potrillo-DR	<3.0	4.0	150.0	0.93[e]	<0.4	14.0	0.05	9.2	21.0	0.3	0.4	<0.3
S-Site	<4.0	3.0	150.0	0.74	<0.4	8.8	0.05	4.3	14.0	<0.3	0.5	<0.3
Near Well D-T9	<4.0	3.0	120.0	0.73	<0.4	10.0	0.05	5.7	14.0	<0.3	0.4	<0.3
Near TA-33	<4.0	3.0	110.0	0.54	<0.4	8.2	0.04	7.8	21.0	<0.3	0.4	<0.3
Mean (±2SD)	<3.5 (1.0)	3.0 (1.9)	109.6 (84.8)	0.63 (0.37)[f]	<0.4 (0.0)	9.2 (5.8)	0.05 (0.02)	<5.1 (4.3)	20.0 (15.7)[f]	<0.3 (0.0)	0.4 (0.1)	<0.3 (0.0)

[a] Analysis by EPA Method 3051 for total recoverable metals.
[b] The less than symbol (<) means the analysis was below the specified detection limit of the analytical method.
[c] Regional Statistical Reference Level; this is the upper-limit background concentration (mean + 2 std dev) from Fresquez 1995.
[d] SAL (Los Alamos National Laboratory Screening Action Level).
[e] Higher than the RSRL.
[f] Statistically significant mean from background mean using a Wilcoxon Rank Sum test at the 0.05 probability level.

Table 6-4. Radionuclides in Produce Collected from Regional, Perimeter, and On-Site Areas during the 1995 Growing Season[a]

	^{3}H (pCi/mL)		^{90}Sr (10^{-3} pCi/dry g)		U (ng/dry g)		^{238}Pu (10^{-5} pCi/dry g)		$^{239,240}Pu$ (10^{-5} pCi/dry g)		^{137}Cs (10^{-3} pCi/dry g)	
Off-Site Regional (Background) Stations												
Española/Santa Fe/Jemez:												
apples	0.3	(0.6)[b]	3.0	(8.0)	1.5	(0.4)	0.0	(2.0)	3.0	(4.0)	7.0	(21.0)
tomatoes	0.1	(0.6)	16.0	(96.0)	40.0	(9.6)	0.0	(0.0)	624.0	(64.0)	54.4	(41.6)
cucumbers	0.2	(0.6)	22.0	(44.0)	9.9	(2.2)	11.0	(22.0)	11.0	(22.0)	29.7	(88.0)
squash	0.0	(0.6)	96.0	(264.0)	8.4	(2.4)	0.0	(0.0)	12.0	(24.0)	88.8	(266.4)
tea	0.4	(0.6)	90.0	(120.0)	28.2	(6.0)	0.0	(12.0)	6.0	(12.0)	7.8	(24.0)
spinach	0.2	(0.6)	105.0	(630.0)	48.3	(8.4)	42.0	(42.0)	273.0	(84.0)	23.1	(71.4)
Mean	0.2	(0.3)[c]	55.3	(92.6)	22.7	(38.0)	8.8	(33.7)	154.8	(506.3)	35.1	(63.0)
RSRL[d]	16.9		75.6		38.2		35.4		67.9		690.1	
Off-Site Perimeter Stations												
Los Alamos:												
tomatoes	–0.1	(0.6)[e]	0.0	(32.0)	4.0	(1.6)	8.0	(16.0)	8.0	(16.0)	40.0	(43.2)
squash	0.0	(0.6)	88.0	(44.0)[f]	6.6	(2.2)	0.0	(22.0)	11.0	(22.0)	7.7	(22.0)
tomatoes	0.5	(0.6)	0.0	(36.0)	6.3	(1.8)	0.0	(0.0)	0.0	(0.0)	22.5	(68.4)
apples	0.1	(0.6)	2.0	(4.0)	3.0	(0.8)	2.0	(4.0)	0.0	(4.0)	1.8	(5.2)
peaches	0.1	(0.6)	10.0	(10.0)	2.5	(1.0)	5.0	(10.0)	20.0	(10.0)	3.5	(10.0)
squash	0.0	(0.6)	50.0	(20.0)	4.0	(0.8)	10.0	(20.0)	20.0	(20.0)	31.0	(30.0)
Mean	0.1	(0.4)	25.0	(72.7)	4.4	(3.4)	4.2	(8.4)	9.8	(18.0)	17.8	(31.6)
White Rock/Pajarito Acres:												
squash	–0.1	(0.6)	14.0	(56.0)	4.2	(0.8)	0.0	(0.0)	14.0	(28.0)	47.6	(142.8)
tomatoes	0.0	(0.6)	0.0	(52.0)	5.2	(1.0)	0.0	(0.0)	0.0	(0.0)	24.7	(23.4)
tea	0.4	(0.6)	63.0	(28.0)	4.2	(1.4)	0.0	(0.0)	0.0	(0.0)	13.3	(40.6)
squash	0.4	(0.6)	0.0	(44.0)	4.4	(0.9)	11.0	(22.0)	0.0	(0.0)	13.2	(41.8)
cucumbers	–0.1	(0.6)	12.0	(48.0)	3.6	(1.2)	12.0	(24.0)	12.0	(24.0)	–6.0	(57.6)
Mean	0.1	(0.5)	17.8	(52.2)	4.3	(1.2)	4.6	(12.6)	5.2	(14.3)	18.6	(39.3)

Table 6-4. Radionuclides in Produce Collected from Regional, Perimeter, and On-Site Areas during the 1995 Growing Season[a] (Cont.)

	^{3}H (pCi/mL)		^{90}Sr (10^{-3} pCi/dry g)		U (ng/dry g)		^{238}Pu (10^{-5} pCi/dry g)		$^{239,240}Pu$ (10^{-5} pCi/dry g)		^{137}Cs (10^{-3} pCi/dry g)	
Cochiti:												
squash	0.1	(0.6)	9.0	(36.0)	7.2	(1.8)	–27.0	(18.0)	0.0	(18.0)	–72.0	(43.2)
tomatoes	0.1	(0.6)	9.0	(36.0)	5.4	(1.8)	9.0	(18.0)	9.0	(18.0)	143.1	(88.2)
cucumbers	0.2	(0.6)	39.0	(52.0)	7.8	(2.6)	13.0	(26.0)	13.0	(26.0)	204.1	(611.0)
tea	0.1	(0.6)	12.0	(24.0)	9.6	(2.4)	0.0	(0.0)	18.0	(12.0)	33.6	(19.2)
spinach	–0.3	(0.6)	54.0	(72.0)	20.7	(3.6)	–9.0	(0.0)	0.0	(0.0)	72.0	(28.8)
Mean	0.0	(0.4)	24.6	(41.4)	10.1	(12.2)	–2.8	(32.0)	8.0	(15.9)	76.2	(211.3)
Pueblo of San Ildefonso:												
squash	–0.1	(0.6)	44.0	(44.0)	16.5	(4.4)	11.0	(22.0)	11.0	(22.0)	5.5	(17.6)
tea	0.0	(0.6)	150.0	(36.0)[f]	25.8	(4.8)	18.0	(1.2)	144.0	(36.0)[f]	28.2	(84.0)
spinach	0.1	(0.6)	30.0	(40.0)	19.0	(4.0)	0.0	(0.0)	0.0	(0.0)	–3.0	(48.0)
tomatoes	0.1	(0.6)	18.0	(36.0)	5.4	(1.8)	0.0	(0.0)	9.0	(18.0)	36.0	(106.2)
cucumbers	0.3	(0.6)	72.0	(48.0)	25.2	(4.8)	0.0	(0.0)	12.0	(24.0)	19.2	(60.0)
Mean	0.1	(0.3)	62.8	(105.5)	18.4	(16.6)	5.8	(16.6)	35.2	(122.0)	17.2	(32.0)
On-Site Stations												
LANL:												
tomatoes	0.6	(0.6)	28.0	(14.0)	2.8	(0.6)	0.0	(14.0)	14.0	(14.0)	22.4	(67.2)
nectarines	0.6	(0.6)	10.0	(20.0)	1.0	(0.2)	10.0	(20.0)	160.0	(20.0)[f]	–2.0	(48.0)
tea	9.7	(1.8)	216.0	(32.0)[f]	68.8	(14.4)[f]	0.0	(16.0)	88.0	(32.0)[f]	–0.8	(38.4)
apples	0.2	(0.6)	32.0	(8.0)	3.6	(0.8)	0.0	(8.0)	0.0	(8.0)	–4.4	(19.2)
apples	0.8	(0.6)	24.0	(8.0)	2.0	(0.8)	28.0	(8.0)	4.0	(8.0)	1.6	(4.8)
Mean	2.4	(8.2)[g]	62.0	(173.0)	15.6	(59.5)	7.6	(24.4)	53.2	(139.3)	3.4	(21.7)

[a]There are no concentration guides for produce; however, all mean radionuclide contents in produce collected from LANL, with the exception of ^{3}H, and perimeter areas were not significantly higher from regional background using a nonparametric Wilcoxon Rank Sum test at the 0.05 probability level (Gilbert 1987).

[b](±2 counting uncertainty); values are the uncertainty in the analytical results at the 95% confidence level.

[c](±2 standard deviation).

[d]Regional Statistical Reference Level; this is the upper-limit background concentration [mean + 2 std dev] from 1981 to 1994 data.

[e]See Appendix B for an explanation of the presence of negative values.

[f]Detectable value (where the analytical result was greater than two counting uncertainties) and higher than than the RSRL.

Table 6-5. Total Committed Effective Dose Equivalent from the Ingestion of Produce Collected during 1994 and 1995

Background Location	Committed Effective Dose Equivalent[a] (mrem/yr) 1994	1995
Española, Santa Fe, Jemez:		
#of Produce Samples	10	6
Average Consumption[b]	[c]	0.141 (± 0.318)[d]
Maximum Consumption[b]	0.149 (± 0.365)[d]	0.383 (± 0.863)[d]
Off-Site		
Cochiti Pueblo:		
# of Produce Samples	6	5
Average Consumption[b]	[c]	0.075 (± 0.166)[d]
Maximum Consumption[b]	0.091 (± 0.169)[d]	0.204 (± 0.450)[d]
White Rock:		
# of Produce Samples	7	5
Average Consumption[b]	[c]	0.029 (± 0.067)[d]
Maximum Consumption[b]	0.061 (± 0.116)[d]	0.078 (± 0.181)[d]
Los Alamos Townsite:		
# of Produce Samples	4	6
Average Consumption[b]	[c]	0.046 (± 0.106)[d]
Maximum Consumption[b]	0.147 (± 0.228)[d]	0.124 (± 0.228)[d]
Pueblo of San Ildefonso:		
# of Produce Samples	5	5
Average Consumption[b]	[c]	0.115 (± 0.200)[d]
Maximum Consumption[b]	0.117 (± 0.300)[d]	0.313 (± 0.541)[d]
On-Site[e]		
# of Produce Samples	10	5
Average Consumption[b]	[c]	0.198 (± 0.601)[d]
Maximum Consumption [b]	0.057 (± 0.260)[d]	0.537 (± 1.630)[d]

[a]Based on DOE dose conversion factors (DOE 1988).
[b]See Table 3-1 for consumption rates.
[c]Calculations for the average consumption rate was not performed for 1994.
[d]±2 sigma of the data in parenthesis; to convert to μSv multiply by 10.
[e]Calculations presented here are for comparison purposes only. Produce grown on site is not available for consumption.

Table 6-6. Total Recoverable Trace and Heavy Metals (μg/dry g) in Produce Collected in 1995[a]

	Ag	As	Ba	Be	Cd	Cr	Hg	Ni	Pb	Sb	Se	Tl
Off-Site Regional (Background) Stations												
Española/Santa Fe/Jemez:												
apples	2.00	<0.50[b]	2.00	<1.00	0.09	<1.30	<0.06	7.10	6.00	<0.10	<0.30	<0.10
tomatoes	<0.10	<0.50	3.30	<0.82	0.13	<1.10	<0.06	4.00	1.00	<0.10	<0.30	<0.10
cucumbers	<0.10	<0.50	7.70	<0.90	<0.05	<1.20	<0.06	<3.00	<0.10	<0.10	<0.30	<0.10
squash	<0.10	<0.50	9.90	<0.90	<0.05	<1.20	<0.06	<3.00	<0.10	<0.10	<0.30	<0.10
tea	<0.10	<0.50	21.00	<0.83	0.13	<1.10	<0.06	<2.80	0.20	<0.10	<0.30	<0.10
spinach	<0.10	<0.50	29.00	<0.90	<0.05	<1.20	<0.06	<3.00	0.20	<0.10	<0.30	<0.10
Mean	<0.42	<0.50	12.15	<0.89	<0.083	<1.18	<0.06	<3.82	<1.27	<0.10	<0.30	<0.10
(±2SD)	(1.55)	(0.00)	(21.33)	(0.13)	(0.080)	(0.15)	(0.00)	(3.33)	(4.69)	(0.00)	(0.00)	(0.00)
RSRL[c]	1.97	0.50	33.48	1.23	0.75	3.40	0.08	7.15	9.04	0.26	0.46	0.10
Off-Site Perimeter Stations												
Los Alamos:												
tomatoes	<0.10	<0.50	2.40	<0.74	0.06	2.00	<0.06	<2.50	0.40	<0.10	<0.30	<0.10
squash	0.50	<0.50	13.00	<0.74	0.06	1.80	<0.06	2.80	0.60	<0.10	<0.30	<0.10
tomatoes	<0.10	<0.50	2.40	<0.75	0.07	1.30	<0.06	<2.50	0.80	<0.10	<0.30	<0.10
apples	<0.10	<0.50	1.40	<0.75	<0.05	1.00	<0.06	<2.50	<0.10	<0.10	<0.30	<0.10
peaches	<0.10	<0.50	1.80	<0.75	<0.05	<1.00	<0.06	4.00	0.70	<0.10	<0.30	<0.10
squash	<0.10	0.50	7.50	<0.75	<0.05	<1.00	<0.06	<2.50	0.50	<0.10	<0.30	<0.10
Mean	<0.17	<0.50	4.75	<0.75	<0.06	<1.35	<0.06	<2.80	<0.52	<0.10	<0.30	<0.10
(±2SD)	(0.33)	(0.00)	(9.23)	(0.01)	(0.02)	(0.89)	(0.00)	(1.20)	(0.50)	(0.00)	(0.01)	(0.01)
White Rock /Pajrito Acres:												
squash	<0.10	<0.50	6.70	<0.75	<0.05	2.20	<0.06	<2.50	0.40	0.60[d]	<0.30	<0.10
tomatoes	<0.10	<0.50	3.70	<0.75	0.08	2.30	<0.06	<2.50	0.20	<0.10	<0.30	<0.10
tea	<0.10	<0.50	28.00	<0.75	0.11	1.20	<0.06	<2.50	0.10	<0.10	<0.30	<0.10
squash	<0.10	<0.50	9.10	<0.74	<0.05	2.40	<0.06	<2.50	1.00	<0.10	<0.30	<0.10
cucumbers	<0.10	<0.50	10.00	<0.75	<0.06	2.20	<0.06	4.00	0.30	<0.10	<0.30	<0.10
Mean	<0.10	<0.50	11.50	<0.75	<0.07	2.06[d]	<0.06)	<2.80	0.40	<0.20	<0.30	<0.10
(±2SD)	(0.00)	(0.00)	(19.80)	(0.00)	(0.05)	(0.98)	(0.00)	(1.34)	(0.71)	(0.45)	(0.00)	(0.00)

Table 6-6. Total Recoverable Trace and Heavy Metals (µg/dry g) in Produce Collected in 1995[a] (Cont.)

