Environmental Surveillance at Los Alamos during 2007

Executive Summary

Los Alamos NATIONAL LABORATORY EST. 1943

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Executive Summary

The Los Alamos National Laboratory (LANL or the Laboratory) is located in Los Alamos County, in north-central New Mexico (NM), 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, a series of mesas separated by deep east-to-west-oriented canyons cut by stream channels. 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 at White Rock Canyon. Most Laboratory and Los Alamos County 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 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 global threats, and (3) solve other emerging national security challenges. 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 full compliance with environmental protection laws. Part of LANL's commitment is to report on its environmental performance. This report

- characterizes LANL's environmental management,
- summarizes environmental occurrences and responses,
- describes compliance with environmental standards and requirements, and
- highlights significant programs and efforts.

ENVIRONMENTAL MANAGEMENT SYSTEM

As part of its commitment to protect the environment and improve its environmental performance, LANL implemented an Environmental Management System (EMS) pursuant to US Department of Energy (DOE) Order 450.1 and the international standard (ISO) 14000-2004. DOE 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 2006, LANL became the first National Nuclear Security Administration (NNSA) national laboratory and the first University of California-operated facility to receive full certification.

- ***Additional certification audits in 2007 by an independent registrar concluded that the Laboratory's environmental management system continues to meet all requirements for full certification to the international standard.***
- ***NNSA again recognized the success of the EMS management by giving the Laboratory the 2007 NNSA "Environmental Stewardship" Award for EMS-developed projects.***

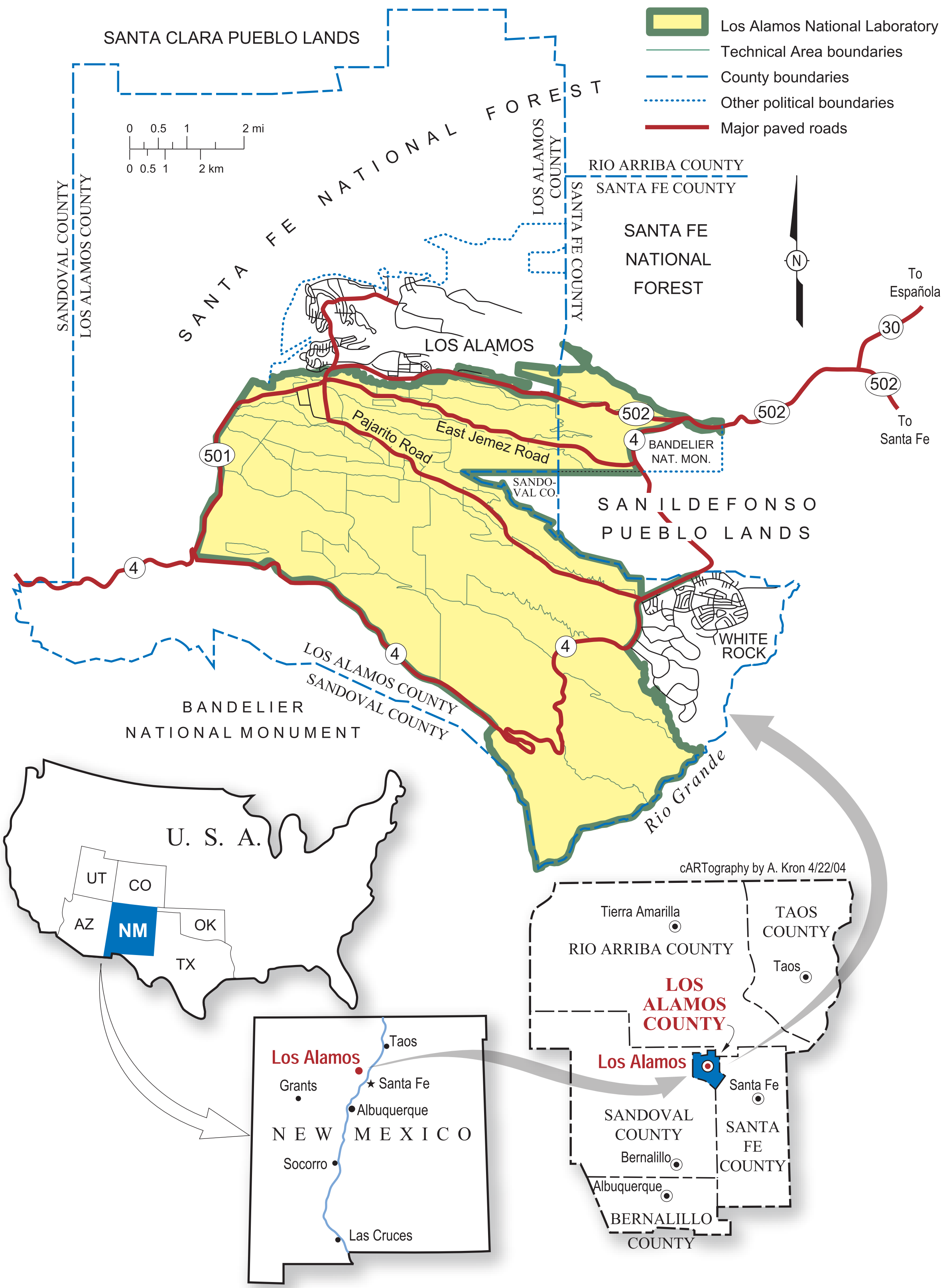

Figure ES-1. Regional location of Los Alamos National Laboratory.

During 2007, the EMS was audited two times by the same independent third-party ISO 14001 auditor who conducted three audits in 2006. The auditors concluded that the LANL EMS continues to meet all the requirements of the ISO 14001-2004 standard with no major non-conformities and recommended that LANL maintain full certification. NNSA recognized the success of the EMS management and the unique approach by giving the Laboratory the 2007 NNSA "Environmental Stewardship" Award for EMS-developed projects.

Federal Facility Compliance Agreement

During 2007, the DOE and the Laboratory continued to work under the requirements of a Federal Facility Compliance Agreement (FFCA) with the US Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED). The agreement establishes a compliance plan for the regulation of storm water point source discharges from solid waste management units (SWMUs) and areas of concern at the Laboratory; the agreement will remain in effect until those sources are regulated by an individual storm water permit issued by EPA.

Compliance Order on Consent

The March 2005 Compliance Order on Consent (the Consent Order) between LANL, DOE, and the NMED is the principal regulatory driver for LANL's environmental restoration programs including the Water Stewardship Program. The Consent Order contains requirements for investigation and cleanup of SWMUs and areas of concern at the Laboratory. The major activities conducted by the Laboratory included investigations and cleanup actions. All major deliverables of the Consent Order were met by the Laboratory during 2007. In June 2007, the NMED Hazardous Waste Bureau issued a Notice of Violation (NOV) to DOE and LANL for failing to complete the sampling of all wells within the Water Canyon watershed within 21 days of the start of a groundwater sampling event. LANL made changes to the methods for notifying organizations that must allow access and reassigned responsibility for coordinating and tracking sample scheduling. NMED determined that the proposed corrective actions should help ensure future compliance. A second NOV was issued in August by NMED's Hazardous Waste Bureau for two alleged violations noted during the 2006 Resource Conservation and Recovery Act (RCRA) compliance inspection. LANL made penalty payments to settle this NOV and two previous NOVs issued in 2006.

- ***The Consent Order is the principal regulatory driver for the Laboratory's environmental restoration activities and the Water Stewardship Program. It specifies actions that the Laboratory must complete to characterize contaminated sites and monitor the movement of contaminants.***
- ***The Laboratory met all major deliverables of the Consent Order.***
- ***The NMED issued two Notices of Violation to LANL and DOE related to the Consent Order for failure to complete a watershed sampling within the required 21 days and for hazardous waste storage violations.***

Improvement Targets

Improvement goals for the Laboratory include continuing to improve RCRA compliance. The Laboratory's RCRA non-compliance rate increased by 0.69% to 3.71% in 2007. The Laboratory continues to improve its processes, systems, and training to reduce the number of violations in the future. Under its new EMS, the Laboratory must identify and minimize environmental impacts and waste sources. Chromium discharged from a cooling tower in the 1960s through 1972 was discovered in the regional aquifer in early 2006, and LANL has installed monitoring wells to evaluate the extent of contamination. Though perchlorate and high explosives residues are no longer discharged, their movement from past effluent discharges is being monitored to determine if they could pose a threat to drinking water sources.

