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-15	—	—	15-44, 45, 287, 0Ko 48, 52
-54			33-86, 26, 25, 85, 146
-33			1-442, 443, 444, 240
-1			40-4, 5, 8, 12, 15
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B) Report, Fr: USDOE, Environment Safety and Health Office of Environmental Audit, Subject: Environmental Survey Final Report.

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16			16 - 300, 302, 304, 306, 307, 489, 342, 340, 516, 515, 512
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Group O
Station A 3

Abandon
Aboveground Tank
Absorption
Abstract
Accelerator
Access
Accident
Accumulation
Acid
Active
Administrative
ADS (Activity Data Sheet)
Adsorption
AEC (Atomic Energy Commission)
Aerial
Agenda
Agreement
Air
Alpha
Americium
Analysis
Analytical
AOC (Area of Concern)
Approval
Aquifer
ARAR (Applicable, Relevant, or Appropriate Requirements)
Archaeology
Archive
Area
Arsenic
Asbestos
Asphalt
Assessment
Audit

Backfill
Bacteria
Barium
Baseline
BCP (Baseline Change Proposal)
Beds
Bermed Area
Beryllium
Beta
Biology
Blank
Boiler
Boneyard
Bunker
Buried
Burn
Burn Site

Cadmium
Caisson
Calibration
Canyon
Capacitor
Caustic
CEARP (Comprehensive Environmental Assessment and Response Program)
Cement
CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act)
Certification
Cesium
Chain of Custody
Chamber
Change Control
Change Order
Charge
Chart
Checklist
Chemical
Chromium
Cleanup
Clearance
Closure
Clothing
CMI/RA (Corrective Measures Implementation/Remedial Action)
CMS/FS (Corrective Measures Study/ Feasibility Study)
Cobalt
Comment
Committee
Community Relations
Compliance
Compressed Gas
Computer Modeling
Computer Output
Concern
Concrete
Concurrence
Configuration
Construction
Container
Containment
Contaminant
Contract
Control
Controlled Distribution
Core
Corrective Action
Correspondence
Criteria
Cyanide

Data
Deadline
Debris
Decision Analysis
Decommission
Decontamination
Deficiency
Deliverable
Demolition
Description
Detection
Detonation
Development
Discharge
Disposal
Documentation
DOE (Department of Energy)
Dose
DQO (Data Quality Objectives)
Draft
Drainage
Drainline
Drawing
Drilling
Drop Tower
Drum
Dry Well
Dump
Duplicates

Ecology
Effluent
EIS (Environmental Impact Statement)
Emission
Engineering
Environmental
EPA (Environmental Protection Agency)
Equipment
ERDA (Energy Research and Development Administration)
Erosion
Error
ES&H (Environment, Safety, and Health)
Estimate
Evacuation
Evaluation
Evaporator
Excavation
Exclusion
Exhaust
Experiment
Explosive
Exposure
Extension
Extraction

Facility
Fallout
Farm
FAX
Fence
Field
Figure
Filter
FIMAD (Facility for Information Management, Analysis, and Display)
Finding
Fire
Firing Site
Fiscal
Fission
Five-Year Plan
Flow
Flow chart
Fluid
Form
Framework
Free
Fuel
Fume

Gamma
Gas
Generation
Generic
Geochemistry
Geology
Geophysics
Glass Beaker
Glove Box
Graph
Guidance
Gun

Handling
Hazardous
Health
HE (High Explosive)
History
Hole
Home Owner
Hood
HSWA (Hazardous and Solid Waste Amendments)
Hydrology
Hygiene

Impact
Implementation
Implosion
Impoundment
Inactive
Incident
Incinerator
Industrial
Infiltration
Injection Well
Injury
Inorganic
Inspection
Installation
Interim
Interim Action
Internal
Interview
Inventory
Investigation
IRM (Interim Remedial Measure)
Isotope
IWP (Installation Work Plan)

Lab Job
Laboratory
Lagoon
Land
Landfill
Laundry
Leach
Lead
Leak
Legal

Letter
Limit
Lines
Liquid
List
Log
Logbook

Magazine
Management
Manhole
Map
Material
MDA (Material Disposal Area)
Media
Meeting
Memo
Mercury
Metal
Microform
Minimization
Minutes
MIS (Management Information System)
Mixed Waste
MOA (Memo of Agreement)
Model
Modification
Money (Allocation, Appropriation, Budget, Cost, Funding, etc.)
Monitoring
Monthly Report
Mortar Impact Area
MOU (Memo of Understanding)
MSA (Major System Acquisition)

NEPA (National Environmental Policy Act)
NFA (No Further Action)
Nitrate
NMED (New Mexico Environment Department)
NMEID (New Mexico Environmental Improvement Division)
NOD (Notice of Deficiency)
Nonexplosive
Notebook
Notification
NPDES (National Pollutant Discharge Elimination System)
NRC (Nuclear Regulatory Commission)
Nuclear

Observation
Off-gas
Oil
Open
Open Burning
Operation
Order
Organic
Organization
OSHA (Occupational Safety & Health Administration)
OU (Operable Unit)
Outfall
Outline

Pad
PA/RFA (Preliminary Assessment /RCRA Facility Assessment)
PCB (Polychlorinated Biphenyl)
Permit
Personal Notes
Personnel
Personnel Qualification
Photo
Pilot Study
Pipe
Pit
Plan
Plant
Plutonium
Pollution
Polonium
Polaroid
Potential
Presentation
Prevention
Priority
Procedure
Program
Programmatic
Project
Project Leader
Propellant
Property
Proposal
Protection
Protocol
PRS (Potential Release Site)
Public
Pump
Purchase Request

Quality
QA (Quality Assurance)
QP (Quality Procedure)
Quarterly Report

Radioactive
Radiochemistry
Radionuclide
Radium
Rationale
RCRA (Resource, Conservation, and Recovery Act)
Reactor
Receipt Acknowledgment
Recommendation
Reconnaissance
Records
Recovery
Recycle
Reduction
Reference
Regulation
Release
Remediation
Removal
Report
Request
Requirements
Research
Resin Bed
Resolution
Resource
Respirator
Response
Restoration
Restriction
Results
Review
Revision
RFI/RI (RCRA Facility Investigation/Remedial Investigation)
Risk
RPF (Records Processing Facility)

Safety
Salamander
Salvage
Sample
Sampling Plan
Sanitary
Satellite
Schedule
Scope

Scrap
Scrap Detonation Site
Screening
Scrubber
Search
Security
Seep
Seminar
Semivolatile
Septic
Sewer
Shaft
Sheet
Shell
Shot
Silver
Site
Sludge
Soil
Solid
Solvent
SOP (Standard Operating Procedure)
SOW (Statement of Scope of Work)
Specific
Spill
Stack
Standard
Statistics
Streamline
Steel
Storage
Strontium
Structure
Study
Subcontractor
Subsurface
Summary
Sump
Support
Surface
Surveillance
Survey
Swipe
SWMU (Solid Waste Management Unit)
System

Table
Tank
Task
TCLP (Toxicity Characteristic Leaching Procedure)
TDD (Technical Document Description)

Technical
Technical Team
Technology
Telephone Record
Test Area
Testing
TLD (Thermoluminescent Dosimeter)
TOC (Table of Contents)
Townsite
Toxic
Tracking
Training
Transcription
Transfer
Transformer
Transport
Treatment
Trench
Trip Report
Tritium
TRU (Transuranic)
TSCA (Toxic Substances Control Act)
Tuballoy
Tuff

Underground
Uranium
Urine
USGS (United States Geological Survey)
UST (Underground Storage Tank)
Utility

Validation
Variance
VE (Value Engineering)
Ventilation
Verification
Video
Volatile
Volume

Warehouse
Waste
Water
WBS (Work Breakdown Structure)
Weapon
Well
Work
Working Group

Zinc

DOE F 1325.8

United States Government | Department of Energy

memorandum

Albuquerque Field Office

165

DATE: MAY 20 1992

REPLY TO ATTN OF: EPD:GKL

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TO:

P. M. Ramey, Area Manager, AAO
J. A. Morley, Area Manager, DAO
K. A. Carlson, Area Manager, KAO
E. W. Bean, Area Manager, KCAO
J. L. Bellows, Area Manager, LAAO
G. W. Johnson, Area Manager, PAO

Attached for your information are two (2) copies of the Environmental Survey Final Report for your respective sites. The reports contain useful information; however, generally, more recent information and data is available on specific findings due to subsequent audits, investigations, and closures. With this in mind, care should be exercised in releasing the report to people or groups not familiar with recent work in these areas.

Specific questions regarding this report should be directed to Barry R. Clark of the Office of Environmental Audit (EH-24), HQ, at FTS 202-586-8695. For general questions, please contact George Laskar at FTS 505-845-4482 or William Harrell at FTS 505-845-4300.

Constance L. Soden
Director
Environmental Protection Division

Attachment

cc:
See page 2

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cc w/o attachment:
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DATE: May 28, 1992	Phone No. (505) 845-4606

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6-3

(2) Cy Paul, PPLS
OUPLS
[redacted]
RWV

None
6-3
Viola

6-8

Mike Kay
Please file in
RPF
Bob Vocke

U.S. DEPARTMENT OF ENERGY

ENVIRONMENT, SAFETY AND HEALTH
OFFICE OF ENVIRONMENTAL AUDIT

ENVIRONMENTAL SURVEY
FINAL REPORT

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

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PREFACE TO
THE DEPARTMENT OF ENERGY
LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL SURVEY FINAL REPORT

This Report contains the results of the U.S. Department of Energy (DOE) Environmental Survey at the Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico. It includes the final findings of the on-site assessment of environmental problems and areas of environmental risk, and the final risk-based ranking of those problems. Information presented in this Report is based on data collected during the on-site assessment in March and April 1987.

The LANL Survey is a portion of a larger, comprehensive program of Environmental Surveys conducted at 36 major DOE operating facilities. The Environmental Survey Program was one of several initiatives, announced on September 18, 1985, by then Secretary of Energy John S. Herrington, to strengthen the Environment, Safety and Health (ES&H) programs and activities within DOE. It is fundamentally an internal DOE management tool designed to facilitate long-range planning and efficient allocation of limited resources.

The purpose of the Program is to identify, via "no fault" baseline Surveys of all the Department's major operating facilities, environmental problems and areas of environmental risk, and then to rank the identified problems based on risk. Because the Survey is a "no fault" environmental assessment rather than an audit, it is not intended to identify specific instances of noncompliance or to analyze environmental management practices. Such incidents and/or management practices are used, however, as a means of identifying existing and potential environmental problems.

Another purpose of the Survey is to develop a baseline of environmental information which allows DOE to measure and validate future environmental performance at its facilities. It can also be used to establish priorities, using the background information, for ongoing and future environmental audit programs within DOE.

The Environmental Survey Program has been managed by the Office of Environmental Audit (EH-24) under the Assistant Secretary for Environment, Safety and Health (EH-1). The Program has consisted of three major aspects -- on-site assessments, sampling and analysis, and prioritization. It has been conducted in accordance with the protocols and procedures set forth in the DOE Environmental Survey Manual (DOE/EH-0053, August 1987). Areas of technical specialty covered in the Survey are related to environmental media, including air, surface water, groundwater, and soil; and non-media environmental issues, including waste management, toxic and chemical materials, radiation, environmental quality assurance, and inactive sites and releases.

The on-site assessments were implemented using five teams, each consisting of from 4 to 19 outside experts in the technical areas described above, led and managed by a Team Leader and Assistant Team Leader from EH-24. The investigations were conducted to identify environmental problems and risks, which were defined to include the following:

- pollutants or contaminants in the air, surface water, groundwater, or soil resulting from DOE operations that pose or may pose a hazard to human health or the environment; and

- conditions at DOE facilities that could potentially cause the release of pollutants or contaminants to the environment in a manner that may pose a hazard to human health or the environment.

The results of the on-site assessment for LANL were included in the Los Alamos National Laboratory Environmental Survey Preliminary Report (DOE/EH/OEV-12-P, January 1988). This document included both a baseline description of the technical areas covered in the Environmental Survey as well as preliminary findings of existing or potential environmental problems.

Subsequent to on-site activities, sampling and analysis (S&A) was conducted by DOE national laboratories based on plans developed by the Survey teams. The S&A effort was designed to confirm the presence or absence of contamination rather than to fully characterize the nature and extent of contamination. Results were used to assist the Survey team in filling data gaps associated with findings, in further

defining the existence and magnitude of identified environmental problems, and in more effectively evaluating risk. The S&A data base is maintained by EG&G Idaho's Data Applications Unit at the Idaho National Engineering Laboratory.

In addition to S&A, technical review comments on the Preliminary Report were received from the sites and/or DOE Field (formerly Operations) Offices. A follow-up site visit to LANL was also conducted in June 1989, more than 2 years after the on-site assessment, to observe the corrective actions made to date on Survey findings. The results of S&A, technical review comments, and follow-up visit observations were used to revise the Preliminary Report findings. The resulting Final Survey Findings as well as any closed Preliminary Survey Findings are presented in Section 8.0 of this Report. It should be noted that corrective actions taken by the site subsequent to the follow-up visit are not reflected in the Final Survey Findings.

The third portion of the Environmental Survey involved the risk-based ranking of environmental problems identified during the on-site assessments. This was accomplished in two major phases -- Mechanistic and Judgmental. The Mechanistic Phase included the aggregation of Survey findings into ranking units (groups of findings consisting of similar environmental problems, environmental settings, or institutional concerns); developing data associated with the ranking units, including S&A results, for input to the Multimedia Environmental Pollutant Assessment System (MEPAS) model; and running the MEPAS model. The MEPAS model is described in Supplemental Mathematical Formulas: The Multimedia Environmental Pollutant Assessment System (MEPAS) (Pacific Northwest Laboratory, PNL-7201, 1989). The Judgmental Phase involved integrating the MEPAS model results [the Hazard Potential Index (HPI)] for each ranking unit with 12 other public health and environmental degradation criteria as part of the Risk Information System (RIS) to yield an overall risk group for each ranking unit. In some cases, ranking units were not amenable to MEPAS modeling because they did not deal with public health issues. For these ranking units, evaluation was based on the environmental degradation criteria of RIS. RIS is further described in Analysis of Health Impact Inputs to the U.S. Department of Energy's Risk Information System (Pacific Northwest Laboratory, PNL-7432, 1990).

Preliminary results of the risk-based rankings for DOE's 16 weapons production facilities were published in the Environmental Survey Preliminary Summary Report

of the Defense Production Facilities (DOE/EH-0072, September 1988). That document was prepared in response to the high degree of public interest in environmental problems at DOE's defense production sites. However, the preliminary rankings in that report were represented only by the HPI, and did not incorporate S&A, site accuracy review comments, or the 12 other public health and environmental degradation criteria of the RIS. Rankings for LANL were included in the Preliminary Summary Report.

Since the publication of DOE/EH-0072, ranking units for all 36 DOE facilities in the Environmental Survey Program have been considered and, where appropriate, have been developed and modeled using MEPAS. S&A results and site comments have been incorporated into the ranking units and modeling input parameters, where applicable, and RIS has been applied to the MEPAS model outputs. The final integrated RIS risk-based ranking results for each LANL ranking unit are presented in Section 2.0 of this Report; the final ranked results for individual RIS criteria, including HPI, are presented in Sections 3.0 and 4.0. These results are based on information collected during the on-site assessment and during the 1989 follow-up visit. They do not reflect corrective actions taken by the site subsequent to the follow-up visit. However, sites have provided updates of the regulatory aspects and status of each of the ranking units as of 1990, which are presented in Section 6.0.

Subsequent to the time of the on-site Environmental Survey and the 1989 follow-up visit, several DOE Headquarters programs, including the Environment, Safety and Health Tiger Team Assessments and the Environmental Restoration and Waste Management Five-Year Plan, have been initiated. These programs are further identifying environmental problems and ensuring implementation of corrective actions for those problems.

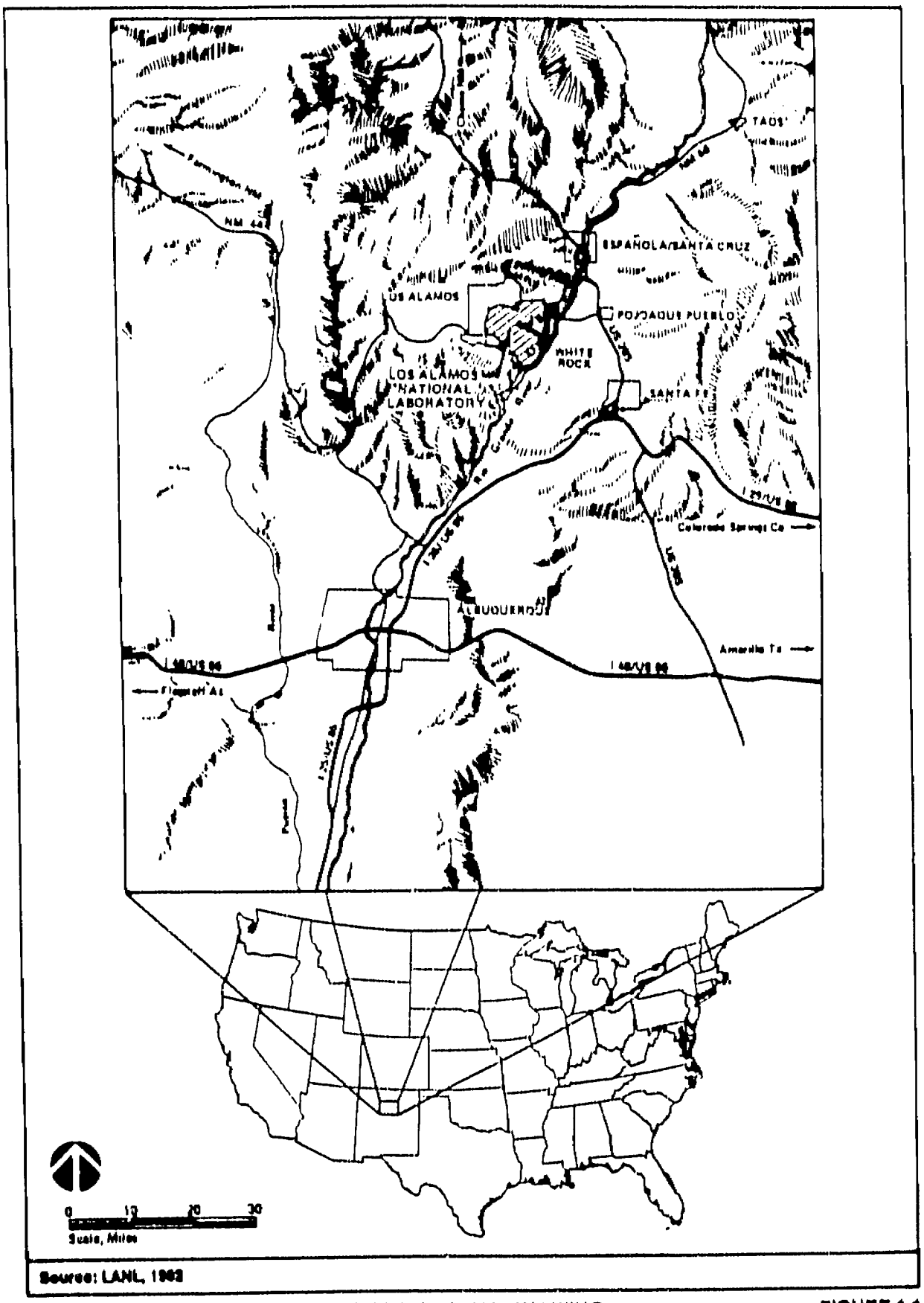
1.0 INTRODUCTION TO LOS ALAMOS NATIONAL LABORATORY

1.1 Site Setting and Mission

This section describes the environmental setting and mission of the Los Alamos National Laboratory (LANL). It is based on information collected during the on-site Environmental Survey in March and April 1987. LANL is located on a 28,186-acre site in north-central New Mexico. The laboratory is approximately 25 miles northwest of Santa Fe, New Mexico (see Figure 1.1). The primary mission of the LANL is nuclear weapons research and development. Other current programs include magnetic and inertial fusion, nuclear fusion, nuclear safeguards and security, and laser separation. The LANL has been in operation since 1943.

