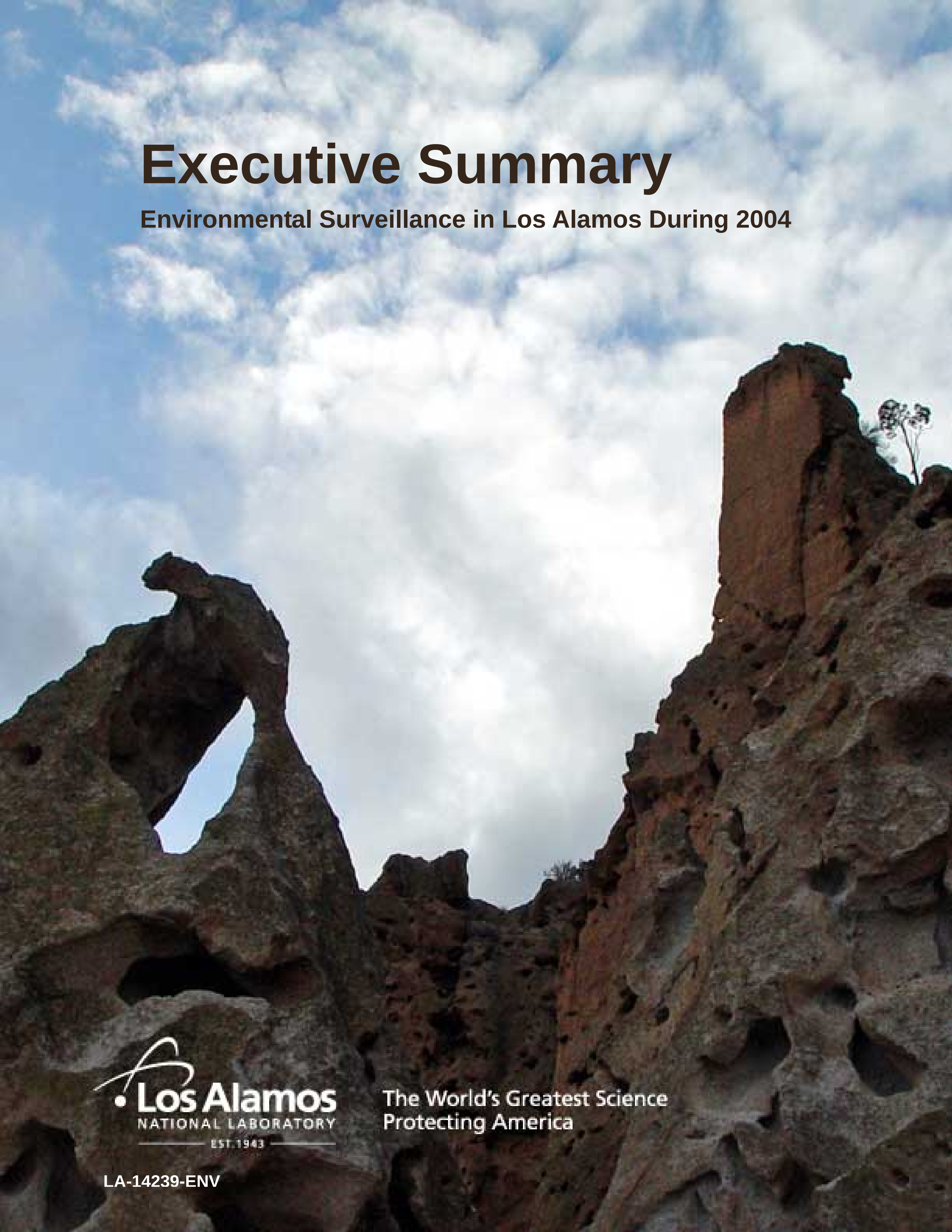
Executive Summary

Environmental Surveillance in Los Alamos During 2004



Los Alamos NATIONAL LABORATORY EST. 1943

The World's Greatest Science Protecting America

LA-14239-ENV

Executive Summary – 2004

The Los Alamos National Laboratory (LANL) is located in Los Alamos County, in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (Figure ES-1). The 40-square-mile Laboratory is situated on the Pajarito Plateau, which consists of a series of mesas separated by deep east-to-west-oriented canyons cut by streams. Mesa tops range in elevation from approximately 7,800 ft on the flanks of the Jemez Mountains to about 6,200 ft above the Rio Grande Canyon. Most Laboratory and community developments are confined to the mesa tops. With the exception of the towns of Los Alamos and White Rock, 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, the US Bureau of Land Management, the Bandelier National Monument, the US General Services Administration, and the Los Alamos County. In addition, Pueblo de San Ildefonso borders the Laboratory to the east.

The mission of LANL is to develop and apply science and technology to (1) ensure the safety and reliability of the US nuclear deterrent, (2) reduce the threat of weapons of mass destruction, proliferation, and terrorism, and (3) solve national problems in defense, energy, environment, and infrastructure. Meeting this diverse mission requires excellence in science and technology to solve multiple national and international challenges. Inseparable from the Laboratory's focus on excellence in science and technology is the commitment to environmental stewardship and compliance. Part of LANL's commitment is to report on environmental performance of the Laboratory. This report

- Characterizes site environmental management,
- Summarizes environmental occurrences and responses,
- Describes compliance with environmental standards and requirements, and
- Highlights significant programs and efforts.

One of the Laboratory's strategic goals is to improve efficiency with which we achieve regulatory compliance and manage risk to support operational excellence.

Environmental Management System

LANL is implementing an Environmental Management System (EMS) pursuant to Department of Energy (DOE) Order 450.1. This order defines an EMS as "a continuous cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental missions and goals." The EMS provides a systematic method for assessing mission activities, determining the environmental impacts of those activities, prioritizing improvements, and measuring results.

In April 2004, the Laboratory Director approved a new environmental policy for the Laboratory. The Laboratory developed a sitewide approach and framework for the EMS. In addition, each division is implementing the system within its organization and ensuring internal systems are appropriate and tailored to its specific functions. The EMS Core team is supporting divisions by facilitating meetings, providing standard procedures, tools, environmental subject matter expertise, and training as needed. The divisions are conducting initial evaluations of products, activities, and processes to determine if they have significant potential environmental impacts. This evaluation is being used to guide development of objectives, targets, action plans, and continuous improvement plans.

Federal Facility Compliance Agreement

During 2004, the Laboratory entered into an agreement with the Environmental Protection Agency (EPA) and the NM Environment Department (NMED) on the requirements of a Federal Facility Compliance Agreement. The agreement establishes a compliance plan for the regulation of storm water discharges from specific types of point sources at the Laboratory until such time as those sources are regulated by an individual storm water permit issued by EPA. In good faith, the Laboratory began implementing the intent of the Federal Facility Compliance Agreement in 2004 before the completion of negotiations.

