

Cleanup at the Los Alamos National Laboratory – The Challenges - 9493

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ABSTRACT

This paper provides an overview of environmental cleanup at the Los Alamos National Laboratory (LANL) and some of the unique aspects and challenges. Cleanup of the 65-year old Department of Energy laboratory is being conducted under a RCRA Consent Order with the State of New Mexico. This agreement is one of the most recent cleanup agreements signed in the DOE complex and was based on lessons learned at other DOE sites. A number of attributes create unique challenges for LANL cleanup—the proximity to the community and pueblos, the site's topography and geology, and the nature of LANL's on-going missions. This overview paper will set the stage for other papers in this session, including papers that present:

- Plans to retrieve buried waste at Material Disposal Area B, across the street from one of Los Alamos' commercial districts and the local newspaper
- Progress to date and joint plans with WIPP for disposal of the remaining inventory of legacy transuranic waste
- Reviews of both groundwater and surface water contamination and the factors complicating both characterization and remediation
- Optimizing the disposal of low-level radioactive waste from ongoing LANL missions
- A stakeholder environmental data transparency project (RACER), with full public access to all available information on contamination at LANL, and
- A description of the approach to waste processing cost recovery from the programs that generate hazardous and radioactive waste at LANL.

BACKGROUND

Los Alamos National Laboratory, known then as Project Y, began in early 1943 as one of the Manhattan Project facilities. The Laboratory had a single mission – to design and build an atomic bomb. Directors of the top secret project selected the Laboratory's location based on its isolation, the ability to control access, and surrounding land that could be used for experiments and explosives testing. Robert Oppenheimer, the scientific director, also envisioned a laboratory in a beautiful setting that would inspire his scientists.¹

¹ Los Alamos Historical Society webpage, losalamoshistory.org

Los Alamos sits atop the Pajarito Plateau, a high desert mesa at nominally 7000 feet, cut by deep canyons that formed narrow fingerling mesas extending from the eastern flank of a geologically active caldera. The 40 square mile facility includes over 100 miles of canyons. Annual precipitation ranges from 8 to 16 inches, with much of that falling in the summer monsoon season.

The initial infrastructure for the Laboratory was the Los Alamos Ranch School, a boys' school established in 1917 to provide outdoor living experience and classical education. The school's facilities, initially thought to be adequate for the expected 30 to 50 scientists, were soon eclipsed by a town that would grow to more than 6000 residents during the war. Buildings to house metallurgy and explosive experiments were quickly constructed in what is now the center of the community of Los Alamos. Enriched uranium and plutonium supporting the experiments and ultimate weapons production were developed at Oak Ridge, TN and Hanford, WA. After two years of research and development at Los Alamos, the Trinity test shot was conducted in south central New Mexico, a precursor to the use of weapons at Hiroshima and Nagasaki that helped to end World War II.

The Laboratory's original mission to design, develop, and test nuclear weapons has broadened and evolved as technologies, US priorities, and the world community have changed. The current LANL mission is to develop and apply science and technology to

- Ensure the safety and reliability of the US nuclear deterrent;
- Reduce global threats; and
- Solve other emerging national security challenges.

OVERVIEW OF ENVIRONMENTAL CONTAMINATION

The Laboratory's sixty years of operation resulted in more than 2,100 locations known or suspected to be contaminated. Twenty-six material disposal facilities were utilized at the laboratory and the largest, TA-54, extends over 60 acres and is still in use for disposal of low-level radioactive waste and storage and processing of transuranic waste. Nearly 4 million curies of radioactive waste have been disposed at TA-54 since it began operations in 1957, and another 10,600 m³ of transuranic waste is in storage pending ultimate shipment to WIPP for disposal.