Los Alamos County is a small incorporated county located in north-central New Mexico on the Pajarito Plateau between the Jemez Mountains to the west and the Rio Grande Valley to the east. Los Alamos County is 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe. Within the county are the LANL and two adjacent communities, Los Alamos and White Rock. The LANL also occupies a small portion of Santa Fe County. Sixteen drainage areas, with a total of 52,500 acres, pass through or start with the LANL site. Streamflow in these canyons is intermittent. Springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons. The amount of water is insufficient to maintain surface flows across the LANL site before depletion. Runoff from heavy thunderstorms or heavy snowmelt reaches the Rio Grande several times a year. The main aquifer in the LANL area is located within the Tesuque Formation beneath the entire plateau and Rio Grande Valley. The lowest part of the Puye Conglomerate and the Tesuque Formation are within the main aquifer beneath the central and western portions of the plateau. The depths to water below the mesa tops range from 1,200 feet along the western margin of the plateau to about 600 feet along the eastern part.

Los Alamos has a semiarid, temperate mountain climate. Average annual precipitation is nearly 18 inches. Forty percent of the annual precipitation occurs during July and August in the form of thunderstorms. The rest of the precipitation is from winter storms. Surface winds in Los Alamos often vary dramatically with time of day and with location because of the complex terrain. With light, large-scale



Source: LANL, 1982

LOCATION MAP SHOWING
THE LOS ALAMOS NATIONAL LABORATORY

FIGURE 1.1

winds and clear skies, a distinct daily wind cycle often exists. A light southeasterly to southerly upslope wind occurs during the day. During the night, a light westerly to northwesterly drainage wind occurs. On the whole, the predominant winds are southerly to westerly over Los Alamos County.

1.2 Summary of Survey Findings and Disposition

The Survey for the LANL includes 36 Category II and III findings. Section 8.0 of this Report includes all LANL Final Survey Findings; complete versions of active findings are included in Section 8.1, and summaries of closed findings are included in Section 8.2.

Two of these findings were not ranked as they were beyond the focus of the prioritization: one because it represents a compliance issue and the other because it dealt with worker safety. These findings are summarized in Section 5.0 of this Report.

The remaining 34 findings are grouped into 18 ranking units (Table 1.1), all of which were evaluated using the risk-based Multimedia Environmental Pollutant Assessment System (MEPAS) model. This model is described in Supplemental Mathematical Formulas: The Multimedia Environmental Pollutant Assessment System (MEPAS) (Pacific Northwest Laboratory, PNL-7201, 1989). Fifteen of these ranking units represent existing or suspected environmental problems and are discussed in Section 3.0 of this Report. Three represent situations that may represent potential future environmental problems. These ranking units involve the potential for uncontained releases from nonradioactive aboveground tanks, polychlorinated biphenyl (PCB) transformers, and product drums, and are discussed in Section 4.0 of this Report. None of the ranking units deal with environmental problems which MEPAS cannot address. The locations of the 18 ranking units are shown on Figure 1.2. The integrated summary ranking of all LANL ranking units, using the U.S. Department of Energy's Risk Information System (RIS), is presented in Section 2.0. A discussion of each ranking unit, including the method and results of MEPAS modeling, where applicable, is presented in Section 6.0; qualifiers to the risk-based MEPAS modeling are presented in Section 7.0.

TABLE 1.1

LANL RANKING UNITS

Ranking Unit Name	Location on Figure 1.2
EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS	
• Sediment Contamination in Canyons	A
• Former Liquid Disposal	L
• Firing Sites	B
• Landfills and Burn Pits	N
• Technical Area 1	O
• Sediment Contamination from Outfalls	C
• Past Liquid Releases	J
• Open Dumps and Boneyards	K
• Potentially Inadequate Decontamination and Decommissioning	F
• Area P	P
• Technical Area 54	D
• Technical Area 33 Marshy Area	E
• Potential for Releases from Radioactive Waste Tanks	F
• Potential for Releases from Underground Storage Tanks	K
• Potential Leaks from Abandoned or Removed Underground Storage Tanks	M
SITUATIONS THAT MAY REPRESENT POTENTIAL FUTURE ENVIRONMENTAL PROBLEMS	
• Potential for Future Releases from Product Drums	I
• Potential for PCB Releases from Transformers	H
• Potential for Future Releases from Nonradioactive Aboveground Tanks	G

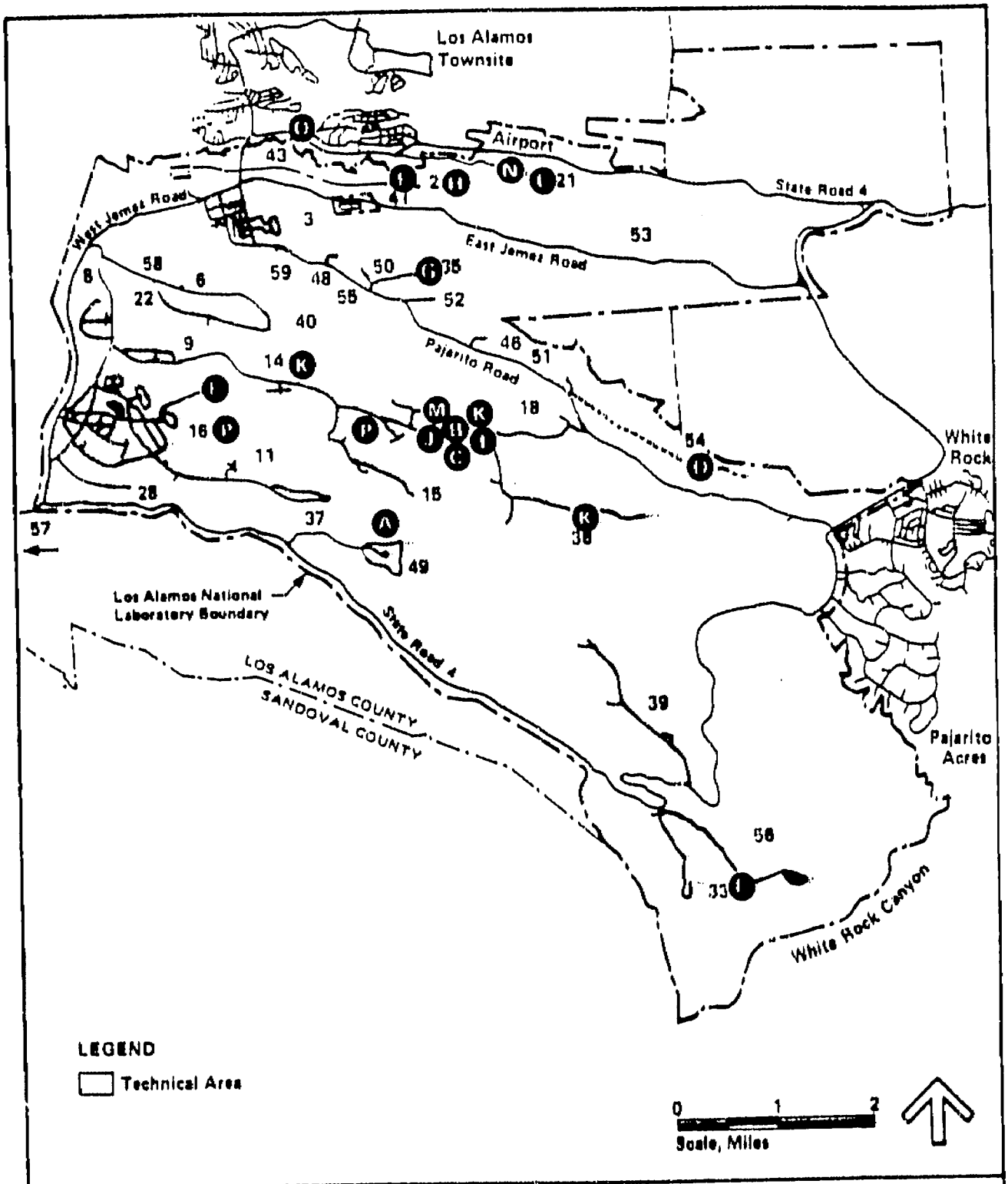


FIGURE 1.2

APPROXIMATE LOCATIONS OF
RANKING UNITS FOR
LOS ALAMOS NATIONAL LABORATORY

2.0 RISK INFORMATION SYSTEM RANKING RESULTS

The U.S. Department of Energy's (DOE's) Risk Information System (RIS) generates a risk-based score for each existing or potential environmental problem included in the Environmental Survey. RIS consists of 13 individual input criteria, 10 of which are measures of risk to public health and 3 of which are measures of environmental degradation. RIS is further described in Analysis of Health Impact Inputs to the U.S. Department of Energy's Risk Information System (Pacific Northwest Laboratory, PNL-7432, 1990). Each of the 13 criteria and their results for the Los Alamos National Laboratory (LANL) are discussed in Section 3.0. These results are based on information collected during the on-site assessment and during a follow-up visit in 1989. They do not reflect corrective actions taken by the site subsequent to the follow-up visit.

This section examines the integrated RIS ranking results for the environmental problems at the LANL, which are based on the judgments of the Integration Panel, a group composed of environmental managers from throughout DOE. The ranking is discussed after a brief review of the risk criteria that the Integration Panel felt should most heavily influence the RIS score.

2.1 Summary of Integration Panel Concerns

The integrated ranking of environmental problems at each DOE facility reflects the judgments made by the Integration Panel in weighting the importance of the 13 risk criteria in the RIS. The Panel determined which risk factors should most influence the ranking unit's final score. For instance, the Panel gave greater weight to human health risks than to potential environmental degradation, reflecting a high degree of concern with protecting public health; nevertheless, the Panel sought to give sufficient emphasis to potential environmental degradation to ensure that this factor had a significant effect on the final ranking.

Within the health risk category, the Panel gave significantly greater emphasis to current and near-term risks than to long-term risks, and greater emphasis to ranking units at which critical data were based upon measured or monitored values, as opposed to conservative assumptions. In addition, the Panel weighted equally risks to maximally exposed individuals and risks to the total exposed population. This

decision reflected the Panel's concern that the ranking sufficiently account for both the severity of risks to any one individual and the extent of risks to the population as a whole. For both population and individual risk, however, the Panel drew sharp distinctions concerning the magnitude of risk, giving strong emphasis to Level 5 risks (i.e., highest assigned level) and progressively less emphasis to lower risk levels (see Sections 3.1.1 and 3.1.2).

In its evaluation of risks to maximally exposed individuals, the Panel's judgments changed depending upon the time period projected for the onset of significant exposures. For ranking units at which risks are considered current or near-term, the Panel gave greater emphasis to risks to the modeled receptor than to the hypothetical receptor at the site boundary. For ranking units at which risks are considered long-term, however, the Panel gave equal emphasis to these criteria, reflecting the belief that the hypothetical exposure scenario represents an increasingly realistic measure of risk in later years. The Panel also gave slightly greater emphasis to carcinogenic risks than to non-carcinogenic risks. Finally, in comparison to the other individual risk measures, the Panel gave relatively little emphasis to the loss of institutional control criterion, but did give this factor slightly greater emphasis for ranking units identified as long-term risks.

In its evaluation of risks to the total exposed population, the Panel chose to rely exclusively on the multiple contaminant - discounted Hazard Potential Index (HPI). This decision reflected the Panel's belief that the ranking of problems, to the extent the data allow, should take into account risks from all contaminants. The decision also reflects the Panel's belief that the ranking should give greater emphasis to health effects estimated to occur within the first 70 years, as opposed to effects that the Multimedia Environmental Pollutant Assessment System (MEPAS) projects may occur centuries from now.

The Panel's judgments concerning the criteria that describe potential environmental degradation in several ways parallel those made for the health risk criteria. The Panel again gave greater emphasis to current than to near-term risks, and greater emphasis to near-term than to long-term risks. In addition, the Panel assigned progressively greater weight to situations in which contaminants are considered more likely to reach a sensitive environment. Finally, the Panel gave greater weight to ranking units that threaten to affect sensitive environments of global or national

importance (e.g., the ozone layer, national parks) than to environments of state or regional importance, but in general made relatively moderate distinctions among the sensitive environment categories.

2.2 Integrated Ranking for the LANL

2.2.1 Description of RIS Risk Groups

The RIS integrated score for each ranking unit is based on the scores for each of the 13 component criteria and the relative importance assigned to each criterion by the Integration Panel. Because these scores synthesize the Integration Panel's subjective assessment of the importance of many risk factors, they do not describe risk in an absolute sense. Instead, the scores are a unitless indicator of the priority the Panel would give each problem in establishing a risk-based ranking. As an integrated measure of relative risks, the scores provide a means of ranking environmental problems that otherwise could not be compared on a consistent basis. However, recognizing the importance of interpreting RIS scores in a way that relates them to more commonly used measures of absolute risk, DOE's Integration Panel divided the scores into five general categories. These categories represent groups of ranking units that share common attributes and, in the Panel's judgment, pose similar risks. The characteristics of each of these groups are described below.

Risk Group 5 includes the ranking units that, in the Panel's estimation, present the highest risk. All of these ranking units exhibit the following characterisitics:

- the time period projected for initial health risks is current; and

- the level of one or both of two criteria given significant weight by the Panel -- the multiple contaminant - discounted population HPI Group and the maximum exposed individual (MEI) risk to the modeled receptor -- is five.

Risk Group 4 includes all ranking units not included in Risk Group 5 that exhibit the following characteristics:

- current health risks and a level of four on the multiple contaminant - discounted population HPI Group or modeled receptor MEI risk; and

- health risks projected within 70 years and a level of five on the multiple contaminant - discounted population HPI Group or modeled receptor MEI risk; or health risks projected within 70 years and a level of four on both the multiple contaminant - discounted population HPI Group and modeled receptor MEI risk, accompanied by a relatively high subscore for potential environmental degradation.

Risk Group 3 includes:

- all remaining ranking units that combine a current time of arrival for health risks with a level of three on the multiple contaminant - discounted population HPI Group or modeled receptor MEI risk;

- other units identified as current health risks with a level of less than three on the multiple contaminant - discounted population HPI Group and modeled receptor MEI risk, but with relatively high levels on other factors (e.g., a level of four for risk to the hypothetical receptor at the site boundary, or a relatively high potential environmental degradation score);

- ranking units that are projected to pose no potentially significant health risks until 71 to 7,000 years from the present, but which receive relatively high potential environmental degradation scores; or

- several ranking units that are projected to pose health risks within 40 years and that have a level of three or more on the multiple contaminant - discounted population HPI Group, modeled receptor MEI risk, or hypothetical boundary receptor MEI risk.

Risk Group 2 encompasses:

- all remaining ranking units identified as potential current health risks. These ranking units have levels of one or two on the multiple contaminant - discounted population HPI Group and modeled receptor MEI risk; or

- other ranking units where the onset of significant health risks, if any, is projected to occur in later periods, and where scores for potential environmental degradation are relatively moderate or low.

Risk Group 1 contains the lowest-ranked environmental problems. The primary characteristics of these ranking units are as follows:

- no significant health effects are anticipated for at least 70 years. With few exceptions, the designated time of arrival for all ranking units is either 71 to 7,000 years or beyond 7,000 years;

- relatively low health risks. With some exceptions, the ranking units have levels of less than three for the multiple contaminant - discounted population HPI Group and modeled receptor MEI risk; and

- relatively low potential environmental degradation scores.

2.2.2 RIS Risk Group Results

The RIS ranking results indicate significant variability in the risks posed by the 18 ranking units at the LANL. Of the 15 ranking units considered existing or suspected environmental problems, Table 2.1 shows that the scoring system placed 5 ranking units in Risk Group 3, 6 in Risk Group 2, and 4 in Risk Group 1. As shown in Table 2.2, of the three ranking units classified as presenting potential future environmental problems, one was classified in Risk Group 3 and two had scores placing them in Risk Group 2. It is noteworthy that the RIS classified no LANL ranking units in the two groups of highest concern (Risk Groups 4 and 5) and that the majority of ranking units (12 of 18) appear in the groups of lowest concern (Risk Groups 2 and 1).

TABLE 2.1

LOS ALAMOS NATIONAL LABORATORY
RIS RANKING OF EXISTING
OR SUSPECTED ENVIRONMENTAL PROBLEMS

Ranking Unit Name	Risk Group
Firing Sites	3
Former Liquid Disposal	3
Sediment Contamination in Canyons	3
Open Dumps and Boneyards	3
Technical Area 1	3
Sediment Contamination from Outfalls	2
Landfills and Burn Pits	2
Potentially Inadequate Decontamination and Decommissioning	2
Past Liquid Releases	2
Potential for Future Releases from Radioactive Waste Tanks	2
Area P	2
Technical Area 33 Marshy Area	1
Potential for Releases from Underground Storage Tanks	1
Technical Area 54	1
Potential Leaks from Abandoned or Removed Underground Storage Tanks	1

TABLE 2.2

LOS ALAMOS NATIONAL LABORATORY
RIS RANKING FOR SITUATIONS THAT MAY REPRESENT POTENTIAL FUTURE ENVIRONMENTAL PROBLEMS

Ranking Unit Name	Risk Group
Potential Future Releases from Product Drums	3
Potential for Future Releases from Nonradioactive Aboveground Tanks	2
Potential for PCB Releases from Transformers	2

For existing or suspected environmental problems, the ranking units in Risk Group 3 are Firing Sites, Former Liquid Disposal, Sediment Contamination in Canyons, Open Dumps and Boneyards, and Technical Area 1. These ranking units were elevated to Risk Group 3 primarily because of their current times of arrival for health effects and because of moderate health risk estimates (HPI Group Levels and modeled MEI Levels 3 or 2). The level of confidence in the data used to estimate health risks also elevated the ranking of these environmental problems (four of the five ranking units were placed in Critical Data Category A).

The six ranking units in Risk Group 2 that pose existing or suspected environmental problems are similar to those classified in Risk Group 3 in that they have current times of arrival for health effects. However, they differ in that they were estimated to have lower health risk potential. The ranking units have multiple contaminant - discounted HPI Group Levels of 1 or 2; in addition, all but one reported an MEI Level 1 modeled risk. The one ranking unit that scored at Level 2 on each of these measures (Landfills and Burn Pits) is classified as having poor data quality (Critical Data Category C).

The four existing or suspected environmental problems in Risk Group 1 were characterized by distant times of arrival (all beyond 70 years), low population risks (discounted HPI Group Level 1), and low MEI risks (MEI Level 1 or 2).

Of the three ranking units classified as potential future environmental problems, one -- Potential for Future Releases from Product Drums -- was assigned to Risk Group 3 primarily because of its current time of arrival and moderate health risk potential (HPI Group Level 3 and MEI Level 3). The remaining two ranking units were estimated to have current times of arrival, but received low scores (Risk Group 2) because of minimal health risk potential (HPI Group Level and MEI Level 1).

3.0 RISK INFORMATION SYSTEM INPUTS FOR EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS

This section includes a description of the Risk Information System (RIS) inputs or criteria pertaining to environmental problems classified as either known or suspected to currently exist. These types of problems include current contamination resulting from either past practices or current activities.

The RIS inputs provide information on a number of aspects of risk to public health and the environment. They include ten measures of risk to public health (Section 3.1) and three measures of environmental degradation (Section 3.2). The public health criteria consist of three means of describing individual risk (Section 3.1.1), four means of describing population risk (Section 3.1.2), and two other measures that act as an adjustment to the risk to public health (Sections 3.1.3 and 3.1.4). Overlying two of the population risk measures and two of the individual risk measures is a health effects criterion. The environmental degradation criteria consist of a qualitative assessment of the potential for contaminants associated with the environmental problem to reach sensitive environments.

3.1 RIS Inputs for Public Health Measures

RIS inputs for public health measures are indicators of potential impacts to human health as a result of contaminant exposures. These measures are categorized into the following three major areas: 1) individual risk; 2) population risk; and 3) adjustment factors, which consist of uncertainty and contaminant time of arrival.