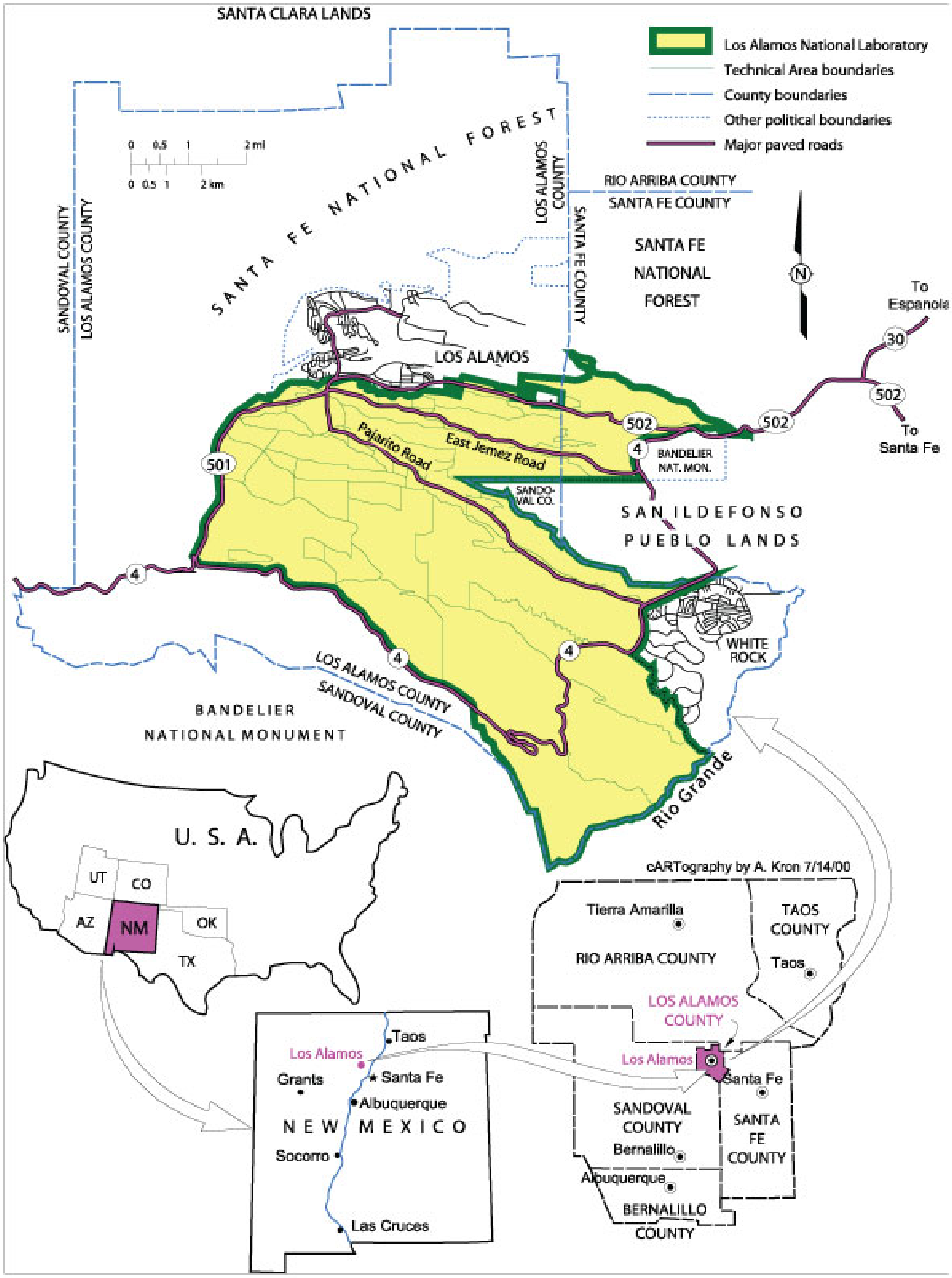
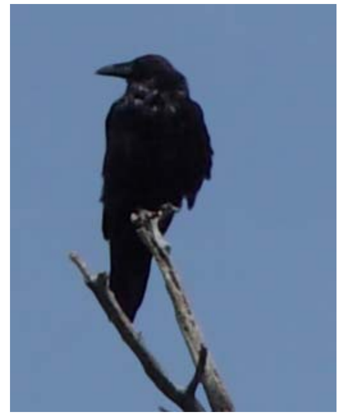


Figure ES-1. Regional location of Los Alamos National Laboratory.



Compliance Order on Consent (Consent Order)

A draft Compliance Order on Consent (Consent Order) was issued through the NMED in September 2004. The Laboratory continued to operate voluntarily in accordance with the November 26, 2002 Order and with the newly issued draft Consent Order. NMED, DOE, and University of California (UC) signed the final Consent Order on March 1, 2005. The Consent Order is the principal regulatory driver for the Laboratory's Environmental Remediation and Surveillance Program and replaces the corrective action requirements of the Hazardous and Solid Waste Amendments Module of the Laboratory's Hazardous Waste Facility Permit (Module VIII). The Consent Order contains requirements for investigation and cleanup of solid waste management units and areas of concern at the Laboratory. The major activities conducted by the Laboratory included investigations and cleanup actions. All of the Laboratory deliverables were submitted on time. In addition, several other plans and reports not required by the draft Consent Order schedules were submitted to NMED in calendar year 2004.

Improvement Targets

Improvement targets remain for the Laboratory and include continuing to improve Resource Conservation and Recovery Act (RCRA) compliance. While RCRA compliance improved in 2004, the NMED annual inspection identified four alleged violations in a Notice of Violation issued April 20, 2005. The Laboratory is improving processes, systems, and training to continue to reduce the number of possible violations in the future. The Laboratory made substantial progress in implementing an Environmental Management System that will require the identification and minimization of environmental impacts and waste sources. The Pollution Prevention Program continues to produce savings of several million dollars through recycling efforts, waste reduction, and support for sustainable design for the construction of new buildings. Though perchlorate is no longer discharged, the movement of perchlorate from past effluent discharges is being monitored to determine if it could pose a threat to water sources.

Design of Surveillance System and Sample Locations

LANL use a variety of materials to accomplish mission activities. Some materials are relatively benign, while other materials are hazardous or radioactive. Experiments and mission activities result in the release of some excess materials in the forms of air emissions, water discharges, and waste. These releases have the potential to affect many different receptors or components of the environment including humans, air quality, water quality, plants, and animals by one or many pathways such as by breathing in contaminants or coming into close proximity or contact with hazardous materials.

