Permit

ENTERED

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May 7, 2010

John E. Kieling, Program Manager
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
E-mail: john.kieling@state.nm.us

Re: Public Comments about the NMED Hazardous Waste Permit for LANL

Dear Mr. Kieling,

Concerned Citizens for Nuclear Safety (CCNS) submits the following public comment for the proposed New Mexico Environment Department (NMED) ten-year hazardous waste permit for Los Alamos National Laboratory (LANL). We submit the following documents and figures into the administrative record, as noted by their "exhibit" or "figure" number:

Exhibits

1. Exhibit CCNS-1. Resume of Joni Arends.

2. Exhibit CCNS-2. "Fire, Water and the Aftermath: The Cerro Grande Fire and Its Effect on the Rio Grande/Bravo Watershed" Conference Program.

3. Exhibit CCNS-3. Alvarez, Robert and Arends, Joni. White Paper: "FIRE, EARTH AND WATER: An Assessment of the Environmental, Safety and Health Impacts of the Cerro Grande Fire on Los Alamos National Laboratory, a Department of Energy Facility." 2000. http://www.nuclearactive.org/docs/CerroGrandeindex.html

4. Exhibit CCNS-4. LANL/Phelps. January 29, 2007 letter to CCNS regarding "Information Concerning Radionuclides in Water Supply Wells." http://www.nuclearactive.org/Water/Phelps.html

5. Exhibit CCNS-5. CCNS. March 20, 2007 CCNS Response to January 29, 2007 LANL/Phelps letter. http://www.nuclearactive.org/Water/Phelps.html

6. Exhibit CCNS-7. George Rice. Evaluation of *Corrective Measures Study Report for MDA H, SWMU 54-004, at TA-54,* Prepared for the MDA H Focus Group, August 7, 2003.

7. Exhibit CCNS-8. NMED. January 17, 2006 Air Quality Bureau Letter to DOE/LANL/Hargis canceling open burn permits 2195J [TA-11 Wood and Fuel Fire Test Site and TA-16 Flash Pad].

8. Exhibit CCNS-9. NMED. January 17, 2006 Air Quality Bureau Letter to DOE/LANL/Hargis canceling open burn permit for 2195K [DX-TA-36 Sled Track].

9. Exhibit CCNS-13. NMED. December 17, 2009 Press Release entitled, "Environment Department Issues Findings of Comprehensive Water Quality Assessment of Pajarito Plateau Watersheds in Northern New Mexico, Seeks Public Comment: *Study Shows Water Quality in Plateau Exceeds Standards for PCBS, Adjusted Gross Alpha, Selenium, Aluminum and other Metals.* http://www.nmenv.state.nm.us/OOTS/documents/PR-PajaritoPlateau-12-17-09jfh.pdf

10. Exhibit CCNS-14. CCNS. "January 16, 2010 Public Comments about the Draft 2010-2012 Clean Water Act Integrated 303(d) Pollutant List and Comprehensive Water Quality Assessment of the Pajarito Plateau Watersheds - Los Alamos National Laboratory."

11. Exhibit CCNS-17: Defense Nuclear Facility Safety Board (DNFSB). November 6, 2009 Weekly Site Rep Report: **Plutonium Facility - Safety Basis Strategy**. http://www.dnfsb.gov/pub_docs/weekly_reports/lanl/wr_20091106_la.pdf

12. Exhibit CCNS-18: DNFSB. November 13, 2009 Weekly Site Rep Report: **Sitewide Seismic Hazards**. http://www.dnfsb.gov/pub_docs/weekly_reports/lanl/wr_20091120_la.pdf

13. Exhibit CCNS-19. DNFSB. December 4, 2009 Weekly Site Rep Report: **Plutonium Facility - Documented Safety Analysis (DSA).** http://www.dnfsb.gov/pub_docs/weekly_reports/lanl/wr_20091204_la.pdf

14. Exhibit CCNS-20. DNFSB. March 15, 2010 letter to DOE Deputy Secretary, The Honorable Daniel B. Poneman.
http://www.dnfsb.gov/pub_docs/correspondence/all/cor_20100315.pdf

15. Exhibit CCNS-21. Albuquerque Journal. January 7, 2009 article: "Lab Firefighting Ability Questioned."

16. Exhibit CCNS-22. *CCNS News Update* "DOE Inspector General Finds Continuing Problems with LANL Fire Protection."
http://www.nuclearactive.org/news/092509.html

17. Exhibit CCNS-23. DNFSB. April 7, 2009 letter to DOE Secretary Steven Chu.
http://www.dnfsb.gov/pub_docs/correspondence/lanl/cor_20090407_la.pdf

18. Exhibit CCNS-24. DNFSB. July 28, 2009 letter to the Honorable Thomas P. D'Agostino, National Nuclear Security Administration.
http://www.dnfsb.gov/pub_docs/correspondence/lanl/cor_20090728_la.pdf

19. Exhibit CCNS-27. EPA. Training Module: *Introduction to Closure/Post-Closure (40 CFR Parts 264/265, Subpart G),* Solid Waste and Emergency Response (5305W) EPA530-K-05-009, September 2005, p. 11.

20. Exhibit CCNS-29. CCNS. Adapted from Westbay brochure.

Figures

Figure 1. Source: Figure 3.2-6 *in* LANL Report *MDA G CME Report – Rev 1* (LA-UR-09- 5509 September 2009). **(AR 32022)**

Figure 2. Figure 2.3-13 "Regional monitoring wells, water supply wells, and groundwater gradient" in LANL MDA G CME Report – Rev. 1 (LA-UR-09-5509 September 2009. **(AR 32022)**

Figure 3. Figure 2.3-13 "Regional monitoring wells, water supply wells, and groundwater gradient" in LANL MDA G CME Report – Rev. 1 (LA-UR-09-5509 September 2009. **(AR 32022)**

Figure 4. The NMED requirements for the network of monitoring wells at the Sandia National Laboratories Mixed Waste Landfill in Albuquerque, New Mexico.

Figure 5. The NMED requirements for the network of monitoring wells at the Sandia National Laboratories Chemical Waste Landfill in Albuquerque, New Mexico.

Figure 6. Location of Three Volatile Organic Compound (VOC) Vapor Plumes at Los Alamos National Laboratory Legacy Waste Dump MDA G. **(AR 30572)**

Figure 7. Location of three tritium hot spot areas below MDA G. **(AR 32022)**

Thank you for your consideration of our comments.

Sincerely,

Joni Arends
Executive Director

Enclosures

Joni Arends

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Santa Fe, NM 87504-8313
(505) 986-1973

Education

Vermont Law School, South Royalton, VT
Juris Doctor and Master of Studies in Environmental Law, May 1998.

- Leopold Schepp Foundation Scholar (character scholarship supporting education that will benefit the general welfare of humankind).
- Jonathon B. Chase Scholarship for Social Justice, Summer 1997.

St. John's College, Santa Fe, NM
Bachelor of Arts, Great Books Program, May 1994.

Experience

Executive Director/Waste Programs Director, Concerned Citizens for Nuclear Safety (CCNS), Santa Fe, NM, August 1998 to present

- Conducting citizen sampling of the springs and biota below Los Alamos National Laboratory (LANL) along the Rio Grande through the *Rio Grande Watershed Initiative.*
- Bringing attention to problems with, and seeking solutions for, LANL groundwater protection practices with Robert H. Gilkeson, Registered Geologist and LANL whistleblower.
- Auditing radioactive emissions from LANL under the federal Clean Air Act citizens' suit CCNS v. Department of Energy (DOE) (D.N.M. 94-1039 M) Consent Decree.
- Monitoring and effecting decision making about radioactive wastes, environmental emissions and transportation issues focusing on DOE sites in New Mexico, including LANL and the Waste Isolation Pilot Plant.
- Providing public outreach, education and legislative review, participating in both local and national organizing efforts focusing on environmental protection, public health, implementing the precautionary principle and networking.
- Fulfilling organizational management duties, including supervising student interns and overseeing communication between the Board of Directors and staff.

Legal Intern, Nuclear Litigation Section, Natural Resources Defense Council Washington, DC, Spring 1998

- Performed legal research for complex federal court cases about DOE compliance with environmental regulations at nuclear facilities across the United States.

Legal Intern, American Environmental Health Studies Project, Inc.
Knoxville, TN, Summer 1997

- Researched legal and health issues for litigation concerning DOE workers and whistleblowers and DOE's proposal to recycle radioactive scrap metal.

Co-Founder and Outreach Director, Concerned Citizens for Nuclear Safety
Santa Fe, NM, 1988-1992

Memberships

Member, New Mexico Bar.

EXHIBIT
CCNS-1

FIRE, WATER AND THE AFTERMATH:

THE CERRO GRANDE FIRE AND ITS EFFECT ON THE RIO GRANDE/BRAVO WATERSHED

SATURDAY, JULY 8, 2000 • 9AM-6PM

ELDORADO HOTEL BALLROOM, SANTA FE

What is Being Done to Protect Our River?

In the aftermath of the Cerro Grande Fire, the Rio Grande stands threatened by radioactive and hazardous wastes from Los Alamos National Laboratory (LANL). The destruction by fire of a vast area of mountain vegetation surrounding the Laboratory will cause flooding, erosion, and runoff that could transport nuclear and hazardous contaminants into the Rio Grande/Bravo Watershed. We need a long range plan to protect the river and our watershed.

The purpose of this conference is to broaden public awareness about the health and environmental risks and to encourage independent oversight of LANL's measures toward protecting New Mexico's largest watershed.

FIRE, WATER AND THE AFTERMATH:

The Cerro Grande Fire and Its Effects on the Rio Grande/Bravo Watershed

DEFINING THE CONTEXT	**9:00 AM TO 12:00 NOON**
WELCOME	Anna Christine Hansen & Suzanne Westerly
INVOCATION	
THE RIO GRANDE	Jose Lucero
OVERVIEW AND FACILITATION	Toby Herzlich & Mike Finney
FRAMING THE ISSUE	Robert Alvarez
TIME BOMB IN THE FOREST	Keith Easthouse
WATER QUALITY & BORDER ISSUES	Cynthia Lopez
ACCOUNT OF WHITE ROCK CANYON, JULY 4th	Jon Asher

10 minute break

TRADITIONAL LAND MANAGEMENT	Louie Hena
ASPECTS OF ENVIRONMENTAL TRANSPORT	Owen Hoffman
EFFECTS OF EXPOSURE AND RISK ANALYSIS	Jim Ruttenber
PSYCHOSOCIAL EFFECTS OF DISASTER	Chellis Glendinning
RESTORATION OF THE RIO: A MATTER OF HEART	Deb Hibbard
CONTEXT STATEMENTS AND CONCERNS	Audience Comments
THE IMPORTANCE OF CITIZEN OVERSIGHT	

lunch break

DEFINING THE INTERVENTIONS	**1:30 PM TO 6:00 PM**
WHO'S ACCOUNTABLE FOR WHAT?	Robert Alvarez
Dept. of Energy & Los Alamos Nat. Lab:	
DOE'S COMMITMENT TO THE ENVIRONMENT.	John Themelis
LANL'S ENVIR. PROTECTION OBJECTIVES	Lee McAtee
DOE PROTECTIVE ACTIONS FOR THE ENVIRONMENT	Ted Taylor
WATERSHEDS & WILDFIRES	Ken Mullen
CONTAMINANTS, SEDIMENTS, FLOODS	Steven Reneau

10 minute break

NEW MEXICO ENVIRONMENT DEPT. (NMED) & STATE ENGINEER:

CERRO GRANDE FIRE SAMPLING	Ralph Ford-Schmid
CONTAMINATION, TRANSPORT AND RELATIVE RISK	James Bearzi
SURFACE WATER QUALITY & THE COMMUNITY	James Davis

10 minute break - reset tables

CLARIFY AND EXPAND	A Dialogue among Presenters
TAKE IT TO THE COMMUNITY	A Dialogue with the Audience
WHAT'S NEXT? ACTION STEPS	
CLOSING PRAYER	

Bios of Speakers in order of Appearance

ANNA CHRISTINE HANSEN, Chairperson for CCNS. She has an MA in photography from UNM and works as a freelance graphic designer, photographer and part-time instructor at Northern New Mexico Community College. She has lived in New Mexico for the past 27 years.

SUZANNE WESTERLY is Acting Executive Director of CCNS and Community Radiation Edu. Program Director. She is also a photo journalist and with frequent features in *News from Indian Country.*

JOSE H. LUCERO, consultant, is a resident and member of the Santa Clara Pueblo. He frequently travels throughout the United States and the world speaking on behalf of Indigenous People of North and South America. Mr. Lucero holds a Bachelor of Science degree from UNM and a Masters of Education degree from Antioch College. He will discuss *The Rio Grande.*

MIKE FINNEY, PH.D. in management and organization, works nationally with groups to design and implement wellness strategies benefiting public health. He is providing technical support in developing the citizen oversight process.

TOBY LYNN HERZLICH is a professional facilitator dedicated to deepening understanding and promoting collaborative problem-solving among groups with highly diverse viewpoints.

ROBERT ALVAREZ is currently the Director of the Nuclear Policy Project a non-profit research organization in Washington, DC. He is considered one of the nation's primary experts on nuclear weapons, civilian nuclear energy and environmental health policies. Between 1993 and 1999, Mr. Alvarez served as a Senior Policy Advisor to the Secretary of Energy National Security and Environmental Policy. He will discuss *Framing the Issues* and *Who Accountable for What.*

KEITH EASTHOUSE, a veteran environmental and science journalist, covered Los Alamos National Laboratory for the Santa Fe New Mexican from 1991 to 1998. Presently, he is associate editor of Forest Magazine, a bi-monthly environmental issues publication based in Eugene, Ore. Last year, in what turned out to be a prescient report, he wrote *Time Bomb in the Forest*, which focused on the extreme fire hazard at Los Alamos.

CYNTHIA LOPEZ, Ph.D. in Epidemiology from Harvard School of Public Health. Currently Assistant Professor, UNM, Dept. of Family and Community Medicine. She will be discussing WATER QUALITY OF THE RIO GRANDE AND BORDER ISSUES.

JOHN ASHER owns Kokopelli Rafting and every summer takes children on educational rafting excursions. He will discuss the condition of that part of the Rio Grande on July 4.

LOUIE HENA is the Environmental Director for Picuris Pueblo and member of Tesuque Pueblo.

OWEN HOFFMAN, PH.D., is president and director of SENES Oak Ridge, Inc., Center for Risk Analysis. He is an environmental scientist with more than 25 years experience in the field of radioactivity. He has studied aspects of environmental transport and health consequences of iodine-131 and other radionuclides released from nuclear facilities. He will be discussing *Aspects of Environmental Transport of Radiation.*

JIM RUTTENBER, PH.D. & M.D., is an environmental and occupational epidemiologist in the Dept of Preventive Medicine and Biometrics, University of Colorado. He was a medical epidemiologist at the Centers for Disease Control and Prevention. He studies relationships between disease and exposures to toxic agents in the environment. He will be discussing *Effects of Exposure and Risk Analysis*

CHELLIS GLENDINNING, PH.D., is a psychotherapist and author of four books, including the Pulitzer Prize-nominated, *When Technology Wounds, Waking Up in the Nuclear Age.* In 1991 she sat on the Board of Listeners of the World Uranium Hearing in Salzburg, Austria. She graduated from the University of California and lives in Chimayo, New Mexico. She will be discussing *Psychosocial Effects Of Disaster.*

DEB HIBBARD efforts are inspired by her commitment to collaboration, creative conflict resolution and community building. She is the community outreach director for Rio Grande Restoration where she puts to good use her more than 25 years of experience as a community educator and organizer. She will be discussing *Restoration Of The Rio Grande: A Matter Of Heart.*

JOHN THEMELIS, B.S., is Acting Deputy Assistant Manager for the Office of Environmental Operations and Services at the Department of Energy's Albuquerque Operations Office. He is responsible for planning, developing, implementing and managing environmental restoration, waste management and transportation projects. He will discuss *DOE's Commitment to the Environment.*

LEE MCATEE is LANL's Deputy Division Director for Environment, Safety and Health. He is currently serving as Technical Advisor to the Laboratory's Emergency Rehabilitation Team, which is coordinating flood control actions in the aftermath of the Cerro Grande Fire. Lee has degrees in Radiation Protection, Radiation Biology. He will discuss *LANL'S Environmental Protection Objectives.*

TED TAYLOR, Ph.D. in economics, is the Environmental Restoration Project Manager at the DOE Los Alamos Office. He manages the LANL's Environmental Restoration Project for DOE. His experience includes more than 20 years service in energy research and environmental protection for the federal and state governments. He will discuss *DOE Protective Actions for the Environment*

KEN MULLEN, Ph.D. in analytical chemistry, is the Watershed Management Program Leader for LANL and the Pajarito Watershed Partnership. He has a fair amount of experience as a hydrological technician, setting his career to work in water quality. He will be discussing *Watersheds And Wildfires.*

Steven Reneau, Ph.D. Geology, U.C. Berkeley, works with the Geology and Geochemistry Group, LANL Team Leader for Sediment Characterization, Canyon Focus Area, Environmental Restoration Project. His specialty is geomorphology and environmental geology. He will be discussing *Contaminants, Sediments, And Floods At Los Alamos.*

Ralph Ford-Schmid, obtained a BS in Biology from Western New Mexico University in 1990. He has worked for DOE Oversight Bureau since 1994. Prior to this he worked for the New Mexico State Engineering, the U.S. Forest Service, and as a reactor operator at the Prairie Island Nuclear Generating Plant. He will discuss *Cerro Grande Fire Sampling.*

James Bearzi is Chief of New Mexico's Hazardous Waste Bureau, which regulates hazardous and mixed-waste management in New Mexico. He hold a M.S.degree in Earth Sciences, and has been with the Environment Department for ten years. He will discuss *Contamination, Transport and Relative Risk.*

James H. Davis, is an over-educated DWM. Ph.D. NMSU, MS U of U, BS UNM, all in Biology. Responsible. Has held only two jobs in the last 20 years. Currently BC of SWQB, NMED. Enjoys public meetings. He will be discussing *Surface Water Quality And The Community.*

CCNS STAFF AND CONFERENCE ORGANIZERS

Joni Arends, J.D. and Masters in the Studies of Environmental Law from Vermont Law School. She co-founded CCNS in 1988 and is CCNS Waste Program Director.

Coila Ash, Administrative Manager for CCNS.

Marian Naranjo is Native American Outreach Director for CCNS, a member of Santa Clara Pueblo and a potter.

Vickie Downey is a Tewa language teacher and a member of Tesuque Pueblo and Tewa Women United.

Conference Co-Producer

Leslie Larsen has been producing and directing multicultural video and live events here in Santa Fe since 1984. She founded Global Gatherings to explore issues of immediate social importance.

CCNS Board Members:
Anna C. Hansen, Chair;
Deborah Reade, Vice Chair;
Charlotte Cooke, Secretary;
Harley Brewer, Treasurer;
Michael Vigil
Carl Tsosie
David Brownlow.

Special Thanks to Eldorado Hotel, Pinon Press, Copyshack, The Flower Market and all volunteers and speakers who have worked to make this conference a success.

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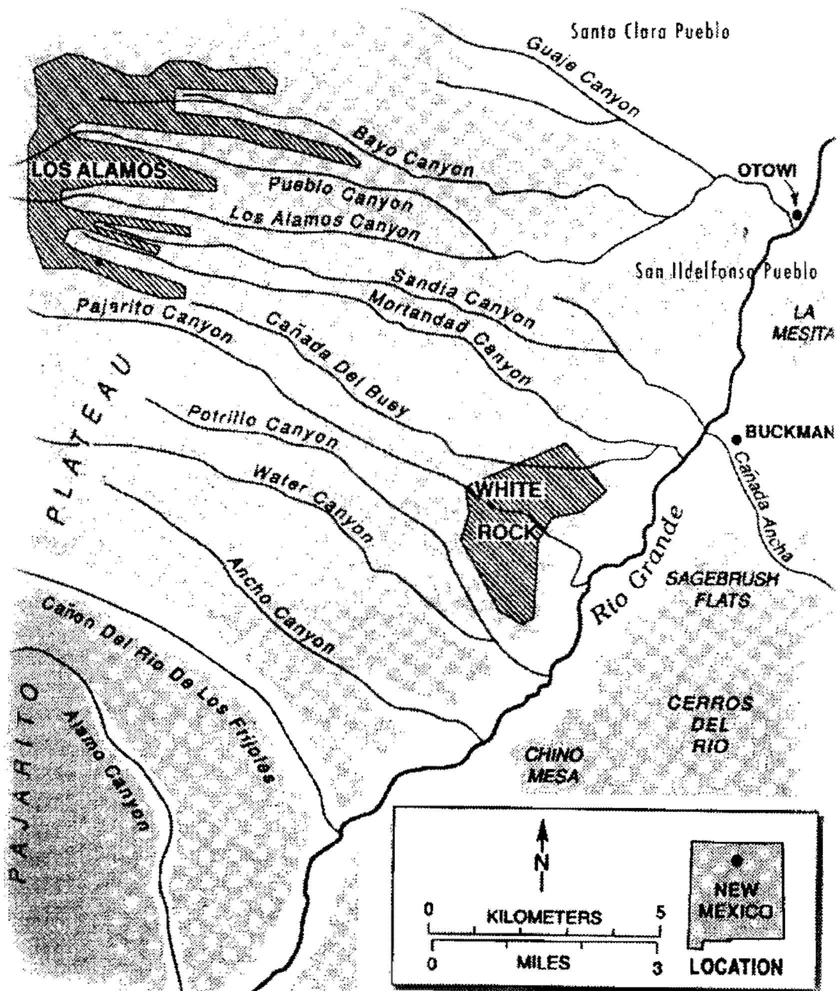

Map from *Plutonium and The Rio Grande* by William L. Graf

FIRE, EARTH AND WATER:
An Assessment of the Environmental, Safety and Health Impacts of the Cerro Grande Fire on Los Alamos National Laboratory, a Department of Energy Facility

by Robert Alvarez and Joni Arends
for Concerned Citizens for Nuclear Safety and the Nuclear Policy Project
Edited by Charlotte Cooke and Tamara Bertell

December 2000

Executive Summary

Summary and Recommendations

Background

Between May 4 and June 10, 2000, a devastating wildfire swept across the Bandelier National Monument in the Jemez Mountains of New Mexico and onto the Department of Energy's Los Alamos National Laboratory (LANL). The Cerro Grande fire burned about 43,000 acres, including 7,500 acres of LANL property. Large areas of vegetation in the Jemez Mountains surrounding LANL were destroyed.

The fire left more than 400 Los Alamos residents homeless, destroyed or damaged several hundred structures and disrupted the operation of the entire LANL site. The fire spread over several hundred waste disposal sites and areas contaminated with radioactivity and other hazardous materials.

While it raged, the fire released radioactive and hazardous airborne contaminants from LANL and from burning vegetation and debris. In the fire's aftermath, the magnitude of its destruction significantly changed environmental conditions and has increased the risks of flash floods, surface and groundwater contamination, and large amounts of LANL contaminants entering the Rio Grande.

The Department of Energy (DOE), LANL, other federal agencies, and the State of New Mexico have taken prompt actions to mitigate risks and have made progress in providing the public with prompt and detailed information pertaining to the risks from the fire aftermath. According to a recent assessment, DOE found that the serious environmental and safety problems associated with flash floods, erosion, and contaminant run-off will persist at LANL for three to five years.

The Cerro Grande Fire Aftermath

In the aftermath of the Cerro Grande fire, cleaning up the contaminant burden at LANL warrants a high priority. There are numerous disposal pits, burial grounds, underground tanks, and hundreds of shafts filled with radioactive and hazardous wastes that have accumulated for more than a half century. Test facilities released large amounts of radioactive materials into the environment, creating severe contamination. All told, there are over 2,120 potential release sites at or near LANL. In June 2000, DOE concluded that the amount of buried transuranic wastes at LANL is approximately 10 times greater than previously estimated. Moreover, LANL expects to generate several hundred thousand cubic meters of additional radioactive and hazardous wastes.

The Pajarito Plateau, on which LANL is located, consists of fingerlike mesas and deep canyon systems. Of particular concern are several canyons, a reactor site, and various heavily industrialized sites. These canyons, including Mortandad, DP, Water, Pueblo, Acid, and Los Alamos, received decades of radioactive and hazardous discharges. Runoff from these canyons can potentially drain well beyond the boundary of LANL and eventually flow into the Rio Grande.

Specific Concerns

Airborne Releases of Contaminants
Fire and winds swept across contaminated waste disposal areas at LANL and may have carried LANL contaminants to areas offsite. LANL found that the increased radioactivity in the ambient air was from naturally occurring radioisotopes that result from the decay of radon. As a result, there may be significant gaps in the data.

Additionally, DOE did not deploy aerial monitoring aircraft to measure contaminants in the smoke plume or to assess potential localized "hot spots" that the fire may have created. Another important concern is the potential for the resuspension of LANL contaminants caused by the fire's disruption.

Large amounts of smoke containing hazardous constituents from burning trees and debris posed acute health risks to those who may have been exposed to the heavy smoke, particularly to the elderly, the young, and people with respiratory diseases.

Flooding and Erosion Risks
The Cerro Grande fire denuded the mountains surrounding LANL and several watersheds that feed into the Rio Grande. The site's extensive canyon drainage system consists of steep slopes, which accelerate the flow of water, sediment, and debris flow from nearby mountains. This greatly increases the volume and velocity of water, runoff, and debris that could wash through LANL property. Fortunately, this year's monsoon season has ended with only a few powerful storms. Of the watersheds that run through LANL property, those of greatest present concern, include:

- Pajarito Canyon (TA-18): Facilities at risk along this canyon include the nuclear reactor criticality test facilities and a vault containing significant quantities of plutonium and highly enriched uranium. The community of White Rock, New Mexico is directly downstream from this canyon.
- Los Alamos Canyon (TA-41, TA-2): Facilities at risk along this canyon include the defunct, and contaminated, Omega West Reactor. Because the reactor is on a canyon bottom, it is vulnerable to slope instability that could result in mudslides, and the falling of debris and large rocks.
- Pueblo Canyon: Structures at risk along this canyon include the Diamond Drive road crossing and utility facilities for Los Alamos County.
- Water Canyon. Significant amounts of residual high explosives from a firing site and contamination already existing in the canyon bottoms could be carried away during flooding into the Rio Grande.

In addition to the aforementioned canyons, several other canyons also have contaminated sediments that could potentially wash downstream. An additional 77 waste disposal sites and contaminated areas have been identified by LANL as being on potential flood plains. LANL and other federal agencies have taken several prompt steps to reduce flood and erosion risks by building water retention structures (dams), channels, and barriers.

Erosion and Runoff into Water Supplies
There is a watershed drainage network of twelve canyons that run through LANL property and ultimately feed into the Rio Grande. Experiences with fires elsewhere suggest that the watersheds running though LANL property will dramatically increase their yields of contaminant-bearing sediment.

On July 8, 2000, Concerned Citizens for Nuclear Safety (CCNS) and the Nuclear Policy Project held a one-day conference in Santa Fe, entitled *Fire, Water and the Aftermath: The Cerro Grande Fire and Its Effect on the Rio Grande Watershed.* At the conference, a LANL soil expert stated that runoff could carry as much as 300,000 cubic meters of contaminated soil, the equivalent of a football field 300 feet high, into the largest fresh water artery in the state. As of September 2000, after modest rainfall, LANL reported that:

- Several dissolved metals were found to exceed screening levels and were being analyzed further.
- Cyanide levels two times above those that are immediately harmful to fish were measured in water and sediments in several canyons and burned areas.
- Low levels of polychlorinated biphenyls (PCBs) were detected in water and sediment samples. Bioaccumulation of PCBs in the food chain is of great concern because there have been numerous high concentration PCB spills from leaking LANL transformers.
- Cesium 137 concentrations in suspended material are five to 20 times higher than pre-fire levels. Plutonium and strontium 90 concentrations increased five to 10 times and two to five times, respectively.

Ground Water Contamination
There are several concerns about LANL's efforts to mitigate flooding and runoff. Impoundments and sediment traps could enhance the downward migration of contaminants into the aquifers beneath the site. On the other hand, erosion can also expose buried wastes.

LANL contaminants have already entered alluvial and perched aquifers as well as the main aquifer. Site baseline measurements and the means of detecting migrating contamination to offsite locations is an ongoing weakness at LANL.

Of concern is the Material Disposal Area (MDA) AB at Technical Area-49, where approximately 40 kilograms of plutonium and other materials were released into shallow shafts from test explosions. According to a LANL study, this area has the largest source of environmental radioactivity at the site.

Over the years, official assumptions about the subsurface migration of plutonium at DOE sites have proven to be wrong. Recently it was discovered that plutonium at the Nevada Test Site had migrated greater distances than previously assumed because it binds to microscopic particles that travel easily through subsurface barriers.

Offsite Radiological Contamination

Environmental contamination in offsite areas is a continuing problem. Ownership of some inactive waste sites has been transferred to Los Alamos County and private owners. LANL has yet to complete and present to the public a formal risk characterization of all inactive waste sites.

In the early 1990s, LANL identified 110 inactive waste sites. Approximately 300 Los Alamos property owners were living and working on or near these areas. LANL did not inform the property owners for more than a year after the situation was analyzed and written up.

Excessive plutonium contamination was recently detected in the south fork of Acid Canyon, a public area in Los Alamos County and situated in the midst of residential dwellings. In 1967, this area was released for unrestricted public use. The south fork was the main discharge point for treated and untreated radioactive and hazardous wastes between the 1940s and the early 1960s.

In April 2000, plutonium concentrations approaching 8,000 picocuries per gram (pCi/gm) were found by LANL in Acid Canyon. Contaminant levels such as these are normally found inside restricted areas at weapons sites where workers are provided protective measures, including clothing and equipment. An example of compliance with the Environmental Protection Agency Guidance for plutonium levels is soil is that of the U.S. Defense Department which set a cleanup limit of 13 pCi/gm in the soil at the Johnston Atoll. In addition to risks to area residents, particularly children who may be exposed, plutonium in Acid Canyon could commingle with storm water runoff coming from Pueblo Canyon and be transported to the Rio Grande.

Recommendations

A Strategic Plan for Environmental Risk Reduction
In the aftermath of the Cerro Grande Fire, a unique and unprecedented set of questions presents themselves:

- What are the risks to human health from the release of airborne contaminants from the LANL site?
- Are the DOE and LANL prepared to address the dangers of flash floods washing down denuded terrain through canyons?
- How have fire and post-fire efforts to control erosion and flooding influenced the subsurface migration of contaminants?
- What is the nature and extent of the contaminant burden from LANL operations in the Rio Grande? How much will be added to this burden?
- What are the environmental and health impacts and risks from LANL contaminants in the Rio Grande?

DOE and LANL lack an overall long-term strategic environmental protection and risk reduction plan. A number of activities to analyze and assess the environmental impacts after the Cerro Grande have been instituted by several federal agencies, DOE, LANL, and the State of New Mexico. A major concern about these activities is that they are mostly palliative, short-term, and lack clearly articulated environmental protection goals. The environmental protection goals for the strategic plan include:

- The quantification of the nature and extent of the environmental, safety, and health risks associated with the fire and its aftermath.
- Protection of the environment and health of those who depend on the air, soil, and water.
- Development of a strong scientific and ecological basis for operational, siting and cleanup decisions.
- Improvement of the overall water quality of the Rio Grande Watershed as a strategic artery for the nation.
- Independent monitoring and oversight by members of the public and LANL workers with an emphasis on trust and transparency.
- Targeted reduction of the burden of contaminants at and near the LANL site.

An Airborne Contaminant Risk Assessment
A dose reconstruction study of potential exposures from airborne contaminants should be undertaken. At present, screening levels for the ambient air monitoring systems have not been validated by actual data. At the minimum, source terms for areas hit by the fire and winds should be established so that a comparison can be made between the source terms and the actual air monitoring data. The risks LANL radioactive and hazardous contaminants in the smoke from burning vegetation and debris should be included in this review.

Quantification of Environmental Source Terms
Accurate inventories of the contaminant burden from buried waste sites and discharges into canyons have not yet been developed by LANL. While it may not be feasible to develop source term estimates for all 2,120 potential release sites, it is essential to determine inventories for the most heavily contaminated areas, including burial grounds, test areas, and canyons. Without a reasonable quantification of the contaminant burdens or source terms that could migrate into surface and groundwaters from LANL operations, transport, uptake, and risk assessments will be tenuous at best.

Enhanced Vadose Zone Characterization
There are major concerns about the adequacy of LANLs program to characterize the impact of subsurface contaminants on surface and groundwater quality. Major issues that should be addressed include:

- At present, the seep-spring recharge mechanisms are not well understood.
- There is an inadequacy of site baseline measurements and the means of detecting migrating contamination from offsite locations.
- There is a lack of water well data about the effect of the faults on groundwater recharge and directional flow, potential infiltration zones, and seismic history on both sides of the fault zone at the site.
- There is an inadequacy of characterization data regarding surface flow contaminants infiltrating into perched aquifer zones in Los Alamos Canyon, which ultimately outcrop as seeps and springs at the confluence of the Rio Grande.
- There is an inadequacy of data regarding contaminant transport pathway mechanisms, and the impact of contaminants on canyon-specific perched aquifer systems.

Mass Budget Modeling of Contaminants in the Rio Grande
As sediments bearing radionuclides and other contaminants from LANL enter the Rio Grande and then move to reservoirs and eventually to the Gulf of Mexico, significant portions are deposited and stored in river sediments and on flood plains. A mass budget analysis determines the amount, types, and locations of LANL contaminants distributed in and around the Rio Grande compared to how much is moved to reservoirs and the ocean. Such an analysis requires information about the water and

sediment movement over large areas because contaminants move with the sediments. In particular, bedload transport models are important for predicting the movement of contaminants.

Wildlife Uptake and Effects Assessments
The impact of contaminants on the wildlife in the Rio Grande watershed system can provide valuable, direct, and timely data. Plants and animals absorb and concentrate contaminants in river environments and therefore should be carefully studied. For many years, research about the effects of man-made contaminants on wildlife health, mortality, and propagation have been done. These studies serve to enlighten efforts to protect endangered species, reduce human health risks, and to validate compliance with environmental standards.

In addition to studying the biota on and near LANL property, the uptake and effects on fauna and flora biota in the river, the flood plain and sediment deposit areas, such as the Cochiti Dam, should be incorporated into measuring the transport and deposition of LANL contaminants and ascertaining their effects.

Human Impact Assessment
There are several ways in which LANL's radiation pollution adversely affects the people of Northern New Mexico. At risk is human health, ecologic viability, cultural vitality with particular regard to the many diverse, rural communities surrounding LANL, and the economic well-being of the entire region which depends upon agriculture and tourism.

The issue of human health is complicated. The scientific database regarding the destructive potential of ionizing radiation is well-established. At issue is the question of low dose radiation pollution occurring over a long period of time via multiple environmental pathways such as air, water and food supplies.

Two types of data contribute to our understanding of this problem. The first is epidemiologic studies that extrapolate from large and disastrous radiation exposures such as Nagasaki, Hiroshima and Chernobyl to understand the risks of low dose exposures. A growing body of epidemiologic data is derived from at-risk low dose populations such as employees in nuclear industries and residents exposed to industry pollution and waste products. These studies depend upon accurate dose information (reconstruction) which requires meticulous measurements of pollutant emissions and vigorous recordkeeping by industry. Needless to say, the nuclear industry has been neither conscientious nor cooperative regarding such efforts. The second type of data regarding the harmful effects of chronic low dose radiation pollution comes from basic science research that conclusively demonstrates that radiation creates DNA-damaging ionization tracts through human and other biologic tissue. The creation of these tracts and the DNA damage they cause are not dependent upon dose. Lower doses simply create fewer ionization tracts--not less damaging ones.

In this case, human health risks are largely based on extrapolations using risk models that generally take into account the amounts of contaminants released, their transport pathways and ecological uptake, human uptake, dose, and risk estimation.

Understanding the limitations of studying a small population, we recommend an epidemiologic study of the exposed versus non-exposed groups. The most vigorous study involves accurate dose data and reconstruction. This information exists for LANL employees, recent past and present. A vigorous and comprehensive study of LANL employees (which has not yet been done) presents the ideal opportunity to add to the database. Studies of the communities living around LANL are also important, not only to respond to the health concerns and suspicions of the people in these communities, but also to investigate the various environmental pathways that are transporting LANL's radioactive waste materials into other areas such as the state's main waterway, the Rio Grande. This type of study would be difficult for several reasons but should still be done because it is morally imperative. The small size of these populations, in addition to the low doses of radiation, means the study results would most likely not reach statistical significance. But notable trends could be followed over a period of years. In addition, there is very little dose data due to the lab's inadequate record keeping and dearth of environmental science involving the pathways. An epidemiologic investigation requiring information of these types would give scientific and political impetus to begin a more vigorous examination of these things.

Specific attention needs to be given to the many diverse, rural communities surrounding LANL. Due to their traditional proximity to the land (and its contaminants), the these communities may be in contact with unique environmental pathways that need to be studied.

Other methods involve the collection of human health information, such as symptoms, disease incidence and mortality, which is statistically compared with unexposed groups.

Also, a follow-up study should be done to ascertain if hazardous smoke from the fire caused acute harm to human health.

Independent Monitoring and Oversight

The CCNS Clean Air Act Compliance Model for LANL
To answer these questions, an integrated effort with a strong scientific underpinning and public credibility is essential. A model that could achieve these objectives is the independent technical audit and oversight program established to ensure LANLs compliance with federal Clean Air Act radionuclide emission standards established by Concerned Citizens for Nuclear Safety (CCNS) as a result of their citizens' suit against DOE in 1994. The overall process has yielded multiple benefits relative to achieving and validating Clean Air Act compliance in a way that has strong public support and credibility.

The CCNS Clean Air Act Audit Model for LANL contains:

- Comprehensive independent technical audits to verify whether LANL is in full compliance with the Clean Air Act radionuclide emission standard. 40 CFR 61, Subpart H.
- An independent auditor (Risk Assessment Corporation [RAC]) chosen by the agencies and citizens and is paid for by DOE.
- A scope of work to be determined by the independent auditor (RAC).
- Technical consultants to the audit process who are responsible to the citizens and are paid for by DOE through the

Department of Justice.

- A draft final report written and submitted to the parties for comments. The comments and the responses by the independent auditor are included in the final report.

A Proposal for Independent Auditing and Oversight
In the context of the Cerro Grande fire aftermath, a Clean Air Act-type audit model could be structured in the following manner:

- *Technical Audits*
  DOE, through the New Mexico Environment Department, should fund a series of technical audits. The audits would review the major technical activities at LANL with respect to risk mitigation and environmental safety, and health assessments being done by the laboratory in the aftermath of the Cerro Grande fire.

  The technical audit team would prepare draft final report with opportunity to comment. Comments and responses to comments will be included in final report

- *Cerro Grande Fire Citizen Oversight Panel*
  A "Cerro Grande Fire Citizen Oversight Panel," consisting of affected groups, such as the Pueblos, farmers, recreational river businesses, and citizen groups, would oversee these audits through independent technical experts that review the work of the auditors. The Oversight Panel would be responsible for reviewing the work scope, spot-checking ongoing work, and review of the final work products.

- *Independent Expert Review of the Audits*
  Each technical audit would have independent technical expertise and report to the Cerro Grande Fire Citizen Oversight Panel. These experts would be paid from the funding of each technical audit. Commensurate with the technical audit teams, the independent experts would be responsible for review of work scope, spot-checking ongoing work, and the final reports.

Background

On May 4th of this year, National Park Service employees set what they planned to be a "controlled burn" to reduce and eliminate drying under-brush and dead growth in the Bandelier National Monument in northern New Mexico. It quickly got out of control and by May 8th out-of state firefighters were called in to battle a major wildfire. Over the ensuing days, the Cerro Grande fire became the largest wildfire in the history of New Mexico, blazing around and on the Department of Energy's Los Alamos National Laboratory (LANL).

On July 8th Concerned Citizens for Nuclear Safety and the Nuclear Policy Project convened a conference in Santa Fe, New Mexico. The purpose of the conference was to address the environmental, safety and health implications of the Cerro Grande fire and its aftermath. Conference participants included representatives of the Department of Energy, LANL, the State of New Mexico, Indian Nations, business people, citizen groups and concerned citizens. As a follow up to this conference, this "white paper" was prepared.

The risks of wildfires have a higher probability of occurring than any other natural danger at Department of Energy nuclear sites around the country. In addition to the Cerro Grande fire, there were two other major wildfires that impacted DOE sites this year. The Hanford wildfire in Washington burned over 192,000 acres in late June. In late July a wildfire cut a swatch about twelve miles long and four miles wide at DOE's Idaho National Engineering and Environmental Laboratory, coming close to large amounts of stored nuclear wastes, and forcing the evacuation of 1,800 workers.

DOE sites have buried wastes and extensive surface contamination whose migration and dispersion in the environment is retarded by soil and vegetation. Nuclear-site wildfires burn off protective layers of soil and vegetation, causing radioactive and other hazardous materials to be carried over great distances. Fires can disrupt safety systems at nuclear facilities, leading to loss of power and ventilation. They can ignite waste areas containing solvents, hydrogen and flammable forms of nuclear materials.

Since 1954, there have been five major fires that burned in the Los Alamos Laboratory area -- the Water Canyon fire in 1954, the La Mesa Fire in 1977, the Dome fire in 1996, the Oso fire in 1998, and the Cerro Grande fire in 2000. In 1998, after being urged by Concerned Citizens for Nuclear Safety, DOE and LANL performed a formal site-wide wildfire risk assessment, which led to the reduction of vegetation around nuclear areas. Had this not been done, the Cerro Grande Fire probably would have had much more serious radiological consequences to public health and the environment.

The Cerro Grande fire burned about 43,000 acres, including 7,500 acres of Laboratory property. Large areas of vegetation in the Jemez Mountains surrounding the Laboratory were destroyed. The fire left more than 400 Los Alamos residents homeless, destroying or damaging 235 structures in the city of Los Alamos. On the laboratory site the fire destroyed or damaged 112 structures, and disrupted the operation of 237 facilities. It spread over 343 waste disposal sites and areas contaminated with radioactivity and other hazardous materials. The Los Alamos National Laboratory

The Los Alamos National Laboratory (LANL) was established in 1943 and occupies about 43 square miles of land situated on the Pajarito Plateau east of the Jemez Mountains of north-central New Mexico. The Laboratory's primary mission is focused on nuclear weapons. As the birthplace of the first nuclear weapons, LANL has for more than a half century played a central role in the design, development, production and testing of America's nuclear arsenal. Currently LANL has a major role in the DOE's. nuclear weapons stockpile stewardship and management program.

The University of California has managed Los Alamos National Laboratory since World War II. The recently created National Nuclear Security Agency, nested within the DOE, has the lead management responsibility. The annual operating budget for LANL is about $2.5 billion, about 15 percent of the total budget for the Department of Energy. The Laboratory has over 11,000 contractor and DOE employees.

LANL is divided into 49 separate Technical Areas. It has over 2,000 structures of which 425 contain radioactive and hazardous materials. These include radio-chemical processing and laboratory facilities, high-explosive production and testing facilities, small nuclear reactors in Technical Area -18, buried wastes, accelerators, and nuclear material processing and storage facilities. According to a 1994 DOE plutonium vulnerability assessment, about 2.6 metric tons of plutonium are stored at 24 facilities at the Laboratory.

Waste Storage and Disposal

LANL has been disposing radioactive and non-radioactive hazardous wastes since 1944. Throughout the history of the Laboratory, the principal means of disposal has been pits and hundreds of shafts. Waste areas also include former test facilities where radioactive and non-radioactive hazardous materials were released to the environment. These areas include uranium ordinance testing areas, hydronuclear and weapons components experiments.