Design of Surveillance System and Sample Locations

To achieve its mission activities, LANL uses a variety of materials, some of which are hazardous or radioactive. Experiments and mission activities result in air emissions, water discharges, and waste generation. These emissions and discharges have the potential to affect different receptors or components of the environment including people, air, water, soil, foodstuffs, plants, and animals by one or more pathways such as inhalation of or contact with hazardous materials.

The Laboratory uses data from monitoring (surveillance) of known release points and multiple receptors (people, air, water, soil, foodstuffs, plants, and animals) over a long time period as a basis for policy and to determine actions to protect the environment. We collect data from the surrounding region to establish baseline environmental conditions not influenced by LANL operations. Regional monitoring also indicates whether LANL operations are impacting areas beyond LANL's boundaries. Examples of regional monitoring include the radiological ambient air sampling network (AIRNET) and foodstuffs and biota (plants and animals) sampling. We also collect data at the Laboratory perimeter to determine if operations are impacting LANL or neighboring properties (e.g., Pueblo and County lands). Perimeter monitoring also measures the highest potential impact to the public. To better quantify releases, we monitor at specific discharge or release points or other locations on LANL property that are known to or have the potential to release contaminants. Examples of locations with this type of monitoring include facility stacks, 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 Technical Area (TA-) 54 (where waste is being handled and stored), and water discharge locations (outfalls). We use these data to demonstrate compliance with applicable environmental laws and regulations. During 2007, the Laboratory collected more than 8,000 environmental monitoring samples from more than 940 locations and requested about 162,000 analyses or measurements on these samples.

Risk Reduction

Risk is evaluated either as current (present-day) or prospective (future) risk. The Laboratory assesses hazards and the corresponding risks by evaluating environmental data, measurements, inventories of buried or stored materials, and potential exposure pathways and scenarios. We use models, data, and computer programs to assist with these estimates.

Over the years, the Laboratory has decreased its release of materials into the environment and has reduced the amount of legacy contamination. Examples include the reduction in both the number of outfalls (plant and process discharges) and the volume of water released, the reduction in air emissions, changes to effluent treatment processes at the Radioactive Liquid Waste Treatment Facility at TA-50, and the removal of contaminated material and waste at sites such as Material Disposal Area (MDA) P. These efforts have significantly reduced or eliminated potential exposure and risk to workers, the public, and the environment.

Examples of ongoing risk reduction activities include the transport of stored legacy transuranic waste from Area G to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, NM; the planned cleanup and remediation of the former plutonium processing facility at TA-21; ongoing studies of groundwater contamination to evaluate future hazards and risks; and numerous investigations and corrective actions at potentially contaminated sites.

- ***Past risk reduction successes include the reduction in the number of outfalls (plant and process discharges) and the volume of water released from them, the reduction in air emissions over the past several years, changes to effluent treatment processes at the Radioactive Liquid Waste Treatment Facility at Technical Area 50, and the removal of contaminated material and waste at former waste disposal sites.***
- ***Ongoing risk reduction efforts include the transport of waste from Area G to permanent disposal at WIPP, studies of the movement of contaminants in groundwater, and planned or active cleanup operations at former waste and radionuclide processing sites.***
- ***The environmental surveillance programs can detect very low levels of potential contaminants and thus help determine whether a new hazard is present and evaluate the associated level of risk.***

The sensitivity of measurements obtained by LANL's environmental surveillance program allows detection of hazardous and radioactive materials and other contaminants during cleanup or normal operations at locations near and remote. All major pathways to people and the environment are monitored. The data from monitoring can be used to assist with possible mitigation of impacts. Air monitoring by the AIRNET system has regularly detected airborne contaminants where both known and unexpected contamination is present on the surface; in many cases, remediation was initiated to remove the source, though levels have never approached regulatory limits. The AIRNET system can detect low levels of radionuclides that are dispersed during cleanup operations, and many additional samplers have been added in anticipation of upcoming cleanup operations. The Direct Penetrating Radiation network detects neutrons and gamma rays from the stored waste at Area G and is used to help keep radiation levels as low as reasonably achievable. Biota and foodstuffs monitoring is conducted to ensure there is no spread of contamination into plants, animals, and food. The monitoring of constituents in groundwater keeps track of the movement of previously-released contaminants and their potential migration in the aquifers.

Compliance

The Laboratory uses the status of compliance with environmental requirements as a key indicator of its environmental performance. Federal and state regulations provide specific requirements and standards to implement these statutes and maintain environmental quality. 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.

Table ES-1
Environmental Statutes under which LANL Operates and Compliance Status in 2007

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	The Laboratory completed 1,939 self-assessments that resulted in a non-conformance finding rate of 3.71%. The Consent Order replaces Module VIII of the Hazardous Waste Facility Permit. All deliverables required by the Consent Order were submitted to NMED on time. NMED issued a Notice of Violation (NOV) to DOE and LANL that alleged for failing to complete the sampling of all monitoring wells in a single watershed within 21 days of the start of a groundwater sampling event. LANL submitted a proposed corrective action and NMED determined no further action was required. The NMED issued a second NOV regarding storage of hazardous waste. The Laboratory is in compliance with groundwater monitoring requirements. Two regional aquifer wells were installed in Sandia Canyon in 2007.
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 were lower than the previous year for nitrogen oxides, carbon monoxide, and particulate matter and similar to the previous year for volatile organic compounds and particulate matter. A smoke opacity deviation 5% greater than permit limits occurred briefly at the power plant. The dose to the maximally exposed individual (MEI) from radioactive air emissions was 0.52 mrem, which is similar to the very low dose for the previous year.
Clean Water Act (CWA)	Water quality and effluent discharges from facility operations	Only three of 1408 samples collected from industrial outfalls and none of the 130 samples collected from the Sanitary Wastewater Systems Plant's outfall exceeded effluent limits.

Table ES-1 (continued)

Federal Statute	What it Covers	Status
CWA (continued)	Water quality and effluent discharges from facility operations	The Laboratory conducted 542 storm water inspections and 99% of the Laboratory's 51 permitted construction sites were compliant with National Pollutant Discharge Elimination System (NPDES) requirements contained in construction site storm water pollution prevention plans. Thirteen precipitation gauges were installed across the Lab to ensure refined data are used to trigger storm water inspections. The Laboratory continued to implement 15 Storm Water Pollution Prevention Plans covering 26 industrial facilities and site-wide SWMUs. This included sampling of storm water discharges from industrial activities and installing and maintaining Best Management Practices to manage pollutants and runoff at these locations.
Aboveground storage tank compliance program	Liquid storage tank monitoring and compliance	Four tank systems at LANSCE (TA-53) and three in TA-3 were closed out with NMED in 2007 leaving a total of 20 regulated tanks. LANL performed additional characterization of the 2002 diesel release from a tank at TA-21 and completed initial characterization of the diesel-contaminated soil near a tank at the TA-3 power plant. The Laboratory paid annual registration fees of $100 per tank to the NMED.
Toxic Substances Control Act (TSCA)	Chemicals such as polychlorinated biphenyls (PCBs)	The Laboratory shipped 46 containers of PCB waste, 60 lbs of capacitors, and 2,795 lbs of fluorescent light ballasts for disposal or recycling in compliance with all manifesting, record keeping, and disposal requirements.
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. The Laboratory used 620 oz of insecticides and 185.5 gal. plus 12 lbs of herbicides.
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 10,883 lbs of lead and 557 lbs of nitric acid. No updates to Emergency Planning Notifications were necessary in 2007. Chemical Inventory Reports were updated to the Los Alamos County fire and police departments for 36 chemicals or explosives.
Endangered Species Act (ESA) & Migratory Bird Treaty Act (MBTA)	Rare species of plants and animals	The Laboratory maintained compliance with the ESA and MBTA and reviewed 636 excavation permits and 107 project profiles for potential impacts to threatened or endangered species. The Laboratory conducted annual surveys for Mexican spotted owl, Southwestern willow flycatcher, Jemez Mountain salamander and grey vireo. LANL prepared biological assessments for one project regarding potential impacts on federally listed threatened or endangered species.
National Historic Preservation Act (NHPA) and others	Cultural resources	The Laboratory maintained compliance with the NHPA. Laboratory conducted 32 projects that required some field verification of previous survey information and identified four new archaeological sites and no new historic buildings. Fifteen archaeological sites were determined eligible for the National Register of Historic Places.
National Environmental Policy Act (NEPA)	Projects evaluated for environmental impacts	During 2007, the Laboratory and NNSA incorporated public comments into the final Site-Wide Environmental Impact Statement for continued operation of LANL. The document was released in early 2008 for a final decision in late 2008 on one of three alternatives.