	Ag	As	Ba	Be	Cd	Cr	Hg	Ni	Pb	Sb	Se	Tl
Cochiti/Pena Blanca/Santo Domingo:												
squash	2.00	<0.50	3.10	<0.75	<0.05	1.40	<0.06	<2.50	0.60	<0.10	<0.30	<0.10
tomatoes	23.00[e]	<0.50	5.60	0.75	0.95[e]	2.00	<0.06	2.80	0.60	<0.10	<0.30	<0.10
cucumbers	0.10	<0.50	5.20	<0.75	0.12	1.80	<0.06	<2.50	0.20	<0.10	<0.30	<0.10
tea	0.10	<0.50	30.00	<0.75	0.24	<1.00	<0.06	<2.50	0.20	<0.10	<0.30	<0.10
spinach	<0.10	<0.50	18.00	<0.75	0.54	<1.00	<0.06	<2.50	0.20	<0.10	0.60[e]	<0.10
Mean	5.06[d]	<0.50	12.38	<0.75	<0.38	<1.44	<0.06	<2.56	0.36	<0.10	<0.36	<0.10
(±2SD)	(20.12)	(0.00)	(22.93)	(0.00)	(0.74)	(0.91)	(0.00)	(0.27)	(0.44)	(0.00)	(0.27)	(0.00)
Pueblo of San Ildefonso:												
squash	<0.10	0.50	11.00	<0.75	<0.05	2.40	<0.06	2.80	0.10	<0.10	<0.30	<0.10
tea	<0.10	<0.50	28.00	<0.75	0.12	1.30	<0.06	<2.50	0.20	<0.10	<0.30	<0.10
spinach	<0.10	<0.50	16.00	<0.75	0.49	1.40	<0.06	<6.25	0.50	<0.10	<0.30	<0.10
tomatoes	<0.10	<0.50	3.80	<0.74	0.10	2.10	<0.06	<2.50	0.20	<0.10	<0.30	<0.10
cucumbers	<0.10	<0.50	10.00	<0.82	0.09	<1.10	<0.06	<2.70	9.00	<0.10	<0.30	<0.10
Mean	<0.10	<0.50	13.76	<0.76	<0.17	<1.66	<0.06	<3.35	2.00	<0.10	<0.30	<0.10
(±2SD)	(0.00)	(0.00)	(18.13)	(0.07)	(0.36)	(1.12)	(0.00)	(3.25)	(7.83)	(0.00)	(0.00)	(0.00)
On-Site Stations												
LANL:												
tomatoes	<0.10	<0.50	5.70	<0.83	0.11	1.60	<0.06	<2.80	1.00	<0.10	<0.30	<0.10
nectarine	<0.10	<0.50	2.60	<0.82	0.08	<1.10	<0.06	4.00	2.00	<0.10	<0.30	<0.10
tea	<0.10	<0.50	49.00[e]	<0.90	0.08	<1.20	<0.06	<3.00	0.20	<0.10	<0.30	<0.10
apples	<0.10	<0.50	12.00	<0.89	0.06	1.50	<0.06	<3.00	0.20	<0.10	<0.30	<0.10
apples	<0.10	<0.50	15.00	<0.75	<0.05	<1.00	<0.06	<2.50	6.00	<0.10	<0.30	<0.10
Mean	<0.10	<0.50	16.86	<0.84	<0.08	<1.28	<0.06	<3.06	1.88	<0.10	<0.30	<0.10
(±2SD)	(0.00)	(0.00)	(37.26)	(0.12)	(0.05)	(0.52)	(0.00)	(1.13)	(4.84)	(0.00)	(0.00)	(0.00)

[a] Analysis by EPA Method 3051 for total recoverable metals.
[b] The less than symbol (<) means the analysis was below the specified detection limit of the analytical method and/or sample.
[c] Regional Statistical Reference Level; this is the upper limit background concentration (mean + 2 std dev) from 1994 and/or 1995 data.
[d] Statistically significant mean from background mean using a Wilcoxon Rank Sum Test at the 0.05 probability level.
[e] Concentrations that were higher than the RSRL.

Table 6-7. Radionuclides in Honey Collected from Regional and Perimeter Beehives during 1995

	^{3}H (pCi/mL)[a]		^{90}Sr (pCi/L)		^{238}Pu (pCi/L)		^{239}Pu (pCi/L)		^{137}Cs (pCi/L)		Uranium (ug/L)		^{241}Am (pCi/L)	
Off-Site Regional (Background) Stations:														
San Pedro	0.10	(0.60)[d]	–1.10[bc]	(1.74)	0.014[c]	(0.038)	0.008[c]	(0.047)	9.6	(24.8)	1.44[c]	(2.22)	[c]	
RSRL[e]	21.22		6.00		0.121		0.103		327.47		6.46			
Off-Site Perimeter Stations:														
Los Alamos	0.00	(0.60)	0.60	(3.80)	0.000	(0.012)	0.007	(0.018)	5.3	(15.8)	0.00	(0.44)	0.089	(0.042)
White Rock/Pajarito Acres	–0.20	(0.60)	3.60	(5.40)	0.025	(0.024)	0.080	(0.040)	11.0	(34.0)	4.09	(0.86)	0.120	(0.060)

[a]pCi/mL of honey moisture; honey contains approximately 18% water and has a density of 1,860 g/L.
[b]See Appendix B for an explanation of the presence of negative values.
[c]Lost in analysis; data if available, was from 1994 (EPG 1995).
[d](±2 counting uncertainty); values are the uncertainty in the analytical results at the 95% confidence level.
[e]Regional Statistical Reference Level; this is the upper-limit background concentration (mean + 2 std dev) from Fresquez 1994b.
[f]Detectable value (where the analytical result was higher than two counting uncertainties) and higher than the RSRL.

Table 6-8. Total Committed Effective Dose Equivalent from the Ingestion of Honey Collected during 1994 and 1995

	Committed Effective Dose Equivalent[a] (mrem/yr)	
Background	**1994[b]**	**1995[b]**
San Pedro:		
# of Honey Samples	1	1
Average Consumption	[c]	0.0006 (± 0.003)[d]
Maximum Consumption[c]	0.001 (± 0.010)[d]	0.002 (± 0.012)[d]
Perimeter		
White Rock:		
# of Honey Samples	1	1
Average Consumption[c]		0.002 (± 0.005)[d]
Maximum Consumption[c]	0.008 (± 0.015)[d]	0.007 (± 0.017)[d]
Los Alamos:		
# of Honey Samples	1	1
Average Consumption		0.0006 (± 0.003)[d]
Maximum Consumption[c]	0.015 (± 0.013)[d]	0.002 (± 0.009)[d]

*Calculations for the average consumption was not performed in 1994.
[a]Based on DOE dose conversion factors (DOE 1988).
[b]Analysis for ^{241}Am was not requested in 1994, but was requested in 1995.
[c]See Table 3-1 for consumption rates.
[d]±2 counting uncertainties in parenthesis; to convert to μSv multiply by 10.

Table 6-9. Radionuclide Concentrations in Eggs Collected in 1995

Radionuclide	Pueblo of San Ildefonso, NM[a]		Albuquerque, NM (Background)		RSRL[b]
^{238}Pu (pCi/L)[c]	–0.008	(0.008)[d]	0.004	(0.006)	0.010
^{239}Pu (pCi/L)	–0.002	(0.008)	–0.002	(0.004)	0.002
^{90}Sr (pCi/L)	0.500	(1.800)	–0.100	(1.400)	1.300
Total U (ug/L)	0.030	(0.020)	0.040	(0.020)	0.060
Tritium (pCi/mL)	0.000	(0.600)	–0.200	(0.600)	0.400
^{137}Cs (pCi/L)	23.000	(18.000)	–3.400	(36.000)	32.600

[a]Presently, the closest free ranging chicken/egg producing area to LANL.
[b]Regional Statistical Reference Level; this is the upper limit background concentration (mean + 2 counting uncertainties) based on the current year's data.
[c]One liter (1L) is equal to approximately two dozen eggs (24 eggs) and the density of eggs is around 1,135 g/L.
[d](±2 counting uncertainties); values are the uncertainty in the analytical results at the 95% confidence level.

Table 6-10. Total Committed Effective Dose Equivalent from the Ingestion of Eggs Collected during 1995

	Committed Effective Dose Equivalent (mrem/yr)[a]	
	Pueblo of San Ildefonso	Regional Background
# Egg Samples	1	1
Average Consumption[b]	0.013 (± 0.013)[c]	0.0003 (± 0.024)[c]
Maximum Consumption[b]	0.021 (± 0.020)[c]	0.0004 (± 0.038)[c]

[a]Based on DOE dose conversion factors (DOE 1988).
[b]See Table 3-1 for consumption rates.
[c]±2 counting uncertainties in parenthesis; to convert to μSv multiply by 10.

Table 6-11. Radionuclide Concentrations in Milk Collected in 1995

	Pojoaque Valley, NM				Albuquerque, NM (Background)				
Radionuclide	June		September		June		September		RSRL[a]
^{238}Pu (pCi/L)	–0.005	(0.006)[b]	0.003	(0.012)	–0.014	(0.006)	0.002	(0.010)	0.013
^{239}Pu (pCi/L)	0.003	(0.006)	–0.006	(0.010)	–0.006	(0.004)	–0.005	(0.004)	0.001
^{90}Sr (pCi/L)	2.600	(5.400)	4.700	(8.200)	5.900	(4.400)	3.000	(8.400)	8.870
Total U (μg/L)	0.140	(0.040)	0.190	(0.040)	0.290	(0.080)	0.050	(0.040)	0.400
^{3}H (pCi/mL)	–0.100	(0.600)	–0.200	(1.200)	–0.200	(0.600)	0.000	(1.200)	0.098
^{137}Cs (pCi/L)	5.600	(16.800)	–5.000	(36.000)	14.030	(10.920)	6.000	(18.000)	19.379
^{131}I (pCi/L)	10.000	(30.000)	3.800	(11.400)	11.000	(33.000)	9.400	(28.200)	11.750

[a]Regional Statistical Reference Level; this is the upper limit background (mean + 2 std dev) from 1994 and 1995 data.
[b](±2 counting uncertainties); values are the uncertainty in the analytical results at the 95% confidence level.

Table 6-12. Total Committed Effective Dose Equivalent from the Ingestion of Milk for 1994 and 1995

	Committed Effective Dose Equivalent (mrem)[a]			
	Dairy in Pojoaque Valley, NM		Dairy in Albuquerque, NM	
	1994	1995	1994	1995
Number of Milk Samples	1	2	1	2
Average Consumption[b]	[c]	0.102 (± 0.198)[d]	[c]	0.191 (± 0.159)[d]
Maximum Consumption[b]	0.135 (± 0.490)[e]	0.256 (± 0.495)[d]	0.195 (± 0.546)[e]	0.478 (± 0.397)[d]

[a]Based on DOE dose conversion factors (DOE 1988).
[b]See Table 3-1 for consumption rates.
[c]CEDE calculations based on the average consumption rate were not calculated for 1994.
[d]±2 sigma of the data in parentheses; to convert to microSv multiply by 10.
[e]±2 counting uncertainties in parentheses.

Table 6-13. Radionuclide Concentrations in Game (Surface-Feeding) and Nongame (Bottom-Feeding) Fish Upstream and Downstream of Los Alamos National Laboratory during 1995

	^{3}H pCi/mL[a]		^{90}Sr 10^{-2} pCi/dry g		^{137}Cs 10^{-2} pCi/dry g		Total Uranium ng/dry g		^{238}Pu 10^{-5} pCi/dry g		^{239}Pu 10^{-5} pCi/dry g	
Game Fish/Surface Feeders												
Upstream (Abiquiu, Heron, and El Vado):												
crappie	–0.1	(0.6)[b,c]	8.5	(6.8)	0.34	(10.20)	3.4	(0.68)	0.0	(00.0)	0.0	(0.0)
crappie	–0.1	(0.6)	4.2	(5.6)	1.96	(1.12)	0.7	(0.28)	0.0	(00.0)	0.0	(0.0)
walleye	0.2	(0.6)	1.4	(8.4)	1.68	(1.40)	1.4	(0.28)	0.0	(00.0)	0.0	(0.0)
walleye/bass	–0.1	(0.6)	16.8	(7.2)	1.56	(1.20)	1.2	(0.24)	12.0	(24.0)	0.0	(0.0)
walleye/trout	–0.1	(0.6)	1.1	(4.4)	1.98	(1.32)	0.8	(0.22)	0.0	(00.0)	0.0	(0.0)
Mean	–0.0	(0.3)[d]	6.4	(13.1)	1.50	(1.35)	1.5	(2.20)	2.4	(10.7)	0.0	(0.0)
RSRL[e]	0.2		17.0		27.70		6.5		23.6		28.3	
Downstream (Cochiti):												
crappie	–0.1	(0.6)	5.1	(6.8)	0.51	(1.36)	5.1	(1.02)	0.0	(00.0)	0.0	(0.0)
pike	0.3	(0.6)	0.0	(3.6)	0.72	(2.16)	1.8	(0.36)	0.0	(00.0)	0.0	(0.0)
pike	0.3	(0.6)	9.1	(33.8)	0.91	(2.60)	3.9	(0.78)	0.0	(00.0)	0.0	(0.0)
walleye/bass	0.0	(0.6)	7.5	(6.0)	0.45	(1.50)	3.0	(0.60)	–15.0	(30.0)	0.0	(0.0)
Mean	–0.1	(0.4)	5.4	(7.9)	0.65	(0.42)	3.5	(2.79)[f]	0.0	(00.0)	0.0	(0.0)
Nongame Fish/Bottom Feeders												
Upstream (Abiquiu, Heron, and El Vado):												
carp	–0.1	(0.6)	1.8	(5.4)	0.90	(2.88)	11.7	(1.80)	0.0	(0.0)	0.0	(0.0)
carp	0.3	(0.6)	8.0	(4.0)	1.40	(0.80)	15.0	(4.00)	10.0	(20.0)	0.0	(0.0)
carp	–0.2	(0.6)	7.2	(7.2)	0.96	(0.96)	15.6	(4.80)	0.0	(0.0)	0.0	(0.0)
sucker	0.1	(0.6)	6.6	(6.6)	1.10	(0.88)	4.4	(0.88)	11.0	(22.0)	0.0	(0.0)
sucker	–0.2	(0.6)	1.2	(7.2)	3.48	(2.64)	4.8	(0.96)	0.0	(0.0)	0.0	(0.0)
Mean	–0.0	(0.4)	5.0	(6.4)	1.57	(2.17)	10.3	(10.83)	4.2	(11.5)	0.0	(0.0)
RSRL[e]	0.2		13.2		26.90		16.2		9.8		19.2	

Table 6-13. Radionuclide Concentrations in Game (Surface-Feeding) and Nongame (Bottom-Feeding) Fish Upstream and Downstream of Los Alamos National Laboratory during 1995 (Cont.)

	^{3}H pCi/mL[a]		^{90}Sr 10^{-2} pCi/dry g		^{137}Cs 10^{-2} pCi/dry g		Total Uranium ng/dry g		^{238}Pu 10^{-5} pCi/dry g		^{239}Pu 10^{-5} pCi/dry g	
Downstream (Cochiti):												
carp	0.1	(0.6)	5.8	(9.2)	1.38	(3.92)	16.1	(2.30)	0.0	(0.0)	0.0	(0.0)
carp	–0.4	(0.6)	4.7	(3.7)	–0.19	(1.86)	11.2	(1.86)	0.0	(0.0)	0.0	(0.0)
carp sucker	–0.1	(0.6)	4.6	(3.7)	0.55	(1.46)	3.7	(1.84)	9.2	(18.4)	0.0	(0.0)
carp sucker	–0.1	(0.6)	1.9	(5.8)	0.10	(4.60)	3.8	(0.77)	9.6	(19.2)	0.0	(0.0)
catfish	0.0	(0.6)	3.7	(3.7)	0.83	(2.58)	13.8	(3.68)	0.0	(0.0)	0.0	(0.0)
catfish	0.2	(0.6)	1.3	(3.9)	0.39	(1.04)	5.9	(1.30)	0.0	(0.0)	0.0	(0.0)
catfish	0.0	(0.6)	0.0	(3.5)	0.23	(0.70)	4.1	(1.16)	0.0	(0.0)	0.0	(0.0)
sucker	–0.1	(0.6)	–1.3	(5.2)	1.43	(4.16)	9.1	(2.60)	0.0	(0.0)	0.0	(0.0)
sucker	0.0	(0.6)	16.8	(4.8)[g]	0.12	(5.67)	7.2	(2.40)	–12.0	(24.0)	0.0	(0.0)
Mean	–0.0	(0.3)	4.2	(10.6)	0.54	(1.14)	8.3	(9.11)	0.8	(12.6)	0.0	(0.0)

[a] mL of tissue moisture.
[b] See Appendix B for an explanation of the presence of negative values.
[c] (±2 counting uncertainty); values are the uncertainty in the analytical results at the 95% confidence level.
[d] (±2 standard deviation).
[e] Regional Statistical Reference Level; this is the upper-limit background concentration (mean + 2 std dev) from Fresquez (1994c).
[f] Statistically significant mean from background mean using a Wilcoxon Rank Sum Test at the 0.05 probability level.
[g] Detectable value (where the analytical result was higher than two times the counting uncertainty) and higher than the RSRL.