The vast preponderance of environmental contamination at LANL is in the subsurface. Like other nuclear weapons sites, the underlying design basis for waste management, for many decades, was to use the environment the Laboratory occupied as a disposal and storage medium. Contaminants were regulated at the point at which they reached the site boundary, not at the point of discharge - creating significant and irreversible contamination concentrations in soil, sediment and water.

Various facilities at the laboratory generate radioactive and non-radioactive wastes at 33 technical areas. The wastes types generated at LANL include: transuranic waste, and mixed transuranic waste, low-level and low-level mixed radioactive wastes, hazardous chemical waste, metals, biological waste, medical waste and sanitary solid and liquid waste. Radioactive and toxic wastes include Laboratory trash (mostly combustible), equipment, chemicals, oil, animal tissue, chemical treatment sludge, cement paste, hot-cell waste, classified materials, liquid discharges, sludge as well as building debris, large pieces of equipment and soil or rock generated or uncovered during site cleanup.

The wastes are contaminated with transuranic radionuclides (plutonium-238, plutonium-239, or Americium-241), uranium (enriched, depleted or normal or U-233), fission products, induced activities or tritium, metals (beryllium), and organic compounds (PCBs , solvents).

Until 1973, when DOE's predecessor, the Atomic Energy Commission, issued more stringent waste disposal standards, few, if any, attempts were to segregate wastes in disposal areas. For many years, the preferred storage container for a significant amount of Laboratory wastes was the cardboard box. Drums were not stacked and were allowed to leak, and waste oils and solvents contaminated with transuranic elements were buried in numerous pits.

According to the Department of Energy's 1996 Baseline Environmental Management Report :

- LANL has over 2,120 radioactive and hazardous waste disposal and contaminated areas known as "potential release sites," including past burial sites, septic system discharges, chemical spill sites, and inactive underground storage tank locations. These areas are contaminated with radionuclides, high explosives, organic compounds and heavy metals.
- The site has an estimated inventory of transuranic wastes mixed with other hazardous materials , equivalent to 55,000 drums (55 gallon), with the equivalent of 1000 additional drums of these wastes generated annually.
- There are seven low level radioactive and mixed waste storage and disposal areas of which one - Area G - remains operational. Low-level radioactive waste has been land filled since 1957 in shafts and large pits. About 6,300 cubic yards is buried annually in Area G.
- LANL is estimated to generate a large amount of radioactive and hazardous wastes, including 279,669 cubic meters of low-level radioactive waste, 102,917 cubic meters of hazardous waste, 272 cubic meters of transuranic and 278 cubic meters of mixed transuranic wastes.

  Of particular concern are the areas containing several canyons on the Pajarito Plateau, a reactor site, and various heavily industrialized sites. For decades radioactive and hazardous discharges were made in several canyons including Mortandad , DP , Pueblo, Acid and Los Alamos. All canyons on the site on drain into the Rio Grande.

Off Site Contamination from Inactive Waste Sites

Environmental contamination in areas offsite from the laboratory is a continuing problem. It results mostly from existing inactive waste sites on property, which was transferred, to Los Alamos County and private owners. LANL has yet to complete and present to the public a formal risk characterization at all inactive waste sites.

In the late 1980's and the early 1990's, the Laboratory identified some 110 inactive wastes sites located on property previously owned by the DOE. Approximately 300 Los Alamos property owners were located on these inactive waste sites. Many of the property owners included new condominium projects completed in Los Alamos after the Laboratory had first prepared a report on this problem in 1987. According to a "Tiger Team" Assessment of the Los Alamos National Laboratory performed by the DOE in 1991:

" DOE and LANL did not notify Los Alamos homeowners in a timely manner that they were located on or near inactive waste sites, nor were these homeowners given an opportunity to comment on or provide early input into the corrective action process."

Nearly a decade later, this problem is reoccurring as excessive radiological contamination is being found in public areas in the township of Los Alamos. The south fork of Acid Canyon was released for unrestricted use and is in the midst of residential dwellings in the city of Los Alamos. This fork of the canyon was the main point for treated and untreated radioactive and hazardous discharges from the 1940's to the early 1960's from a waste processing facility in TA-45.

The south fork of Acid Canyon was transferred for recreational use to Los Alamos County in 1967. It is now is open to hiking and is close to a public skateboard park.

Recently, at the urging of the State of New Mexico, the Laboratory issued a report, which indicates that plutonium, contamination in this canyon in amounts significantly higher and pervasive than previously believed. Concentrations of plutonium approaching 8,000 picocuries per gram (pCi/gm) were found in the canyon's sediments.

These are contaminant levels that are normally present inside restricted areas at weapons sites such as the defunct Rocky Flats plutonium foundry near Denver, Colorado. By contrast, this level is several thousand times higher than background from nuclear weapons test fallout. It is substantially higher than proposed by the EPA. A limit (13 pCi/gm) was adopted by the Defense Department to cleanup contaminated soil at the Johnston Atoll based on the proposed EPA guidance.

TA-45 itself is now located in the Los Alamos town site. It underwent remediation in the mid 1960's and the early 1980's , which involved decontamination and decommissioning (D&D) of buildings and drain lines and removal of contaminated soil, sediments, and tuff. According to the 1991 DOE "Tiger Team" Assessment:

"TA-45 is used as an unpaved storage and stockpile area for equipment and fill materials. Large volumes of miscellaneous soil and fill materials from undocumented locations, including at least one steel tank, have been disposed of in TA-45 and have been dumped over the canyon edgesÉ. Continued disposal of uncharacterized materials at former TA-45 will impair the ability of LANL to characterize residual contamination from past operations, to conduct remedial actions, and to determine liability for remedial actions."

Plutonium contamination in the south fork of Acid Canyon did not result from the wildfire. However, there are concerns that contaminants in Acid Canyon could commingle with storm water run-off coming from Pueblo Canyon. This problem raises questions about health risks, the quality of past characterization efforts and the importance of more extensive environmental remediation of laboratory waste areas. It appears that the 1991 DOE "Tiger Team Assessment still is germane as it concluded:

" LANL does not have a formal, consistent, and documented program for risk management to ensure continued protection of public health and the environment at inactive waste sites."

The Cerro Grande Fire Aftermath

In the aftermath of the Cerro Grande fire there are several environmental, safety and health issues of concern. The fire changed the environmental circumstances, which have increased the risks for destructive flash floods, the release of additional airborne contaminants, increased surface runoff that carry contaminated sediments into water supplies and erode soil, and expose buried wastes. Also, the migration of subsurface contaminants may lead to their increased infiltration into aquifers.

Airborne releases of contaminants
Fire and winds swept into waste disposal areas and areas of contamination from laboratory activities, which could have carried laboratory contaminants to offsite areas. During the fire, monitoring for airborne contaminants was carried out by the U.S. Department of Energy (including LANL), the Environmental Protection Agency and the New Mexico Environmental Department.

The single largest in-place system deployed to measure ambient airborne contaminants came from the AIRNET system maintained by LANL for ongoing monitoring of the lab's operations. Increased radioactivity in the ambient air was detected from this network, which was found by LANL to be from naturally occurring radioisotopes that result from the decay of radon. The NEWET system maintained by LANL to detect increases in external penetrating gamma radiation, did not measure significant gamma radiation increases. Other systems deployed by the DOE, EPA and the state of New Mexico found similar results.

However, all systems were down for 48 hours during the peak of the fire as it swept across the Laboratory. Therefore, there may be significant gaps in the data. Also, the Department of Energy did not deploy aerial monitoring assets to measure contaminants in smoke or to assess potential localized "hot spots" that the fire may have created. Another important concern is the potential for the resuspension of laboratory contaminants caused by the fire's disruption. There are many outdoor locations at LANL that are known, or suspected to be contaminated with uranium or other radioactive materials. It is not clear, based on publicly accessible data, that additional monitoring was or is being deployed to ascertain if localized areas of contamination, disrupted by the fire, may be a source of resuspended airborne contamination.

Hazardous constituents in smoke from burning vegetation were posed potentially serious health risks.

Flooding risks
Precipitation and elevation provide the energy that is the primary driving force behind river processes in the Northern Rio Grande Basin. The laboratory sits on the Pajarito Plateau, which is 8 to 16 miles wide and 30 to 40 miles long, lying between the Sierra de los Valles to the west and the Rio Grande River to the east. The plateau slopes eastward from an elevation of 7,800 feet to 6,200 feet adjacent to the Rio Grande. There are numerous deep cut streams or watersheds, which flow to the southeast. The eastern part of the plateau, which feeds into the Rio Grande is about 1000 feet above the River.

Los Alamos has a semiarid temperate mountain climate with average annual precipitation of about 18 inches. Three fourths of this precipitation falls during monsoon season from May to October, with storm activities peaking in August. The average winter yields about 50 inches of snow with as much as 6 inches or more falling in 24 hours. Vegetation consists of desert shrubs and drought resistant grasses. The most widely distributed type of vegetation on the site is the Pinon, Juniper and ponderosa pines.

At Los Alamos, the Cerro Grande fire denuded the mountains surrounding the Laboratory and several watersheds that feed into the Rio Grande. This loss of vegetation and soil disruption greatly increases the volume, velocity and rate of water, run-off and debris that could wash from the mountains through the site's extensive and steep-sloped canyon drainage system.

The design basis that the Environmental Restoration Team at the Laboratory is using assumes a rainstorm of 6 hours duration that would occur once every 100 years. The hydrological model used by LANL and the Army Corps of Engineers to calculate peak flows and water surface elevations still contain major uncertainties.

For instance, modeling by the DOE and the Army Corps of Engineers (COE) of the flow expected from a rainfall event of .69 inches on June 28th greatly under predicted the actual flow. At TA-18 the LANL/COE model anticipated a peak flow was 11 cubic feet per second, compared to the actual flow of 150 cfs. (+ or - 30 cf/seconds) - a rough order of magnitude difference. This demonstrates that the risks and consequences of flash floods can be high and severe. There are three small nuclear reactors, used for nuclear criticality tests, along this flood path.

Fortunately, this years' monsoon season is concluding with a low frequency of powerful storms that could cause significant floods and run-off from the LANL site. However, because of the magnitude of the destruction of vegetation in the mountains surrounding the Laboratory, flooding and run-off risks will be major concerns for several years.

Of the watersheds that run through the Laboratory, those of greatest concern at this time include:

- Pajarito Canyon (TA-18). Facilities at risk along this canyon include the nuclear weapons criticality test facilities or reactors which contain "high energy burst assemblies," and a vault containing significant quantities of plutonium and highly enriched uranium. The community of White Rock, NM is directly downstream from this canyon. The DOE has issued an Environmental Assessment to consider the transfer of these facilities to another DOE site.
- Los Alamos Canyon (TA-41, TA-2). Facilities at risk along this canyon include the defunct and contaminated Omega West Reactor. Because the reactor is on a Canyon bottom, it is vulnerable to slope instability that could result in mudslides, and the falling of debris and large rocks. Between 1944 and 1993 there were twenty-four separate rock fall incidents in this area from rocks ranging in size from 300 to 21,000 pounds. The risks of falling rocks also extend to residential housing in homes and apartments in lower Los Alamos Canyon.
- Pueblo Canyon. Structures at risk along this Canyon include the Diamond Drive road crossing and utility facilities, such as the Bayo Treatment Sewage Treatment Plant for the town of Los Alamos.
- Water Canyon. Significant amounts of residual high explosives from a firing site and contamination already existing in the canyon bottoms could be carried away during flooding into the Rio Grande.

In addition to these canyons, several other canyons also have contaminated sediments that could potentially wash down stream. An additional 77 waste disposal sites and contaminated areas have been identified by LANL as being on potential flood plains.

Currently, the Emergency Rehabilitation Team (ERT) at Los Alamos is responsible for addressing these risks and are coordinating projects aimed at reducing flood risks and contaminant movement. Among the major actions taken are :

- Construction by the Army Corps of Engineers (COE) of a 70-foot flood retention dam in Pajarito Canyon upstream of TA-18 and White Rock.
- Installation of about 1000 feet of sheet piling, 5-feet high to protect "Kiva 1" a nuclear reactor criticality test facility at TA-18.
- Construction of a diversion channel to increase stream capacity.
- Construction of armoring road crossings by the COE in canyons upstream of TA-18 so they will act as small retention basins.
- Removal of 700 cubic meters of contaminated sediment in Los Alamos Canyon near the Omega West reactor.
- Removal of the cooling tower and evaporator of the old Omega West Reactor.
- Installation of an 86-inch culvert at Diamond Drive road crossing.
- Contour felling of trees, rock-check dams and hydro seeding of the mountain slopes above the Laboratory site.

Erosion and Runoff into water supplies

The northern portion of the Rio Grande , which is the largest fresh water artery in New Mexico, flows near the lab. The drainage network of the 71,700- sq-km area, which contains the lab, is the primary means by which contaminants from LANL are transported and deposited in the river system.

The LANL site lies on volcanic rocks erupted from two significant eruptions that deposited ash and pumice, which is referred to as the Bandelier Tuff (slightly welded to welded ash, tuff breccia, and crystal fragment tuff). The Bandelier Tuff overlays the Puye Formation of the Santa Fe Group sediments. The upper member of the Puye Formation's, the Fanglomerate Member, consists of silts and sands, and pebble to boulder breccia of volcanic rocks. The Puye Formation's lower member, the Totavi Lentil, consists of sands, pebbles, and boulders of quartzite, granite, latite, dacite, and other volcanic rocks. The Tesuque formation, consisting of sand, silt, clay, and some interbedded gravels, underlies the Puye Formation. Generally, the Totavi Lentil is overlain by basalt flows of the Chino Mesa on the eastern portion of the plateau. The Puye Formation is interbedded with volcanic rocks of the Tschicoma Formation on the western portion of the plateau, the Sierra de los Valles.

The steep slopes of the canyons on the Laboratory site shed their debris and associated contaminants more rapidly than moderately sloping terrain. There is a drainage network of twelve canyons that run through Los Alamos Laboratory and ultimately feed into the Los Alamos Canyon - the main entry point for site contaminants into the River. Many years of erosion has created unstable side slopes along the canyons running through LANL - causing sediment particles ranging from sand to gravel as well as clay-size particles to be transported into the river. The river channel processes affecting the mobility of contaminants from LANL within landforms, soils geology, climate and vegetation.

Studies conducted by LANL show that stream sediments contain the main source of radioactivity from waste disposal activities and that runoff processes are moving sediments downstream. Onsite, the water in an effluent discharge area in at least one canyon, Mortandad, has been severely impacted. The TA-50 Low-Level Waste Treatment Plant was constructed in the early 1960s to process industrial liquid radioactive wastes resulting from various processes throughout LANL's facilities. Treated liquid effluent was discharged through an outfall pipe to the ground surface at the upper portion of Mortandad Canyon.

Radiologically contaminated effluents to Mortandad Canyon were above concentration guide values for many years, on an average annual basis. Nitrate levels were measured as high as 117 mg/L (the drinking water standard is 10 mg/L) in 1989 and 86 mg/L in 1990. Other high contaminant levels identified in Mortandad Canyon include total dissolved solids (maximum of 1780 mg/L), sodium (maximum of 320 mg/L) and sulfate (maximum of 107 mg/L). It is not clear if the potential impact of such high pollutant levels on possible uses of the water by wildlife has been evaluated.

Elevated levels of uranium and plutonium isotopes have also been detected in sediments in onsite canyons. Tritium, cesium-137, strontium-90, and americium-241 have been detected in Los Alamos and Mortandad Canyon sediments. Also, plutonium isotope concentrations have been detected in Pueblo Canyon both on-site and off-site. Uranium isotope concentrations have been detected in Los Alamos Canyon both on-site and off-site in soils at the TA-14, TA-15, and TA-36 firing sites.

In just one storm at Los Alamos, surface water run off transported 1 to 2 percent of the entire sediment-bound inventory of plutonium. According to a 1998 Laboratory monitoring report, offsite concentrations of laboratory radionuclides in the river sediment near the San Il Defonso Pueblo "often exceeded the DOE dose concentration guidelines."

Once contaminated sediment particles enter stream channels, their distribution is uneven. However, bottom sediments appear to store a significant amount of the contaminant burden in the Rio Grande. A recent study now indicates that 50 percent of the plutonium deposited in sediments in the Cochiti Reservoir 18 miles downstream from LANL have come from laboratory operations. Previously the Laboratory assumed that only 10 percent of the plutonium in this reservoir came from its operations. Cochiti sediment data collected by the U.S. Geological Survey also raises concerns about releases of uranium from the laboratory. According to a recent report on this subject "historical uranium releases by LANL into Canyons draining into the Rio Grande are a concern."

Fate and Transport in the River

However, official assumptions about the contaminant risk to the Rio Grande contain strong elements of speculation. Major uncertainties arise from the absence of a mass budget analysis of the fate and transport of lab contaminants in the river. The contaminant burden in on-site sediments on the site from laboratory operations has not been quantified in terms of mass balance estimates of discharges, matched up with sediment characterization data. These are basic and elemental requirement for any comprehensive assessment of the fate and transport of laboratory contaminants into the Rio Grande. This is further complicated by the absence of validated source term estimates. Source terms provide basic data as to the nature and extent of the contaminant inventory in sediments, which could be released. Several canyons contain an array of radioactive and non-radioactive hazardous materials from decades of discharges and disposal. Characterization of some canyons is being done.

Experience with fires elsewhere suggest that the watersheds running through the Laboratory will dramatically increase their sediment yields. In comparison with other streams that feed into the Rio Grande, such as the Rio Chama and Jemez Rivers, the total amount of sediments discharged will probably be small as far as the total Rio Grande system is concerned. However, concentrations of contaminants in LANL runoff is very high compared with the other drainages, so the contaminant loading is likely to be far greater than the other contributions.

At the July 8th conference in Santa Fe, a laboratory soil expert stated that runoff could carry as much as 300,000 cubic meters of contaminated soil, the equivalent of a football field 300 feet high, into the largest fresh-water artery in the state. Higher-than-average levels of plutonium and other contaminants are already showing up in the river. As of September of this year, the Laboratory reported that about 25 percent of the runoff volume is sediment.

The evaluation of metals in water and sediment samples is an early stage. As of September of this year, several dissolved metals were found by the Laboratory to exceed its screening levels and are being analyzed further.

High-levels of cyanide were measured in water and sediments in several canyons and burned areas on LANL property. Levels two times above those that are immediately harmful to fish were found in ash-laden runoff waters both above and across the Laboratory. Toxic levels of cyanide may persist. The likely source is inconclusive.

Low -levels of PCBs (polychorinated biphenols) were detected in the water and sediment samples and is of concern because of the bioaccumulation of this contaminant in the food chain. There have been numerous high concentration spills of PCB's from leaking transformers at the Laboratory.

The levels of radioactive substances dissolved in water are comparable to or possibly elevated above pre-fire levels, and are below EPA drinking water limits. However, cesium-137 concentrations in suspended material are 5 to 20 times higher than pre-fire levels. Plutonium is 5 to 10 times and strontium 90 concentrations are increased by 2 to 5 times.

The Laboratory suggests that the increases may be mainly due to the bioaccumulation of radioactive fallout in trees, which was concentrated into ash by the fire. In a 1997 study, the National Cancer Institute estimated radioactive iodine "hotspots" in northern New Mexico are from nuclear weapons tests exploded at the Nevada Test Site. Radioactivity from Laboratory operations could also have spread to the nearby forests only to return as ash from the Cerro Grande Fire.

Hydro-Geological Issues - Historical and ongoing operations at LANL are impacting groundwater. Contaminant sources include historical and current industrial and sanitary wastewater discharges; surface impoundments and lagoons; underground storage tanks; waste burial and storage areas; and runoff from active and inactive waste sites, including landfills and firing sites.

In the aftermath of the Cerro Grande Fire, the risks of accelerated migration of subsurface contaminants in increased. Erosion reduces sediments which holds up radionuclides, and can expose buried wastes. Also, efforts by the Laboratory to mitigate flooding and run-off, such as impoundments and sediment traps could enhance the migration of contaminants into the aquifers beneath the site.

The LANL site is hydrogeologically complex, considering the mountainous terrain of volcanic origin, complex recharge and discharge regimes, extensive geologic faulting, and highly variable stratigraphy. The presence of springs, high groundwater production flow rates in the vicinity of LANL, and steep vertical groundwater gradients add to the complexity of the hydrogeologic regime.

The area between the surface of the laboratory site and the water table is known as the "vadose zone" - a geological term for dry subsurface areas. The vadose zone beneath LANL, in general terms, contains several different rock and sediment formations that were the result of volcanic and sedimentary processes.

Groundwater beneath the laboratory site can occur near the surface in perched formations or at deeper levels. The full extent of these perched and alluvial groundwater supplies is not known or characterized. The main aquifer, which has sufficient amounts of water that can be used for human activities, varies in depth from 900 feet in the Southwest portion of the Laboratory to 600 feet (artesian conditions near the Rio Grande) along the eastern edge below the surface of the Parajito plateau. The aquifer is recharged through intermountain basins formed by the Valle de Caldera and the Sierra de Los Valles. The main aquifer discharges through springs in White Rock Canyon into the Rio Grande.

Perched water occurs in the interbedded basalts of the Puye Formation near the eastern edge of the site in Pueblo, Los Alamos and Sandia Canyons. Recharge of perched water zones is somewhat uncertain, but it is generally assumed that are replenished from small water sources in the soil layers above them in the three canyons.

The main aquifer is a regional aquifer of erosional outwash sediments consisting mostly of sand and gravel, which were deposited within an ancient river valley coincident with the top of the Rio Grande Rift. The undisturbed direction of groundwater flow in the Los Alamos vicinity is generally eastward towards the Rio Grande. Recharge to the main aquifer is thought to be largely from infiltration of precipitation that falls directly on the western perimeter of LANL in or near the Valle Grande.

Groundwater in the LANL area is used as the source of potable water for LANL as well as the County of Los Alamos and the surrounding communities of White Rock and Pajarito Acres. Additionally, LANL operates the Water Canyon Gallery field to supply groundwater for nonpotable purposes such as steam plant makeup water.

The earliest characterization of main aquifer was based on data collected from water supply wells installed by the U.S. Geological Survey (USGS). It should be noted that these wells were designed for potable water supply, not as part of a groundwater monitoring program. The main aquifer was the focus of subsequent investigations conducted by the USGS until 1970 and by LANL since 1970. The U.S. Geological Survey prior to 1960 largely developed the existing groundwater monitoring well network at LANL. It was developed to mostly facilitate and assess the siting of facilities and was not part of site-wide a Ground Water Management Plan. This network is not considered adequate to determine the complex hydrogeologic conditions of the Pajarito Plateau.

According to DOE's internal standards, the Laboratory is required to prepare a Groundwater Protection Management Program Plan. Specific elements of this plan should include the "documentation of the groundwater regime with respect to quality and quantity, design and implementation of a monitoring program, a management program for groundwater protection and remediation, a summary of areas that may be contaminated, and strategies for controlling sources of these contaminants. The groundwater protection program should be summarized, including a review of the monitoring program that describes the number of wells."

The Laboratory established a Groundwater Integration Team several years ago, which is currently focused on measuring the degree to which contaminants remain stored in soil and sediment, the vertical flow of water over time, and to provide data for subsurface modeling efforts.

More recently, the Laboratory initiated a monitoring program to measure the spread of contaminants in the subsurface from efforts to reduce run-off. In this regard some 150 upstream subsurface monitoring wells are planned along weirs built to retard run-off and erosion. Three wells have been drilled to date. The program's objectives are to: monitor water infiltrating through the subsurface; characterize the hydrology and chemistry of perched ground water; and characterize the subsurface soil, sediment and rock formations above the ground water and to assess the impact of contaminants migrating in the subsurface from floods in Los Alamos Canyon.

Contaminants from the Laboratory have entered the alluvial and perched aquifers as well as the main aquifer. The shallower aquifers have been impacted by historic discharges to areas such as Mortandad Canyon, which has a significant contaminant burden in sediments. Leaks from the Omega Reactor and releases from Technical Area 21 released significant radiological contaminants into the Los Alamos Canyon and underlying alluvial aquifer. The surface flow from the Los Alamos County-operated Bayo sanitary wastewater treatment facility effluent in Pueblo Canyon infiltrates into the perched alluvial groundwater resulting in a transfer of radionuclides. These radionuclides leach into the perched alluvial groundwater offsite via Los Alamos Canyon. The relationship between the alluvial and perched aquifers and the main aquifer in terms of contaminant migration is uncertain. However, the Laboratory indicates that groundwater movement from the alluvial and perched formations is a contaminant transport pathway to the deeper main aquifer.

LANL discharges uncontaminated liquids to surface and subsurface soils that have been contaminated with radioactive material from past practices. Liquid discharges, even though uncontaminated, are prohibited by DOE orders from being discharged to contaminated sites to prevent the spread of radionuclides.

For instance, discharges from the TA-50 Liquid Waste Treatment Plant over the years has resulted in soil contamination adjacent to the outfall and to the Mortandad canyon below. Liquid sanitary effluent was discharged into two lagoons previously contaminated at the TA- 53 Los Alamos Nuclear Science Facility. These lagoons were not decontaminated after the radiological liquid effluent discharge into these lagoons was discontinued. The two original sanitary lagoons are lined with clay. Tritium was detected at a depth of 80 feet in soil below the lagoons, which indicates that discharges of uncontaminated liquids may have caused subsurface soil contamination.

Understanding the fate and transport of Laboratory contaminants in the vadose zone beneath the site is, perhaps, the most uncertain effort to address potential environmental and health risks at the laboratory. Gaps in characterization data poses the most significant challenge. Significant quantities of long-lived radionuclides discharged into soil and the deliberate plutonium releases in subsurface wells above ground water supplies, underscores the need for a more aggressive vadose zone characterization and modeling program.

Subsurface contamination at LANL is extensive and includes topsoil sediments, deliberate releases of large amounts of plutonium and other contaminants in subsurface tests, burial grounds, underground tanks, liquid discharges.

A case in point is the Material Disposal Area (MDA) AB in Technical Area-49. Between 1959 to mid-1961, MDA AB was the location of some 70 hydronuclear and related experiments. These experiments involved high explosive disposal of highly enriched uranium and plutonium 239, as well as lead beryllium and uranium 238 at the bottom of shallow shafts. Approximately 40 kilograms of plutonium, 93 kilograms of uranium 235, 170 kilograms of uranium 238, over 90,000 kilograms of lead, 11 kilograms of beryllium and an unreported amount of high-explosives were released into the shafts. According to a LANL study, the plutonium in these shafts constitute the single largest source of radioactivity in the environment at the laboratory.

In once instance, an experimental detonation in 1960 spread significant subsurface contamination through fractures into a nearby shaft, which was inadvertently excavated -- resulting in surface contamination from drainage that extends beyond the boundary of TA-49. In an other instance, water infiltration and contamination in a test hole has been occurring since the mid-1970's.

Over the years, official assumptions about the subsurface migration of plutonium at DOE sites have often been shown be incorrect. As early as 1958, it was recognized at Los Alamos that the mixing of plutonium with organic chemicals could enhance its migration. Past models have failed to take into account changes in the physical and chemical forms of plutonium, preferential flow mechanisms in the subsurface and other interactive phenomena. For instance, plutonium migration at the Nevada Test Site from underground nuclear tests, greatly exceeded modeling assumptions because the plutonium was found bound in a colloidal form. Plutonium could escape the filtration in volcanic rock similar to that at the Nevada Test Site beneath the Laboratory and be transported on microscopic colloidal particles. At the minimum, these data raise the question as to whether plutonium in the bottom of the hydronuclear test wells is in a similar physical state and whether it is migrating at a rate much faster than assumed.

These problems call for more extensive characterization to determine the lateral and vertical extent of surface, near surface and deeper subsurface contamination at TA-49. Potential transport pathways need to be identified in the vadose zone which may pose risks to ground water.

The Need for a Comprehensive Assessment

A number of activities to analyze and assess the environmental impacts after the Cerro Grande fire are underway by several federal agencies, the Laboratory, and the state of New Mexico. A major concern is that these efforts are mostly reactive, short-term. There does not appear to be formally documented data base and decision process used to reach the assumptions about post-fire risks. Quantifying the nature and extent of the environmental, safety and health risks associated with the fire and its aftermath, must be in support of overarching environmental protection policies. They include:

- Reducing the contaminant burden at the Los Alamos National Laboratory site.
- Protecting the health and environment of those who that depend on the air, soil and water of in affected areas.
- Developing a strong scientific and ecological basis for operational, siting and cleanup decisions.
- Improving the overall quality of the Rio Grande at a time when water quality and availability are have strategic importance for the nation.
- Building trust through openness, transparency and participation by affected workers and members of the public through independent monitoring and oversight.

Currently, the Laboratory is beginning to undertake more comprehensive approaches to assess the fate, transport, uptake and risks associated with the migration of Laboratory contaminants. These decisions have been based on information regarding historical equations, which may not be complete, or on a limited analytical data base. These activities are commendable but, given the comprehensive nature of the challenge posed by the aftermath of the Cerro Grande Fire, an overall integration of technical work should, at the minimum, include:

An Airborne Contaminant Pathway Risk Assessment
A dose reconstruction study of potential exposure pathways from airborne contaminants should be undertaken. The data from the ambient monitoring systems represent screening levels, which have yet to be validated through comparisons with the actual environmental inventories of contamination that may have been released. At the minimum, source terms for areas hit by the fire and winds should be established to compare and validate the monitoring data. The fire hit several areas or source terms, which were unmonitored. Collection of additional monitoring data for potential resuspension of contaminants should also be considered. Hazardous constituents from burning vegetation should also be factored into this risk assessment.

Quantification of Environmental Source Terms
Accurate inventories of the contaminant burden from buried waste sites and discharges into canyons have not yet been developed at the Laboratory. While it may not be feasible to develop source term estimates for all 2,120 waste sites, it is essential to determine inventories for the most heavily contaminated areas, including burial grounds, test areas, and canyons. This should be done by employing a mass balance approach where discharges are reconstructed and matched up with environmental characterization data. A review of historical operations in terms of material throughput, process flow, and waste discharges has yet to be done. It is necessary to accurately quantify contaminant inventories in the environment of the site. Without a reasonable quantification of the contaminant burdens or source terms that could migrate into ground and surface waters from Laboratory operations, transport, uptake and risk assessments will continue to be tenuous at best.

Enhanced Vadose Zone Characterization
The risks of groundwater contamination from Laboratory contaminants is not an abstract issue. Measurements of ground water beneath the site show varying degrees of contamination from radioactive and hazardous materials. The geological conditions beneath the laboratory site are complex and full of uncertainties. There are major questions whether LANL's site wide hydrogeological groundwater monitoring well network and vadose zone characterization program is extensive enough to characterize the impact of DOE operations on groundwater quality as required by DOE orders. They include:

- A thorough understanding of the seep-spring recharge mechanisms.
- The adequacy of site baseline measurements and the means of detecting migrating contamination from offsite locations.
- Lack of well data to better understand the effect of the faults on groundwater recharge and directional flow, potential infiltration zones, and seismic history on both sides of the fault zones at the site.

- The adequacy of characterization data regarding surface flow contaminants infiltrating into perched aquifer zones in Los Alamos Canyon, Water Canyon, Pajarito Canyon and Rendija Canyon which ultimately outcrop as seeps and springs at the confluence of the Rio Grande.
- The adequacy of data regarding contaminant transport pathway mechanisms and the impact of contaminants on canyon-specific perched aquifer systems.

Mass Budget Modeling of Contaminants in the Rio Grande
As sediments bearing radionuclides and other contaminants from the Laboratory enter the Rio Grande and then move to reservoirs and the ocean, a significant portion is deposited and stored in river sediments and on flood plains. Determining the amount, types and locations of the Laboratory contaminants distributed in and around the Rio Grande verses how much is moved to reservoirs and the ocean is the basis for a mass budget analysis. Because contaminants move with the sediments, such an analysis requires information about the water and sediment movement over large areas. In particular, bed load transport models are important to predicting movement of contaminants.

According to Dr. William Graf, who performed a major study of the fate and transport of plutonium in the Rio Grande, understanding how contaminated sediments are distributed in the river depend on " (1) the characteristics of the sedimentary environments along the channels, (2) the physical properties of the contaminated sediments that influenced their transport and mixing of contaminated and uncontaminated materials. This argues that environmental managers and planners at LANL could take into account these points in general, if not a precise, quantitative way." An accurate account of stream flow is also essential to the development of a basin-wide mass balance or "budget" for water, sediment and contaminants.

River budgets have provided important insights about river contamination in Germany, Netherlands and the United States. For instance, an investigation of lead and arsenic loading along a portion of the Belle Fource River in South Dakota revealed that flood plains have stored one third to one half of the contaminants entering the system from mine tailings from the Homestake mine.

In terms of enhancing the current river monitoring system, studies of slope, drainage basin, channel, and flood plain processes are a key to the development of sampling and monitoring programs for a mass budget approach. In particular, direct water and sediment sampling stations should be established at the lower reaches of Bayo, Rendija, Pueblo, Los Alamos, Sandia, Mortandad, Canada del Buey drainages at the very least. Potrillo and Water Canyons in Technical Area-49 are important too, though perhaps from a more standard heavy metal perspective rather than only radionuclides.

The basic principals for establishing a sampling and monitoring program for LANL contaminants are thoughtfully articulated by Graf.

"Obtain an accurate inventory of sediment-bound contaminants at the source location. A precise assessment of the original mass of polluted sediment is critical to accurate predictions of potential concentrations downstream in the natural river system.

"Obtain an accurate understanding of temporal trends in the erosion of contaminants from the source areas. Without knowing the rate of introduction, subsequent research on the main river and on receiving areas is not likely to be accurate.

" Become familiar with the geography of contaminants in sediments in the vicinity of the source of pollution and be able to make detailed maps of sediments and their contaminant content.

"Investigate the distribution of sediments and LANL contaminants in the nearest downstream reservoir. A sampling scheme for reservoir sediments must take into account the process history of the materials and specify the location on the reservoir floor. "

A monitoring protocol could involve as few as 60 samples of active sediment and 40 or so of inactive sediment. In many respects, the location of samples is more important than the number. In terms of active sediments, care should be taken so that contaminant concentrations are not missed, as is the case when material is collected from the downstream side of an obstruction, like a boulder. Contaminants such as heavy metals usually have the highest concentration in the finest sediment. For this reason, the finest sediments available should be sampled where they are collected, such as those on the floors of pools in the river channel. Effluent monitoring needs to be representative of the discharge for all outfalls and samples from multiple source monitoring should be flow weighted for reporting to the public and the regulators.

Wildlife Uptake and Effects Assessments
The study of wildlife in the Rio Grande system can provide valuable more direct and prompt data on contaminant impacts. Plants and animals absorb and concentrate contaminants in river environments. Health, mortality and propagation effects of human-made contaminants on wildlife have been studied for many years, and serve to enlighten efforts to protect endangered species, reduce human health risks, and to validate compliance with environmental standards.

The most abundant mammal in the Los Alamos area is the Western Harvest Mouse. Also in the northern New Mexico area are elk, deer, and bear as the predominant large mammals. Bobcat, raccoon, and skunk are the predominant medium-size mammals. There are numerous amphibians, reptiles, waterfowl, and birds, including the Golden Eagle and Cooper's Hawk. Additionally, the Rio Grande , which flows to the east of the LANL site and forms part of the site's eastern boundary, supports a large variety of aquatic wildlife.

The U.S. Fish and Wildlife Service developed a program where a wildlife effects assessment is used as an important tool to address the cleanup and land use parameters for the Rocky Mountain Arsenal in Colorado. Fish and Wildlife effects studies are serving to assess EPA's Superfund cleanup activities at the DOE's Hanford site in Washington.

In addition to biota on and near the Laboratory, the uptake and effects on fauna and flora biota in the river, in the flood plain and sediment deposit areas, such as the Cochiti Dam, should be incorporated into measuring the transport and deposition of laboratory contaminants and ascertaining their effects. For instance, current studies of uranium uptake in fish in the Cochiti reservoir raise important questions as to the source of this contamination. State and federal agencies have done wildlife studies. But, in the face of potential for significantly increased volumes of contaminated sediments from the laboratory, wildlife studies have yet to be incorporated into an overall river assessment modeling effort.

Human Impact Assessment
The risks to people from increased migration of contaminants from the Los Alamos National Laboratory has several facets. They tend to fall into the categories of human health, cultural, and economic impacts.

In this case, human health risks are largely based on extrapolations using risk models that generally take into account: amounts of contaminants released, their transport pathways and ecological uptake, human uptake, dose and risk estimation. Other methods involve the collection of human health information, such as symptoms, disease incidence and mortality, which is statistically compared with unexposed groups. Current risk studies do not necessarily factor in the culture and lifestyles of native people who may have more direct contact with contaminants.

There may have been immediate health impacts from the inhalation of smoke. Efforts should be made to review hospital and medical data that may exist from people who sought medical assistance due to smoke-related respiratory problems, particularly in the communities nearest to the fire.

The potential risk to human health from Los Alamos radioactive and hazardous contaminants is likely to be diluted and may be expressed over a period of many years --- making risks very difficult, and sometimes impossible to quantify. This is not to say that such risks do not exist. Rather, current scientific measuring tools are not necessarily able to measure this risk without large uncertainties. For these reasons, the technical viability of human health risk assessment in the context of the Cerro Grande Fire and its aftermath is very dependent on quantifying what is not known . Regardless of these uncertainties, human health risk assessment should not be viewed in a vacuum because it can a provide valuable insights from an overall comprehensive perspective.

In terms of cultural risks, several Indian Pueblo Nations have lived along the Rio Grande for many centuries and maintain strong ties to their cultural heritage and a strong affinity with the natural environment. In addition to depending more directly on the land and water than non-Indians, numerous sacred areas exist where religious ceremonies are celebrated. The gathering of plants for religious purposes is also an important factor. The changed environmental circumstances created by the Cerro Grande Fire clearly have important implications for tribal cultures. The risks to the cultural quality of the Pueblos along the Rio Grande from the migration of laboratory contaminants should be a key element of any risk assessment endeavor.

In this case, economic impacts from are largely influenced by evidence of risk and perception of risk. The influx of fire debris and contaminant run-off into the Rio Grande can deter people from pursuing recreational and tourist activities. The perception created by ash from the Cerro Grande Fire depositing on farms can lead to consumer rejection of the crops. These kinds of risks should not be ignored and should be factored in.

Independent Monitoring and Oversight

In the aftermath of the Cerro Grande Fire, a unique and unprecedented set of questions present themselves. What are the risks to human health from the release of airborne contaminants from the Laboratory site? Is the DOE and the Laboratory prepared to address the dangers of flash floods coming down denuded terrain and washing through canyons? How has fire and post fire mitigation efforts influencing the subsurface migration of contaminants? What is nature and extent of the contaminant burden from Laboratory operations in the Rio Grande, and how much will be added to this burden? What are the environmental and health impacts and risks from Laboratory contaminants in the Rio Grande?

The Los Alamos Clean Air Act Compliance Model
To answer these questions, an integrated effort with a strong scientific underpinning and public credibility is essential. A model that could achieve these objectives is the independent technical audit and oversight program established to ensure compliance by the Los Alamos National Laboratory with federal Clean Air Act radionuclide emission standards.

This endeavor was established under a consent decree by the Federal District Court in Albuquerque, NM in order to resolve a lawsuit brought against the DOE by Concerned Citizens for Nuclear Safety. It involves an independent technical audit of the laboratory's emission sources, monitoring and abatement activities. The independent technical audit is reviewed by CCNS experts through an iterative process, in terms of workscope, ongoing analysis and final work product. The overall process has yielded multiple benefits relative to achieving and validating Clean Air Act compliance in a way that has strong public support and credibility.

A Comprehensive Assessment
The DOE and the Laboratory should establish an overall integration of the assessment work underway which addresses the environmental, safety and health implications of the Cerro Grande Fire. There are five distinct areas which should be formalized and integrated. They include:

- a dose reconstruction of air emissions pathways resulting from the fire.
- the development of comprehensive source term estimates;
- a safety review of efforts to mitigate risks of floods, major erosion and run-off.
- vadose zone and subsurface contaminant characterization.
- an assessment of the impacts on the Rio Grande, including a mass budget analysis, and impact and risk assessment of Laboratory contaminants in the Rio Grande on biota and humans.

A Proposal for Independent auditing and Oversight
In the context of the environmental, safety and health implications of the Los Alamos site and the Cerro Grande Fire, the Clean Air Act audit model could be structured in the following manner:

- Technical Audits - A series of technical audits would be funded by the DOE, through the New Mexico Environment Department. The audits would review the five major technical activities of the laboratory with respect to risk mitigation and environmental safety, and health assessments being done by the Laboratory, the New Mexico Environment Department, the New Mexico Department of Health, the U.S. Environmental Protection Agency and the University of New Mexico in the aftermath of the Cerro Grande Fire.

- Citizen Oversight - An "Oversight Consortium" made up affected groups, such as the Indian Pueblos, farmers, recreational river businesses, and citizen groups would oversee these audits through independent technical experts that review the work of the auditors. The Oversight Consortium would be responsible for reviewing the work scope, spot-checking ongoing work, and review of the final work products.

- Independent expert review of the audits - Each technical audit, would have independent technical expertise which reports to the "oversight" consortium. These experts would be paid as part of each technical audit. They would be required to have expertise of the various disciplines, including radioecology, engineering, flood safety, morphology, hydrogeology, hydrology and risk assessment. Commensurate with the technical audit teams, the independent experts would be responsible for review of work scope, spot-checking ongoing work, and the final reports.

back

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Date: January 29, 2007
Refer to: EP2007-0004

Ms. Joni Arends
Executive Director
Concerned Citizens for Nuclear Safety
107 Cienega
Santa Fe, NM 87501

SUBJECT: INFORMATION CONCERNING RADIONUCLIDES IN WATER SUPPLY WELLS

Dear Ms. Arends:

Thank you for your request and your concern regarding potential neptunium-237, plutonium-238, 239 and 240, americium-241, cesium-137 and strontium-90 contamination in the drinking water supply wells for Los Alamos County and the Buckman Wellfield. The protection of the drinking water supplies of nearby communities is one of the primary groundwater protection goals of the Laboratory. We appreciate the opportunity to provide information on this subject.

The Laboratory added alpha spectrometry analysis for neptunium for the Los Alamos County water supply wells samples in December 2006. We also identified some existing August 2006 Los Alamos County water supply samples at the analytical chemistry laboratory. We asked the analytical laboratory to also analyze these samples for neptunium using alpha spectrometry. The results for the August 2006 samples were all non-detects.

We reviewed the radioactivity data for Los Alamos County supply wells from 2001-2006 (attached). This period of record was chosen because the same independent analytical laboratory analyzed the water supply samples during this period. We have also included a period of 2001-2004 to correspond to the data record presented in the Site-Wide Environmental Impact Statement (SWEIS).

EXHIBIT
CCNS-4

From the attachment, it can be seen that there are routine detections of naturally occurring radionuclides, such as uranium, potassium-40, and gross beta. For the remaining radionuclides the overall pattern is that they are not detected in water supply samples. For several LANL-derived contaminants, americium-241, cobalt-60, and cesium-137, there were no detections in the water supply wells from 2001-2006. Thus, there are no rising levels of radionuclides in these data.

Tritium has been detected at Los Alamos County water supply well Otowi-1 (O-1). These values are less than 0.3% of the drinking water standard, although this well is not used for supplying drinking water. These data are routinely reported in the Environmental Surveillance Report. Beginning in 2000, the tritium measurements at O-1 increased for four years from about 30 pCi/L to 60 pCi/L, and have decreased to about 20 pCi/L over the past two years.

Detections of LANL-derived contaminants, such as plutonium, americium, and strontium, have occurred sporadically in water supply wells. As indicated in the attachment, the bulk of these detections occurred from samples collected at the same time and analyzed by the analytical laboratory in the same batch. Because the overall frequency of detection is low, we believe that these sporadic detections are false positives or caused by problems at the analytical laboratory. This conclusion is supported by numerous reanalyses of these samples and by lack of consistent detections in paired samples. Again, there are no increasing trends in these data.