Unplanned Releases

There were no unplanned airborne releases from LANL in 2007. There were no unplanned releases of radioactive liquids. There were 17 spills or releases of potable water, fire suppression water, or domestic wastewater and one spill of a quart of motor oil into a storm drain. All liquid releases were reported to NMED and will be administratively closed upon final inspection. A smoke opacity deviation of 25% (just above the permit limit of 20%) was observed for a very short time at the power plant at TA-3.

Radiological Dose Assessment

Humans, plants, and animals potentially receive radiation doses from various Laboratory operations (Table ES-2). The DOE dose limits for the public and biota are the mandated criteria that are used to determine whether a measurement represents a potential exposure concern. Figure ES-2 shows doses to the hypothetical maximally exposed individual (MEI) via the air pathway over the last 13 years at an off-site location; this location was East Gate through 2005 but was at the Los Alamos County Airport terminal for 2006 and at a location along DP Road in 2007. The annual dose to the MEI was approximately 0.52 mrem, compared to 0.47 mrem in 2006 and a regulatory limit of 10 mrem (Figure ES-2). Contributing to the low dose at this location was disturbed soil from road grading as part of preparations for a cleanup activity at a material disposal area adjacent to DP Road. The Laboratory calculated potential radiological doses to members of the public from LANL emissions and discharges. During 2007, the population within 80 km of LANL received a collective dose of about 0.36 person-rem, down from 0.6 person-rem in 2006 and a substantial decrease from the dose of 2.46 person-rem reported for 2005. The doses received in 2007 from LANL operations by an average Los Alamos residence and an average White Rock residence totaled about 0.022 mrem and 0.024 mrem, respectively. Direct radiation from waste stored at TA-54, Area G could result in an exposure to an individual in the adjacent sacred area of Pueblo de San Ildefonso of 0.8 mrem per year.

- ***Radiation dose to the hypothetical maximally exposed individual (MEI) was slightly lower than the very low level measured in 2006 and is partly attributable to the additional emission control system added in late 2005.***
- ***The MEI location was determined to be along DP Road in eastern Los Alamos. This location received a combination of low levels of radiation from stack emissions and low levels of contamination from road grading next to a former material disposal area.***

Table ES-2
What are the Sources of Radiological Doses?

Source	Recipient	Dose	Location	Trends
Background (includes man-made sources)	Humans	~470 mrem/yr	All sites	Not applicable
Air	Humans	0.52 mrem/yr	Along DP Road in Los Alamos	Similar to very low level in previous year
Direct irradiation	Humans	0.8 mrem/yr	San Ildefonso – offsite	Lower than previous year
Food	Humans	<0.1 mrem/yr	All sites	Steady
Drinking water	Humans	<0.1 mrem/yr	All sites	Steady
All	Terrestrial animals	<20 mrad/day	TA-15 “EF site”, TA-21 material disposal area (MDA) B	Steady
All	Terrestrial plants	<50 mrad/day	TA-21 MDA B	Steady

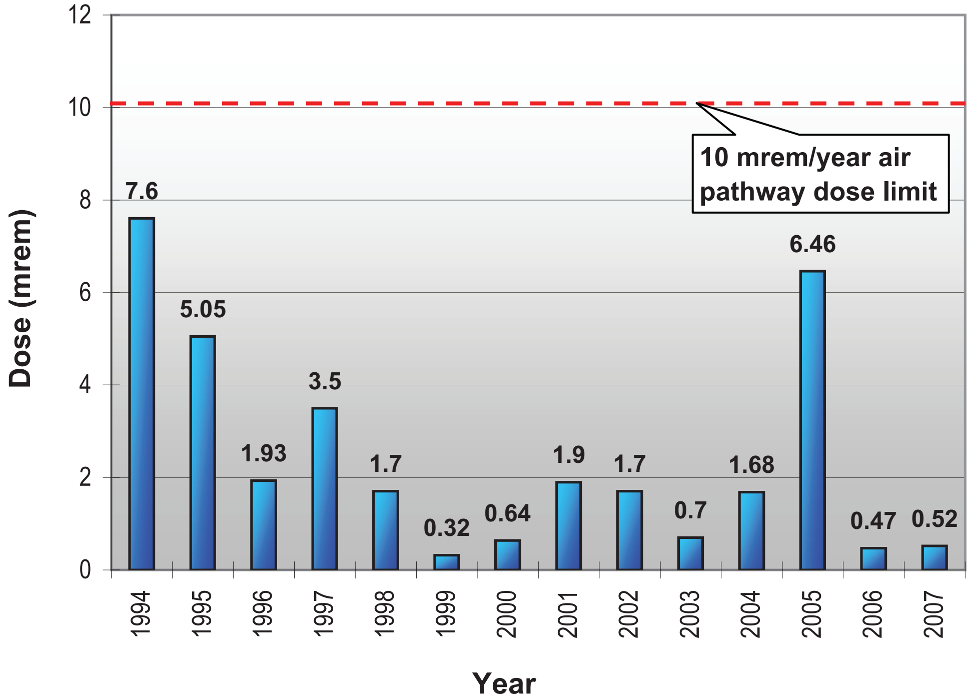

Figure ES-2. **Annual airborne pathway dose (mrem) to the off-site MEI over the past 14 years. The location of the calculated MEI changed to a location other than East Gate, in this case to a location along DP Road in the eastern part of Los Alamos.**

Biota Dose

The DOE biota dose limits are intended to protect populations of plants and animals, especially with respect to preventing the impairment of reproductive capability within the biota population. All radionuclide concentrations in vegetation sampled were far below the plant 0.1 rad/day biota dose screening level (10% of 1 rad/day dose limit), and all radionuclide concentrations in terrestrial animals sampled were far below the terrestrial animal 0.01 rad/day biota dose screening level (10% of 0.1 rad/day dose limit) (Table ES-2). Two storm runoff samples contained slightly elevated uranium levels and triggered an evaluation of biota doses. The locations of these samples, near TA-15 firing sites, do not contain aquatic habitats; nevertheless, the most conservative (worst case) assumptions result in potential doses of up to 0.5 mrad/day to terrestrial animals and 0.1 mrad/day to terrestrial plants, both of which are less than 1% of the DOE biota dose limits.

Air Emissions and Air Quality

The Laboratory measures the emissions of radionuclides at the emission sources (building stacks) and categorizes these radioactive stack emissions into one of four types: (1) particulate matter, (2) vaporous activation products (radioactive elements created by the LANSCE particle accelerator beam), (3) tritium, and (4) air activation products. Similarly, the Laboratory collects air samples at general locations within LANL boundaries, at the LANL perimeter, and regionally to estimate the extent and concentration of radionuclides that may be released from Laboratory operations. These radionuclides include isotopes of plutonium, americium, uranium, and tritium.