Primary contaminants of concern include plutonium, tritium, various heavy metals, barium and uranium from explosives tests, and organic solvents. With the Laboratory's mesa-canyon topography and the arid climate, most of the contamination remains at or near the surface. More mobile volatile organic compounds and tritium have been detected in the vadose zone a few hundred feet below ground surface. Chromium has been detected at levels above the drinking water standards in the regional aquifer, the top of which ranges from 600 to 1,200 feet below the Laboratory's mesa top elevations.

With historical discharge practices and natural mass-wasting transport in LANL's mesa-canyon topography, much of the areas of contamination concern are in the canyons (Figure 1). The material disposal areas (MDAs), included in Figure 1, and Los Alamos and Pueblo Canyons are primary areas of focus for remediation.

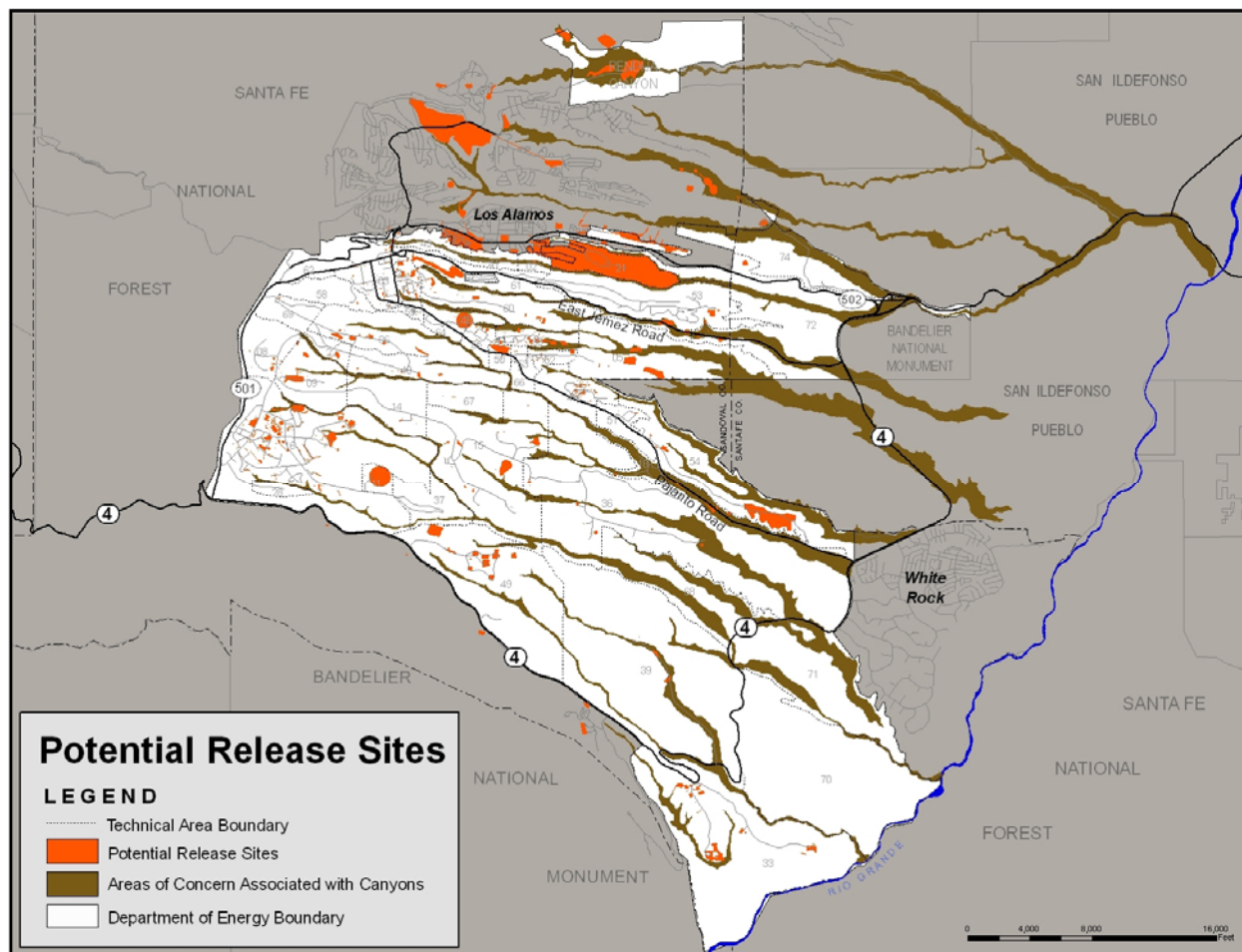


Figure 1. Potentially contaminated areas at LANL.