In conclusion, we believe the data demonstrate no radionuclide detections in the water supply wells, with the exception of tritium in Otowi-1.

We welcome your continued comments and concerns about the drinking water systems. If you have further questions, please contact Lorrie Bonds Lopez, (505) 665-0216, or lorriel@lanl.gov.

Sincerely,

Andrew Phelps
Associate Director
Environmental Programs

AP/JD/tml

Enclosure: 1) Water Supply Radioactivity Summary from WQDB
2) Santa Fe City Water Supply Radioactivity Summary from WQDB

Cy: (w/enc.)
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Buck Monday, Los Alamos County, Los Alamos, NM
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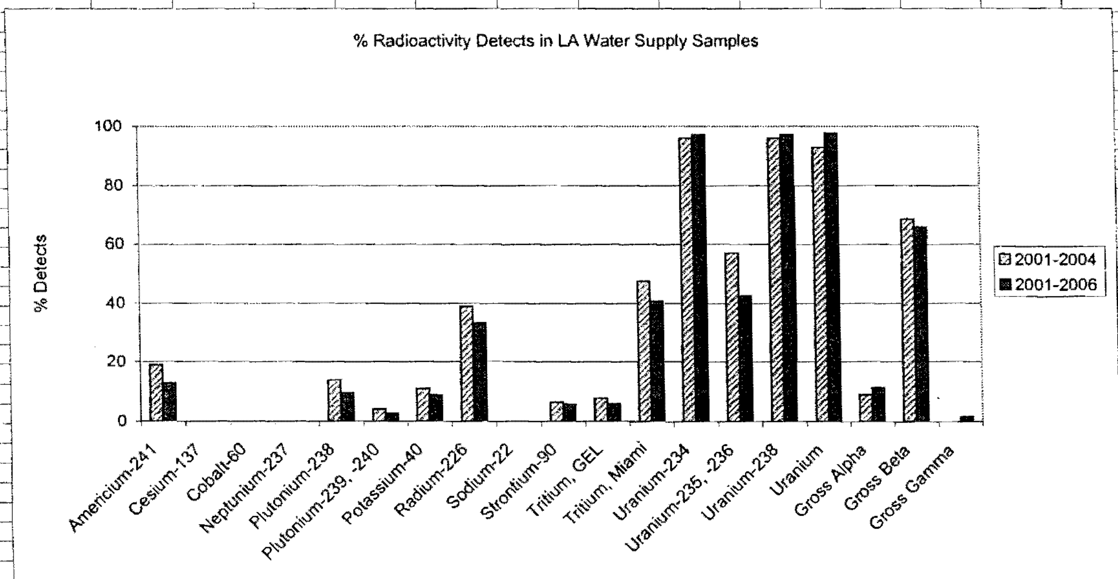
Ellen Louderbough, LC-LESH, MS A187
Deborah Woitte, LC-LESH, MS A187
Phil Wardwell, LC-LESH, MS A187
LWSP File, MS M992
IRM-RMMSO, MS A150
RPF, MS M707

Water Supply Radioactivity Summary from WQDB-

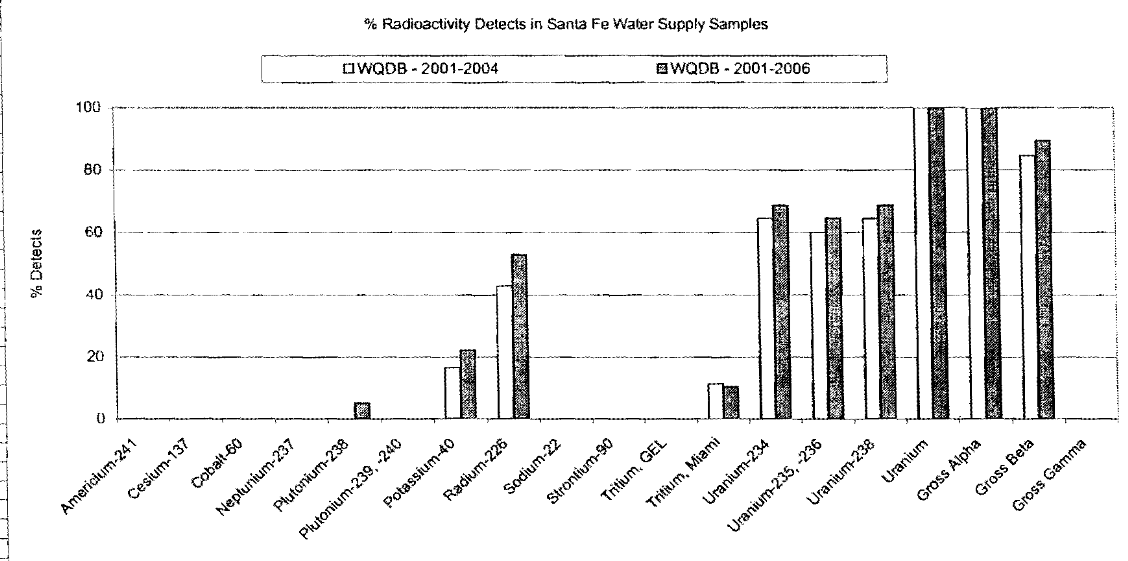
		WQDB - 2001-2004			WQDB - 2001-2006			
Measurement		**detected**	**analyzed**	**% detect**	**detected**	**analyzed**	**% detect**	**notes**
Americium-241	pCi/L	10	53	18.9	10	77	13.0	6 detects on 5/9/01, one not supported by dup, also detected in 2 field blanks, 4 detects on 8/29/03, latter not confirmed by reanalyses
Cesium-137	pCi/L	0	55	0.0	0	79	0.0	
Cobalt-60	pCi/L	0	55	0.0	0	79	0.0	
Neptunium-237	pCi/L	0	55	0.0	0	88	0.0	
Plutonium-238	pCi/L	7	49	14.3	7	73	9.6	7 detects on 5/9/01, one not supported by dup, one in field blank, result=mda, uncert=0
Plutonium-239, -240	pCi/L	2	49	4.1	2	73	2.7	2 detects on 5/9/01, one not supported by dup, result=mda, uncert=0
Potassium-40	pCi/L	6	55	10.9	7	79	8.9	2 detects on 5/9/01, 3 detects on 8/29/03, one not supported by field dup, 1 detect on 5/20/04, not supported by field dup, one detect on 5/17/06
Radium-226	pCi/L	14	36	38.9	16	48	33.3	naturally occurring
Sodium-22	pCi/L	0	55	0.0	0	79	0.0	
Strontium-90	pCi/L	13	203	6.4	13	227	5.7	13 detects on 11/28/01 by EPA:905, 5 qualified U in secondary validation, one U on reanalysis
Tritium, GEL	pCi/L	5	61	8.2	5	85	5.9	5 detects on 5/19/04
Tritium, Miami	pCi/L	66	139	47.5	72	177	40.7	57 detects in O-1
Uranium-234	pCi/L	47	49	95.9	71	73	97.3	naturally occurring, 2 ND and one detect (8/21/03) in field blanks
Uranium-235, -236	pCi/L	28	49	57.1	31	73	42.5	naturally occurring, one detect in field blank 8/21/03
Uranium-238	pCi/L	47	49	95.9	71	73	97.3	naturally occurring, 2 ND and one detect (8/21/03) in field blanks
Uranium	µg/L	13	14	92.9	42	43	97.7	naturally occurring, one ND in field blank
Gross Alpha	pCi/L	6	64	9.4	10	89	11.2	naturally occurring, 2 detects on 8/24/02, three on 5/20/04, three on 5/18/05
Gross Beta	pCi/L	44	64	68.8	58	88	65.9	naturally occurring
Gross Gamma	pCi/L	0	35	0.0	1	59	1.7	naturally occurring

Notes:
WQDB detection based on analytical laboratory qualifiers (no X or U qualifiers)
except Miami tritium detction based on result < 3 * uncertainty.
Except for Miami tritium, all analyses by GEL.



Santa Fe City Water Supply Radioactivity Summary from WQDB-								
		WQDB - 2001-2004			WQDB - 2001-2006			
Measurement		detected	analyzed	% detect	detected	analyzed	% detect	notes
Americium-241	pCi/L	0	13	0.0	0	19	0.0	
Cesium-137	pCi/L	0	12	0.0	0	18	0.0	
Cobalt-60	pCi/L	0	12	0.0	0	18	0.0	
Neptunium-237	pCi/L	0	12	0.0	0	18	0.0	
Plutonium-238	pCi/L	0	13	0.0	1	19	5.3	one detect 7/12/2006, just above MDA, below 3 sigma
Plutonium-239, -240	pCi/L	0	13	0.0	0	19	0.0	
Potassium-40	pCi/L	2	12	16.7	4	18	22.2	naturally occurring
Radium-226	pCi/L	6	14	42.9	9	17	52.9	naturally occurring
Sodium-22	pCi/L	0	2	0.0	0	18	0.0	
Strontium-90	pCi/L	0	34	0.0	0	43	0.0	
Tritium, GEL	pCi/L	0	9	0.0	0	15	0.0	
Tritium, Miami	pCi/L	5	44	11.4	5	48	10.4	
Uranium-234	pCi/L	29	45	64.4	35	51	68.6	naturally occurring, 16 R values 10/13/01
Uranium-235, -236	pCi/L	27	45	60.0	33	51	64.7	naturally occurring, 16 R values 10/13/01
Uranium-238	pCi/L	29	45	64.4	35	51	68.6	naturally occurring, 16 R values 10/13/01
Uranium	µg/L	34	34	100.0	45	45	100.0	naturally occurring
Gross Alpha	pCi/L	13	13	100.0	19	19	100.0	naturally occurring
Gross Beta	pCi/L	11	13	84.6	17	19	89.5	naturally occurring
Gross Gamma	pCi/L	0	12	0.0	0	18	0.0	naturally occurring

Notes:
WQDB detection based on analytical laboratory qualifiers (no X or U qualifiers) and secondary validation qualifiers (no R qualifiers)
except Miami tritium detction based on result < 3 * uncertainty.
Except for Miami tritium and four uranium results by EES-6, all analyses by GEL.



Los Alamos
NATIONAL LABORATORY
EST. 1943

Environmental Programs
LANL Water Stewardship Program
P.O. Box 1663, Mailstop M992
Los Alamos, New Mexico 87545
(505) 606-0312/FAX (505) 606-0503

Date: January 29, 2007
Refer to: EP2007-0004

Ms. Joni Arends
Executive Director
Concerned Citizens for Nuclear Safety
107 Cienega
Santa Fe, NM 87501

SUBJECT: INFORMATION CONCERNING RADIONUCLIDES IN WATER SUPPLY WELLS

Dear Ms. Arends:

Thank you for your request and your concern regarding potential neptunium-237, plutonium-238, 239 and 240, americium-241, cesium-137 and strontium-90 contamination in the drinking water supply wells for Los Alamos County and the Buckman Wellfield. The protection of the drinking water supplies of nearby communities is one of the primary groundwater protection goals of the Laboratory. We appreciate the opportunity to provide information on this subject.

The Laboratory added alpha spectrometry analysis for neptunium for the Los Alamos County water supply wells samples in December 2006. We also identified some existing August 2006 Los Alamos County water supply samples at the analytical chemistry laboratory. We asked the analytical laboratory to also analyze these samples for neptunium using alpha spectrometry. The results for the August 2006 samples were all non-detects.

We reviewed the radioactivity data for Los Alamos County supply wells from 2001-2006 (attached). This period of record was chosen because the same independent analytical laboratory analyzed the water supply samples during this period. We have also included a period of 2001-2004 to correspond to the data record presented in the Site-Wide Environmental Impact Statement (SWEIS).

EXHIBIT
CCNS-4

From the attachment, it can be seen that there are routine detections of naturally occurring radionuclides, such as uranium, potassium-40, and gross beta. For the remaining radionuclides the overall pattern is that they are not detected in water supply samples. For several LANL-derived contaminants, americium-241, cobalt-60, and cesium-137, there were no detections in the water supply wells from 2001-2006. Thus, there are no rising levels of radionuclides in these data.

Tritium has been detected at Los Alamos County water supply well Otowi-1 (O-1). These values are less than 0.3% of the drinking water standard, although this well is not used for supplying drinking water. These data are routinely reported in the Environmental Surveillance Report. Beginning in 2000, the tritium measurements at O-1 increased for four years from about 30 pCi/L to 60 pCi/L, and have decreased to about 20 pCi/L over the past two years.

Detections of LANL-derived contaminants, such as plutonium, americium, and strontium, have occurred sporadically in water supply wells. As indicated in the attachment, the bulk of these detections occurred from samples collected at the same time and analyzed by the analytical laboratory in the same batch. Because the overall frequency of detection is low, we believe that these sporadic detections are false positives or caused by problems at the analytical laboratory. This conclusion is supported by numerous reanalyses of these samples and by lack of consistent detections in paired samples. Again, there are no increasing trends in these data.

In conclusion, we believe the data demonstrate no radionuclide detections in the water supply wells, with the exception of tritium in Otowi-1.

We welcome your continued comments and concerns about the drinking water systems. If you have further questions, please contact Lorrie Bonds Lopez, (505) 665-0216, or lorriel@lanl.gov.

Sincerely,

Andrew Phelps
Associate Director
Environmental Programs

AP/JD/tml

Enclosure: 1) Water Supply Radioactivity Summary from WQDB
2) Santa Fe City Water Supply Radioactivity Summary from WQDB

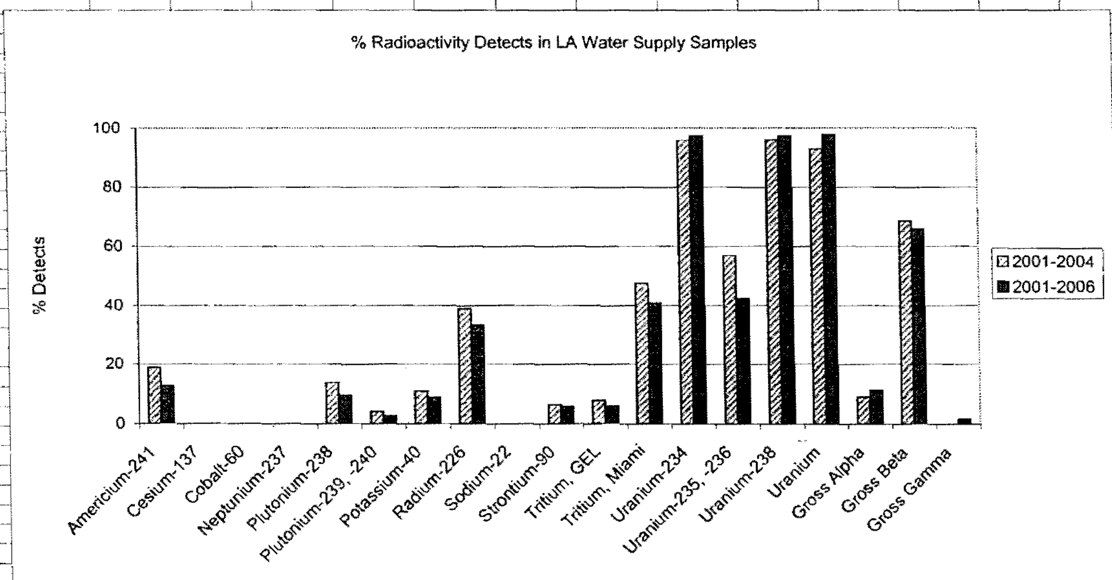
Cy: (w/enc.)
John Wiley, NAS, Washington, D.C.
Rich Mayer, EPA, Region 6, Dallas, TX
Buck Monday, Los Alamos County, Los Alamos, NM
Tim Glasco, Los Alamos County, Los Alamos, NM
Pete Padilla, Los Alamos County, Los Alamos, NM
Claudia Borchert, Santa Fe County, Santa Fe, NM

Cy: (continued)
Thomas Skibitski, NMED-DOE-OB, Santa Fe, NM
Gene Turner, DOE-LASO, MS A316
Mathew Johansen, DOE-LASO, MS A316
Steve Yanicak, DOE-LAAO, MS J993
Andrew Phelps, ADEP, MS J591
Carolyn Mangeng, ADEP, MS J591
Doug Stavert, ERSS-DO, MS M992
Bruce Gallaher, ERSS-GS, MS M992
Andrew Green, ERSS-GS, MS M992
David Rogers, ERSS-GS, MS M992
Keith Greene, ERSS-GS, MS M992
Tina Behr-Andres, LWSP, MS M992
Jean Dewart, LWSP, MS M992
Ardyth Simmons, LWSP, MS M992
Tori George, ENV-DO, MS J978
Tony Grieggs, ENV-RCRA, MS K490
Bob Beers, ENV-RCRA, MS K490
Ellen Louderbough, LC-LESH, MS A187
Deborah Woitte, LC-LESH, MS A187
Phil Wardwell, LC-LESH, MS A187
LWSP File, MS M992
IRM-RMMSO, MS A150
RPF, MS M707

Water Supply Radioactivity Summary from WQDB-

Measurement		WQDB - 2001-2004 detected	analyzed	% detect	WQDB - 2001-2006 detected	analyzed	% detect	notes
Americium-241	pCi/L	10	53	18.9	10	77	13.0	6 detects on 5/9/01, one not supported by dup, also detected in 2 field blanks, 4 detects on 8/29/03, latter not confirmed by reanalyses
Cesium-137	pCi/L	0	55	0.0	0	79	0.0	
Cobalt-60	pCi/L	0	55	0.0	0	79	0.0	
Neptunium-237	pCi/L	0	55	0.0	0	88	0.0	
Plutonium-238	pCi/L	7	49	14.3	7	73	9.6	7 detects on 5/9/01, one not supported by dup, one in field blank, result=mda, uncert=0
Plutonium-239, -240	pCi/L	2	49	4.1	2	73	2.7	2 detects on 5/9/01, one not supported by dup, result=mda, uncert=0
Potassium-40	pCi/L	6	55	10.9	7	79	8.9	2 detects on 5/9/01, 3 detects on 8/29/03, one not supported by field dup, 1 detect on 5/20/04, not supported by field dup, one detect on 5/17/06
Radium-226	pCi/L	14	36	38.9	16	48	33.3	naturally occurring
Sodium-22	pCi/L	0	55	0.0	0	79	0.0	
Strontium-90	pCi/L	13	203	6.4	13	227	5.7	13 detects on 11/28/01 by EPA:905, 5 qualified U in secondary validation, one U on reanalysis
Tritium, GEL	pCi/L	5	61	8.2	5	85	5.9	5 detects on 5/19/04
Tritium, Miami	pCi/L	66	139	47.5	72	177	40.7	57 detects in O-1
Uranium-234	pCi/L	47	49	95.9	71	73	97.3	naturally occurring, 2 ND and one detect (8/21/03) in field blanks
Uranium-235, -236	pCi/L	28	49	57.1	31	73	42.5	naturally occurring, one detect in field blank 8/21/03
Uranium-238	pCi/L	47	49	95.9	71	73	97.3	naturally occurring, 2 ND and one detect (8/21/03) in field blanks
Uranium	µg/L	13	14	92.9	42	43	97.7	naturally occurring, one ND in field blank
Gross Alpha	pCi/L	6	64	9.4	10	89	11.2	naturally occurring, 2 detects on 8/24/02, three on 5/20/04, three on 5/18/05
Gross Beta	pCi/L	44	64	68.8	58	88	65.9	naturally occurring
Gross Gamma	pCi/L	0	35	0.0	1	59	1.7	naturally occurring

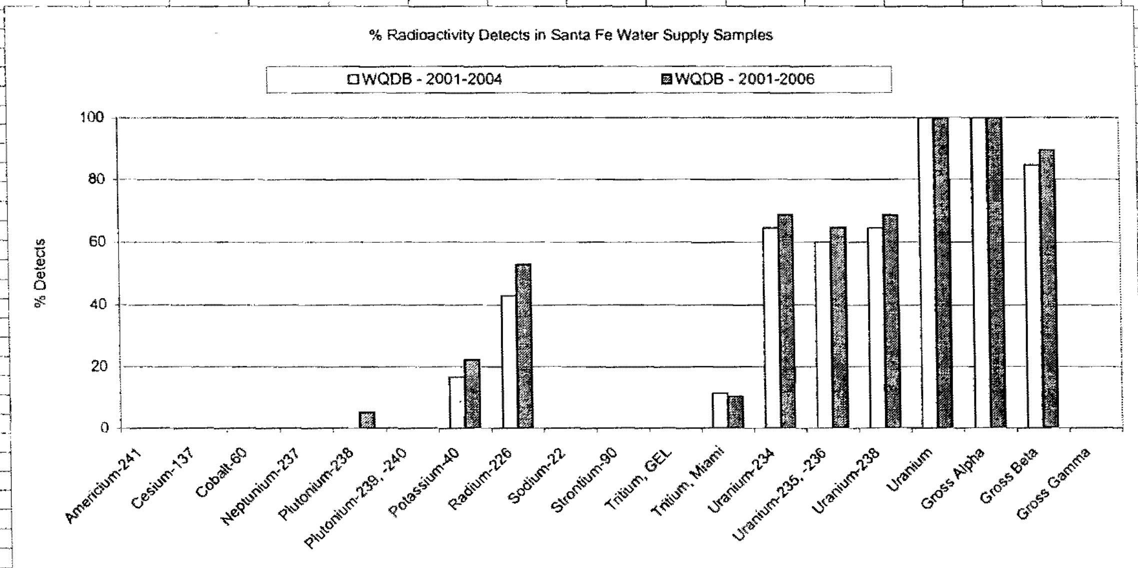
Notes:
WQDB detection based on analytical laboratory qualifiers (no X or U qualifiers)
except Miami tritium detction based on result < 3 * uncertainty.
Except for Miami tritium, all analyses by GEL.



Santa Fe City Water Supply Radioactivity Summary from WQDB-

Measurement		WQDB - 2001-2004 detected	analyzed	% detect	WQDB - 2001-2006 detected	analyzed	% detect	notes
Americium-241	pCi/L	0	13	0.0	0	19	0.0	
Cesium-137	pCi/L	0	12	0.0	0	18	0.0	
Cobalt-60	pCi/L	0	12	0.0	0	18	0.0	
Neptunium-237	pCi/L	0	12	0.0	0	18	0.0	
Plutonium-238	pCi/L	0	13	0.0	1	19	5.3	one detect 7/12/2006, just above MDA, below 3 sigma
Plutonium-239, -240	pCi/L	0	13	0.0	0	19	0.0	
Potassium-40	pCi/L	2	12	16.7	4	18	22.2	naturally occurring
Radium-226	pCi/L	6	14	42.9	9	17	52.9	naturally occurring
Sodium-22	pCi/L	0	2	0.0	0	18	0.0	
Strontium-90	pCi/L	0	34	0.0	0	43	0.0	
Tritium, GEL	pCi/L	0	9	0.0	0	15	0.0	
Tritium, Miami	pCi/L	5	44	11.4	5	48	10.4	
Uranium-234	pCi/L	29	45	64.4	35	51	68.6	naturally occurring, 16 R values 10/13/01
Uranium-235, -236	pCi/L	27	45	60.0	33	51	64.7	naturally occurring, 16 R values 10/13/01
Uranium-238	pCi/L	29	45	64.4	35	51	68.6	naturally occurring, 16 R values 10/13/01
Uranium	µg/L	34	34	100.0	45	45	100.0	naturally occurring
Gross Alpha	pCi/L	13	13	100.0	19	19	100.0	naturally occurring
Gross Beta	pCi/L	11	13	84.6	17	19	89.5	naturally occurring
Gross Gamma	pCi/L	0	12	0.0	0	18	0.0	naturally occurring

Notes:
WQDB detection based on analytical laboratory qualifiers (no X or U qualifiers) and secondary validation qualifiers (no R qualifiers) except Miami tritium detction based on result < 3 * uncertainty.
Except for Miami tritium and four uranium results by EES-6, all analyses by GEL.



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March 20, 2007

Andrew Phelps, Associate Director
Carolyn Mangeng, Acting Associate Director
Environmental Programs
LANL Water Stewardship Program
P. O. Box 1663, Mailstop M992
Los Alamos, NM 87545

Re: Your Letter of January 29, 2007, EP2007-0004
Information Concerning Radionuclides in Water Supply Wells

Dear Mr. Phelps and Ms. Mangeng:

Thank you for your letter as referenced above, hereinafter referred to as the Phelps letter. We note that Mr. Phelps is being reassigned at Los Alamos National Laboratory (LANL) and therefore we also address this letter to his replacement, Ms. Mangeng.

We believe the Phelps letter is in response to the comments by Concerned Citizens for Nuclear Safety (CCNS) about the draft Site-Wide Environmental Impact Statement for LANL (draft LANL SWEIS), DOE/EIS-0380D. We remain concerned about impacts of LANL contaminants to regional drinking water supplies. The Phelps letter does not addresses the many concerns raised in our comments to the draft LANL SWEIS about the need to protect regional groundwater.

In response to the Phelps letter, we provide the following specific and general comments about LANL's inability to protect the regional drinking water supplies. Robert H. Gilkeson, Registered Geologist, and George Rice, Groundwater Hydrologist, assisted CCNS in preparing these comments. We note the reoccurring pattern of behavior in which LANL presents data to the public for comment and, upon receiving critical comments about the data, LANL later dismisses that data as spurious. This is the case in this situation.

We address our ongoing general concerns about:

EXHIBIT
CCNS-5

1. The radionuclide contamination in the Los Alamos County and City of Santa Fe drinking water wells that are reported in the 1999 and 2006 LANL SWEIS documents.
2. Over three years ago, LANL found elevated levels of chromium in regional characterization well R-28. LANL computer modeling predicts the plume reaches the Los Alamos County and City of Santa Fe drinking water wells. See Figure 4-33, which is attached as Attachment 1. Predicted plume migration for sources released at the water table below Mortandad Canyon, based on a steady-state, with pumping, flow field. Los Alamos National Laboratory's Hydrogeologic Studies of the Pajarito Plateau: A Synthesis of Hydrogeologic Workplan Activities (1998-2004), LA-14263-MS, p. 4-54. Despite the LANL modeling, we still do not know the dimensions of the plume or how fast it is moving toward the drinking water wells.
3. Data Gaps Prevent Accurate Calculation of Contaminant Travel Times by Computer Models. See Attachment 2.
4. DOE/LANL has used improper fluid-assisted drilling methods that mask detection of groundwater contamination for the installation of the LANL characterization wells that are planned to be used as monitoring wells. See Attachment 3.
5. The Need to Plug and Abandon the Old LANL Test Wells, including DT-5A, DT-9 and DT-10 at TA-49, and Install New Characterization Wells. See Attachment 4.
6. The on-going failure of DOE/LANL to formulate a path forward to correct the mistakes made over the past ten years.

CCNS made comments about the radionuclide contamination in the drinking water wells for Los Alamos County and the City of Santa Fe as was reported in Appendix F, "Environmental Sample Data," of the 2006 draft LANL SWEIS. The contamination presented in Appendix F was from a review of LANL water quality data by the consulting company that wrote the draft LANL SWEIS. In addition, the 1999 final LANL SWEIS also reported the measurement of many radionuclide contaminants in the drinking water wells and some of that data is included in the graphs in Appendix F of the 2006 draft LANL SWEIS.

Based on the data presented in the draft LANL SWEIS, CCNS contacted the City of Santa Fe and the County of Los Alamos to discuss the findings. As a result of those meetings, CCNS contacted the Environmental Protection Agency (EPA) about obtaining the necessary funding for additional sampling and analysis of key wells in the public drinking water systems. We then met together, with the New Mexico Environment Department (NMED), to prioritize the wells to be sampled for certain analytes. Sampling took place in late February and early March. We expect the results soon.

In our draft LANL SWEIS comments, CCNS questioned the very high values of neptunium-237 that were reported in the drinking water wells for both Los Alamos County and the City of Santa Fe and expressed the belief that the high values were probably because of the poor resolution of the gamma spectrometry analytical method. CCNS recommended that water samples be analyzed with the high precision alpha spectrometry method. The Phelps letter demonstrates that our recommendation has been followed, and in fact, states that the more precise analytical method did not detect neptunium-237 in any of a limited number of water samples. We question why the LANL did not identify the need years ago to use the proper method to resolve the possible contamination of the drinking water wells with dangerously high levels of neptunium-237.

Unfortunately, the Phelps letter fails to address the detection of radionuclide contamination in the drinking water wells of Los Alamos County and the City of Santa Fe. The two attachments to the Phelps letter indicate the number of detections, the number of samples analyzed and the percentage of detections. It does not provide actual measurements for the detections. We request that the analytical results be provided to us.

Please clarify the source of data in the attachments to the Phelps letter. Is the data limited to the discrete wells that were sampled and the data provided in the LANL Environmental Surveillance Reports for 2001, 2002, 2003 and 2004? See Exhibit 2 to the CCNS draft LANL SWEIS comments.

Specific Comments in Response to the Phelps Letter

Claims made in the Phelps letter are unsupported by the data tables found in the attachments. First, the claim is made:

> For several LANL-derived contaminants, americium-241, cobalt-60, and cesium-137, there were no detections in the water supply wells from 2001-2006. Thus, there are no rising levels of radionuclides in these data.

Americium-241, Cobalt-60 and Cesium-137. In response, there is no information in the Phelps letter to support the claim of no detections of americium-241, cobalt-60, and cesium-137. Whereas, the draft LANL SWEIS reports the common occurrence of all three radionuclides in the drinking water wells. Our conclusion is that the claims in the Phelps letter of "no detections" are technically incorrect and without basis to the data.

Los Alamos County Wells - Table F-18 in Appendix F of the draft LANL SWEIS

Contaminant	No. detected	No. analyzed	Maximum (pCi/L)
americium-241	16	51	0.157*
cobalt-60	1	13	1.76
cesium-137	7	53	15.2

*The measured level of americium-241 exceeds the recommended drinking water standard of 0.15 pCi/L.

City of Santa Fe Wells in the Buckman Well Field
Table F-19 in Appendix F of the draft LANL SWEIS

Contaminant	No. detected	No. analyzed	Maximum (pCi/L)
americium-241	1	15	0.0111
cobalt-60	2	3	1.87
cesium-137	13	25	6.60

The reported presence of the three radionuclide contaminants in the drinking water wells of both Los Alamos County and the City of Santa Fe in the draft LANL SWEIS is a serious problem that cannot be waved away with the unsupported statement that "contamination is not detected."

Plutonium-238, Plutonium-239, -240, Strontium-90 and Tritium. Similarly, the Phelps letter does not adequately address the contamination of the drinking water wells with the radionuclide contaminants plutonium-238, plutonium-239, -240, strontium-90, and tritium.

Los Alamos County Wells - Table F-18 in Appendix F of the draft LANL SWEIS

Contaminant	No. detected[A]		No. analyzed[A]		Maximum (pCi/L)	
plutonium-238	12	(7)	47	(49)	0.0187	N.L.[B]
plutonium-239, -240	12	(2)	47	(49)	0.0308	N.L.
strontium-90	50	(13)	172	(203)	0.272	N.L.
tritium	11	(-)	59	(-)[C]	874	(-)

[A] The first value is from the draft LANL SWEIS. The values in parenthesis are from Attachment 1 of the Phelps letter.
[B] N.L. The measured values are not listed in the Phelps letter.
[C] (-) See discussion of tritium data presented in the Phelps letter below.

City of Santa Fe Wells in the Buckman Well Field
Table F-19 in Appendix F of the draft LANL SWEIS

Contaminant	No. detected[A]		No. analyzed[A]		Maximum (pCi/L)	
plutonium-238	1	(0)	15	(13)	0.00420	N.L.[B]
plutonium-239,-240	2	(0)	15	(13)	0.00910	N.L.
strontium-90	10	(0)	32	(34)	0.226	N.L.
tritium	4	(-)	14	(-)[C]	84.1	(-)

[A] The first value is from the draft LANL SWEIS. The values in parenthesis are from Attachment 2 of the Phelps letter.
[B] N.L. The measured values are not listed in the Phelps letter.
[C] (-) See discussion of tritium data presented in the Phelps letter below.

The Phelps letter acknowledges many fewer "detections" of contamination for every radionuclide compared to the number of detections in the draft LANL SWEIS without any defense of the discrepancy. Simply listing fewer detections does not prove there are fewer detections. In addition, the Phelps letter does not adequately defend the dismissal of the "detections" mentioned with the rationale of "below 3 sigma" or "false positives."

The draft LANL SWEIS presents many detections of tritium contamination in the drinking water wells of both Los Alamos County (to a maximum level of 874 pCi/L) and the Buckman Well Field (to a maximum level of 84.1 pCi/L). However, the Phelps letter claims that tritium is only detected in Los Alamos County water supply well Otowi-1.

Further, the conclusion in the Phelps letter that the tritium measured in well Otowi-1 is the only radionuclide contamination measured in any of the drinking water wells of Los Alamos County or the City of Santa Fe is not supported by any factual data. The potential for LANL contaminants to travel to the drinking water wells is unknown. The new network of LANL characterization wells do not produce reliable and representative water samples for the presence or absence of the LANL radionuclide contaminants.

General Comments

There are many recent LANL reports and independent reports by the Department of Energy Inspector General (DOE IG) and the EPA that prove the new network of LANL characterization wells and the old LANL test wells do not produce reliable data for the contamination of the regional aquifer with radionuclides and chemicals from LANL wastes.

Environmental Protection Agency (EPA). DOE/LANL allowed organic drilling additives (both organic fluids, foams and clay muds) to invade the screened intervals in all of the new characterization wells installed during the past ten years under the Hydrogeologic Workplan. In addition, many of the new wells were drilled with the mud-rotary method that invaded the screened intervals with bentonite clay drilling muds that also contained organic additives. The organic and bentonite clay drilling additives have well-known properties to mask the detection of most LANL chemical and radionuclide contaminants. The organic additives create a new mineralogy of iron precipitates, a slime that coats the strata and surrounds the screened interval, masking the detection of contamination. The failure of DOE/LANL to install a reliable network of monitoring wells is summarized in the notes recorded by a LANL scientist of a telephone conference call with the scientists from the EPA National Risk Management Research Laboratory in Ada, Oklahoma:

> EPA also thought that iron minerals would not return to predrilling conditions in the foreseeable future.
>
> EPA further expressed the opinion that it would be difficult to determine when and whether the impacted screens would return to predrilling conditions. EPA expressed the opinion that LANL would never be able to get representative samples from the impacted wells, but could only make choices and tradeoffs based on specific contaminants at various locations.

Department of Energy (DOE) Inspector General. The DOE IG wrote a report that described the failure of DOE/LANL to meet the requirements of the Resource Conservation and Recovery Act (RCRA) to install monitoring wells that produce reliable and representative water samples for the detection of LANL contaminants. From IG Report DOE/IG-0703, September 2005:

> However, LANL did not adhere to specific constraints established in the RCRA guidance when using muds and other drilling fluids, and, as a result, LANL could not assure that certain residual drilling fluids were fully removed; and muds and other drilling fluids that remained in certain wells after construction created a chemical environment that could mask the presence of radionuclide contamination and compromise the reliability of groundwater contamination data.

The DOE IG Report also described the requirement for DOE/LANL to implement a surveillance groundwater monitoring program by December 31, 2005 under DOE Order 450.1. DOE/LANL are not in compliance with the DOE Order. Again, from the DOE IG Report:

> The current requirements for a groundwater surveillance monitoring program are found in DOE O 450.1, "Environmental Protection Program," which LANL has until December 31, 2005, to implement. As LANL works to meet this deadline, we

believe that the Laboratory should, as the Hydrogeologic Workplan wells are converted to monitoring wells, ensure that monitoring data are reliable. We also believe that particular attention should be given to well development and purging methods, the quality of radionuclide data, and any qualifications on that data.

LANL Well Screen Analysis Report (WSAR). DOE/LANL are not in compliance with the DOE Order as demonstrated by the conclusion presented in the LANL Well Screen Analysis Report (WSAR), which was published in November 2005. The WSAR states that only approximately 50% of the new LANL characterization wells produce reliable and representative water samples. The WSAR was only a study of the effects of the drilling additives on the water quality data and did not address the many other factors that prevent the wells from meeting the requirements of monitoring wells.

On September 18, 2006, the New Mexico Environment Department (NMED) issued a Notice of Disapproval to LANL for the WSAR because of its failure to perform a thorough study. When all factors are considered, the number of LANL characterization wells that fail to produce representative and reliable water quality data is possibly greater than 90%. In the past few days, LANL submitted the first revision of the WSAR to NMED as required by the Notice of Disapproval. CCNS will provide comments about the revised WSAR to NMED.

CCNS Recommendations

A Rigorous Sampling Program is Needed. A rigorous monthly sampling program for the Los Alamos County and Santa Fe drinking water wells and the construction of new characterization wells are necessary because of the:

1. failure of DOE/LANL to install the surveillance network of monitoring wells as required by RCRA and DOE Order 450.1, and
2. contamination that is reported in the 2006 draft LANL SWEIS and in the 1999 final LANL SWEIS.

The unreliable new network of characterization wells does not provide accurate information about the characteristics of the groundwater beneath LANL which is required by DOE Order 450.1, RCRA, New Mexico Water Quality Control Commission regulations, as well as the NMED/LANL Consent Order. After 10 years and approximately $150 million, the continued obfuscation of data does not help the process, nor protect drinking water supplies. Data from a reliable network of monitoring wells is the frontline of information about the source of contamination and impacts to the drinking water wells.

The rigorous sampling program requires collection of water samples on a monthly schedule. The analysis of those samples must be for a large suite of naturally occurring chemical and radionuclide constituents, chemical contaminants and radionuclide contaminants, done with the appropriate analytical methods for the highest possible precision in the measurements.

The question remains whether the contamination is present in the drinking water wells, while people are drinking the water. An independent verification and validation process is needed. DOE must hire an independent contractor to resolve this matter.

The Need for an Independent Company to Review LANL Data. The contradiction between the claim of "no contamination" in the Phelps letter and the large amount of contamination listed in the data tables in the two LANL SWEIS documents (1999 final and 2006 draft) are critical issues that LANL cannot resolve. There is a need for an independent company to conduct a careful review of the radionuclide and chemical contaminant data for the drinking water wells of Los Alamos County and the City of Santa Fe, with specific data quality objectives.

It is a poor process and the data in the LANL Water Quality Database are in poor repair. The data are published in critically important reports about which DOE/LANL has requested public comments under the National Environmental Policy Act (NEPA). CCNS and other interested organizations and people have spent considerable time and effort to make comments about the environmental consequences of past, current and proposed new activities at LANL. Once again, we are dismayed to learn that LANL now says that the data published in LANL reports written to satisfy requirements under NEPA are spurious. Therefore, the draft LANL SWEIS should be retracted and a new draft submitted to the public for review.

The databases that are used to provide spurious data for the SWEIS documents, reports to Congress and NMED, annual LANL Environmental Surveillance Reports, and Agency for Toxic Substances and Disease Registry (ATSDR) reports, among others, must be thoroughly reviewed. The Phelps letter is one example of a larger problem. In order to protect public health and the environment, LANL has a responsibility to provide accurate data in these reports. We ask why this problem exists. We request again for the retraction of the reports listed in this paragraph.

Attachments. The following are provided in further support of the issues raised in this letter and our comments to the draft LANL SWEIS and are available on our website at www.nuclearactive.org:

1. Attachment 1. Figure 4-33. Predicted plume migration for sources released at the water table below Mortandad Canyon, based on a steady-state, with pumping, flow field. Los Alamos National Laboratory's Hydrogeologic Studies of the Pajarito Plateau: A Synthesis of Hydrogeologic Workplan Activities (1998-2004), LA-14263-MS, p. 4-54.
2. Attachment 2. Data Gaps Prevent Accurate Calculation of Contaminant Travel Times by Computer Models.

3. Attachment 3. DOE/LANL has used improper fluid-assisted drilling methods that mask detection of groundwater contamination for the installation of the LANL characterization wells that are planned to be used as monitoring wells.
4. Attachment 4. The Need to Plug and Abandon the Old LANL Test Wells, including DT-5A, DT-9 and DT-10 at TA-49, and Install New Characterization Wells.

We also reference the Exhibits to the CCNS and EVEMG Comments about draft LANL SWEIS, dated September 20, 2006, which may be found at www.nuclearactive.org:

5. Exhibit 1. The Complex Geologic Setting Beneath LANL Requires the Use of Drilling Methods that Mask Detection of Most Radionuclide and Chemical Contaminants in Groundwater, by Robert H. Gilkeson.
6. Exhibit 2. Deficiencies in the Draft LANL SWEIS for the Water Quality Data Produced From the LANL Monitoring Wells, by Robert H. Gilkeson.
7. Exhibit 3. Failure of Draft LANL SWEIS to Address the Environmental Impact From the Hexavalent Chromium Plume in the Regional Aquifer, by Robert H. Gilkeson.
8. Exhibit 4. Failure of the Draft LANL SWEIS to Address Environmental Impact Because of Groundwater Contamination From the RCRA Regulated Disposal Sites at Technical Area 54, by Robert H. Gilkeson.
9. Exhibit 5. Comments on the Draft Site-Wide Environmental Impact Statement for Continued Operations of Los Alamos National Laboratory, Los Alamos New Mexico, by George Rice.

Figures for Exhibits 1 to 4, listed above, are also available at www.nuclearactive.org.

10. Figure 1-1. Map showing location of wells constructed under the Hydrogeologic Workplan.
11. Figure 1-2. Overall condition of screens for producing reliable and representative water-quality samples as of November 2005.
12. Figure 1-3. Hydrostatigraphy at LANL Wells R-28 and R-13.
13. Figure 1-4. Schlumberger Permeability Logs for Wells R-28 and R-34.
14. Figure 1-5. The misrepresentation in the LANL "Synthesis Report" that the regional aquifer beneath the San Ildefonso Pueblo does not have high permeability.
15. Figure 1-6. The LANL characterization wells R-16, R-20, R-21, R-22, R-23, and R-32 that surround the three RCRA regulated units MDA G (Area G), MDA L, and MDA H. None of the six wells meet the requirements of RCRA for monitoring groundwater contamination.
16. Figure 1-7. As-built construction of LANL characterization well R-16, a sentry well for LANL contaminants traveling to the Rio Grande and to the Buckman well field.
17. Figure 1-8. Well R-16 Schlumberger Geophysics of Screen #4.
18. Figure 1-9. Schlumberger Geophysics for Well R-22.

Next Steps. We understand from Ines Triay and George Rael that a meeting will be set up to discuss these issues. We look forward to your response and continuing this dialogue in order to protect critical regional drinking water supplies. Should you have any questions or comments, please contact us by phone or email.