3.1.1 RIS Inputs for Individual Risk Measures

Individual risk measures presented in Table 3.1 focus on risks to an individual at three potential receptor locations. The maximum individual risk to the modeled receptor provides the maximum individual risk to current potential receptors. The maximum individual risk to the hypothetical boundary receptor provides individual risk information at the site boundary, which may be considered a worst-case location for the off-site public (assuming current site access restrictions are maintained). The loss of institutional control, consistent with the U.S. Department of Energy's (DOE's)

TABLE 3.1

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS
INDIVIDUAL RISK MEASURES

Ranking Unit Name	A			B			C
	Modeled Receptor			Hypothetical Boundary Receptor			Loss of Institutional Control
	Maximum Individual Risk Level	Time Period of Maximum Impact	Health Effects Type*	Maximum Individual Risk Level	Time Period of Maximum Impact	Health Effects Type*	Contamination Remaining
Firing Sites	3	0-70	Rad	3	0-70	Rad	NR*
Former Liquid Disposal	3	0-70	Rad	3	0-70	Rad	NR*
Open Dumps and Boneyards	2	0-70	Rad	2	0-70	Rad	NR*
Technical Area 1	2	0-70	Rad	1	NP*	No Effects	NR*
Sediment Contamination in Canyons	2	0-70	Rad	2	0-70	Rad	Some
Landfills and Burn Pits	2	0-70	Rad	2	0-70	Rad	NR*
Potential for Releases from Underground Storage Tanks	2	6301-6370	Carcin	2	6721-6790	Carcin	Most
Potential Leaks from Abandoned or Removed Underground Storage Tanks	1	NP*	No Effects	1	NP*	No Effects	Most
Past Liquid Releases	1	0-70	Rad	1	0-70	Rad	NR*
Potential for Releases from Radioactive Waste Tanks	1	0-70	Non-Carcin	1	0-70	Non-Carcin	NR*
Area P	1	0-70	Non-Carcin	1	0-70	Non-Carcin	NR*
Potentially Inadequate Decontamination and Decommissioning	1	0-70	Carcin	1	0-70	Carcin	NR*

TABLE 3.1 (Continued)

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS
INDIVIDUAL RISK MEASURES

Ranking Unit Name	A			B			C
	Modeled Receptor			Hypothetical Boundary Receptor			Loss of Institutional Control
	Maximum Individual Risk Level	Time Period of Maximum Impact	Health Effects Type*	Maximum Individual Risk Level	Time Period of Maximum Impact	Health Effects Type*	Contamination Remaining
Technical Area 54	1	6301-6370	Carcin	2	5601-5670	Carcin	Most
Sediment Contamination from Outfalls	1	0-70	Rad	1	0-70	Carcin	NR*
Technical Area 33 Marshy Area	1	NP*	No Effects	1	NP*	No Effects	None

*Non-Carcin = Non-Carcinogen
Rad = Radionuclide
Carcin = Carcinogen (Other Than a Radionuclide)
NR = Not Ranked
NP = Not Projected Within 7000 Years

current radioactive materials management, assumes current site access restrictions are relinquished after 100 years and an individual has access to the site at that time.

Table 3.1 provides data concerning calculated risks, the time period in which the calculated risk occurs, and the type of health effect associated with the risk. It also provides a qualitative estimate of the contamination remaining at the site under the loss of institutional control scenario.

The calculated Maximum Individual Risk Levels for both the modeled receptors and the hypothetical boundary receptors are defined in terms of levels at which regulatory actions are generally initiated.

LEVEL 5 - Individual risk level is generally above levels at which regulatory decisions are made and is equal to or greater than a 10^{-2} risk for carcinogens or a level greater than or equal to 100 times the reference dose for non-carcinogens.

LEVEL 4 - Individual risk level is generally above levels at which regulatory decisions are made and is less than a risk of 10^{-2} but greater than a risk of 10^{-4} for carcinogens or a level less than 100 but greater than or equal to 10 times the reference dose for non-carcinogens.

LEVEL 3 - Individual risk level is generally within levels requiring further study under regulatory programs and is less than or equal to a risk of 10^{-4} but greater than or equal to a risk of 10^{-6} for carcinogens or a level less than 10 times but greater than or equal to the reference dose for non-carcinogens.

LEVEL 2 - Individual risk level is generally below levels at which regulatory actions are taken and is less than a risk of 10^{-6} but greater than or equal to a risk of 10^{-9} for carcinogens or a level less than the reference dose but greater than or equal to one-tenth the reference dose for non-carcinogens.

LEVEL 1 - Individual risk level is generally below levels at which regulatory actions are taken and is less than a risk of 10^{-9} for carcinogens or a level less than one-tenth the reference dose for non-carcinogens.

The Time Period of Maximum Impact indicates the 70-year period during which the maximum risk is projected to occur. The Multimedia Environmental Pollutant Assessment System (MEPAS) was designed to evaluate chronic health impacts following the U.S. Environmental Protection Agency (EPA) guidance for both non-radioactive and radioactive constituents. Although the duration of exposure varies between problems, the effects are computed in terms of 70-year lifetimes.

The Health Effects Type indicates whether the human health risk is projected to result from a radionuclide, carcinogen (other than a radionuclide), or non-carcinogen. Radionuclides and carcinogens other than radionuclides are separated to match the historical division for considering health effects. The health effects for radionuclides were based on available National Research Council recommendations. EPA guidance (i.e., Integrated Risk Information System) was used as the primary source of toxicity values for the other carcinogens.

3.1.1.1 Maximum Individual Risk to Modeled Receptor by Health Effects Type

This criterion, as shown in Table 3.1 (column A), presents the Maximum Individual Risk Level, Time Period of Maximum Impact, and Health Effects Type projected for current potential receptors. Comparing this criterion to population risk measures presented in Table 3.2 allows decision makers to be aware of situations involving large impacts to small populations. It also identifies when high scores are due to small impacts to large populations.

All the ranking units for Los Alamos National Laboratory (LANL) result in individual doses to modeled receptors at levels lower than those at which regulatory actions are generally taken. Two of the ranking units fall in that range of scores which may require further study. In three of the ranking units the individual risk to modeled receptors score does not mirror that of the population-based criteria provided in Table 3.2 (column C).

3.1.1.2 Hypothetical Maximum Exposed Individual Risk at Site Boundary by Health Effects Type

This criterion, as shown in Table 3.1 (column B), presents the Maximum Individual Risk Level, Time Period of Maximum Impact, and Health Effects Type posed by

TABLE 3.2

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS
POPULATION MEASURES

Ranking Unit Name	Discounted			Undiscounted			E
	A		B	C		D	
	Single		Multiple	Single		Multiple	Time Period of Maximum Impact
	HPI Group Level	Health Effects Type*	HPI Group Level	HPI Group Level	Health Effects Type*	HPI Group Level	
Sediment Contamination in Canyons	3	Rad	3	3	Rad	3	0-70
Former Liquid Disposal	3	Rad	3	3	Rad	3	0-70
Firing Sites	3	Rad	3	3	Rad	3	0-70
Landfills and Burn Pits	2	Rad	2	2	Rad	2	0-70
Open Dumps and Boneyards	2	Rad	2	2	Rad	2	0-70
Technical Area 1	2	Rad	2	2	Rad	2	0-70
Potential Leaks from Abandoned or Removed Underground Storage Tanks	1	No Effects	1	2	Carcin	2	NP*
Potential for Releases from Underground Storage Tanks	1	Carcin	1	3	Carcin	3	6301-6370
Past Liquid Releases	1	Rad	1	1	Rad	1	0-70
Potential for Releases from Radioactive Waste Tanks	1	Rad	1	1	Rad	1	0-70
Area P	1	Non-Carcin	1	1	Non-Carcin	1	0-70
Potentially Inadequate Decontamination and Decommissioning	1	Carcin	1	1	Carcin	1	0-70
Technical Area 54	1	Non-Carcin	1	2	Carcin	2	6301-6370

TABLE 3.2 (Continued)

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS
POPULATION MEASURES

Ranking Unit Name	Discounted			Undiscounted			E
	A		B	C		D	
	Single		Multiple	Single		Multiple	Time Period of Maximum Impact
	HPI Group Level	Health Effects Type*	HPI Group Level	HPI Group Level	Health Effects Type*	HPI Group Level	
Sediment Contamination from Outfalls	1	Rad	2	1	Rad	2	0-70
Technical Area 33 Marshy Area	1	No Effects	1	1	No Effects	1	NP*

*Non-Carcin = Non-Carcinogen
Rad = Radionuclide
Carcin = Carcinogen (Other Than a Radionuclide)
NR = Not Ranked
NP = Not Projected Within 7000 Years

projected contamination at the site boundary. This component is designed to simulate DOE's current radiation management approach concerning responsibility for off-site impacts. It also provides useful information concerning situations where off-site contamination may exist with no current potential receptors.

To score this criterion, the potential maximum individual ingestion and inhalation risks were summed. The potential exposure from drinking water was determined at a location at the site boundary hydrologically downgradient from the ranking unit. The inhalation risk was determined at a boundary location which approximates the location where, considering prevailing winds and proximity to the boundary, the maximum risk would occur.

In general, the LANL ranking units result in maximum exposed individual scores at the LANL boundary that fall within those levels that generally require further study or lower. This generally mirrors the scores for current receptors. One ranking unit scored lower for maximum individual risk to modeled receptors at the boundary due to the projected impacts from this ranking unit being located off-site. One ranking unit scored higher for maximum individual risk to modeled receptors at the boundary. This difference could be accounted for by the greater distance to current receptors.

3.1.1.3 Loss of Institutional Control

This criterion, as shown in Table 3.1 (column C), provides qualitative information concerning the impact of potential contamination assuming the future loss of institutional control over the site. This criterion is patterned after current DOE guidelines for radiation management and thus assumes institutional control is lost after 100 years, at which time an individual would have access to the site.

This criterion is described in terms of the fraction of the initial contamination projected to remain in the soil 100 years from now as follows:

MOST - At least half of the contamination remains.

SOME - Less than half of the contamination remains.

NONE - None of the contamination remains.

NOT RANKED - Due to difficulties in modeling, such projections cannot be made for surface soil currently available for resuspension or volatilization. Thus, ranking units whose scores are based on resuspension or volatilization are not calculated for this criterion.

Four of the ranking units at the LANL involve environmental problems where most or some of the contamination is projected to be remaining 100 years in the future assuming no remedial actions. These ranking units mainly entail groundwater transport from underground storage tanks (USTs) which are projected to leak over a period of years. The ranking unit, Sediment Contamination in Canyons, is projected to have some contamination remaining 100 years in the future. The ranking units, Potential Leaks from Abandoned or Removed Underground Storage Tanks, Technical Area 54, and Potential for Releases from Underground Storage Tanks, are projected to have most of the associated contamination remaining.

3.1.2 RIS Inputs for Population Measures

Population measures, presented in Table 3.2, focus on risks to the population surrounding the site. Two policy issues are assessed in addressing this measure -- time weighting and single (indicator) parameter versus multiple (characterization) parameters.

The population measures are given in terms of the Hazard Potential Index (HPI) Group Level. The HPI Group Level is a composite score that reflects the receptor population risk combined over one hundred 70-year periods. The 70-year periods simulate the approximate lifetimes of individuals. This combination is presented as both discounted (time weighted) and undiscounted. In discounting, the health effects associated with each 70-year period are weighted half as much as the preceding 70-year period to account for the greater concern of health risks that may occur in nearer-term time frames. In addition, the HPI Group Level is presented for both the highest risk for a single contaminant (as an indicator of the significance of the problem) and the combined risk for multiple contaminants (representative of a characterization perspective). The multiple contaminants measure assumes health effects across chemicals are additive. All four combinations of the population

measures (Discounted Single Contaminant, Discounted Multiple Contaminants, Undiscounted Single Contaminant, and Undiscounted Multiple Contaminants) are presented in Table 3.2.

There are five HPI Group Levels describing population measures. HPI Group Level 5 includes those ranking units of most concern from the perspective of potential public health hazard. HPI Group Level 4 includes those ranking units of secondary concern from the perspective of potential public health hazard. HPI Group Level 3 includes those ranking units of tertiary concern from the perspective of potential public health hazard. HPI Group Level 2 includes those ranking units characterized as generally reaching receptors at levels well below those used in regulatory decisions. HPI Group Level 1 includes those ranking units that are not expected to reach receptors.

Given the level of precision associated with the Environmental Survey's data, MEPAS model results are represented logarithmically, as HPI Groups, on a scale of 0 to 10. This provides for relative rankings between orders of magnitude. However, for the population measures of the RIS, these HPI Groups are further aggregated into HPI Group Levels to represent the level of significance associated with each as described in the preceding paragraph.

For each of the population measures, the corresponding HPI Groups included within the HPI Group Levels are:

HPI Group Level 5	HPI Groups 8, 9, 10
HPI Group Level 4	HPI Groups 6, 7
HPI Group Level 3	HPI Groups 4, 5
HPI Group Level 2	HPI Groups 1, 2, 3
HPI Group Level 1	HPI Group 0

The Time Period of Maximum Impact indicates the 70-year period during which the maximum risk is projected to occur. MEPAS is focused on chronic health impacts and thus, consistent with most EPA assumptions on chemical effects, calculates all impacts on the basis of a 70-year lifetime.

The Health Effects Type indicates whether the human health risk is projected to result from a radionuclide, carcinogen (other than a radionuclide), or non-carcinogen. Radionuclides are considered separately to allow the decision maker to identify which problems may be impacted by recent National Research Council studies on the health effects of low-level radiation. This criterion allows the decision makers to weight the various types of health effects as they see appropriate.

3.1.2.1 Single Contaminant Population Risk by Health Effects Type - Discounted

This criterion, as shown in Table 3.2 (column A), is represented by the HPI Group Level and Health Effects Type. By comparing this criterion to that presented in column C (as discussed in Section 3.1.2.2), the effect of discounting risks associated with future 70-year periods is evident.

The highest scoring ranking units at the LANL for this criterion are the Firing Sites, Former Liquid Disposal, and Sediment Contamination in Canyons, which ranked in HPI Group Level 3. The Firing Sites ranking unit involves test firing of high explosives which resulted in the scattering of depleted uranium. The Former Liquid Disposal ranking unit consists of 11 sites at which radioactive and chemical liquid wastes were formerly disposed of. With regard to the Sediment Contamination in Canyons ranking unit, elevated levels of heavy metals, organics, and radionuclides have been detected in water and sediments in Los Alamos, Mortandad, and Water Canyons downgradient of the Technical Areas.

The lowest scoring ranking units at the LANL resulted in an HPI Group Level 1. These low scores can be attributed to the slow groundwater velocity and leach rates through the geologic formations underlying the LANL and the low concentrations of contaminants.

The great depth to groundwater and low permeability of the saturated zone result in low scores for many of the ranking units involving potential groundwater concerns. Non-use of surface water downstream of the ranking units for ingestion and/or bathing results in low scores for problems involving the use of surface water for these purposes. In a few instances, due to the persistence of the contaminants potentially emitted, the air and overland transport pathways are a potential concern.

3.1.2.2 Single Contaminant Population Risk by Health Effects Type - Undiscounted

This criterion, as shown in Table 3.2 (column C), presents the HPI Group Level and Health Effects Type. By comparing this criterion to that presented in column A, the effect of discounting risks associated with future 70-year periods is evident.

LANL ranking units for this criterion generally score in HPI Group Levels that are considered tertiary levels of concern or lower. With the exception of two ranking units, these scores mirror those for the discounted criterion (column A). The two ranking units that had increased scores involve potential exposures through the groundwater pathway. These potential exposures would occur in a more distant future time period. Thus, eliminating the discounting factors that are included in column A accounts for the higher scores for these ranking units.

3.1.2.3 Multiple Contaminant Population Risk - Discounted

This criterion, as shown in Table 3.2 (column B), is similar to the criterion in column A, except that the time-weighted population risks for all contaminants are added. The Multiple Contaminant HPI Group Level assumes health effects across chemicals are additive. This information allows consideration of multiple contaminants at a site. By comparing this criterion to that presented in column A, the effect of adding contaminant risks can be assessed.

There is one change from the single contaminant - discounted criterion when multiple contaminants are considered. Considering the entire suite of contaminants identified as present in the Sediment Contamination from Outfalls ranking unit, multiple contaminants moved the score for that ranking unit up one HPI Group Level.

3.1.2.4 Multiple Contaminant Population Risk - Undiscounted

This criterion, as shown in Table 3.2 (column D), is similar to the criterion in column C, except that the undiscounted population risks for all constituents are added. The Multiple Contaminant HPI Group Level - Undiscounted is similar to the Multiple

Contaminant - Discounted, in that health effects across chemicals are assumed to be additive. This information allows consideration of multiple contaminants at a site without discounting the health risk to future generations. By comparing this criterion to that presented in column C, the effect of adding contaminant risks can be assessed.

There is one change from the single contaminant - undiscounted criterion when multiple contaminants are considered. Considering the entire suite of contaminants identified as present in the Sediment Contamination from Outfalls ranking unit, multiple contaminants moved the score for that ranking unit up one HPI Group Level.

3.1.3 RIS Inputs for Uncertainty Measures

Uncertainty measures provide a perspective on the potential variability of the scores that are influenced by the sensitivity of the MEPAS model and the quality of the MEPAS model input data. These criteria, as shown in Table 3.3, include a qualitative assessment of the overall uncertainty associated with the resultant scoring. The uncertainty associated with the scores is a combination of uncertainty associated with the MEPAS model sensitivity, represented as Model Variability, and uncertainty associated with the data, represented as the Critical Data Category.

Model Variability represents the total variation in the range of HPI Groups (the logarithmic 0 to 10 scale). The Model Variability values are based on Multimedia Environmental Pollutant Assessment System (MEPAS) Sensitivity Analysis of Computer Codes (Pacific Northwest Laboratory, PNL-7296, 1990). The variability source tables are documented in the previously referenced Pacific Northwest Laboratory publication, PNL-7432. The sensitivity analysis was based on a well-characterized site and identifies variation in scoring ranging from 0 to 3 HPI Groups, depending on the applicable constituent/pathway.

The Critical Data Category is an assessment by the modelers of the values assigned to those parameters which are most critical in driving the HPI score. The assessment is based on the source of the critical data and ranges from Critical Data Category A, representing those ranking units with the lowest uncertainty in the data, to Critical

TABLE 3.3

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS
UNCERTAINTY MEASURES

Ranking Unit Name	Qualitative Uncertainty Score	Critical Data Category	Model Variability	HPI Group
Landfills and Burn Pits	High	C	0	3
Sediment Contamination in Canyons	Moderate	B	0	5
Potential Leaks from Abandoned or Removed Underground Storage Tanks	Moderate	B	2	0
Former Liquid Disposal	Low	A	0	4
Firing Sites	Low	A	0	4
Open Dumps and Boneyards	Low	A	0	2
Technical Area 1	Low	A	0	1
Past Liquid Releases	Low	A	0	0
Area P	Low	A	0	0
Technical Area 33 Marshy Area	Low	A	0	0
Potentially Inadequate Decontamination and Decommissioning	Low	A	0	0
Potential for Releases from Underground Storage Tanks	Low	A	0	0
Potential for Releases from Radioactive Waste Tanks	Low	A	0	0
Technical Area 54	Low	A	0	0
Sediment Contamination from Outfalls	Low	A	0	0

Data Category C, representing those with the highest uncertainty. The critical data categories are defined below based upon the source of the critical data.

CRITICAL DATA CATEGORY A - The values used for the critical data were based on measured or monitored data.

CRITICAL DATA CATEGORY B - The values used for the critical data were based on a combination of measured or monitored data and a moderate amount of assumptions.

CRITICAL DATA CATEGORY C - The values used for the critical data were derived mainly from assumptions.

The overall qualitative uncertainty score, which combines the two areas of uncertainty, is presented as either high, moderate, or low. Since few of the ranking units can be described as well characterized, it appears that the uncertainty in the scores is generally more a function of the Critical Data Category than of the Model Variability. Thus, in describing overall uncertainty more weight is given to the uncertainty associated with the data than that associated with the model. Therefore, uncertainty characterized as low includes ranking units with Critical Data Category A; moderate includes ranking units with Critical Data Category B; and high includes ranking units with Critical Data Category C.