REGULATORY FRAMEWORK

Environmental cleanup at Los Alamos is governed principally by a Consent Order negotiated under the Resource Conservation and Recovery Act (RCRA). This regulatory agreement, which was signed in March 2005, is an agreement similar to those governing cleanup at other DOE sites. One notable difference, however, is the signatories – DOE, the State of New Mexico, and the contractor operating the Laboratory. EPA is not a party to the agreement. The contractor's position as a signatory to the agreement puts it in a more direct role than at some other DOE sites in terms of both liability and in the decision-making processes.

Like other DOE cleanup agreements, the Consent Order provides a regulatory framework for cleanup, defines specific processes to be followed in reaching decisions on cleanup, mandates public involvement through the process, and establishes enforceable milestones for the investigation and cleanup processes. Unlike many other cleanup agreements, the Consent Order contains enforceable dates for *completing* cleanup--dates that were defined when the agreement was signed. Final cleanup is required to be completed by December 2015. The Consent Order also provides no provisions to adjust the enforceable milestone dates based on funding levels authorized by Congress each fiscal year. A milestone that is not met due to funding shortfalls is subject to the same penalties as a milestone missed for performance issues.

Based on the Consent Order, approximately 200 enforceable milestones and document submittals are required each year. Each year, the State of New Mexico identifies up to 15 milestones for the next year that will be subject to automatic stipulated penalties should they be missed (i.e. the parties stipulated in the Consent Order that there would be automatic penalties for a set of milestones that would be determined by the State of New Mexico each year.) While DOE and the LANL contractor have the opportunity to review these milestones, the State can designate them unilaterally and typically has done so.

The RCRA-based Consent Order does not explicitly incorporate CERCLA's data quality objective or risk assessment processes. As a RCRA agreement, the Consent Order does not govern the cleanup of radioactive contamination at the Laboratory; DOE is the regulator in that regard. Since nearly all hazardous and radioactive contamination is co-mingled, reaching cleanup decisions under two separate regulatory authorities can be challenging. Where possible, assessments and remedial-action decisions for radioactive contamination are developed in parallel with similar processes for RCRA-regulated contaminants.

The Consent Order does not govern the decontamination and decommissioning (D&D) of facilities at LANL. While this provides some flexibility in how D&D is conducted, it does not provide a regulatory driver for funding. Funding for D&D has generally been lowest on the priority list for the past several years as authorized funding has not been sufficient to meet all regulatory requirements under the Consent Order. In some locations at LANL, most notably the tritium and plutonium processing facilities constructed on DP Mesa right after World War II, much of the contamination of concern is beneath the facilities. Conducting subsurface characterization and corrective actions has been significantly complicated with the facilities still in place and with restricted access to some areas due to interior levels of contamination.

EPA has separate regulatory authority under the Toxic Substances Control Act for the cleanup of PCBs at LANL. EPA also has regulatory oversight for stormwater control under the Clean Water Act. Due to LANL's topography, stormwater runoff and control is a significant part of the cleanup program. A new stormwater permit expected to be issued in the near future includes more than 700 sites across the Laboratory and defines specific monitoring and control provisions. Many of the locations are in remote areas with difficult access. While monitoring has been greatly improved with the installation of automatic samplers, personnel are still required to inspect each location immediately after rainfall events that result in measurable runoff, work that is difficult to pre-schedule.