Sincerely,

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Attachment: January 29, 2007 Phelps letter in .pdf
Attachment 1. Figure 4-33. Predicted plume migration for sources released at the water table below Mortandad Canyon, based on a steady-state, with pumping, flow field.

cc: Senator Jeff Bingman
Senator Pete V. Domenici
Representative Tom Udall
Governor Bill Richardson
Senate and House Members of the New Mexico State Legislature
Senate and Assembly Members of the California State Legislature
Communities for Clean Water
New Mexicans for Sustainable Energy and Effective Stewardship
Ines Triay, DOE EM-3
George Rael, DOE
John Wiley, NAS, Washington, DC
Rich Mayer, EPA Region 6
Steve Acree, Hydrologist, EPA Applied Research & Technical Support Branch
Robert Ford, Ph.D., Environmental Scientists, EPA Subsurface Remediation Branch

Randall R. Ross, Ph.D., Hydrologist, EPA Applied Research & Technical Support Branch

Ron Curry, Secretary of New Mexico Environment Department
Mike Huber, NMED Drinking Water Bureau
Tom Skibitski, NMED DOE OB, Santa Fe, NM
Steve Yanicak, NMED DOE OB, White Rock, NM
David Coss, Mayor, City of Santa Fe
Claudia Borchert, City of Santa Fe, Santa Fe, NM
Robert Gallegos, City of Santa Fe, Santa Fe, NM
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Buck Monday, Los Alamos County, Los Alamos, NM
Tim Glasco, Los Alamos County, Los Alamos, NM
Pete Padilla, Los Alamos County, Los Alamos, NM
Arjun Makhijani, Ph.D., Institute for Energy and Environmental Research
Don Hancock, Southwest Research and Information Center
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Gene Turner, DOE LASO, MS A316
Mat Johansen, DOE LASO, MS A316
Doug Stavert, ERSS DO, MS M992
Bruce Gallaher, ERSS GS, MS M992
Andrew Green, ERSS, MS M992
Keith Greene, ERSS GS, MS M992
Tina Behr-Andres, LWSP, MS M992
Jean Dewart, LWSP, MS M992
Ardyth Simmons, LWSP, MS M992
Tori George, ENV DO, MS J978
Tony Grieggs, ENV RCRA, MS K490
Bob Beers, ENV RCRA, MS K490
Ellen Louderbough, LC LESH, MS A187
Deborah Woitte, LC LESH, MS A187
Phil Wardwell, LC LESH, MS A187

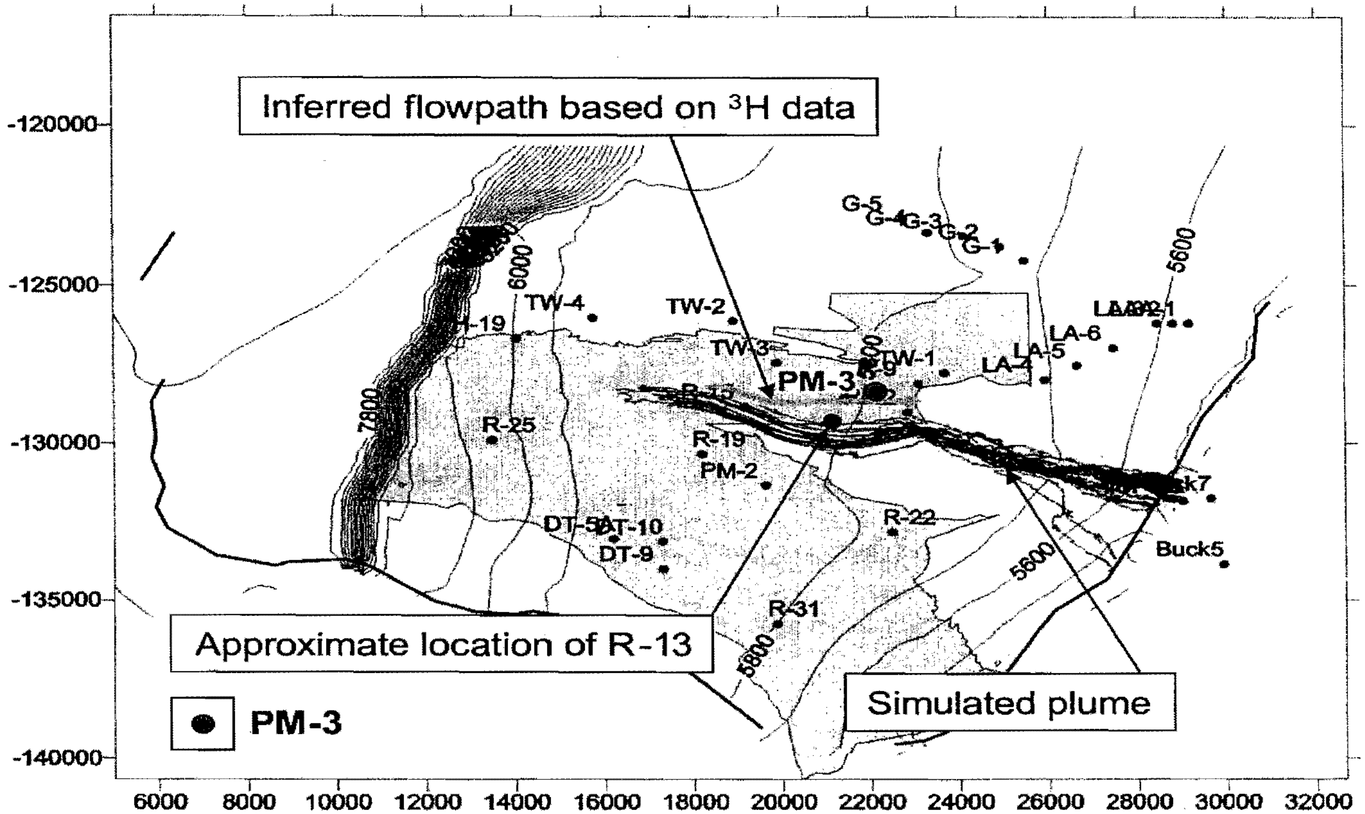


Figure 4-33. Predicted plume migration for sources released at the water table below Mortandad Canyon, based on a steady-state, with pumping, flow field.

Attachment 2. Data Gaps Prevent Accurate Calculation of Contaminant Travel Times by Computer Models.

***Vadose Zone Journal* Article.** The conclusion to the August 2005 *Vadose Zone Journal* article, by LANL employees Elizabeth H. Keating, Bruce Robinson, and Velimir V. Vesselinov, entitled "Development and Application of Numerical Models to Estimate Fluxes through the Regional Aquifer beneath the Pajarito Plateau," states:

> The implications of this work for water resources beneath the [Pajarito] plateau is that groundwater production is mining an old aquifer that has not received significant recharge on the time scale of this study (decades). The implications of this work for contaminant transport issues is that because of parameter uncertainty, predicted fluxes and velocities are quite uncertain. Part of the reason for this is uncertainty in total recharge to the aquifer. Uncertainties in permeability and porosity values lead to additional model uncertainty. These uncertainties can be reduced meaningfully with more data collection, including multiwell pumping and tracer tests. Finally, local recharge does occur along canyons that cross the LANL property. From a large-scale water budget perspective, local recharge is relatively small. Nevertheless, this recharge has important water quality implications in locations where contaminated effluent discharges have been released. Vol. 4, August 2005, p. 668.

The high number of uncertainties (parameter, predicted fluxes, velocities, total recharge, permeability, porosity values) is of concern. The lack of representative data presents other problems, including the use of spurious, unreliable and unrepresentative data in expensive computer models. In order to validate any computer model, representative groundwater data must be obtained. Data uncertainties magnify our inability to trust in the computer models.

Accordingly, we are concerned about how the series of articles in the *Vadose Zone Journal* provide the basis for analysis in the draft LANL SWEIS, specifically Appendix F. The articles are not readily available for review. If the articles continue to form the basis for decision making in the final LANL SWEIS, the articles should be reprinted in that document.

Need for Pristine Groundwater Samples. Groundwater samples must be pristine because of the small amount of contamination that can cause health problems if ingested. For example, the EPA drinking water standard for strontium-90 is 8 pCi/L. A conversion of 8 pCi/L equals 60 parts per quintillion (ppq). One part per quintillion is one trillionth of a millionth. Further, over the years there have been problems with the sampling, detection and analysis of strontium-90 in groundwater, a subject that we will not discuss in this letter.

Unjustified Reliance on Computer Contaminant Transport Models. LANL scientists have a record of over-reliance on models built on "assumptions" to demonstrate that LANL wastes will not reach the groundwater resource. This over-reliance was presented to the NAS study committee that is investigating LANL groundwater protection practices. The NAS was told by LANL scientists that travel times to the regional aquifer from atop mesas is in excess of 1000 years.

A 2000 National Academy of Sciences (NAS) report by Shlomo P. Neuman and Benjamin Ross described the over reliance by the DOE with on transport models to demonstrate the effects of waste disposal sites on groundwater resources. *Long-Term Institutional Management of U.S. Department of Energy Legacy Waste Sites.* The report by Neuman and Ross contained the following closing remarks:

> There has been a tendency by the DOE and some other agencies to rely excessively on models in the context of waste disposal and site contamination issues. Models have been used repeatedly to "demonstrate" that a potential waste disposal site or remedial option complies with regulations and is therefore "safe." More often than not, the ability of models to provide such safety assurances has been taken for granted without a serious attempt to validate them against site data. The tendency has been to rely on models at the expense of detailed site investigations, site monitoring, and field experimentation. In fact, models have often been used to "demonstrate" that additional site or experimental data would be of little value for a project. The reasons for this state of affairs are easily identified as regulatory and budgetary pressures.
>
> It is often tempting to "demonstrate" by means of a model that a given waste disposal or remedial option is safe, or that additional site data would be of little value, by basing the model on assumptions, parameters and inputs that favor a predetermined outcome. A common example of such bias is the assignment of lower permeability's to a groundwater flow model than is justified by available data. It is likewise tempting to help a model appear credible by basing it on a unique system conceptualization and subjecting it to sensitivity and uncertainty analyses in which parameters and input variables are constrained to vary within narrower ranges of values than is warranted by the available information. Such practices are common and ultimately detract from the credibility of agencies that employ them. Appendix G "Mathematical Models Used for Site Closure Decisions."

Material Disposal Area G. An example of LANL dependence on the assumptions in the computer models is Material Disposal Area (MDA) G, the LANL active waste disposal facility for radionuclide waste. This 65-acre site has disposed of chemical and radioactive waste for a period of over 50 years. A transport model was used to demonstrate that the buried wastes at Area G, would not reach the regional aquifer for a period in excess of 1000 years. DOE/LANL use the results from the Area G transport model to "demonstrate" that groundwater monitoring is not necessary for the many historical waste disposal sites that are located atop mesas across the laboratory facility.

LANL scientists adhere to their model, even though groundwater contamination is present in the regional aquifer beneath Area G.

Data Gaps as a Result of Poor Well Construction and Sampling. As an example, LANL drilled Regional Well R-22 with five screened intervals for monitoring groundwater 500 feet east of the Area G boundary. The groundwater contamination is summarized below and is evidence that the transport of chemical and radionuclide contamination to the regional aquifer has occurred over a period of time that is less than 50 years.

Contaminants Listed in the LANL Well R-22 Geochemistry Report (LA-13986-MS, 2002)

Contaminant	*Listed Hazardous Constituent*	*Exceedance Requiring Corrective Action*	*Appendix IX Groundwater Monitoring List*	*Level Measured in Water Samples*
tritium				109 picocuries per liter (pCi/L) at the water table of the regional aquifer
technetium-99				4.3 and 4.9 pCi/L
*pentachlorophenol	X	X	X	6.2 parts per billion (ppb)
*chloroform	X		X	0.94 ppb
*phenol	X		X	19 and 32 ppb
*4-methylphenol				44 to 210 ppb
*2-butanone				6.9 to 8.9 ppb
*diethylphthalate	X		X	1.3 ppb
benz(a)pyrene	X	X	X	0.24 ppb
benzoic acid				3 to 12.5 ppb
butyl benzyl phthalate	X		X	9.8 ppb
Toluene	X		X	0.2 to 0.76 ppb
methylene chloride	X		X	0.62 and 2.2 ppb
bis(2-ethylhexyl) phthalate			X	1.0 and 3.9 ppb

* The six contaminants are highly mobile in groundwater and are all commonly found in groundwater beneath toxic waste landfills.

Several substituted benzene compounds including:

isopropylbenzene	0.16 to 0.54 ppb
1,4-dichlorobenzene	0.16 to 0.23 ppb

The water-based drilling fluids diluted the tritium contamination of 109 pCi/L at the water table. The well drilling penetrated a confining bed at a distance of less than 60 feet below the water table. Drilling an open borehole through the confining bed allowed the contamination at the water table to drain deep into the regional groundwater resource for a period of approximately 70 days.

A September 2004 LANL report, LA-UR-04-6777, recognizes the contamination detected in the water samples produced from well R-22 as follows:

> Thirty-one volatile and semi-volatile organic compounds have also been detected in water from well R-22. Only two of these, pentachlorophenol (1 detection, 6.2 ppb, MCL = 1 ppb) and benzo(a)pyrene (2 detections, 0.24 ppb, MCL = 0.2 ppb) were present at concentrations above the MCL [Maximum Contaminant Level for EPA Drinking Water Standards]. Monitoring for organic compounds at well R-22 will continue. [Emphasis added.]

It is important to note that the mistakes in the drilling and installation of well R-22 have prevented all of the water samples taken there from being reliable and representative. The new mineralogy (i.e., chemistry) formed by the organic drilling additives and the no-purge water sampling methodology are now preventing the detection of contamination in the water samples produced from the well. With this knowledge, the scheme to continue collecting spurious water samples from well R-22 is irresponsible and a violation of both RCRA and DOE Orders.

Table 4 in the 2004 LANL report cited above describes the water quality data produced from the five-screened intervals in well R-22 as follows:

> Screens 1, 3, 4, 5 are not yet representative, although residual drilling fluid is breaking down through oxidation reactions and concentrations of sulfate are returning above detection. Screen #2 is the least affected by residual drilling fluid and has representative water chemistry.

The measured permeability of screen #2 is a very low 0.04 ft/day compared to values of 50 to greater than 100 ft/day for strata above and below screen #2. The recent plan of DOE/LANL to block-off screen #1 and use the water produced from screen #2 to monitor releases from Area G does not comply with RCRA groundwater monitoring requirements to monitor groundwater from the "uppermost aquifer," the aquifer strata nearest the water table that produce a significant amount of groundwater. The poorly productive basalt rock surrounding screen #2 does not meet the RCRA definition of "aquifer."

The well screens in R-22 are misplaced and/or permanently damaged and do not meet the monitoring requirements of RCRA or DOE Orders.

Regulatory Issues. RCRA describes waste disposal facilities, such as the LANL MDAs G, H, and L at Technical Area 54 that received hazardous waste after July 26, 1982, as "regulated units" that must comply with the groundwater monitoring requirements in the Detection Monitoring Section of RCRA §§264.91 through 264.101 (RCRA Subpart F). Further, the release of hazardous materials from LANL activities found in well R-22 requires LANL to install of a network of monitoring wells to investigate groundwater contamination beneath and away from MDA G as ordered by the Compliance Monitoring Section of RCRA Subpart F. DOE/LANL have not installed the set of monitoring wells required by RCRA for the regulated units at Technical Area 54.

The groundwater monitoring requirements under RCRA Subpart F for the LANL SWMUs are summarized in an email to CCNS on February 20, 2007 from Richard Mayer, an EPA scientist in EPA Region 6:

> The groundwater monitoring requirements for [solid waste management units] SWMUs should mirror the requirements for regulated units under Subpart F. The groundwater monitoring wells should be located (hydraulically down-gradient) close/near/next to the SWMU or regulated unit in adequate/sufficient numbers. Also, for the monitoring wells located next to the SWMU/regulated unit, the uppermost aquifer should be monitored (in addition, other deeper zones may need to be monitored according to site conditions, other factors, etc.). The site should also have a sufficient number of "background" groundwater monitoring wells in order to determine a release for natural occurring contaminants like metals and some radionuclides.
>
> If contamination is found in the monitoring wells next to the SWMU/regulated unit, then further horizontal and vertical delineation of the groundwater plume is required with additional wells.
>
> Also, the words sufficient or adequate can be interpreted differently. For example, if a SWMU/regulated unit was 300' by 300' and the groundwater flow direction was from Northwest to Southeast, two downgradient monitoring wells next to the unit (initial wells) would not be a sufficient/adequate number. Now if you had a unit that was 50' by 50', with groundwater flow from Northwest to Southeast, then 2 downgradient monitoring wells next to the unit/SWMU probably would be sufficient.

This is just a brief general summary. As you know, each site can have its own unique groundwater monitoring issues."

During the past ten years, DOE/LANL have installed a network of 25 characterization wells across the LANL facility with screens installed in the regional aquifer. Well R-22 is the only well installed close enough to a LANL waste disposal facility to investigate contamination in groundwater flowing from beneath the facility. The mistakes in the installation of well R-22 and the failure of DOE/LANL to install characterization wells at appropriate locations to investigate and monitor for groundwater contamination from the other LANL waste disposal sites is a serious problem that requires immediate attention.

Attachment 3. DOE/LANL has used improper fluid-assisted drilling methods that mask detection of groundwater contamination for the installation of the LANL characterization wells that are planned to be used as monitoring wells.

We disagree with DOE/LANL about the need to use fluid-assisted open-hole drilling methods for the installation of the LANL characterization wells that are intended to be used as monitoring wells for the next 50 to 100 years. For example, R-16, the sentry well for the Buckman Wellfield, which provides residents of the City of Santa Fe with over 40% of its drinking water, is a well that DOE/LANL found needed to be drilled with fluid-assisted open-hole drilling methods and with the mud-rotary drilling method. The result is a multi-million dollar well that requires replacement.

The casing advance drilling methods are commonly used in the monitoring well industry to prevent the drilling fluids from compromising the integrity of monitoring wells and to maintain a pristine environment in the aquifer strata that produce water to monitoring wells. Some monitoring wells installed at depths greater than 500 feet at Sandia National Laboratory in Albuquerque, New Mexico are examples of the proper application of the casing advance drilling methods.

DOE/LANL has a long history of making statements in reports and at meetings describing the casing advance drilling method as too risky and too costly for drilling in the complex geologic environment beneath the Pajarito Plateau. In fact, the well drilling industry created the casing advance drilling method for drilling in unstable geology. A well that is often used as an example of the failure of the casing advance drilling method is well R-16. It is located on the mesa east of White Rock, above the Rio Grande, and was installed as a sentry well for the City of Santa Fe's Buckman Wellfield.

However, the information in the LANL well R-16 Completion Report (LA-UR-03-1841, June 2003) is proof that the casing advance drilling method was not responsible for the abandonment of retractable drill casing in the well R-16 borehole. The borehole for well R-16 was first drilled with the open hole fluid-assisted air rotary drilling method to a depth of 729 feet below ground surface (bgs). Because of the difficult drilling with open hole methods, a decision was made to withdraw the open-hole drilling equipment and install cemented steel casing to stabilize the open borehole.

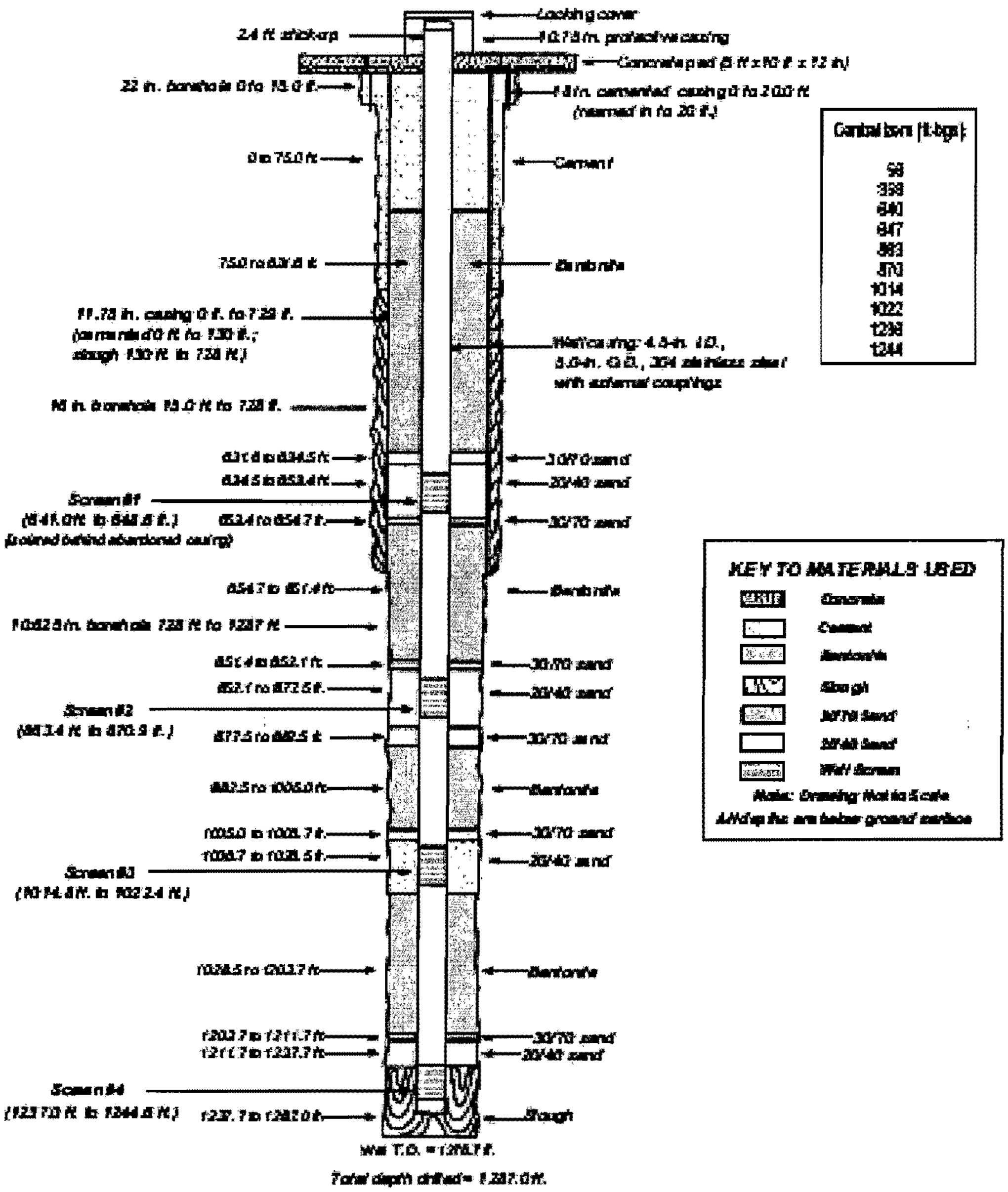
After the unstable strata collapsed into the open borehole and the casing could not be lowered into the borehole, a decision was made to use the casing advance drilling method to advance one dimension of retractable drill casing to a depth of 729 feet bgs. Because of the unstable strata, three strings of telescoped drill casing should have been used for drilling to the 729-foot depth. The three different diameters of drill casing were available for use, and the three strings would have greatly reduced the friction that resulted from drilling with one string.

The as-built schematic for well R-16 is shown below. The retractable drill casing that was abandoned in the borehole blocks off screen #1. Screen #4 does not produce representative groundwater samples because the screen is surrounded by bentonite clay slough sediments that were not cleaned from the borehole before the well was constructed. None of the well screens produce reliable and representative water samples because of the mud-rotary drilling method that invaded the screened intervals with organic and bentonite clay drilling fluids.

Further, the use of the no-purge Westbay^R water sampling equipment collects stagnant water samples from the screened intervals. The regulations require that a continuous flow of water is produced from the well to determine that representative samples are collected from the in-situ groundwater. The Westbay^R equipment does not allow for the purging of the large quantities of water that are required by the regulations.

An additional problem is that the Schlumberger^R borehole geophysics report, included as an appendix in the LANL Well R-16 Completion Report, shows that the well screens are not installed in the strata with highest permeability, the aquifer strata that are the fast pathways for contaminants to travel to the Buckman Wellfield. There are many factors that require replacement of Well R-16.

As-Built Schematic for LANL Characterization Well R-16



Source: LANL Well R-16 Completion Report, LA-UR-03-1841.

In fact, an important example of the justification by DOE/LANL of the essential need for the casing advance drilling method to install monitoring wells at LANL is that the casing advance drilling method was used for the installation of the single-screen well (Well R-16r) that was installed close to well R-16 to replace the blocked screen in well R-

16. Three strings of telescoped drill casing were used to drill the borehole for well R-16r. The three strings were retracted from the borehole during the construction of the well.

Unfortunately, organic drilling foam was allowed to invade the screened interval of the single-screen well R-16r and the well development activities were unsuccessful in removing the drilling foam and the drilling air trapped within the foam. The drilling foam plugged the aquifer strata resulting in an unreasonably low and spurious permeability value measured by a pumping test. Below is an excerpt from the pumping test report included as an appendix in the LANL Well R-16r Completion Report (Kleinfelder Project No. 49436, February 2006) –

> Test data were affected profoundly by air trapped or dissolved in the formation. During testing, the air was able to come out of solution and/or expand and contract in response to pumping and recovery. The air affected performance by clogging formation pores and entering the well and pump, resulting in very unusual data sets.

In addition, the new mineralogy formed by the organic drilling foam causes the well to produce unreliable water quality data for knowledge of the presence of the LANL contaminants. There is a need for additional development and performance of a new pumping test in well R-16r. After the redevelopment efforts, an extensive field test of the ability of the well to accurately detect LANL groundwater contamination is necessary. It may be necessary to replace well R-16r.

The casing advance drilling method that was used for the installation of well R-16r could have been used to prevent the invasion of the screened interval with the drilling additives. The correct drilling operations would have been to use fluid-assisted drilling with the two larger diameter drill casings to an appropriate location above the water table of the regional aquifer. The third string of telescoped drill casing should have been drilled with the <u>dry</u> air rotary drilling method in the unsaturated strata and with the water-only rotary method for drilling in the regional aquifer to the selected depth for installation of the screened interval in the regional aquifer. This drilling strategy would have prevented the screened interval from being invaded with the organic drilling fluids that cause the data from well R-16r to be unreliable.

Conclusion. Further, in Keating, Elizabeth, B.A. Robinson, and V.V. Vesselinov, 2005, "Development and Application of Numerical Models to Estimate Fluxes through the Regional Aquifer beneath the Pajarito Plateau," *Vadose Zone Journal*, Volume 4, August 2005, the authors state:

> Simulations suggest that flow beneath the Rio Grande (west to east) has been induced by production at the Buckman well Field. Our calculations show that this

flux may have increased from zero (pre-1980) to approximately 45 kg s^{-1} at present, or about 20% of the total annual production at Buckman. Page 658.

Travel times through the regional aquifer are poorly understood because of the lack of tracer tests and in situ measurements of effective porosity. Page 658.

Data concerning the spatial distribution of anthropogenic [LANL] contaminants in the regional aquifer has been inconclusive because of the exceptionally thick and complex vadose zone which makes it impossible to define the location and timing of contaminant entry to the regional aquifer. Page 658.

As shown in Table 3, a significant proportion of uncertainty in fluxes downgradient of LANL results from uncertainty in the permeability of the basalts. Basalt units are very important for potential contaminant transport because of their expected low effective porosity. Therefore, we can expect at least a factor of 3 uncertainty in the associated travel times resulting in uncertainty in the flow equation. Page 666.

The current understanding of hydrostratigraphy, as implemented in the numerical models, is sufficient to explain general trends in heads (spatial and temporal) but is lacking in a few key areas such as in the vicinity of R-9, R-12, R-22, and R-16. Detailed transport calculations in the vicinity of these wells would benefit from a refinement of the hydrostratigraphic framework model." Pages 667 to 668.

The implication of this work for contaminant transport issues is that because of parameter uncertainty, predicted fluxes and velocities are quite uncertain. Uncertainties in permeability and porosity values lead to additional model uncertainty." Page 668.

These uncertainties can be reduced meaningfully with more data collection, including multi-well pumping and tracer tests. Page 668.

The report by Keating et al. acknowledges the failure of LANL over the past ten years to acquire the knowledge that is necessary to protect the valuable groundwater resource from the LANL contaminants. Specifically, Keating et al. describe the poor knowledge of contaminant transport in the basalt strata beneath and away from Material Disposal Area (MDA) G to the property of the San Ildefonso Pueblo, the Rio Grande, and on to the Buckman Wellfield. There is a pressing need for the installation of a reliable network of monitoring wells to provide knowledge of groundwater contamination below and away from MDAs G, H, and L and to support the necessary field studies to address the contaminant transport issues.

Attachment 4. The Need to Plug and Abandon the Old LANL Test Wells, including DT-5A, DT-9 and DT-10 at TA-49, and Install New Characterization Wells

There is a large untapped groundwater resource across the southern region of Los Alamos National Laboratory (LANL), including beneath Technical Area 49 (TA-49) where the hydronuclear research was performed in the early 1960's. The research produced a large amount of radionuclide and chemical contamination, including 88 pounds of plutonium buried at depths up to an estimated 100 feet below the ground surface and many mobile chemical contaminants. The four test areas for the hydronuclear research at TA- 49 are designated as LANL solid waste management unit (SWMU) Material Disposal Area (MDA) AB. The danger of the buried wastes produced by the hydronuclear research to contaminate the regional aquifer has never been monitored and is not a monitoring requirement of the New Mexico Environment Department (NMED) Consent Order for LANL.

In fact, at the present time there are no monitoring wells across the southern region of the laboratory that produce reliable and representative water samples. The large groundwater resource in the southern region of the laboratory is even a larger resource than where the network of drinking water supply wells for Los Alamos County is located. The emerging presence of LANL contaminants in the regional aquifer in the northern region of the laboratory may require installation of supply wells in the southern region of the laboratory. Because of the failure of LANL to determine the danger of the hexavalent chromium contamination and radionuclide contaminants to the Los Alamos County drinking water wells, a wise water management strategy would be to install a minimum of three drinking water supply wells in the southern region of LANL at this time.

Three test wells were drilled in 1960 in preparation for the hydronuclear tests conducted at MDA AB. They were drilled with the mud rotary method that masks the detection of contamination. Information on the locations and construction of the three wells, known as DT-5A, DT-9 and DT-10, are shown on the enclosed Figures IX-U and IX-V from the LANL report, *Geologic and Hydrologic Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs and Surface Water Stations in the Los Alamos Area,* by W.D. Purtyman (LA-12883-MS, January 1995).

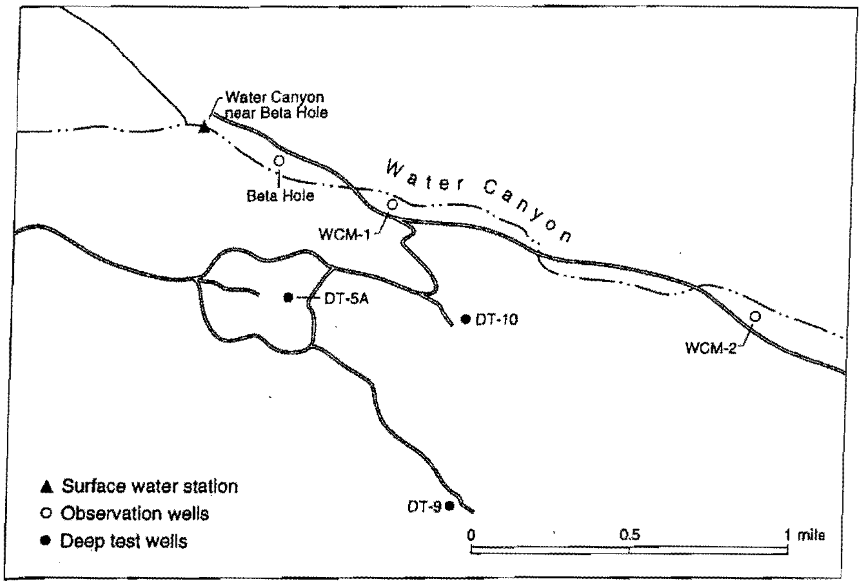


Fig. IX-U. Locations of wells, holes, and a surface water sampling station in Water Canyon north of TA-49.

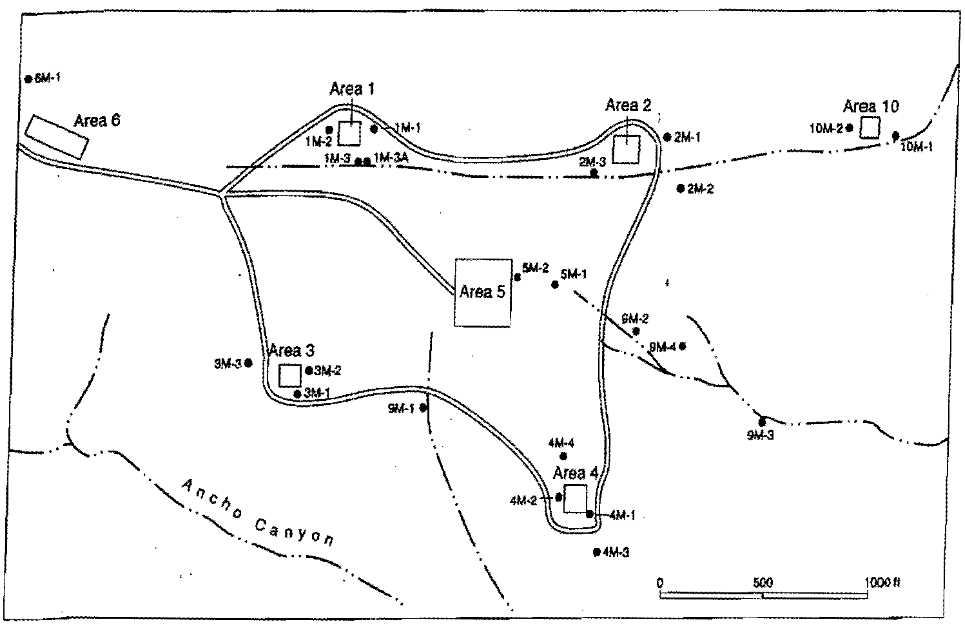


Fig. IX-V. Locations of moisture-access holes at TA-49.

The presence of groundwater contamination from MDA AB in the regional aquifer is not known because LANL relies on water samples collected from the three old LANL test wells that do not produce reliable and representative water samples.

The wells have never met the standard industry practice for monitoring wells to detect the contaminants of concern at TA-49. Nevertheless, LANL has written reports for over the past 40 years that describe the water quality data from the test wells as reliable and representative. Unfortunately, the NMED/LANL Consent Order allows LANL to continue to use the old test wells for the present interim monitoring and also for long-term monitoring.

The factors that prevent the wells from producing reliable and representative water samples for the detection of contamination from the four test areas at MDA AB at TA-49 include the following:

1. The wells are not at appropriate locations as shown by intercomparison of Figures IX-U and IX-V in the Purtyman report. Well DT-5A is located within Area 5 and at a distance of approximately 1000 feet from Areas 1 and 3 and approximately 900 feet from Areas 2 and 4. In addition, well DT-5A is located upgradient of the direction of groundwater travel beneath Areas 2 and 4. Well DT-9 is located approximately 3500 feet to the east of Area 2 and well DT-10 is located approximately 4500 feet to the southeast of Area 4. The regional direction of groundwater flow is shown on an enclosed map.

2. The three test wells were drilled with the mud rotary drilling method that allowed a very large quantity of bentonite clay drilling mud to invade the screened intervals.

3. The three test wells have very long screened intervals. All three have torch cut slots to form screens for a distance of:

DT-5A	649 feet
DT-9	461 feet
DT-10	329 feet

Because of concerns for dilution in long screens, the general requirements of RCRA and the NMED/LANL Consent Order are for screens to be no longer than 10 feet for monitoring wells. From the Consent Order:

> The selection of the well screen length depends upon the objective of the well. Piezometers and wells where only a discrete flow path is monitored are generally completed with short screens (two ft or less). While monitoring wells are usually constructed with longer screens (usually five to ten ft), they shall be kept to the minimum length appropriate for intercepting a contaminant plume. Page 195.

The long screen lengths in the old test wells are a reason to plug and abandon the wells.

4. Corrosion products of the common steel casing and galvanized steel well fittings in the three old test wells have strong properties to mask detection of contaminants in the water samples produced from the three wells. The effects of corrosion products to prevent detection of contaminants are summarized in the *EPA RCRA Groundwater Monitoring: Draft Technical Guidance Document:*

> Corrosion products include iron, manganese, and trace metal oxides as well as various metal sulfides (Barcelona et al., 1983). Under oxidizing conditions, the principal products are solid hydrous metal oxides; under reducing conditions, high concentrations of dissolved metallic corrosion products can be expected (Barcelona et al., 1983). The products of corrosion of galvanized steel include iron, manganese, zinc, and traces of cadmium (Barcelona et al., 1983).
>
> The presence of corrosion products represents a high potential for the alteration of groundwater sample chemical quality. The surfaces where corrosion occurs also present potential sites for a variety of chemical reactions and adsorption. These surface interactions can cause significant changes in dissolved metal or organic compounds in ground-water samples (Marsh and Lloyd, 1980).
>
> According to Barcelona et al. (1983), even purging the well prior to sampling may not be sufficient to minimize this source of sample bias because the effects of the disturbance of surface coatings or accumulated corrosion products in the bottom of the well are difficult, if not impossible, to predict.
>
> On the basis of these observations, the use of carbon steel, low-carbon steel, and galvanized steel in monitoring well construction is not recommended in most natural geochemical environments.

The above factors greatly reduce the likelihood that the old test wells will detect contamination from MDA AB. Nevertheless, the LANL reports over the past 30 years, describe the water quality data from the old test wells as proof that MDA AB has not contaminated the ground water. We provide examples from LANL reports below of such statements, along with excerpts from four recent *LANL Environmental Surveillance Reports* (2002 through 2005) that present water quality data from the three old test wells as valid for the detection of groundwater contamination from the four Test Areas at MDA AB.

From page 7-2 of the *LANL Interim Facility-Wide Groundwater Monitoring Plan:*

> **7.4 Scope of Activities - Ancho Canyon.** Monitoring locations in Ancho Canyon are situated near or downstream from areas of past Laboratory weapons-testing

activities. Most monitoring locations in Ancho Canyon access the regional aquifer. Three decades of water quality records from regional wells in this area (DT-5A, DT-9, and DT-10), and recent data from R-31, show no substantial changes in water chemistry or the presence of Laboratory contaminants in the regional aquifer.

The 1999 final LANL SWEIS contradicts the *Interim Groundwater Monitoring Plan* by describing LANL contaminants in the regional aquifer at TA-49:

> Organic compounds have been detected in samples taken from main aquifer test wells at TA-49 (DT-5A, DT-10, and DT-9; Figure 4.3.2.1-2). The largest detection was for pentachlorophenol from the TA-49 test well DT-9 (Figure 4.3.2-1) of 110 parts per billion [1993 ESR]. The EPA [Safe Drinking Water Act] SDWA standard for pentachlorophenol is 1 part per billion. The sources of the contaminants detected in the TA-49 test wells are not known (LANL 1993b [ESR 91], LANL 1994b [ESR 92], LANL 1995f [ESR 93], **LANL 1996e [ESR 94],** and LANL 1996i [ESR 95]). [Emphasis added.] Test well DT-9 was retested in 1996, and no organic compounds were detected. However, the LANL Hydrogeologic Workplan (LANL 1998b) proposes the installation of borehole R-27 to further characterize the source of these contaminants. The TA-49 test wells are approximately 2 miles (3.2kilometers) away and cross-gradient of the nearest public water supply well (PM2) (Figure 4.3.2.1-2), and no public supply wells exist down-gradient of the TA-49 test wells. Therefore, the presence of organic compounds in these samples does not suggest a danger to the existing public water supply (Purtymun 1995). p. 4-76.

Reference LANL 1996e, which is the *Environmental Surveillance at Los Alamos during 1994*, LA-13047-ENV, UC 902, contradicts the above statement made in the above paragraph and identifies the source of these contaminants:

> The appearance of high lead levels in test wells at TA-49 is of concern because past underground tests at the site, involving high explosives and radioactive materials, raise the possibility of groundwater contamination (Purtymun 1987b). The tests were conducted in 1960 and 1961, at the direction of President Eisenhower, to evaluate safety aspects of certain nuclear weapons systems. Tests were carried out in large-diameter holes, up to 37 m (120 ft) deep. Materials dispersed by detonation of the high explosives remain at the bottom of the experimental holes. These materials include 40 kg (88 lb) of plutonium, 93 kg (205 lb) of enriched uranium, 82 kg (180 lb) of depleted uranium, and 90,000 kg (198,000 lb) of lead which was used as shielding (Purtymun 1987b; LANL 1992b). The area is considered to be a hazardous and radioactive material disposal area for purposes of compliance with DOE and EPA requirements. Environmental monitoring carried out since the time of the testing has indicated no contamination of the groundwater, which lies at a depth of 366 (1,200 ft) below TA-49. Age dating of

groundwater from test wells at TA-49 supports the conclusion that there is no component of recent recharge in this area (see Section VII.E.1.b). p. 249 - 250.

We point out these errors as an example of the lack of veracity in LANL documents provided to the public about annual impacts of LANL operations on public health, safety and the environment. We renew our request for the retraction of the *LANL Environmental Surveillance Reports.*

NMED/LANL Consent Order Requirements. A serious mistake in the NMED/LANL Consent Order is that DOE/LANL are not required to plug and abandon the three old test wells and install a reliable network of monitoring wells to investigate groundwater contamination beneath the four test areas at MDA AB. Instead, the Consent Order allows for the ongoing collection of spurious water samples from the old test wells to meet the

1. groundwater monitoring requirements in the NMED approved *LANL Interim Facility-Wide Groundwater Monitoring Plan,* and
2. long-term monitoring well requirements for the protection of the very large groundwater resource from the wastes buried at MDA AB.

In addition, the *Interim Plan* describes LANL characterization well R-31, a multiple screen well, as being at an important location for monitoring groundwater contamination from MDA AB. However, LANL characterization well R-31 does not produce reliable water quality data to assess groundwater contamination from the hydronuclear experiments at MDA AB because of the following factors:

1. Well R-31 is located at a distance of approximately three miles from MDA AB.
2. The screened intervals in well R-31 are contaminated with a new mineralogy of iron precipitates that were formed by the organic drilling additives. The iron precipitates have strong sorption properties to mask the detection of groundwater contamination from the buried waste at MDA AB.
3. Water samples are collected from well R-31 with the Westbay[R] no-purge sampling equipment that collects stagnant water samples from the zone of new mineralogy that surrounds the well screens.

A basic issue is that NMED does not recognize that the groundwater requirements under RCRA Section 264 Subpart F are also the requirements for the LANL solid waste management unit (SWMUs), such as MDA AB, where very large volumes of chemical and radionuclide waste are buried above a very large and precious groundwater resource.

The position of EPA that the groundwater monitoring requirements under RCRA Subpart F also apply to MDA AB is summarized in an email to CCNS on February 20, 2007 from Richard Mayer, an EPA scientist in EPA Region 6:

The groundwater monitoring requirements for [solid waste management units] SWMUs should mirror the requirements for regulated units under Subpart F. The groundwater monitoring wells should be located (hydraulically down-gradient) close/near/next to the SWMU or regulated unit in adequate/sufficient numbers. Also, for the monitoring wells located next to the SWMU/regulated unit, the uppermost aquifer should be monitored (in addition, other deeper zones may need to be monitored according to site conditions, other factors, etc.). The site should also have a sufficient number of "background" groundwater monitoring wells in order to determine a release for natural occurring contaminants like metals and some radionuclides.

If contamination is found in the monitoring wells next to the SWMU/regulated unit, then further horizontal and vertical delineation of the groundwater plume is required with additional wells.

Also, the words sufficient or adequate can be interpreted differently. For example, if an SWMU/regulated unit was 300' by 300' and the groundwater flow direction was from Northwest to Southeast, two downgradient monitoring wells next to the unit (initial wells) would not be a sufficient/adequate number. Now if you had a unit that was 50' by 50', with groundwater flow from Northwest to Southeast, then 2 downgradient monitoring wells next to the unit/SWMU probably would be sufficient.

This is just a brief general summary. As you know, each site can have its own unique groundwater monitoring issues.

The above summary of groundwater requirements under RCRA demonstrates the need to plug and abandon the three old test wells and immediately installs a minimum of four characterization wells in the regional aquifer at the immediate downgradient boundary of each of the four test areas at MDA AB.

Evaluation of Corrective Measures Study Report for MDA H, SWMU 54-004, at TA-54

Prepared for the MDA H Focus Group

George Rice

August 7, 2003

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1.0 Executive Summary

This is an evaluation of a document produced by Los Alamos National Laboratory (LANL): *Corrective Measures Study Report for MDA H, SWMU 54-004, at TA-54* (CMS Report). It examines the adequacy of the Laboratory's recommended corrective measure at Material Disposal Area H (MDA H). This evaluation was performed on behalf of the MDA H Focus Group.