A relatively low amount of uncertainty is associated with the ranking units included within this site. Most of the uncertainty is associated with the data used in the modeling. The highest scoring ranking unit at the LANL has an associated moderate degree of Model Variability.

3.1.4 RIS Inputs for Time of Arrival

This criterion, as shown in Table 3.4, is designed to describe the urgency associated with the environmental problem. Thus it separates impacts projected to arrive at potential receptors within the next few years from those projected to arrive in time periods farther in the future. The time of arrival indicates the time at which either the individual risk to the modeled receptor first exceeds 10^{-7} for carcinogens or the dose exceeds one-tenth of the reference dose for non-carcinogens. If impacts are

TABLE 3.4

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS
TIME OF ARRIVAL

Ranking Unit Name	Time of Arrival	HPI Group Level
Sediment Contamination in Canyons	Present	3
Former Liquid Disposal	Present	3
Landfills and Burn Pits	Present	2
Firing Sites	Present	3
Past Liquid Releases	(Present)*	1
Area P	(Present)*	1
Open Dumps and Boneyards	(Present)*	2
Potentially Inadequate Decontamination and Decommissioning	(Present)*	1
Potential for Releases from Radioactive Waste Tanks	(Present)*	1
Technical Area 1	(Present)*	2
Sediment Contamination from Outfalls	(Present)*	1
Potential for Releases from Underground Storage Tanks	71-7000 Years	1
Potential Leaks from Abandoned or Removed Underground Storage Tanks	Not Within 7000 Years	1
Technical Area 54	(71-7000 Years)*	1
Technical Area 3C Marshy Area	Not Within 7000 Years	1

*Impacts are not projected to reach a risk to an individual at the modeled receptor in excess of 10^{-7} for carcinogens or a dose in excess of one-tenth of the reference dose for non-carcinogens.

not projected to reach these levels, then the time at which the maximum individual risk or dose to the modeled receptor occurs is indicated in parentheses. These levels were chosen since EPA generally requires cleanup actions at the 10^{-6} or reference dose levels. The time of arrival is defined below in terms of the period in which the above-described exposures occur.

PRESENT - The above-defined exposure is calculated or measured currently.

WITHIN THE CURRENT 5-YEAR PLANNING TIME HORIZON - The above-defined exposure is calculated to occur between 1 and 7 years from 1990 (i.e., until the end of the 5-year planning period of 1992 to 1997).

8 TO 20 YEARS - The above-defined exposure is calculated to occur during the 8- to 20-year time period.

21 TO 40 YEARS - The above-defined exposure is calculated to occur during the 21- to 40-year time period.

41 TO 70 YEARS - The above-defined exposure is calculated to occur during the 41- to 70-year time period.

71 TO 7,000 YEARS - The above-defined exposure is calculated to occur during the 71- to 7,000-year time period.

NOT WITHIN 7,000 YEARS - No contaminants are calculated to reach modeled receptors within 7,000 years.

The HPI Group Level for the single contaminant population risk - discounted, as presented in Table 3.2, column A, is also given to provide perspective on time of arrival relative to the significance of the associated ranking unit.

Since contaminants from four of the ranking units have been detected in surface water discharges or during air monitoring, they are calculated to be at the receptor presently. None of the remaining ranking units are projected to reach receptors at 10^{-7} risk or reference dose levels, although the individual risk from seven ranking units is projected to reach a maximum level at the present time. The individual risk

from the remaining ranking units is not projected to reach maximum levels within the current 70-year lifetime.

3.2 RIS Inputs for Environmental Degradation Measures

RIS inputs for environmental degradation are indicators of the presence of contaminants at sensitive environments located within or near the site. Sensitive environments were identified through a screening procedure that took into account evidence of existing contamination, output from fate and transport modeling, and/or distance of the sensitive environment from the site. This procedure makes it possible to have one ranking unit affecting multiple sensitive environments. As presented in Table 3.5, the risk of contamination for each sensitive environment/ranking unit pair is characterized by three criteria. First, the sensitive environment is classified in one of seven categories that describe the type of environment potentially affected. Table 3.6 lists the sensitive environments included in categories A, B, C, D, E, F, and X. Categories A through D are drawn from EPA's Hazard Ranking System (40 Code of Federal Regulations 300, Appendix A), while categories E, F, and X are included to address specific DOE concerns. Second, the likelihood of contamination criterion assesses the probability that contaminants will reach the receptor. The three categories used to indicate likelihood are probable (exposure has already occurred or there is a greater than 90 percent likelihood that it will occur), possible (there is a realistic likelihood of exposure, between 10 and 90 percent, depending on uncertain circumstances), and negligible (exposure is highly unlikely to occur, less than 10 percent). Third, the time of arrival criterion reflects the expected period of time before the contaminant in question reaches the sensitive environment (current, within 10 years, more than 10 years).

Two sensitive environments of concern -- Bandelier National Monument (Environment Type A) and a federally-designated wetlands supporting a state-designated endangered species (Environment Type B) -- were identified for the LANL site. As indicated in Table 3.5, the site evaluation suggests that contaminants from five ranking units were of concern to the Bandelier National Monument, while those from eight ranking units were of concern to the wetlands.

The likelihood that the sensitive environments would be exposed to contamination was deemed negligible for all but two cases. The two exceptions -- wetlands

TABLE 3.5

LOS ALAMOS NATIONAL LABORATORY
RIS ENVIRONMENTAL DEGRADATION INPUTS
FOR EXISTING OR SUSPECTED ENVIRONMENTAL PROBLEMS

Ranking Unit Name	Sensitive Environment Type	Likelihood of Contamination	Time of Arrival
Area P	B	Negligible	Beyond 10 Years
Firing Sites	A	Negligible	Current
Former Liquid Disposal *	Not Applicable	Not Applicable	Not Applicable
Landfills and Burn Pits	A	Negligible	Current
Open Dumps and Boneyards	A	Negligible	Current
Past Liquid Releases	B	Negligible	Within 10 Years
Potential for Future Releases from Radioactive Waste Tanks	B	Negligible	Beyond 10 Years
Potential for Releases from Underground Storage Tanks	B	Negligible	Beyond 10 Years
Potential Leaks from Abandoned or Removed Underground Storage Tanks *	Not Applicable	Not Applicable	Not Applicable
Potentially Inadequate Decontamination and Decommissioning	A	Negligible	Within 10 Years
Sediment Contamination from Outfalls	B	Possible	Current
Sediment Contamination in Canyons	B	Possible	Current
Technical Area 1	A	Negligible	Current
Technical Area 33 Marshy Area	B	Negligible	Current
Technical Area 54	B	Negligible	Beyond 10 Years

* Sensitive environments were not identified for this ranking unit and therefore environmental degradation is not an applicable criterion.

TABLE 3.6

SENSITIVE ENVIRONMENT CATEGORIES

Category A

Critical habitat for federally designated endangered or threatened species
Marine Sanctuary
National Park
Designated Federal Wilderness Area
Areas identified under the Coastal Zone Management Act
Sensitive areas identified under the National Estuary Program or Near Coastal Waters Program
Critical areas identified under the Clean Lakes Program
National Monument (air pathway only)
National Seashore Recreational Area
National Lakeshore Recreational Area

Category B

Habitat known to be used by federally designated or proposed endangered or threatened species
Wetlands (freshwater, estuarine or coastal -- five-acre minimum)
National Preserve
National or State Wildlife Refuge
Unit of the Coastal Barrier Resources System
Coastal Barrier (undeveloped)
Federal land designated for protection of natural ecosystems
Administratively Proposed Federal Wilderness Area
Spawning areas critical for the maintenance of a fish species within a river system, coastal embayment, or estuary (e.g., anadromous salmon, alewives, shad)
Migratory pathways critical for the maintenance of a fish species within a river system, coastal embayment, or estuary
Feeding areas critical for the maintenance of a fish species within a river system, coastal embayment, or estuary
National river reach designated as recreational

Category C

Habitat known to be used by State-designated endangered or threatened species
Habitat known to be used by a species under review as to its Federal endangered or threatened status
State-designated areas for the protection or maintenance of aquatic life (coastal, estuarine, or freshwater area)
Coastal Barrier (partially developed)
Federally designated Scenic or Wild River

TABLE 3.6

SENSITIVE ENVIRONMENT CATEGORIES
(Continued)

Category D

State land designated for wildlife or game management
State-designated Scenic or Wild River
State-designated Natural Areas
Particular areas, relatively small in size, important to the maintenance of unique biotic communities (e.g., prairie pot holes, buffalo wallows, alligator holes, desert springs)

Category E

Other environmental resources (applied only to ranking units that pose no threat to human heatlh)

Category F

Important aquifers (e.g., sole-source aquifers)

Category X

Stratospheric ozone layer

Source: Categories A through D are taken directly from the proposed HRS (Federal Register, Vol. 53, No. 247, Dec. 23, 1988, pp. 52019-20). Categories E, F and X have been added to reflect additional concerns at DOE sites.

potentially affected by Sediment Contamination from Outfalls or by Sediment Contamination in Canyons -- were classified as possible. Other problems at the LANL were estimated to pose a negligible risk of contaminating the wetlands or Bandelier National Monument due to the distance to the sensitive environments and the limited opportunities for contaminant transport.

Although the probability that contaminants from the LANL may reach a sensitive environment was generally considered low, site evaluators identified seven instances in which the nature of contaminant release and transport justified classifying time of arrival for these concerns as current. This was the case for three ranking units concerning the wetlands, and four ranking units concerning Bandelier. The most likely time of contaminant arrival was considered near-term for two other ranking units, and long-term for the remaining four.

4.0 RISK INFORMATION SYSTEM INPUTS FOR SITUATIONS THAT MAY REPRESENT POTENTIAL FUTURE ENVIRONMENTAL PROBLEMS

This section includes a discussion of the Risk Information System (RIS) inputs or criteria pertaining to situations that have the potential for future environmental problems. These types of situations consist of conditions that, if left unattended, may result in releases to the environment at some future time. It should be stressed that releases noted in these ranking units have not actually occurred. The potential future release conditions have been assigned to the following major categories:

- Spill Containment;
- Potential Releases of Polychlorinated Biphenyls (PCBs) from PCB Equipment;
- Drum Handling; and
- Other.

The RIS inputs provide information on a number of aspects of risk to public health and the environment. They include nine measures of risk to public health (Section 4.1) and three measures of environmental degradation (Section 4.2). The public health criteria consist of three means of describing individual risk (Section 4.1.1), four means of describing population risk (Section 4.1.2), and one other measure that acts as an adjustment to the risk to public health (Section 4.1.3). Overlying two of the population risk measures and two of the individual risk measures is a health effects criterion. A tenth measure of risk to public health, loss of institutional control, is not evaluated for situations that may represent potential future environmental problems. The environmental degradation criteria consist of a qualitative assessment of the potential for contaminants associated with the environmental problem to reach sensitive environments.

4.1 RIS Inputs for Public Health Measures

RIS inputs for public health measures are indicators of potential impacts to human health as a result of contaminant exposures. These measures are categorized into the following three major areas: 1) individual risk; 2) population risk; and 3) adjustment factors, which consist of uncertainty and contaminant time of arrival.

4.1.1 RIS Inputs for Individual Risk Measures

Individual risk measures presented in Table 4.1 focus on risks to an individual at two potential receptor locations. The maximum individual risk to the modeled receptor provides the maximum individual risk to current potential receptors. The maximum individual risk to the hypothetical boundary receptor provides individual risk information at the site boundary, which may be considered a worst-case location for the off-site public (assuming current site access restrictions are maintained). Table 4.1 provides data concerning calculated risks, the time period in which the calculated risk occurs, and the type of health effect associated with the risk. These have been described previously in Section 3.1.1.

4.1.1.1 Maximum Individual Risk to Modeled Receptor by Health Effects Type

This criterion, as shown in Table 4.1 (column A), presents the Maximum Individual Risk Level, Time Period of Maximum Impact, and Health Effects Type projected for current potential receptors. Comparing this criterion to population risk measures presented in Table 4.2 allows decision makers to be aware of situations involving large impacts to small populations. It also identifies when high scores are due to small impacts to large populations.

The ranking units involving potential future environmental problems at the Los Alamos National Laboratory (LANL) result in individual risks to modeled receptor at levels lower than those at which regulatory actions are generally taken. One ranking unit falls in that range of scores which may require further characterization of the individual risk. The individual risk scores mirror those of the population-based criteria provided in Table 4.2.

4.1.1.2 Hypothetical Maximum Exposed Individual Risk at Site Boundary by Health Effects Type

This criterion, as shown in Table 4.1 (column B), presents the Maximum Individual Risk Level, Time Period of Maximum Impact, and Health Effects Type posed by projected contamination at the site boundary. This component is designed to simulate the U.S. Department of Energy's (DOE's) current radiation management approach concerning responsibility for off-site impacts. It also provides useful

TABLE 4.1

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR SITUATIONS THAT MAY REPRESENT POTENTIAL FUTURE ENVIRONMENTAL PROBLEMS
INDIVIDUAL RISK MEASURES

Ranking Unit Name	A			B		
	Modeled Receptor			Hypothetical Boundary Receptor		
	Maximum Individual Risk Level	Time Period of Maximum Impact	Health Effects Type*	Maximum Individual Risk Level	Time Period of Maximum Impact	Health Effects Type*
Spill Containment						
Potential for Future Releases from Nonradioactive Aboveground Tanks	1	0-70	Carcin	1	0-70	Carcin
Polychlorinated Biphenyls						
Potential for PCB Releases from Transformers	1	0-70	Carcin	1	0-70	Carcin
Drum Handling						
Potential for Future Releases from Product Drums	3	0-70	Carcin	3	0-70	Carcin

*Non-Carcin = Non-Carcinogen
Rad = Radionuclide
Carcin = Carcinogen (Other Than a Radionuclide)

TABLE 4.2

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR SITUATIONS THAT MAY REPRESENT POTENTIAL FUTURE ENVIRONMENTAL PROBLEMS
POPULATION MEASURES

Ranking Unit Name	Discounted			Undiscounted			E
	A		B	C		D	
	Single		Multiple	Single		Multiple	Time Period of Maximum Impact
	HPI Group Level	Health Effects Type*	HPI Group Level	HPI Group Level	Health Effects Type*	HPI Group Level	
Spill Containment							
Potential for Future Releases from Nonradioactive Aboveground Tanks	1	Carcin	1	1	Carcin	1	0-70
Polychlorinated Biphenyls							
Potential for PCB Releases from Transformers	1	Carcin	1	1	Carcin	1	0-70
Drum Handling							
Potential for Future Releases from Product Drums	3	Carcin	3	3	Carcin	3	0-70

*Non-Carcin = Non-Carcinogen
Rad = Radionuclide
Carcin = Carcinogen (Other Than a Radionuclide)

information concerning situations where off-site contamination may exist with no current potential receptors. The scoring of this criterion was described in Section 3.1.1.2.

All three of the ranking units result in maximum individual scores at the LANL boundary that are below levels at which regulatory actions are generally taken. These scores mirror those for the maximum individual risk to modeled receptors provided in Table 4.1 (column A).

4.1.2 RIS Inputs for Population Measures

Population measures, presented in Table 4.2, focus on risks to the population surrounding the site. Two policy issues are assessed in addressing this measure -- time weighting and single (indicator) parameter versus multiple (characterization) parameters. The inputs for population measures have been discussed previously in Section 3.1.2.

4.1.2.1 Single Contaminant Population Risk by Health Effects Type - Discounted

This criterion, as shown in Table 4.2 (column A), is represented by the Hazard Potential Index (HPI) Group Level and Health Effects Type. By comparing this criterion to that presented in column C (as discussed in Section 4.1.2.2), the effect of discounting risks associated with future 70-year periods is evident.

The Potential for Future Releases from Product Drums ranking unit results in an HPI Group Level 3 as a result of the potential transport through the air and potential inhalation of 1,1,1-trichloroethane. The Potential for PCB Releases from Transformers ranking unit and Potential for Future Releases from Nonradioactive Aboveground Tanks ranking unit resulted in an HPI Group Level 1 for both as a result of the low concentration and inventory of PCBs and low surface area for resuspension.

4.1.2.2 Single Contaminant Population Risk by Health Effects Type - Undiscounted

This criterion, as shown in Table 4.2 (column C), presents the HPI Group Level and Health Effects Type. By comparing this criterion to that presented in column A, the effect of discounting risks associated with future 70-year periods is evident.

The LANL ranking units for this criterion score in HPI Group Levels that are considered a tertiary level of concern and lower. This is consistent with the results presented for the discounted criterion (column A).

4.1.2.3 Multiple Contaminant Population Risk - Discounted

This criterion, as shown in Table 4.2 (column B), is similar to the criterion in column A, except that the time-weighted population risks for all contaminants are added. The Multiple Contaminant HPI Group Level assumes health effects across chemicals are additive. This information allows consideration of multiple contaminants at a site. By comparing this criterion to that presented in column A, the effect of adding contaminant risks can be assessed.

There are no changes from the rankings for the single contaminant - discounted criterion when multiple contaminants are considered.

4.1.2.4 Multiple Contaminant Population Risk - Undiscounted

This criterion, as shown in Table 4.2 (column D), is similar to the criterion in column C, except that the undiscounted population risks for all constituents are added. The Multiple Contaminant HPI Group Level - Undiscounted is similar to the Multiple Contaminant - Discounted in that health effects across chemicals are assumed to be additive. This information allows consideration of multiple contaminants at a site without discounting the health risk to future generations. By comparing this criterion to that presented in column C, the effect of adding contaminant risks can be assessed.

There are no changes from the rankings for the single contaminant - undiscounted criterion when multiple contaminants are considered.

4.1.3 RIS Inputs for Uncertainty Measures

Uncertainty measures provide a perspective on the potential variability of the scores that are influenced by the sensitivity of the Multimedia Environmental Pollutant Assessment System (MEPAS) model and the quality of the MEPAS model input data. These criteria, as shown in Table 4.3, include a qualitative assessment of the overall uncertainty associated with the resultant scoring. As discussed in Section 3.1.3, the uncertainty associated with the scores is a combination of uncertainty associated with the MEPAS model sensitivity, represented as Model Variability, and uncertainty associated with the data, represented as the Critical Data Category.

A low amount of uncertainty is associated with two of the three ranking units involving potential future environmental problems at the LANL. A high amount of uncertainty is associated with the third ranking unit. Most of the uncertainty is associated with the data used in the model.

4.1.4 RIS Inputs for Time of Arrival

This criterion, as shown in Table 4.4 and discussed in Section 3.1.4, is designed to describe the urgency associated with the environmental problem. Thus it separates impacts projected to arrive at potential receptors within the next few years from those projected to arrive in time periods farther in the future. The HPI Group Level for the single contaminant population risk - discounted, as presented in Table 4.2, column A, is also given to provide perspective on time of arrival relative to the significance of the associated ranking unit.

The three ranking units at the LANL which involve potential future environmental problems include air transport, and contaminants are projected to reach receptors at the current time. However, for two of these ranking units the risk is projected to be below 10^{-7} for carcinogens or one-tenth of the reference dose for non-carcinogens.

4.2 RIS Inputs for Environmental Degradation Measures

RIS inputs for environmental degradation are indicators of the presence of contaminants at sensitive environments located within or near the site. The

TABLE 4.3

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR SITUATIONS THAT MAY REPRESENT POTENTIAL FUTURE ENVIRONMENTAL PROBLEMS
UNCERTAINTY MEASURES

Ranking Unit Name	Qualitative Uncertainty Score	Critical Data Category	Model Variability	HPI Group
Spill Containment				
Potential for Future Releases from Nonradioactive Aboveground Tanks	Low	A	0	0
Polychlorinated Biphenyls				
Potential for PCB Releases from Transformers	Low	A	0	0
Drum Handling				
Potential for Future Releases from Product Drums	High	C	2	5

TABLE 4.4

LOS ALAMOS NATIONAL LABORATORY
RIS PUBLIC HEALTH INPUTS
FOR SITUATIONS THAT MAY REPRESENT POTENTIAL FUTURE ENVIRONMENTAL PROBLEMS
TIME OF ARRIVAL

Ranking Unit Name	Time of Arrival	HPI Group Level
Spill Containment		
Potential for Future Releases from Nonradioactive Aboveground Tanks	(Present)*	1
Polychlorinated Biphenyls		
Potential for PCB Releases from Transformers	(Present)*	1
Drum Handling		
Potential for Future Releases from Product Drums	Present	3

*Impacts are not projected to reach a risk to an individual at the modeled receptor in excess of 10^{-7} for carcinogens or a dose in excess of one-tenth of the reference dose for non-carcinogens.

identification of sensitive environments and the associated three input criteria, as presented in Table 4.5, has been discussed previously in Section 3.2.