Monitoring (surveillance of) the complex activities and multiple receptors (people, air, water, plants, and animals) over a long time period requires a comprehensive monitoring plan and strategy. In addition, monitoring information has several uses including serving as a basis for policy and to identify actions to protect or improve the environment while accomplishing the mission effectively. Monitoring also contributes data needed to ensure and demonstrate compliance with regulations.

The Laboratory employs a tiered approach to monitor the environment and identify impacts from LANL operation. First, the Laboratory monitors the general region to establish a baseline of environmental conditions not influenced by LANL operations. Regional monitoring also demonstrates if LANL operations are impacting areas beyond the Laboratory's boundaries. Examples of regional monitoring include the radiological air-sampling network (AIRNET), and foodstuff and biota sampling locations. The second level of monitoring of the environment is at the LANL perimeter. This information helps determine if operations are impacting the general LANL property and neighboring property (e.g., pueblo and county lands). Perimeter monitoring can measure the highest potential impact to the public. The third level of monitoring is at specific project sites on LANL that are known or have the potential to result in emissions or discharges. Examples of locations with this type of monitoring include facility stacks for air emissions, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility, the Los Alamos Neutron Science Center (LANSCE), remediation sites where legacy waste is being managed, decontamination and decommissioning projects, Area G at TA-54 (where waste is being handled and stored), and water discharge locations (outfalls). This tiered approach also provides the data used to demonstrate compliance with applicable environmental laws and regulations.

Compliance

Laboratory compliance continues to improve. In addition, the Laboratory continues to reduce releases to the environment, waste generated, and water discharges.

The Laboratory uses the status of compliance with environmental requirements as a key indicator of performance. Federal and state regulations provide specific requirements and standards to implement these statutes and maintain environmental qualities. The EPA and the NMED are the principal administrative authorities for these laws. The Laboratory also is subject to DOE requirements for control of radionuclides. Table ES-1 presents a summary of the Laboratory's status in regard to environmental statutes and regulations.

Environmental Radiological Dose Assessment (see Chapter 3)

Humans, plants, and animals potentially receive radiation doses from various Laboratory operations (Table ES-2). The DOE dose limits are the mandated criteria that are used to determine whether a measurement represents a hazard. Figure ES-2 shows trends of doses to the maximally exposed individual (MEI) over the last 12 years at an off-site location. We calculated potential radiological doses to members of the public that resulted from LANL emissions and discharges. During 2004, the population within 80 km of LANL received a collective dose of 0.90 person-rem. The total off-site MEI dose was approximately 1.68 mrem. The dose received by an average Los Alamos residence from Laboratory operations totaled about 0.04 mrem. Similarly, the total dose to an average White Rock residence from Laboratory operations totaled about 0.03 mrem.

Annual radiation doses to the public are evaluated for: inhalation, ingestion, and direct (or external) radiation pathways. We calculate doses for

(1) population within 80 km of LANL

(2) the on-site MEI (on LANL property)

(3) residents of Los Alamos and White Rock

Biota Dose

Biota dose was estimated for sites where contaminants are present from past and current activities. The Material Disposal Areas (MDAs) are of particular interest because deep-rooted plants can penetrate pockets of contamination and transport it to the surface. MDAs A, B, C, T, and G all show signs that some plants have penetrated the radioactive material. The preliminary assessment indicates that the biota doses for plants and animals at LANL are below the DOE limits. The locations with the highest radionuclide concentrations resulted in doses less than 20% of the 100 mrad/day limit for terrestrial animals and less than 10% of the 100 mrad/day limit for terrestrial plants and aquatic animals.

Table ES-1. Environmental Statutes under which LANL Operates and Compliance Status in 2004

Federal Statute	What it Covers	Status
Resource Conservation and Recovery Act (RCRA)	Generation, management, and disposal of hazardous waste and cleanup of inactive, historical waste sites.	NMED conducted one 'wall-to-wall' RCRA hazardous waste compliance inspection in 2004. NMED identified 4 alleged violations, a 64% reduction from the 11 violations identified in 2003. The Laboratory completed 1,095 self-assessments that resulted in a nonconformance finding rate of less than 3.5%. The Laboratory (under the Environmental Remediation and Surveillance Program) continued to operate in accordance with requirements. Additionally, the Laboratory voluntarily operated in accordance with the November 26, 2002 Order containing corrective action requirements and later replaced by the September 1, 2004 draft Compliance Order on Consent (Consent Order), both issued through the NMED. The Laboratory is in compliance with groundwater monitoring requirements. Five groundwater characterization wells were completed in 2004.
Emergency Planning and Community Right-to-Know Act (EPCRA)	The public's right to know about chemicals released into the community.	The Laboratory reported releases, waste disposal, and waste transfers totaling 58,516 lb of lead, 665 lb of nitric acid, and 37,553 lb of nitrate compounds.
Clean Air Act (CAA)	Air quality and emissions into the air from facility operations	The Laboratory met all permit limits for emissions to the air. Non-radiological air emissions continued to be reduced in comparison to previous years. In addition, use of refrigerants continued to decline. The dose to the Maximum Exposed Individual (MEI) from LANL air emissions was 1.68 mrem, much less than the annual limit of 10 mrem. The Los Alamos Neutron Science Center (LANSCE) was the principal contributor to the dose. The Laboratory self-reported the removal of asbestos by a contractor without appropriate advance notification, resulting in NMED issuing a Notice of Violation.
Clean Water Act (CWA)	Water quality and effluent discharges from facility operations	Two of the 1283 samples collected from industrial outfalls exceeded effluent limits; we implemented additional analytical procedures when matrix interference is suspected. None of the 145 samples collected from the Sanitary Wastewater Systems Plant's outfall exceeded effluent limits. Changes in analytical procedures were made to prevent future exceedances. About 70% of the Laboratory's permitted construction sites were compliant with National Pollutant Discharge Elimination System (NPDES) requirements. Corrective actions for the noncompliant sites are scheduled for 2005. Additionally, the LANL engineering standards were updated to ensure compliance. The Laboratory is in compliance with groundwater monitoring requirements. Five groundwater characterization wells were completed in 2004. The new regional well R-33 in Mortandad Canyon shows no contamination from nitrate, perchlorate, and tritium based on initial analytical results. However, the intermediate wells show impacts of perchlorate and nitrate.
Toxic Substances Control Act (TSCA)	Chemicals such as PCBs	The Laboratory disposed of 1,964 kg of capacitors and 4,792 kg of fluorescent light ballasts in 171 containers at EPA-permitted treatment and disposal facility.