MDA H is in Technical Area 54, on Mesita del Buey. There are three other waste disposal sites on the mesa. Between 1960 and 1986 approximately 275 tons of hazardous and radioactive wastes were buried in nine unlined shafts. The shafts are six feet in diameter and 60 feet deep.

A wide variety of materials were disposed in the shafts including scrap metal, plastics, paper, glass, and explosives. However, records of the wastes are not well detailed and the contents of the shafts are not completely known.

Six investigative borings have been drilled at MDA H. The depths of the borings range from 90 feet to 300 feet.

MDA H is underlain by Bandelier Tuffs, the Cerros del Rio Basalts, and the Puye Conglomerate. The stratigraphy is somewhat uncertain because the deepest borings at MDA H terminate in the Bandelier Tuffs. The Bandelier Tuffs are approximately 600 feet thick, tend to be very dry, and consist of several units. All of the units are fractured to some extent, although the uppermost units are the most extensively fractured. The water table of the regional aquifer is approximately 1000 feet below land surface.

There is no information on groundwater quality at MDA H. The nearest downgradient monitor well on Mesita del Buey is approximately two miles east of MDA H. Tritium has been detected in this well.

Vapor-phase contaminants; tritium and volatile organic compounds (VOCs), have diffused from the waste shafts into the tuffs. The full extents of the vapor plumes have not been determined, but they are known to extend at least 100 feet from the waste shafts, and to a depth of at least 250 feet.

LANL evaluated five corrective measure alternatives. Each alternative was required to protect human health and the environment for a 1000 year performance period. The alternatives ranged from regrading and revegetating the surface of MDA H, to completely excavating the wastes and transporting them to an off-site disposal facility. The estimated costs of the alternatives ranged from $592,000 to $68,244,000.

LANL's recommended alternative is to install an engineered cover over the site. The cover would be four to six feet thick and consist of several layers. The purpose of the cover would be to limit the amount of water that percolates into the shafts. The site would be monitored and maintained to control erosion, and the water contents of the cover and surrounding tuff would be monitored. The CMS Report contains a brief description of a preliminary contingency plan to be invoked if water contents increase above predetermined levels. A final contingency plan will be developed in conjunction with the State of New Mexico. The estimated cost of this alternative is $723,000.

The effects of the recommended alternative on groundwater quality were simulated with the computerized model FEHM. Two infiltration rates were simulated, 1 mm/year and 10 mm/year. All flow through the unsaturated tuff was assumed to occur as matrix flow. Flow through fractures was assumed to be insignificant. The simulations predicted the concentrations of contaminants (e.g., uranium, lead, RDX[1]) at the water table of the regional aquifer during the 1000 year performance period.

The predicted concentrations of all but one contaminant were well below values that would cause concern. At the higher infiltration rate (10 mm/year), the predicted concentration of RDX was above the EPA drinking water guideline.

This evaluation identified the following issues:

- There is no monitor well at MDA H. Thus, the depth to water and quality of water at this site are unknown. LANL should install at least one monitor well near MDA H. This well should be part of a network designed to monitor conditions at all the waste sites on Mesita del Buey.

- The full extents of the vapor-phase tritium and volatile organic carbon (VOC) plumes have not been determined. At a minimum, LANL should determine whether the vapor-phase plumes have reached the water table of the regional aquifer.

- LANL did not report the predicted RDX concentration at the high infiltration rate, or state that this concentration exceeded the EPA drinking water guideline. This information should be included in the CMS Report.

- The preliminary contingency plan does not call for a reconsideration of the corrective measure if water contents increase above predetermined levels. The final contingency plan should include provisions calling for reconsideration, and possible replacement, of the corrective measure if monitoring indicates it is not performing as required.

- The proposed monitoring plan is not likely to detect episodic fracture flow through the vadose zone.

- LANL's conclusion that fracture flow is insignificant at MDA H is open to question. The data used to support this conclusion are ambiguous and subject to interpretations that are consistent with the occurrence of fracture flow. Fracture flow has been observed at one of the other waste disposal sites on Mesita del Buey.

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[1] RDX is an explosive.

- The recommended corrective measure alternative does not include features to minimize or prevent the transport of contaminants from the waste shafts by water flowing through fractures. Unless fracture flow can be shown to be insignificant, LANL should either excavate the wastes, or implement an alternative that includes features designed to deal with fracture flow. These features include low permeability barriers to reduce the amount of flow that reaches the wastes, or capillary barriers to route flow around the wastes.

2.0 Introduction

This is an evaluation of a document produced by Los Alamos National Laboratory (LANL, the Laboratory): *Corrective Measures Study Report for MDA H, SWMU 54-004, at TA-54*[2] (CMS Report). It examines the adequacy of LANL's recommended corrective measure at Material Disposal Area H (MDA H). The evaluation is based on a review of the CMS Report and related documents, and discussions with LANL and New Mexico Environment Department (NMED) personnel. It was performed on behalf of the MDA H Focus Group.

3.0 Physical Setting

3.1 Laboratory

Los Alamos National Laboratory is in north central New Mexico, approximately 40 miles northwest of Santa Fe[3] (Figure 3-1). It is on the Pajarito Plateau between the Rio Grande and the Jemez Mountains[4]. The Pajarito Plateau consists of a series of east-west oriented canyons and mesas. The elevations of the mesas range from about 6200 feet above the canyon of the Rio Grande to about 7800 feet along the flanks of the Jemez Mountains[5].

The uppermost rocks that form the plateau are the Bandelier Tuffs. These are volcanic rocks derived from the Jemez Mountains[6]. The tuffs are more than 1000 feet thick near the Jemez Mountains and thin to a few hundred feet near the Rio Grande[7]. The tuffs are underlain the by the Puye Conglomerates[8]. The Cerros del Rio Basalts are interbeded with the conglomerates[9]. In the central portion of the laboratory the combined thickness of the conglomerates and basalts is greater than 1000 feet[10]. The conglomerates and basalts are underlain by Santa Fe Group sediments[11]. Alluvial deposits[12] cover the canyon bottoms[13].

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[2] LANL, 2003a.
[3] Dale, 1998, page 1.
[4] LANL, 2002b, page 5.
[5] LANL, 2002b, page 5.
[6] LANL, 2002b, page 5.
[7] LANL, 2002b, page 5.
[8] Purtyman, 1995, page 5. The Puye Conglomerates are also referred to as Puye fanglomerates, e.g., LANL, 2003b, page 4-5.
[9] LANL, 2003b, page 4-6.
[10] Stone and McLin, 2003, pages 2, 24, and 28.
[11] Purtyman, 1995, pages 4 and 5.
[12] Alluvium is stream-deposited gravel, sand, silt, and clay.
[13] LANL, 2003b, page 4-13.

Groundwater beneath the Pajarito Plateau occurs in three zones: 1) as shallow perched zones[14] in the alluvium[15], 2) as intermediate perched zones within the tuffs, basalt, and conglomerate[16], and 3) in the regional aquifer. Depending on location, the water table of the regional aquifer is found in the basalt, the conglomerate, or the Santa Fe Group[17]. Groundwater in the regional aquifer generally flows from west to east, from the Jemez Mountains toward the Rio Grande[18].

3.2 MDA H

MDA H is in Technical Area 54 (TA-54), on Mesita del Buey, a mesa between Pajarito Canyon on the south and Cañada del Buey on the north[19]. The average annual precipitation at Mesita del Buey is 14 inches[20].

There are four waste disposal areas on Mesita del Buey: MDA G, MDA H, MDA J, and MDA L (Figure 3-2). MDA G is the largest, MDA H the smallest.

MDA H is 200 feet long and 70 feet wide (approximately 0.3 acres)[21]. Six investigative borings have been drilled at MDA H. The depths of the borings range from 90 feet to 300 feet[22] (Figure 3-3).

MDA H is underlain by the Bandelier Tuffs, the Cerros del Rio Basalts, and the Puye Conglomerate (Figure 3-4). The tuffs are approximately 600 feet thick, and the combined thickness of the basalts and conglomerate is more than 400 feet[23]. The stratigraphy is somewhat uncertain because the deepest borings at MDA H terminate in the tuffs. The presence and position of the basalts and conglomerate are inferred from monitor well R-22. Well R-22 is on Mesita del Buey, just east of MDA G, approximately two miles from MDA H[24] (Figure 3-2).

The Bandelier Tuffs are divided into two sub-units: the Tshirege Member and the Otowi Member. The Tshirege is above the Otowi. The members are separated by the Cerro Toledo interval. The Tshirege is further subdivided into Unit 1g, Unit 1vc, Unit 1vu, and Unit 2 (Figure 3-4). The Guaje Pumice bed is at the base of the Otowi Member[25].

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[14] Groundwater that occurs above the main aquifer is said to be perched. The strata immediately above and below the perched zone are unsaturated.
[15] LANL, 2003b, page 4-13.
[16] Stone and McLin, 2003, pages 14 and 25; LANL, 2003b, page 4-13; Longmire, 2002a, page 3; and Gardner et al., 1993, pages 16 and 17.
[17] Stone and McLin, 2003, pages 2, 21, 24, and 28; LANL, 2003b, page 1-11.
[18] Stone, 2001a.
[19] LANL, 2003a, page 1.
[20] LANL, 2001a, B-1.
[21] LANL, 2003a, page 4.
[22] LANL, 2003a page 15; LANL 2001a, appendix H; and LANL, 2002a appendix H.
[23] LANL, 2003a, page 16.
[24] LANL, 2003a page 14.
[25] LANL 2003b, page 4-6.

The upper tuff units at MDA H tend to be very dry, with volumetric water contents around five percent[26]. The low water contents are thought to be due to evaporation caused by warm, dry, air moving through fractures and permeable beds in the mesa[27]. Other information, including oxygen-18 and deuterium data[28], and chloride data[29], also indicates that evaporation is occurring within the mesa.

All of the tuff units at Mesita del Buey are fractured to some extent[30]. The degree of fracturing varies greatly among the units. The uppermost units (2 and 1vu) are the most extensively fractured[31].

No perched groundwater has been found at MHD H[32]. The position of the regional aquifer water table is estimated to be 1000 feet below land surface. This is based on data from monitor well R-22[33]. At well R-22, the water table is found in the Cerros del Rio Basalts at a depth of approximately 880 feet[34].

4.0 Wastes

Between 1960 and 1986[35] approximately 275 tons[36] of wastes were buried in nine unlined shafts at MDA H (Figure 3-3). Each shaft is six feet in diameter, 60 feet deep[37], and penetrates tuff units 2 and 1vu[38].

Lighter wastes were dropped into the shafts while heavier wastes were lowered in with heavy equipment[39]. The wastes were packed in plastic bags or drums[40]. The disposal of liquids was prohibited[41]. However, some of the wastes contained liquid residues[42]. Between waste deliveries the shafts were covered with a locking steel plate[43].

Shafts one through eight are plugged with a three-feet thick layer of concrete placed beneath three feet of crushed tuff. Shaft nine is plugged with a six-feet thick layer of concrete[44].

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[26] LANL, 2003a page 18.
[27] LANL, 2003a page F-8; and Turin, 1995, pages 12 and 13.
[28] Newman, 1996; and Bergfeld and Newman, 2001.
[29] Newman, 1996; and Bergfeld and Newman, 2001.
[30] Turin, 1995, page 8.
[31] LANL, 2003a page J-14.
[32] LANL, 2003a page 13.
[33] LANL, 2003a page 13.
[34] Stone and McLin, 2003, page 28.
[35] LANL, 2003a, page 1.
[36] LANL, 2003a, page 8.
[37] LANL, 2003a, page 4.
[38] LANL, 2003a page 15; LANL 2001a, appendix H; and LANL, 2002a appendix H.
[39] LANL, 2003a, page 5.
[40] LANL, 2003a, page 5.
[41] LANL, 2003a, page 5.
[42] LANL, 2003a, page 5.
[43] LANL, 2003a, page 5.
[44] LANL, 2003a, page 4.

The wastes are a mixture of hazardous (e.g., cadmium, lead, explosives) and radioactive materials (e.g., plutonium, tritium, uranium). Some of the wastes are classified (e.g., nuclear weapons components).

The waste inventory is not well detailed but lists a wide variety of materials including: metals, plastics, paper, glass, explosives, film, fuel elements, cones, vessels, cylinders, detonators, keys, reactor parts, styrofoam, tape, a safe, a tank, graphite with motor oil, expended mortar shells, and a machine gun[45]. Although the inventory lists many types of materials, it is not complete. For example, volatile organic compounds (VOCs; e.g., benzene, toluene, trichloroethene) were detected in the boreholes drilled near the waste shafts[46], although there is no record of VOCs being disposed at MDA H[47].

Figure 4-1 and Table 4-1 provide information on waste types and quantities.

Table 4-1
Quantities of Materials in MDA H Waste Shafts[48]

Material Type	Estimated Amount (lb)
Aluminum	58,700
Cadmium	20
Lead	78,250
Lithium	4300
Mercury	1300
Steel	156,500
High Explosive (RDX)	1275
Plastics	53,200
Uranium	105,000
Plutonium	300
Tritium	80

5.0 Corrective Measures

Contaminants in the waste shafts may be released through three pathways: 1) vapor-phase contaminants may diffuse through the subsurface and into the atmosphere, 2) plant roots or burrowing animals may bring contaminants to land surface, 3) infiltrating water may transport contaminants to the regional aquifer[49]. The corrective measure alternatives evaluated by LANL are intended to prevent any significant contaminant releases.

[45] LANL, 2003a, appendix B.
[46] LANL, 2001a, page 34; LANL, 2002a, pages 8-13.
[47] LANL, 2003a, appendix B.
[48] LANL, 2003a, Table 2.1-1. Note: the table does not list all material types.
[49] LANL, 2003a, page 60.

5.1 Corrective measure alternatives

The Laboratory developed and evaluated five final corrective measure alternatives for MDA H[50]:

1. Upgrade existing surface
2. Engineered evapotranspiration (ET) cover
3. Encapsulation with ET cover
4. Complete excavation with off-site disposal
5. Complete excavation with on-site disposal

Each corrective measure alternative is required to be effective for a minimum 1000 year performance period. During the first 100 years of the period, it is assumed that institutional controls will be in effect. That is, site access will be controlled, and monitoring and maintenance will be performed. For the remaining 900 years, it is assumed that institutional controls no longer exist[51].

LANL determined that each of these alternatives could protect human health and the environment over the 1000 year performance period[52].

5.1.1 Alternative 1: Upgrade existing surface

Under this alternative the surface of MDA H would be regraded and recontoured. The surface would then be covered with a six-inch layer of soil and gravel. The site would be revegetated with native plants[53]. The purposes of this alternative are to 1) reduce the amount of water that infiltrates into the waste shafts, and 2) reduce erosion[54].

The regrading and recontouring would promote the runoff of water from the site. The gravel in the soil layer would protect it from erosion. The vegetation would also reduce erosion, and would transpire (remove) water that infiltrated into the soil.

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[50] LANL, 2003a, Table 2.5-1.
[51] LANL, 2003a, page 20.
[52] LANL, 2003a, pages 82-84.
[53] LANL, 2003a, page 36.
[54] LANL, 2003a, page 50.

The site would be monitored and maintained to control erosion[55]. Moisture monitoring equipment would be installed within and below the soil layer[56]. Existing boreholes would be used to monitor the water content of the tuff (vadose zone[57])[58].

Estimated cost[59]: $592,000.

5.1.2 Alternative 2: Engineered ET cover

An engineered evapotranspiration[60] (ET) cover would be constructed over MDA H. Although the final cover design has not yet been developed, it would likely consist of three layers and be four to six feet thick (Figure 5-1)[61]. The purposes of the cover would be to 1) minimize the amount of water that infiltrates into the waste shafts, 2) reduce erosion, and 3) reduce the intrusion of plant roots and burrowing animals[62].

The top layer would be a vegetated soil-gravel mixture. As with the first alternative, the gravel in the soil would protect it from erosion, and the vegetation would act to reduce erosion and to transpire water that infiltrated the layer.

The second layer would consist of crushed tuff. Snowmelt or intense rainfalls will occasionally penetrate the top layer more rapidly than it can be evaporated and transpired. The purpose of the crushed tuff would be to store this water until it could be removed by evapotranspiration.

The third layer would be a cobble biobarrier. It would reduce root penetration and burrowing by animals. It may also act as a capillary break, keeping water in the crushed tuff layer from percolating downward[63]. However, the capillary break would only function as long as the water content of the crushed tuff did not approach saturation. If the tuff layer approached saturation, water could flow into the cobble layer and pond on the existing soil surface (Figure 5-1). The water would then be protected from evapotranspiration and could infiltrate into the subsurface. This design does not include a mechanism (e.g., drains) to remove water that penetrates the biobarrier.

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[55] LANL, 2003a, page 36.
[56] LANL, 2003a, page 50.
[57] Vadose zone: the region above the water table where the pore spaces of the rock are not completely filled with water. Also called the 'unsaturated zone'.
[58] LANL, 2003a, page 50.
[59] Cost estimates for all alternatives are 30 year present values. Costs include capital costs, monitoring costs, and operation and maintenance costs (LANL, 2003a, pages 76 and 77).
[60] Evapotranspiration: the transfer of water to the atmosphere by evaporation, and transpiration by plants.
[61] LANL 2003a, page 85.
[62] LANL, 2003a, page 36.
[63] Dwyer, 2002, pages 11 and 12.

As with Alternative 1, the site would be monitored and maintained to control erosion[64]. Moisture monitoring equipment would be installed within and below the cover[65]. Existing boreholes would be used to monitor the water content of the vadose zone[66].

Estimated cost[67]: $723,000.

5.1.3 Alternative 3: Encapsulation with ET cover

There are two encapsulation alternatives, 3a and 3b. Both alternatives include an ET cover similar to that described under Alternative 2[68]. Both alternatives also include cement caps over each of the waste disposal shafts[69]. The site would be monitored and maintained to control erosion, and the water content of the cover and vadose zone would be monitored[70].

5.1.3.1 Alternative 3a: Partial encapsulation

A vertical barrier would be constructed around the perimeter of the site (Figure 5-2). The barrier would be composed of grout mixed with tuff[71]. Its purpose would be to restrict the lateral intrusion of roots and burrowing animals[72].

Estimated cost: not provided[73].

5.1.3.2 Alternative 3b: Complete encapsulation

Vertical barriers would be constructed around and beneath each waste disposal shaft[74] (Figure 5-3). The barriers would consist of low permeability grout[75]. The purpose of the barriers would be to prevent water from entering the shafts.

Estimated cost[76]: $2,925,000.

5.1.4 Alternative 4: Complete excavation with off-site disposal

Under this alternative the wastes would be completely excavated and disposed at on off-site facility[77]. Due to the danger of fires and explosions, the wastes would be excavated

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64 LANL, 2003a, page 36.
65 LANL, 2003a, page 51.
66 LANL, 2003a, page 51.
67 LANL, 2003a, page 76.
68 LANL, 2003a, page 38.
69 LANL, 2003a, pages E-2 and E-3.
70 LANL, 2003a, page 54.
71 LANL, 2003a, page 38.
72 LANL, 2003a, page 38.
73 A cost estimate for this alternative was not included in the CMS Report (LANL, 2003a, pages 71 and 76).
74 LANL, 2003a, page 38.
75 LANL, 2003a, page E-4.
76 LANL, 2003a, page 76.
77 LANL, 2003a, page 41.

using remote methods[78]. Also, because of the presence of classified wastes, excavation would be conducted under temporary structures (e.g., tents)[79].

Estimated cost[80]: $51,906,000.

5.1.5 Alternative 5: Complete excavation with on-site disposal

As with alternative 4, the wastes would be completely excavated[81]. The safety and security measures required for alternative 4 would also be required for this alternative. However, the wastes would be disposed at a facility on the laboratory instead of an off-site facility[82].

Low-level radioactive wastes could be disposed at an existing facility (e.g., MDA G)[83]. However, hazardous or mixed wastes (hazardous and radioactive) would have to be disposed at a new facility; either a RCRA landfill or a Corrective Action Management Unit (CAMU)[84].

5.1.5.1 Alternative 5a: RCRA landfill

The wastes would be disposed in a RCRA landfill. The landfill would be required to include a low permeability cap, a leachate collection system, a leak detection system, and a double composite liner. Wastes from other LANL operations could also be disposed at the landfill[85].

Estimated cost[86]: $68,244,000.

5.1.5.2 Alternative 5b: CAMU

A CAMU is not required to meet the same construction requirements as a RCRA landfill[87]. However, LANL would be required to demonstrate that the CAMU protects human health and the environment[88]. A CAMU can only accept wastes resulting from remediation activities[89]. It cannot accept wastes generated by other LANL operations.

Estimated cost[90]: $66,894,000.

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[78] LANL, 2003a, pages 41 and 83.
[79] LANL, 2003a, pages 41 and 43.
[80] LANL, 2003a, page 77.
[81] LANL, 2003a, page 43.
[82] LANL, 2003a, page 43.
[83] LANL, 2003a, page 43.
[84] LANL, 2003a, page 43.
[85] LANL, 2003a, page 45.
[86] LANL, 2003a, page 77.
[87] LANL, 2003a, page 45.
[88] LANL, 2003a, page 45.
[89] LANL, 2003a, page 46.
[90] LANL, 2003a, page 77.

5.2 Recommended Corrective Measure

LANL chose Alternative 2 (Engineered ET cover) as its recommended corrective measure[91].

5.2.1 Rational

LANL believes Alternative 2 would protect human health and the environment as well as any of the other alternatives[92].

LANL chose Alternative 2 over Alternative 1 because it believes that monitoring may be less reliable under Alternative 1[93].

LANL chose Alternative 2 over Alternatives 3, 4, and 5 because it would require less time to implement and would be less expensive. In addition, Alternatives 4 and 5 pose substantially more risk to workers[94].

5.2.2 Long-term monitoring and contingency plan

The site would be monitored and maintained to control erosion[95]. The regional aquifer would be monitored as part of a TA-54 mesa-wide groundwater monitoring program[96]. Moisture monitoring devices would be installed within and beneath the engineered ET cover[97]. The water content of the vadose zone would be monitored in three of the existing boreholes[98].

LANL will develop a final contingency in conjunction with the NMED[99]. However, the CMS Report contains a brief description of a preliminary contingency plan[100]. This plan requires action only if monitoring reveals significant increases in the water content of the vadose zone. If the volumetric water content between the depths of 60 feet and 100 feet rises above 11%, LANL shall:

1) Inspect the vegetative cover to determine whether it is properly established.

2) If the vegetative cover is properly established, LANL shall reevaluate the cover thickness, and add additional cover material as appropriate.

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[91] LANL, 2003a, page 82.
[92] LANL, 2003a, page 85.
[93] LANL, 2003a, page 85.
[94] LANL, 2003a, page 85.
[95] LANL, 2003a, page 36.
[96] LANL, 2003a, page 87.
[97] LANL, 2003a, page 87.
[98] LANL, 2003a, page 87. Boreholes 54-1023, 54-1561, and 54-1562 would be monitored (LANL, 2003a, page 90).
[99] LANL, 2003a, page 33.
[100] LANL, 2003a, page 90.

The preliminary plan does not call for reconsideration, and possible replacement, of the corrective measure if monitoring indicates it is not functioning as required[101].

6.0 Contaminant Migration

6.1 Existing conditions

6.1.1 Groundwater

There is no information on groundwater contamination at MDA H because the investigative borings do not extend to the water table of the regional aquifer. The only monitor well installed on Mesita del Buey is R-22[102]. Well R-22 is downgradient of both MDA H and MDA G, but is much closer to MDA G[103] (Figure 3-2). Tritium has been detected at the water table in well R-22[104].

6.1.2 Vapor-phase contaminants in vadose zone

Two types of vapor-phase contaminants have been found the unsaturated tuff at MDA H, tritium and VOCs[105]. These contaminants appear to have diffused from the waste shafts. They were detected in gas samples extracted from the investigative boreholes (Figure 3-3).

The VOC plume is composed of a wide variety of contaminants including benzene, methylene chloride, toluene, and trichloroethene[106].

Both the tritium and VOC plumes extend at least 100 feet from the waste shafts, and to a depth of at least 250 feet[107]. The full extent of each plume has not been determined[108].

LANL claims to have determined the full extent of the tritium plume[109], but this claim is not supported by the data. Neither the depth[110] nor the lateral[111] extent of the tritium plume have been determined.

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[101] LANL, 2003a, page 90.
[102] Two monitor wells, R-20 and R-32, are closer to MDA H than R-22. However, these wells were drilled in Pajarito Canyon rather than through Mesita del Buey (LANL, 2003b, pages 1-7, 1-12, and 4-24).
[103] MDA G is similar to MDA H in that wastes at both sites are buried in unlined shafts (Rogers, 1977, page G-43). The depths of the shafts at MDA G range from 25 feet to 60 feet, and some are lined (Rogers, 1977 pages G-43 and G-47). The shafts at both sites are in the upper units of the Tshirege Member (Turin, 1995, page 21; Rogers and Gallaher, 1995, page 38.). MDA G is much larger than MDA H (Figure 3-2) and contains waste disposal pits and trenches as well as shafts (Rogers, 1977 pages G-42 -G-46).
[104] Longmire and Counce, 2002.
[105] LANL, 2002a, pages 6-13.
[106] LANL, 2002a, pages 8-13.
[107] LANL, 2002a, pages 6-13.
[108] LANL, 2002a, page 8.
[109] LANL, 2002a, page 17.
[110] The deepest tritium samples collected at MDA H are from 250 feet (boreholes 54-01023 and 54-15462; LANL, 2002a, page 7). While the deep sample from borehole 54-15462 contained a low tritium concentration

6.2 Estimates of future contaminant migration

6.2.1 Groundwater

LANL used the computerized model FEHM to simulate the transport of contaminants from the waste shafts, through the unsaturated zone, to the regional aquifer[112]. FEHM is a finite element model capable of simulating the flow of fluids and the transport of contaminants in three dimensions[113].

The purpose of the simulations was to predict the concentrations of contaminants (e.g., uranium, lead, RDX[114]) at the water table of the regional aquifer during the 1000 year performance period[115].

The geologic units included in the model were: units 1 and 2 of the Tshirege Member, the Otowi Member, the Guaje Pumice, and the Puye Conglomerate and Cerros del Rio Basalts. The conglomerate and basalts were treated as a single unit[116]. The water table at MDA H was set at approximately 1050 feet below the surface of the mesa[117].

The model requires the input of hydraulic parameters for each unit (e.g., hydraulic conductivity, van Genuchten parameters[118]), and geochemical parameters for contaminants[119] (e.g., partition coefficient[120]). The hydraulic parameters for the tuffs were derived from data collected at LANL[121]. The hydraulic parameters for the combined conglomerate/basalt unit were derived from data collected in Idaho[122]. The geochemical information used in the model was derived from data collected at LANL and at Yucca Mountain, Nevada[123].

(2.4 pCi/mL), the deep sample from borehole 54-01023 contained a relatively high concentration (166 pCi/mL).

[111] Boreholes 54-15461 and 54-15462 are farthest from the waste shafts, approximately 100 feet (Figure 3-3). Relatively high tritium concentrations were found at both these locations; 1330 pCi/mL at borehole 54-15461, and 1450 pCi/mL at borehole 54-15462 (LANL, 2002a, page 7).

[112] LANL, 2003a, appendix J.

[113] LANL, 2003a, page J-7.

[114] RDX is an explosive.

[115] LANL, 2003a, pages J-5 and J-9 – J-12.

[116] LANL, 2003a, page J-3.

[117] LANL, 2003a, pages F-9, I-3, J-1, and J-8.

[118] Hydraulic conductivity is a measure of the ability of water to flow through a material. The higher the hydraulic conductivity, the more rapidly water can flow. The van Genuchten parameters describe the relationship between water content and hydraulic head in an unsaturated material. In an unsaturated material, hydraulic conductivity is a function of water content.

[119] LANL, 2003a, page J-5.

[120] The partition coefficient (distribution coefficient) is a measure of the degree to which a contaminant will attach (sorb) to solids. Contaminants with low partition coefficients travel more rapidly than those with high coefficients. Contaminants with a partition coefficient of zero travel at the same velocity as the groundwater in which they are being transported.

[121] LANL, 2003a, page J-3.

[122] LANL, 2003a, page J-3.

[123] LANL, 2003a, pages J-4 and J-5.

The simulations were performed using two mesa-top infiltration[124] rates, 1mm/yr and 10 mm/yr. LANL considers 1 mm/yr to be a "base case value" and 10 mm/yr to be a "high upper bound"[125].

All flow through the unsaturated tuff was assumed to occur as matrix flow[126]. Flow through fractures was assumed to be insignificant[127].

The predicted concentrations of all but one contaminant were well below values that would cause concern. The exception is RDX. LANL reported an estimated cancer risk for RDX of 5×10^{-6} (for the 10 mm/yr infiltration rate). This value is within the acceptable range for cancer risk (1.0×10^{-6} to 1.0×10^{-4})[128].

However, the predicted concentration of RDX was above the EPA drinking water guideline. Although LANL did not report a concentration for RDX, the information presented in the CMS Report (normalized concentration at 1000 years[129] and solubility limit[130]) was used to calculate a concentration. The calculated concentration, 5.2 µg/L[131,132], is 2.6 times higher than the EPA's drinking water guideline for RDX (2 µg/L [133]).

6.2.2 Vapor-phase diffusion and biointrusion

LANL evaluated the migration of contaminants via the vapor-phase diffusion and biointrusion pathways and estimated the human health effects due to the combined pathways. The evaluation considered the effects of dermal absorption, dust inhalation, irradiation from the soil, soil ingestion, eating garden produce[134], and exposure to radioactive gases diffusing from the shafts[135]. According to LANL, the migration of contaminants via the diffusion and biointrusion pathways will not have a significant effect on human health during the 1000 year performance period[136].

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124 In this report 'infiltration' is synonymous with 'recharge' and 'percolation'. It refers to water that enters the subsurface and eventually flows down to the regional aquifer.
125 LANL, 2003a, page J-8.
126 Matrix flow: flow that occurs through the pore spaces of the rock.
127 LANL, 2003a, page J-6.
128 LANL, 2003a, pages J-5 and J-9 – J-12.
129 LANL, 2003a, Figure J-5.1-2 for Kd = 0.
130 LANL, 2003a, Table J-2.0-2.
131 Normalized concentration at 1000 years, (N) = 1×10^{-4}. Solubility limit (SL) = 2.34×10^{-4} = $5.2\ 10^{+4}$ µg/L (the molecular weight RDX ($C_3H_6N_6O_6$) = 222 g/mole). Concentration = N x SL = (1×10^{-4}) x $5.2\ 10^{+4}$ µg/L = 5.2 µg/L.
132 Note: the CMS Report contains an error. The normalized concentrations shown in figures J-5.1-1 and J-5.1-2 are approximately ten times too large (Dr. Kay Birdsell, personal communication, July 2003). This error results in an estimated RDX concentration of about 52 µg/L.
133 ATSDR, 1996. Guideline based on lifetime exposure for adults.
134 LANL, 2003a, pages H-25 – H-30.
135 LANL, 2003a, page 68. LANL evaluated the effects of tritium and radon diffusing from the shafts but not the effects of VOCs. According to LANL, VOC concentrations are too low to affect human health (LANL 2003a, page I-1).
136 LANL, 2003a, page 69.

7.0 Issues, Comments, and Recommendations

7.1 Lack of monitor wells

There is no monitor well at MDA H. The deepest investigative boring terminates in the Otowi Member of the Bandelier Tuff, hundreds of feet above the water table. Therefore, the site-specific stratigraphy, i.e., the depth and thickness of each geologic unit below the tuffs, and the position of the water table are not known.

The stratigraphy and depth of the water table were inferred from information collected at monitor well R-22[137]. R-22 is the only monitor well installed on Mesita del Buey and is approximately two miles east of MDA H[138].

The quality of the groundwater beneath MDA H is not known. Tritium has been detected in R-22[139], which is downgradient of both MDA H and MDA G, but is much closer to MDA G (Figure 3-2). Tritium-contaminated wastes were buried at both sites[140].

LANL should install at least one monitor well near MDA H. The well should be part of a network designed to monitor conditions at all the waste sites on Mesita del Buey.

7.2 Extent of vapor-phase plumes unknown

The full extents of the vapor-phase tritium and VOC plumes have not been determined. Both the tritium and VOC plumes extend at least 100 feet from the waste shafts, and to a depth of at least 250 feet[141].

Although LANL claims to have determined the full extent of the tritium plume[142], this claim is not supported by the data.

To fully define the extent of the plumes, additional boreholes would have to be installed. The new boreholes would have to be farther from the shafts, and deeper than the existing boreholes. At a minimum, LANL should determine whether the vapor-phase plumes have reached the water table of the regional aquifer.

7.3 Predicted RDX concentration not reported

LANL did not report the predicted RDX concentration at the high infiltration rate. This concentration, 5.2 µg/L, exceeds the EPA drinking water guideline (2 µg/L)[143] and should be mentioned in the CMS Report.

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[137] LANL, 2003a, pages 13 and 14.
[138] Two monitor wells, R-20 and R-32, are closer to MDA H than R-22. However, these wells were drilled in Pajarito Canyon rather than through Mesita Del Buey (LANL, 2003b, pages 1-7, 1-12, and 4-24).
[139] Longmire and Counce, 2002.
[140] LANL, 2003a, page 11.
[141] LANL, 2002a, pages 6 – 13.
[142] LANL, 2002a, page 17.
[143] ATSDR, 1996. Guideline based on lifetime exposure for adults.

7.4 Vadose zone monitoring and preliminary contingency plan

The proposed monitoring plan is not likely to detect episodic fracture flow through the vadose zone. Episodic fracture flow is difficult to detect and may not be discovered by routine monitoring techniques.

The preliminary contingency plan does not call for a reconsideration of the corrective measure if water contents increase above predetermined levels[144]. The final contingency plan should include provisions calling for reconsideration, and possible replacement, of the corrective measure if monitoring indicates it is not performing as required.

7.5 Fracture flow

LANL has concluded that fracture flow through the vadose zone at MDA H is not significant[145]. However, this conclusion is not strongly supported by available information. Some of the information is ambiguous, and some appears to contradict this conclusion.

If fracture flow is significant, contaminants from the waste shafts may be transported to the water table more rapidly, and in higher concentrations, than LANL has predicted.

Fracture flow may be difficult to identify, especially if it is episodic. Episodic flows may occur only after some threshold is reached, such as sufficient rainfall to cause ponding at the soil/tuff interface[146].

Fracture flow through tuffs has been studied extensively at Yucca Mountain, Nevada. Yucca Mountain is similar to LANL in that the uppermost unit it is a fractured tuff. In fact, some of the geochemical parameters used in the FEHM model were based on studies of Yucca Mountain tuffs[147]. On the other hand, the average annual rainfall at Yucca Mountain is less that at the Laboratory (about 7 inches/year[148] vs. 14 inches/year), and the deep evaporation that occurs at Mesita del Buey probably does not occur at Yucca Mountain.

At Yucca Mountain, unsaturated flow in the surficial tuff unit is believed to occur primarily through fractures[149]. Threshold conditions may be reached only several times a year, or only once in several years[150]. A conceptual model of flow at Yucca Mountain is shown in Figure 7-1.

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144 LANL, 2003a, page 90.
145 LANL, 2003a, page J-6.
146 DOE, 2000b, pages 20 and 23.
147 LANL, 2003a, pages J-4 and J-5.
148 DOE, 2000b, page 20.
149 DOE, 2000a, pages 27 and 28.
150 At Yucca Mountain, significant infiltration is believed to occur only every few years (DOE, 2000a, page 21).

The following sections discuss information related to fracture flow that has been collected at Mesita del Buey. Much of the information was collected from MDA G. MDA G is similar to MDA H[151], and more studies have been performed at MDA G than at MDA H.

7.5.1 Fracture studies at Mesita del Buey

Fracture studies have not been done at MDA H, but have been done at MDA J and MDA G[152]. MDA J is adjacent to MDA H[153] and MDA G is about 1.5 miles east of MDA H[154].

Fractures in Tshirege Unit 2 were studied in the disposal trenches at MDA J[155]. Most fractures were nearly vertical[156] and the median distance between fractures was 4.2 feet[157]. The median fracture width was approximately one-third inch and the maximum width was six inches[158].

At MDA G, pproximately 72% of the fractures in Tshirege Unit 2 were filled[159]. Fill materials included clay, soil, calcite, and rubble[160]. Nine percent of the fractures were plated and 19% were open[161].

The fractures in Tshirege Unit 2 tend not to continue into the underlying unit[162].

7.5.2 Water content of vadose zone

Neutron probes were used to measure the water content in the upper 200 feet of the vadose zone at MDA H (Figure 7-2)[163]. The measurements showed very low water contents in the upper 130 feet of the profile. There is a sharp increase in water content between about 130 feet and 150 feet. This corresponds to the position of the 'vapor phase notch', a tuff unit found throughout much of the laboratory[164] (Figure 3-4)[165]. This increase in water content at the vapor phase notch is also seen at MDA G[166].

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[151] Both sites are on Mesita del Buey. MDA G is about 1.5 miles east of MDA H (Figure 3-2). Wastes at both sites are buried in unlined shafts (Rogers, 1977, page G-43). The shafts at both sites are in the upper units of the Tshirege Member (Turin, 1995, page 21; Rogers and Gallaher, 1995, page 38.).
[152] LANL, 2002a, Appendix J.
[153] Some portions of MDA J are less than 200 feet from MDA H. All of MDA J is less than 1000 feet from MDA H (LANL, 2003a, Figure 2.5-5).
[154] LANL, 2002a, page K-4.
[155] LANL, 2002a, page J-3.
[156] Forty one of the fifty two fractures studied had dips greater than 65 degrees. A dip of 90 degrees is vertical (LANL, 2002a, page J-4).
[157] LANL, 2002a, page J-3.
[158] LANL, 2002a, page J-5.
[159] LANL, 2001a, Table B-4.4-1. Percent fractures filled at MDA J not reported.
[160] LANL, 2002a, page J-5.
[161] LANL, 2001a, Table B-4.4-1.
[162] LANL, 2002a, page J-3.
[163] LANL, 2003a, page 18. Measurements taken in boreholes 54-15461 and 54-15462.
[164] LANL, 2003b, page 4-8.
[165] In figure 7-2 the vapor phase notch is at the contact of units Qbt1vc and Qbt1g. This nomenclature is slightly different than that used in figure 3-4.
[166] Krier, et al., 1997, pages 18-21.

The low water content shown in figure 7-2 is used to support the notion of " ... an extremely low moisture percolation rate in unsaturated rock ... on the order of a few millimeters per yr ..."[167].

However, these water content data are not inconsistent with the existence of fracture flow. An alternate interpretation of the data is possible. This interpretation is consistent with the occurrence of fracture flow at rates significantly higher than a few millimeters per yr:

- Episodic fracture flow is occurring. The water content in the upper 130 feet is low because fracture flow is rapid and does not leave traces that are likely to be detected by infrequent neutron probe measurements.

- The vapor phase notch, or some feature near it, impedes the flow of water moving through the matrix and the fractures. This accounts for the increased moisture content. The water that accumulates in this region is a mixture of matrix water and fracture water.

- Fracture flow or convergent flow[168] through the unit underlying the vapor phase notch is initiated when water accumulating above the notch reaches some threshold amount.

This interpretation may be tested by analyzing vadose zone water for chlorine-36[169]. Episodic fracture flow that has occurred between the late 1950s and the mid 1980s should contain bomb pulse chlorine-36[170]. Other environmental tracers such as carbon-14 may also be used to estimate the age of water in the vadose zone. However, carbon-14 data may not be useful if vadose zone water exchanges gasses with the atmosphere. This may be the case if deep evaporation is driven by the movement of air through the mesa (see section 3.2, Physical Setting, MDA H).

7.5.3 Recharge rates and water age by the chloride mass balance method

Recharge[171] rates and the ages of vadose zone water at MDA H were estimated by measuring chloride concentrations in pore water[172]. This 'chloride mass balance' method

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[167] LANL, 2003a, pages 17, J-4, and J-6.
[168] Convergent flow may occur through saturated fingers.
[169] Vadose zone water with low chloride concentrations should be analyzed. Low chloride concentrations may indicate water originating as fracture flow. See section 7.5.3: Recharge rates and water age by the chloride mass balance method.
[170] Bomb pulse chlorine-36 had been largely flushed from the atmosphere by the mid-1980s (Wolfsberg et al., page 351).
[171] Recharge: water that enters the subsurface and eventually flows down to the saturated zone, i.e., the regional aquifer. In this report, used synonymously with 'infiltration' or 'percolation'.
[172] Bergfeld and Newman, 2001; and Newman, 1996. Chloride concentrations measured in cores taken from boreholes 54-1023 and 54-15462.

is based on the fact that rainwater contains chloride[173]. When rainwater evaporates the chloride is concentrated in the remaining water[174]. Thus, recharge is inversely proportional to the chloride concentration; higher chloride concentrations indicate lower recharge rates.

The method incorporates several assumptions: 1) water moves downward through the vadose zone as 'piston flow'[175], i.e., flow through fast pathways such as fractures is insignificant, 2) there is little or no mixing of waters, 3) rainwater is the only source of chloride, and 4) chloride is not removed by plants or other mechanisms.

At MDA H, chloride concentrations are high in the upper portion of the vadose zone and decrease substantially below the vapor phase notch. This decrease in concentrations also occurs at MDA L and MDA G (Figure 7-3)[176].

LANL used the chloride concentration data to estimate a recharge rate of 0.2 mm/yr above the vapor phase notch, and a rate of 3.3 mm/yr below the notch[177]. LANL believes the higher rate below the notch may be a relict of a wetter climate that existed thousands of years ago[178].

LANL also estimated the age of water at two depths in the vadose zone. An age of about 10,500 years was estimated at 139 feet. An age of about 12,000 years was estimated at 299 feet[179].

As with the water content data, the chloride data are not inconsistent with the existence of fracture flow. An alternate interpretation of the chloride data is possible[180].

- The high chloride concentrations above the vapor phase notch represent water in the matrix, not water that episodically flows through fractures. Estimated recharge rates and ages apply to water in the matrix, not water in fractures.

- Water that infiltrates rapidly through fractures would be subjected to less evaporation than water flowing through the matrix. Therefore, fracture water would contain less chloride than matrix water. The low chloride concentrations below the

[173] The chloride concentration of rainwater at Los Alamos is approximately 0.29 mg/L (Bergfeld, and Newman, 2001, page K-3).
[174] For example, if half the rainwater evaporated, the chloride concentration of the remaining water would double. If 90% of the rainwater evaporated, the chloride concentration of the remaining water would increase by a factor of ten, and so on.
[175] Bergfeld, and Newman, 2001, page K-2.
[176] In figure 7-3 the vapor phase notch is at the contact of units Qbt 1v(c) and Qbt 1g. This nomenclature is slightly different than that used in figure 3-4.
[177] Bergfeld, and Newman, 2001, page K-4.
[178] Bergfeld and Newman, 2001, page K-4.
[179] Bergfeld, and Newman, 2001, page K-7.
[180] Note, the water contents and chloride concentrations were measured in different boreholes.

notch (as low as 5 mg/L below vs. 1700 mg/L above) [181] are due to the mixing of fracture water and matrix water[182].

- Recharge via fracture flow may be significantly greater than recharge through the matrix. A chloride concentration of 5 mg/L is equivalent to a recharge rate of approximately 20 mm/yr[183]. The chloride concentrations of unmixed fracture water may be lower than 5 mg/L.

It should be noted that if this interpretation is correct, two of the assumptions on which the chloride mass balance method is based, piston flow and no mixing, are violated. Consequently, the method could not validly be applied at MDA H.