- ***Emissions from the stacks at LANSCE, normally the source of most radionuclide emissions, remained very low in 2007.***
- ***Emissions of radionuclides from other Laboratory stacks were comparable to previous years.***

Gaseous activated air product emissions from the LANSCE stack were the lowest since 1999. Emissions from all other stacks were comparable to previous years or slightly lower. Total stack emissions during 2007 were approximately 477 curies (Ci), a drop of 60% compared to 2006 levels. Diffuse emissions from the LANSCE facility and other smaller sources contributed another 83 Ci. Of the total, tritium emissions composed about 260 Ci (70% less than 2006) and short-lived air activation products from LANSCE stacks and diffuse emissions contributed 301 Ci (45% less than in 2006). Most of the curies from LANSCE are from very short-lived radionuclides that decay significantly before reaching the location of the MEI; these gasses also have a very low dose impact to a human. Combined airborne emissions of other radionuclides, such as plutonium, uranium, americium, and thorium, were less than 0.000012 Ci (about 67% less) and emissions of particulate/vapor activation products decreased by about two orders of magnitude from 2006 to 0.016 Ci.

- ***Measurable concentrations of radionuclides in ambient air were not detected at regional sampling locations nor at most perimeter locations.***
- ***The highest mean air concentrations at perimeter locations were below 1% of the applicable EPA limits.***

Radionuclide concentrations from ambient air samples in 2007 were generally comparable with concentrations in past years. As in past years, the AIRNET system detected contamination from known areas of contamination below the Ashley Hotel and Suites (formerly Los Alamos Inn), at the Laboratory's waste disposal site at Area G, and from the former plutonium processing site at TA-21. No new or increased airborne radioactivity was detected. At regional locations away from Los Alamos, all air sample measurements were consistent with background levels. Annual mean radionuclide concentrations at all LANL perimeter stations were less than 1% of the EPA dose limit for the public. Measurable amounts of tritium were reported at most on-site locations and at perimeter locations; the highest concentrations were measured at the Area G waste site in TA-54 after a decommissioned tank from TA-21 was moved to Area G. The tank was subsequently moved to the tritium shafts at Area G and tritium levels declined. The highest off-site tritium concentration (measured at station #75 along DP Road) was 3.7 pCi/m^3 (0.25% of the EPA public dose limit of 1,500 pCi/m^3). The highest on-site tritium measurement (0.001% of the DOE limit for workers) was made at Area G near a pit containing tritium-contaminated waste. Plutonium-238 was detected at two LANL perimeter stations: near the Ashley Hotel and Suites (formerly Los Alamos Inn) at about 19 aCi/m^3 or about 1% of the EPA public dose limit (from historical activities at LANL's old main technical area), and at very low levels near MDA B where soil disturbance from road construction occurred in preparation for remediation of the MDA.

On-site detections of plutonium occurred at Area G (an area with known low levels of contamination) and levels were substantially below 0.005% of the DOE limit for workplace exposure. Americium-241 was detected near Area G at levels less than 0.001% of worker exposure limits and at eight off-site locations at levels less than 0.5% of public exposure limits. The maximum annual uranium concentrations were from natural uranium at locations with high dust levels from local soil disturbances. The regional and pueblo samples had higher average concentrations of natural uranium isotopes than the perimeter group. Depleted uranium (which has lower radioactivity than natural uranium) was detected in seven samples from areas around LANL firing sites where depleted uranium was used in the past. Enriched uranium was not detected during 2007. Uranium concentrations have been generally declining since the Cerro Grande fire in 2000.

- ***As in previous years, PM-10 and PM-2.5 particulate measurements in ambient air were well below EPA standards.***
- ***Most of the dust measured by the PM-10 and PM-2.5 samplers is from natural sources such as dust and wildfire smoke.***

Air monitoring 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) continued at one White Rock and two Los Alamos locations. The annual averages at all locations for PM-10 was about 14 micrograms (µg)/m^3 and about 8 µg/m^3 for PM-2.5 and were mostly caused by natural dust and wildfire smoke. These averages are each only 1 µg greater than measured in 2006 and are 28% and 53% of the EPA standards, respectively. In addition, the 24-hour maxima for both PM-10 and PM-2.5 at all three locations never exceeded 44% and 30% of the respective EPA standards.

The Laboratory analyzed filter samples from 23 sites for beryllium. These sites are located near potential beryllium sources at LANL or in nearby communities. Beryllium air concentrations for 2007 were similar to those measured in recent years and are equal to or less than 1% of the National Emission Standard for Hazardous Air Pollutants (NESHAP) standard. Past studies correlated beryllium concentrations with aluminum concentrations, which indicate that all measurements of beryllium are from naturally occurring beryllium in resuspended dust.

Groundwater Monitoring

- ***In general, groundwater quality at LANL continues to improve as a result of past efforts that have eliminated outfalls, reduced the quantity of discharges, and improved the quality of discharges.***
- ***Contamination may be discovered in additional locations, however, as groundwater characterization continues.***

Groundwater at the Laboratory occurs as a regional aquifer (water-bearing rock capable of yielding significant quantities of water to wells and springs) 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.

Laboratory contaminants have affected deep groundwater, including intermediate perched zones and the regional aquifer, primarily through liquid effluent disposal. Since the early 1990s, the Laboratory has significantly reduced both the number of industrial outfalls (from 141 to 17 active) and the volume of water released (by more than 86%). For 1993 to 1997, total estimated average flow was 1,300 million gal./yr; in 2006, the flow was 222 million gal. and in 2007 the flow was 178 million gal. All discharges met applicable federal and state standards. Where Laboratory contaminants are found at depth, the setting is either a canyon where alluvial groundwater is usually present (perhaps because of natural runoff or Laboratory effluents) or a location where large amounts of liquid effluent have been discharged (e.g., Mortandad Canyon and upper Sandia Canyon). Table ES-3 summarizes contaminants detected in portions of the groundwater system.

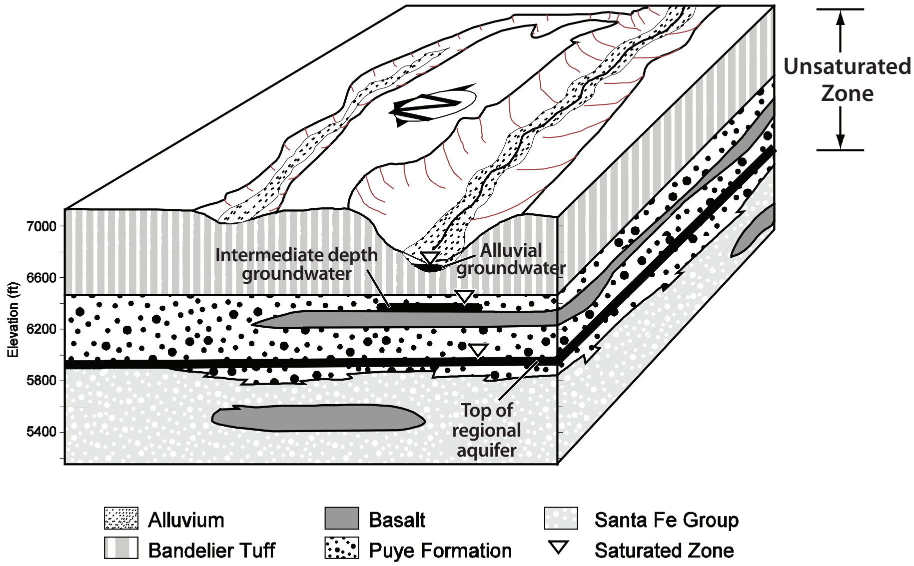

Figure ES-3. Illustration of geologic and hydrologic relationships in the Los Alamos area, showing the three modes of groundwater occurrence.

Drainages that received liquid radioactive effluents in the past include Mortandad Canyon, Pueblo Canyon from its tributary Acid Canyon, and Los Alamos Canyon; only Mortandad currently receives radioactive effluent from the Radioactive Liquid Waste Treatment Facility. For the past seven years, this facility has met all DOE radiological discharge standards in all but two months, met all National Pollutant Discharge Elimination System requirements, and voluntarily met NM groundwater standards for fluoride, nitrate, and total dissolved solids in all but two weeks.