Table ES-1. Environmental Statutes under which LANL Operates and Compliance Status in 2004 (Cont.)

Federal Statute	What it Covers	Status
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Storage and use of pesticides	The Laboratory remained in compliance with regulatory requirements regarding use of pesticides and herbicides.
Endangered Species Act (ESA) & Migratory Bird Treaty Act (MBTA)	Rare species of plants and animals	The Laboratory maintained compliance with the ESA and MBTA. The Laboratory continued to monitor endangered species status.
National Historic Preservation Act (NHPA) and others	Cultural resources	The Laboratory maintained compliance with the NHPA. The laboratory continued to survey sites and buildings and consult with the pueblos.
National Environmental Policy Act (NEPA)	Projects evaluated for environmental impacts	The NEPA team completed 9 large environmental evaluations. No non-compliances were reported.

Table ES-2. Where are the Sources of Radiological Doses?

Pathway	Dose	Location	Trends
Air	1.52 mrem/yr	East Gate	None; remains well below regulatory limits
Direct irradiation	1.75 mrem/yr	TA-18 – onsite	None
	0.88 mrem/yr	San Ildefonso – offsite	
Food	<0.1 mrem/yr	All sites	None
Drinking water	<0.1 mrem/yr	All sites	None
Background	300 to 500 mrem/yr	All sites	N/A
Dose to terrestrial animals	<20 mrad/day	TA-15 EF site, TA-21 MDA B	None
Dose to aquatic animals	<85 mrad/day	TA-50 Effluent Canyon	None
Dose to terrestrial plants	<50 mrad/day	TA-21 MDA B	None

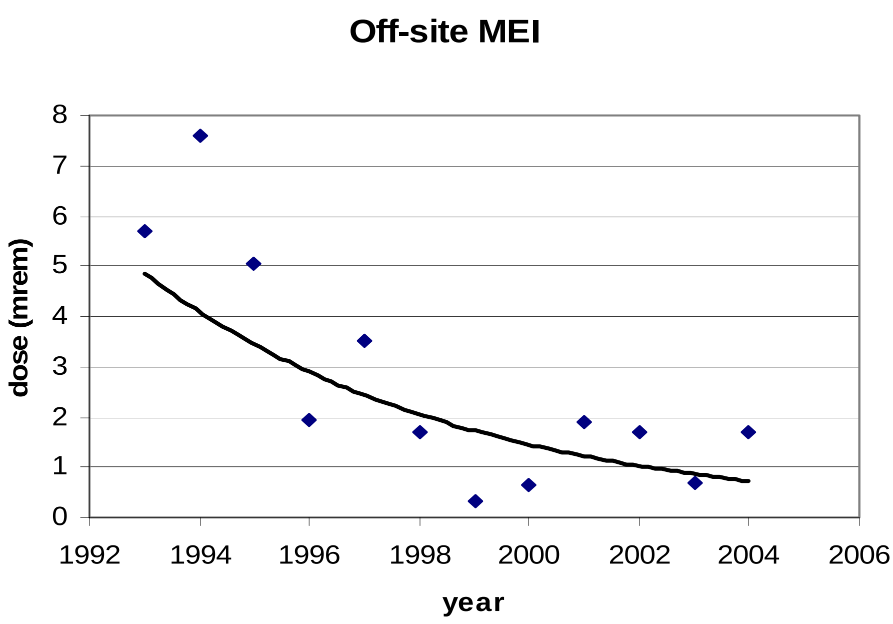


Figure ES-2. Trend of dose (mrem) to the maximally exposed individual off-site. Most years, this location is at East Gate, located along Highway 502 near the east end of the Los Alamos airport.

Air Emissions and Air Quality (see Chapter 4)

The Laboratory measures the emissions of radionuclides at the emission sources (building stacks). LANL categorizes its radioactive stack emissions into one of four types: (1) particulate matter, (2) vaporous activation products, (3) tritium, and (4) gaseous mixed activation products (GMAP). Similarly, the Laboratory takes air samples at general locations at LANL, at the perimeter, and regionally to estimate the extent and concentration of radionuclides that may be released from Laboratory operations. These radionuclides include plutonium, americium, uranium, and tritium.

- *Stack emissions were comparable with previous years.*
- *About 85% of radioactive air emissions were from LANSCE operations.*

Stack emissions were comparable to previous years and in most cases lower than previous years. LANL stack emissions during 2004 totaled approximately 5,230 Ci. Of this total, tritium emissions composed about 790 Ci, and air activation products from LANSCE stacks contributed nearly 4,440 Ci (85% of total emission). Combined airborne emissions of materials such as plutonium, uranium, americium, and thorium were less than 0.0001 Ci. Emissions of particulate/vapor activation products also were less than 1 Ci. Because of the close proximity of the LANSCE facility with the LANL site boundary, GMAP emissions from LANSCE remain the greatest source of off-site dose from the airborne pathway.

Radionuclide concentrations in 2004 from ambient air samples were generally comparable with concentrations in past years. Measurable concentrations of radionuclides were not detected at regional sampling locations. The highest annual mean radionuclide concentrations from air samples within LANL boundaries and at perimeter locations were well below 1% of the applicable EPA and DOE standards. Measurable amounts of tritium were found at most on-site locations and at perimeter locations; the highest concentrations of tritium were at TA-54 from waste emissions and at TA-21 related to decommissioning operations at a former tritium facility. The highest plutonium-238 concentration of 2.4 aCi/m^3 was from an on-site sample location at TA-54. One off-site perimeter sample location (Los Alamos Inn-South) had plutonium-239 concentrations averaging 20 aCi/m^3. This concentration was a result of resuspension of plutonium deposited during historical activities. Am-241 concentrations were highest at Area G. The maximum annual uranium concentrations were from natural uranium at locations with high dust levels from local soil disturbances such as dirt roads at the Los Alamos County Landfill and LANL's TA-54, Area G.

- *Measurable concentrations of radionuclides were not detected at regional sampling locations.*
- *The highest air concentrations on LANL and at perimeter locations were well below 1% of the applicable EPA and DOE guidelines.*

Air monitoring continued at one White Rock and two Los Alamos locations for particles with diameters of 10 micrometers (µm) or less (PM-10) and for particles with diameters of 2.5 µm or less (PM-2.5). The annual average for PM-10 was about 14 micrograms/m^3 and was 7 micrograms/m^3 for PM-2.5 at all locations. These averages are well below the EPA standards. In addition, the 24 hour maxima for both PM-2.5 and PM-10 at all three locations were much less than the EPA standards.