This interpretation may also be tested by analyzing vadose zone water for chlorine-36[184].

7.5.4 Fracture flow observed at MDA G

Fracture flow was observed in MDA G pit 7 after two days of heavy rain (September 10-11, 1973, total = 2.22 in.). The available description of the flow is brief[185]:

> *Depth of ponding in the pits ranged from a fraction of an inch to 24.1 cm (9.5 in.) (see Fig. G-22a). Where water was ponded against the walls of a pit, it moved up the walls (in the tuff) by capillary action. Of particular interest is the movement of precipitation through the soil into intersecting joints which in Fig. G-22b channeled water to an opening on the south wall of Pit 7.*

The quality of figure G-22b (a photograph dated 9-13-73) is poor. However, the caption states[186]:

> *Mud streak in dashed area: Result of water movement through joint #34 and associated joints and not from water movement over the rim.*

The depth at which the flow was observed was not reported, but pit 7 is up to 30 feet deep[187].

Flow along the soil-tuff interface was also observed[188]:

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[181] Bergfeld, and Newman, 2001, page K-4.
[182] Similarly low chloride concentrations (4-5 mg/L) are found near and below the vapor phase notch at MDA G (Newman, 1996, tables 1a, 1c, and 1d).
[183] Assuming annual precipitation of 14 in/yr (356 mm/yr) and a concentration of 0.29 mg/L chloride in precipitation, recharge = (0.29/5) x 356 mm/yr = 20.6 mm/yr (Newman, 1996, page 6).
[184] See section 7.5.2: Water content of vadose zone.
[185] Rogers, 1977, page G-70. A joint is a fracture.
[186] Rogers, 1977, page G-71.
[187] Rogers, 1977, page G-36
[188] Rogers, 1977, page G-70.

Following Rain 1, ponding occurred in Pit 8 only. Moisture continued to run into the pit throughout the day (September 10). This moisture seemed to be moving along the soil-tuff interface to the intersection of this interface with the north ramp of Pit 8 and then down the ramp into the pit.

7.5.5 Rock-contaminant interaction: fracture vs. matrix

Contaminants can be expected to travel much more rapidly in fractures than in the matrix. This is due not only to the fact that water flows more rapidly through the fractures. It is also due to differences in geochemical interactions between contaminants and the surfaces of fractures and matrixes.

Many contaminants are 'retarded' as they are transported in groundwater. That is, they move more slowly than the groundwater because they become attached (sorbed) to the solid materials through which they pass[189].

A geochemical parameter that controls the degree to which a contaminant will be retarded is the partition coefficient. Contaminants with lower partition coefficients travel more rapidly than those with higher coefficients. Contaminants with a partition coefficient of zero travel at the same speed as the groundwater in which they are being transported.

Partition coefficients for contaminants moving through fractures are significantly lower than those for contaminants moving through a matrix. Consequently, contaminants in fractures will be retarded significantly less than contaminants in a matrix. An analysis of contaminant retardation in the Bandelier Tuff and the tuffs at Yucca Mountain concluded[190]:

... retardation factors were calculated for fractured volcanic rock (Table 11). These retardation factors are quite low, suggesting that elements of concern will migrate at the same rate as water within the fractures.

Some contaminants transported in fractures may not be dissolved in the groundwater. Instead, they may be sorbed to colloidal particles that are suspended in the groundwater[191]. As long as the colloids themselves are not retarded, they, and the contaminants they are carrying, will travel at the speed of the groundwater flowing through the fractures. Although colloids also exist in the matrix, they travel at the speed of the matrix water and are susceptible to being filtered by the small pore spaces of the matrix[192].

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[189] Sorption is a reversible process. As some contaminant molecules leave the groundwater solution and become attached to the solids, others detach from the solids and reenter solution.
[190] Krier et al., 1997, page 49.
[191] DOE, 2000a, page 30.
[192] DOE, 2000a, page 31.

7.5.6 Fracture flow and corrective measures

The significance of fracture flow at MDA H remains an open question. Unless fracture flow can be shown to be insignificant, any prudent corrective measure should be designed to address the transport of wastes through fractures.

One alternative is to excavate the wastes. Short of that, LANL could implement an alternative that includes features designed to deal with fracture flow. These features include low permeability barriers to reduce the amount of flow that reaches the wastes (e.g., alternative 3b), or capillary barriers to route flow around the wastes.

Capillary barriers would consist of coarse sand or gravel sized material. They should surround the waste shafts to intercept flow from any direction.

7.6 Disagreement between calculated flow rates and field evidence

The physical conditions that control unsaturated groundwater flow and contaminant transport rates are complex and difficult to determine.

This difficulty is illustrated at Mortandad Canyon[193] monitor well MCM 5.9A. Based on estimates of unsaturated hydraulic conductivity and hydraulic head at this well, LANL calculated a matrix infiltration rate of 0.003 feet/year[194].

However, Laboratory-generated contaminants (chloride, nitrate, tritium)[195] were detected at depths of up to 200 feet[196]. The contaminants were discharged no more than 27 years before they were detected[197]. Thus, the minimum infiltration rate at this site is more than five feet/year[198].

This large discrepancy between calculated and measured infiltration rates illustrates the uncertainty associated with predictions of flow and transport through the vadose zone. Even the best attempts to predict future conditions may not account for all the natural factors that control flow and contaminant transport[199].

In this case, the discrepancy may be explained by fracture flow, or by lateral flow originating upstream of well MCM 5.9A[200].

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[193] Mortandad Canyon is approximately one mile north of Mesita del Buey (LANL, 2002b, page 7).
[194] Rogers and Gallaher, 1995, page 35, harmonic mean for 8 cores. Geometric and arithmetic means = 0.3 ft/yr and 5.6 ft/yr, respectively. The harmonic mean is used to calculate flow rates perpendicular to geologic units, as in this case.
[195] Tritium may be transported in the vapor-phase as well as by infiltrating water. Chloride and nitrate are transported only by infiltrating water (Rogers and Gallaher, 1995, page 19).
[196] Rogers and Gallaher, 1995, pages 20 and 66.
[197] Rogers and Gallaher, 1995, page 20.
[198] Calculation based on depth of nitrate: 150 feet (Rogers and Gallaher, 1995, pages 20 and 66).
[199] LANL discusses the discrepancy on pages 19 and 20 of Rogers and Gallaher, 1995.
[200] Rogers and Gallaher, 1995, page 20.

8.0 References

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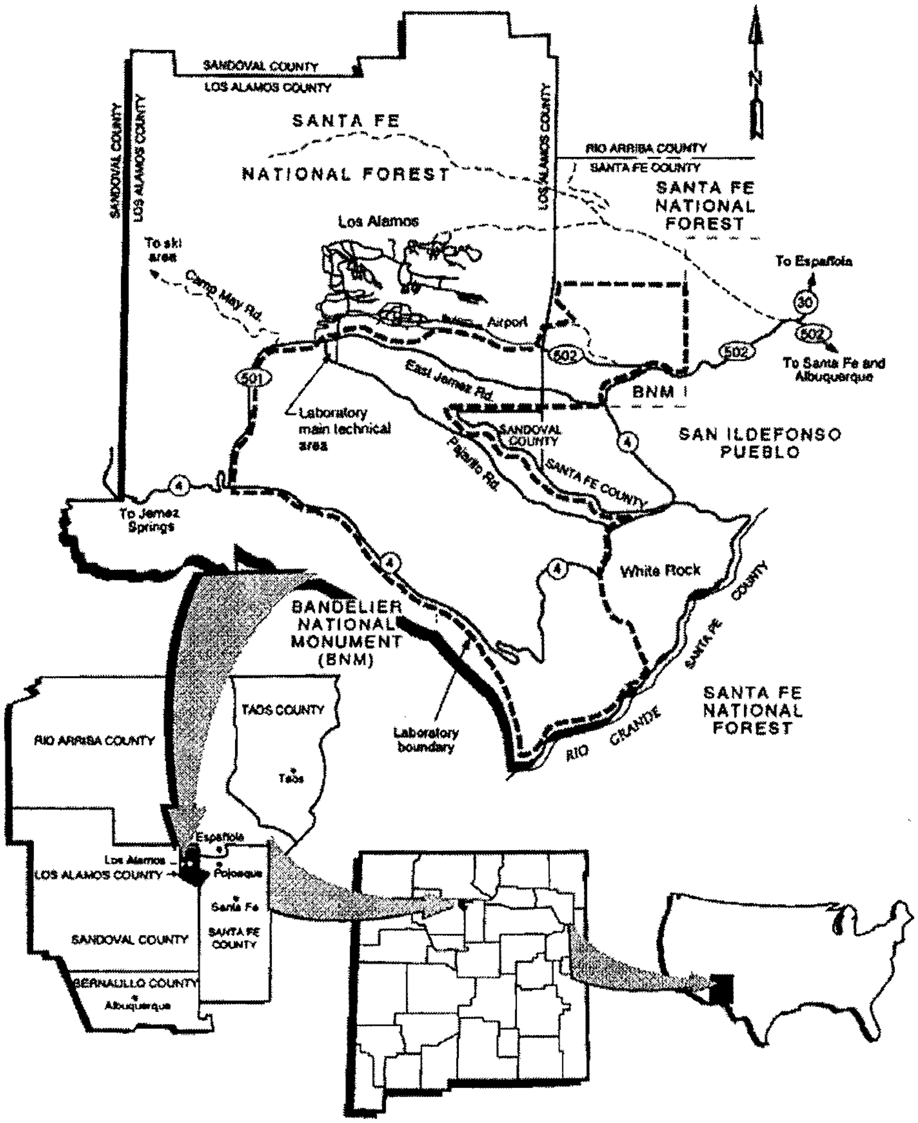


Figure 3-1
Location of Los Alamos National Laboratory

(Adapted from LANL 1992)

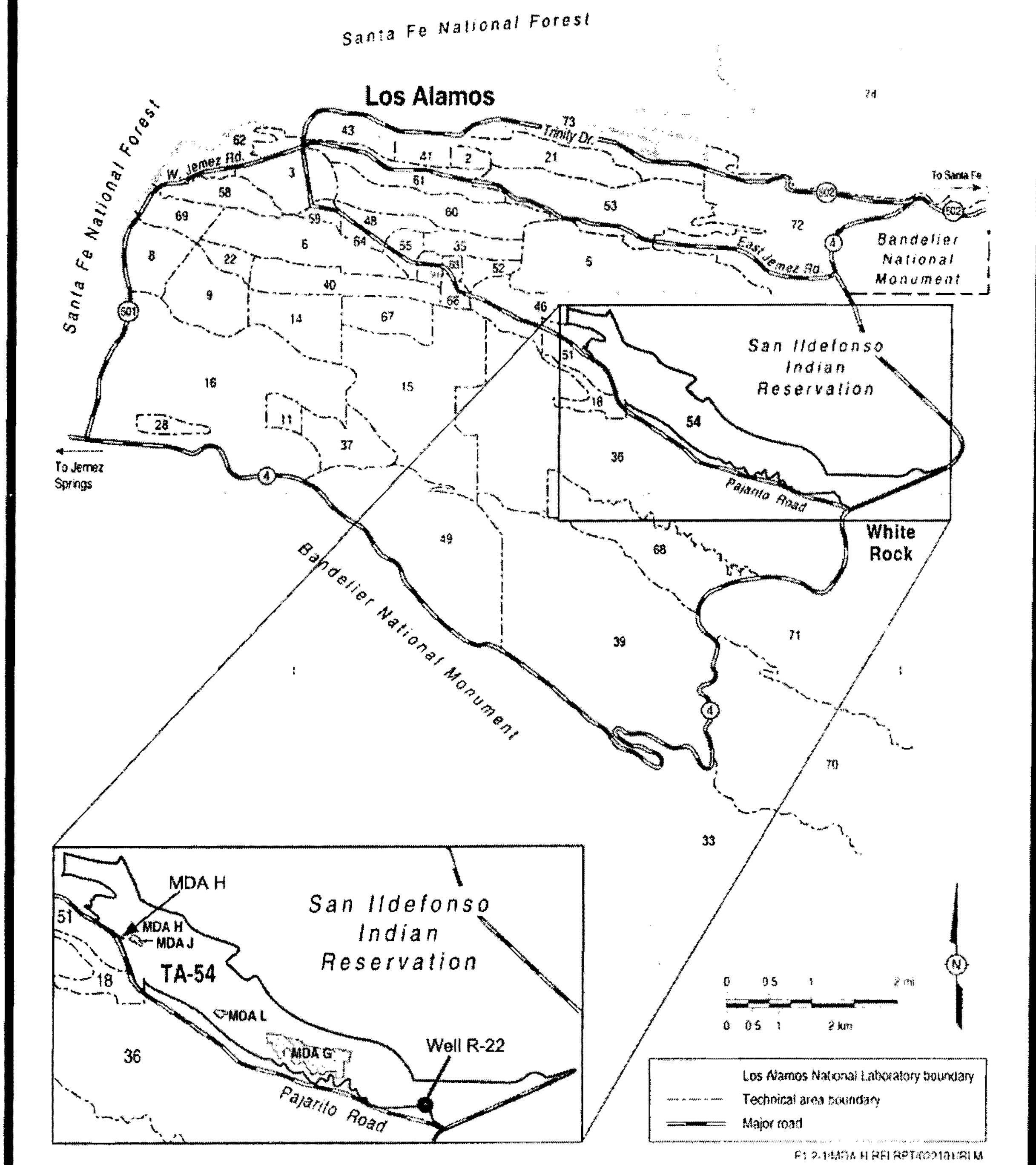


Figure 3-2
Location of MDA H
(Adapted from LANL 2001a)

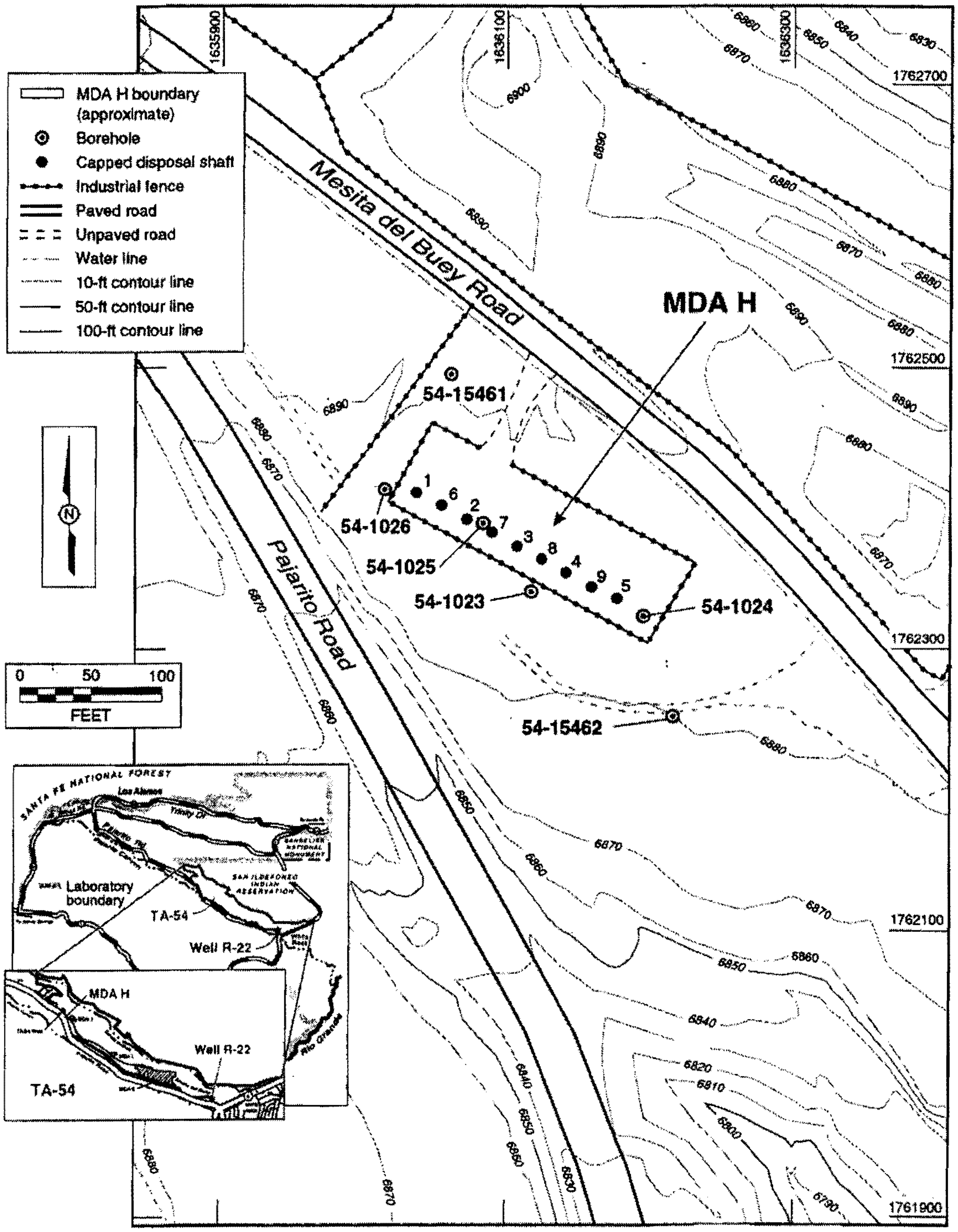


Figure 3-3
MDA H
Locations of Waste Shafts and Boreholes
(Adapted from LANL 2003a)

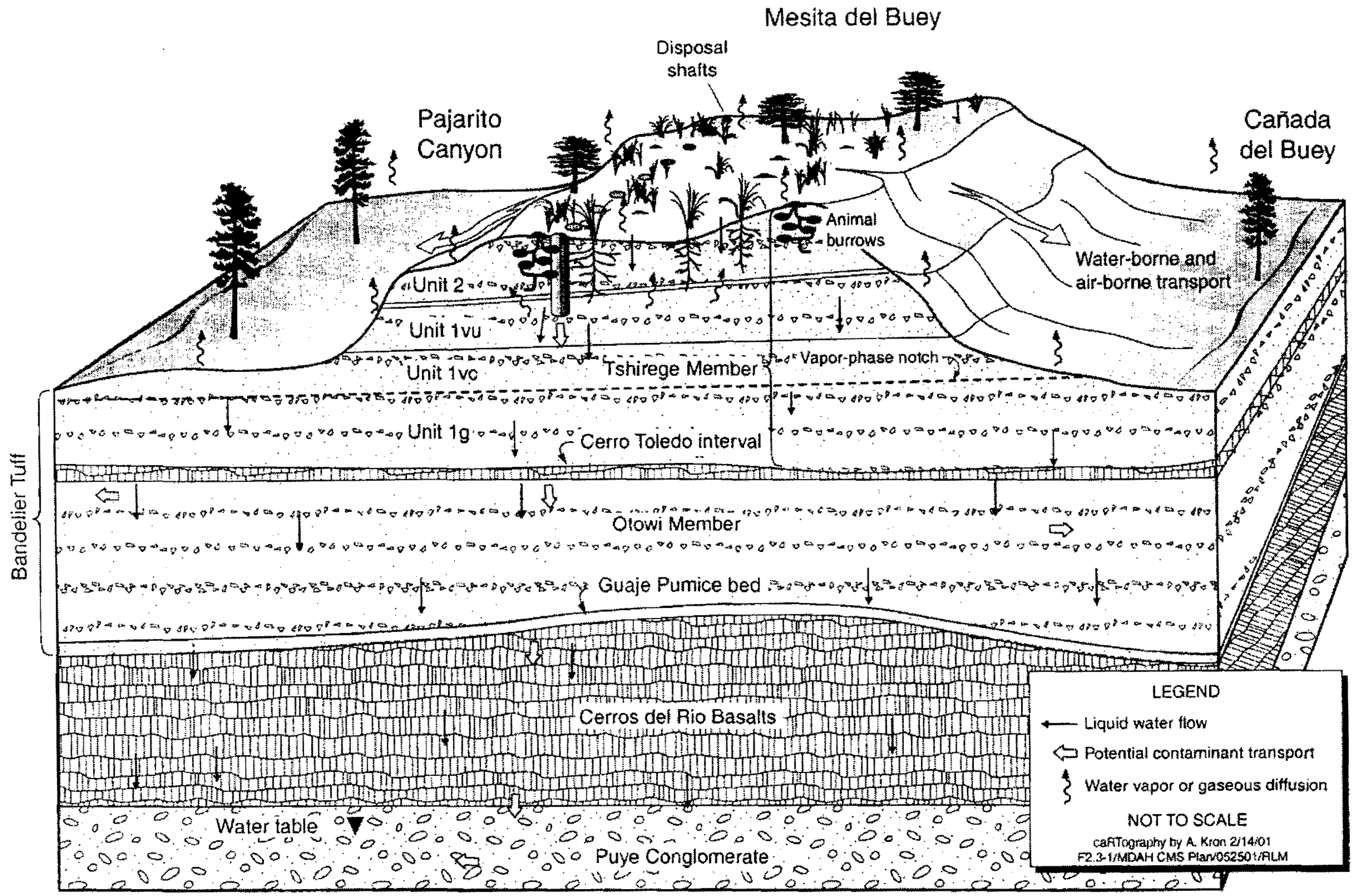


Figure 3-4
Mesita del Buey Statigraphy
(Adapted from LANL 2001a)

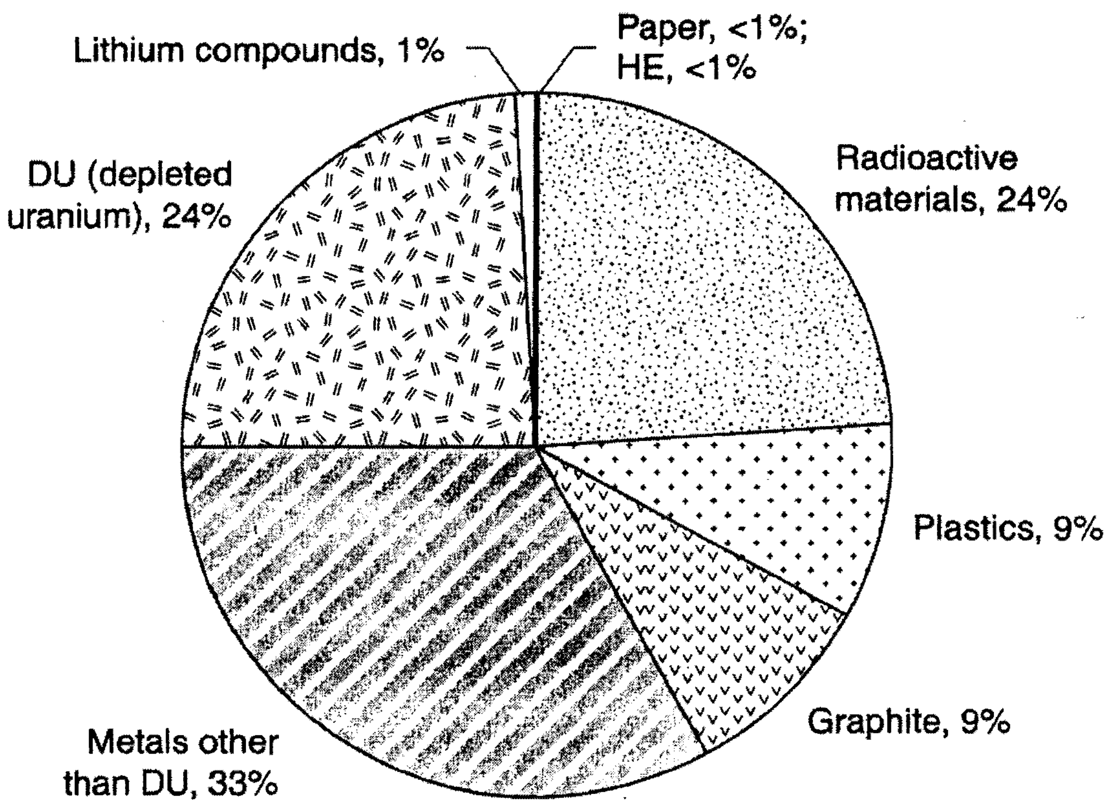


Figure 4-1
Major Waste Types at MDA H
(Adapted from LANL2003a)

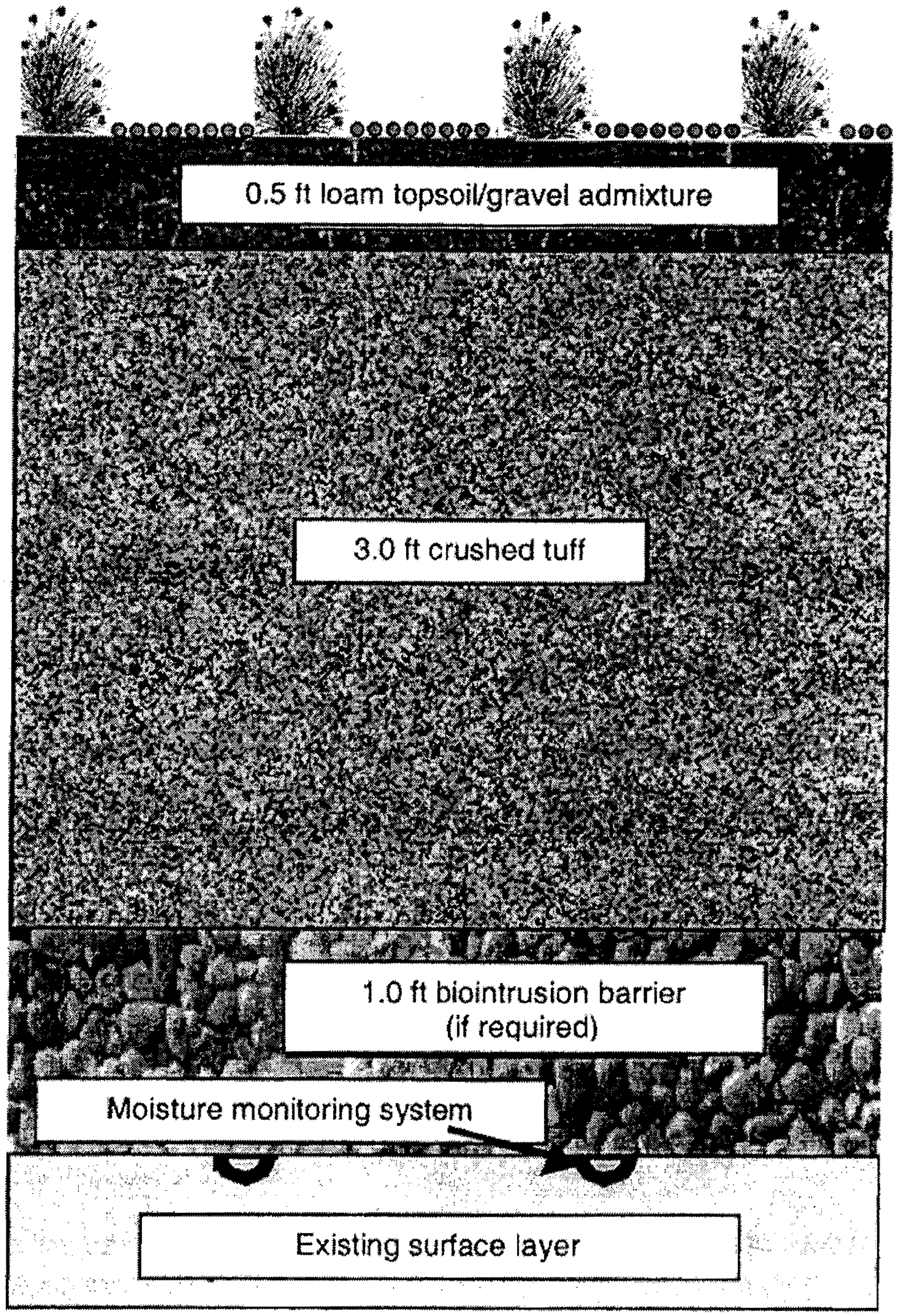


Figure 5-1
Engineered Evapotranspiration Cover
(Adapted from LANL 2003a)

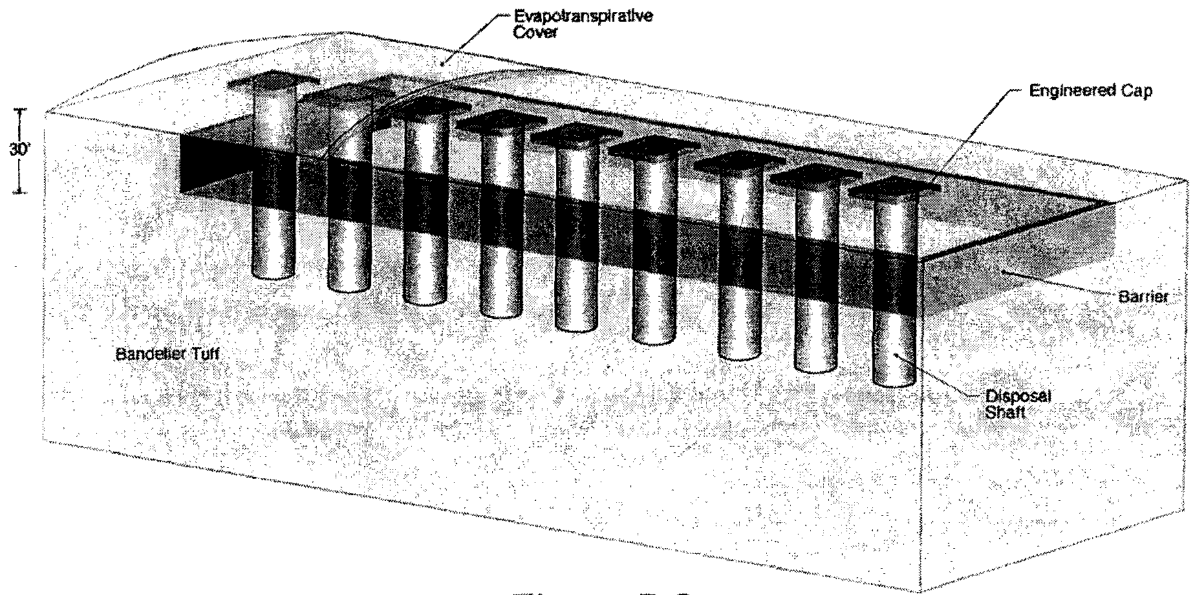


Figure 5-2
Partial Encapsulation
(Adapted from LANL 2003a)

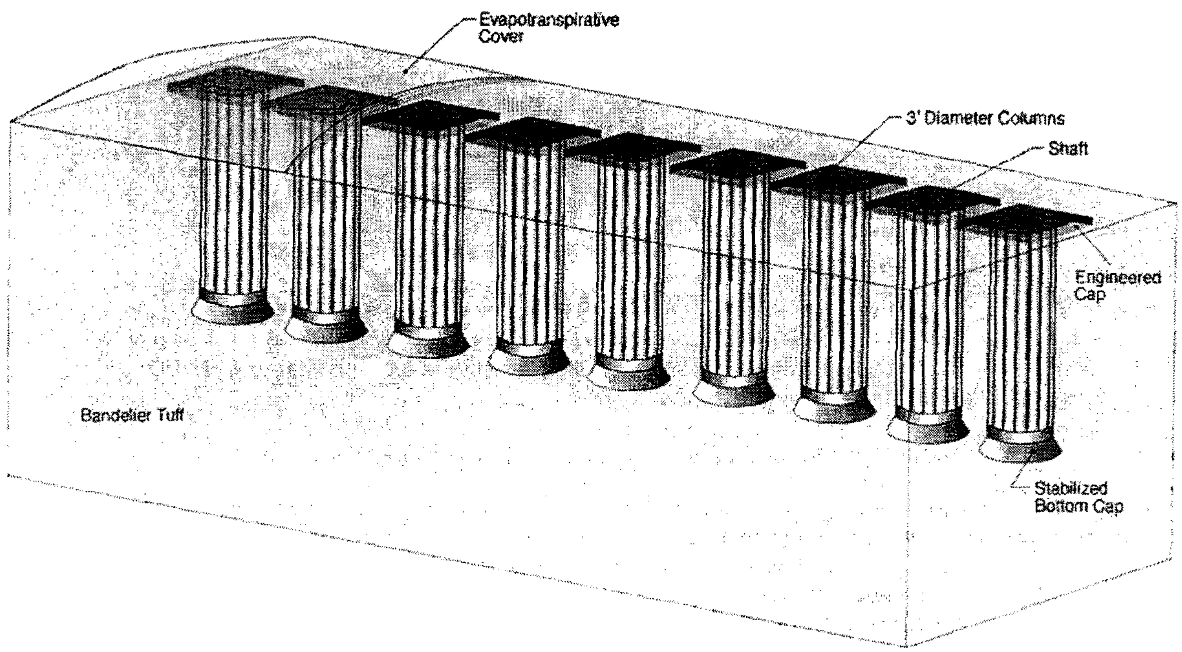


Figure 5-3
Complete Encapsulation
(Adapted from LANL 2003a)

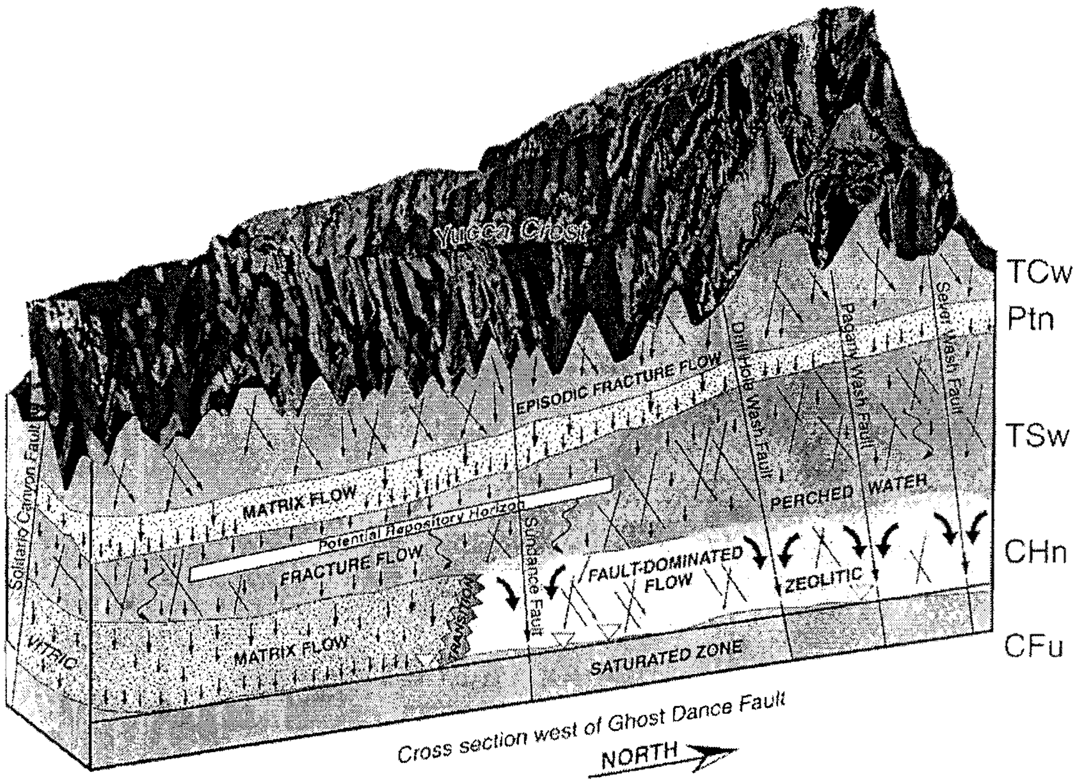


Figure 7-1
Yucca Mountain
Conceptual Model of Flow Through Vadose Zone
(Adapted From DOE 2000a)

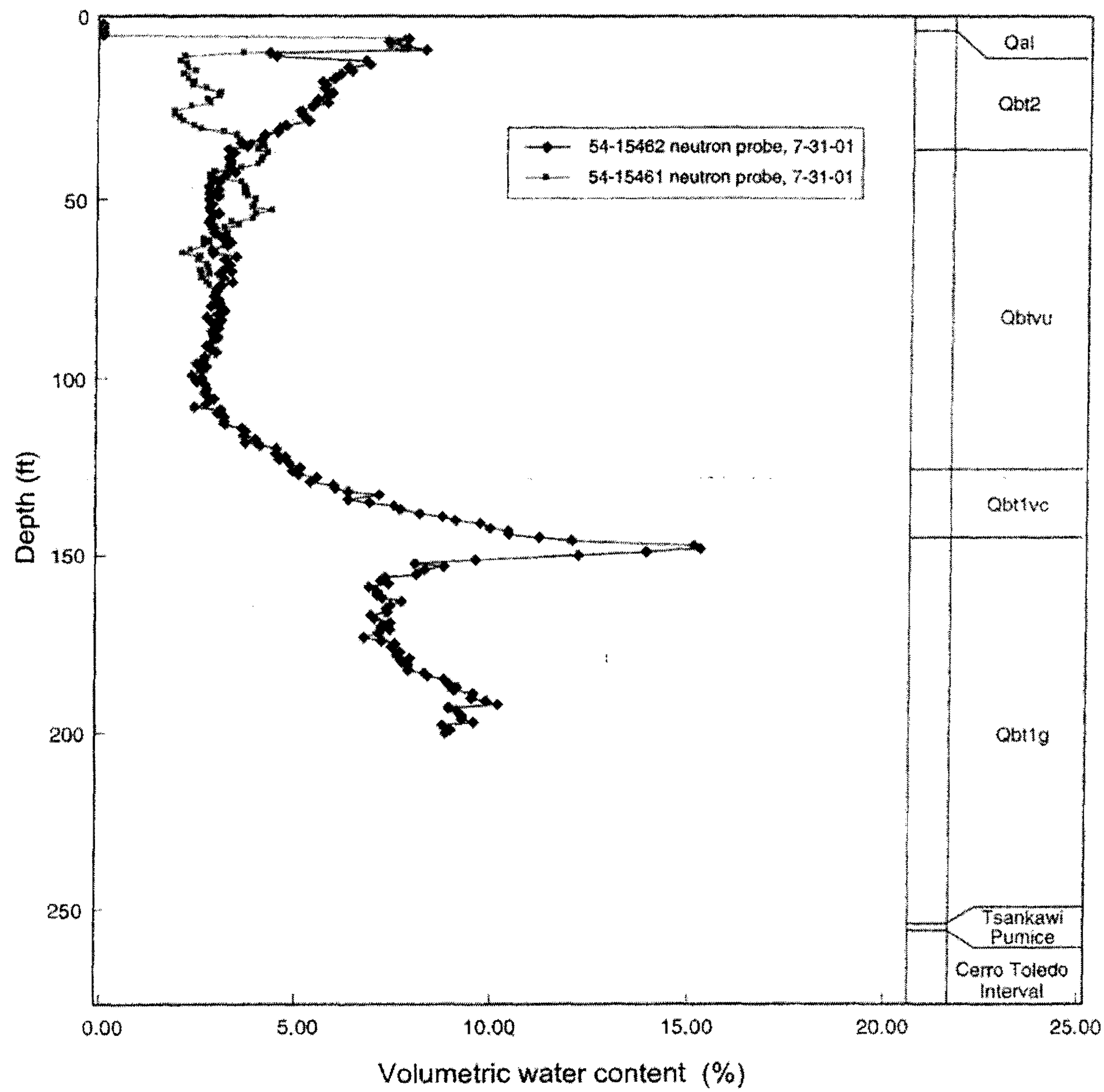
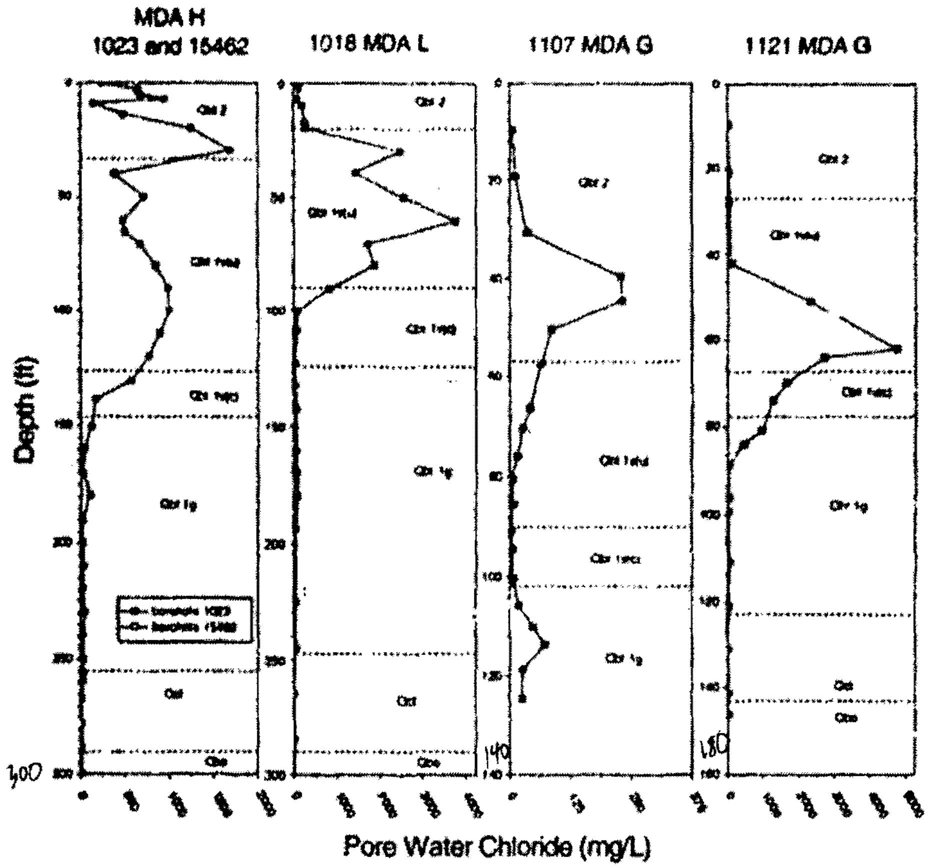


Figure 7-2
MDA H Vadose Zone Water Content
(Adapted from LANL 2003a)

one day in July 2001



Chloride Concentration Ranges	
1023 & 15462:	0 - 2000 mg/l
1018:	0 - 4000 mg/l
1107:	0 - 275 mg/l
1121:	0 - 5000 mg/l

Figure 7-3
Mesita del Buey
Vadose Zone Chloride Concentrations
(Adapted from Bergfeld and Newman, 2001)

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BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

January 17, 2006

Kenneth M. Hargis
Division Leader (Acting)
Environmental Stewardship
Environmental Remediation and
Surveillance (ERS) Program, MS M992
US Department of Energy Los Alamos
Los Alamos, NM 87545

Administrative Permit Revision
20.2.72.219.A.1 NMAC
NSR No. 2195JR1
IDEA ID No. 856 - PRN20060001
Los Alamos National Laboratory
AIRS No. 350280001

Dear Mr. Hargis:

This letter is to acknowledge your letter of January 10, 2006 to revise Air Quality Permit 2195J for the TA-11 Wood and Fuel Fire Test Site and TA-16 Flash Pad at Los Alamos National Laboratory. This revision is pursuant to Title 20 of the New Mexico Administrative Code Chapter 2 Part 72 (20.2.72 NMAC) Construction Permits Section 219.A.1. This revision consists of canceling permit 2195J due to Los Alamos National Laboratory no longer needing to perform the types of testing and activities authorized by the permit. The request was received by the New Mexico Environment Department's Air Quality Bureau (Department) on January 12, 2006.

A review of the information you submitted confirms that the requirements specified in 20.2.72 NMAC, Construction Permits, Permit Processing and Requirements, Section 219.A are met.

20.2.72.219.A.3 NMAC specifies that administrative permit revisions become effective upon receipt of the notification by the Department.