- ***LANL detected chromium contamination in the regional aquifer under one canyon at concentrations above the NM Groundwater Standards and under an adjacent canyon at 70% of the standard.***
- ***The contamination is likely the result of cooling tower discharges containing chromate from the late 1950s to early 1970s.***
- ***No drinking water wells have been affected by the chromium contamination.***

The contaminated alluvial and intermediate perched groundwater bodies are separated from the regional aquifer by hundreds of feet of dry rock, so infiltration from the shallow groundwater occurs slowly. As a result, less contamination reaches the regional aquifer than the shallow perched groundwater bodies, and impacts on the regional aquifer are small.

Water Canyon and its tributary Cañon de Valle formerly received effluents produced by high explosives 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 many sanitary treatment plants but currently operates only one plant that discharges into Sandia Canyon.

Figure ES-4 summarizes groundwater quality issues in the regional aquifer at the Laboratory. The high explosive compound Royal Demolition Explosive (RDX) continued to be detected in the regional aquifer at Pajarito Canyon regional well R-18. The concentration was near the analytical detection limit and at 2% of the EPA tap water screening level. RDX was not found in samples taken during 2005 from this well.

- ***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.***
- ***No drinking water supply wells have been affected by Laboratory contaminants. One currently unused well has levels of perchlorate at 1/10th of the EPA guidance for drinking water.***

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

Chemical	On-Site	Off-Site	Significance	Trends
Tritium	Intermediate groundwater in Mortandad Canyon	No	Not used as a drinking water supply	Insufficient data to define trend
Strontium-90 and gross beta	Alluvial groundwater in DP/Los Alamos and Mortandad Canyons	No	Not used as a drinking water supply; has not penetrated to deeper groundwater	Mainly fixed in location; some decrease due to effluent quality improvement
Chromium	Regional aquifer in Sandia and Mortandad Canyons, intermediate groundwater in Mortandad Canyon	No	Found in regional aquifer above groundwater standards; not affecting drinking water supply wells; source eliminated in 1972.	Insufficient data to define trends
Perchlorate	Alluvial and intermediate groundwater in Mortandad Canyon	No	Not used as a drinking water supply; source eliminated in 2002	Decreasing in Mortandad Canyon alluvial groundwater as effluent quality improves; insufficient data for intermediate groundwater
Nitrate	Alluvial and intermediate groundwater in Pueblo and lower Los Alamos canyons, regional aquifer in Sandia Canyon, intermediate groundwater and regional aquifer in Mortandad Canyon	Yes, Pueblo Canyon	In Pueblo and lower Los Alamos canyons, result may be due to Los Alamos County's Bayo Sewage Treatment Plant; otherwise due to effluent discharges	Insufficient data in Mortandad Canyon, values in Pueblo Canyon are variable, values in Sandia Canyon rising
Fluoride	Intermediate groundwater in Pueblo Canyon, alluvial groundwater in DP and Mortandad Canyons	Yes, Pueblo Canyon	Result of past effluent releases; not affecting drinking water supply wells	Slow decrease in concentration due to effluent quality improvement
Dioxane[1,4-]	Intermediate groundwater in Mortandad Canyon	No	Not used as drinking water supply; limited in extent	Insufficient data for trends
Dichloroethene[1,1-], Dioxane[1,4-], Trichloroethane[1,1,1-], Trichloroethene	Intermediate groundwater below former warehouse in main technical area	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Tetrachloroethene, Trichloroethene	Alluvial and intermediate groundwater in Cañon de Valle	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Boron	Intermediate groundwater in Cañon de Valle	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Barium	Alluvial groundwater in Cañon de Valle and Water Canyon	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
RDX	Alluvial and intermediate groundwater in Cañon de Valle, intermediate groundwater in Pajarito Canyon	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Chloride, TDS	Alluvial groundwater in Pueblo, DP, Sandia, Mortandad, Pajarito canyons, intermediate groundwater near SM-30 and in Sandia Canyon	Yes, Pueblo Canyon	May be caused by road salt in snowmelt runoff, except intermediate groundwater in Sandia Canyon	Values highest in winter samples
Fluoride, uranium, nitrate, TDS	No	Yes, Pine Rock Spring, Pueblo de San Ildefonso	Water quality apparently affected by irrigation with sanitary effluent at Overlook Park	Steady over several years

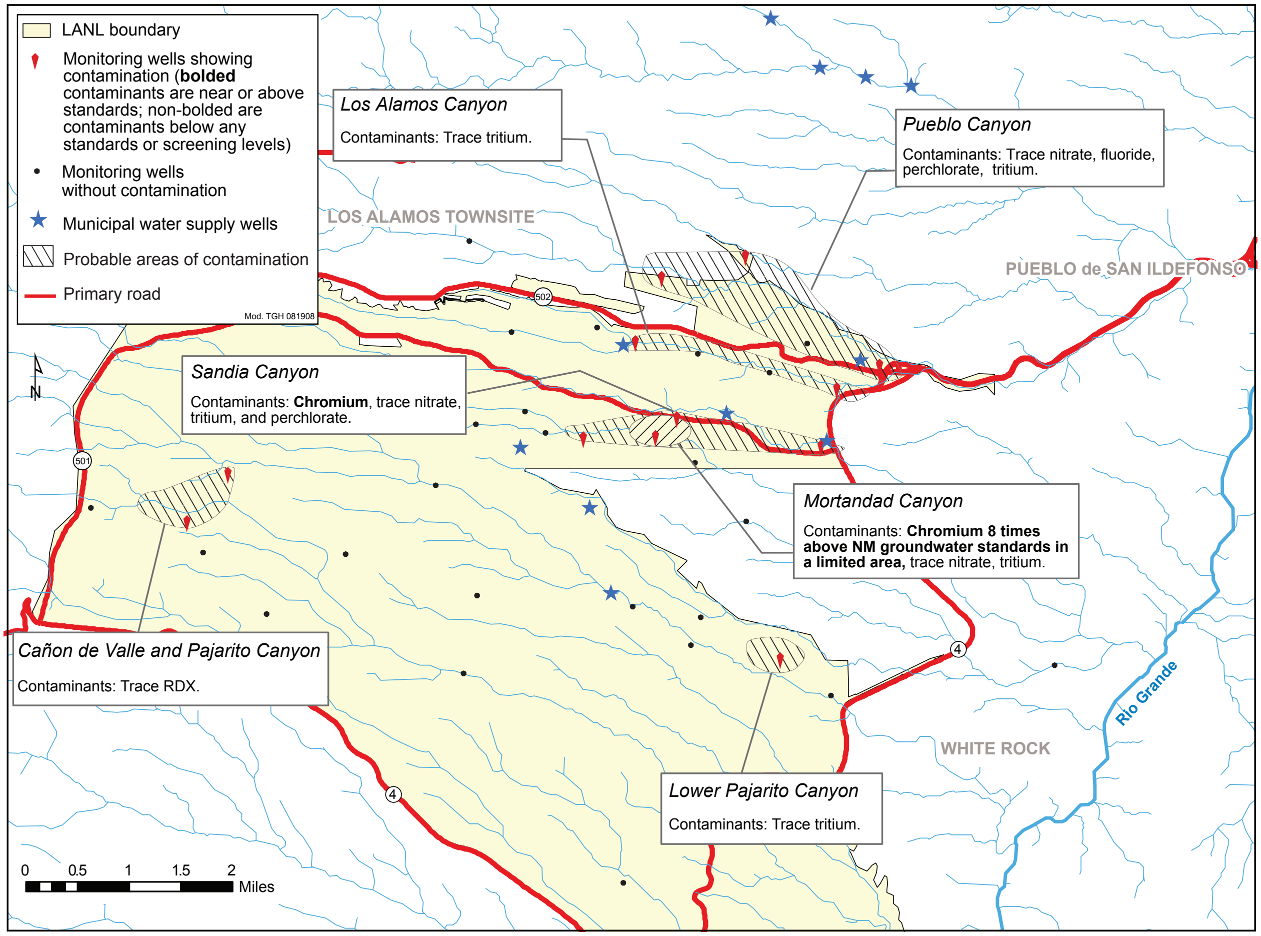

Figure ES-4. Summary of regional aquifer groundwater quality issues at the Laboratory.