EPA also regulates industrial point-source discharges of wastewater at LANL under the National Pollutant Discharge Elimination System (NPDES) permit program. Permitted discharges have been reduced from 141 in 1993 to 17 in the current NPDES permit. LANL has established an Outfall Reduction Program to further reduce these wastewater discharges to 6 by 2012.

UNIQUE ASPECTS OF ENVIRONMENTAL CLEANUP AT LANL

LANL's location and its missions create some unique challenges in characterizing and remediating environmental contamination. Perhaps the most notable is the Laboratory's topography. In the period during and after World War II, it was not unusual for wastes to be discharged over the edge of the canyon. As a result, many of the significant areas of contamination are on the canyon walls, complicating both investigation and cleanup actions (Figure 2).



Figure 2. LANL's topography and historical disposal practices complicate characterization and cleanup.

Although not necessarily unique, the subsurface geology at LANL is some of the more complex of the DOE installations across the US. As further described in a separate paper and illustrated later in Figure 4, LANL is underlain by a number of different formations within the first 2000 feet below ground surface, principally volcanic in origin, each with significantly different hydrologic characteristics, and many that are discontinuous and highly fractured. This complicates drilling activities, as well as modeling and analyses. Levels of contaminants in the intermediate and regional aquifers can be significant in some locations and not detected just a short distance away.

The early LANL processing facilities and laboratories were constructed in a location that is now the central part of the community of Los Alamos. While cleanups were conducted in the 1960s before the land was transferred from federal to private or municipal ownership, those cleanups were primarily for radioactive materials and may not meet today's standards. Sampling and characterization efforts have begun in Upper Los Alamos Canyon, in and around businesses and residences (Figure 3). Plutonium is one of the contaminants of concern in this area, although levels are expected to be below current risk-based cleanup standards. LANL has conducted extensive coordination with businesses, property owners, and residents prior to the initiation of drilling and sampling activities and will continue to do so through this project.

As is further discussed in the paper on MDA B, the proximity of the community to Laboratory property and areas with legacy contamination is a significant factor not only in cleanup decisions, but also in the design of the remedial action. The 6-acre MDA-B waste disposal facility is just across the street from one of the community of Los Alamos' commercial districts. Remediation of this area will be based on full retrieval of the buried waste. MDA-B received waste between 1945 and 1948 and disposal records are sketchy. LANL has augmented the limited disposal records by interviewing the workers from that period who are still living and through reconstruction of process and material balance records. While much of the waste is believed to be contaminated trash and debris, shock-sensitive chemicals are a concern.



Figure 3. Major investigations are underway in downtown Los Alamos.

Residences in the community of White Rock are just to the east of LANL’s primary waste storage and disposal facility at TA-54. The closest are just over a mile from the eastern-most transuranic waste storage and processing facilities. The proximity of the public and the dispersible nature of the waste form led the Defense Nuclear Facilities Safety Board and DOE to designate several hundred drums of high-activity transuranic waste as one of LANL’s highest risks after the Cerro Grande fire in 2000. While less than 1% of the aboveground inventory of waste in storage, the high-activity drums were nearly one-third of the total curie inventory in storage. As described later in this session, expedited efforts were made to modify facilities to enable processing of this waste under Hazard Category II requirements, to open and repackage more than 160 of the waste containers, and to complete full characterization and certification before shipment to WIPP.

Laboratory property is adjacent to five separate Native-American pueblos and the pueblos are significant governments with interest in LANL’s cleanup programs. Specific Native-American values are incorporated into the cleanup decision-making processes, as are pueblo ceremonial and social activities in contaminant exposure analyses. The ongoing waste disposal operations at TA-54 are just across a narrow canyon from one of the San Ildefonso Pueblo’s sacred areas and the site of numerous ceremonies. Waste operations are suspended several times a year at the request of San Ildefonso Pueblo, and the Pueblo’s objectives will be a key factor in the ultimate cleanup of this area.