This letter shall be attached to Air Quality Permit No. 2195J issued by the Department on March 29, 2005 to serve as acknowledgment by the Department that this administrative permit revision is authorized.

EXHIBIT
CCNS-8

If you have any questions, please do not hesitate to contact me in Santa Fe at 505-955-8012.

Sincerely,

Kerry Carr
Permit Specialist
NSR/TV permitting section

Cc:

Concerned Citizens for Nuclear Safety
107 Cienega Street
Santa Fe, NM 87501

Embudo Valley Environmental Monitoring Group
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January 17, 2006

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US Department of Energy Los Alamos
Los Alamos, NM 87545

Administrative Permit Revision
20.2.72.219.A.1 NMAC
NSR No. 2195KR1
IDEA ID No. 856 - PRN20060002
Los Alamos National Laboratory
AIRS No. 350280001

Dear Mr. Hargis:

This letter is to acknowledge your letter of January 10, 2006 to revise Air Quality Permit 2195K for the DX-TA-36 Sled Track at Los Alamos National Laboratory. This revision is pursuant to Title 20 of the New Mexico Administrative Code Chapter 2 Part 72 (20.2.72 NMAC) Construction Permits Section 219.A.1. This revision consists of canceling permit 2195K due to Los Alamos National Laboratory no longer needing to perform the types of testing and activities authorized by the permit. The request was received by the New Mexico Environment Department's Air Quality Bureau (Department) on January 12, 2006.

A review of the information you submitted confirms that the requirements specified in 20.2.72 NMAC, Construction Permits, Permit Processing and Requirements, Section 219.A are met.

20.2.72.219.A.3 NMAC specifies that administrative permit revisions become effective upon receipt of the notification by the Department.

This letter shall be attached to Air Quality Permit No. 2195K issued by the Department on March 29, 2005 to serve as acknowledgment by the Department that this administrative permit revision is authorized.

EXHIBIT
CCNS-9

If you have any questions, please do not hesitate to contact me in Santa Fe at 505-955-8012.

Sincerely,

Kerry Carr
Permit Specialist
NSR/TV permitting section

Cc:

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Subject: **NMED Issues Findings of Comprehensive Water Quality Assessment of Pajarito Plateau Watersheds in Northern New Mexico**
Date: Thursday, December 17, 2009 1:19 PM
From: Bardino, Marissa, NMENV <Marissa.Bardino@state.nm.us>
To: <undisclosed-recipients:;>
Conversation: NMED Issues Findings of Comprehensive Water Quality Assessment of Pajarito Plateau Watersheds in Northern New Mexico

NEW MEXICO
ENVIRONMENT DEPARTMENT

Office of the Secretary

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Bill Richardson
Governor

R
S
Jon
Depu

December 17, 2009 — Contact: Marissa Stone Bardino, NMED
Communications Director
For Immediate Release — (505) 827-0314 or (505) 231-0475

Environment Department Issues Findings of Comprehensive Water Quality Assessment of Pajarito Plateau Watersheds in Northern New Mexico, Seeks Public Comment

Study Shows Water Quality in Plateau Exceeds Standards for PCBS, Adjusted Gross Alpha, Selenium, Aluminum and other Metals

(Santa Fe, N.M.) The New Mexico Environment Department – with significant data from Los Alamos National Laboratory – performed a comprehensive assessment of watersheds in the Pajarito Plateau in Northern New Mexico indicating those waters exceeded state standards for polychlorinated byphenyls, adjusted gross alpha, aluminum and other metals.

EXHIBIT
CCNS-13

The study, which was primarily focused on storm water samples collected between 2004 and 2008, represents the largest single surface water quality assessment conducted by NMED.

"I commend our Surface Water Quality and Department of Energy Oversight bureaus for their years of work that made this study possible," said New Mexico Environment Department Water and Waste Management Division Director Marcy Leavitt. "We are concerned that waters in these areas exceed state standards designed to protect human health and wildlife. We must continue to do more to address those concerns."

The Pajarito Plateau is located on the eastern slope of the Jemez Mountains and includes watersheds that drain through the Los Alamos area to the Rio Grande. The assessment included more than 29,000 data values from 78 stations around the plateau. The study is included as part of the department's draft 2010-2012 Integrated List that indicates whether waters are meeting designated uses for New Mexico's water quality standards. Those uses include domestic and public water supplies, irrigation, aquatic life, wildlife habitat and human health. The study does not focus on the origins of the impairments.

The department used all readily available surface water quality data collected during 2004-2008 from watershed stations throughout the Pajarito Plateau for the assessment (See link for a map of the stations http://www.nmenv.state.nm.us/SWQB/303d-305b/2010-2012/Pajarito/index.html)

"We appreciate LANL's data collection and compilation contribution to this project," Leavitt said.
The water quality assessment included data collected by NMED's Surface Water Quality Bureau and Department of Energy Oversight bureaus, and LANL. The SWQB dataset, which was collected as part of a special study of the Pajarito Plateau in 2006 and 2007, was funded by the U.S. EPA.
The results of the assessment largely confirmed, with much greater detail, the water quality impairments identified by the department during a prior Pajarito Plateau assessment conducted in 2006. Primary findings of the new assessment include:

- **PCBs** – Available data exceed the human health criterion of 0.00064 µg/L in storm water throughout most of the study area where sufficient data were available, and exceed the Wildlife Habitat criterion of 0.014 µg/L primarily in Pajarito, Los Alamos, Pueblo, Sandia and their associated side canyons.

- **Adjusted Gross Alpha** – New Mexico has a 15 pCi/L livestock watering criterion for "adjusted gross alpha" which means the total radioactivity due to alpha particle emission excluding radon-222, uranium and source, special nuclear and by-product material as defined by the Atomic Energy Act of 1954. Even after adjusting for special nuclear materials and other excluded nuclides when possible, the 15 pCi/L criterion was exceeded nearly everywhere sufficient data were available within the study area.
- **Selenium** – Assessment of available data resulted in delisting all of the AUs previously listed for selenium, presumably because the previous listing were based on elevated concentrations of selenium following the 2000 Cerro Grande fire.

- **Aluminum** – By far, the largest metal impairment identified was exceedences of the acute aluminum standard of 750 µg/L. The large number of exceedences may reflect natural sources associated with the geology of the region; for example, there are also many aluminum listing in other areas of the Jemez mountains.

- **Other metals** – There were 14 stream reaches (assessment units) listed for exceedences of the acute copper criteria, 6 for mercury, and 4 for acute zinc. These are primarily located in Pajarito, Los Alamos, Pueblo, Sandia and their associated side canyons.

The draft 2010-2012 Integrated List is now open for a 60-day public comment period that closes Feb. 16, 2010. The public is invited to review the data and assessment conclusions and provide comment.

For further information, contact Lynette Guevara at lynette.guevara@state.nm.us or (505) 827-2904 or James Hogan at james.hogan@state.nm.us or (505) 827-3671.

###

Subject: **Public Comments d 2010-2012 CWA Integrated 303(d) Pollutant List**
Date: Tuesday, February 16, 2010 1:29 PM
From: Joni Arends <jarends@nuclearactive.org>
To: <lynette.guevara@state.nm.us>
Conversation: Public Comments d 2010-2012 CWA Integrated 303(d) Pollutant List

February 16, 2010

By email to: lynette.guevara@state.nm.us

Ms. Lynette Guevara
Surface Water Quality Bureau
New Mexico Environment Department
P. O. Box 26110
Santa Fe, NM 87502

Re: Public Comments about the Draft 2010-2012 Clean Water Act Integrated 303(d) Pollutant List and
Comprehensive Water Quality Assessment of the Pajarito Plateau Watersheds - Los Alamos National Laboratory

Dear Ms. Guevara:

Concerned Citizens for Nuclear Safety (CCNS), a Santa Fe based non-governmental organization, provides the following public comments about the Draft 2010-2012 Clean Water Act Integrated 303 (d) Pollutant List for the Pajarito Plateau Watersheds, where Los Alamos National Laboratory (LANL) is located.

We commend the New Mexico Environment Department (NMED) for conducting a comprehensive study of the Pajarito Plateau Watersheds as part of the Clean Water Act 303(d)/305(b) Report.

Unfortunately, the wrong criteria were used for assessing impairment in most of the waters on LANL property. The aquatic life standards that were used for the intermittent streams on LANL property are weaker than those used for almost any other water body in New Mexico. The only other water body with as weak of standards is Sulpher Creek, a stream with naturally occurring high levels of metals. We are concerned that acute standards were used rather than the more protective chronic standards. The analyses that were done to justify the use of the weak standards being applied to the Pajarito Plateau waters was flawed. Further, it was not sent out for public comment as required by law.

Because NMED used the weaker and less protective standards in developing the list of polluted waters (303d list), we don't know the true extent of the pollution in these waters.

We are concerned about the transport of toxic, hazardous and radioactive contaminants through the canyons. And we know that even using the weaker standards, 22 of the 23 water bodies assessed on LANL property were listed as not meeting water quality standards. A wide range of pollutants exceeded the weaker standards, including PCBs, gross alpha radiation, copper, aluminum and

EXHIBIT
CCNS-14

mercury.

Because many members of CCNS live downstream from these canyons, we are concerned about the safety of the drinking water that will be diverted from the Rio Grande through the soon-to-be completed Buckman Direct Diversion Project.

Therefore, CCNS requests that the:

1. analyses be redone using the more protective water quality standards;

2. development of Total Maximum Daily Load (TMDLs) for the Pajarito Plateau begin now. A TMDL is a calculation of the maximum amount of a pollutant that waters may receive and still meet water quality standards. Given that 22 of the 23 waters are out of compliance, this effort needs to be done now on a strict schedule; and

3. NMED and the Environmental Protection Agency take broad enforcement action in order to protect our waters.

Thank you for your consideration of our comments. Please contact me with any questions or comments.

Sincerely,

Joni Arends, Executive Director
Concerned Citizens for Nuclear Safety
107 Cienega Street
Santa Fe, New Mexico 87501
Tel (505) 986-1973
Fax (505) 986-0997
www.nuclearactive.org

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

November 6, 2009

MEMORANDUM FOR: T. J. Dwyer, Technical Director
FROM: B. Broderick and R.T. Davis
SUBJECT: Los Alamos Report for Week Ending November 6, 2009

Staff members C. March, M. Moury, J. Pasko, J. Plaue and R. Tontodonato were onsite this week to discuss Recommendation 2009-2, *LANL Plutonium Facility Seismic Safety*, with NNSA Headquarters, site office and LANL personnel.

Radioactive Liquid Waste Treatment Facility: This week, LANL completed the Laboratory Readiness Assessment (LRA) associated with the restart of transuranic liquid waste processing activities in Room 60/60A. A total of 6 pre-start findings (3 closed during the review), 17 post-start findings (one closed during the review) and 4 noteworthy practices were identified by the LRA team. Pre-start findings that remain open include fire protection issues in an adjacent room (e.g. obstructed sprinkler head), fire department access road and water connection issues, and Potential Inadequacy of the Safety Analysis compensatory measures that are not included in the facility Safety Basis Document List. As a noteworthy practice, the team observed that the reader/worker method of procedural compliance and system status board updates both worked extremely well. Restart of transuranic liquid processing in Room 60/60A will allow resumption of aqueous processing activities in the Plutonium Facility that had been curtailed due to the inability to process radioactive liquid waste effluents.

Plutonium Facility – Ventilation: A backfit analysis on the Plutonium Facility Active Confinement Ventilation System was recently completed to evaluate gaps and recommend actions to upgrade the system from safety significant to safety class. The analysis concluded that with appropriate upgrades and improvements the system can perform a safety class function. Recommendations identified during the analysis to improve the system include 1) installation of a new safety class control system, 2) replacement of the uninterruptible power supply (this is part of the TA-55 Reinvestment Project, Phase II), 3) installation of electro-hydraulic actuators for dampers, 4) provide functional backup for basement exhaust and 5) complete ventilation modeling. LANL plans to complete backfit analyses for support systems (electrical and instrument air) this fiscal year.

This week, LANL personnel noted that seismic evaluations of ventilation, fire suppression and support systems against the updated Probabilistic Seismic Hazards Analysis will be completed using the methodology established during the SAFER Project. These evaluations along with the ventilation system modeling and analysis will provide key information to inform decisions related to the selection and upgrade of safety class systems for challenging seismic accident scenarios.

Plutonium Facility – Safety Basis Strategy: This week, the NNSA site office approved a revised Safety Basis Strategy for the annual update to the Plutonium Facility Documented Safety Analysis scheduled to be submitted in early December. The revised strategy document discusses an approach for refining analysis of the seismically-induced fire accident scenario by disaggregating the material at risk into the various physical forms (e.g. metal, oxide, solutions, etc) actually found in the facility and assigning analytical values that correspond to the dispersibility of these different material forms. The current DSA assumes that all material at risk on the laboratory floor that could be involved in a seismically-induced fire has the extremely high dispersibility of molten plutonium metal.

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

November 13, 2009

MEMORANDUM FOR: T. J. Dwyer, Technical Director
FROM: B. P. Broderick and R.T. Davis
SUBJECT: Los Alamos Report for Week Ending November 13, 2009

Low Level Waste Operations: While performing sorting and segregation operations for mixed and low level waste on Monday, a continuous air monitor (CAM) alarmed indicating airborne contamination. Workers responded appropriately and exited the area. Subsequent surveys found that one worker had contamination on his lab coat and positive nasal smears. Surveys of the area and analysis of the CAM filter paper indicated uranium contamination levels in the range of 250 to 1000 dpm per 100 cm^2.

This year, LANL began a campaign to disposition approximately 20 legacy metal crates that contain mixed and low level waste. The Integrated Work Document (IWD) and Radiological Work Permit (RWP) used for the legacy campaign had been developed for activities involving a different waste stream. Respiratory protection was required for the initial opening of waste crates; however, if initial surveys indicate no contamination, respirator protection was not required for subsequent sorting and segregation activities. For the legacy campaign, the IWD and RWP were not re-evaluated to ensure work controls were appropriate for the hazards associated with this new activity. Corrective actions identified by LANL management include re-evaluation of the process and work controls specific to the legacy waste campaign and evaluation of triggers that would drive changes in work scope to receive an appropriate level of review to ensure hazards are adequately captured and controlled.

Radioactive Liquid Waste Treatment Facility (RLWTF): This week, RLWTF experienced another failure of the low level waste tubular ultrafilter unit when a plastic connection assembly failed, releasing contaminated water to the room. This is the third event in the last 13 months caused by the same failure mode. A plastic curtain, installed after the last failure in June, mitigated water spray and prevented equipment damage. However, three workers were in the vicinity when the failure occurred. Exit surveys of the workers found no personnel contamination and nasal swipes were negative. Recovery efforts to decontaminate the room, inspect the tubular ultrafilter unit and isolate affected portions of the system completed this week (site rep weekly 6/12/09).

Also, work continues to address pre-start findings from the recently completed Laboratory Readiness Assessment for transuranic waste processing operations in RLWTF's Room 60/60A. One pre-start finding requires physical modifications to change the sprinkler head configuration for a section of the facility's fire suppression system. This work may complete in time to support resumption of transuranic liquid processing this calendar year (site rep weekly 11/6/09).

Transuranic Waste Operations: This week, the NNSA site office provided comments to LANL on draft hazard and accident analyses reviewed to support the upcoming submittal of a rule-compliant Area G Basis for Interim Operations. As part of their 64 total comments, the site office noted that safety management programs had been selected over engineered controls or specific administrative controls (SAC) for some accident scenarios without adequate justification. Also, some SACs were found to lack specificity in control limits or did not have well defined technical bases to support explicitly identified limits.

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

December 4, 2009

MEMORANDUM FOR: T. J. Dwyer, Technical Director
FROM: B. P. Broderick and R.T. Davis
SUBJECT: Los Alamos Report for Week Ending December 4, 2009

Plutonium Facility – Documented Safety Analysis (DSA): This week, LANL submitted the annual update of the DSA and the Technical Safety Requirements to the site office for review and approval. Notably, this update includes revised analysis of the post-seismic accident scenarios (both with and without fire). As discussed in the safety basis strategy, LANL disaggregated the material-at-risk into the various physical forms (e.g. metal, oxide, solutions) present in the facility and assigned the specific analytical values for dispersibility for each of these material forms. In addition, LANL proposes a specific administrative control for material-at-risk for each of these forms to protect the assumptions made in the DSA. Based on the revised analysis, the dose consequence for the postulated post-seismic fire accident scenario is reduced by more than an order of magnitude versus the DSA approved in December 2008. However, mitigated consequences (the only credited control for this scenario is the building structure with an associated leak path factor) remain above the DOE evaluation guideline.

The DSA was also updated to use the most recent weather data for dispersion modeling which resulted in an increase of approximately 30% for all offsite dose calculations. In addition, LANL addressed several conditions of approval that were identified by the site office Safety Evaluation Report including the following: incorporation of the results of the backfit analysis and industry code evaluation for the safety class fire suppression system; identification of criticality safety controls for inclusion in the DSA (vault racks and shelving criticality safety functions were included in this update); improved safety system, structure and component descriptions in chapter 4; clarification and improved basis for Technical Safety Requirements; and improved process descriptions in chapter 2.

Radioactive Liquid Waste Treatment Facility Replacement (RLWTF-R) Project: This week, NNSA Headquarters began their Technical-Independent Project Review (T-IPR) of the RLWTF-R Project to determine whether the current status of design, scope, cost, schedule, safeguards and security and safety aspects meet mission objectives and project performance requirements. Specifically, the T-IPR team has been asked to focus on the overall design (e.g. material selection, confinement strategy, nuclear safety strategy, seismic design), the system engineering approach used to manage the design requirements, adequacy of the design solution against technical requirements, the quality assurance program and implementation and actions to resolve DNFSB issues. LANL is currently at the 60% design point for this project and plans to pursue Critical Decision-2, Approval of Performance Baseline, in May 2010.

Weapons Engineering Tritium Facility (WETF): This week, LANL continued to resolve pre-implementation findings identified during the safety basis Implementation Verification Review and complete other readiness activities to support a return to operations mode in the near term. This mode change will allow WETF personnel to begin overpacking (in credited secondary containers or gloveboxes) approximately 70 containers that may exceed their maximum allowable working pressure and do not currently have secondary confinement. Consistent with site office direction, LANL will complete a Laboratory Readiness Assessment (LRA) prior to tritium gas handling operations. The LRA is now scheduled for January 2010.

John E. Mansfield, Vice Chairman
Joseph F. Bader
Larry W. Brown
Peter S. Winokur

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700 Washington, D.C. 20004-2901
(202) 694-7000

March 15, 2010

The Honorable Daniel B. Poneman
Deputy Secretary of Energy
U. S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Deputy Secretary Poneman:

The Defense Nuclear Facilities Safety Board (Board) is concerned that a recent regulatory interpretation by the Department of Energy (DOE) of Title 10, Code of Federal Regulations, Part 830, *Nuclear Safety Management* (10 CFR 830), undermines the principles of providing adequate protection of the public, workers, and the environment from DOE's defense nuclear facility operations. Specifically, the National Nuclear Security Administration (NNSA) has recently approved documented safety analyses in which the mitigated dose consequences to the public exceed DOE's Evaluation Guideline. Such approval implies that exceeding the Evaluation Guideline is an acceptable outcome of the prescribed safety analysis and control selection process.

Since its promulgation in January 2001, DOE has relied upon implementation of 10 CFR 830 to provide adequate protection of the public. The principle of adequate protection is dependent on the execution of regulatory criteria that lead to the implementation of an adequate set of hazard controls and demonstration of the adequacy of those controls to eliminate, limit, or mitigate the identified hazards to a "small fraction" of the Evaluation Guideline. Fundamental to this principle is the appropriate selection of safety class controls to prevent or mitigate adverse consequences to the members of the public from potential accidents. The selection of safety class controls is provided for in the "safe harbor" methodology set forth in DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.*

Acceptable execution of the safe harbor methodology described in DOE Standard 3009 has been the subject of recent discussions with DOE. On December 30, 2009, the Board's staff met with representatives of NNSA and the Office of Health, Safety and Security to discuss this regulatory framework and its implementation at some defense nuclear facilities. Subsequently, NNSA's Chief of Defense Nuclear Safety developed a white paper intended to outline expectations for implementation of the safe harbor methodology.

The expectations outlined in the white paper, presented by DOE and NNSA personnel during extensive discussions, and evident (for example) in NNSA's approval of the documented safety analysis for Technical Area 55 at Los Alamos National Laboratory are fundamentally in

EXHIBIT CCNS-20

conflict with the Board's understanding of DOE's past practices during the 15 years since DOE Standard 3009 was established, as well as the Board's explicit position as outlined in past correspondence. A key document is the Board's letter to DOE dated July 8, 1999, in which the Board agreed with DOE's position that the requirement to ensure adequate protection of the public would be met by (1) compliance with the methodology prescribed in DOE Standard 3009 regarding analysis of the unmitigated dose consequences of design basis accidents, (2) comparison with the Evaluation Guideline, and (3) "designation as 'safety class' of any structure, system or component required to prevent exposures at the boundary from exceeding 25 rem Total Effective Dose Equivalent."

DOE Standard 3009 is clear about the application of the Evaluation Guideline and the fact that its value is not considered an acceptable public exposure; rather, its use sets a clear guideline for establishing when to invoke an effective set of safety class controls that reduce the potential dose consequences to the public to acceptably low values, referred to as a "small fraction of the Evaluation Guideline." *By accepting documented safety analyses with calculated mitigated consequences greater than the Evaluation Guideline, DOE is essentially nullifying the consequence-based methodology established by 10 CFR 830 and evident in DOE's practices since DOE issued the rule.*

The accident analysis process, the proper application of the Evaluation Guideline, and the identification of effective safety class controls are all fundamental for DOE to ensure adequate protection of the public health and safety. The Board would like to understand DOE's and NNSA's intent; specifically, if the recent regulatory interpretation is meant to apply across all DOE defense nuclear facilities. This is necessary to determine appropriate action on the part of the Board.

Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a response to the following questions within 30 days of receipt of this letter:

1. What is the regulatory status of DOE Standard 3009? That is, if a contractor chooses to use this methodology, what part of the recommended approach to safety and the contents of Appendix A for implementation of the Evaluation Guideline are mandatory, and what parts are optional?

2. What is DOE's regulatory framework for assuring adequate protection of the public, the workers, and the environment if the methodology prescribed in DOE Standard 3009 is used but the goals specified in Appendix A are not achieved? More specifically, if the mitigated dose consequences to the public, with safety class controls being credited, approach or exceed the Evaluation Guideline, what steps or actions must be taken to ensure adequate protection of public health and safety is provided?

Pursuant to 42 U.S.C. § 2286b(d), the Board further requests a report within 60 days of receipt of this letter describing:

1. Which defense nuclear facilities do not have a set of safety class controls that reduce the mitigated dose consequences to the public below the Evaluation Guideline?

2. For these facilities, what barriers exist to prevent DOE from meeting the Evaluation Guideline?

3. Which of these facilities deviate from, or have been unable to meet, DOE's position in response to items 1 and 2 on the previous page, and to what extent?

Sincerely,

John E. Mansfield, Ph.D.
Vice Chairman

c: The Honorable Thomas P. D'Agostino
The Honorable Kristina Johnson
The Honorable Scott Blake Harris
Mr. Glenn S. Podonsky
Mr. Mark B. Whitaker, Jr.

Lab Firefighting Ability Questioned

ABQJ 1-7-09

BY RAAM WONG
Journal Staff Writer

If a fire ever broke out in one of Los Alamos' nuclear facilities, a new report raises questions about the ability of local firefighters to properly put it out.

The report comes three months after the federal government signed a new agreement in which Los Alamos County's fire department will continue protecting the nuclear weapons lab, a sprawling site that covers 40 square miles.

A cover letter attached to the December report states "there are weaknesses in the current capability to respond to a fire or other emergency event in the unique hazard environments associated with nuclear facilities at [Los Alamos National Laboratory]."

The report by federal safety officials also raises concerns about staffing at the lab, as well as a lack of progress in addressing previously-identified weaknesses in fire protection. A lab spokesman said Tuesday improving fire protection is an ongoing priority.

Recent drills suggest "significant weaknesses" in the capability of firefighters to respond to emergencies in nuclear facilities, according to the report.

In a July 2007 exercise at a facility that handles radioactive waste, for instance, county fire personnel were ineffective in providing first aid to an injured and contami-

See LAB on PAGE 3

Lab Firefighting Questions Raised

from PAGE 1

nated subject because of a lack of understanding about the hazard presented by fictional contamination, according to the report.

During another drill, the route used by emergency personnel in responding to a fire at the Plutonium Facility would have spread the contamination, the report states. Personnel also failed to establish "clean and contaminated zone perimeters."

Despite the problems, "the exercise objectives were rated as having been successfully met in most cases," according to the report.

The federal government's contract with the county to provide fire services expired in 1997. Since then, protection was provided under renewing 45-day agreements as officials hammered out a new contract.

After some 11 years of negotiating, the National Nuclear Security Administration and the county signed a five-year cooperative agreement in October.

The agreement describes minimum staffing, staffing at key fire stations, and response times for nuclear facility emergencies. It also calls for a nuclear facilities reserve force of seven firefighters that cannot be deployed to non-lab events without notifying NNSA.

The agreement also requires that training plans be reviewed and approved annually by the county and the NNSA.

Fire Chief Douglas MacDonald said he had not yet read the report by the Defense Nuclear Facilities Safety Board and referred questions to the NNSA.

An agency spokesman in Washington, D.C., referred questions to the NNSA's Los Alamos office, which did not return a call for comment.

Lab spokesman Kevin Roark said in a statement: "We are continually working through the (NNSA's) Los Alamos Site Office with the Los Alamos Fire Department to help improve training, emergency fire scenario exercise activities, and overall fire protection response services."

Roark said a good indicator of the lab's current capability was the response to a fire in Ancho Canyon last summer that involved more than 40 multiagency firefighters. The fire — sparked by a lab equipment test — was under control in just a few hours, Roark said.

"Of course we believe that fire protection services can always be improved and have always worked toward that end," the spokesman said.

Weaknesses in the lab's fire protection program were last detailed in 2004 when LANL completed a so-called baseline needs assessment.

Since that time, "minimal progress" has been made in addressing those issues, some of which date back to 1995, according to the report. The lab is now updating that assessment.

Other concerns raised in the report include inadequate staffing in the lab's Fire Protection Group.

Previous evaluations found a need for 10 engineers in the group, while the budgeted staffing level for the positions is only six.

The letter attached to the report asks the NNSA to respond within 90 days with information detailing immediate measures taken to improve fire and emergency response capabilities, a copy of the new baseline needs assessment, and a strategy and schedule for achieving the emergency response capability.

EXHIBIT
CCNS-21

DOE Inspector General Finds Continuing Problems with LANL Fire Protection

September 25, 2009

The Inspector General of the Department of Energy (DOE) recently released an inspection report about the problems with fire protection at Los Alamos National Laboratory (LANL), a facility with "unique" hazards. http://ig.energy.gov/documents/IG-0821.pdf This is the second report since June, indicating a heightened awareness of the problems that have been documented for over a decade by the Inspector General, as well as the Defense Nuclear Facility Safety Board and the National Nuclear Security Administration.

The Inspector General cited the outstanding recommendations that have not been addressed in the 1995 and 2004 Baseline Needs Assessments, which include staffing, training and the need for pre-fire plans for facilities that handle hazardous chemicals, explosives and radioactive materials. Some of the issues were resolved on September 30, 2008 when the Los Alamos County and the National Nuclear Security Administration signed a Cooperative Agreement for fire protection services, after 11 years of negotiations and temporary contracts. But many of the issues will not be addressed until 2010. The Inspector General said, "... the challenges facing [the National Nuclear Security Administration], LANL, and the County are significant, especially given the history of failed attempts to secure the appropriate level of fire suppression services for LANL. We believe that the recent initiatives taken by the [National Nuclear Security Administration] under the Cooperative Agreement are good first steps, but additional actions are needed."

Kevin Roark, LANL spokesman, said, "We have every confidence that the county firefighters have the required information and access authorities to deal with a fire situation at any of our radiological facilities."

Yet on June 8, 2009, Los Alamos County firefighters could not respond to two smoke alarms at the Los Alamos Neutron Science Complex, a radiological facility, after normal business hours because the gate was closed. The badge reader did not read the firefighters' badges and the override key could not be found. After about 10 minutes, the firefighters gained access. The DOE Office of Health, Safety and Security reported, "This event involves several issues including emergency responder access, communication between several LANL functions, and equipment control/management. It was learned that emergency personnel were not added to the authorized users' list for the badge readers after the method of access was changed a month earlier." www.hss.energy.gov/CSA/Analysis/ll/occur/061509-061909.pdf

http://www.hss.energy.gov/CSA/Analysis/ll/occur/061509-061909.pdf Sheri Kotowski, Lead Organizer for the Embudo Valley Environmental Monitoring Group, has been monitoring emergency preparedness and has participated in the extensive negotiations about the draft New Mexico Environment Department hazardous waste permit for LANL. She said that the DOE Inspector General and other federal oversight agencies do not have enforcement powers so that they cannot require LANL to rectify the on-going deficiencies. However, the New Mexico Environment Department does. Kotowski said, "In permits issued by the Environment Department, there are enforcement mechanisms so that the deficiencies must be corrected to ensure that the facilities are in compliance. In the case of the hazardous waste permit, the Environment Department needs to step up and use their enforcement powers to keep the public protected."

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A.J. Eggenberger, Chairman
John E. Mansfield, Vice Chairman
Joseph F. Bader
Larry W. Brown
Peter S. Winokur

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700 Washington, D.C. 20004-2901
(202) 694-7000

April 7, 2009

The Honorable Steven Chu
Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Secretary Chu:

The Defense Nuclear Facilities Safety Board (Board) remains concerned that the safety-class vault water bath system at the Plutonium Facility at Los Alamos National Laboratory (LANL) is unable to fulfill its safety function in a reliable manner. This system is relied upon to protect the public by preventing one of the laboratory's highest consequence accident scenarios. Despite this critically important safety function, significant unresolved issues with this safety-class system are unaddressed, leaving it in an indeterminate and degraded state with respect to operability, reliability, and effectiveness—a situation that is unacceptable to the Board.

Many of the highest consequence accidents at LANL involve the processing, handling, and storage of plutonium-238 enriched heat source plutonium (HS-Pu). The vast majority of LANL's inventory of HS-Pu is stored in the Plutonium Facility's vault water baths, which are relied upon to dissipate heat generated by the intense radioactive decay of HS-Pu. This heat dissipation prevents about 200 non-safety-class containers—some of which have no reliable design information—from overpressurizing, failing, and releasing their contents. The unmitigated offsite consequences of an overpressurization event involving even a single container of HS-Pu amount to nearly 500 rem; the consequences of multiple failures are much higher.

In a letter to the National Nuclear Security Administration (NNSA) dated October 16, 2007, the Board identified deficiencies in a number of vital safety systems and urged both NNSA and the laboratory to take actions that would rapidly increase confidence in credited safety systems. In particular, inadequacies were identified in the safety basis associated with the safety-class vault water baths. The Board has determined that the safety function of the vault water baths has not been effectively defined, implemented, or protected. As a result, inadequate controls exist to make certain that vital water level and cooling are maintained to ensure that all of the non-safety-class HS-Pu containers will remain submerged and adequately cooled during all anticipated normal and abnormal conditions. In particular, a failure of the system cooling function for the vault water baths, which is not credited as a safety control, could allow the water in the baths to boil in as little as 18 hours, followed shortly by uncovering of the containers. Insufficient information exists to reliably predict how some of the containers would respond to such a loss of cooling.

EXHIBIT
CCNS-23

Notwithstanding these facts, the existing LANL system surveillance required only a monthly verification of water level and a spot check that the non-safety-class containers were submerged. The Board has identified a number of other weaknesses related to the vault water baths that further challenge their ability to perform the required safety function. Based on recent interactions with the Board's staff, both LANL and the Los Alamos Site Office have acknowledged the existence of these issues, however, it is not clear that proposed near-term actions will resolve the issues in an acceptable manner.

The Board is deeply concerned by this lack of progress in addressing deficiencies with the safety-class vault water baths to ensure that this critical system can perform as a reliable and effective control. The Board notes that an assessment of the vault water baths performed by LANL in 2008 failed to identify any of the issues outlined in this letter. This calls into question the laboratory's ability to conduct credible assessments of system safety functions. Based on the severity and persistence of these issues, as well as other safety system deficiencies identified in the Board's October 16, 2007 letter, the Board believes emphasis must be placed on improving the ability to identify and expeditiously address operability issues associated with the vault water baths and other vital safety systems at LANL.

Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a report and briefing within 45 days of receipt of this letter describing (1) any compensatory measures and immediate actions NNSA has taken to improve the safety posture of non-safety-class HS-Pu containers stored in the vault water baths, and (2) the strategy for fully characterizing and correcting vault water bath deficiencies identified by the Board or for improving the robustness of HS-Pu containerization. Additionally, the Board requests a briefing within 60 days of receipt of this letter describing the plan of action, including milestones and completion dates, to improve the process used to identify and resolve operability issues related to other vital safety systems at LANL.

Sincerely,

A. J. Eggenberger
Chairman

c: The Honorable Thomas P. D'Agostino
Mr. Donald L. Winchell, Jr.
Mr. Mark B. Whitaker, Jr.

A.J. Eggenberger, Chairman
John E. Mansfield, Vice Chairman
Joseph F. Bader
Larry W. Brown
Peter S. Winokur

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700 Washington, D.C. 20004-2901
(202) 694-7000

July 28, 2009

The Honorable Thomas P. D'Agostino
Administrator
National Nuclear Security Administration
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Mr. D'Agostino:

On April 7, 2009, the Defense Nuclear Facilities Safety Board (Board) sent a letter to Secretary Chu outlining urgent concerns with the safety-class vault water bath system at Los Alamos National Laboratory (LANL). The Board received the National Nuclear Security Administration's (NNSA) response letter dated May 18, 2009, as well as a briefing by the Los Alamos Site Office (LASO) Assistant Manager on May 19, 2009. The letter and briefing described the compensatory measures and actions taken by NNSA and LANL to improve the safety posture of non-safety-class containers of plutonium-238 enriched, heat-source plutonium (HS-Pu) stored in the vault water baths. More specifically, LASO provided plans for a number of engineering improvements designed to increase the reliability of the vault water bath system. The Board agrees that, once implemented, these proposed improvements should significantly enhance the ability of the system to perform its safety function.

The Board understands that the primary approach being taken to improve the safety posture of HS-Pu storage is to ensure all such material is packaged in safety-class containers by June 2010. However, the Board disagrees with NNSA's assertion that all the non-safety-class containers presently stored in the vault water baths can currently survive for at least 18 months in air. There is no engineering data to support such a claim for 40 of these containers. While future analysis may support this position, the fact that the necessary data do not currently exist underscores the need to safely and aggressively pursue actions to improve the robustness of HS-Pu containerization.

The LANL contractor briefed the Board on May 20, 2009, on its plans to correct weaknesses noted by the Board with respect to the process used to identify and resolve operability issues for all vital safety systems. These plans included revising the vital safety system assessment (VSSA) and system health reporting procedures, increasing the number of qualified cognizant system engineers, augmenting the LANL staff with more experienced assessment personnel, and providing standardized training for performing VSSAs. The Board understands that LASO's goal is for LANL to complete the VSSAs and implement system health reporting for all vital safety systems by September 30, 2009.

EXHIBIT
CCNS-24

The Board and its staff will continue to closely follow the progress of NNSA and LANL in meeting the scheduled milestones and commitments to correct the deficiencies in the vault water bath system, improve HS-Pu containerization, and strengthen the process to identify and resolve vital safety system operability issues at LANL.

Sincerely,

A. J. Eggenberger
Chairman

c: Mr. Mark B. Whitaker, Jr.

Solid Waste and Emergency Response
(5305W)
EPA530-K-05-009

RCRA Training Module

EPA
United States
Environmental Protection
Agency

CLOSURE AND POST-CLOSURE

CONTENTS

1. INTRODUCTION

All hazardous waste management facilities must eventually cease their treatment, storage, or disposal activities. When such operations cease, the owner and operator must close the facility in a way that ensures it will not pose a future threat to human health and the environment. The Resource Conservation and Recovery Act (RCRA) closure and post-closure regulations in 40 CFR Parts 264 and 265, Subpart G, are designed to achieve this goal. Closure is the period following active management during which a facility no longer accepts hazardous wastes. When an owner or operator of a treatment, storage, and disposal facility (TSDF) completes treatment, storage, and disposal operations, he or she must apply final covers to landfills and dispose of or decontaminate equipment, structures, and soils. Post-closure, which applies only to land disposal facilities and facilities that cannot decontaminate (or "clean close") all equipment, structures, and soils, is normally a 30-year period after closure during which owners and operators conduct monitoring and maintenance activities to preserve the integrity of the disposal system and continue to prevent or control releases of contaminants from the disposal units.

When you have completed this training module you will know the difference between closure and post-closure and how to apply the appropriate regulations. Specifically, you will be able to:

- list the types of facilities that are subject to closure/post-closure
- define the difference between partial and final closure
- specify who submits a closure plan and when a closure plan must be submitted, list the steps in the process, and state the time frame for submittal
- identify when a closure plan must be amended and how closure plans are amended
- explain the time frame for notification of closure, and the deadlines for beginning and completing closure
- specify which facilities need contingent post-closure plans
- list the elements of post-closure and cite the requirements
- specify the conditions and timing for amending a post-closure plan
- state who must certify closure/post-closure
- explain the alternatives to post-closure permits for interim status facilities.

Use this list of objectives to check your knowledge of this topic after you complete the training session.

2. REGULATORY SUMMARY

The closure and post-closure regulations can be divided into two parts: (1) general standards in Part 264/265, Subpart G, and (2) technical standards for specific types of hazardous waste management units found in Part 264/265, Subparts I through X. These combined requirements ensure that a specific unit or facility will not pose a future threat to human health or the environment after a TSDF closes.

2.1 CLOSURE PERFORMANCE STANDARDS

Owners and operators must close each facility in a manner that minimizes the need for care after closure. To achieve this requirement, facilities must control, minimize, or eliminate the escape of hazardous waste, hazardous leachate, or hazardous waste decomposition by-products to the extent necessary to protect human health and the environment, (§264/265.114). Facilities must also meet the closure requirements for each unit type (§264/265.111). For example, permitted containers must be closed according to §264.178.

2.2 CLOSURE PHASES

RCRA facilities often have several different hazardous waste management units that close at different times. The regulations account for this possibility by differentiating between partial closure and final closure. Partial closure means closure of one or more hazardous waste management units at a facility where other hazardous waste management units remain active. The closed portion (also "inactive portion") of a facility is defined as that portion of a facility that has been closed in accordance with an approved closure plan and applicable regulatory requirements, while the active portion of the facility is that portion where treatment, storage, or disposal operations continue to occur. Final closure of a facility occurs when all hazardous waste management units at a facility are closed according to closure regulations.

2.3 CLOSURE PLAN

All TSDFs must submit closure plans for both partial and final closure in accordance with §264/265.112. These plans explain in detail how the owner and operator will achieve the closure performance standard under §264/265.111. Permitted facilities are required to submit a closure plan with the Part B permit application; the approved closure plan then becomes an enforceable component of the facility permit. Interim status facilities must have a written closure plan on the premises six months after the facility becomes subject to §265.112.

CONTENTS OF THE CLOSURE PLAN

The closure regulations do not mandate any specific format for the closure plan. Nor do the regulations mandate any particular level of detail, length, or supporting documentation. Rather, the regulations provide general guidelines on the type of information that the closure plan must include. By requiring these specific elements, EPA hopes to force owners and operators to consider their future closure responsibilities and consequently realize the impact of their current operating practices on closure. According to §264/265.112(b), the closure plan must contain:

- a description of how each hazardous waste management unit will be closed
- a description of how final closure of the facility will be achieved
- an estimate of the maximum inventory of hazardous waste ever on site during the facility's active life
- a detailed description of closure methods, including actions necessary to remove waste and decontaminate the site
- a description of any other steps that may be necessary in order to comply with the closure standards, such as groundwater monitoring or leachate collection
- a schedule of closure dates for each unit and for final closure, including the amount of time that closure of each unit and related activities will take
- the expected year of final closure for facilities that use trust funds for financial assurance, and for facilities without approved closure plans.

AMENDING THE PLAN

The closure plan may be amended by either the facility owner/operator or the Regional Administrator (RA) by following the steps in §264/265.112(c) when there is a change in the design or operation of the facility, a change in the expected closure date, or an unexpected event. An example of an unexpected event is the discovery of more contamination than anticipated, resulting in the need to close a storage unit (e.g., a tank) as a disposal unit.

The owner and operator of a permitted facility or an interim status facility with an approved closure plan must submit a written request to the RA, along with a copy of the amended plan 60 days prior to a planned change. If the change is a result of an unexpected event, the amended closure plan must be submitted no more than 60 days after the unexpected event if it occurs before closure, and no more than 30 days after an unexpected event if it occurs during closure. Facilities can amend the closure plan at any time prior to notification of partial or final closure; however, permitted facilities must also submit a permit modification per §270.42, in addition to the written request to amend the plan. Owners and operators of interim status facilities without approved closure plans may amend the closure plan at any time prior to notification of partial or final closure.

2.4 CLOSURE TIMETABLE

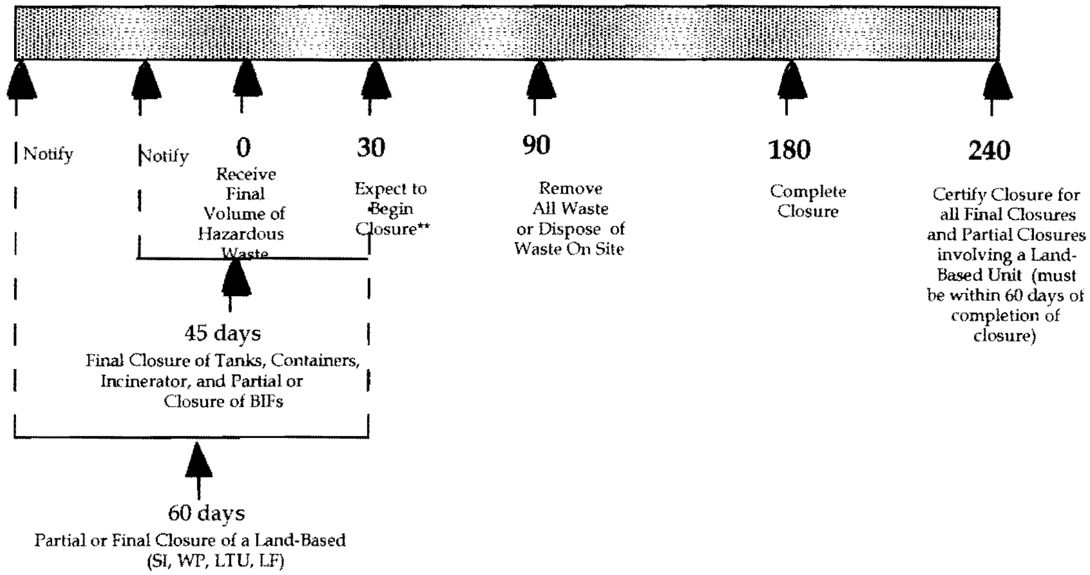
The closure regulations establish specific timetables for the initiation and completion of closure activities. One element of this timetable is prior notification to the RA of the commencement of closure. For permitted units the owner and operator must notify the RA at least 60 days prior to the date on which they "expect to begin closure" of a surface impoundment, waste pile, land treatment or landfill unit, or final closure of a facility with such a unit (§264.112(d)). The date when the owner and operator "expect to begin closure" must be no later than 30 days after the date on which the unit accepts the known final volume of hazardous waste (§264.112(d)(2)(i)). For facilities with only tanks, containers, or incinerators, notification must occur at least 45 days prior to the date they expect to begin final closure. For hazardous waste boilers or industrial furnaces, notification must occur at least 45 days prior to partial or final closure. Interim status units have similar notification requirements to their permitted counterparts. The additional stipulation is that closure plans must be submitted according to the dates found in §265.112(d) of the regulations (closure plans for permitted units are submitted in the Part B application process).