The Laboratory detected hexavalent chromium and nitrate in several regional aquifer monitoring wells. The hexavalent chromium was above the NM groundwater standard in one regional aquifer well in Mortandad Canyon and at 70% of the standard in another nearby regional well in Sandia Canyon. Nitrate reached 50% of the NM groundwater standard in two regional aquifer monitoring wells and fluoride was 50% of the standard in one well. Traces of tritium and perchlorate were also detected in the regional aquifer.

Naturally occurring uranium was the main radioactive element detected in the regional aquifer, springs, and wells throughout the Rio Grande Valley. High concentrations of naturally occurring arsenic are also found in groundwater samples from some regional aquifer wells and springs. Most other metals found at high concentrations in groundwater samples at LANL result from well sampling and well construction issues rather than from LANL contamination. The use of fluids to assist with well drilling and the use of other materials in well completion has affected the chemistry of some groundwater samples.

Drinking water wells in the Los Alamos area have not been adversely impacted by Laboratory discharges. Well O-1 in Pueblo Canyon contains perchlorate at concentrations that average 1/10th of the EPA's Drinking Water Equivalent Level of 24.5 micrograms per liter (µg/L). This well is not used by Los Alamos County for water supply.

- ***Beginning in 1999, LANL made significant upgrades to the Radioactive Liquid Waste Treatment Facility treatment system, which discharges into Mortandad Canyon.***
- ***The facility has met all DOE radiological discharge standards and all NPDES (outfall) requirements for the past eight years.***
- ***The facility has met NM groundwater standards for fluoride, nitrate, and total dissolved solids for seven years except for fluoride in two weekly composite samples in 2003.***

The intermediate groundwater in various locations shows localized tritium, organic chemicals (RDX, chlorinated solvents, dioxane[1,4-]), and inorganic chemicals (hexavalent chromium, barium, boron, perchlorate, fluoride, and nitrate) from Laboratory operations.

The Laboratory uses federal and state drinking water and human health standards as "screening levels" to evaluate radionuclide concentrations in all groundwater, even though many of these standards only apply to drinking water. Only in the alluvial groundwater in portions of Mortandad and DP/Los Alamos Canyons does the total radionuclide activity from LANL discharges exceed the guidance that is applicable to drinking water (4 mrem/yr). The maximum strontium-90 concentrations in Mortandad Canyon and DP/Los Alamos Canyon alluvial groundwater were also above the EPA's drinking water standard.

Perchlorate is detected in most groundwater samples analyzed from across northern NM. Naturally occurring perchlorate concentrations range from about 0.1 µg/L to 1.8 µg/L. Water samples from most LANL locations show low perchlorate concentrations in this range, but samples from Mortandad Canyon alluvial and intermediate groundwater show values near or above the EPA Drinking Water Equivalent of 24.5 µg/L. Discharge of perchlorate from the Radioactive Liquid Waste Treatment Facility dropped to an undetectable level in 2002 and perchlorate values in alluvial groundwater downstream of the facility's discharge in Mortandad Canyon have been steadily declining.

Watershed Monitoring

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

Watersheds that drain LANL property are dry for most of the year. Of the more than 80 miles of watercourse, approximately two miles are naturally perennial, and approximately three miles are perennial water created by effluent discharges (most notably in upper Sandia Canyon). Storm water runoff occasionally extends across the Laboratory but is short-lived. The surface water within the Laboratory is not a source of municipal, industrial, or irrigation water, though wildlife does use the water.

Occasional floods can redistribute sediment downstream. None of the streams within the Laboratory boundary average more than one cubic ft per second (cfs) of flow annually. It is unusual for the combined mean daily flow from all LANL canyons to be greater than 10 cfs, although one event in late fall of 2007 (November 30 to December 2, 2007) resulted in an estimated combined mean daily runoff from LANL of about 22 cfs on December 1. By comparison, the average daily flow in the Rio Grande at Otowi Bridge during that event was 800 cfs, or approximately 35 times higher.

- ***Polychlorinated biphenyls (PCBs) are often measured in Sandia and Los Alamos Canyons above screening levels.***
- ***Radioactive elements from past Laboratory operations are being transported by runoff events. All radionuclide levels are well below applicable guidelines or screening levels.***
- ***PCBs, radionuclides, and other contaminants adsorb onto sediment particles and thus overall water concentrations can be reduced by slowing the stream flows, reducing erosion, and allowing suspended sediment to settle out.***

Total runoff leaving the Laboratory in 2007 measured at downstream gages in the canyons was estimated at about 205 ac-ft of which about 91 ac-ft was from snowmelt runoff, 70 ac-ft was from storm water runoff in the summer, and 44 ac-ft was from the late fall event. The volume of storm water runoff in 2007 was the least since the Cerro Grande fire in 2000 and similar to pre-fire runoff volumes. The estimated total volume of snowmelt runoff measured in Los Alamos Canyon at the Laboratory's eastern boundary was about 91 ac-ft, decreasing to about 29 ac-ft in lower Los Alamos Canyon near the confluence with the Rio Grande.

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

LANL Impact	On-Site	Off-Site	Significance	Trends
Specific radionuclides	No	No	Exposure potential is limited. Los Alamos Canyon surface water at 40% of DOE biota concentration guide for year; dose mainly from radium-226 that is of natural origin	Steady
Gross alpha radioactivity	Mortandad, Pueblo, and Los Alamos Canyons	No	57% of surface water results greater than screening level; major source is naturally occurring radioactivity in sediments, except in Mortandad, Pueblo, and Los Alamos Canyons where there are LANL contributions	Steady in Mortandad; downward in fire-affected canyons as stream flows recover to pre-fire levels
Copper	Multiple watersheds	No	Over screening level in Pajarito, Threemile, and Twomile canyons. Origins uncertain; probably several sources	Steady
Lead	Threemile and Water Canyons	No	Elevated in two samples collected at site monitoring locations in Threemile and Water Canyons	Steady
Mercury	Various canyons; highest in Sandia Canyon at a site monitoring station	Yes	Above screening level only in unfiltered samples. Also above screening level in canyons near residential areas; not all sources from LANL	Steady
Antimony	Several canyons	No	Source is developed areas; highest in stormwater from TA-3	Steady
Barium	Cañon de Valle	No	Source related to high explosive research in Cañon de Valle area; subject of focused investigations on barium and high explosives	Steady
Silver	Cañon de Valle	No	Above screening level. From known former photography processing laboratory	Steady
Polychlorinated biphenyls (PCBs)	Many canyons	Yes, particularly in Los Alamos and Pueblo Canyons	Above screening levels. Wildlife exposure potential in Sandia Canyon.	Steady
RDX	Cañon de Valle	No	Confined to LANL; subject of focused investigations	Steady

The overall quality of most surface water in the Los Alamos area is good, with low levels of dissolved solutes. Of the more than 100 analytes measured in sediment and surface water within the Laboratory, most are at concentrations far below screening levels. However, nearly every major watershed indicates some effect from Laboratory operations, often for just a few analytes. Table ES-4 shows the locations of Laboratory-impacted surface water. All radionuclide levels are well below applicable guidelines or standards (Table ES-5).