Table 6-14. Total Committed Effective Dose Equivalent from the Ingestion of Fish from Cochiti and Upstream of the Laboratory for 1994 and 1995

	Committed Effective Dose Equivalent (mrem/yr)[a]			
	Upstream (Abiquiu, Heron, El Vado)		Cochiti Reservoir	
	1994[b]	1995[c]	1994[b]	1995[c]
Bottom Feeders:				
# Fish Samples	10	5	9	9
Average Consumption[d]	[e]	0.015 (± 0.019)[f]	[e]	0.012 (± 0.027)[f]
Maximum Consumption[d]	0.068 (± 0.085)[f]	0.056 (± 0.071)[f]	0.038 (± 0.074)[f]	0.043 (± 0.099)[g]
Surface Feeders:				
# Fish Samples	10	5	6	4
Average Consumption[d]	[e]	0.014 (± 0.027)[f]	[e]	0.012 (± 0.017)[f]
Maximum Consumption[d]	0.059 (± 0.084)[f]	0.051 (± 0.099)[f]	0.072 (± 0.077)[f]	0.043 (± 0.063)[f]

[a]Based on DOE dose conversion factors (DOE 1988).
[b]Tritium analyses not performed in 1994.
[c]Includes results from tritium analyses.
[d]See Table 3-1 for consumption rates.
[e]Calculations for the average consumption rate was not performed for 1994.
[f]±2 sigma of the data in parenthesis; to convert to μSv multiply by 10.

Table 6-15. Total Recoverable Trace and Heavy Metals in Bottom-Feeding Fish (μg/wet g) Collected in 1995

	Abiquiu/Heron/El Vado Reservoirs (Background)		Cochiti Reservoir		
Element	Mean[a,b]	(±2 std dev)	Mean	(±2 std dev)	RSRL[c]
Ag	<1.000	(0.000)	<1.000	(0.000)	2.59
As	<0.200	(0.000)	<0.200	(0.000)	0.69
Ba	<0.140	(0.000)	<0.140	(0.000)	2.93
Be	<0.080	(0.000)	<0.080	(0.000)	2.96
Cd	<0.400	(0.000)	<0.400	(0.000)	0.64
Cr	<0.500	(0.000)	<0.500	(0.000)	1.09
Hg	0.340	(0.522)	0.120	(0.089)	0.39
Ni	<2.000	(0.000)	<2.000	(0.000)	2.83
Pb	<0.670	(0.055)	<0.476	(0.284)	4.49
Sb	<0.670	(0.055)	<0.492	(0.256)	0.67
Se	0.220	(0.167)	0.180	(0.167)	0.65
Tl	<0.670	(0.054)	<0.476	(0.284)	0.67

[a]The average of five bottom-feeding fish (mostly catfish, suckers and carp) each from Cochiti, Abiquiu, Heron, and El Vado Reservoirs.
[b]There were no significant differences in Hg and Se in fish collected from Cochiti Reservoir as compared to fish collected from Abiquiu/Heron/El Vado reservoirs using a Wilcoxon Rank Sum test at the 0.05 probability level.
[c]Regional Statistical Reference Level; this is the upper limit background concentration (mean + 2 std dev) from 1991, 1994 and 1995 data.

Table 6-16. Radionuclide Concentrations in Muscle and Bone Tissues of Elk Collected from On-Site (LANL) Areas during 1994/1995

Sample/Location/Date	^{3}H pCi/mL[a]		Total U (ng/dry g)		^{137}Cs (10^{-3} pCi/dry g)		^{90}Sr (10^{-3} pCi/dry g)		^{238}Pu (10^{-5} pCi/dry g)		^{239}Pu (10^{-5} pCi/dry g)	
Leg Bone:												
Cow Elk (TA-46/Pajarito Road/11-14-94)	0.7	(0.8)[b]	6.45	(1.72)[c]	12.90	(8.60)	1,634.00	(172.00)	129.00	(86.00)[c]	–43.00	(86.00)
Cow Elk (TA-49/State Road 4/12-13-94)	3.1	(0.8)[c]	186.90	(170.00)[c]	0.00	(256.32)	2,189.00	(320.40)	427.00	(320.00)[c]	–106.80	(106.80)
Bull Elk (TA-16/S-Site Road/1-30-95)	0.3	(0.8)	4.16	(1.04)	15.60	(41.60)	1,404.00	(208.00)	208.00	(104.00)[c]	–52.00	(104.00)
Bull Elk (TA-16/S-Site Road/6-21-95)	12.5	(2.2)[c]	1.48	(0.50)	9.90	(29.58)	1,429.70	(197.20)	0.00	(295.80)	49.30	(295.80)
Elk (background) Mean (±2 std dev)[d]	0.0	(0.6)	1.90	(3.60)	73.50	(237.80)	1,833.70	(2,074.20)	18.30	(63.60)	21.30	(74.00)
RSRL[e]	0.6		5.50		311.30		3,907.90		81.90		95.30	
Muscle:												
Cow Elk (TA-46/Pajarito Road/11-14-94)	0.1	(0.8)	2.10	(0.84)	40.30	(120.96)	12.60	(25.20)	–4.20	(25.20)	25.20	(33.60)
Cow Elk (TA-49/State Road 4/12-13-94)	4.7	(1.0)[c]	0.21	(0.17)	11.30	(12.60)	4.20	(16.80)	–11.76	(26.00)	0.00	(26.00)
Bull Elk (TA-16/S-Site Road/1-30-95)	0.5	(0.8)	0.10	(0.20)	–5.88	(23.52)	4.90	(19.60)	0.00	(9.80)	0.00	(9.80)
Bull Elk (TA-16/S-SiteRoad/6-21-95)	11.1	(2.0)[c]	0.92	(0.18)	25.30	(17.40)	9.20	(18.40)	9.20	(27.60)	4.60	(27.60)
Elk (background) Mean (±2 std dev)	0.1	(0.6)	0.80	(2.60)	209.40	(416.80)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
RSRL	0.7		3.40		626.20		0.00		0.00		0.00	

[a]pCi/mL of tissue moisture; the average dry/wet ratio for elk bone and muscle was 0.58 and 0.24, respectively.
[b](±2 counting uncertainty); values are the uncertainty in the analytical results at the 95% confidence level.
[c]Detectable value (where the analytical result was greater than two times the counting uncertainty) and higher than the RSRL.
[d]Data from Fresquez 1994a.
[e]Regional Statistical Reference Level; this is the upper limit background concentration (mean + 2 std dev) from Fresquez 1994a.

Table 6-17. Total Committed Effective Dose Equivalent from the Ingestion of Elk Muscle and Bone for 1993–1995

	Committed Effective Dose Equivalent (mrem/yr)[a]		
	On Site		Off Site[b]
	1993[c]	1994/1995[b]	1993[c]
# Elk Collected	3	4	3
Muscle:			
Average Consumption Rate[d]	0.019 (± 0.030)[e]	0.007 (± 0.013)[e]	0.028 (± 0.057)[e]
Maximum Consumption Rate[d]	0.045 (± 0.071)[e]	0.017 (± 0.031)[e]	0.068 (± 0.136)[e]
Bone:			
Average Consumption Rate[d]	0.232 (± 0.181)[e]	0.360 (± 0.227)[e]	0.354 (± 0.417)[e]
Maximum Consumption Rate[d]	0.555 (± 0.433)[e]	0.820 (± 0.518)[e]	0.806 (± 0.951)[e]

[a]Based on DOE dose conversion factors (DOE 1988).
[b]Includes tritium analyses.
[c]For 1993, the dose calculations were based on the total consumption of a 233 kg elk. Values shown here are calculated using the current intake rates and the 1993 analytical data. Tritium analyses were not requested in 1993 (Fresquez 1994a).
[d]See Table 3-1 for consumption rates.
[e]±2 sigma of the data in parenthesis; to convert to μSv multiply by 10.

Table 6-18. Terrestrial Insects found on Los Alamos National Laboratory Property as of December 1995

Order	Family	Common Name
Thysanura (Bristletails)	Lepismatidae	Silverfish
	Machilidae	Jumping bristletail
Collembola (Springtails)	Sminthuridae	Globular springtail
	Entomobryidae	Slender springtail
	Isotomidae	Smooth springtail
	Hypogastruridae	Elongate-Bodied springtail
Odonata (Dragon and damselflies)	Aeshnidae	Darner
	Libellulidae	Common skimmer
	Coenagrionidae	Narrow-winged damselfly
	Gomphidae	Clubtail
Phasmida (Walkingsticks)	Heteronemiidae	Common walkingstick
Orthoptera (Grasshoppers and crickets)	Acrididae	Short-horned grasshopper
	Gryllacrididae	Camel cricket
	Gryllidae	True cricket
Plecoptera (Stoneflies)	Perlidae	Common stonefly
Dermaptera (Earwigs)	Forficulidae	Common earwig
Thysanoptera (Thrips)	Thripidae	Common thrip
Hemiptera (True bugs)	Belostomatidae	Giant water bug
	Miridae	Plant bug
	Reduviidae	Assassin bug
	Phymatidae	Ambush bug
	Lygaeidae	Seed bug
	Cydnidae	Burrower bug
	Scutelleridae	Shield-backed bug
	Pentatomidae	Stink bug
	Anthocoridae	Minute pirate bug
	Coreidae	Squash bug
	Nabidae	Damsel bug
Homoptera (Cicadas and kin)	Cicadidae	Cicada
	Aphididae	Aphids
	Cercopidae	Spittlebugs
	Cicadellidae	Leafhoppers
	Coccidaea	Soft Scales
	Delphacidae	Planthoppers
	Eriosomatidae	Gall-making Aphids
	Psyllidae	Jumping plantlice
Neuroptera (Net-veined insects)	Myrmeleontidae	Antlion
	Hemerobiidae	Brown Lacewings
	Raphidiidae	Snakefly
Coleoptera (Beetles)	Cicindelidae	Tiger beetle
	Carabidae	Ground beetle
	Silphidae	Carrion beetle
	Lampyridae	Firefly
	Cantharidae	Soldier beetle
	Lycidae	Net-winged beetle
	Buprestidae	Metallic wood-boring beetle
	Staphylinidae	Rove beetle
	Erotylidae	Pleasing fungus beetle

Table 6-18. Terrestrial Insects found on Los Alamos National Laboratory Property as of December 1995 (Cont.)

Order	Family	Common Name
	Nitidulidae	Sap beetle
	Coccinellidae	Ladybird beetle
	Tenebrionidae	Darkling beetle
	Meloidae	Blister beetle
	Cerambycidae	Long-horned beetle
	Lucanidae	Stag beetle
	Scarabaeidae	Scarab beetle
	Chrysomelidae	Leaf beetle
	Curulionidae	Weevil
	Dermestidae	Dermestid beetle
Lepidoptera (Butterflies, moths)	Papilionidae	Swallowtail
	Lycaenidae	Copper
	Hesperiidae	Skipper
	Pieridae	White, sulphur, and orange
	Nymphalidae	Brush-footed butterfly
	Satyridae	Satyr, nymph, and artic
	Noctuidae	Noctuid moth
	Sphingidae	Sphinx moth
	Saturniidae	Giant silkworm moth
	Gelechiidae	Gelechiid moth
	Geometridae	Measuring worms
	Pterophoridae	Plume moth
Diptera (Flies)	Tabanidae	Horse and deer flies
	Therevidae	Stiletto fly
	Asilidae	Robber fly
	Bombyliidae	Bee fly
	Syrphidae	Hover fly
	Tachinidae	Tachinid fly
Siphonaptera (Fleas)	Pulicidae	Dog fleas
Hymenoptera (Bees, ants, wasps)	Ichneumonidae	Ichneumonid wasp
	Cynipidae	Gall wasp
	Mutillidae	Velvet ant
	Scoliidae	Scoliid wasp
	Formicidae	Ant
	Pompilidae	Spider wasp
	Eumenidae	Euminid wasp
	Vespidae	Vespid wasp
	Sphecidae	Sphecid wasp
	Halictidae	Metallic wasp
	Megachilidae	Leafcutting bee
	Apidae	Honey and bumble bees

Table 6-19. Noninsect Terrestrial Arthropods found on Los Alamos National Laboratory Property as of December 1995

Class/Order	Family
Chilopoda (centipedes)	Geophilidae
	Lithobiidae
Diplopoda (millipedes)	Julidae
Arachnida/Acarina (spiders/mites)	Bdellidae
	Bryobiidae
	Calligonellidae
	Cryptognathidae
	Cunaxidae
	Erythraeidae
	Eupodidae
	Gymnodamaeidae
	Laelapidae
	Nanorchestidae
	Paratydaeidae
	Phytoseiidae
	Rhagidiidae
	Rhaphignathidae
	Scutacaridae
	Stigmaeidae
	Tenuipalpidae
	Terpnacaridae
	Trombidiidae
	Tydeidae
	Tarsonemidae
	Zerconidae
Archnida/Araneida	Agelenidae
	Amaurobiidae
	Anyphaenidae
	Araneidae
	Clubionidae
	Dictynidae
	Gnaphosidae
	Hahniidae
	Linyphiidae
	Lycosidae
	Micryphantidae
	Miryphantidae
	Oonopidae
	Pholcidae
	Tetragnathidae
	Salticidae
	Theridiidae
	Thomisidae
	Phalangiidae

Table 6-20. Species of Amphibians and Reptiles Captured in Pajarito Canyon during 1995

Common Name	Species	Total	Relative Abundance
Tiger Salamander	AMTI	1	1.39%
Woodhouse toad	BUWO	2	2.78%
Plateau whiptail	CNVE	42	58.33%
Many-lined skink	EUMU	20	27.78%
Chorus frog	PSTR	3	4.17%
Eastern fence lizard	SCUN	3	4.17%
Western terrestrial garter snake	THEL	1	1.39%
Total		72	100.00%

Table 6-21. Bird Species found at Los Alamos National Laboratory during 1995

Scientific Name	Species Code	Common Name
Melanerpes formicivorus	ACWO	Acorn Woodpecker
Falco sparverius	AMKE	American Kestrel
Turdus migratorius	AMRO	American Robin
Myiarchus cinerascens	ATFL	Ash-throated Flycatcher
Hirundo rustica	BASW	Barn Swallow
Archilochus alexandri	BCHU	Black-chinned Hummingbird
Pheucticus melanocephalus	BHGR	Black-headed Grosbeak
Guiraca caerulea	BLGR	Blue Grosbeak
Polioptila caerulea	BGGN	Blue-gray Gnatcatcher
Euphagus cyanocephalus	BRBL	Brewer's Blackbird
Selasphorus platycercus	BTHU	Broad-tailed Hummingbird
Molothrus ater	BHCO	Brown-headed Cowbird
Psaltriparus minimus	BUSH	Bushtit
Pipilo fuscus	CATO	Canyon Towhee
Catherpes mexicanus	CAWR	Canyon Wren
Spizella passerina	CHSP	Chipping Sparrow
Nucifraga columbiana	CLNU	Clark's Nutcracker
Hirundo pyrrhonota	CLSW	Cliff Swallow
Corvus corax	CORA	Common Raven
Accipiter cooperii	COHA	Cooper's Hawk
Junco hyemalis	DEJU	Dark-eyed Junco
Picoides pubescens	DOWO	Downy Woodpecker
Empidonax oberholseri	DUFL	Dusky Flycatcher
Sturnus vulgaris	EUST	European Starling
Otus flammeolus	FLOW	Flamulated Owl
Dendroica graciae	GRWA	Grace's Warbler
Empidonax wrightii	GRFL	Gray Flycatcher
Bubo virginianus	GHOW	Great-horned Owl
Picoides villosus	HAWO	Hairy Woodpecker
Catharus guttatus	HETH	Hermit Thrush
Carpodacus mexicanus	HOFI	House Finch
Passer domesticus	HOSP	House Sparrow

Table 6-21. Bird Species found at Los Alamos National Laboratory during 1995 (Cont.)