The Laboratory analyzed samples from 22 sites for beryllium. These sites are located near potential beryllium sources at LANL or in nearby communities. Previous results indicated that the source of beryllium in our AIRNET samples was naturally occurring beryllium in resuspended dust. Beryllium air concentrations for 2004 were similar to those measured in recent years. All values are equal to or less than 2% of the National Emission Standard for Hazardous Air Pollutants (NESHAP) standard.

- *PM-10 and PM-2.5 measures were well below EPA standards.*
- *Beryllium air concentrations for 2004 were similar to past years and were equal to or less than 2% of the NESHAP standard.*

Groundwater Monitoring (see Chapter 5)

Groundwater at the Laboratory occurs as a regional aquifer at depths ranging from 600 to 1,200 ft and as perched groundwater of limited thickness and horizontal extent, either in canyon alluvium or at intermediate depths of a few hundred feet (Figure ES-3). All water produced by the Los Alamos County water supply system comes from the regional aquifer and meets federal and state drinking water standards. No drinking water is supplied from the alluvial and intermediate groundwater sources.

Liquid effluent disposal is the primary means by which Laboratory contaminants have had a limited effect on the regional aquifer. Liquid effluent disposal at the Laboratory has significantly affected the quality of alluvial groundwater in some canyons. In some canyons, six decades of liquid effluent disposal by LANL have degraded groundwater quality in the alluvium. Because flow through the underlying approximately 900-ft-thick zone of unsaturated rock is slow, the impact of effluent disposal is seen to a lesser degree in intermediate-depth perched groundwater and is only seen in some wells within the regional aquifer. Table ES-3 summarizes contaminants found in portions of the groundwater system.

In general, groundwater quality is improving as

- *outfalls are eliminated,*
- *quantity of discharges are reduced, and*
- *water quality of the discharges improves.*

Drainages that in the past received liquid radioactive effluents include Mortandad Canyon, Pueblo Canyon from its tributary Acid Canyon, and Los Alamos Canyon from its tributary DP Canyon; only Mortandad currently receives such effluent.

Water Canyon and its tributary Cañon de Valle formerly received effluents produced by high explosives (HE) processing and experimentation. In past years, Los Alamos County has operated three sanitary treatment plants in Pueblo Canyon; currently only one plant is operating. The Laboratory also operated numerous sanitary treatment plants.

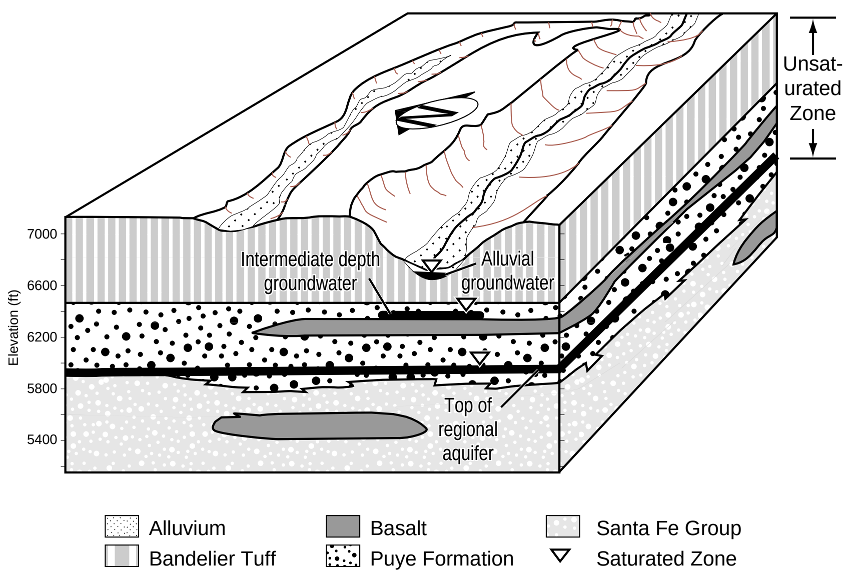


Figure ES-3. Illustration of geologic and hydrologic relationships in the Los Alamos area, showing the three modes of groundwater occurrence.

Table ES-3. Where Can We See LANL Impacts on Groundwater that Result in Values Near or Above Regulatory Standards or Risk Levels?

Chemical	On-Site	Off-Site	Significance	Trends
Tritium	Alluvial and intermediate groundwater in Mortandad Canyon	No	Not used as a drinking water supply	Activity decreasing as effluent quality improves
Other radionuclides	Alluvial groundwater in Mortandad Canyon	No	Not used as a drinking water supply; radionuclides have not penetrated to deeper groundwater	Some constituents are fixed in location; some are decreasing as effluent quality increases
Perchlorate	All groundwater zones in Mortandad Canyon, regional aquifer in Pueblo Canyon, alluvial groundwater in Cañon de Valle	Yes, in Pueblo Canyon	No established regulatory standard; values exceed EPA provisional risk level in all Mortandad Canyon groundwater zones; supply well with values below risk level is permanently off line	Decreasing in Mortandad Canyon alluvial groundwater as effluent quality improves; insufficient data for other groundwater
Nitrate	Intermediate groundwater in Mortandad Canyon, alluvial and intermediate groundwater in Pueblo Canyon	Yes, in Pueblo Canyon	Potential effect on drinking water, some above NM groundwater standards. In Pueblo Canyon, may be due to LA County's Bayo Sewage Treatment Plant	Insufficient data in Mortandad, values in Pueblo are variable
Molybdenum	Alluvial groundwater in Los Alamos Canyon	No	Not used as drinking water, limited in extent	Near NM GW limit for 10 years
Barium	Alluvial groundwater in Cañon de Valle	No	Not used as drinking water, limited in area	Insufficient data
High explosives	Alluvial and intermediate groundwater in Cañon de Valle	No	Limited in area, presence in regional aquifer uncertain	Insufficient data

[a] Shallow groundwater includes alluvial and intermediate groundwaters.

Naturally occurring uranium was the main radioactive element detected in the regional aquifer, springs, and wells throughout the Rio Grande Valley. Other naturally occurring radioactivity in groundwater samples comes from members of the uranium isotope decay chains, including isotopes of thorium and radium. Potassium-40 is also a source of natural radioactivity.

We compared radionuclide levels in all groundwater with drinking water and human health standards even though these standards only apply to drinking water sources. None of the radionuclide activities in perched alluvial groundwater were above the 100-mrem/yr DOE standard used to protect the public. For nonnatural radioactivity, only strontium-90 concentrations in alluvial groundwater from Mortandad and DP/Los Alamos canyons were near or exceeded the 4-mrem DOE derived concentration guide (which we use as a screening level) applicable to drinking water (Figure ES-4). The maximum strontium-90 values in

Mortandad and DP/Los Alamos Canyon alluvial groundwater were 7.6 and 4.6 times, respectively, the EPA drinking water standard. Total LANL-derived radioactivity exceeded the 4 mrem derived concentration guide in Mortandad Canyon alluvial groundwater samples.