Two sensitive environments -- Bandelier National Monument (Environment Type A) and a federally-designated wetlands supporting a state-designated environmental species (Environment Type B) -- were identified as possible targets of potential releases from the LANL site. As indicated in Table 4.5, Potential for Future Releases from Product Drums and Potential for PCB Releases from Transformers were associated with potential environmental risk to Bandelier National Monument, while Potential for Future Releases from Nonradioactive Aboveground Tanks was associated with potential environmental risk to the wetlands. The likelihood that both the wetlands and the National Monument would be exposed to the contaminants was deemed negligible for all three ranking units. The time of arrival of potential contamination at Bandelier National Monument from Potential for Future Releases from Product Drums was estimated as near-term, while the time of arrival for the other two unit-sensitive environment pairs was estimated as being beyond 10 years. In general, most problems at the LANL were estimated to pose limited risk due to the arid climate, the soil type, the distance to surface water, and the depth to groundwater.

TABLE 4.5

LOS ALAMOS NATIONAL LABORATORY
RIS ENVIRONMENTAL DEGRADATION INPUTS
FOR SITUATIONS THAT MAY REPRESENT POTENTIAL FUTURE ENVIRONMENTAL PROBLEMS

Ranking Unit Name	Sensitive Environment Type	Likelihood of Contamination	Time of Arrival
Spill Containment			
Potential for Future Releases from Nonradioactive Aboveground Tanks	B	Negligible	Beyond 10 Years
Polychlorinated Biphenyls			
Potential for PCB Releases from Transformers	A	Negligible	Beyond 10 Years
Drum Handling			
Potential Future Releases from Product Drums	A	Negligible	Within 10 Years

5.0 SUMMARY OF FINDINGS NOT INCLUDED WITHIN THE SUMMARY RANKINGS

Two Category II and III findings were not included within the ranking. One (Final Survey Finding: Waste Management II-1) was not included because it represents a compliance issue dealing with the characterization of hazardous waste, and the other (Final Survey Finding: Toxic and Chemical Materials III-6) because it is a worker safety issue dealing with asbestos.

6.0 RANKING UNIT NARRATIVES

This section includes a short narrative on each ranking unit in the order that they are presented in Section 1.0 of this Report. Each narrative is formatted to provide a concise discussion of specific information pertaining to the ranking unit. The specific information in these narratives includes a short discussion of the following:

- description of the ranking unit;
- supporting Final Survey Findings (see explanation below);
- how the ranking unit was modeled;
- results of the risk-based ranking;
- qualifiers to the risk-based ranking;
- qualitative uncertainty analysis;
- regulatory aspects of the ranking unit; and
- status of the ranking unit in 1990.

The supporting Final Survey Findings are organized by the following technical areas: air, soil, surface water, groundwater, waste management, toxic and chemical materials, radiation, quality assurance/quality control, and inactive sites and releases.

Roman numerals refer to the category in which the finding has been placed. Thus, Category II findings have a Roman numeral II, while a Roman numeral III represents a Category III finding. The second number refers to the specific finding in the category. Thus, an Air III-4 refers to the fourth air Category III finding in the Environmental Survey Preliminary Report for that site.

Section 8.0 of this Report should be reviewed for a more detailed discussion of each finding. Many of the Final Survey Findings have multiple aspects. To reflect this,

some findings are included in more than one ranking unit, while others are grouped together with related findings into a single ranking unit. In addition, for some findings, only a part of the finding was ranked. The remainder may have centered on an aspect that was beyond the focus of this ranking.

The ranking units, Final Survey Findings, and results of the risk-based ranking are based on information collected during the on-site assessment and during a 1989 follow-up visit. They do not reflect corrective actions taken by the site subsequent to the follow-up visit. However, sites have provided updates of the regulatory aspects and status of each of the ranking units as of 1990, which are presented in this Section.

6.1 Existing or Suspected Environmental Problems

6.1.1 Sediment Contamination in Canyons

Description of Ranking Unit

Three canyons are of most concern at the Los Alamos National Laboratory (LANL): these are Los Alamos, Mortandad, and Water. Elevated concentrations of heavy metals, organics, and radionuclides have been detected in water and sediments downgradient of Technical Areas (TAs) in these canyons.

Supporting Final Survey Findings

Soil III-1 and Surface Water III-1

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of

crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater transport pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived from Los Alamos National Laboratory Annual Surveillance Reports and the Survey Sampling and Analysis (S&A) Data Document for the LANL. Constituents modeled include americium-241, cesium-137 + D, neptunium-237, plutonium-239, protactinium-233, strontium-90, tritium, uranium-233, 235, and 238, yttrium-90, barium, cadmium, chromium VI, furan, isophorone, pentachlorophenol, and uranium. Since the contaminants were known to consist of radionuclides, heavy metals, and organics, there is no major gap in the type of contaminants modeled.

As part of the Survey S&A Program, sediment, sludge, and water samples were collected and analyzed for volatiles, semivolatiles, metals, high explosives (HE), and radionuclides. The analysis confirmed the presence of contaminants such as plutonium-239, uranium-238, and cadmium. These data were used to develop the source term.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in a Hazard Potential Index (HPI) Group 5, which would place the ranking unit with those environmental problems that represent a tertiary level of concern from the potential hazard perspective. Scores for this group are generally a result of either small receptor populations, low doses, or low-toxicity contaminants. The driving contaminant was cesium-137, which potentially could be transported by surface water to receptors where it could pose the potential for recreational exposure. The contaminant and pathway scored in HPI Group 5 because of the large volume of contaminated soil available for release and the toxicity of the

contaminants, which result in a potential near-term impact at the receptor. The area surrounding the LANL was modeled as supporting a medium population.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit scores for cesium-137 in a surface water pathway. For a well-characterized problem, the Model Variability associated with this combination of scoring transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the source term of radioactive contaminants available for transport to surface water and the size of the receptor population using surface water for recreational purposes, which were derived in part from measured data and in part from assumptions. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is a "B", implying a moderate level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a moderate amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the Hazardous and Solid Waste Amendments (HSWA) of 1984 (Sections 3004 [u] and [v] of the Resource Conservation and Recovery Act [RCRA]), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that the perched aquifers within the canyons are currently being investigated under Special Condition C.1 of the HSWA module of the permit. Initial characterization will be completed by December 1990.

The RCRA Facility Investigation (RFI) required under the module will commence in October 1992.

6.1.2 Former Liquid Disposal

Description of Ranking Unit

Former radioactive and chemical liquid waste disposal sites at the LANL have potentially contaminated surface and subsurface soils. Eleven sites were determined to be of particular concern. Of these 11, Material Disposal Area-T in TA-21 received the largest volume of radioactive waste.

Supporting Final Survey Finding

Inactive Sites and Releases III-1

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); 2) ranking unit to overland runoff to surface water; 3) potential contaminant migration to groundwater; and 4) potential contaminant migration to groundwater to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; 4) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities; 5) the potential for ingestion of potentially contaminated groundwater; 6) the potential for ingestion and inhalation of bathwater derived from potentially contaminated groundwater; and 7) the potential for ingestion of crops irrigated and livestock watered with potentially contaminated groundwater.

The exposure pathways for ingestion of and/or bathing with surface water were not addressed because the surface water is not used for these purposes downstream of the ranking unit.

Data used in modeling this ranking unit were derived from the Environmental Survey Preliminary Report and Survey S&A data. Constituents modeled include americium-241, neptunium-237, plutonium-238 and 239, protactinium-233, strontium-90, thorium-230, tritium, uranium-233, 234, and 235, yttrium-90, acetone, 1,1-dichloroethane, 1,2-dichloroethane (1,2-DCA), methylene chloride, methyl ethyl ketone, phenol, toluene, and 1,1,1-trichloroethane. Since the contaminants were known to consist of radionuclides and organics only, there is no major gap in the type of contaminants modeled.

As part of the Survey S&A Program, surface soil, subsurface soil, pond water, sediment, and sludge samples were collected and analyzed for volatiles, HE, radionuclides, metals, polychlorinated biphenyl (PCB)/pesticides, and semivolatiles. The analysis confirmed the presence of contaminants such as acetone, 1,2-DCA, americium-241, and uranium-235. These data were used to develop the source term for modeling.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 4, which would place the ranking unit with those environmental problems that represent a tertiary level of concern from the potential hazard perspective. Scores for this group are generally a result of either small receptor populations, low doses, or low-toxicity contaminants. The driving contaminant was americium-241, which potentially could be transported through the air to receptors where it could potentially be inhaled. The contaminant and pathway scored in HPI Group 4 because of the volume of radioactively contaminated surface soil available for resuspension and the size of the receptor population, which result in a potential near-term impact at the receptor. The area surrounding the LANL was modeled as supporting a moderate-size population.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit scores for americium-241 in a resuspension pathway. For a well-characterized problem, the Model Variability associated with this combination of scoring transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the source term for the radioactive contaminants and the volume of surface area available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 (u) of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/Contaminant Migration Study (CMS) process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in Activity Data Sheets [ADSs]) to be activated under the schedule presented in the Environmental Restoration/Environmental Management (ER/EM) Five-Year Plan.

6.1.3 Firing Sites

Description of Ranking Unit

Test firings of HE occur at 26 locations within the LANL. Some of these firing sites use depleted uranium to simulate fissionable materials. During firings, the depleted uranium is scattered over the firing site. The larger pieces are collected and disposed of. Residual surface soil contamination remains.

Supporting Final Survey Findings

Soil III-2 and Inactive Sites and Releases III-6

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock and fish dependent on potentially contaminated surface water; and 4) the potential external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities.

Groundwater pathways were not considered due to the low mobility of uranium, as well as the great depth to groundwater and the low permeability of the partially saturated zone. Volatilization was not modeled due to the low volatility of the modeled contaminant. There is no reported use of the river for drinking water in the potentially affected area; therefore, exposure through ingestion of and/or bathing with surface water was not considered.

Data used in modeling this ranking unit were derived from Survey S&A data and information supplied by the site. Constituents modeled include cesium-137 + D, thorium-230, uranium-234, 235, and 238, barium, beryllium, chromium VI, copper, lead, nickel, uranium, and zinc compounds. Since the contaminants were known to

consist of radionuclides and heavy metals only, there is no major gap in the type of contaminants modeled.

As part of the Survey S&A Program, soil samples were collected and analyzed for metal, radionuclides, and HE. The analysis confirmed the presence of contaminants such as barium, cesium-137, uranium-238, and chromium VI. These data were used to develop the source term for modeling.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 4, which would place the ranking unit with those environmental problems that represent a tertiary level of concern from the potential hazard perspective. Scores for this group are generally a result of either small receptor populations, low doses, or low-toxicity contaminants. The driving contaminant was uranium-238, which potentially could be transported through the air to the receptors where it could potentially be inhaled. The contaminant and pathway scored in HPI Group 4 because of the volume of the contaminant available for resuspension and the size of the receptor population, which result in a potential near-term impact at the receptor. The area surrounding the LANL was modeled as supporting a moderate-size population.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit scores for uranium-238 in a resuspension pathway. For a well-characterized problem, the Model Variability associated with this combination of scoring transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the source term of the radioactive contaminants and the volume of contaminated surface soil available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low

level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit. Five firing sites are regulated by RCRA as explosive waste treatment, storage, and disposal (TSD) facilities.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.1.4 Landfills and Burn Pits

Description of Ranking Unit

There are 49 inactive landfills, burial areas, and former burn pits at the LANL that are either known to contain or may contain radioactive and/or chemical waste.

Supporting Final Survey Findings

Inactive Sites and Releases III-5, Waste Management III-7 and III-8

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); 2) ranking unit to overland runoff to surface water; 3) potential contaminant migration to groundwater; and 4) potential contaminant migration to groundwater to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; 4) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities; 5) the potential for ingestion of potentially contaminated groundwater; 6) the potential for ingestion and inhalation of bathwater derived from potentially contaminated groundwater; and 7) the potential for ingestion of crops irrigated and livestock watered with potentially contaminated groundwater.

The exposure pathways for ingestion of and/or bathing with surface water were not addressed because the surface water is not used for these purposes downstream of the ranking unit.

Data used in modeling this ranking unit were derived primarily from site-supplied information. Constituents modeled include americium-241, neptunium-237, plutonium-238 and 239, protactinium-233, thorium-230, uranium-233, 234, 235, and 238, benzene, benzo(b)fluoranthene, cadmium, chromium VI, DDT, dieldrin, endosulfan I (Alpha), phenanthrene, and uranium. Since the contaminants were known to consist of radionuclides, heavy metals, and organics, there is no major gap in the type of contaminants modeled.

As part of the Survey S&A Program, surface and subsurface soils and soil gas samples were collected and analyzed for volatiles, semivolatiles, metals, radionuclides, PCB/pesticides, and HE. The analysis confirmed the presence of contaminants such as uranium-238 and plutonium-239. These data were used to develop the source term for modeling.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 3, which would place this ranking unit with those environmental problems that are characterized as generally reaching receptors at levels well below those used in regulatory decisions. The driving contaminant was americium-241, which potentially could be transported through the air to the receptors where it could potentially be inhaled. The

contaminant and pathway scored low because of the concentration of contaminant over a large volume of surface area. This pathway results in a potential near-term impact at the receptor. The area surrounding the LANL was modeled as supporting a moderate-size population.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit scores for americium-241 in a resuspension pathway. For a well-characterized problem, the Model Variability associated with this combination of scoring transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the concentrations of contaminants located in the landfills and burn pits and the volume of contaminated surface soil available for resuspension, which were derived from assumptions. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is a "C", implying a high level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a large amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.1.5 Technical Area 1

Description of Ranking Unit

Chemicals may have been released to the soils in the vicinity of the former TA-1 Sigma Building. In 1966, the land was transferred to Los Alamos County and private landowners. Portions of the former TA were developed as condominiums in the Town of Los Alamos, as well as other facility development, thus possibly further distributing the contaminants.

Supporting Final Survey Findings

Inactive Sites and Releases III-8 and III-9

How the Ranking Unit was Modeled

The transport pathway that was modeled is soil as a source.

The exposure pathway that was modeled is the potential for accidental ingestion of potentially contaminated surface soil.

The soil exposure pathway for ingestion of crops or livestock was not modeled because agricultural production and livestock are not known to occur in the affected areas.

Data used in modeling this ranking unit were derived from the Environmental Survey Preliminary Report and site-supplied information. Constituents modeled include uranium-238, acetone, barium, lead, 1,1,1-trichloroethane, and uranium. Since the contaminants were known to consist of radionuclides, heavy metals, and organics, there is no major gap in the type of contaminants modeled.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 1, which would place the ranking unit with those environmental problems that are characterized as generally

reaching receptors at levels well below those used in regulatory decisions. The driving contaminant was uranium-238, which potentially could accidentally be ingested. The contaminant and pathway scored low because of the concentration of contaminants in the soil and the volume of surface soil available for potential ingestion, which results in a potential near-term impact at the receptor. The area potentially affected by this ranking unit was modeled as supporting a small-size population.

Qualifiers to the Risk-Based Ranking

None of the standard qualifiers apply to this ranking unit.

Qualitative Uncertainty Analysis

This ranking unit scores for uranium-238 by ingestion. For a well-characterized problem, the Model Variability associated with this combination of scoring transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the source term of the radioactive contaminants and the size of the potentially exposed population, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 (v) of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that this ranking unit is currently being addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. This process began in May 1990.

6.1.6 Sediment Contamination from Outfalls

Description of Ranking Unit

Of the outfalls at the LANL that have discharged or are discharging wastes to Los Alamos, Mortandad, and Water Canyons on-site, three outfalls are of most concern. Radionuclides, HE, organics, and other contaminants were reported to be present in these wastewaters, thus contaminating soils beneath the discharge water flume and at the discharge point.

Supporting Final Survey Findings

Surface Water II-1, III-2, III-4, and III-5 and Waste Management III-1

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived from the Environmental Survey Preliminary Report, Survey S&A data, and site-supplied data. Constituents

modeled include beryllium-7, cesium-137, cobalt-57 and 60, manganese-54, sodium-22, uranium-238, zinc-65, barium, chromium VI, HMX (H-NO_2 Tetzocine), lead, TNT, 1,1,1-trichloroethane, uranium, and zinc compounds. Since the contaminants were known to consist of radionuclides, heavy metals, and organics, there is no major gap in the type of contaminants modeled.

As part of the Survey S&A Program, soil, water, and sludge samples were collected and analyzed for volatiles, semivolatiles, metal, HE, and radionuclides. The analysis confirmed the presence of contaminants such as beryllium-7, cobalt-60, and HMX. These data were used to develop the source term.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place this ranking unit with those environmental problems that are not projected to reach receptors. A wide variety of organic, inorganic, and radioactive constituents were modeled, and none of them scored. This ranking unit scored low because of the low concentration of contaminants in the soil.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the source term of the radioactive contaminants and the volume of surface soil available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 (u) of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.1.7 Past Liquid Releases

Description of Ranking Unit

Past and ongoing releases of liquids from drains, drums, and tanks at the LANL have resulted in the contamination of surface soils. Leakage of fluids during storage and transfer operation and areas of stained soil were noted during the Environmental Survey. Evidence of drum spillage and leakage was observed at ten TAs. Operations involving the storage and transfer of dielectric oil have resulted in spillage and leakage at TA-35. In addition, two surface impoundments at TA-35 may have received hazardous waste from past operations.

Supporting Final Survey Findings

Toxic and Chemical Materials III-1 and III-5, Inactive Sites and Releases III-2, and Waste Management III-2

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because the surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived from the Environmental Survey S&A Data Document. Constituents modeled include uranium-238, acetone, anthracene, Aroclor-1254 (PCB), benzene, benzoic acid, chlordane, chromium VI, cyanide ion, DDD, DDT, Endosulfan I (Alpha), lead, methylene chloride, pyrene, and uranium. Since the contaminants were known to consist of radionuclides, inorganics, and organics, there is no major gap in the type of contaminants modeled.

As part of the Survey S&A Program, soil and sludge samples were collected and analyzed for PCB/pesticides, radionuclides, volatiles, semivolatiles, and metals. The analysis confirmed the presence of contaminants such as uranium-238, PCBs, and chromium VI. These data were used to develop the source term.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach receptors. A wide variety of radionuclides, inorganics, and organics were modeled and none of them scored. This ranking unit scored low because of the low concentration of contaminants.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the inventories of contaminants and the volume of surface soil available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that two surface impoundments were found to contain hazardous waste. They are all but closed under RCRA, awaiting concurrence by the state. Elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.1.8 Open Dumps and Boneyards

Description of Ranking Unit

Thirty locations have been identified at the LANL where chemical and radioactive wastes have been disposed of in open dumps, and contaminated equipment has been stored in boneyards. These storage and disposal practices may have resulted in surface soil contamination. Seven locations in five TAs are of particular concern based on the type of waste or contaminated equipment exposed at the surface. In addition, lead shots, lead shavings, lead sheeting, and lead bricks are stored in a number of areas directly on the ground in unprotected, unbermed locations, which may result in lead contamination of soils. Of particular concern is the TA-53 boneyard, which contains 25 uncovered, deteriorating drums of this material.

Supporting Final Survey Findings

Waste Management III-6 and Inactive Sites and Releases III-4

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived primarily from the Environmental Survey S&A Data Document for the LANL. Constituents modeled include cesium-134, strontium-90, uranium-238, yttrium-90, and beryllium. Since the contaminants were known to consist of radionuclides, heavy metals, and organics, there is no major gap in the type of contaminants modeled.