Scientific Name	Species Code	Common Name
Troglodytes aedon	HOWR	House Wren
Passerina cyanea	INBU	Indigo Bunting
Carduelis psaltria	LEGO	Lesser Goldfinch
Melanerpes lewis	LEWO	Lewis' Woodpecker
Lanis ludovicianus	LOSH	Loggerhead Shrike
Oporornis tolmiei	MAWA	MacGillivray's Warbler
Anas platyrhynchos	MALL	Mallard Duck
Falco columbarius	MERI	Merlin
Parus gambeli	MOCH	Mountain Chickadee
Zenaida macroura	MODO	Mourning Dove
Colaptes auratus	NOFL	Northern Flicker
Mimus polyglottos	NOMO	Northern Mockingbird
Glaucidium gnom	NOPO	Northern Pygmy-Owl
Gymnorhinus cyanocephalus	PIJA	Piñon Jay
Carduelis pinus	PISI	Pine Siskin
Parus inornatus	PLTI	Plain Titmouse
Sitta pygmaea	PYNU	Pygmy Nuthatch
Sitta canadensis	RBNU	Red-breasted NuthatchButeo
jamaicensis	RTHA	Red-tailed Hawk
Agelaius phoeniceus	RWBL	Red-winged Blackbird
Regulus calendula	RCKI	Ruby-crowned Kinglet
Selasphorus rufus	RUHU	Rufous Hummingbird
Pipilo erythrophthalmus	RSTO	Rufous-sided Towhee
Sayornis saya	SAPH	Say's Phoebe
Aphelocoma coerulescens	SCJA	Scrub Jay
Vireo solitarius	SOVI	Solitary Vireo
Melospiza melodia	SOSP	Song Sparrow
Strix occidentalis lucida	SPOW	Spotted Owl
Cyanocitta stelleri	STJA	Steller's Jay
Piranga ruber	SUTA	Summer Tanager
Myadestes townsendi	TOSO	Townsend's Solitaire
Cathartes aura	TUVU	Turkey Vulture
Tachycineta thalassina	VGSW	Violet-green Swallow
Vermivora virginiae	VIWA	Virginia's Warbler
Vireo gilvus	WAVI	Warbling Vireo
Sialia mexicana	WEBL	Western Bluebird
Tyrannus verticalis	WEKI	Western Kingbird
Piranga ludoviciana	WETA	Western Tanager
Contopus sordidulus	WWPE	Western Wood-Pewee
Sitta carolinensis	WBNU	White-breasted Nuthatch
Zonotrichia albicollis	WTSP	White-throated Sparrow
Aeronautes saxatalis	WTSW	White-throated Swift
Sphyrapicus thyroideus	WISA	Williamson's Sapsucker
Wilsonia pusilla	WIWA	Wilson's Warbler
Dendroica petechia	YEWA	Yellow Warbler
Dendroica coronata	YRWA	Yellow-rumped Warbler

Table 6-22. Mean Radionuclide Concentrations[a] for Small Mammal Pelt and Carcass Samples, Area G (Sites 1 and 2) and Frijoles Canyon (Site 4), 1995

	Site 1			Site 2			Site 4 (Control)		
Radionuclide	**N**	**Pelt**	**Carcass**	**N**	**Pelt**	**Carcass**	**N**	**Pelt**	**Carcass**
Total U	3	2.12	0.393	3	0.9	0.347	3	1.77	0.707
^{241}Am	3	0.093	0.026	3	0.148	0.066	3	0.152	0.016
^{238}Pu	3	0.07	0.013	3	0.049	0.021	3	0.008	0.007
^{239}Pu	3	0.115	0.024	3	0.226	0.061	3	0.16	0.005
^{90}Sr	3	0.4	1.233	3	0.4	1.067	3	2.2	1.633
^{137}Cs	3	0.9	0.303	3	0.92	0.473	3	3.91	2.267
^{3}H	3	86,933	125,167	3	5,233	20,700	3	200	333

[a]Radionuclide concentrations for U are measured μg/g ash; ^{3}H are in pCi/L; all other contaminants are measured in pCi/g ash.

Table 6-23. Radionuclide Analysis of Surface Soil Samples Taken from Technical Area 54, Area G Perimeter in 1995

Sampling[a] Location	% H_2O	^{3}H (pCi/L)	^{241}Am (pCi/g)	^{137}Cs (pCi/g)	Total U (µg/g)	^{238}Pu (pCi/g)	^{239}Pu (pCi/g)
G-5-1	4.47	100	0.12	1.76	4.86	0.004	0.085
G-5-2	2.86	400	0.09	0.88	3.89	0.056	0.060
G-6-1	1.90	200	0.03	0.05	2.52	0.00	0.003
G-7-1	4.12	400	0.02	0.25	2.84	0.001	0.009
G-8-1	3.62	100	0.01	0.15	2.13	0.004	0.007
G-8-2	2.08	300	0.15	0.45	2.33	0.001	0.021
G-29-1	1.89	43,300	–0.15[b]	0.07	2.98	0.059	0.022
G-29-2	1.23	60,000	0.00	0.28	2.55	0.053	0.028
G-29-3	1.00	90,500	0.01	0.23	2.57	0.012	0.014
G-30-1	0.94	83,600	0.07	0.03	1.60	0.007	0.005
G-31-1	5.87	33,700	0.02	0.88	3.31	0.035	0.079
G-31-2	1.82	71,900	0.00	0.02	2.06	0.013	0.020
G-31-3	1.51	69,100	–0.05	0.10	1.99	0.003	0.004
G-32-1	1.38	32,100	0.11	0.02	1.66	0.006	0.009
G-32-2	2.25	24,300	0.05	0.15	3.24	0.011	0.067
G-32-3	1.89	16,100	0.03	0.19	2.67	0.034	0.021
G-34-4	2.49	4,500	0.00	0.15	3.02	0.029	0.034
G-34-5	2.02	5,000	0.23	0.05	2.63	0.008	0.007
G-34-7	3.45	2,300	0.19	0.03	2.21	0.006	0.003
G-34-9	3.22	3,100	0.07	0.32	3.10	0.017	0.071
G-34-10	5.84	1,700	0.12	0.14	2.21	0.028	0.199
G-34-13	2.26	3,400	0.01	0.09	2.19	0.212	0.023
G-38-2	6.32	15,100	0.14	0.25	2.75	0.078	0.132
G-39-1	3.78	1,800	0.03	0.11	1.62	0.445	0.213
G-39-2	0.77	2,900	0.08	0.02	2.18	0.085	0.114
G-40-1	1.64	1,600	0.09	0.16	2.10	1.309	0.169
G-40-2	2.95	1,700	0.22	0.34	2.66	1.731	0.267
G-41-2	3.85	500	0.14	0.22	2.44	2.182	0.206
G-42-1	1.21	1,600	0.08	0.27	3.00	1.42	0.736
G-42-6	5.98	1,700	0.08	0.03	2.86	0.12	6.290
G-43-1	2.19	7,200	0.40	0.46	2.95	0.277	0.558
G-44-2	3.44	5,000	0.97	0.42	2.88	0.626	0.942
G-45-4	3.45	14,000	0.74	0.35	2.47	0.964	1.301
G-45-5	4.18	3,600	0.69	0.33	2.25	0.303	0.378
G-45-6	3.27	10,000	0.12	0.08	2.42	0.231	0.151
G-45-7	5.38	35,700	0.63	0.68	3.09	10.7	1.200
G-46-1	19.00	1,900	0.34	1.10	3.07	7.76	1.060
G-46-2	3.84	2,500	0.92	0.33	2.57	1.971	0.825
G-47-1	3.22	1,300	0.89	<.47[c]	2.39	0.111	2.477
G-49-1	6.92	1,200	0.61	0.14	2.11	0.044	0.342
G-49-2	5.73	1,100	0.42	0.13	2.61	0.022	0.092
G-50-1	3.47	2,600	0.30	0.19	2.93	0.062	0.211
G-50-2	3.21	1,700	0.67	0.03	2.52	0.038	0.048
G-52-1	1.51	1,400	0.90	0.35	2.91	0.014	0.025
G-52-2	2.01	1,160	0.32	0.16	1.97	0.005	0.012
G-52-3	1.39	1,900	0.051	0.37	2.49	0.028	0.035

Table 6-23. Radionuclide Analysis of Surface Soil Samples Taken from Technical Area 54, Area G Perimeter in 1995 (Cont.)

Sampling[a] Location	% H_2O	^{3}H (pCi/L)	^{241}Am (pCi/g)	^{137}Cs (pCi/g)	Total U (µg/g)	^{238}Pu (pCi/g)	^{239}Pu (pCi/g)
G-53-1	6.29	300	0.01	0.50	2.39	0.010	0.020
G-53-2	5.72	3,800	0.49	0.42	2.78	0.019	0.023
G-54-1	5.56	400	–0.01	0.44	2.70	0.016	0.025
G-54-2	4.46	600	0.04	0.35	2.95	0.009	0.035
G-55-1	5.71	300	0.03	0.11	2.49	0.004	0.020
G-57-1	4.45	200	0.02	1.63	4.19	0.011	0.093
G-58-1	3.76	2,200	0.01	0.18	2.36	0.025	0.033
G-59-1	3.23	200	0.02	0.02	3.51	0.004	0.002
G-60-1	3.41	200	0.06	0.16	2.92	0.004	0.009
G-62-1	4.66	–100	0.06	0.66	3.00	0.008	0.025
G-64-1	3.76	200	0.02	0.40	2.85	0.005	0.011
G-65-2	4.03	0	0.0	0.17	2.91	0.004	0.010

[a]Samples were taken July 15, 1995.
[b]See Appendix B for an explanation of negative values.
[c]Less than symbol (<) means measurement was below the specified detection limit of the analytical method.

Table 6-24. Metal Analysis (µg/g) of Surface Soil Samples Taken from Technical Area 54, Area G Perimeter in 1995

Sampling[a] Location	Ag	As	Ba	Be	Cd	Cr	Hg	Ni	Pb	Sb
G-29-3	5.5	2	53	0.54	<.4[b]	5.6	0.05	<2	8	<.3
G-38-2	<.4	2	77	0.53	<.4	6.6	0.04	2.2	9	<.3
G-43-1	<.4	2	44	0.38	<.4	4.7	0.05	<2	7	<.3
G-44-2	<.4	3	74	0.67	<.4	9.3	0.05	<5	8	<.3
G-45-5	<.4	3	70	0.56	<.4	7.7	0.06	<5	10	<.3
G-46-1	4.2	2	47	0.35	<.4	8.6	0.05	<2	9	<.3

[a]Samples were taken July 25, 1995.
[b]Less than symbol (<) means measurement was below the specified detection limit of the analytical method.

E. Figures

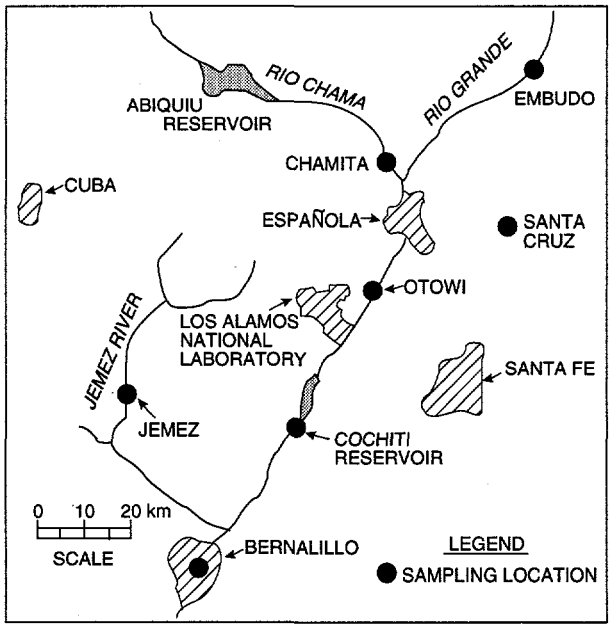


Figure 6-1. Off-site regional sampling locations for soil.

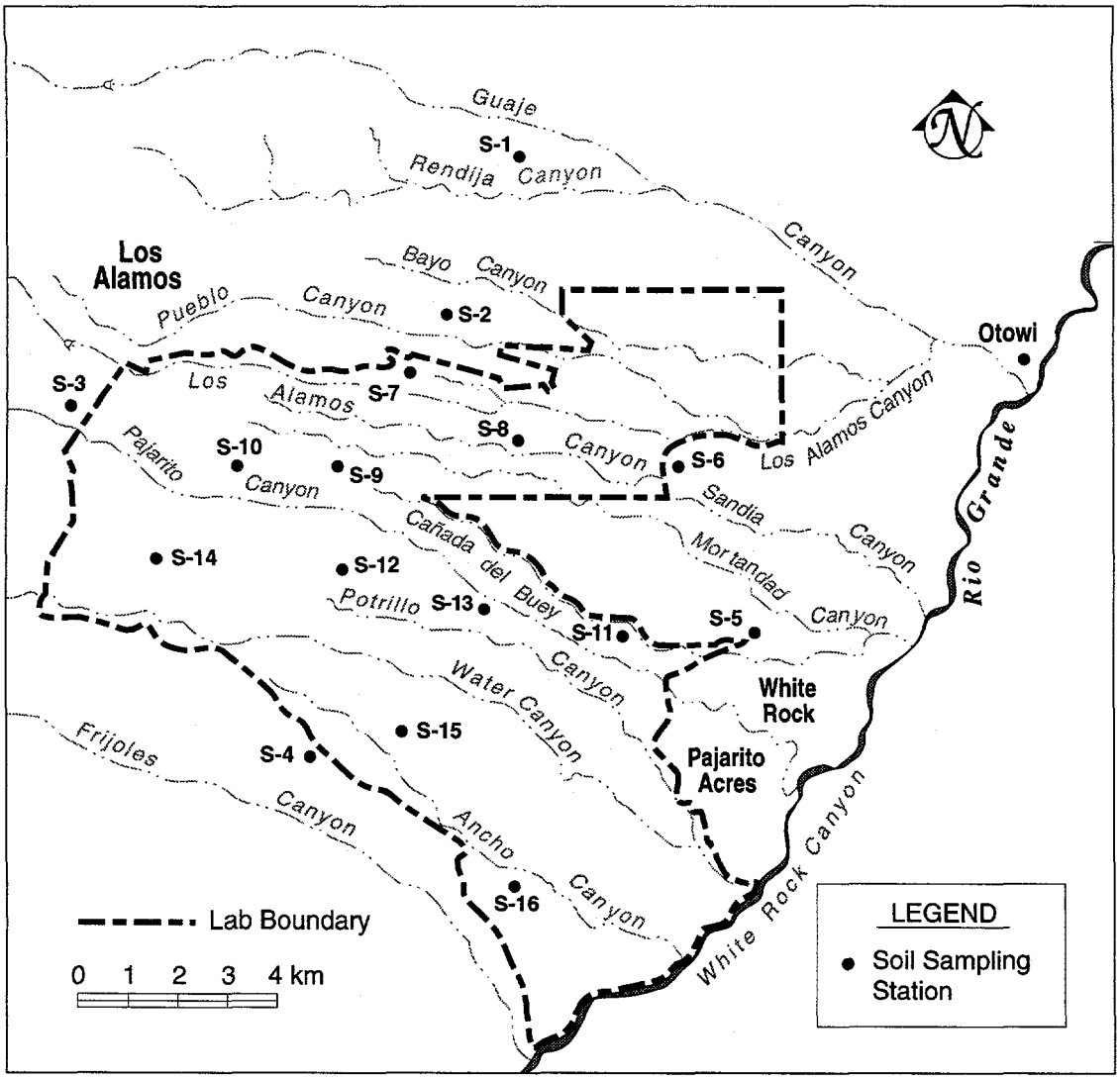


Figure 6-2. Off-site perimeter and on-site Laboratory soil sampling locations. (Map denotes general locations only. Refer to Table 6-1 for specific coordinates.)

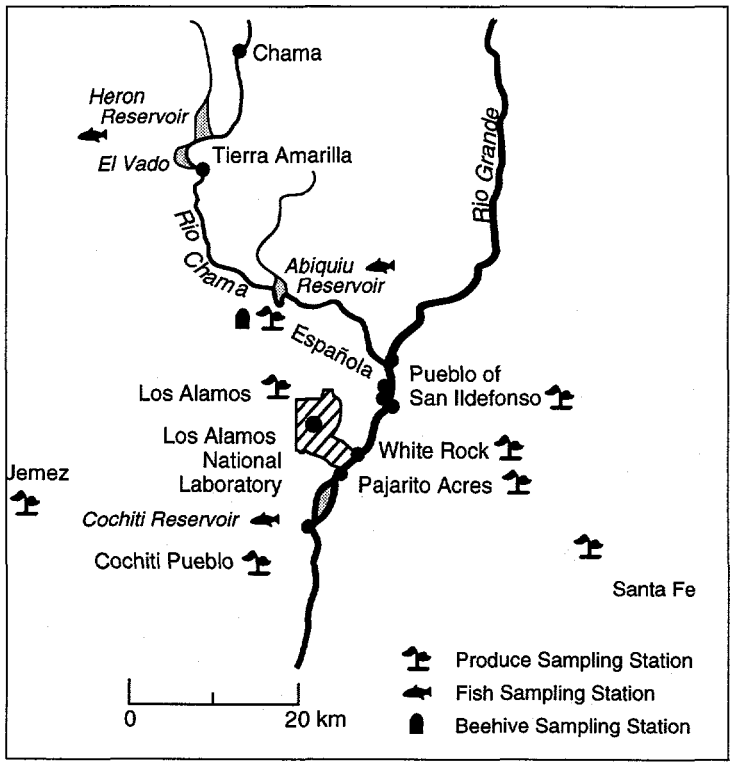


Figure 6-3. Produce, fish, and beehive off-site (regional and perimeter) sampling locations. (Map denotes general locations only.)