Section 264/265.113 establishes deadlines for initiating and completing closure activities. Within 90 days of receipt of the final volume of hazardous waste at a permitted facility, the owner and operator must treat, remove from the site, or dispose of all hazardous waste on site. For interim status facilities, this deadline, as well as the deadlines for all subsequent closure activities, is based on the timing of the latter of two events: receipt of the final volume of hazardous waste at the unit, or approval of the closure plan (§265.113(a) and (b)). For example, the owner and operator of an interim status facility must treat, remove from the site, or dispose of all hazardous waste on site within 90 days of receipt of the final volume of hazardous waste, or within 90 days of the approval of the closure plan, whichever is later. Figures 1 and 2 illustrate the closure timelines for permitted and interim status facilities (with approved plans), respectively. You will see significant time differences in requirements for land-based units and facilities with only tanks, containers, and incinerators.

Once partial or final closure is initiated, closure activities must be completed within 180 days of receiving the final volume of hazardous waste (§264/265.113(b)). For interim status facilities, closure activities must be completed within 180 days of approval of the closure plan, or within 180 days of receiving the final volume of hazardous waste, whichever is later.

Figure 1

CLOSURE TIMETABLE FOR PERMITTED FACILITIES and INTERIM STATUS FACILITIES WITH APPROVED CLOSURE PLANS*

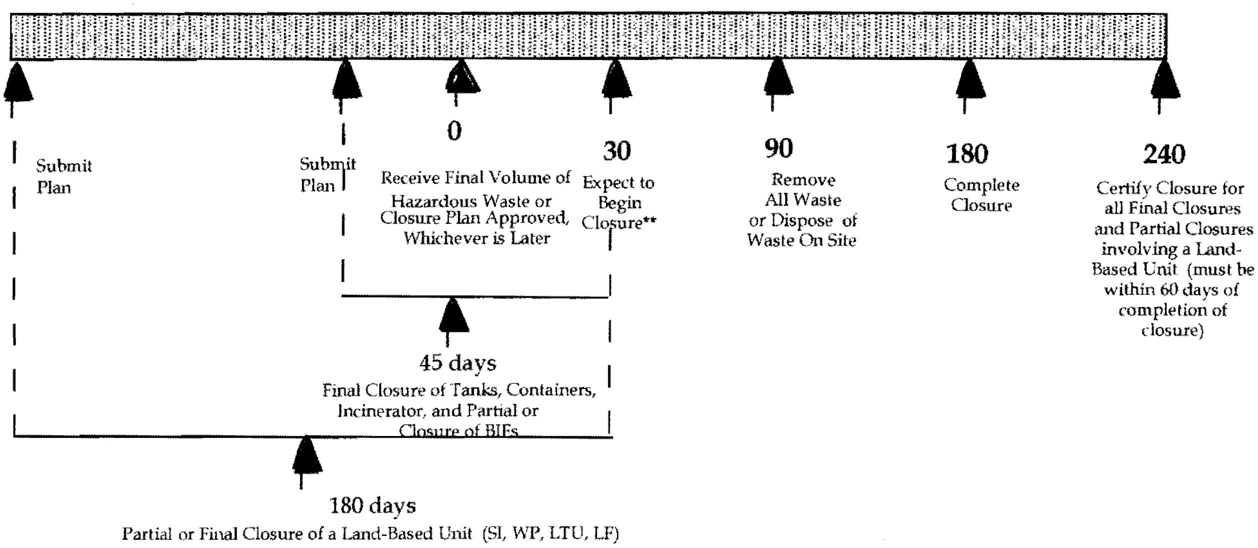


* This figure does not take into account Delay of Closure

** If the unit has the capacity to receive additional wastes, begin closure no later than one year after final volume of waste is received.

Figure 2

CLOSURE TIMETABLE FOR INTERIM STATUS FACILITIES WITHOUT APPROVED CLOSURE PLANS*



* This figure does not take into account Delay of Closure

** If the unit has the capacity to receive additional wastes, begin closure no later than one year after final volume of waste is received.

EXTENSIONS

When the closure activities will take longer than 90 (or 180) days to complete, the RA may grant extensions to the 90- and 180-day deadlines, provided the facility or unit has the capacity to accept hazardous or nonhazardous waste (§264/265.113(a) and (b)).

DELAY OF CLOSURE

A facility meeting specific eligibility criteria in §264/265.113(d) and (e) may delay closure and continue to receive nonhazardous waste following the final receipt of hazardous waste. This provision is only available to certain landfills, surface impoundments, and land treatment units. It is not available to units such as storage or treatment tanks, container storage areas, waste piles, incinerators, land treatment units, or units that have lost interim status.

In addition, all owners and operators of units that choose to delay closure will continue to be subject to all applicable Subtitle C requirements and must ensure that the co-disposal of nonhazardous waste with hazardous waste will in no way endanger human health and the environment.

2.5 DISPOSAL OR DECONTAMINATION OF EQUIPMENT, STRUCTURES, AND SOILS

During partial and final closure periods, all contaminated equipment, structures, and soils must be properly disposed of or decontaminated unless otherwise specified in the unit-specific closure requirements (§264/265.114). During this process the owner and operator may become a generator of hazardous waste and, therefore, become subject to the requirements in Part 262. Furthermore, hazardous waste management units built as part of the closure process must be permitted or comply with the generator accumulation unit provisions in §262.34.

2.6 CERTIFICATION OF CLOSURE

According to §264/265.115, the owner and operator must submit to the RA (by registered mail) a certification that the hazardous waste management unit or facility has closed in accordance with the specifications in the approved closure plan. This submittal must take place within 60 days of completion of closure of each regulated unit and within 60 days of the completion of final closure. The certification must be signed by the owner and operator and by an independent, registered, professional engineer. The RA may request supporting documentation to verify the validity of the engineer's certification.

2.7 SURVEY PLAT

The owner and operator must submit to the RA or local zoning authority a survey plat indicating the location and dimensions of the hazardous waste units (§264/265.116). The survey plat must be submitted no later than the submission of certification of closure of each hazardous waste disposal unit. The survey plat provides important information on closed units in the event that the facility is sold or abandoned.

2.8 CLEAN CLOSURE

Generally, two types of closure are allowed: closure by removal or decontamination, referred to as "clean closure," and closure with the waste in place. If all hazardous waste and contaminants, including contaminated soils and equipment, can be removed from the site or unit at closure, the site or unit can be clean closed and post-closure care is not required. In order to demonstrate clean closure, the owner and operator must show that levels of hazardous contaminants do not exceed EPA-recommended exposure levels, or clean closure levels.

EPA has not specified contaminant levels for clean closure. "How clean is clean" is a site-specific decision made by the EPA Region or authorized state. Limited amounts of hazardous constituents may remain in media after clean closure provided they are present at concentrations below which they may pose a risk to human health and the environment. The implementing agency can identify clean closure based on established, protective, risk-based levels (e.g., maximum contaminant levels (MCLs) under the Safe Drinking Water Act), or site-specific risk-based levels. EPA clarified its policies on risk-based clean closure in a March 16, 1998, memorandum (Cotsworth to EPA Regional Advisors).

2.9 POST-CLOSURE

EPA developed the post-closure standards for land disposal units (LDUs) that leave hazardous waste in place at closure. These include landfills, land treatment units, surface impoundments, and other units where equipment, structures, and soils cannot be fully decontaminated (i.e., clean closed). Facilities where waste remains in place after the completion of closure must conduct monitoring and maintenance activities to ensure the integrity of the liners and leak detection systems and prevent or control releases to the environment. Owners and operators of facilities that require post-closure care must comply with both the general post-closure regulations in §264/265.116 through 264/265.120, and the unit-specific post-closure requirements in Part 264/265, Subparts K, L, M, N, and X. These facilities also must obtain permits for the post-closure period and comply with the groundwater monitoring requirements of Part 264/265, Subpart F.

POST-CLOSURE PERMITS

Owners and operators of certain land disposal units and units that cannot clean close must obtain a permit for the post-closure period, thus ensuring that appropriate monitoring and maintenance activities will be conducted. Post-closure permits apply to owners and operators of surface impoundments, landfills, land treatment units, and waste piles that received waste after July 26, 1982, or that certified closure after January 26, 1983, unless they demonstrate closure by removal pursuant to §270.1(c)(5) and (6). At the discretion of the implementing agency, an owner or operator may obtain, in lieu of a post-closure permit, an enforceable document that imposes the requirements in §265.121 (§270.1(c)(7)).

The denial of a permit for the active life of a hazardous waste management facility (i.e., the period from first receipt of hazardous waste until certification of final closure) does not affect the requirement to obtain a post-closure permit. A storage unit (e.g., a tank) that cannot be clean closed and is closed as a landfill must obtain either a post-closure permit or an enforceable document that imposes post-closure permit requirements.

POST-CLOSURE CARE

Post-closure care consists of two primary responsibilities: groundwater monitoring and maintaining waste containment systems (§264/265.117). The post-closure period normally lasts for 30 years after the date closure is completed but may be amended (e.g., extended or shortened) by the RA. Groundwater monitoring and reporting must be conducted in accordance with Part 264/265, Subparts F, K, L, M, and N.

Waste containment systems must be monitored and maintained in accordance with the applicable regulatory requirements of Part 264/265, Subparts K, L, M, N, and X. Post-closure use of the property may not disturb the final cover, liners, or other containment or monitoring systems unless such disturbance is necessary for the proposed use or to protect human health and the environment (see unit-specific closure requirements in Part 264/265, Subparts I through O). Post-closure activities include maintaining the integrity of the cap or final cover and ensuring that monitoring equipment works properly during the post-closure period.

POST-CLOSURE PLAN

Owners and operators must prepare a post-closure plan for units that do not clean close. The post-closure plan requirements in §264/265.118 include:

- a description of planned groundwater monitoring activities
- a description of planned maintenance activities
- the name, address, and telephone numbers of the person or office to contact during the post-closure period.

Permitted facilities must submit the post-closure care plan as part of the post-closure permit application. Thus, any amendments to the plan require a permit modification. Owners and operators of interim status facilities must submit a post-closure plan to the RA at least 180 days before the date they expect to begin partial or final closure of the first hazardous waste disposal unit. If a facility's interim status is terminated, or the RA issues a judicial decree or order under RCRA §3008 to cease receiving wastes or close, the owner and operator must submit the post-closure plan to the RA within 15 days (§265.118(e)(1) and (2)).

POST-CLOSURE NOTICES

Within 60 days after closure certification by a registered engineer or qualified soil scientist, the local zoning or land use authority and the RA must receive a record of the type, location, and quantity of hazardous wastes in each disposal unit (§264/265.119). For wastes disposed of prior to January 12, 1981, the owner and operator must provide a "best estimate" for the quantity of waste in each unit.

Also within 60 days of closure certification of each hazardous waste disposal unit, a notice must be placed in the property deed and recorded. This notice must state that the land was used for hazardous waste management; that the use of the land is restricted per Part 264/265, Subpart G; and that the survey plat and record of closure were submitted to the local zoning authority and the RA.

CERTIFICATION OF COMPLETION OF POST-CLOSURE CARE

No later than 60 days after completion of the established post-closure care period for each hazardous waste disposal unit, the owner and operator must submit to the RA by registered mail a certification that the post-closure care period was performed in accordance with the specifications established in the approved closure plan (§264/265.120).

ALTERNATIVES TO POST-CLOSURE PERMITS

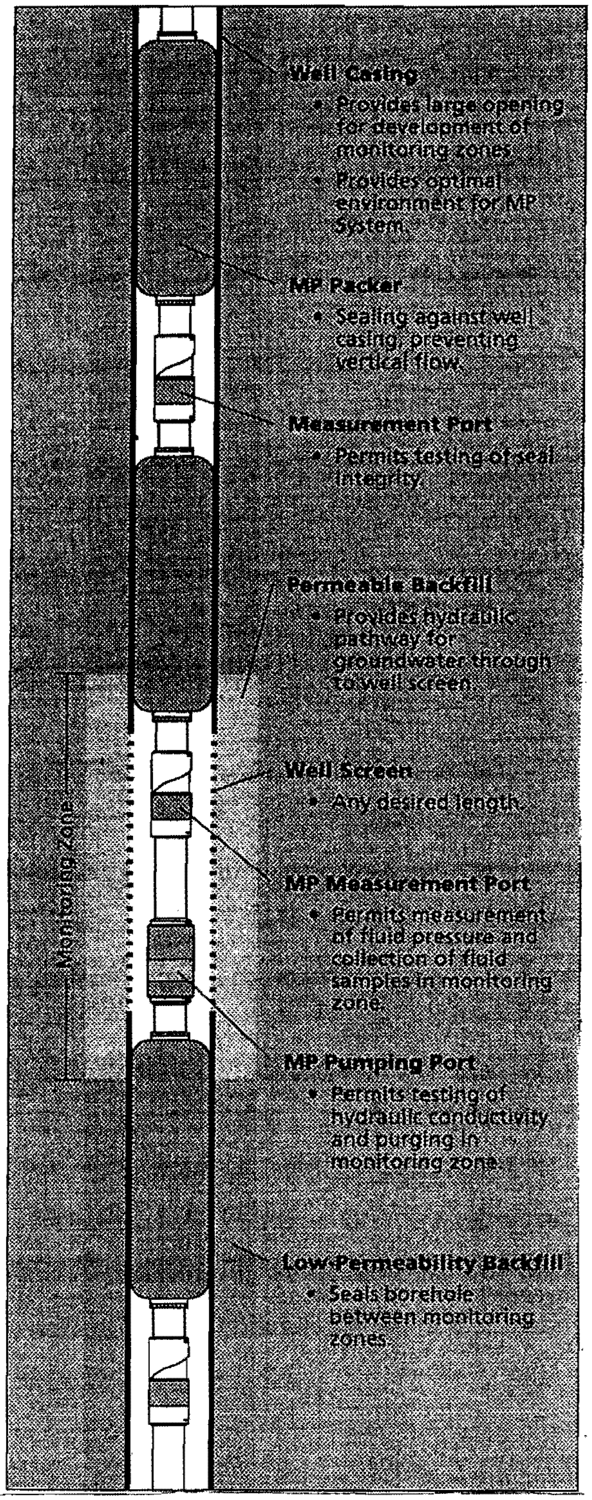
The RCRA closure standards mandate post-closure care and a post-closure permit when the owner and operator closes a disposal unit or leaves hazardous waste in place after the facility closes. Obtaining a post-closure permit and implementing corrective action through that permit is difficult and in some cases impossible because the facility cannot meet the requirements to obtain a post-closure permit in RCRA §3005(c) (see the module entitled RCRA Corrective Action). On October 22, 1998, EPA addressed this issue by revising the closure and post-closure requirements to allow the use of various authorities to impose requirements on non-permitted LDUs requiring post-closure care (63 FR 56710).

The new guidelines remove the requirement to address post-closure care requirements through a post-closure permit in all instances, thereby giving the Agency the ability to use the most appropriate and efficient remedial authorities, such as enforcement orders, available at a closing facility. However, any alternative authority used in lieu of a post-closure permit must provide the same substantive requirements that apply to units receiving post-closure permits. Additionally, facilities that close with waste in place and use a non-permit mechanism in lieu of a permit to address post-closure responsibilities will have to meet three important requirements that apply to permitted facilities: (1) the more extensive groundwater monitoring required in Part 264, as it applies to regulated units; (2) the requirement to submit information about the facility in §270.28; and (3) facility-wide corrective action for solid waste management units as required in §264.101 (§265.121).

The October 22, 1998, final rule also provided flexibility for situations in which a regulated unit (e.g., landfill) is situated among solid waste management units (SWMUs), a release has occurred, and both the regulated unit and SWMU are suspected of contributing to the release. In

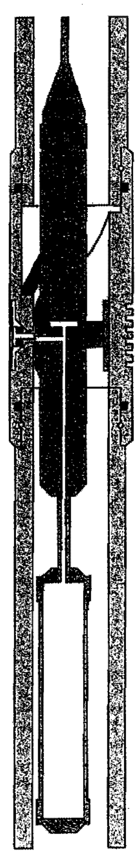
3. SPECIAL ISSUES

Interim status terminates for facilities that fail to comply with the applicable provisions of §270.73(a) through (g), which establish deadlines for the submission of permit applications. For example, an incinerator that received interim status prior to November 8, 1984, had its interim status terminated on November 8, 1989, unless the owner or operator of the facility submitted a Part B application for a RCRA permit by November 8, 1986. An interim status facility that fails to meet any applicable portion of §270.73 falls into the loss of interim status category. The owner or operator of the facility must then submit a closure plan in accordance with §265.112(d) and initiate final closure activities.



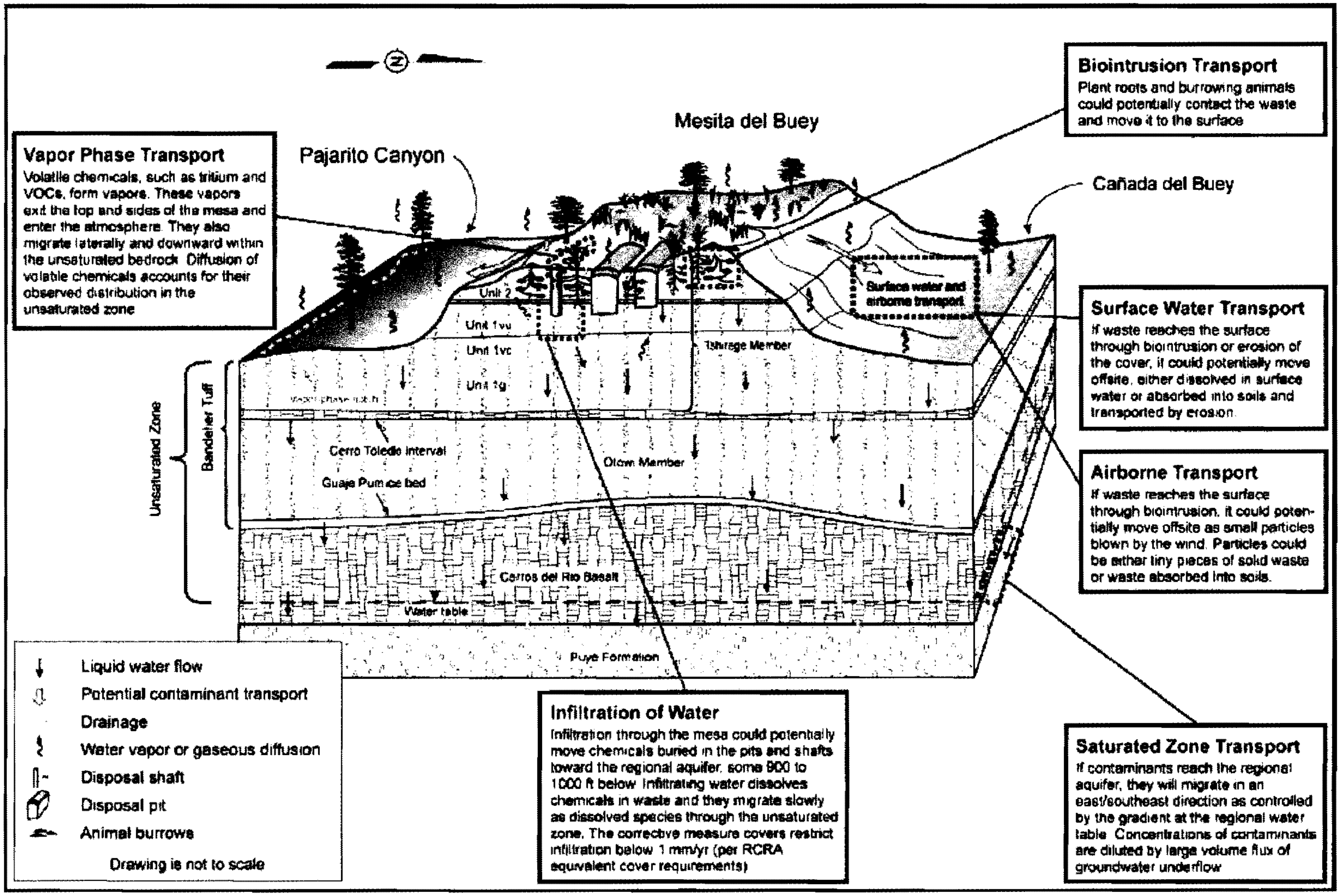
The figure at left illustrates the design for Westbay MP System® completions in deep alluvial environments or any instance which demands thorough verification of hydraulic integrity. The completion incorporates the following major components:

- Large-diameter borehole drilled by any suitable method
- Conventional well casing with screens located at depths selected for monitoring zones
- Select backfill placed by tremmie methods outside the well casing, e.g.:
  - — sand filter material around screens
  - — bentonite/sand mix to seal annulus between screens.



Monitoring zones are accessed using wireline-operated probes and tools, such as the sampling probe illustrated above.

Figure 1. Source: Figure 3.2-6 *in* LANL Report *MDA G CME Report – Rev 1* (LA-UR-09- 5509 September 2009). AR 32022.



J. Tauxe 062101 after A. Kron_Rev for F2.3-1, MDA H RS 122001, RLM_Rev for MDA H CMS Rpt 051403 cf; modified 102207, ptm

Figure 3.2-6 Hydrogeologic conceptual site model for Area G

Figure 2. Figure 2.3-13 "Regional monitoring wells, water supply wells, and groundwater gradient" in LANL MDA G CME Report – Rev. 1 (LA-UR-09-5509 September 2009. AR 32022.

- The distance from the northern boundary of MDA L to well R-38 is ~ 1/4 mile
- The contour lines are the elevation of the water table of the regional aquifer
- The direction of groundwater flow below MDA G is to the southeast.
- The R-wells are the monitoring wells installed in the regional aquifer.

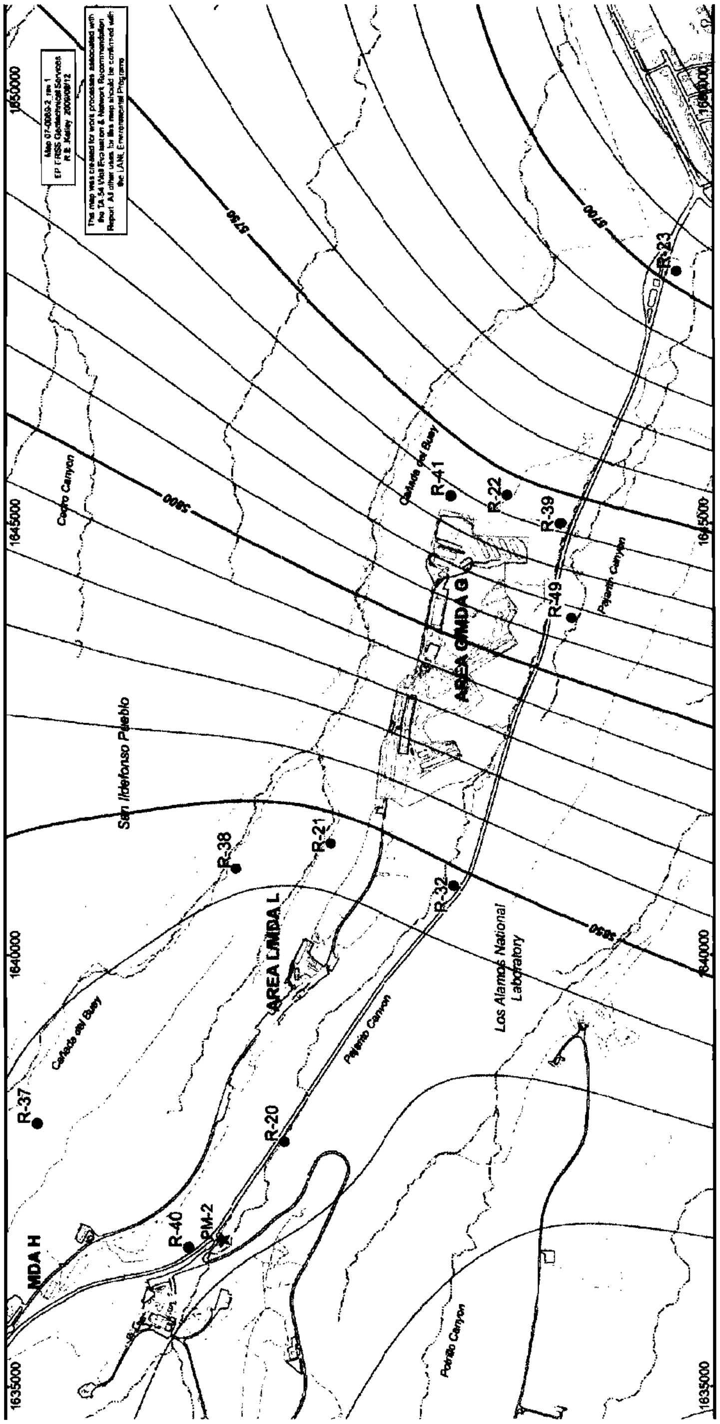
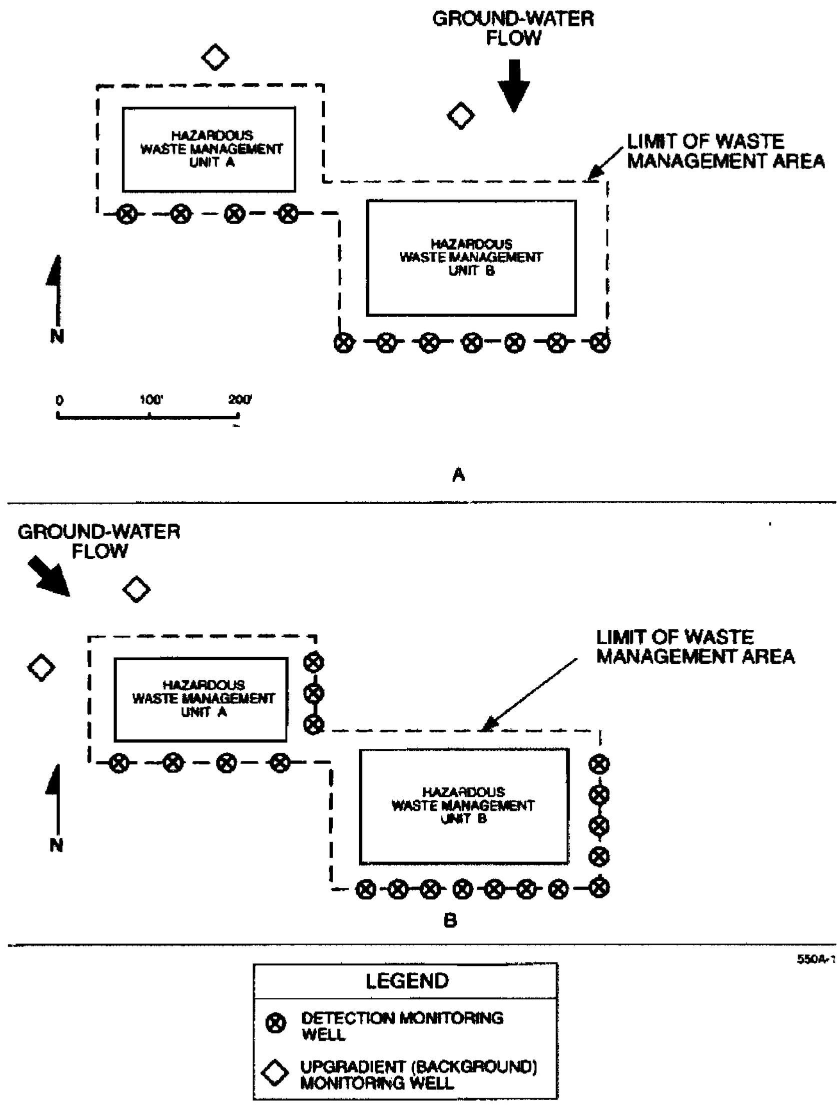


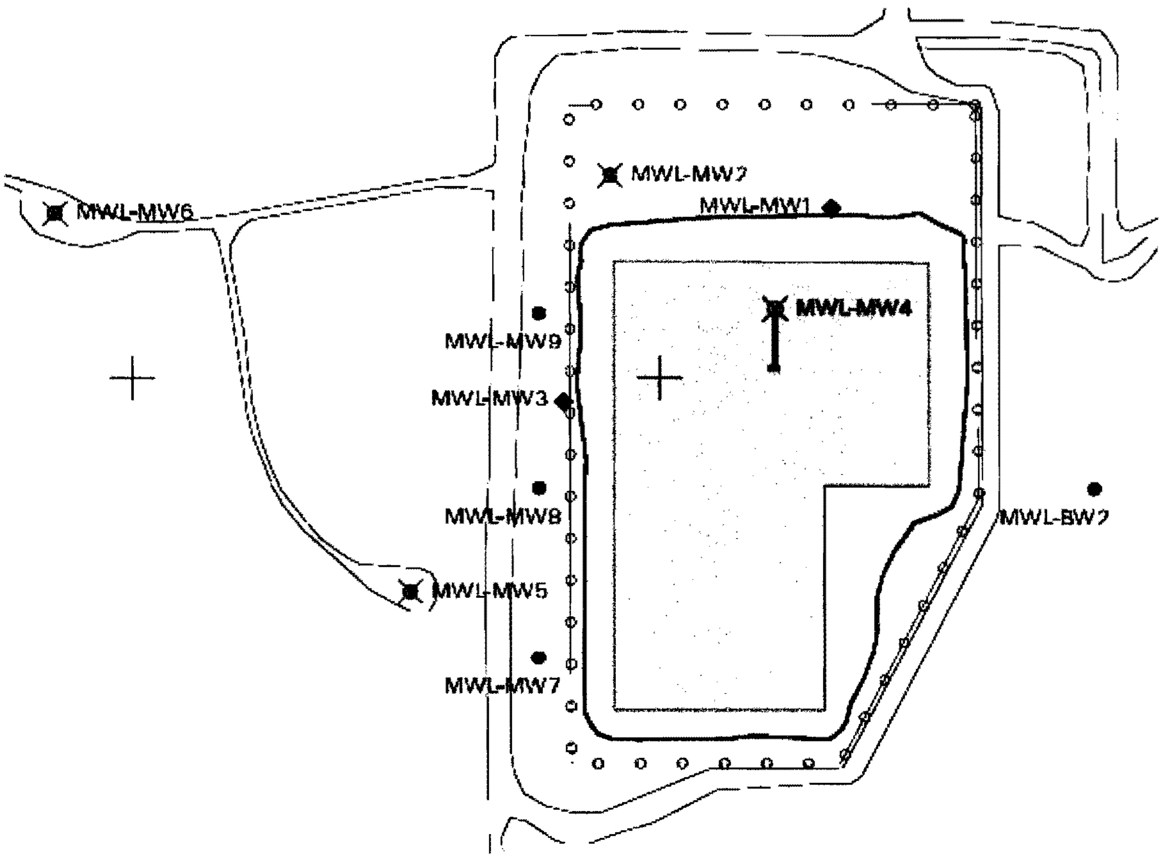
Figure 3. Schematic of locations for "point of compliance" contaminant detection monitoring wells and upgradient background water quality wells for RCRA "regulated units."

Source: Figure 9 in *RCRA GROUND-WATER MONITORING: DRAFT TECHNICAL GUIDANCE* OFFICE OF SOLID WASTE U.S. ENVIRONMENTAL PROTECTION AGENCY 401 M STREET, S.W. WASHINGTON, D.C. 20460 NOVEMBER 1992



DOWNGRADIENT WELLS IMMEDIATELY ADJACENT TO THE HAZARDOUS WASTE MANAGEMENT AREA LIMITS

Figure 4. The NMED requirements for the network of monitoring wells at the Sandia National Laboratories Mixed Waste Landfill in Albuquerque, New Mexico.



Scale 0--------------------200 feet

Source: Sandia National Laboratories *Long-Term Monitoring and Maintenance Plan* for the Mixed Waste Landfill, September 2007.

- **The down-gradient detection monitoring wells required for the long-term monitoring program are MWL-MW5, -MW6, -MW7, -MW8 and -MW9.**

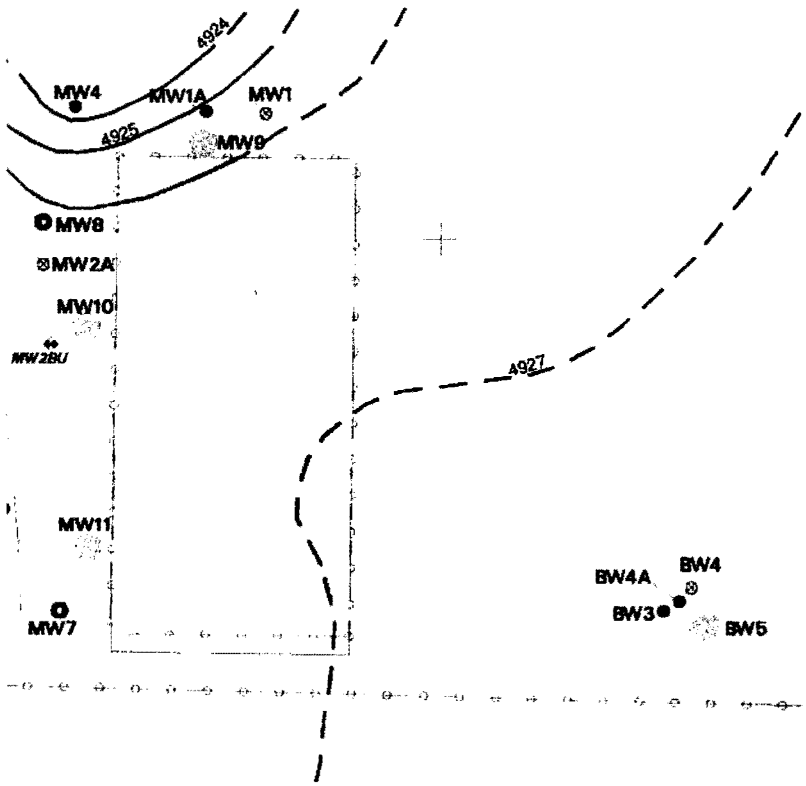
- **Well MWL-MW4 is a detection monitoring well installed inside the Mixed Waste Landfill to monitor groundwater contamination below an unlined trench.**

- **Well MWL-BW-2 is the background water quality well that is located hydraulically upgradient of the Mixed Waste Landfill.**

- **The 2.6 acre Mixed Waste Landfill was in operation from 1959 through 1988. The hazardous and mixed waste are buried in unlined pits and trenches. The NMED has approved a plan to leave the wastes buried below a dirt cover.**

Figure 5. The NMED requirements for the network of monitoring wells at the Sandia National Laboratories Chemical Waste Landfill in Albuquerque, New Mexico.

- The Chemical Waste Landfill is a RCRA "regulated unit" waste disposal facility.



Scale 0......................200 feet

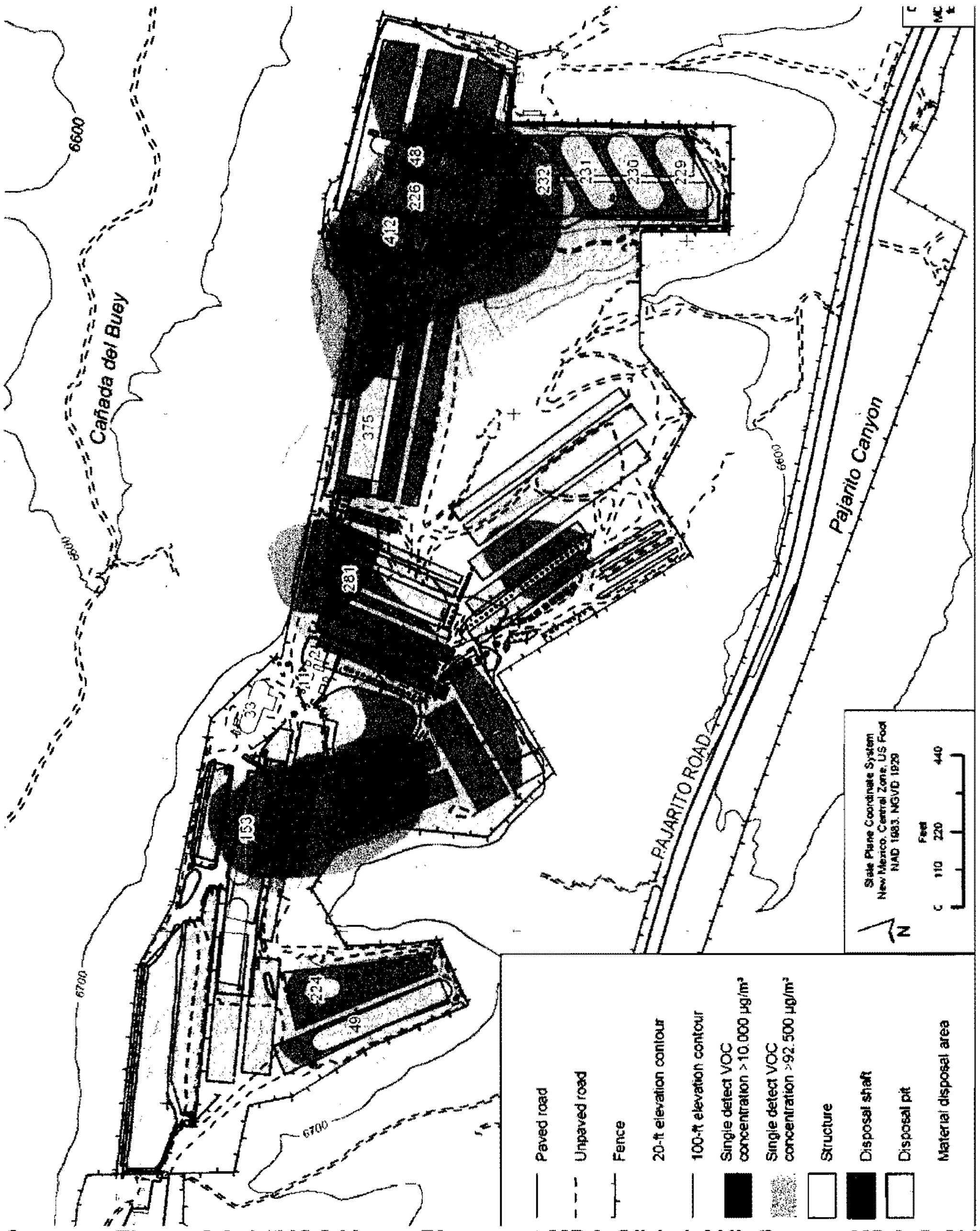
- **MW-9, MW-10 and MW-11 Contaminant detection monitoring wells**
- **BW-5 Background water quality monitoring well**

- **The contour lines show the direction of groundwater travel at the water table of the regional aquifer**

Source: Sandia National Laboratories Chemical Waste Landfill Closure Plan, August 2009

Figure 6. Location of Three Volatile Organic Compound (VOC) Vapor Plumes at Los Alamos National Laboratory Legacy Waste Dump MDA G.

- The three VOC plumes are colored brown and are present in the eastern, central and western parts of MDA G. The highest VOC concentrations are in the eastern plume at the shaft field that is located west of pits 2 and 4 ~ 700 feet from the eastern boundary of MDA G. Pits 2 and 4 are identified on Figure 2. The dominant subsurface VOC vapor contaminant is 1,1,1-trichloroethane (TCA) in the eastern and central portion of MDA G; trichloroethene (TCE) is more dominant in the western portion of MDA G.



Source: Figure 2.3-1 "VOC Vapor Plumes at MDA G" *in* LANL Report *MDA G SVE Pilot Test Report* (LA-UR-08-6883 October 2008) AR 30572

Figure 7. Location of three tritium hot spot areas below MDA G.

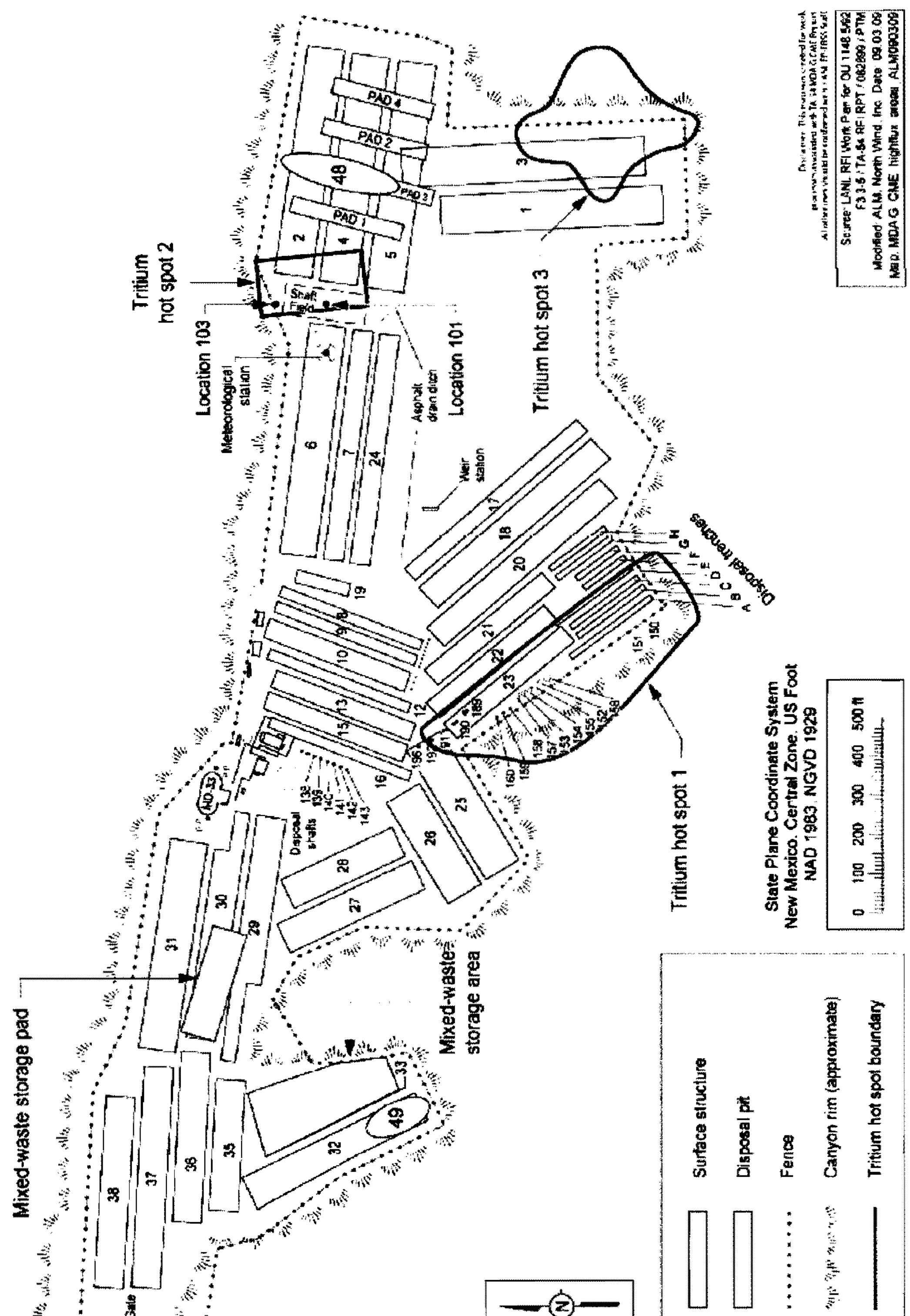


Figure 2.3-5 Locations of tritium high-flux areas at Area G

Source: Figure 2.3-5 *in* LANL Report *MDA G CME Report – Rev 1* (LA-UR-09-5509 September 2009. AR 32022