As part of the Survey S&A Program, surface and subsurface soil samples were collected and analyzed for PCB/pesticides, radionuclides, volatiles, semivolatiles, and metals. The analysis confirmed the presence of cesium-134, strontium-90, uranium-238, yttrium-90, and beryllium. These data were used to develop the source term.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 2, which would place the ranking unit with those environmental problems that are characterized as generally reaching receptors at levels well below those used in regulatory decisions. The driving contaminant was uranium-238, which potentially could be transported through the air to the receptors where it could potentially be inhaled. The contaminant and pathway scored low because of the concentration of contaminant over a large volume of surface area. This pathway results in a near-term impact at the receptors. The area surrounding the LANL was modeled as supporting a moderate-size population.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit scores for uranium-238 in a resuspension pathway. For a well-characterized problem, the Model Variability associated with this combination of scoring transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the

critical data are the inventories of the contaminants and the volume of surface soil available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.1.9 Potentially Inadequate Decontamination and Decommissioning

Description of Ranking Unit

Surface and shallow subsurface soils in the vicinity of contaminated structures that have been decontaminated and/or decommissioned may contain residual contaminants. As representative of this potential problem, this ranking unit includes two sites formerly used in HE processing operations where the decontamination and decommissioning processes were completed in the 1960s.

Supporting Final Survey Finding

Inactive Sites and Releases III-7

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); 2) potential contaminant migration to groundwater; and 3) potential contaminant migration to groundwater to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; 4) the potential for accidental ingestion of potentially contaminated surface water during recreational activities; 5) the potential for ingestion of potentially contaminated groundwater; 6) the potential for ingestion and inhalation of bathwater derived from potentially contaminated groundwater; and 7) the potential for ingestion of crops irrigated and livestock watered with potentially contaminated groundwater.

The exposure pathways for ingestion of and/or bathing with surface water were not addressed because surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived from the Environmental Survey S&A Data Document. Constituents modeled include acetone, beryllium, copper, and toluene. Since the contaminants were known to consist of heavy metals and volatile organics, there is no major gap in the type of contaminants modeled.

As part of the Survey S&A Program, subsurface soil samples were collected and analyzed for HE, volatiles, and metals. The analysis confirmed the presence of acetone, beryllium, copper, and toluene. These data were used to develop the source term.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach

receptors. A wide variety of inorganics and organics were modeled and none of them scored. The ranking unit scored low because of low contaminant concentrations.

Qualifiers to the Risk-Based Ranking

None of the standard qualifiers apply to this ranking unit.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the inventory of contaminants and the volume of surface soil available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 (u) of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.1.10 Area P

Description of Ranking Unit

Area P of TA-16 at the LANL is the former disposal site for hazardous waste from HE research and development, and from waste HE burning operations at TA-16. This area may be contributing to contamination of surface water with HE, barium, and heavy metal discharges resulting from stormwater runoff draining from the exposed waste on the face of the landfill.

Supporting Final Survey Finding

Waste Management III-4

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater transport pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because the surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived from the Environmental Survey Preliminary Report. The constituent modeled was barium, which was the only constituent of concern.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach receptors. Barium was modeled and did not score. This ranking unit scored low because of the low concentration of contaminant in the soil.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the inventory of barium in the surface soil and the volume of surface soil available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit. Closure is regulated under 40 CFR 265 Subpart G.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that a closure plan has been submitted to the state. The LANL plans to revise the plan and resubmit it to the state. Closure activities will begin when approval of the plan is received.

6.1.11 Technical Area 54

Description of Ranking Unit

Area L of TA-54 at the LANL was previously used as a disposal area for hazardous organic waste. Thirty-four shafts, ranging from 3 to 8 feet in diameter and 60 feet deep, are located in Area L. Organic vapors have been detected in Area L at a depth of 100 feet in the parts-per-million range. The hazardous waste disposal site represents a potential source of contamination to the groundwater through vapor phase flow.

Supporting Final Survey Findings

Waste Management II-2 and Groundwater III-1

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) potential contaminant migration to groundwater; and 2) potential contaminant migration to groundwater to surface water.

The exposure pathways that were modeled include: 1) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; 2) the potential for external exposure and for accidental ingestion of potentially contaminated surface water during recreational activities; 3) the potential for ingestion of potentially contaminated groundwater; 4) the potential for ingestion and inhalation of bathwater derived from potentially contaminated groundwater; and 5) the potential for ingestion of crops irrigated and livestock watered with potentially contaminated groundwater.

The transport by wind, overland runoff, and direct exposure pathways were not considered as the Area L shafts are capped. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because the surface water is not used for these purposes downstream of the ranking unit.

Data used in modeling this ranking unit were derived from the Environmental Survey S&A Data Document for LANL, the LANL Waste Management Site Plan, and the Closure and Post Closure Plan for TA-54. Constituents modeled include acetone, ethanol, kerosene, methanol, methylene chloride, methyl ethyl ketone, toluene, 1,1,1-trichloroethane, trichloroethylene, trichloromonofluoromethane, americium-241, neptunium-237, plutonium-238 and 239, protactinium-233, thorium-230, uranium-233, 234, and 235, barium, chromium VI, DDD, DDT, fluoranthene, phenanthrene, and pyrene. Since the contaminants were known to consist of organics, heavy metals, and radionuclides, there is no major gap in the type of contaminants modeled.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach receptors. Volatile and semivolatile organics, and radionuclides were modeled and none of them scored. This ranking unit scored low because of the slow groundwater velocity and leach rates through the geologic formations underlying the LANL.

Qualifiers to the Risk-Based Ranking

None of the standard qualfiers apply to this ranking unit.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the low groundwater velocity and leach rates for the geologic formations underlying the LANL, which were derived from measured data. Therefore, the Critical Data

Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit. It is subject to 40 CFR 264 as a permitted TSD facility and 40 CFR 265 as interim status (mixed waste).

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that a closure plan has been submitted to the state for the landfill portion of TA-54, Area L. The LANL plans to revise the plan and resubmit it to the state. Closure activities will begin when approval of the plan is received. The LANL is also pursuing dealing with this unit under the HSWA. Treatment and storage of hazardous waste is a permitted RCRA activity. Mixed waste treatment and storage will receive interim status and probably be permitted.

6.1.12 Technical Area 33 Marshy Area

Description of Ranking Unit

Wastewater from Building TA-33-86, a high-pressure tritium-handling facility, is discharged into two sumps, which allow the liquids to percolate into the soil in an area east of the building. This disposal practice has created a marshy area. The wastewater is known to contain tritium, and may also contain solvents and oils.

Supporting Final Survey Finding

Surface Water III-3

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) potential contaminant migration to groundwater; and 2) potential contaminant migration to groundwater to surface water.

The exposure pathways that were modeled include: 1) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; 2) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities; 3) the potential for ingestion of potentially contaminated groundwater; 4) the potential for ingestion and inhalation of bathwater derived from potentially contaminated groundwater; and 5) the potential for ingestion of crops irrigated and livestock watered with potentially contaminated groundwater.

The surface soil to air (resuspension and volatilization) transport pathways were not modeled because there is no exposed soil and the contaminant is not volatile. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because the surface water downstream of the ranking unit is not used for these purposes. The overland transport pathway was not modeled because the sump system allows the water to percolate into the soil rather than run off the soil.

Data used in modeling this ranking unit were derived from the Environmental Survey Preliminary Report and site-supplied Comprehensive Environmental Assessment and Response Program (CEARP) data. The only constituent modeled was tritium, which was the only constituent of concern.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach receptors. Tritium was modeled and did not score. This ranking unit scored low because of the long time needed for transport through the geologic formations and the relatively short half-life of tritium.

Qualifiers to the Risk-Based Ranking

None of the standard qualifiers apply to this ranking unit.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the inventory of contaminants and the low groundwater velocity and leach rates for the geologic formations underlying the LANL, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA) and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that this ranking unit is being addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. This process began in May 1990.

6.1.13 Potential for Releases from Radioactive Waste Tanks

Description of Ranking Unit

Several aboveground storage tanks (ASTs) without adequate spill containment are used for the storage of radioactive liquids at the LANL. Four tanks at TA-21-257 are

only partially contained. Spills of significant quantities at these tanks would result in soil contamination. One tank at Omega West TA-2-26 is totally uncontained and within 50 feet of the stream in Los Alamos Canyon.

Supporting Final Survey Finding

Waste Management III-5

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater transport pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived from site-supplied data. Constituents modeled include technetium-99 and magnesium. Since the contaminants were known to consist of radionuclides and heavy metals, there is no major gap in the type of contaminants modeled.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place this ranking unit with those environmental problems that are not projected to reach

receptors. Radionuclides and heavy metals were modeled and none of them scored. The ranking unit scored low because of low contaminant concentrations.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data is the flow rate of the surface water used for watering livestock, which was derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA), and the HSWA module of the RCRA operating permit. It is subject to RCRA permit, Attachment I for waste stream characterization. The unit may be subject to RCRA if determined to be mixed waste. New Mexico received mixed waste authority on July 25, 1990.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.1.14 Potential for Releases from Underground Storage Tanks

Description of Ranking Unit

The storage of hazardous and radioactive liquids in active underground storage tanks (USTs) at the LANL presents the potential for undetected releases to surface and subsurface soils. A number of tanks with the potential for leakage are in operation at the LANL, and have not been tested to determine whether or not they are leaking.

Supporting Final Survey Finding

Toxic and Chemical Materials III-2

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) potential contaminant migration to groundwater; and 2) potential contaminant migration to groundwater to surface water.

The exposure pathways that were modeled include: 1) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; 2) the potential for accidental ingestion of potentially contaminated surface water during recreational activities; 3) the potential for ingestion of potentially contaminated groundwater; 4) the potential for ingestion and inhalation of bathwater derived from potentially contaminated groundwater; and 5) the potential for ingestion of crops irrigated and livestock watered with potentially contaminated groundwater.

The air and overland runoff transport pathways were not modeled because the tanks are buried. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because surface water downstream of the ranking unit is not used for these purposes.

Data for this ranking unit were derived from site-supplied data and the Environmental Survey Preliminary Report. Constituents modeled include PCBs

(general), diesel fuel, Fuel Oil #2, gasoline, and motor oil. Since the contaminants were known to consist of organics and PCBs, there is no major gap in the type of contaminants modeled.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach receptors. Organics and PCBs were modeled and did not score. This ranking unit scored low because of the low groundwater flow rate and leach rate for the geologic formations underlying the LANL.

Qualifiers to the Risk-Based Ranking

None of the standard qualifiers apply to this ranking unit.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the groundwater flow rate and leach rate for the geologic formations underlying the LANL, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA) and the HSWA module of the RCRA operating permit. It is subject to New Mexico UST regulations.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.1.15 Potential Leaks from Abandoned or Removed Underground Storage Tanks

Description of Ranking Unit

Undetected releases may occur at the LANL from USTs that have been abandoned in place or removed. These USTs were used for storage of fuels, oils, and radionuclides.

Supporting Final Survey Finding

Inactive Sites and Releases III-3

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) potential contaminant migration to groundwater; and 2) potential contaminant migration to groundwater to surface water.

The exposure pathways that were modeled include: 1) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; 2) the potential for external exposure to and accidental ingestion of potentially contaminated surface water during recreational activities; 3) the potential for ingestion of potentially contaminated groundwater; 4) the potential for ingestion and inhalation of bathwater derived from potentially contaminated groundwater; and 5) the potential for ingestion of crops irrigated and livestock watered with potentially contaminated groundwater.

The air and overland runoff transport pathways were not modeled because the tanks are buried. The exposure pathways for ingestion of and/or bathing with

surface water were not addressed because the surface water downstream of the ranking unit is not used for these purposes.

Data for this ranking unit were derived from the Environmental Survey Preliminary Report and site-supplied data. Constituents modeled include americium-241, neptunium-237, plutonium-239, protactinium-233, uranium-233 and 235, and PCBs (general). Since the contaminants were known to consist of radionuclides and organics, there is no major gap in the type of contaminants modeled.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach receptors. Radionuclides and organics were modeled and did not score. This ranking unit scored low because of the low mobility of the constituents.

Qualifiers to the Risk-Based Ranking

None of the standard qualifiers apply to this ranking unit.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the adsorption coefficients of the contaminants, which were derived in part from measured data and in part from assumptions. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is a "B", implying a moderate level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a moderate amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that this unit is regulated under the HSWA of 1984 (Section 3004 [u] of RCRA), 40 CFR 264 Subpart F, and the HSWA module of the RCRA operating permit.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that elements of this ranking unit will be addressed in the RFI/CMS process as required under the HSWA module of the RCRA operating permit. The elements will be addressed as tasks (identified in ADSs) to be activated under the schedule presented in the ER/EM Five-Year Plan.

6.2 Situations That May Represent Potential Future Environmental Problems

6.2.1 Potential for Future Releases from Product Drums

Description of Ranking Unit

There is a potential for leakage and spills from the storage of oil and hazardous materials in drums stored outdoors at the LANL. These drums contain dielectric oil, motor oil, hydraulic fluid, alcohols, chlorinated solvents, various laboratory and process wastes, and discarded product materials. Inadequate practices associated with these drums include storage directly on the soil, storage without secondary containment, unlabeled drums, storage in uncovered locations, and storage of drums in or adjacent to drainage ditches.

Supporting Final Survey Finding

Toxic and Chemical Materials II-2

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater transport pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because the surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived primarily from the Environmental Survey Preliminary Report, the Environmental Surveillance Report for the LANL for 1985, and assumptions concerning the quantity and quality of drum storage at the LANL. Constituents modeled include acetone, PCBs (general), chloroform, ethanol, Freon 113, hydraulic fluid, methylene chloride, methyl ethyl ketone, 1,1,1-trichloroethane, and trichloroethylene. Since the contaminants were known to consist of volatile organics and PCBs, there is no major gap in the type of contaminants modeled.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 5, which would place the ranking unit with those environmental problems that represent a tertiary level of concern from the potential hazard perspective. Scores for this group are generally a result of either small receptor populations, low doses, or low-toxicity contaminants. The driving contaminant was 1,1,1-trichloroethane, which potentially could be transported through the air to receptors where it could potentially be inhaled. The contaminant and pathway scored in HPI Group 5 because of the toxicity and quantity of the contaminant and the speed of transport through air, which result in a potential near-term impact at the receptor. The area surrounding the LANL was modeled as supporting a moderate-size population.

Qualifiers to the Risk-Based Ranking

This ranking unit scores for potential contamination of groundwater or surface water by organics and includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit scores for 1,1,1-trichloroethane in a volatilization pathway. For a well-characterized problem, the Model Variability associated with this combination of scoring transport scenario and constituent will typically exhibit a range of two HPI Groups. Based on an evaluation of the modeling for this ranking unit, the critical data are the inventory of 1,1,1-trichloroethane present in drums and the quantity and quality of drums, which were derived from assumptions. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is a "C", implying a high level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a large amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that the Clean Water Act of 1972, Spill Prevention Control and Countermeasure (SPCC) Plan, 40 CFR 112 and 125, requires construction of secondary containment structures to control spills of oil and other liquids. It also requires preparation of contingency and countermeasure plans for control of spills.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that the LANL has completed secondary containment structures for spill control for product drums in accordance with its SPCC Plan. Additional containment structures are being planned in order to provide containment for all product drums at the site.

6.2.2 Potential for PCB Releases from Transformers

Description of Ranking Unit

There is a potential for the release of PCB-containing fluids to the environment at the LANL. During the Survey, there were 133 PCB transformers in use that had PCB concentrations greater than 500 parts per million (ppm) in their dielectric fluid. In addition, there were 110 PCB-contaminated transformers in use with concentrations of PCBs in the range of 50 to 500 ppm. A 1986 inventory of capacitors in use at the LANL reported that 2,796 PCB-containing units are in service. The total amount of PCB fluids in these units is significant. Numerous PCB transformers and capacitors are situated near drains, lack adequate spill containment facilities, and/or are in poor condition due to their age.

Supporting Final Survey Finding

Toxic and Chemical Materials II-1

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater transport pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because surface water downstream of the ranking unit is not used for these purposes.

Data used in modeling this ranking unit were derived primarily from site-supplied information concerning electrical transformers which contain PCBs. Constituents modeled include PCBs, which were the only constituents of concern.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach receptors. PCBs were modeled and did not score. This constituent and pathway scored low because of the low surface area for resuspension and the low concentration of PCBs in the transformer dielectric fluid.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the inventory of PCBs in the dielectric fluid released during a catastrophic failure and the volume of surface soil available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that the Toxic Substances Control Act (TSCA) of 1976, 40 CFR Part 761, requires the regulation of harmful new chemicals

entering commerce and the control of those toxic substances (PCBs) already in commercial use.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that the LANL is replacing or retrofilling all PCB transformers according to a priority schedule developed between the engineering and environmental staffs. The target date for removal of all PCB transformers at the laboratory is 1996.

6.2.3 Potential for Future Releases from Nonradioactive Aboveground Tanks

Description of Ranking Unit

There are a number of ASTs at the LANL that lack adequate spill containment. Fourteen were identified without secondary containment and 12 with minor secondary containment. Two acid waste tanks at TA-46-88 are unbermed. The constituents of the tanks varied from diesel fuel, gasoline, and dielectric oil contaminated with PCBs to acidic and basic fluids.

Supporting Final Survey Findings

Waste Management III-3, Toxic and Chemical Materials III-3 and III-4

How the Ranking Unit was Modeled

The transport pathways that were modeled include: 1) surface soil to air (resuspension and volatilization); and 2) ranking unit to overland runoff to surface water.

The exposure pathways that were modeled include: 1) the potential for inhalation of contaminants; 2) the potential for consumption of crops and crop-fed livestock potentially contaminated by airborne deposition; 3) the potential for ingestion of crops, livestock, and fish dependent on potentially contaminated surface water; and 4) the potential for accidental ingestion of potentially contaminated surface water during recreational activities.

The groundwater transport pathway was not modeled because of the great depth to groundwater and the low permeability of the partially saturated zone. The exposure pathways for ingestion of and/or bathing with surface water were not addressed because surface water downstream of the ranking unit is not used for these purposes.

Data for this ranking unit were derived from site-supplied data. Constituents modeled include PCBs, which were the only constituents of interest.

Results of the Risk-Based Ranking

This ranking unit at the LANL ranks in an HPI Group 0, which would place the ranking unit with those environmental problems that are not projected to reach receptors. PCBs were modeled and did not score. This ranking unit scored low because of the low inventory of PCBs and the small volume of potentially contaminated surface soil available for resuspension and overland runoff.

Qualifiers to the Risk-Based Ranking

This ranking unit includes potential for contaminated soil runoff. The qualifiers discussed in Section 7.0 apply.

Qualitative Uncertainty Analysis

This ranking unit ranks in HPI Group 0. For a well-characterized problem, the Model Variability associated with the combination of the modeled transport scenario and constituent will typically exhibit a range within the same HPI Group. Based on an evaluation of the modeling for this ranking unit, the critical data are the inventory of PCBs stored in ASTs and the volume of surface soil available for resuspension, which were derived from measured data. Therefore, the Critical Data Category, which represents the uncertainty associated with the data, for this ranking unit is an "A", implying a low level of uncertainty is associated with the data. The combined Model Variability and Critical Data Category result in a relatively low amount of uncertainty associated with this ranking unit.

Regulatory Aspects of the Ranking Unit

In August 1990, the site informed the Survey that the Clean Water Act of 1972, SPCC Plan, 40 CFR 112 and 125, requires construction of secondary containment structures to control spills of oil and other liquids. It also requires preparation of contingency and countermeasure plans for control of spills.

Status of the Ranking Unit in 1990

In August 1990, the site informed the Survey that the LANL has completed secondary containment structures for spill control for ASTs in accordance with its SPCC Plan. Additional containment structures are being planned in order to provide containment for all ASTs at the site. The two acid waste tanks at TA-46-88 have been emptied and cleaned, and they no longer receive waste acid.