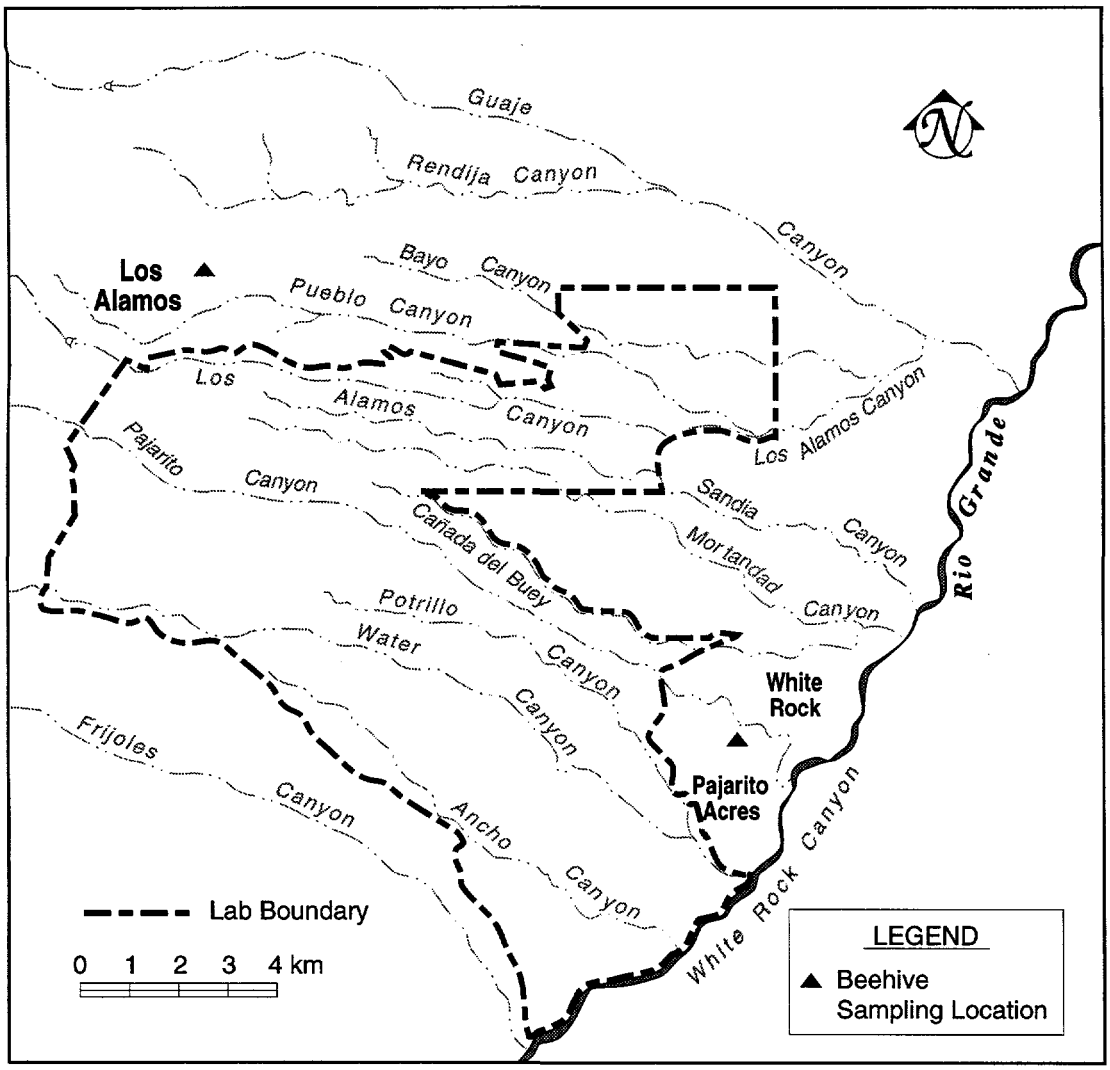


Figure 6-4. Locations of beehives. (Map denotes general locations only.)

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Standards for Environmental Contaminants

Throughout this report, concentrations of radioactive and chemical constituents in air and water samples are compared with pertinent standards and guidelines in regulations of federal and state agencies. No comparable standards for soils, sediments, and foodstuffs are available. Los Alamos National Laboratory (LANL or the Laboratory) operations are conducted in accordance with directives for compliance with environmental standards. These directives are contained in Department of Energy (DOE) Orders 5400.1, "General Environmental Program;" 5400.5, "Radiation Protection of the Public and the Environment;" 5480.1, "Environmental Protection, Safety, and Health Protection Standards;" 5480.11, "Requirements for Radiation Protection for Occupational Workers;" and 5484.1, "Environmental Radiation Protection, Safety, and Health Protection Information Reporting Requirements," Chap. III, "Effluent and Environmental Monitoring Program Requirements."

Radiation Standards. DOE regulates radiation exposure to the public and the worker by limiting the radiation dose that can be received during routine Laboratory operations. Because some radionuclides remain in the body and result in exposure long after intake, DOE requires consideration of the dose commitment caused by inhalation, ingestion, or absorption of such radionuclides. This evaluation involves integrating the dose received from radionuclides over a standard period of time. For this report, 50-yr dose commitments were calculated using the dose factors from Refs. A1 and A2. The dose factors adopted by DOE are based on the recommendations of Publication 30 of the International Commission on Radiological Protection (ICRP).[A3]

In 1990, DOE issued Order 5400.5, which finalized the interim radiation protection standard (RPS) for the public.[A4] Table A-1 lists currently applicable RPSs, now referred to as public dose limits (PDLs), for operations at the Laboratory. DOE's comprehensive PDL for radiation exposure limits the effective dose equivalent (EDE) that a member of the public can receive from DOE operations to 100 mrem/yr. The PDLs and the information in Refs. A1 and A2 are based on recommendations of the ICRP and the National Council on Radiation Protection and Measurements.[A3,A4]

The EDE is the hypothetical whole-body dose that would result in the same risk of radiation-induced cancer or genetic disorder as a given exposure to an individual organ. It is the sum of the individual organ doses, weighted to account for the sensitivity of each organ to radiation-induced damage. The weighting factors are taken from the recommendations of the ICRP. The EDE includes doses from both internal and external exposure.

Radionuclide concentrations in air and water in uncontrolled areas measured by the Laboratory's surveillance program are compared with DOE's derived air concentrations (DACs) and derived concentration guides (DCGs), respectively (Table A-2).[A5] These guides represent the smallest estimated concentrations in water or air, taken in continuously for a period of 50 years, that will result in annual EDEs equal to the PDL of 100 mrem in the 50th year of exposure.

In addition to the 100 mrem/yr effective dose PDL, exposures from the air pathway are also limited by the Environmental Protection Agency's (EPA's) 1989 standard of 10 mrem/yr EDE.[A6] To demonstrate compliance with these standards, doses from the air pathway are compared directly with the EPA dose limits. This dose limit of 10 mrem/yr replaced the previous EPA limits of 25 mrem/yr (whole body) and 75 mrem/yr (any organ).[A7]

Nonradioactive Air Quality Standards. Federal and state ambient air quality standards for nonradioactive pollutants are shown in Table A-3. New Mexico nonradiological standards are generally more stringent than national standards.

Drinking Water Standards. For chemical constituents in drinking water, regulations and standards are issued by EPA and adopted by the New Mexico Environment Department (NMED) as part of the NM Drinking Water Supply Regulations (Table A-4).[A8] EPA's primary maximum contaminant level (MCL) is the maximum permissible level of a contaminant in drinking water that is delivered to the ultimate user of a public water system.[A9] EPA has set "action levels" in lieu of MCLs for lead and copper. If more than 10% of the samples from specified sites exceed the action level, the agency that manages the public water supply must initiate a corrosion control program. EPA's secondary drinking water standards, which are not included in the NM Drinking Water Supply Regulations and are not enforceable, relate to contaminants in drinking water that primarily affect aesthetic qualities associated with public acceptance of drinking water.[A9] There may be health effects associated with considerably higher concentrations of these contaminants.

Radioactivity in drinking water is regulated by EPA regulations contained in 40 CFR 141[A9] and NM Drinking Water Supply Regulations, Sections 206 and 207.[A8] These regulations provide that combined radium-226 and

radium-228 may not exceed 5 pCi/L. Gross alpha activity (including radium-226, but excluding radon and uranium) may not exceed 15 pCi/L.

A screening level of 5 pCi/L for gross alpha is established to determine when analysis specifically for radium isotopes is necessary. In this report, plutonium concentrations are compared with both the EPA gross alpha standard for drinking water (Table A-4) and the DOE guides calculated for the DCGs applicable to drinking water (Table A-2).

For man-made beta- and photon-emitting radionuclides, EPA drinking water standards are limited to concentrations that would result in doses not exceeding 4 mrem/yr, calculated according to a specified procedure. In addition, DOE Order 5400.5 requires that persons consuming water from DOE-operated public water supplies do not receive an EDE greater than 4 mrem/yr. DCGs for drinking water systems based on this requirement are in Table A-2.

Surface Water Standards. In its Resource Conservation and Recovery Act (RCRA) regulations, EPA has established minimum concentrations of certain contaminants in water extracted from wastes that will cause the waste to be designated as hazardous because of its toxicity.[A10] The toxicity characteristic leaching procedure (TCLP) must follow steps outlined by the EPA in 40 CFR 261, Appendix II. In this report, the TCLP minimum concentrations (Table A-5) are used for comparison with concentrations of selected constituents extracted from the Laboratory's active waste areas.

Wildlife Water Standards. The purpose of thes standards is to designate the uses for which the surface waters of the State of New Mexico shall be protected and to describe the water quality standards necessary to sustain the designated uses. In this report, the Wildlife Watering Standards (Table A-6)[A11] are used to compare with the quality of surface water at the Laboratory.

Table A-1. Department of Energy Public Dose Limits (PDL) for External and Internal Exposures

	EDE[b] at Point of Maximum Probable Exposure
Exposure of Any Member of the Public[a]	
All Pathways	100 mrem/yr[c]
Air Pathway Only[d]	10 mrem/yr
Drinking Water	4 mrem/yr
Occupational Exposure[a]	
Stochastic Effects	5 rem (annual EDE[e])
Nonstochastic Effects	
Lens of eye	15 rem (annual EDE[e])
Extremity	50 rem (annual EDE[e])
Skin of the whole body	50 rem (annual EDE[e])
Organ or tissue	50 rem (annual EDE[e])
Unborn Child	
Entire gestation period	0.5 rem (annual EDE[e])

[a]In keeping with DOE policy, exposures shall be limited to as small a fraction of the respective annual dose limits as practicable. DOE's PDL applies to exposures from routine Laboratory operation, excluding contributions from cosmic, terrestrial, and global fallout; self-irradiation; and medical diagnostic sources of radiation. Routine operation means normal, planned operation and does not include actual or potential accidental or unplanned releases. Exposure limits for any member of the general public are taken from Ref. A4. Limits for occupational exposure are taken from DOE Order 5480.11.

[b]As used by DOE, EDE includes both the EDE from external radiation and the committed EDE to individual tissues from ingestion and inhalation during the calendar year.

[c]Under special circumstances and subject to approval by DOE, this limit on the EDE may be temporarily increased to 500 mrem/yr, provided the dose averaged over a lifetime does not exceed the principal limit of 100 mrem/yr.

[d]This level is from EPA's regulations issued under the Clean Air Act (40 CFR 61, Subpart H).

[e]Annual EDE is the EDE received in a year.

Table A-2. Department of Energy's Derived Concentration Guides for Water and Derived Air Concentrations[a]

Nuclide	DCGs for Water in Uncontrolled Areas (pCi/L)	DCGs for Drinking Water Systems (pCi/L)	DACs (μCi/mL) Uncontrolled Areas	DACs (μCi/mL) Controlled Areas
^{3}H	2,000,000	80,000	1×10^{-7}	2×10^{-5}
^{7}Be	1,000,000	40,000	4×10^{-8}	8×10^{-6}
^{89}Sr	20,000	800	3×10^{-10}	6×10^{-8}
^{90}Sr[b]	1,000	40	9×10^{-12}	2×10^{-9}
^{137}Cs	3,000	120	4×10^{-10}	7×10^{-8}
^{234}U	500	20	9×10^{-14}	2×10^{-11}
^{235}U	600	24	1×10^{-13}	2×10^{-11}
^{238}U	600	24	1×10^{-13}	2×10^{-11}
^{238}Pu	40	1.6	3×10^{-14}	3×10^{-12}
^{239}Pu[b]	30	1.2	2×10^{-14}	2×10^{-12}
^{240}Pu	30	1.2	2×10^{-14}	2×10^{-12}
^{241}Am	30	1.2	2×10^{-14}	2×10^{-12}
	(μg/L)	(μg/L)	(pg/m^3)	(pg/m^3)
Natural U	800	30	1×10^{5}	3×10^{7}

[a]Guides for uncontrolled areas are based on DOE's PDL for the general public[A4]; those for controlled areas are based on occupational RPSs for DOE Order 5480.11. Guides apply to concentrations in excess of those occurring naturally or that are due to worldwide fallout.
[b]Guides for ^{239}Pu and ^{90}Sr are the most appropriate to use for gross alpha and gross beta, respectively.

Table A-3. National and New Mexico Ambient Air Quality Standards

Pollutant	Averaging Time	Unit	New Mexico Standard	Federal Standards	
				Primary	Secondary
Sulfur dioxide	Annual arithmetic mean	ppm	0.02	0.03	
	24 hours[a]	ppm	0.10	0.14	
	3 hours[a]	ppm			0.5
Total suspended particulate matter	Annual geometric mean	$\mu g/m^3$	60		
	30 days	$\mu g/m^3$	90		
	7 days	$\mu g/m^3$	110		
	24 hours[a]	$\mu g/m^3$	150		
PM_{10}[b]	Annual arithmetic mean	$\mu g/m^3$		50	50
	24 hours	$\mu g/m^3$		150	150
Carbon monoxide	8 hours[a]	ppm	8.7	9	
	1 hour[a]	ppm	13.1	35	
Ozone	1 hour[c]	ppm	0.06	0.12	0.12
Nitrogen dioxide	Annual arithmetic mean	ppm	0.05	0.053	0.053
	24 hours[a]	ppm	0.10		
Lead	Calendar quarter	$\mu g/m^3$		1.5	1.5
Beryllium	30 days	$\mu g/m^3$	0.01		
Asbestos	30 days	$\mu g/m^3$	0.01		
Heavy metals (total combined)	30 days	$\mu g/m^3$	10		
Nonmethane hydrocarbons	3 hours	ppm	0.19		

[a]Maximum concentration, not to be exceeded more than once per year.
[b]Particles <10 μm in diameter.
[c]The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the limit is ≤1.

Table A-4. Safe Drinking Water Act Maximum Contaminant Levels in the Water Supply for Radiochemicals, Inorganic Chemicals, Organic Chemicals, and Microbiologicals

Contaminants	
Radiochemical:	**MCL**
Gross alpha[a]	15 pCi/L
Gross beta & photon	4 mrem/yr
^{3}H	20,000 pCi/L
^{90}Sr	8 pCi/L
^{226}Ra & ^{228}Ra	5 pCi/L
U	20 µg/L
	Screening Limits
Gross alpha[a]	5 pCi/L
Gross beta	50 pCi/L
Inorganic Chemical:	
Primary Standards	**MCL (µg/L)**
Asbestos	7 million fibers/L (longer than 10 µm)
As	0.05
Ba	2
Be	0.004
Cd	0.005
CN	0.2
Cr	0.1
F	4.0
Hg	0.002
Ni	0.1
NO_3 (as N)	10
NO_2 (as N)	1
Se	0.05
Sb	0.006
Tl	0.002
	Action Levels (µg/L)
Pb	0.015
Cu	1.3
Secondary Standards	**(µg/L)**
Cl	250
Cu	1
Fe	0.3
Mn	0.05
SO_4	250
Zn	5.0
TDS[b]	500
pH	6.5–8.5 standard unit

Table A-4. Safe Drinking Water Act Maximum Contaminant Levels in the Water Supply for Radiochemicals[a], Inorganic Chemicals, Organic Chemicals, and Microbiologicals (Cont.)