Table ES-5
Estimated Annual Average Unfiltered Surface Water Concentrations of Radionuclides in Selected Canyons Compared with the Biota Concentration Guides (pCi/L)

Radionuclide	BCG[a]	Acid Canyon above Pueblo Canyon	Lower Pueblo Canyon	DP Canyon below TA-21	Los Alamos Canyon between DP Canyon and NM 4	Los Alamos Canyon at Rio Grande	Mortandad Canyon below Effluent Canyon	Maximum percent of BCG[a]
Am-241	400	0.59	0.08	0.4	0.3	0.02	0.9	0.2%
Cs-137[b]	20,000	ND[c]	ND	ND	2	ND	10	0.05%
H-3	300,000,000	17	1.6	23	16	22	853	< 0.01%
Pu-238	200	0.04	0.00	0.03	0.03	ND	1.5	0.7%
Pu-239/240	200	5.6	22	0.2	0.6	0.2	2	11%
Sr-90	300	0.5	0.02	35	2	0.08	1.9	12%
U-234	200	1.0	3	2	0.9	1.4	1.0	1%
U-235/236	200	0.06	0.01	0.01	0.05	0.09	0.05	0.1%
U-238	200	0.8	2	2	0.8	1.0	0.9	1%
Ra-226	4	1.0	1.1	ND	ND	ND	0.6	28%

[a] BCG = DOE Biota Concentration Guides
[b] The BCG for cesium-137 is a site-specific modified BCG
[c] ND indicates no analytical laboratory detection in 2007

Laboratory activities have caused contamination of sediment in several canyons, mainly because of past industrial effluent discharges. These discharges and contaminated sediment also affect the quality of storm water runoff, which carries much of this sediment during short periods of intense flow. In some cases, sediment contamination is present from Laboratory operations conducted more than 50 years ago. However, all measured sediment contaminant levels are below recreational screening levels.

Consistent with previous years, most surface water samples in 2007 had gross alpha radiation greater than the screening level of 15 pCi/L for livestock watering. Of the 330 non-filtered samples analyzed from the Pajarito Plateau, 57% exceeded 15 pCi/L. However, it has been previously shown that the majority of the alpha radiation in surface water on the plateau is due to the decay of naturally occurring isotopes in sediment and soil carried in storm water runoff from uncontaminated areas, and that Laboratory impacts are relatively small. This is supported by the generally positive correlation between gross alpha radiation and suspended sediment in non-filtered surface water samples.

The highest concentrations of several radionuclides in surface water samples were measured in Mortandad Canyon downstream from the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) outfall, including americium-241, cesium-137, plutonium-238, plutonium-239/240, and tritium. The highest concentration of strontium-90 was measured in DP Canyon downstream from a former outfall at TA-21, which also released radioactive effluent. The highest concentrations of uranium-234, uranium-235, and uranium-238 were measured at a site-monitoring area location in the Potrillo Canyon watershed at a firing site in TA-15.

The highest concentrations of most radionuclides in sediment were obtained from one fine-grained sample from the Mortandad Canyon sediment traps, including the highest values for americium-241, cesium-137, plutonium-238, plutonium-239/240, and strontium-90. This sediment was deposited by a flood on August 25, 2006, which was the largest flood on record in that canyon since discharges of radioactive effluent began at the TA-50 Radioactive Liquid Waste Treatment Facility in 1963. These values are all less than previous results from the sediment traps and are below recreational screening action levels. The highest concentrations of tritium were measured in drainages below MDA G at TA-54, and are also below recreational screening action levels. No results for uranium isotopes in 2007 are above background levels.

The types of organic compounds tested for varied depending on the location and typically included the following suites: dioxins and furans, explosive compounds, herbicides, pesticides and PCBs, semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons-diesel range organics, and volatile organic compounds. PCBs were the only class of organic chemicals that were frequently detected at concentrations greater than the screening level. Monitoring results show no measurable effects of PCBs from LANL in the Rio Grande.

The high explosive compound RDX was detected in Cañon de Valle watershed above a screening level. This canyon is the subject of ongoing investigations and corrective measures regarding high explosives contamination.

No herbicides were detected in any surface water samples.

Potential impacts to the Rio Grande were assessed in 2007 by comparing contaminant concentrations in sediment at locations upriver and downriver of LANL. All measurements of radionuclides in upriver and downriver sediments collected from the Rio Grande and Cochiti Reservoir were orders of magnitude below recreational or residential screening levels. In river sediment, no radionuclides were detected above background levels either above or below the Laboratory. Concentrations of plutonium-239/240 from Cochiti Reservoir bottom sediment were above background levels in two samples. These concentrations were comparable to those measured in previous years after the Cerro Grande fire and are slightly elevated above regional background levels that result from atmospheric fallout.

Soil Monitoring

Table ES-6 summarizes soil sampling results. Large-scale soil sampling within and around the perimeter of LANL is conducted every three years and the last soil sampling event was in 2006. In general, results of that investigation showed that soil samples from on-site and perimeter areas contained radionuclides at very low (activity) concentrations and most were either not detected or below regional statistical reference levels (RSRLs, equal to the average plus three standard deviations). The few samples with radionuclide concentrations above the RSRLs were collected from near known or expected areas of contamination though the levels are below residential screening levels and thus do not pose a potential unacceptable dose to the public.

Although large-scale soil sampling was not conducted in 2007, we annually collect soil samples from two locations on the Pueblo de San Ildefonso land downwind of TA-54, Area G. Radionuclides and metals in these soil samples were below background or near background and were consistent with levels measured in previous years.

- ***Soil samples from most off-site locations show radionuclides and metals have not increased over the past years and are mostly at background levels.***
- ***Plutonium-239/240 in a soil sample collected at the LANL/Pueblo de San Ildefonso boundary northeast of Area G was above background.***
- ***Soil samples from most on-site locations show no increases and some decreases of radionuclides and metals from previous years.***
- ***All PCBs, high explosives, and nearly all semi-volatile organics in soil from perimeter and on-site locations are below detection limits.***

Other soil monitoring sites routinely sampled in 2007 were from around the perimeter of Area G and DARHT. Soil samples from around the perimeter of Area G contain above-background concentrations of tritium, americium-241, plutonium-238, and plutonium-239/24. The highest levels of tritium around Area G were detected at the southern end and the highest levels of the actinides were detected around the northern, northeastern, and eastern sections. One soil sample on the eastern side of Area G and one soil sample collected at the LANL/ Pueblo de San Ildefonso boundary northeast of Area G contained plutonium 239/240 concentrations a few times higher than measured the year before, though all levels are well below residential screening levels used to trigger investigations and the amounts decrease rapidly with distance from Area G. At DARHT, levels of uranium in soil are slightly elevated but well below screening levels. Other constituents such as PCBs, high explosives, and SVOCs were not detected.

Table ES-6
Where Can We See LANL Impacts on Mesa-Top Surface Soil that Result in Values Near or Above Background or Screening Levels?

LANL Impact	On-Site	Off-Site	Significance	Trends
Tritium	Yes, above background at some sites, particularly at TA-54, Area G	No	Far below residential screening levels	Consistently detected in the south sections of Area G, but not increasing
Plutonium-239/240	Yes, above background along State Road 502 at TA-73 (downwind of TA-21) and at TA-54, Area G	Yes, above background along State Road 502 on the west side of the airport (downwind of TA-21) and at LANL/Pueblo de San Ildefonso boundary and Sacred Area northwest of Area G	Far below residential screening levels	Plutonium-239/240 downwind of TA-21 is highly variable from sample to sample but is generally not increasing. Also, consistently detected on the north, northeast, and eastern sections of Area G, mostly not increasing except on the eastern side.
Other Radionuclides	Mostly depleted uranium at DARHT	Mostly no	Far below residential screening levels	Uranium-238 at DARHT increased through 2006 but decreased in 2007 likely because of the use of steel containment vessels
Inorganic Chemicals	Few detections: beryllium at DARHT is just above background	Few detections	Far below residential screening levels	Steady
PCBs	Most samples below detection limits. Aroclor-1260 detected at Los Alamos Weir	No	Far below residential screening levels	Re-sampling around a positive PCB soil result in 2006 at Area G showed no PCB amounts. Steady at Los Alamos Canyon weir.
High Explosives	All below detection limits	No	Minimal potential for exposure	None
Semi-volatile Organic Compounds (SVOCs)	One sample along State Road 502 at TA-73 in 2006 detected SVOCs	No	Far below residential screening levels; from asphalt (not a LANL source)	None

At the request of Jemez Pueblo, soil samples were collected along a transect starting from a point east of a LANL explosives firing site to the Valles Caldera. There were no detections of any of 14 different high explosives compounds analyzed.