The Radioactive Liquid Waste Treatment Facility, which discharges into Mortandad Canyon, has met all DOE radiological discharge standards for five consecutive years; has met all NPDES requirements for five consecutive years; and has met NM groundwater standards for fluoride, nitrate, and total dissolved solids for all but two weeks of the past five years.

During the last decade, the EPA has recognized the potential for perchlorate toxicity at concentrations in the ppb (µg/L) range. No EPA regulatory limit exists for perchlorate in drinking water, though several states have set limits in the range of 10 to 20 ppb, and California has a public health goal of 6 ppb. EPA Region VI has established a risk level of 3.7 ppb.

LANL and the NMED DOE Oversight Bureau have detected perchlorate in most groundwater samples analyzed from across northern New Mexico. The perchlorate concentrations in samples not affected by known contaminant sources range from about nondetect (<0.05 ppb) to 0.85 ppb. Water samples from most LANL locations show low perchlorate concentrations in this range, but samples taken downstream from inactive perchlorate release sites show higher values, that is above about 0.6 ppb. Figure ES-5 illustrates the perchlorate values found in alluvial groundwater downstream of the RLWTF discharge in Mortandad Canyon. Discharge of perchlorate from the plant effectively ceased in 2002 with installation of equipment designed to remove perchlorate from the effluent. As shown in Figure ES-5, the concentrations of perchlorate in groundwater and surface water have dropped since that time.

Watershed Monitoring (see Chapter 6)

Watersheds that drain the Laboratory are dry for most of the year. Of the 85 miles of watercourse, approximately 2 miles are naturally perennial, and approximately 3 miles are perennial waters created by effluent. No perennial surface water extends completely across the Laboratory in any canyon. Storm runoff occasionally extends across the Laboratory but is short-lived. Wildlife drink from the stream channels when water is present.

- *The overall quality of most surface water within the Los Alamos area is very good.*
- *Of the more than 100 analytes, most are within normal ranges or at concentrations far below regulatory standards or risk-based advisory levels.*
- *However, nearly every major watershed shows some effect from Laboratory operations.*

LANL activities have caused contamination of sediments in several canyons, mainly because of past industrial effluent discharges. These discharges and contaminated sediments also affect the quality of storm runoff, which carries much of this sediment for short periods of intense flow. In some cases, sediment contamination is present from Laboratory operations conducted more than 50 years ago. Table ES-4 shows the locations of LANL-impacted surface water and sediments. All radionuclide levels are well below protective guideline limits (Table ES-5).

Sediment radioactivity levels are above fallout background but substantially lower than screening action levels (SALs) in Los Alamos and Pueblo Canyons. Cesium-137 in Mortandad Canyon sediments is at elevated levels in an approximately 1.5-mile-long reach on-site and some samples exceed industrial site soil screening levels. Plutonium-239,240 in sediments extends off-site down Los Alamos Canyon into the Rio Grande, but levels remain well below the screening levels for unrestricted use of the land. Polychlorinated biphenyls (PCBs) are present in sediments in most watercourses that drain the Laboratory and are at concentrations below EPA industrial soil screening levels in Sandia Canyon sediments, where the highest levels occur. Channel sediments in Pueblo, Los Alamos, Sandia, and Mortandad Canyons contain polycyclic aromatic hydrocarbons (PAHs) of uncertain origin with maximum concentrations near or above applicable EPA soil screening levels. The overall pattern of radioactivity in channel sediments, such as along lower Los Alamos Canyon, has not greatly changed in 2004.

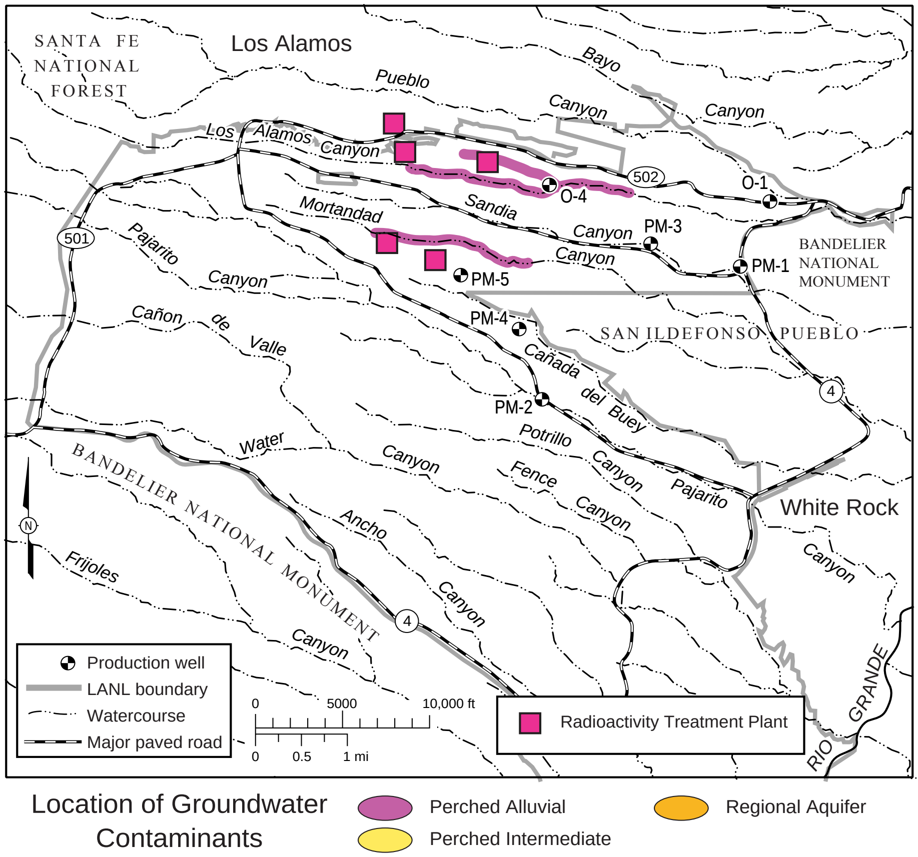


Figure ES-4. Location of groundwater contamination by strontium-90 above the 8 pCi/L EPA drinking water maximum contaminant limit. The extent of alluvial groundwater contamination lateral to the canyon is not to scale: contamination is confined to the alluvium within the canyon bottom and is narrow at the map scale.