Contaminants	
Organic Chemical:	**MCL (μg/L)**
Alachlor	2
Atrazine	3
Carbofuran	40
Chlordane	2
Dibromochloropropane	0.2
2,4-D	70
Ethylene dibromide	0.05
Heptachlor	0.4
Heptachlor epoxide	0.2
Lindane	0.2
Methoxychlor	40
Polychlorinated biphenyls	0.5
Pentachlorophenol	1
Toxaphene	3
2,4,5-TP	50
Benzo[a]pyrene	0.2
Dalaphon	200
Di(2-ethylhexyl)adipate	400
Di(2-ethylhexyl)phthalate	6
Dinoseb	7
Diquat	20
Endothall	100
Endrin	2
Glyphosate	700
Hexachlorobenzene	1
Hexachlorocyclopentadiene	50
Oxamyl (Vydate)	200
Picloram	500
Simazine	4
2,3,7,8-TCDD (Dioxin)	0.00003
Total trihalomethanes	100
Vinyl chloride	2
Benzene	5
Carbon tetrachloride	5
1,2-dichloroethane	5
Trichloroethylene	5
para-Dichlorobenzene	75
1,1-Dichloroethylene	7
1,1,1-Trichloroethane	200
cis-1,2-Dichloroethylene	70
1,2-Dichloropropane	5
Ethylbenzene	700
Monochlorobenzene	100

Table A-4. Safe Drinking Water Act Maximum Contaminant Levels in the Water Supply for Radiochemicals[a], Inorganic Chemicals, Organic Chemicals, and Microbiologicals (Cont.)

Contaminants	
Organic Chemical: (Cont.)	**MCL (μg/L)**
o-Dichlorobenzene	600
Stryene	100
Tetrachloroethylene	5
Toluene	1,000
trans-1,2-Dichloroethylene	100
Xylenes (total)	10,000
Dichloromethane	5
1,2,4-Trichlorobenzene	70
1,1,2-Trichloroethane	5
Microbiological:	**MCL**
Presence of total coliforms	5% of samples/month
Presence of fecal coliforms or Escherichia coli	No coliform positive repeat samples following a fecal coliform positive sample

[a]See text for discussion of application of gross alpha MCL and gross alpha screening level of 5 pCi/L.
[b]Total dissolved solids.

Table A-5. Levels of Contaminants Determined by the Toxicity Characteristic Leaching Procedure[a]

Contaminant	(μg/L)
Arsenic	5.0
Barium	100.0
Benzene	0.5
Cadmium	1.0
Carbon tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100.0
Chloroform	6.0
Chromium	5.0
o-Cresol	200.0
m-Cresol	200.0
p-Cresol	200.0
Cresol	200.0
2,4-D	10.0
1,4-Dichlorobenzene	7.5
1,2-Dichloroethane	0.5
1,1-Dichloroethylene	0.7
2,4-Dinitrotoluene	0.13
Endrin	0.02
Heptachlor (and its epoxide)	0.008
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Hexachloroethane	3.0
Lead	5.0
Lindane	0.4
Mercury	0.2
Methoxychlor	10.0
Methyl ethyl ketone	200.0
Nitrobenzene	2.0
Pentachlorophenol	100.0
Pyridine	5.0
Selenium	1.0
Silver	5.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
2,4,5-TP (Silvex)	1.0
Vinyl chloride	0.2

[a]Ref. A[10].

Table A-6. Livestock Watering Standards

Livestock Contaminant	Concentration (μg/L)
Dissolved Al	5.0
Dissolved As	0.02
Dissolved B	5.0
Dissolved Cd	0.05
Dissolved Cr[5]	1.0
Dissolved Co	1.0
Dissolved Cu	0.5
Dissolved Pb	0.1
Total Hg	0.01
Dissolved Se	0.05
Dissolved V	0.1
Dissolved Zn	25.0
	pCi/L
$^{226,228}Ra$	30
Tritium	20,000
Gross alpha	15

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A1. US Department of Energy, "Internal Dose Conversion Factors for Calculation of Dose to the Public," US Department of Energy report DOE/EH-0071 (July 1988).

A2. US Department of Energy, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public," US Department of Energy report DOE/EH-0070 (July 1988).

A3. International Commission on Radiological Protection, "Limits for Intakes of Radionuclides by Workers," ICRP Publication 30, Parts 1, 2, and 3, and their supplements, *Annals of the ICRP* **2**(3/4) –**8**(4) (1979–1982), and Publication 30, Part 4, **19**(4) (1988).

A4. National Council on Radiation Protection and Measurements, "Recommendations on Limits for Exposure to Ionizing Radiation," NCRP report No. 91 (June 1987).

A5. US Department of Energy, "Radiation Protection of the Public and the Environment," US Department of Energy Order 5400.5 (February 8, 1990).

A6. US Environmental Protection Agency, "40 CFR 61, National Emission Standards for Hazardous Air Pollutants, Radionuclides; Final Rule and Notice of Reconsideration," *Federal Register* **54,** 51 653–51 715 (December 15, 1989).

A7. US Environmental Protection Agency, "National Emission Standard for Radionuclide Emissions Other than Radon from Department of Energy Facilities," *Code of Federal Regulations,* Title 40, Part 61, Subpart H (December 15, 1989).

A8. New Mexico Environmental Improvement Board, "NM Drinking Water Supply Regulations," (as amended through January 1, 1995).

A9. US Environmental Protection Agency, "National Interim Primary Drinking Water Regulations," *Code of Federal Regulations,* Title 40, Parts 141 and 142 (1989), and "National Secondary Drinking Water Regulations," Part 143 (1989).

A10. US Environmental Protection Agency, "Identification and Listing of Hazardous Waste, Table I. Maximum Concentration of Contaminants for the Toxicity Concentrations," *Code of Federal Regulations*, Title 40, Section 261.24 (1992).

A11. New Mexico Water Quality Control Commission, "Water Quality Standards for Interstate and Intrastate Streams in New Mexico," Section 3-101.K (as amended through November 12, 1991).

UNITS OF MEASUREMENT

Throughout this report the International System of Units (SI) or metric system of measurements has been used, with some exceptions. For units of radiation activity, exposure, and dose, US Customary Units (that is, curie [Ci], roentgen [R], rad, and rem) are retained as the primary measurement because current standards are written in terms of these units. The equivalent SI units are the becquerel (Bq), coulomb per kilogram (C/kg), gray (Gy), and sievert (Sv), respectively.

Table B-1 presents prefixes used in this report to define fractions or multiples of the base units of measurements. Scientific notation is used in this report to express very large or very small numbers. Translating from scientific notation to a more traditional number requires moving the decimal point either left or right from the number. If the value given is 2.0×10^3, the decimal point should be moved three numbers (insert zeros if no numbers are given) to the right of its present location. The number would then read 2,000. If the value given is 2.0×10^{-5}, the decimal point should be moved five numbers to the left of its present location. The result would become 0.00002.

Table B-2 presents conversion factors for converting SI units into US Customary Units. Table B-3 presents abbreviations for common measurements.

Data Handling of Radiochemical Samples and Discussion of Negative Values.

Measurements of radiochemical samples require that analytical or instrumental backgrounds be subtracted to obtain net values. Thus, net values are sometimes obtained that are lower than the minimum detection limit of the analytical technique. Consequently, individual measurements can result in values of positive or negative numbers. Although a negative value does not represent a physical reality, a valid long-term average of many measurements can be obtained only if the very small and negative values are included in the population calculations.[B1]

For individual measurements, uncertainties are reported as one standard deviation. The standard deviation is estimated from the propagated sources of analytical error.

Standard deviations for the station and group (off-site regional, off-site perimeter, and on-site) means are calculated using the following equation:

$$s = \sqrt{\frac{\sum_{i=1}^{N} \left(\bar{c} - c_i\right)^2}{(N-1)}},$$

where

ci = sample i

$\bar{c}$ = mean of samples from a given station or group, and

N = number of samples comprising a station or group.

This value is reported as the uncertainty for the station and group means.

Appendix B

Table B-1. Prefixes Used with SI (Metric) Units

Prefix	Factor	Symbol
mega	1 000 000 or 10^6	M
kilo	1 000 or 10^3	k
centi	0.01 or 10^{-2}	c
milli	0.001 or 10^{-3}	m
micro	0.000001 or 10^{-6}	μ
nano	0.000000001 or 10^{-9}	n
pico	0.000000000001 or 10^{-12}	p
femto	0.000000000000001 or 10^{-15}	f
atto	0.000000000000000001 or 10^{-18}	a

Table B-2. Approximate Conversion Factors for Selected SI (Metric) Units

Multiply SI (Metric) Unit	By	To Obtain US Customary Unit
Celsius (°C)	9/5 + 32	Fahrenheit (°F)
Centimeters (cm)	0.39	Inches (in)
Cubic meters (m^3)	35.3	Cubic feet (ft^3)
Hectares (ha)	2.47	Acres
Grams (g)	0.035	Ounces (oz)
Kilograms (kg)	2.2	Pounds (lb)
Kilometers (km)	0.62	Miles (mi)
Liters (L)	0.26	Gallons (gal)
Meters (m)	3.28	Feet (ft)
Micrograms per gram (μg/g)	1	Parts per million (ppm)
Milligrams per liter (mg/L)	1	Parts per million (ppm)
Square kilometers (km2)	0.386	Square miles (mi^2)

Table B-3. Common Measurement Abbreviations and Measurement Symbols

aCi	attocurie
ac ft	acre feet
Bq	becquerel
Btu/yr	British thermal unit per year
cc/sec	cubic centimeters per second
cfm	cubic feet per minute
cfs	cubic feet per second
Ci	curie
cpm/L	counts per minute per liter
fCi/g	femtocurie per gram
ft	foot
gal.	gallon
in.	inch
kg	kilogram
kg/h	kilogram per hour
L	liter
lb	pound
lb/h	pound per hour
lin ft	linear feet
m^3/s	cubic meter per second
µCi/L	microcurie per liter
µCi/mL	microcurie per milliliter
µg/g	microgram per gram
$\mu g/m^3$	microgram per cubic meter
mL	milliliter
mm	millimeter
µm	micrometer
µmho/cm	micro mho per centimeter
µR	microroentgen
mCi	millicurie
mR	milliroentgen
mrad	millirad
mrem	millirem
mSv	millisievert
nCi	nanocurie
nCi/dry g	nanocurie per dry gram
nCi/L	nanocurie per liter
ng/m^3	nanogram per cubic meter
pCi/dry g	picocurie per dry gram
pCi/g	picocurie per gram
pCi/L	picocurie per liter
pCi/m^3	picocurie per cubic meter
pCi/mL	picocurie per milliliter
pg/g	picogram per gram
pg/m^3	picogram per cubic meter
PM_{10}	small particulate matter (less than 10 µm diameter)
R	roentgen
ST or σ	standard deviation
Sv	sievert
sq ft (ft^2)	square feet
TU	tritium unit
>	greater than
<	less than
±	plus or minus
~	approximately

Appendix B

REFERENCES

B1. R. O. Gilbert, "Recommendations Concerning the Computation and Reporting of Counting Statistics for the Nevada Applied Ecology Group," Batelle Pacific Northwest Laboratories report BNWL-B-368 (September 1975).

DESCRIPTIONS OF TECHNICAL AREAS AND THEIR ASSOCIATED PROGRAMS

Locations of the technical areas (TAs) operated by the Laboratory in Los Alamos County are shown in Figure 1-3. The main programs conducted at each of the areas are listed in this Appendix.

TA-0: The Laboratory has about 180,000 sq ft of leased space for training, support, architectural engineering design, unclassified research and development in theLos Alamos townsite and White Rock. The publicly accessible Community Reading Room, the Bradbury Science Museum, and DOE's Los Alamos Area Office are also located in the townsite.

TA-2, Omega Site: Omega West Reactor, an 8-MW nuclear research reactor, is located here. It served as a research tool by providing a source of neutrons for fundamental studies in nuclear physics and associated fields before it was shut down in 1993.

TA-3, Core Area: The Administration Complex contains the Director's office, administrative offices, and support facilities. Laboratories for several divisions are in this main TA of the Laboratory. Other buildings house central computing facilities, chemistry and materials science laboratories, and earth and space science laboratories, physics laboratories, technical shops, cryogenics laboratories, the main cafeteria, and the Study Center. TA-3 contains about 50% of the Laboratory's employees and floor space. A Van de Graaff accelerator was put on shutdown status in 1994.

TA-5, Beta Site: This site contains some physical support facilities such as an electrical substation, test wells, several archaeological sites, and environmental monitoring and buffer areas.

TA-6, Two-Mile Mesa Site: The site is mostly undeveloped and contains gas cylinder staging and vacant buildings pending disposal.

TA-8, GT Site (or Anchor Site West): This is a dynamic testing site operated as a service facility for the entire Laboratory. It maintains capability in all modern nondestructive testing techniques for ensuring quality of material, ranging from test weapons components to high-pressure dies and molds. Principal tools include radiographic techniques (x-ray machines with potentials up to 1,000,000 V and a 24-MeV betatron), radioisotope techniques, ultrasonic and penetrant testing, and electromagnetic test methods.

TA-9, Anchor Site East: At this site, fabrication feasibility and physical properties of explosives are explored. New organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.

TA-11, K Site: Facilities are located here for testing explosives components and systems, including vibration testing and drop testing, under a variety of extreme physical environments. The facilities are arranged so that testing may be controlled and observed remotely and so that devices containing explosives or radioactive materials, as well as those containing nonhazardous materials, may be tested.

TA-14, Q Site: This dynamic testing site is used for running various tests on relatively small explosive charges for fragment impact tests, explosives sensitivities, and thermal responses.

TA-15, R Site: This is the home of PHERMEX (the pulsed high-energy radiographic machine emitting x-rays) a multiple-cavity electron accelerator capable of producing a very large flux of x-rays for weapons development testing. It is also the proposed site to DARHT (the dual-axis radiographic hydrotest facility) whose major feature is its intense high-resolution, dual-machine radiographic capability. This site is also used for the investigation of weapons functioning and systems behavior in non-nuclear tests, principally through electronic recordings.

TA-16, S Site: Investigations at this site include development, engineering design, prototype manufacture, and environmental testing of nuclear weapons warhead systems. TA-16 is the site of the new Weapons Engineering Tritium Facility for tritium handled in gloveboxes. Development and testing of high explosives, plastics, and adhesives and research on process development for manufacture of items using these and other materials are accomplished in extensive facilities.

TA-18, Pajarito Laboratory Site: The fundamental behavior of nuclear chain reactions with simple, low-power reactors called critical assemblies is studied here. Experiments are operated by remote control and observed by closed-circuit television. The machines are housed in buildings known as kivas and are used primarily to provide a controlled means of assembling a critical amount of fissionable material so that the effects of various shapes, sizes, and configurations can be studied. These machines are also used as a large-quantity source of fission neutrons for experimental purposes.

TA-21, DP Site: This site has two primary research areas: DP West and DP East. DP West is gradually being decontaminated and decommissioned. DP East is a tritium research site.

TA-22, TD Site: This site is used in the development of special detonators to initiate high explosive systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with initiating high explosives and research in rapid shock-induced reactions.

TA-28, Magazine Area A: This is an explosives storage area.

TA-33, HP Site: An old high-pressure, tritium handling facility located here is being phased out. An intelligence technology group and the National Radio Astronomy Observatory's Very Large Baseline Array Telescope are located at this site.

TA-35, Ten Site: Nuclear safeguards research and development, which are conducted here, are concerned with techniques for nondestructive detection, identification, and analysis of fissionable isotopes. Research is done on reactor safety, laser fusion, optical sciences, pulsed-power systems, and high-energy physics. Tritium fabrication, metallurgy, ceramic technology, and chemical plating are also done here.

TA-36, Kappa Site: Phenomena of explosives, such as detonation velocity, are investigated at this dynamic testing site.

TA-37, Magazine Area C: This is an explosives storage area.

TA-39, Ancho Canyon Site: The behavior of non-nuclear weapons is studied here, primarily by photographic techniques. Investigations are also made into various phenomenological aspects of explosives, interactions of explosives, explosions involving other materials, shock wave physics, equation state measurements, and pulsed-power systems design.

TA-40, DF Site: This site is used in the development of special detonators to initiate high-explosive systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with the physics of explosives.

TA-41, W Site: Personnel at this site engage primarily in engineering design and development of nuclear components, including fabrication and evaluation of test materials for weapons.

TA-43, Health Research Laboratory and Center for Human Genome Studies: This site is adjacent to the Los Alamos Medical Center in the townsite. Research performed at this site includes structural, molecular, and cellular radiobiology, biophysics, mammalian radiobiology, mammalian metabolism, biochemistry, and genetics.

TA-46, WA Site: Applied photochemistry, which includes development of technology for laser isotope separation and laser enhancement of chemical processes, is investigated here. The Sanitary Wastewater System Consolidation project has been installed at the east end of this site. Environmental management operations are also located here.

TA-48, Radiochemistry Site: Laboratory scientists and technicians at this site study nuclear properties of radioactive materials by using analytical and physical chemistry. Measurements of radioactive substances are made, and hot cells are used for remote handling of radioactive materials.