While many of the DOE facilities undergoing cleanup are slated for closure, LANL is one of the DOE facilities with ongoing missions that are expected to continue well into the future. Conducting characterization and cleanup in and around active operations, most of which are highly-classified, can be complicated. Careful schedule coordination with the weapons program and other missions is essential for

monitoring, site investigation, and remedial actions. Cleanup also presents a complicating factor to ongoing missions at LANL. Cleanup and closure of the Laboratory's primary waste management facility at TA-54 will require replacement capabilities to be designed, funded, and constructed on a schedule that ensures TA-54 closure under the Consent Order.

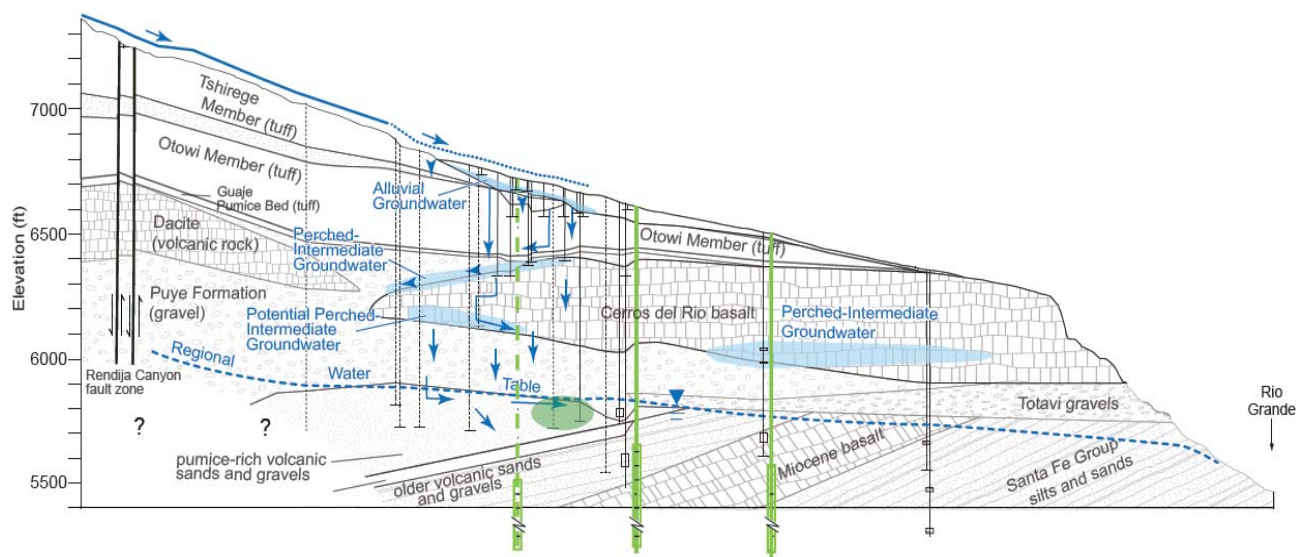


Figure 4. LANL's complex subsurface hydrogeology complicates characterization and modeling

PROGRESS AND PLANS TO COMPLETE CLEANUP

Of the 2129 sites that have been identified as potentially contaminated, 1269 have been remediated or determined not to require cleanup. The 860 sites that remain include some of the more challenging and complex at the Laboratory, in particular the ten (of 26 total) material disposal areas that remain to be remediated. While some of the MDAs are expected to require capping and continued monitoring, others may require some additional actions.

As noted above, the high-activity drums of TRU waste stored at TA-54 were designated by the Defense Nuclear Facilities Safety Board and DOE as one of the highest nuclear safety risks at LANL. The last high-activity drum of those scheduled for shipment was shipped to WIPP on November 13, 2008, completing a significant reduction in risk at the Laboratory.