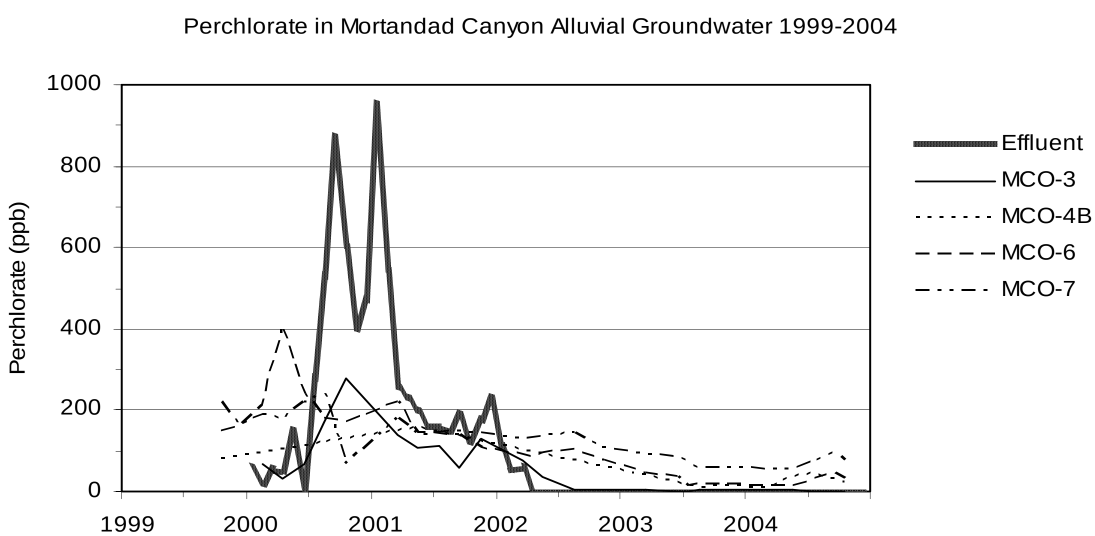


Figure ES-5. Perchlorate in Mortandad Canyon Alluvial Groundwater and RLWTF effluent, 1999–2004. Ion-exchange treatment was started in March 2002 to remove perchlorate to below 1 ppb.

Table ES-4. Where Can We See LANL Impacts on Surface Water and Sediments that Result in Values Near or Above Regulatory Standards or Risk Levels?

LANL Impact	On-Site	Off-Site	Significance	Trends
Radionuclides	Higher than background in sediments in Pueblo, DP, Los Alamos, Pajarito, and Mortandad canyons	Yes, in Los Alamos/ Pueblo canyons; slightly elevated in the Rio Grande and Cochiti Reservoir	Sediments below health concern except on-site along a short distance in Mortandad Canyon but exposure potential is limited	Increased transport in Pueblo Canyon in response to postfire flooding and increased urbanization
	Higher than background in runoff in Pueblo, DP, Los Alamos, and Mortandad canyons	Yes, in Los Alamos/ Pueblo Canyons	Minimal exposure potential because events are typically sporadic. Mortandad Canyon surface water 60% of DCG for year	Flows in Pueblo Canyon occurring more often after fire; flows in other LANL canyons recovered to near prefire levels
Polychlorinated biphenyls (PCBs)	Detected in sediment in nearly every canyon. Detected in Sandia Canyon runoff and base flow above NM stream standards	Yes, particularly in the Los Alamos/ Pueblo Canyons	Wildlife exposure potential in Sandia Canyon. Elsewhere findings include non-Laboratory and Laboratory sources	None
Dissolved copper	Detected in many canyons above NM acute standards	Yes, in Los Alamos Canyon	Origins uncertain, probably several sources	None
High-explosive residues and barium	Detections near or above screening values in Cañon de Valle base flow and runoff	No	Minimal potential for exposure	None
Benzo(a)pyrene	Detections near or above industrial screening levels in Los Alamos Canyon	Yes, in Los Alamos/Pueblo Canyons	Origins uncertain; probably multiple sources	None

Table ES-5. Estimated Annual Average Surface Water Concentrations of Radionuclides in Selected Canyons Compared with the DCGs[a] and BCGs[b].

	Estimated 2004 Average Concentration (pCi/L)					
Radionuclide	Lower Pueblo Canyon	DP Canyon below TA-21	LA Canyon between DP and SR-4	Mortandad Canyon below Effluent Canyon	Max Percent of DCG[a]	Max Percent of BCG[b]
H-3	0.7	64	14	12600	0.6	0.004
Sr-90	0.6	23	0.4	4	2	8
Cs-137	0.02	1	0.4	42	1	0.2
U-234	0.1	0.8	0.1	3	0.6	1
U-235,236	0.01	0.05	0.01	0.2	0.03	0.08
U-238	0.1	0.1	0.1	0.3	0.04	0.1
Pu-238	0.001	0.02	0.005	5	13	3
Pu-239,240	0.3	0.1	0.05	5	16	2
Am-241	0.01	0.2	0.07	8	27	2

[a] DCGs = 100-mrem Derived Concentration Guides for Public Exposures
[b] BCGs = Biota Concentration Guides

Radioactivity in surface water below current radioactive effluent discharges in Mortandad Canyon would result in only 60% of the 100-mrem/yr DOE limit for public exposure, but the water is not used as a drinking source and flows do not extend off-site (Figure ES-6). Samples of base flow (persistent surface waters) collected near the Laboratory or from the Rio Grande in 2004 met the New Mexico stream standards for livestock watering or wildlife habitat except for a PCB result from Sandia Canyon, which was greater than the wildlife habitat standard. A small number of the short-lived storm runoff events contained concentrations of some metals, gross alpha, and PCBs above the state stream standards or above background levels.

Soil Monitoring (see Chapter 7)

Soil acts as an integrating medium that can account for contaminants released to the environment. This year, we collected soil surface samples from two areas on Pueblo de San Ildefonso lands and additional samples at Area G and at DARHT. We had samples analyzed from these areas for radionuclides and heavy metals and then compared them with samples collected off-site from regional (background) areas located away from the Laboratory.

Radionuclide concentrations in soils from Pueblo de San Ildefonso were well below the concentration level that would result in exceeding the DOE dose limit of 100 mrem/yr. Radionuclide concentrations in most samples were either at a nondetect level or below the regional statistical reference level (RSRL). Non-radionuclide contaminant levels in most samples from Pueblo de San Ildefonso were at nondetect levels or below the RSRL. All samples were well below the screening level.