TA-49, Frijoles Mesa Site: This site is currently restricted to carefully selected functions because of its location near Bandelier National Monument and past use in high-explosive and radioactive materials experiments. The Hazardous Devices Team Training Facility is located here. The eastern portion is designated for a future sanitary landfill.

TA-50, Waste Management Site: Personnel at this site have responsibility for treating and disposing of most industrial liquid and radioactive liquid waste received from Laboratory technical areas, for development of improved methods of solid waste treatment, and for containment of radioactivity removed by treatment.

TA-51, Environmental Research Site: Research and experimental studies on the long-term impact of radioactive waste on the environment and types of waste storage and coverings are studied at this site.

TA-52, Reactor Development Site: A wide variety of theoretical and computational activities related to nuclear reactor performance and safety are done at this site.

TA-53, Los Alamos Neutron Scattering Center: The Los Alamos Neutron Scattering Center (LANSCE) (formerly the Los Alamos Meson Physics Facility), the Ground Test Accelerator, and the Proton Storage Ring are located at this TA.

TA-54, Waste Disposal Site: The primary function of this site is radioactive solid and hazardous chemical waste management and disposal.

TA-55, Plutonium Facility Site: Processing of plutonium and research on plutonium metallurgy are done at this site.

TA-57, Fenton Hill Site: About 45 km (28 mi) west of Los Alamos on the southern edge of the Valles Caldera in the Jemez Mountains, this site is the location of the Laboratory's Hot Dry Rock geothermal project, which has been inactive for the past several years.

TA-58: This site is reserved for multi-use experimental sciences requiring close functional ties to programs currently located at TA-3.

TA-59, Occupational Health Site: Occupational health and safety and environmental management activities are conducted at this site. Emergency management offices are also located here.

TA-60, Sigma Mesa: This area contains physical support and infrastructure facilities, including the Test Fabrication Facility and Rack Assembly and the Alignment Complex.

TA-61, East Jemez Road: This site is used for physical support and infrastructure facilities, including the sanitary landfill.

TA-62: This site is reserved for multi-use experimental science, public and corporate interface, and environmental research and buffer uses.

TA-63: This is a major growth area at the Laboratory with expanding environmental and waste management functions and facilities. This area contains physical support facilities operated by Johnson Controls, Inc.

TA-64: This is the site of the Central Guard Facility.

TA-65: This undeveloped TA was incorporated into TA-51 and no longer exists.

TA-66: This site is used for industrial partnership activities.

TA-67: This is a dynamic testing area that contains significant archaeological sites. It is designated for future mixed and low-level hazardous waste storage.

TA-68: This is a dynamic testing area that contains archaeological and environmental study areas.

TA-69: This undeveloped TA serves as an environmental buffer for the dynamic testing area.

TA-70: This undeveloped TA serves as an environmental buffer for the high-explosives test area.

TA-71: This undeveloped TA serves as an environmental buffer for the high-explosives test area.

TA-72: This is the site of the Protective Forces Training facility.

TA-73: This area is the Los Alamos Airport.

TA-74, Otowi Tract: This large area, bordering the Pueblo of San Ildefonso on the east, is isolated from most of the Laboratory and contains significant concentrations of archaeological sites and an endangered species breeding area. The site also contains Laboratory water wells and future well fields.

activation products	Radioactive products generated as a result of neutrons and other subatomic particles interacting with materials such as air, construction materials, or impurities in cooling water. These activation products are usually distinguished, for reporting purposes, from fission products.
ALARA	As low as reasonably achievable. The term that describes an approach to radiation exposure control or management whereby the exposures and resulting doses are maintained as far below the limits specified for the appropriate circumstances as economic, technical, and practical considerations permit.
alpha particle	A positively charged particle (identical to the helium nucleus) composed of two protons and two neutrons that are emitted during decay of certain radioactive atoms. Alpha particles are stopped by several centimeters of air or a sheet of paper.
ambient air	The surrounding atmosphere as it exists around people, plants, and structures. It is not considered to include the air immediately adjacent to emission sources.
aquifer	A saturated layer of rock or soil below the ground surface that can supply usable quantities of groundwater to wells and springs. Aquifers can be a source of water for domestic, agricultural, and industrial uses.
AEC	Atomic Energy Commission. A federal agency created in 1946 to manage the development, use, and control of nuclear energy for military and civilian applications. It was abolished by the Energy Reorganization Act of 1974 and was succeeded by the Energy Research and Development Administration (now part of the US Department of Energy (DOE) and the US Nuclear Regulatory Commission [NRC]).
artesian well	A well in which the water rises above the top of the water-bearing bed.
atom	Smallest particle of an element capable of entering into a chemical reaction.
background radiation	Ionizing radiation from sources other than the Laboratory. This radiation may include cosmic radiation; external radiation from naturally occurring radioactivity in the earth (terrestrial radiation), air, and water; internal radiation from naturally occurring radioactive elements in the human body; worldwide fallout; and radiation from medical diagnostic procedures.
beta particle	A negatively charged particle (identical to the electron) that is emitted during decay of certain radioactive atoms. Most beta particles are stopped by 0.6 cm of aluminum.
blank sample	A control sample that is identical, in principle, to the sample of interest, except that the substance being analyzed is absent. The

	measured value or signals in blanks for the analyte is believed to be caused by artifacts and should be subtracted from the measured value. This process yields a net amount of the substance in the sample.
blind sample	A control sample of known concentration in which the expected values of the constituent are unknown to the analyst.
BOD	Biochemical (biological) oxygen demand. A measure of the amount of oxygen in biological processes that breaks down organic matter in water; a measure of the organic pollutant load. It is used as an indicator of water quality.
CAA	Clean Air Act. The federal law that authorizes the Environmental Protection Agency (EPA) to set air quality standards and to assist state and local governments to develop and execute air pollution prevention and control programs.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Also known as Superfund, this law authorizes the federal government to respond directly to releases of hazardous substances that may endanger health or the environment. The EPA is responsible for managing Superfund.
CFR	Code of Federal Regulations. A codification of all regulations developed and finalized by federal agencies in the *Federal Register*.
confined aquifer	An aquifer bounded above and below by low-permeability rock or soil layers.
COC	Chain-of-Custody. A method for documenting the history and possession of a sample from the time of collection, through analysis and data reporting, to its final disposition.
contamination	(1) Substances introduced into the environment as a result of people's activities, regardless of whether the concentration is a threat to health (see pollution). (2) The deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel.
controlled area	Any Laboratory area to which access is controlled to protect individuals from exposure to radiation and radioactive materials.
Ci	Curie. Unit of radioactivity. One Ci equals 3.70×10^{10} nuclear transformations per second.
cosmic radiation	High-energy particulate and electromagnetic radiations that originate outside the earth's atmosphere. Cosmic radiation is part of natural background radiation.
DOE	US Department of Energy. The federal agency that sponsors energy research and regulates nuclear materials used for weapons production.

dose	A term denoting the quantity of radiation energy absorbed.
absorbed dose	The energy imparted to matter by ionizing radiation per unit mass of irradiated material. (The unit of absorbed dose is the rad.)
effective dose equivalent	The hypothetical whole-body dose that would give the same risk of cancer mortality and serious genetic disorder as a given exposure but that may be limited to a few organs. The effective dose equivalent is equal to the sum of individual organ doses, each weighted by degree of risk that the organ dose carries. For example, a 100 mrem dose to the lung, which has a weighting factor of 0.12, gives an effective dose that is equivalent to $100 \times 0.12 = 12$ mrem.
equivalent dose	A term used in radiation protection that expresses all types of radiation (alpha, beta, and so on) on a common scale for calculating the effective absorbed dose. It is the product of the absorbed dose in rads and certain modifying factors. (The unit of dose equivalent is the rem.)
maximum boundary dose	The greatest dose commitment, considering all potential routes of exposure from a facility's operation, to a hypothetical individual who is in an uncontrolled area where the highest dose rate occurs. It assumes that the hypothetical individual is present 100% of the time (full occupancy), and it does not take into account shielding (for example, by buildings).
maximum individual dose	The greatest dose commitment, considering all potential routes of exposure from a facility's operation, to an individual at or outside the Laboratory boundary where the highest dose rate occurs. It takes into account shielding and occupancy factors that would apply to a real individual.
population dose	The sum of the radiation doses to individuals of a population. It is expressed in units of person-rem. (For example, if 1,000 people each received a radiation dose of 1 rem, their population dose would be 1,000 person-rem.)
whole body dose	A radiation dose commitment that involves exposure of the entire body (as opposed to an organ dose that involves exposure to a single organ or set of organs).
dosimeter	A portable detection device for measuring the total accumulated exposure to ionizing radiation.
EA	Environmental Assessment. A report that identifies potentially significant environmental impacts from any federally approved or funded project that may change the physical environment. If an EA shows significant impact, an Environmental Impact Statement is required.
effluent	A liquid waste discharged to the environment.

EIS	Environmental Impact Statement. A detailed report, required by federal law, on the significant environmental impacts that a proposed major federal action would have on the environment. An EIS must be prepared by a government agency when a major federal action that will have significant environmental impacts is planned.
emission	A gaseous waste discharged to the environment.
environmental compliance	The documentation that the Laboratory complies with the multiple federal and state environmental statutes, regulations, and permits that are designed to ensure environmental protection. This documentation is based on the results of the Laboratory's environmental monitoring and surveillance programs.
environmental monitoring	The sampling of contaminants in liquid effluents and gaseous emissions from Laboratory facilities, either by directly measuring or by collecting and analyzing samples in a laboratory.
environmental surveillance	The sampling of contaminants in air, water, sediments, soils, foodstuffs, and plants and animals, either by directly measuring or by collecting and analyzing samples in a laboratory.
EPA	Environmental Protection Agency. The federal agency responsible for enforcing environmental laws. Although state regulatory agencies may be authorized to administer some of this responsibility, EPA retains oversight authority to ensure protection of human health and the environment.
exposure	A measure of the ionization produced in air by x-ray or gamma ray radiation. (The unit of exposure is the roentgen).
external radiation	Radiation originating from a source outside the body.
fission products	Atoms created by the splitting of larger atoms into smaller ones accompanied by release of energy.
friable asbestos	Asbestos that is brittle or readily crumbled.
gallery	An underground collection basin for spring discharges.
gamma radiation	Short-wavelength electromagnetic radiation of nuclear origin that has no mass or charge. Because of its short wavelength (high energy), gamma radiation can cause ionization. Other electromagnetic radiation (such as microwaves, visible light, and radiowaves) has longer wavelengths (lower energy) and cannot cause ionization.
gross alpha	The total amount of measured alpha activity without identification of specific radionuclides.
gross beta	The total amount of measured beta activity without identification of specific radionuclides.

groundwater	Water found beneath the surface of the ground (subsurface water). Groundwater usually refers to a zone of complete water saturation containing no air.
^3H	Tritium. A radionuclide of hydrogen with a half-life of 12.3 years. The very low energy of its radioactive decay makes it one of the least hazardous radionuclides.
half-life, radioactive	The time required for the activity of a radioactive substance to decrease to half its value by inherent radioactive decay. After two half-lives, one-fourth of the original activity remains ($1/2 \times 1/2$), after three half-lives, one-eighth ($1/2 \times 1/2 \times 1/2$), and so on.
hazardous waste	Wastes exhibiting any of the following characteristics: ignitability, corrosivity, reactivity, or yielding toxic constituents in a leaching test. In addition, EPA has listed as hazardous other wastes that do not necessarily exhibit these characteristics. Although the legal definition of hazardous waste is complex, the term generally refers to any waste that EPA believes could pose a threat to human health and the environment if managed improperly. Resource Conservation and Recovery Act (RCRA) regulations set strict controls on the management of hazardous wastes.
hazardous waste constituent	The specific substance in a hazardous waste that makes it hazardous and therefore subject to regulation under Subtitle C of RCRA.
HSWA	Hazardous and Solid Waste Amendments of 1984 to RCRA. These amendments to RCRA greatly expanded the scope of hazardous waste regulation. In HSWA, Congress directed EPA to take measures to further reduce the risks to human health and the environment caused by hazardous wastes.
hydrology	The science dealing with the properties, distribution, and circulation of natural water systems.
internal radiation	Radiation from a source within the body as a result of deposition of radionuclides in body tissues by processes such as ingestion, inhalation, or implantation. Potassium-40, a naturally occurring radionuclide, is a major source of internal radiation in living organisms.
ion	An atom or compound that carries an electrical charge.
ionizing radiation	Radiation possessing enough energy to remove electrons from the substances through which it passes. The primary contributors to ionizing radiation are radon, cosmic and terrestrial sources, and medical sources such as x-rays and other diagnostic exposures.
isotopes	Forms of an element having the same number of protons in their nuclei but differing in the number of neutrons. Isotopes of an element have similar chemical behaviors but can have different nuclear behaviors.

- long-lived isotope - A radionuclide that decays at such a slow rate that a quantity of it will exist for an extended period (half-life is greater than three years).
- short-lived isotope - A radionuclide that decays so rapidly that a given quantity is transformed almost completely into decay products within a short period (half-life is two days or less).

LDR — Land disposal restrictions (land ban). A regulatory program that identifies hazardous wastes that are restricted from land disposal.

MCL — Maximum Contaminant Level. Maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet of the ultimate user of a public water system (see Appendix A and Table A-4). The MCLs are specified by the EPA.

MEI — Maximum exposed individual. The average exposure to the population in general will always be less than to one person or subset of persons because of where they live, what they do, and their individual habits. To try to estimate the dose to the MEI one tries to find that population subgroup (and more specifically, the one individual) that potentially has the highest exposure, intake, etc. This becomes the MEI.

mixed waste — Waste that contains a hazardous waste component regulated under Subtitle C of the RCRA and a radioactive component consisting of source, special nuclear, or byproduct material regulated under the federal Atomic Energy Act (AEA).

mrem — Millirem (10^{-3} rem). See definition of rem. The dose equivalent that is one-thousandth of a rem.

NEPA — National Environmental Policy Act. This federal legislation, passed in 1969, requires federal agencies to evaluate the impacts of their proposed actions on the environment prior to decision making. One provision of NEPA requires the preparation of an EIS by federal agencies when major actions significantly affecting the quality of the human environment are proposed.

NESHAP — National Emission Standards for Hazardous Air Pollutants. These standards are found in the Clean Air Act; they set limits for such pollutants as beryllium and radionuclides.

nonpoint source — Any nonconfined area from which pollutants are discharged into a body of water (e.g., agricultural runoff, construction runoff, and parking lot drainage).

NPDES — National Pollutant Discharge Elimination System. This federal program, under the Clean Water Act, requires permits for discharges into surface waterways.

nuclide — A species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons,

number of neutrons, and energy content; or alternately, by the atomic number, mass number, and atomic mass. To be a distinct nuclide, the atom must be capable of existing for a measurable length of time.

PA — Performance Assessment. A systematic analysis of the potential risks posed by waste management systems to the public and environment, and a comparison of those risks to established performance objectives.

PCBs — Polychlorinated biphenyls. A family of organic compounds used since 1926 in electric transformers, lubricants, carbonless copy paper, adhesives, and caulking compounds. They are also produced in certain combustion processes. PCBs are extremely persistent in the environment because they do not break down into new and less harmful chemicals. PCBs are stored in the fatty tissues of humans and animals through the bioaccumulation process. EPA banned the use of PCBs, with limited exceptions, in 1976. In general, PCBs are not as toxic in acute short-term doses as some other chemicals, although acute and chronic exposure can cause liver damage. PCBs have also caused cancer in laboratory animals. When tested, most people show traces of PCBs in their blood and fatty tissues.