7.0 LIST OF QUALIFIERS TO THE RISK-BASED RANKINGS

Potential Contamination of Groundwater or Surface Water by Organics

Modeling of organics in surface water or groundwater in this report assumes no reduction due to decay or volatilization. Including these factors in the analysis would have the effect of reducing the impacts and thus the scores of these ranking units. The amount of reduction generally would be in the range of one Hazard Potential Index (HPI) Group or less. These factors were not included since this information is generally not available at the stage of investigation associated with many of the ranking units. To have applied these factors at the few sites where they exist would have resulted in inconsistent application of the ranking.

Potential for Contaminated Soil Runoff

The complex nature of sediment transport makes using simplified modeling techniques difficult for contaminated soil runoff as a potential transport pathway. Thus, a significant, but unquantified, amount of uncertainty is associated with ranking unit scores that encompass contaminated soil runoff as a transport pathway. Such pathways consistently score low in this report. Therefore, it is possible that this aspect of the environmental problem is not sufficiently represented in the scoring.

8.0 FINDINGS AND OBSERVATIONS

This section contains all Category I, II, and III Final Survey Findings. Category IV findings from the Environmental Survey Preliminary Report are not included because they represent instances of administrative noncompliance and of management practices that are not directly related to environmental risk. Citations and references provided in this section can be found in the Environmental Survey Preliminary Report for this site.

The Final Survey Findings include modifications in response to the Technical Accuracy Review Comments on the Environmental Survey Preliminary Report that were received from the site and/or DOE Operations (now Field) Office. The Final Survey Findings also include the results of Survey Sampling and Analysis (S&A), as appropriate, and reflect the status of the finding as reported by the site at the time of the Data Accuracy Review (DAR) meeting in June 1989. It should be noted that corrective actions taken by the site since the DAR meeting are not reflected in the Final Survey Findings.

8.1 Active Findings and Observations

8.1.1 Air

There are no Category I, II, or III Final Survey Findings for Air at the Los Alamos National Laboratory (LANL).

8.1.2 Soil

The following constitute the Final Survey Findings for Soil at the LANL. There are no Category I or II Final Survey Findings for Soil. The Category III Final Survey Findings are provided below.

Final Survey Finding: Soil III-1 (Preliminary Survey Finding: Soil III-1)

Soil Contamination by Plutonium-239. Data from a LANL surface sediment monitoring program in Technical Area 49 (TA-49) indicate that sediment

contaminated with plutonium-239 is moving through surface drainage patterns onto the surface soils of Water Canyon and Ancho Canyon.

In 1975, the LANL established a sediment monitoring program near TA-49. The program now consists of 12 sediment monitoring stations in the natural drainages from the four underground experimental areas and in three canyons downgradient from the area. The data, collected annually, indicate that three on-site stations exhibit plutonium concentrations in excess of worldwide fallout. These stations are downgradient from Areas 2 and 11. For station A3, having the highest concentrations, the levels of plutonium-239 have ranged from 0.01 to 17 pCi/g, with a mean of 3.5 and a standard deviation of 5.2 pCi/g. (Background concentration of plutonium-239 in northern New Mexico is about 0.01 pCi/g.) The plutonium and the sediments transported by storm runoff into Water Canyon and Ancho Canyon are dispersed over a large area and do not leave the LANL site.

The plutonium has two possible sources. First, cuttings brought to the surface from a side drift extended at the bottom of one of the shafts in late 1960 had plutonium contamination. Apparently, plutonium had been dispersed through fractures in the tuff by the detonation of an experiment in an adjacent shaft. The personnel reportedly removed all surface soil contamination and placed it back in the shaft, then filled the shaft with clean sand and capped it with a concrete plug. The surface of Area 2 in TA-49 was covered with as much as 6 feet of compacted aggregate and a 4- to 6-inch layer of asphalt. However, trace amounts of the contamination remain. Second, Area 11 housed a radioactive chemistry laboratory used to provide analytical chemistry data. Effluent from the laboratory drained into a buried drain field in Area 11. The sediment monitoring program has detected radioactivity downstream from both Area 2 and Area 11.

A series of underground experiments were performed at TA-15 from 1968 through 1972. Four 130-foot holes were drilled, but only two were used. Only the second hole contained toxic elements, which included less than 200 grams of beryllium, approximately 200 curies of tritium, and lead shielding.

The TA-33 test chambers were 46 feet underground, and they were used from 1947 to 1952. Test materials consisted of polonium-210, which has decayed away, and possibly beryllium and lead.

As part of the Survey S&A Program, subsurface soil samples were collected from the drain field and analyzed for volatiles, semivolatiles, metals, and radionuclides. The analysis confirmed the presence of contaminants such as plutonium-239, cadmium, and uranium. These data were used to model the Sediment Contamination in the Canyons ranking unit.

Final Survey Finding: Soil III-2 (Preliminary Survey Finding: Soil III-2)

Potential Soil Contamination from High Explosives (HE) and Barium. As a result of past detonations, all 26 of the active firing sites have the potential for contamination from HE and barium. In addition, at many of the sites there is a potential for contamination with radioactivity such as depleted uranium and other metals such as beryllium, lead, mercury, copper, cadmium, and nickel. LANL personnel conduct test-firings of HE for experimental purposes at firing sites. A firing site consists of a firing pad (usually consisting of a sandy flat area) and a control bunker which houses equipment and personnel.

Most of the experiments completely consume the HE. However, in some experiments the HE does not completely detonate, thereby dispersing HE into the surrounding area. Some experiments include depleted uranium and/or thorium to simulate fissionable materials; and beryllium and/or other metals such as lead, mercury, copper, cadmium, and nickel. Some of the HE (baratol and baronal) contain barium. The 26 firing sites are divided into 7 groups based on the type of HE used, the constituents tested, and the history of HE use at the site. The type of HE used and the constituents tested determine the substances that could contaminate the surrounding soils.

The first group includes TA-11-26 and the sites at TA-40 (TA-40-4, 5, 8, 12, and 15). The high explosives consisted of various types of HE including TNT, HMX, RDX, and baratol. No radioactive material was used in any tests at these sites. TA-11 is the drop tower where HE is dropped onto a concrete pad as an aid to determine handling characteristics. At the TA-40 sites, small quantities of HE are used in the explosion of detonators.

The second group includes the TA-36 sites (TA-36 Eenie, Meenie, Minie, Lower Slobbovia, and IJ). These sites use large quantities of HE per test, and large quantities (up to 9,000 pounds) annually.

Active sites using medium amounts of HE per test form the third group, which includes TA-15 PHERMEX and ECTOR. At these two sites, up to 125 pounds of HE are used per test. Types of HE used at these two groups include HMX, RDX, baratol, PETN, and cycotol. Other potential contaminants include depleted uranium, thorium, tritium, lead, copper, aluminum, mercury, cadmium, silver, nickel, and beryllium.

The fourth group, infrequently used but nevertheless considered active, includes TAs-15-44 and 45. In the past, these two sites employed large amounts of HE per test as well as annually; today they are used occasionally instead of PHERMEX or ECTOR if diagnostic needs can be satisfied thereby. Potential types of HE used at this group include HMX, RDX, and baratol. Other potential contaminants include depleted uranium, tritium, aluminum, mercury, cadmium, and beryllium.

The LANL conducts shock-wave experiments at the fifth group of firing sites, all of which are at TA-39 (TAs-39-6, 57, and 88). Experiments conducted at these sites use small to medium amounts of HE. These sites are located in a canyon, which limits dispersion of the materials used. Types of HE used at TA-39 include HMX and baratol. Other potential contaminants include depleted uranium, thorium, copper, chromium, mercury, and beryllium.

Small sensitivity studies are performed at the sixth group, which consists of five sites at TA-14 (TAs-14-25, 26, 27, 28, and 29). These studies involve detonation of small amounts of HE to determine its characteristics. Unexploded HE may remain. These sites also use small amounts of HE per test and per year. Other potential contaminants include depleted and natural uranium.

The seventh group is composed of gun sites TA-39-56 and 69 and TA-14-34. Gun sites are locations where the LANL fires projectiles at HE or into canyon walls. Various types of HE are used. Potential contaminants include depleted uranium, lead, copper, aluminum, steel, and beryllium.

As part of the Survey S&A Program, soil samples were collected from selected active firing sites and analyzed for radionuclides. The analysis confirmed the presence of contaminants such as uranium-238 and uranium. These data were used to model the Firing Sites ranking unit.

8.1.3 Surface Water

The following constitute the Final Survey Findings for Surface Water at the LANL. There are no Category I Final Survey Findings for Surface Water. The Category II and III Final Survey Findings are provided below.

Final Survey Finding: Surface Water II-1 (Preliminary Survey Finding: Surface Water II-1)

Potential Organic and Inorganic Contamination in the Soils at Permitted National Pollutant Discharge Elimination System (NPDES) Outfalls. Several NPDES-permitted outfalls are discharging organic (e.g., methyl ethyl ketone, acetone) and inorganic (e.g., barium) constituents that are not monitored and result in potential contamination of soils and sediments.

These substances were not included on the permit application that was sent to the U.S. Environmental Protection Agency (EPA) for the NPDES Permit and are not included as permit monitoring conditions. In the 1985 permit application, a representative sample was taken from one discharge point for each outfall category and analyzed for permit requirements. However, since all operations are not identical, each discharge point has its own composition of discharged wastewater. Specific examples include the following:

- NPDES Outfall 058

  This outfall serves Buildings 300, 302, 304, 306, and 307 in TA-16. Building 300 formulates "mock" explosives, a major ingredient being barium salts. Additionally, solvents (methyl ethyl ketone, acetone, ethyl and butyl acetates) are being used in Buildings 300 and 302. Since barium nitrate is soluble in water and solvents to some degree are also soluble, they would all be in the water discharged from the sumps. In turn, the HE formulations have some

solubility (particularly in warm water). Thus, all these materials could be contaminating soils in the vicinity of the outfall. Outfall 058 is monitored for chemical oxygen demand (COD), pH, flow, and total suspended solids (TSS), pursuant to NPDES Permit requirements.

As part of the Survey S&A Program, sediment and water samples were collected and analyzed for volatiles, metals, HE, radionuclides and asbestos. The analysis confirmed the presence of contaminants such as beryllium-7, cobalt-60, and uranium. These data were used to model the Sediment Contamination from Outfalls ranking unit.

- NPDES Outfall 062

This outfall discharges water from Building 342 in TA-16. This is a dry formulation building. However, there is a wet scrubber used to scrub any chemical dust from the mixer loading. This water, plus any water from the mixers, is discharged to Outfall 062. Since barium salts are used, barium could be contaminating the soils at the outfall. HE outfalls in TA-16 are monitored for COD, pH, flow, and TSS. As part of the Survey S&A Program, sediment samples were collected and analyzed for volatiles, HE, metals, and radionuclides. The analysis confirmed the presence of contaminants such as 1,1,1-trichloroethane, barium, and HMX. These data were used to model the Sediment Contamination from Outfalls ranking unit.

- NPDES Outfall 03S

This outfall is the discharge from the sanitary waste treatment facility at TA-16. The wastewater from the laundry at TA-16 is discharged to the sanitary facility. All work clothes from TA-16 and clothing from the LANL sites where personnel handle beryllium are washed at this laundry. Thus, there is the potential for barium, beryllium, HE, and solvent materials to be in these wastewaters. They might not be removed in the treatment facility and could thus contaminate soils at the outfall. The sanitary waste treatment facilities at the LANL are monitored for pH, biological oxygen demand (BOD), flow, and TSS. As part of the Survey S&A Program, sludge samples were collected from the sanitary waste treatment facility sludge beds and analyzed for volatiles, HE, metals, and

radionuclides. The analysis confirmed the presence of contaminants such as chromium VI and zinc. These data were used to model the Sediment Contamination from Outfalls ranking unit.

Final Survey Finding: Surface Water III-1 (Preliminary Survey Finding: Surface Water III-1)

Radionuclide Contamination in Several Canyons. Site activities have resulted in the release of radionuclides into several of the canyons. Sampling results reported in the Annual Environmental Surveillance Reports indicate that plutonium in the sediments from Los Alamos Canyon has been transported to the Rio Grande at levels above background. In 1984, sediment samples at Otowi contained 0.096 pCi/g plutonium-239 and 240, as compared to a regional background of 0.005 pCi/g. Los Alamos Canyon receives flow from Acid, Pueblo, and DP Canyons, all of which received industrial discharges in the past. The plutonium is bound up with the sediments that are moved down during runoff events.

Water Canyon can potentially receive plutonium in surface runoff from TA-49. This contamination can then move downstream toward the Rio Grande. However, surveillance of sediments in Water Canyon at State Road 4 and the Rio Grande have failed to detect any contamination related to TAs drained by Water Canyon.

The treated wastewaters from the TA-50-1 treatment plant discharge to Mortandad Canyon. This treatment plant is the principal industrial waste treatment facility at the LANL. As such, it handles various wastewater streams that contain heavy metals, organics, and radionuclides. This outfall is monitored monthly for radionuclides, COD, total dissolved solids (TDS), and several metals including cadmium, chromium, copper, nickel, lead, mercury, and zinc. While the facility provides a good degree of removal, some contaminants are still present in the discharge. Over a period of time, there has been an accumulation of radionuclide contaminants in the sediment; thus, the sediment has the potential to be contaminated by other metals as well. LANL's monitoring of the sediment has shown a mean plutonium-239 and 240 concentration of 14 pCi/g from the seven monitoring stations in Mortandad Canyon for 1986 (LANL, 1987a). A series of sediment traps have been installed in the canyon between sample stations MCO-7 and MCO-9 to prevent movement of contaminated sediment down the canyon. These appear to have functioned properly; however,

extreme flood events could result in the movement of contaminated sediments down the canyon.

As part of the Survey S&A Program, sediment samples were collected and analyzed for volatiles, semivolatiles, metals, and radionuclides. The analysis confirmed the presence of contaminants such as uranium and strontium-90. These data were used to model the Sediment Contamination from Outfalls ranking unit.

Final Survey Finding: Surface Water III-2 (Preliminary Survey Finding: Surface Water III-2)

Potential for HE and Solvent Contamination of Soils at NPDES Outfall 054. Organics (e.g., methyl ethyl ketone, acetone, butyl and ethyl acetate) are present in this discharge, resulting in the potential contamination of the soils beneath the discharge water flume and at the discharge point.

Explosives synthesis is performed at TA-16-340. Wastewaters from this building are discharged to a baffled sump behind Building TA-16-340. From this sump, the wastewater is discharged to Outfall 054. The COD concentration has been as high as 1,200 to 1,300 mg/L as a result of the volatile organics that are present. A weir box and a fiberglass trough (water flume) have been installed to convey the wastewater to the canyon bottom and to provide aeration of organic constituents. However, the weir box and trough were not properly sized at the time of installation, resulting in overflow of discharge water. This overflow may have resulted in contamination of the soils beneath and downgradient of the weir box and trough with organics and HE.

As part of the Survey S&A Program, soil and water samples were collected and analyzed for volatiles, semivolatiles, metals, and HE. The analysis confirmed the presence of beryllium-7, uranium-238, chromium VI, and lead. These data were used to model the Sediment Contamination from Outfalls ranking unit.

Final Survey Finding: Surface Water III-3 (Preliminary Survey Finding: Surface Water III-3)

Potential Contamination by Organic Solvents, Tritium, and Other Radionuclides of Soils at TA-33, Building 86. Tritium and organics may be discharged from TA-33-56 and may be contaminating the marshy area east of the security fence. Any wildlife or workers walking in this area may be exposed to water containing tritium, as there is no security fence around the marsh.

It is estimated that the marsh is approximately 200 feet by 100 feet. A tritium laboratory is located in a portion of Building TA-33-86. The drains from this building discharge to a sump east of the building. The water from Building TA-33-86 (particularly washwater) can contain tritium from contamination of the equipment and walls. In addition, solvents such as trichloroethylene (TCE), acetone, and ethanol are used in a nearby building. This water seeps from the sump to a marshy area, since the flow into the sump simply percolates out to the soils. Thus, tritium and solvent contamination of the soils may have occurred from recent operations. Past practices are thought to have used polonium, and there is potential for past use of uranium and thorium.

Final Survey Finding: Surface Water III-4 (Preliminary Survey Finding: Surface Water III-4)

Potential Contamination of Soils with Radionuclides and Other Substances Due to the TA-53 Lagoon Outfall (NPDES Outfall 095). Radionuclides, oil and grease, and possibly heavy metals may be contaminating the soils in Los Alamos Canyon below Outfall 095.

The lagoon system is a sanitary treatment system that also receives wastewater containing radionuclides. Radionuclides (tritium, beryllium-7, sodium-22, manganese-54, cobalt-57 and 60, and cesium-134) are contained in Outfall 095 and may be contaminating the soils at the outfall (LANL, 1987a). Under normal operation, these lagoons are designed to operate as evaporation ponds. Owing to increased employee population at TA-53, however, discharge does occur through NPDES Outfall 095. (Discharge occurred from July through December 1986.) This has resulted in contamination of soils at the outfall with radionuclides. Potential exists for transport off-site during periods of heavy runoff.

As part of the Survey S&A Program, lagoon sludge samples were collected and analyzed for volatiles, semivolatiles, metals, and radionuclides. The analysis confirmed the presence of contaminants such as beryllium-7, cobalt-60, and cesium 137. These data were used to model the Sediment Contamination from Outfalls ranking unit.

Final Survey Finding: Surface Water III-5 (Preliminary Survey Finding: Surface Water III-5)

Potential Soil Contamination with HE and Solvents from the Outfall at TA-16-478. This outfall may have discharged water containing HE and organics in the past, thus contaminating soils in the vicinity of the outfall. As in all the buildings where HE is processed, wastewater is discharged to a sump behind the building; the water then passes through a series of baffles where the velocity is decreased so as to allow other suspended solids to settle. The sump outlet to the drain pipe has been filled with concrete to prevent additional discharge. However, soil sampling (Baytos, 1986a) performed in 1985 by the LANL found soil concentrations of HE near 5 percent at this outfall.

8.1.4 Groundwater

The following constitute the Final Survey Findings for Groundwater at the LANL. There are no Category I or II Final Survey Findings for Groundwater. The Category III Final Survey Finding is provided below.

Final Survey Finding: Groundwater III-1 (Preliminary Survey Finding: Groundwater III-1)

Potential Groundwater Contamination with Organic Constituents. Area L, the hazardous waste disposal site, and to a lesser extent Area G, the radioactive waste disposal site, represent a potential source of contamination to the groundwater through vapor phase flow.

Studies conducted by site personnel clearly indicate that liquid phase flow (in either saturated or unsaturated modes) is not a viable transport mechanism for organic contaminants in this environment. However, studies have indicated that vapor

phase flow by diffusion has occurred, and organic vapors are detected at a depth of 100 feet. The full vertical and horizontal extent of the vapor plume is presently unknown. At Area L, pore gas samples at the depth of 100 feet contain organic vapors in the parts-per-million range. Organic vapors in the parts-per-billion range are detectable at the 100-foot depth in Area G as well. Further study of the extent of movement of vapors at Area L is planned by LANL personnel.

8.1.5 Waste Management

The following constitute the Final Survey Findings for Waste Management at the LANL. There are no Category I Final Survey Findings for Waste Management. The Category II and III Final Survey Findings are provided below.

Final Survey Finding: Waste Management II-1 (Preliminary Survey Finding: Waste Management II-1)

Lack of Effective Characterization and Segregation of Waste. The LANL does not effectively characterize and segregate radioactive, mixed, hazardous, and solid waste.

The lack of accurate waste characterization and segregation results in hazardous waste entering radioactive waste disposal areas and sanitary landfill areas. Disposal of hazardous wastes in radioactive and sanitary disposal areas is an environmental and regulatory problem. Hazardous waste disposal can contribute to subsurface soil contamination and vapor phase releases. In addition, disposal of hazardous waste in other than permitted and properly constructed disposal facilities is an environmental compliance problem.

Improper characterization and segregation of waste is a problem that occurs at many locations throughout the LANL. The following have resulted from the lack of effective characterization and segregation of waste:

- The TA-54, Area G, Radioactive Waste Landfill is receiving mixed waste for disposal.