One of the more challenging cleanup actions completed to date is the Airport Ashpile Project. Incinerator ash containing heavy metals, semi-volatile organics, and low-level radioactive wastes was dumped over the side of a steep canyon from the late 1940's to the early 1970's. Challenges included performing work on a 60 degree slope, and working in an unexploded ordnance and asbestos environment. Cleanup involved removal of over 2000 cubic yards of debris and ash using a combination of a "skyline logger" and a unique Spyder excavator, followed by removal of an additional 900 cubic yards of ash and impacted soil using vacuum units. The photograph on the right side of Figure 2 above shows the Spyder excavator on the steep hillside during ash removal.

Groundwater contamination is a major concern for past releases to the environment, and the State of New Mexico has required additional groundwater monitoring wells as part of the evaluation of chromium

contamination in the regional aquifer and to help in selection of remedies for the MDAs and other sites. LANL has completed 13 deep wells over the past nine months despite the complex geology and related drilling challenges. Groundwater monitoring at LANL will be discussed later in this session.

LANL has subcontracted most of the required characterization and remedial action work and will continue to do so. Over the past two years, the subcontracting approach has moved from time-and-materials type service subcontracts to performance-based and fixed price subcontracts. This has not only supported significant improvement in costs, but the focus on completing defined scope has expedited overall progress.

The process for stakeholder involvement in DOE's decisions on cleaning up radioactive contamination is just beginning and has not been completely defined. As with other DOE cleanup programs, there can be a significant discrepancy between the public's perception of risk and their desire for cleanup action and actual risk based on analyses of contaminant levels and exposure routes. This is particularly the case for MDA-AB, the site of underground experiments that deposited significant amounts of plutonium and uranium. The site contains one of LANL's highest activity-based radioactive inventories. Because of the nature of the tests and the subsurface hydrogeology, that contamination is not mobile and is not projected to pose an unacceptable risk to the public or the environment. However, the quantity of radioactive materials is a significant stakeholder concern.

LANL's lifecycle baseline for cleanup was validated by DOE in 2008, after extensive independent review. One of the ongoing challenges in executing the baseline plans in recent years has been the shortfall in funding to meet not only the Consent Order requirements, but also other cleanup activities such as D&D. LANL is working to incorporate more aggressive cleanup actions targeted at key risks, efficiencies in work execution, and lessons learned and best practices from progress to date and from similar cleanup actions at other DOE sites. This approach has supported increased DOE funding targets and will significantly improve compliance with Consent Order requirements, reducing the potential for significant fines and penalties and related delays and political angst.

A key factor in environmental cleanup at LANL has and will continue to be relations with the State regulator. Not unlike experience at other DOE sites, regulator and stakeholder perceptions of LANL arrogance and fear that shortcuts will be taken have colored LANL's relationship. Improving that relationship requires demonstrating a clear commitment to compliance, meeting commitments, engaging the regulators early in emerging issues, sustaining an effective senior NMED/DOE/LANL senior management dialogue, speaking with one voice from LANL, and frankly, choosing battles wisely.

From the opposite perspective, the fact that cleanup at LANL under the Consent Order is still primarily in the investigation and evaluation phase has resulted in a frustration within DOE and Congress that not much cleanup progress is being made. LANL is developing an approach that supports early action, footprint and risk reduction, and will yield notably more tangible cleanup progress. That progress, in turn, is expected to support improved relationships with LANL's regulators and stakeholders.

One of the concerns by stakeholders is the availability of environmental data that may show the presence or absence of environmental contamination. A project called RACER (Risk Analysis, Communication, Evaluation, and Reduction) has been created at LANL in an effort to enhance the LANL's ability to effectively communicate the data and processes used to evaluate environmental risks to the public and the environment. The project includes data collected by both LANL and the New Mexico Environment Department, and provides the public with web-based access to environmental measurement data collected in and around the LANL site. While ready access to nearly six million data records is expected to generate numerous inquiries, we expect the overall cleanup-decision process will be facilitated.