PDL — Public Dose Limit. The new term for Radiation Protection Standards, a standard for external and internal exposure to radioactivity as defined in DOE Order 5400.5 (see Appendix A and Table A-1).

perched groundwater — A groundwater body above a slow-permeablity rock or soil layer that is separated from an underlying main body of groundwater by a vadose zone.

person-rem — The unit of population dose that expresses the sum of radiation exposures received by a population. For example, two persons, each with a 0.5 rem exposure, receive 1 person-rem, and 500 people, each with an exposure of 0.002 rem, also receive 1 person-rem.

pH — A measure of the hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH less than 7, basic solutions have a pH greater than 7, and neutral solutions have a pH of 7.

point source — Any confined and discrete conveyance from which pollutants are discharged into a body of water (e.g., pipe, ditch, well, or stack).

pollution — Levels of contamination that may be objectionable (perhaps due to a threat to health [see contamination]).

ppb — Parts per billion. A unit measure of concentration equivalent to the weight/volume ratio expressed as µg/L or ng/mL. Also used to express the weight/weight ratio as ng/g or µg/kg.

ppm — Parts per million. A unit measure of concentration equivalent to

	the weight/volume ratio expressed as mg/L. Also used to express the weight/weight ratio as µg/g or mg/kg.
QA	Quality assurance. Any action in environmental monitoring to ensure the reliability of monitoring and measurement data. Aspects of quality assurance include procedures, interlaboratory comparison studies, evaluations, and documentation.
QC	Quality control. The routine application of procedures within environmental monitoring to obtain the required standards of performance in monitoring and measurement processes. QC procedures include calibration of instruments, control charts, and analysis of replicate and duplicate samples.
R	Roentgen. The roentgen is a unit for measuring exposure. It is defined only for the effect on air and applies only to gamma and x-rays in air. It does not relate biological effects of radiation to the human body. 1 roentgen = 1,000 milliroentgen (mR)
rad	Radiation absorbed dose. The rad is a unit for measuring energy absorbed in any material. Absorbed dose results from energy being deposited by the radiation. It is defined for any material. It applies to all types of radiation and does not take into account the potential effect that different types of radiation have on the body. 1 rad = 1,000 millirad (mrad)
radiation	The emission of particles or energy as a result of an atomic or nuclear process.
radionuclide	An unstable nuclide capable of spontaneous transformation into other nuclides through changes in its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.
RCRA	Resource Conservation and Recovery Act of 1976. RCRA is an amendment to the first federal solid waste legislation, the Solid Waste Disposal Act of 1965. In RCRA, Congress established initial directives and guidelines for EPA to regulate hazardous wastes.
reagent	Any substance used in a chemical reaction to detect or measure another substance or to convert one substance into another.
release	Any discharge to the environment. Environment is broadly defined as water, land, or ambient air.
rem	Roentgen equivalent man. The rem is a unit for measuring dose equivalence. It is the most commonly used unit and pertains to only people. The rem takes into account the energy absorbed (dose) and the biological effect on the body (quality factor) due to the different types of radiation. rem = rad x quality factor 1 rem = 1,000 millirem (mrem)

RPS	Radiation Protection Standards. See PDL.
SAL	Screening Action Limit. A defined contaminant level that if exceeded in a sample, requires further action.
SARA	Superfund Amendments and Reauthorization Act of 1986. This act modifies and reauthorizes CERCLA. Title III of this act is known as the Emergency Planning and Community Right-to-Know Act of 1986.
saturated zone	Rock or soil where the pores are completely filled with water, and no air is present.
self-irradiation	Irradiation that comes from natural sources that are commonly found in the body. For example, potassium (K) is an essential element for the body. The potassium found in the body is nonradioactive (K) and radioactive (40K) potassium. The 40K has a 1.2 MeV gamma that will irradiate tissue in the body. (Note: Basically the more fat that you have, the more 40K you have.) The 40 mrem for self-irradiation is an average for a "standard" man.
SWMU	Solid waste management unit. Any discernible site at which solid wastes have been placed at any time, regardless of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at or around a facility at which solid wastes have been routinely and systematically released. Potential release sites include, for example, waste tanks, septic tanks, firing sites, burn pits, sumps, landfills (material disposal areas), outfall areas, canyons around LANL, and contaminated areas resulting from leaking product storage tanks (including petroleum).
TCLP	Toxicity Characteristic Leaching Procedure. An analytical method designed to determine the mobility of both organic and inorganic compounds present in liquid, solid, and multi-phase wastes. It is used to determine applicability of the LDR to a waste.
TDS	Total Dissolved Solids. The portion of solid material in a waste stream that is dissolved and passed through a filter.
terrestrial radiation	Radiation emitted by naturally occurring radionuclides such as potassium-40; the natural decay chains of uranium-235, uranium-238, or thorium-232; or cosmic-ray-induced radionuclides in the soil.
TLD	Thermoluminescent dosimeter. A material (the Laboratory uses lithium fluoride) that, after being exposed to radiation, emits a light signal when heated to approximately 300°C. This light is proportional to the amount of radiation (dose) to which it was exposed.
TRU	Transuranic waste. Waste contaminated with long-lived transuranic elements in concentrations within a specified range established by DOE, EPA, and NRC. These are elements shown

above uranium on the chemistry periodic table, such as plutonium, americium, and neptunium.

TSCA — Toxic Substances Control Act. TSCA is intended to provide protection from substances manufactured, processed, distributed, or used in the United States. A mechanism is required by the act for screening new substances before they enter the marketplace and for testing existing substances that are suspected of creating health hazards. Specific regulations may also be promulgated under this act for controlling substances found to be detrimental to human health or to the environment.

TSP — Total suspended particulates. Refers to the concentration of particulates in suspension in the air irrespective of the nature, source, or size of the particulates.

tuff — Rock formed from compacted volcanic ash fragments.

uncontrolled area — An area beyond the boundaries of a controlled area (see controlled area in this glossary).

unsaturated zone — See vadose zone in this glossary.

uranium — **Isotopic Abundance (atom %)**

	^{234}U	^{235}U	^{238}U
depleted	≤0.0055	<0.72	>99.2745
natural	0.0055	0.72	99.2745
enriched	≥0.0055	>0.72	<99.2745

Total uranium is the chemical abundance of uranium in the sample, regardless of its isotopic composition.

UST — Underground storage tank. A stationary device, constructed primarily of nonearthen material, designed to contain petroleum products or hazardous materials. In a UST, 10% or more of the volume of the tank system is below the surface of the ground.

vadose zone — The partially saturated or unsaturated region above the water table that does not yield water for wells. Water in the vadose zone is held to rock or soil particles by capillary forces and much of the pore spaces is filled with air.

water table — The water level surface below the ground at which the unsaturated zone ends and the saturated zone begins. It is the level to which a well that is screened in the unconfined aquifer would fill with water.

water year — October through September.

watershed — The region draining into a river, a river system, or a body of water.

wetland — A lowland area, such as a marsh or swamp, that is inundated or saturated by surface water or groundwater sufficient to support hydrophytic vegetation typically adapted for life in saturated soils.

wind rose	A diagram that shows the frequency and intensity of wind from different directions at a particular place.
WLM	Working level month. A unit of exposure to radon-222 and its decay products. Working level (WL) is any combination of the short-lived radon-222 decay products in 1 L of air that will result in the emission of 1.3×10^5 MeV potential alpha energy. At equilibrium, 100 pCi/L of radon-222 corresponds to 1 WL. Cumulative exposure is measured in working level months, one of which is equal to 170 working level hours.
worldwide fallout	Radioactive debris from atmospheric weapons tests that has been deposited on the earth's surface after being airborne and cycling around the earth.

ACIS	Automated Chemical Inventory System
ADS	Activity Data Sheet
AEC	Atomic Energy Commission
AIP	Agreement in Principle
AL	Albuquerque Operations Office (DOE)
ALARA	as low as reasonably achievable
ANOI	Advanced Notice of Intent
ANSI	American National Standards Institute
AO	Administrative Order
AQCR	Air Quality Control Regulation (New Mexico)
BEIR	biological effects of ionizing radiation
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BOD	biochemical/biological oxygen demand
BP	barometric pressure
Btu	British thermal unit
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAI	controlled-air incinerator
CAS	Condition Assessment Survey
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CGS	Canadian Geologic Survey
CMR	Chemistry and Metallurgy Research (LANL building)
CO	compliance order
COC	chain-of-custody
COD	chemical oxygen demand
COPC	contaminants of potential concern
CSU	Colorado State University
CWA	Clean Water Act
CY	calendar year
CYRSL	current years regional statistical reference level
DAC	derived air concentration (DOE)
DARHT	Dual Axis Radiographic Hydrotest facility
DCG	Derived Concentration Guide (DOE)
D&D	decontamination and decommissioning
DEC	DOE Environmental Checklist
DoD	Department of Defense
DOE	Department of Energy
DOE-EM	DOE, Environmental Management
DOT	Department of Transportation
DREF	dose rate effectiveness factors
EA	Environmental Assessment

Acronyms and Abbreviations

EARE	Environmental Assessments & Resource Evaluations (LANL Group)
ECD	electron capture detection
EDE	effective dose equivalent
EES	Earth and Environmental Sciences (LANL Division)
EES-1	Geology and Geochemistry Group
EIS	Environmental Impact Statement
EMSL-CI	Environmental Monitoring and Support Laboratory - Cincinnati
EO	Executive Order
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ER	Environmental Restoration Project
ERAM	Ecological Risk Assessment Model
ERDA	Energy, Research, and Development Administration
ESAL	Ecotoxicological Screening Action Level
ESH	Environment, Safety, & Health (LANL Division)
ESH-13	ESH Training Group
ESH-14	Quality Assurance Group
ESH-17	Air Quality Group
ESH-18	Water Quality & Hydrology Group
ESH-19	Hazardous & Solid Waste Group
ESH-20	Environmental Assessments & Resource Evaluations Group
EST	Ecological Studies Team (ESH-20)
FDA	Food and Drug Administration
FFCA	Federal Facilities Compliance Agreement
FFCAct	Federal Facilities Compliance Act
FFCAgreement	RCRA Federal Facility Compliance Agreement
FONSI	Finding of No Significant Impact
FY	fiscal year
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
GMP	Groundwater Monitoring Plan
GMPMPP	Groundwater Protection Management Program Plan
HAP	Hazardous Air Pollutant
HAZWOPER	hazardous waste operations training class
HE	high-explosive
HEPA	high-efficiency particulate air (filter)
HPGe	high purity germanium detector
HPIC	high pressure ion chamber
HPTL	High Pressure Tritium Laboratory
HSWA	Hazardous and Solid Waste Amendments
HWMR	Hazardous Waste Management Regulations (New Mexico)
HWTU	Hazardous Waste Treatment Unit
ICPMS	inductively coupled plasma mass spectrometry
ICPES	inductively coupled plasma emission spectroscopy
ICRP	International Commission on Radiological Protection

ISF	Infrastructure Support Facility
JCI	Johnson Controls, Inc.
JENV	JCI Environmental
KPA	kinetic phosphorimetric analysis
LAAO	Los Alamos Area Office
LAMPF	Los Alamos Meson Physics Facility (a.k.a. Clinton P. Anderson Meson Physics Facility - LANL building)
LAMPFNET	Los Alamos Meson Physics Facility network
LANL	Los Alamos National Laboratory (or the Laboratory)
LDR	land disposal restrictions
LET	linear energy transfer
LLW	low-level radioactive waste
LLMW	low-level mixed waste
LTRSL	long-term regional statistical reference level
MCL	maximum contaminant level
MDA	minimum detectable amount (activity)
MDA	material disposal area
MDL	minimum detection limit
MEI	maximum exposed individual
MIDAS	Meteorological Information Dispersion Assessment System
MOU	Memorandum of Understanding
MS	mass spectrometry
MWDF	Mixed Waste Disposal Facility
MWRSF	Mixed Waste Receiving and Storage Facility
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	no further action
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology (formerly National Bureau of Standards)
NMDA	New Mexico Department of Agriculture
NMED	New Mexico Environment Department
NMEIB	New Mexico Environmental Improvement Board
NMHWA	New Mexico Hazardous Waste Act
NMWQCA	New Mexico Water Quality Control Act
NMWQCC	New Mexico Water Quality Control Commission
NOD	Notice of Deficiency
NOI	Notice of Intent
NON	Notice of Noncompliance
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
OB/OD	open burning/open detonation
ODS	ozone depleting substance

O&G	oil and grease
OHL	Occupational Health Laboratory (LANL building)
ORSRL	overstory regional statistical reference level
OSHA	Occupational Safety and Health Act/Administration
OU	operable unit
PA	performance assessment
PAT	purge-and-trap gas chromatography/mass spectrometry
PCB	polychlorinated biphenyl
PDL	public dose limit
PHERMEX	Pulsed high-energy radiographic machine emitting x-rays
ppb	parts per billion
ppm	parts per million
P^3O	Pollution Prevention Program Office
PP	pollution prevention
PPOA	Pollution Prevention Opportunity Assessment
PRS	potential release site
PWA	Process Waste Assessment
QA	quality assurance
QAP	Quality Assurance Program
QAPP	Quality Assurance Program Plan
QC	quality control
RAS	Radiochemistry and Alpha Spectometry
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RD&D	research, development, and demonstration
RFA	RCRA facility assessment
RFI	RCRA facility investigation
ROD	Record of Decision
RPS	Radiation Protection Standard (now PDL)
RSRL	regional statistical reference level
SAL	screening action level
SARA	Superfund Amendments and Reauthorization Act
SCYLLA	LANL/Nevada Test Site Explosive Pulsed Power Experiment
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer (New Mexico)
SIC	Standard Industrial Classification
SIO	Stakeholder Involvement Office
SLD	Scientific Laboratory Division (New Mexico)
SOC	synthetic organic compound
SODAR	sound, distance, and ranging
SOP	standard operating procedure
SOP	stratospheric ozone protection
SPCC	Spill Prevention Control and Countermeasures
SR	state road
SRM	standard reference material

SVOC	semivolatile organic compound
SWAT	soil, water, and air testing
SWEIS	Site-Wide Environmental Impact Statement
SWPP	Storm Water Prevention Plan
SWDA	Solid Waste Disposal Act
SWMR	solid waste management regulations
SWMU	solid waste management unit
SWSC	Sanitary Wastewater Systems Consolidation
TA	Technical Area
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
THM	trihalomethane
TLD	thermoluminescent dosimeter
TLDNET	thermoluminescent dosimeter network
TRI	toxic chemical release inventory
TRU	transuranic waste
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSP	total suspended particles
TSS	total suspended solids
TU	tritium unit
TWISP	Transuranic Waste Inspectable Storage Project
UC	University of California
ULB	upper limit background
URSRL	understory regional statistical reference level
USGS	United States Geological Survey
UST	underground storage tank
UV	ultraviolet
VAC	Voluntary Corrective Action
VOC	volatile organic compound
WCTF	Weapons Component Testing Facility
WETF	Weapons Engineering Tritium Facility
WIPP	Waste Isolation Pilot Project
WL	working level
WLM	working level month
WM	Waste Minimization
WM	Waste Management
WSC	Waste Stream Characterization
WQCC	Water Quality Control Commission

Elemental and Chemical Nomenclature

Actinium	Ac
Aluminum	Al
Americium	Am
Argon	Ar
Antimony	Sb
Arsenic	As
Astatine	At
Barium	Ba
Berkelium	Bk
Beryllium	Be
Bicarbonate	HCO_3
Bismuth	Bi
Boron	B
Bromine	Br
Cadmium	Cd
Calcium	Ca
Californium	Cf
Carbon	C
Cerium	Ce
Cesium	Cs
Chlorine	Cl
Chromium	Cr
Cobalt	Co
Copper	Cu
Curium	Cm
Cyanide	CN
Carbonate	CO_3
Dysprosium	Dy
Einsteinium	Es
Erbium	Er
Europium	Eu
Fermium	Fm
Fluorine	F
Francium	Fr
Gadolinium	Gd
Gallium	Ga
Germanium	Ge
Gold	Au
Hafnium	Hf
Helium	He
Holmium	Ho
Hydrogen	H
Hydrogen oxide	H_2O
Indium	In
Iodine	I
Iridium	Ir
Iron	Fe
Krypton	Kr
Lanthanum	La
Lawrencium	Lr (Lw)
Lead	Pb
Lithium	Li
Lithium fluoride	LiF
Lutetium	Lu
Magnesium	Mg
Manganese	Mn
Mendelevium	Md
Mercury	Hg
Molybdenum	Mo
Neodymium	Nd
Neon	Ne
Neptunium	Np
Nickel	Ni
Niobium	Nb
Nitrate (as Nitrogen)	NO_3-N
Nitrite (as Nitrogen)	NO_2-N
Nitrogen	N
Nitrogen dioxide	NO_2
Nobelium	No
Osmium	Os
Oxygen	O
Palladium	Pd
Phosphaeus	P
Phosphate (as Phosphous)	PO_4-P
Platinum	Pt
Plutonium	Pu
Polonium	Po
Potassium	K
Praseodymium	Pr
Promethium	Pm
Protactinium	Pa
Radium	Ra
Radon	Rn
Rhenium	Re
Rhodium	Rh
Rubidium	Rb
Ruthenium	Ru
Samarium	Sm
Scandium	Sc
Selenium	Se
Silicon	Si
Silver	Ag
Sodium	Na
Stronium	Sr
Sulfate	SO_4
Sulfite	SO_3
Sulfur	S
Tantalum	Ta
Technetium	Tc
Tellurium	Te
Terbium	Tb
Thallium	Tl
Thorium	Th
Thulium	Tm
Tin	Sn
Titanium	Ti
Tritiated water	HTO
Tritium	^3H
Tungsten	W
Uranium	U
Vanadium	V
Xenon	Xe
Ytterbium	Yb
Yttrium	Y
Zinc	Zn
Zirconium	Zr

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