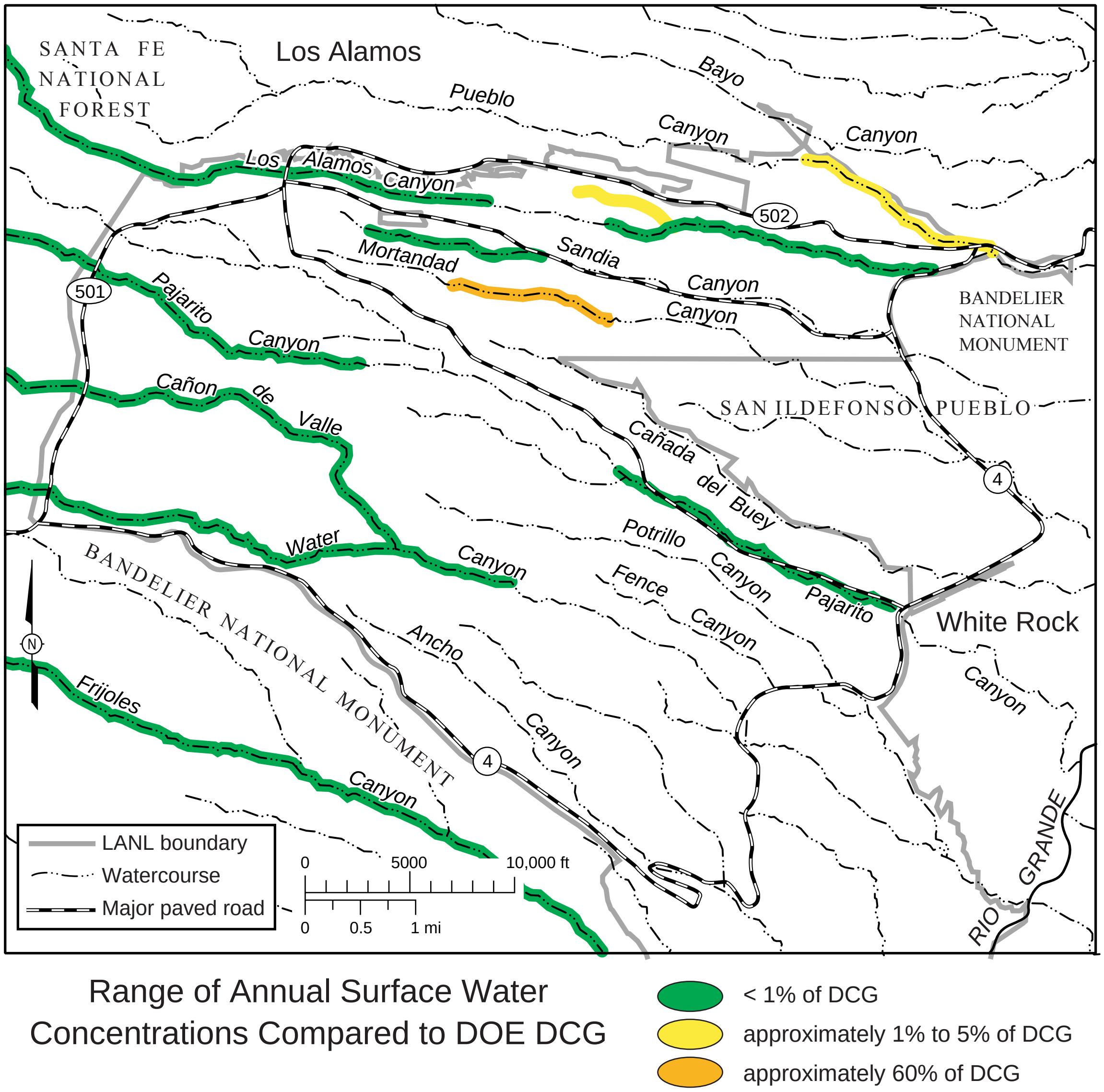


Figure ES-6. Annual average radioactivity in persistent surface waters compared with the DOE Derived Concentrations Guides (DGCs). The extent of contamination lateral to the canyon is not to scale: contamination is confined to the canyon bottom and is narrow at the map scale.

Foodstuffs and Nonfoodstuffs Biota Monitoring (see Chapter 8)

A wide variety of wild and domestic edible plant, fruit, and fish and animal products are harvested in the area surrounding the Laboratory. We collected foodstuff and nonfoodstuff biota within and near LANL property to determine whether they were impacted by Laboratory operations. Also, we collected nonfoodstuff biota at Area G, the Laboratory's principal low-level waste disposal area, and at the Laboratory's principal explosive test facility (DARHT). Concentrations, trends, and doses were assessed.

All radionuclides in domestic crop plants (vegetables and fruits) from all communities surrounding the Laboratory were indistinguishable from natural or fallout levels. Similarly, all trace element concentrations in vegetable and fruit samples collected were within or similar to the regional background levels and showed no increasing trends in concentrations.

Wild edible plants (oak acorns, wild spinach, and purslane) were sampled from Pueblo de San Ildefonso lands near the Laboratory boundary. Some radionuclides in these plants were at higher levels than natural or fallout levels; however, all were below levels that would result in a dose of 0.1 mrem for each pound of each consumed, which is 0.1% of the DOE dose limit of 100 mrem/yr.

All nonradionuclide contaminant concentrations, with the exception of barium, in these wild edible plants were either undetected or within the regional background levels. Barium concentrations were about three times higher than regional background concentrations reported for common produce plants. Bioaccumulation of barium by purslane plants is suspected to cause this elevated level.

No vegetation or small mammal samples were collected in 2004 from the overall site or the region. However, vegetation and small mammal samples were collected at TA-54 (Area G) and from TA-15 (DARHT). All radionuclide concentrations in vegetation were below a level that would result in 0.1 rad/day, which is 10% of the DOE dose limit of 1 rad/day for the protection of terrestrial plants. Radionuclide concentrations in small mammals varied; however, all concentrations would result in doses well below 10% of the DOE identified levels for biota.

- *All radionuclides in all crop plant samples were indistinguishable from natural or fallout levels.*
- *All radionuclide concentrations in wild edible plants were below levels that would result in a dose of 0.1 mrem per year per pound consumed (0.1% of the DOE dose limit of 100 mrem).*

PCB congener concentrations were measured in stationary semi-permeable membrane devices from the Rio Grande at two locations above LANL and three locations below LANL in 2002 and 2003. Semi-permeable membrane devices consist of a polyethylene membrane and triolein lipid, both of which mimic the accumulation of PCBs and other dissolved organic contaminants by fish. Results showed only a small amount of similarity between the type of aroclors indicated in the Rio Grande below LANL and aroclors known to exist at LANL. For the particular time periods studied, it was concluded that LANL was not likely contributing PCBs to the Rio Grande as indicated by the statistically similar total PCBs between the two stations above LANL and the station immediately below LANL.