Foodstuffs Monitoring

In 2007 we collected a wide variety of fruit and vegetable crops at many on-site, perimeter, and regional background locations in an effort to determine the impact of LANL operations on the human food chain. Goat milk and wild edible plants were also collected. We collected 10 fruit and vegetable samples (apples, apricots, cherries, chile, corn, grapes, lettuce, peaches, squash, and tomatoes) from each of four communities surrounding the Laboratory (Los Alamos, White Rock, Pueblo de San Ildefonso, and Cochiti area) and additional fruit samples from within LANL technical areas. The results were compared to past data and levels in fruits and vegetables collected from several background areas as far north as Dixon. No elevated levels of radionuclides were measured in any of the community samples. Only an elevated tritium level was measured in a fruit sample from a technical area that formerly processed tritium. Radionuclides and metal elements in produce from background areas are the result of worldwide fallout and naturally occurring sources. For metals, only selenium and chromium were slightly elevated in two samples from off-site locations and are likely due to fertilizer additions by the small-scale farmer.

Radionuclides in a goat milk sample from the White Rock area were either not detected or consistent with background samples from Pena Blanca, Penasco, and Lumberton, New Mexico.

Wild edible plants were sampled downwind and downgradient from TA-54, Area G in Cañada del Buey at the LANL/Pueblo de San Ildefonso boundary. Only low levels of tritium in the samples closest to the area were detected above background levels.

- ***All radionuclides and most metals in fruits and vegetables from communities surrounding LANL or downstream of LANL were indistinguishable from worldwide fallout and/or natural sources (background).***
- ***Metals in the fruits and vegetables were also not elevated except for chromium and selenium in a few off-LANL samples and is likely from fertilizer use by the small-scale farmer. No LANL fruit samples contained elevated metals.***

Biota Monitoring

Table ES-7 summarizes biota sampling results. In plants collected around Area G, only tritium and plutonium were detected in a few samples closest to the boundary fence and adjacent to known sources of these radionuclides.

In vegetation around the DARHT facility, only depleted uranium was detected above background levels; the levels are lower than in previous years which may be because testing is now conducted in metal vessels instead of in the open. Depleted uranium in mice and bees were also detected at DARHT and the bees contained slightly higher levels of barium and copper. Bird monitoring near the DARHT facility over several years showed no adverse impacts to the numbers or types of birds inhabiting the area.

Upgradient of the Los Alamos Canyon Weir, slightly elevated levels of plutonium, uranium, strontium, and americium were measured in plants. Aroclor 1260 (a type of PCB) was detected in both sediment and mice. The concentrations of all radionuclides, metals, and PCBs in all biotic and abiotic media collected upgradient of the weir were below screening levels and do not pose a potential unacceptable dose from radionuclides or risk from non-radionuclides to humans (sediment) or to the biota sampled. Above the Pajarito Canyon Flood Retention Structure, no contaminants were considered significantly elevated.

- ***Vegetation at Area G contained elevated levels of radionuclides near known sources.***
- ***Biota samples at DARHT contained depleted uranium but the levels were lower than previous years probably because of new contained testing measures.***
- ***Biota and sediment samples collected above the Los Alamos Canyon Weir contained slightly elevated levels of some radionuclides and PCBs but far below screening levels.***

Table ES-7
Where Can We See LANL Impacts on Foodstuffs and Biota that Result in Values Near or Above Background or Screening Levels?

Media	LANL Impact	On-Site	Off-Site	Significance	Trends
Wild edible plants	Radionuclides	Tritium in plants from Canada del Buey	Above background concentrations for strontium-90 in plants from Mortandad Canyon on Pueblo de San Ildefonso land in 2006	Far below screening level. Higher strontium-90 in wild plants is a function of low calcium in the soil and not to increased contamination levels	Steady
	Inorganic chemicals	No	No	No data	Steady
Native vegetation	Radionuclides	Mostly tritium and plutonium-239,240 at Area G; and depleted uranium at DARHT	Few detections	Far below screening levels	Tritium and plutonium-239/240 are steady at Area G, Uranium-238 in trees at DARHT increased through 2006, decreased in 2007
	Inorganic chemicals	Few detections: arsenic in one plant sample at DARHT	No	No	Steady for most metals
Small mammals, bees, and birds	Radionuclides	Depleted uranium at DARHT; some radionuclides in biota upstream of the Los Alamos Canyon Weir and the Pajarito Canyon Flood Retention Structure	None collected	Far below screening levels	Steady for most radionuclides
	Inorganic chemicals	Some detections in a bird at DARHT	None collected	One sample out of two	Insufficient data
	PCBs	Detected in mice at the Los Alamos Canyon weir	None collected	The toxicity equivalency quotients in mice on LANL property were comparable with the control	Insufficient data
	Species diversity	Abundance and species diversity of birds at DARHT during operations are similar to baseline	None collected	No stress to birds at DARHT	Steady

Environmental Restoration Program

Corrective actions proposed and/or conducted at LANL in 2007 follow the requirements of the Consent Order. The goal of the investigation efforts is to ensure that waste and contaminants from past operations do not threaten human or environmental health and safety. Accomplishments include the completion of investigation activities, approvals of proposed investigation activities, and approvals of the work completed at some sites. The chromium investigations in Sandia and Mortandad canyons continued with the installation of two monitoring wells (R-35a and b) immediately upstream of PM-3, a municipal drinking water well. Numerous sampling activities were conducted in 2007 and included sampling of pore gas at MDA A; drilling of four boreholes at MDA C to characterize the subsurface below former chemical waste disposal pits; sampling and geophysical, geodetic, and radiological surveying in Bayo Canyon where radioactive materials were used; additional sampling in several locations within TA-21 where the country's original plutonium processing facility was located; additional characterization sampling at MDA V and MDA T (both in TA-21) where liquid wastes were stored and processed; and sediment sampling in Sandia Canyon to determine the amount and extent of chromium migration. After results are received and interpreted, these sampling activities will be documented in reports to the NMED. During 2007, environmental restoration activities collected more than 2,200 samples from more than 4,000 locations and requested more than 710,000 analyses or measurements on these samples.

Previous risk reduction successes include the cleanup of TA-73 (Airport Ashpile), which contained landfills, septic systems, an incinerator and surface disposal area, and other miscellaneous sites; and MDA V at TA-21 where three absorption beds and other contaminated soil and tuff were excavated.

- ***Characterization and cleanup of sites contaminated or potentially contaminated by past LANL activities follow the Consent Order.***
- ***Twenty-three investigation work plans and 23 investigation reports were submitted to NMED in 2007.***
- ***Eight sites were granted certificates of completion.***

Under the Consent Order, 23 investigation work plans and 23 investigation reports were submitted to NMED. Six Historical Investigation Reports were also submitted as companion documents to some work plans. In 2007, NMED approved a total of 17 investigation work plans and 17 investigation reports, some with modifications or directions. Of the documents approved, LANL submitted nine work plans and 10 reports in 2007; the other approved plans were submitted in previous years. A total of eight SWMUs and areas of concern were granted certificates of completion, which signifies that the investigations have been completed. In addition, NMED was reviewing seven work plans and nine reports as of the end of the calendar year.

The investigation activities are designed to characterize SWMUs, areas of concern, consolidated units, aggregate areas, and watersheds. The characterization activities conducted include surface and subsurface sampling, drilling boreholes, geophysical studies, and installation of monitoring wells. Corrective action activities performed included the removal of structures (e.g., buildings, septic systems, sumps, and drainlines), excavation of contaminated media, and confirmatory sampling. These activities defined the nature and extent of contamination and determined the potential risks and doses to human health and the environment.