The Area G Radioactive Waste Landfill is receiving mixed and hazardous waste from several sources, primarily the TA-3-66 Sigma Building foundry, the TA-3-102 machine shop, and to a lesser extent various other buildings using radioactive material. In addition, hazardous substances may be entering Area G from TA-50-1. The Area G Landfill is not constructed with the liners and leachate collection system required for hazardous waste disposal under the Resource Conservation and Recovery Act (RCRA) and is not authorized for disposal of hazardous waste. Area G has been administratively closed to hazardous waste since May 1985. However, it was receiving mixed waste at the time of the Survey. The TA-3-66 waste consists of dust collected in the air cleaning system and solids from the breakout station that accumulate from lead and uranium operations in the Sigma Building. The breakout station solids are estimated by LANL Sigma Building personnel to total approximately 100 ft^3/yr. The air pollution control system dust totals approximately 500 ft^3/yr of waste. In addition, the TA-3-102 Machine Shop disposes of waste from lead machining in radioactive waste containers that are disposed of at Area G in pits. The amount of lead material disposed of could not be determined due to the variability in production.

The Area G Landfill has also received organic solvents that are contained on Kimwipes and rags from buildings using radioactive materials. For example, solvents such as TCE, chloroform, methylene chloride, and Freon are used to clean components, parts, molds, and equipment throughout the LANL site. Such solvent-contaminated rags suspected of containing low-level radioactive waste are disposed of in the Area G pits.

Finally, the TA-50-1 dewatered sludge disposed of at Area G may be contaminated with organic solvents due to the use of the radioactive waste sewer for the disposal of laboratory analytical wastes. These wastes may include organic solvents such as methylene chloride, xylene, methyl ethyl ketone, and others.

Area G has been sampled by soil gas analysis and has shown vapor phase release of organics at parts-per-billion levels at 100-foot depth. The continued disposal of materials containing solvents at the Area G Landfill may contribute to the source of subsurface vapor phase releases.

- The Los Alamos County Sanitary Landfill is receiving hazardous wastes from the LANL for disposal.

  The Los Alamos County Sanitary Landfill is receiving scrap lead and waste cleaning solvents from numerous LANL operations. The widespread use and machining of lead has resulted in lead being disposed of in the sanitary waste stream. For example, the machine shops at TA-3-102 and TA-9 dispose of waste lead to the sanitary landfill with regular trash. In addition, the cleaning of machine parts and components with solvents such as acetone and toluene results in the disposal of small quantities of these solvents to the sanitary landfill. For example, the TA-3 Plastics Shop and TA-3 Paint Shop dispose of small quantities of organic solvent materials to the sanitary trash.

Final Survey Finding: Waste Management II-2 (Preliminary Survey Finding: Waste Management II-2)

Chemical Contamination of Subsurface Soil at TA-54, Area L. The current hazardous waste treatment and storage area, TA-54, Area L, is releasing hazardous chemicals as a result of past chemical waste disposal.

Subsurface sampling conducted by the LANL has detected vapor phase releases from the chemical disposal shafts and pit in parts-per-million concentrations at 100 feet below the Area L surface. The release results in an environmental problem and a compliance problem. The vapor phase contamination may be considered a release from a waste management unit that requires corrective action. Section 3016 of the RCRA contains provisions for corrective action pertaining to solid waste management units (SWMUs) if there has been a release of hazardous waste or hazardous constituents to the environment. The LANL has detected and reported the vapor phase releases described above to regulatory authorities. The LANL is aware of the potential compliance problem and was reviewing corrective action options for Area L at the time of the Survey.

The extent to which the vapor phase contamination has extended below the 100-foot level is unclear.

Final Survey Finding: Waste Management III-1 (Preliminary Survey Finding: Waste Management III-1)

Potential Hazardous Waste Contamination of the TA-53 Lagoons. The TA-53 lagoons have potentially received hazardous waste from operations at TA-53. Soils beneath the lagoon may be contaminated with hazardous wastes.

The LANL has analyzed the sludge in the lagoons by the Extraction Procedure (EP) toxicity test to determine if the sludge is a hazardous waste. However, the EP toxicity test does not detect organic contamination as does the Toxicity Concentration Leaching Procedure (TCLP). The lagoons have occasionally received oily wastes (personal communication, TA-53 personnel), which appear as a surface sheen. In addition, wastes released to drains in the TA-53 Machine Shop may contain paint or solvent material, which may be piped to the lagoons.

The two upper lagoons contain 1 to 4 inches of sludge, and are gunite-lined at the sides for stability, but are unlined at the bottom. As a part of the Survey S&A Program, sludge samples from the Upper Lagoon were collected and analyzed for volatiles, semivolatiles, radionuclides, and metals. The analysis confirmed the presence of contaminants such as 1,1,1-trichloroethane, chromium VI, and manganese-54. These data were used to model the Sediment Contamination from Outfalls ranking unit.

Final Survey Finding: Waste Management III-2 (Preliminary Survey Finding: Waste Management III-2)

Potential Hazardous Waste Contamination of Waste-oil Surface Impoundments in TA-35. Two surface impoundments in TA-35 may have received hazardous waste from operations in TA-35-125 and TA-35-85. The sludges in the ponds have been tested for polychlorinated biphenyls (PCBs), but have not been fully characterized and have not been tested by the EP toxicity test to determine if they are hazardous wastes.

The pond at TA-35-125 is located near the Antares Building, which contains large PCB transformers. The pond is situated approximately 20 feet lower than the building at a saddle on the side of a mesa. It measures approximately 20 feet square,

is of unknown depth, and is cement-lined. The cement lining is constructed with an overflow spout that leads to soils on the mesa side. The cement lining, the spout, and the soils both up and down the elevation gradient from the pond are stained with a black substance. The liquid in the pond is covered by a floating yellow substance of unknown composition. In addition, the mesa top above the pond was the storage location for deteriorating waste drums, some of which had discharged their contents to the asphalt area nearby. The size and appearance of the pond at TA-35-85 is similar to that of the pond near TA-35-125.

As part of the Survey S&A Program, sludge samples were collected and analyzed for volatiles, semivolatiles, metals, pesticides, and PCB. The analysis confirmed the presence of contaminants such as acetone, PCB, chromium VI, and uranium. These data were used to model the Past Liquid Releases ranking unit.

Final Survey Finding: Waste Management III-3 (Preliminary Survey Finding: Waste Management III-3)

Potential Hazardous Waste Release to Soils at the TA-46-88 Acid Waste Tanks. The two acid waste tanks at TA-46-88 are unbermed; one has released hazardous waste to nearby soils during a spill in March 1987, and there is a potential to result in future releases.

One 5,000-gallon nitric acid tank has no automatic overflow preventer and requires frequent manual inventory reduction to avoid a release. At least 5 gallons of 6 to 7 Molar nitric acid were released to nearby soils due to an overflow that occurred during the early morning of March 19, 1987. In addition, at the time of the Survey, the 750-gallon tanks receiving sulfuric acid were marked as containing nitric acid. The tank marking has the potential to result in improper handling of this hazardous waste.

Personnel at the LANL stated that the area is to be bermed in the future but that the schedule for such construction is unclear.

Final Survey Finding: Waste Management III-4 (Preliminary Survey Finding: Waste Management III-4)

Hazardous Waste Contamination of TA-16, Area P. Area P may be contributing to contamination of surface water with HE, barium, and heavy-metal discharges resulting from stormwater runoff draining from the exposed waste on the face of the landfill.

Area P of TA-16 has been the site of disposal of hazardous waste from HE research and development and waste-HE burning operations at TA-16. Area P has also received chemical bottles, trash, and incinerator ash (DOE-AO, 1986). The site encompasses 6.7 acres at the edge of Canyon de Valle. Some of the landfill has been covered with soil, but metal debris is visible protruding from the face of the landfill. The site has been sampled, is known to be contaminated with barium, and is expected to contain HE contamination as well. The concentration of barium in Area P was found to be above regulated concentration limits (i.e., exceeded EP toxicity test level) by LANL sampling conducted in 1985 (DOE-AO, 1986). The site will close under the RCRA and a closure plan has been submitted to the state. The LANL is currently assessing proper closure alternatives and may revise its existing closure plan to completely cover Area P and provide run-on and runoff control that was not in place at the time of the Survey.

Final Survey Finding: Waste Management III-5 (Preliminary Survey Finding: Waste Management III-5)

Potential Releases of Radioactive Substances from Partially Contained or Uncontained Aboveground Tanks. A number of aboveground storage tanks (ASTs) at the LANL used for the storage of radioactive liquids have insufficient secondary containment capacity for major spills or leaks.

Four tanks at TA-21-257 are only partially contained. Spills of significant quantities at tanks TA-21-257-110, 111, 112, and 113 would not be totally contained, resulting in contamination of soils surrounding them. These tanks each contain 16,000 gallons of low-level radioactive waste. One tank at Omega West (TA-2-46) was totally uncontained. Any leak at this tank could result in the release of small quantities of radionuclides (e.g., activation products) to nearby soils and possibly to a stream in Los Alamos Canyon, which is approximately 50 feet from the tank.

Final Survey Finding: Waste Management III-6 (Preliminary Survey Finding: Waste Management III-6)

Potential Lead Contamination of Surface Soils. Lead shots, lead shavings, lead sheeting, and lead bricks are stored directly on the ground, in unprotected, unbermed locations, which may result in lead contamination of soils.

Of particular concern is the TA-53 bone yard, which contains 25 barrels of lead bricks, shot, and other lead material stored in drums which are deteriorating, uncovered, or have released lead materials to the soil. The improper storage of lead is a pervasive problem throughout the LANL. The Environmental Survey team found individual lead bricks or groups of lead bricks in a range of locations, where they appeared to be abandoned (i.e., partially buried with soil) or stored in a manner constituting disposal.

Final Survey Finding: Waste Management III-7 (Preliminary Survey Finding: Waste Management III-7)

Potential Contamination at Active Burn Areas. Three active burn areas at the LANL may be contaminated by hazardous waste and other substances that have the potential to contaminate the soils in the vicinity of the TA-14 incinerator, TA-14 trash pile, and TA-36 debris pit. The TA-14 incinerator is a 55-gallon drum with holes punched into the bottom to provide a draft for burning laboratory trash from TA-16 (personal communication with TA-14 personnel). The area in a 5-foot radius from the drum was covered to a depth of approximately 2 inches with ash, bottles, and other debris from the drum incinerator. The TA-14 trash area contained a small trash pile approximately 5 feet in diameter and 2 feet high, which contained unburned wood and other trash from TA-14 maintenance operations. In addition, the pile contained approximately 10 five-gallon plastic pails labeled as having contained HE. The trash area is located between electrical boxes 27 and 28. The TA-36 Lower Slobbovia debris pit is located southwest of the Lower Slobbovia firing site and measures 80 feet long by 20 feet wide by 15 feet deep. The pit contains debris such as wood, ash, and other substances from firing site operations within TA-36.

As part of the Survey S&A Program, ash samples and surface soils were collected and analyzed for volatiles, radionuclides, metals, and HE. The analysis confirmed the

presence of contaminants such as uranium-235, cadmium, chromium VI, DDT, and uranium. These data were used to model the Landfills and Burn Pits ranking unit.

Final Survey Finding: Waste Management III-8 (Preliminary Survey Finding: Waste Management III-8)

Potential for Hazardous and Mixed Waste Disposal into a Landfill at TA-39. The Survey team was told that sand from the TA-39 firing sites has been disposed of in the TA-39 disposal pit by TA-39 personnel in the past. If so, the sand may have contained barium, lead, uranium, and other contaminants resulting from HE research, development, and testing activities in TA-39. The sand currently at the TA-39 firing sites was recently sampled by the LANL and found to contain barium at levels which are well below hazardous waste limits. No other constituents were analyzed and the landfill itself was not tested. The landfill receives lead waste from the TA-39 Machine Shop; perchloroethylene-soaked rags from gun-cleaning operation in TA-39-69; and paint cans, epoxy activators, and potentially HE-contaminated materials. The landfill has a potential for subsurface soil contamination due to the lack of a lining and may be considered to have received hazardous waste. The landfill has been in continuous operation for approximately 10 years. In addition, there is a closed pit (which was operated for approximately 10 years prior to the construction of the current pit) adjacent to the pit described above, and two similar closed pits near TA-39-69. It is likely that all the pits, when they were operational, received materials only from TA-39.

As part of the Survey S&A Program, soil gas, subsurface soil, and surface soil samples were collected and analyzed for volatiles, semivolatiles, metals, HE, and total uranium. The analysis confirmed the presence of contaminants such as chromium VI and uranium. These data were used to model the Landfills and Burn Pits ranking unit.

8.1.6 Toxic and Chemical Materials

The following constitute the Final Survey Findings for Toxic and Chemical Materials at the LANL. There are no Category I Final Survey Findings for Toxic and Chemical Materials. The Category II and III Final Survey Findings are provided below.

Final Survey Finding: Toxic and Chemical Materials II-1 (Preliminary Survey Finding: Toxic and Chemical Materials II-1)

Potential Release of PCB-Containing Fluids. Widespread use of PCB fluids in electrical transformers and capacitors represents a potential for the release and transport of PCBs into the environment and, in some instances, the potential for direct contact.

During the Survey, there were 133 PCB transformers in use that had PCB concentrations greater than 500 parts-per-million (ppm) in their dielectric fluids. In addition, there were 110 PCB-contaminated transformers in use with concentrations of PCBs in the range of 50 to 500 ppm. A 1986 inventory of capacitors in use at the LANL reports that 2,796 PCB-containing units are in service. The total amount of PCB fluids in these units is significant: 565,000 kilograms in PCB transformers; 99,800 kilograms in PCB-contaminated transformers; and 117,000 kilograms in capacitors. The potential for serious environmental damage in using these materials is enhanced by several factors:

- absence of spill containment facilities;
- location of PCB transformers near drains;
- operating condition and age of the PCB transformers in use; and
- location of PCB transformers and capacitors indoors within high traffic areas for LANL personnel.

A brief discussion of each of these factors follows.

A. Absence of Spill Containment at Outdoor Transformers

In total, 57 of the 133 PCB transformers are outdoors. No dikes are in place to contain a possible leak of PCB fluid from these units, and any significant leak would flow directly to the surrounding soil. Minor leaks that were contained using plastic bags were reported for three PCB transformers in this group during the January

monthly inspection conducted by Pan Am linemen. Units at TA-53-67, TA-35-32, and TA-3-56 had small leaks.

Of particular concern are two PCB transformers in TA-2 outside the Omega West Reactor in Building 51 adjacent to the stream flowing through Los Alamos Canyon. These transformers are of particular concern because of the possibility of rockfalls from the canyon wall above the transformer location. At the time of the Environmental Survey, a large boulder was secured by cables directly above the transformer pad. The pad supporting the transformers has no dike to retain the transformer fluid should a leak develop in the units. A drain in the pad empties directly to the canyon stream. Should a leak occur, the PCB fluid would discharge directly to the canyon stream. Rockfall from the canyon wall near these units would almost certainly hit the transformers and initiate a leak of PCB fluids.

B. Location of PCB Transformers Near Drains

There are eight PCB transformers located indoors near drains. Three units located in TA-3-22, the Powerhouse, are of particular concern. These transformers contain a total of 2,013 gallons of PCBs, are 36 to 40 years old, and have had pinhole leaks that were contained with plastic bags and epoxy cement. The three transformers had a total of five plastic bags and three epoxy plugs. A sewer opening is adjacent to one of these units. Because no containment dike is in place, any leak in these units would flow to the drain system.

C. Operating Condition and Age of the PCB Transformers

Pan Am electricians inspect the 133 PCB transformers on a regular monthly basis. Review of the linemen's inspection report to the LANL indicates that leaks were observed at 31 of these units. In some cases more than one leak was observed. It is evident that the leaks are common to the older operating units. The average age of units in this category is in the range of 31 to 35 years. It is logical to expect increasing failure rate with increasing age.

D. Location of PCB Transformers Indoors Within High Traffic Areas

The majority of leaking transformers are located indoors. There is particular concern that the 17 transformers in TA-3, Building 29, are close to LANL personnel performing routine assignments in their work areas. There is potential for direct contact by these staff members with PCB fluids should major leaks develop. The possibilities increase with the increasing age of the transformers.

Final Survey Finding: Toxic and Chemical Materials II-2 (Preliminary Survey Finding: Toxic and Chemical Materials II-2)

Potential Release of Oil and Hazardous Materials. There is a significant potential for releases of oil and hazardous materials to the environment due to inadequate drum management practices.

Because of the large number of drums observed at the LANL by the Environmental Survey team, a detailed inspection of drum management practices was performed in 10 TAs where a large number of drums had been observed. More than 800 drums of products and wastes were observed during this inspection. Materials contained in drums included dielectric oil, motor oil, hydraulic fluid, alcohols, chlorinated solvents, various laboratory and process wastes, and discarded materials. The following inadequate drum management practices were observed:

- storage of drums directly on the ground surface (soil);
- storage of drums without secondary containment berms, dikes, or drip pans;
- storage of unmarked and unlabeled drums;
- storage of drums in uncovered locations; and
- storage of drums adjacent to drainage ditches.

Each management practice is discussed below.

- Storage of drums directly on the ground surface. Storage of drums directly on the ground surface is of concern because it increases the potential for corrosion of drums and soil contamination following spills or leakage from drums. That is, there is no secondary barrier (e.g., asphalt or concrete) to prevent soil contamination following release from drums. Several factors are of importance when determining the environmental significance of storage of drums directly on the soil surface. These factors include the toxicity of the material stored in the drum (i.e., the potential hazard associated with release), the condition of the drum (i.e., the likelihood for a release), and the location of the drum (i.e., the potential to impact receptors). Instances of particular concern with respect to the material stored in the drums were the storage of drained HE-contaminated oil drums on the soil near Building TA-16-517 and the storage of drums containing waste dielectric oil (which had not been analyzed for PCBs) and chlorinated solvent on the ground south of Building TA-46-76. In both cases, leakage from drums would result in contamination of the soil with hazardous materials.

- Storage of drums without secondary containment berms, dikes, or drip pans. Storage of drums without secondary containment berms, dikes, or drip pans is of concern because it increases the potential for environmental contamination resulting from drum leaks. Nevertheless, this practice was widespread throughout the areas surveyed. No dikes or bermed storage areas were observed, and it is estimated that less than half of the product drums stored on horizontal racks had drip pans. As with storage on the ground, the factors related to significance of potential environmental problems are those related to the likelihood and consequences of leakage (i.e., contents, condition, and location). One instance of particular concern was the storage of waste transformer oil in an unbermed location north of Building TA-53-2. This oil is potentially contaminated with PCBs, and uncontained leakage could result in contamination of a large area with this material. Also, 16 waste oil drums were stored on pavement at the north edge of Mortandad Canyon south of Building TA-35-67. There was no containment structure between the drums and the canyon to prevent leaks from reaching the canyon.

- Storage of unmarked and unlabeled drums. Storage of unmarked and unlabeled drums is of concern because it increases the opportunity for

mishandling the stored material. Of particular concern are unmarked product drums which may be misused or improperly disposed of by laboratory personnel. As an example, an unlabeled product drum was located on a storage rack next to Building TA-21-210. Personnel in the area did not know what the stored material was. Also of particular concern are unlabeled drums stored together. This practice increases the opportunity for improper storage of incompatible or reactive materials. Approximately 20 unlabeled drums were stored together next to Building TA-16-516. These drums could potentially contain incompatible materials.

- Storage of drums in uncovered locations. Storage of drums in uncovered locations is of concern because it exposes drums to the weather and increases the opportunity for rusting and corrosion. The vast majority of drums observed at the LANL by the Environmental Survey were stored in uncovered locations. A factor complicating this practice is that outdoor storage generally presents a greater opportunity for contaminant migration should spillage occur (e.g., outdoor storage allows for direct contract with surface runoff). Of particular concern were two drums of solvents near Building TA-8-110 and one unmarked drum near Building TA-18-126. These drums were all stored outside, were rusted or corroded, and were located very near drainage sumps. Similarly, a rusted unlabeled drum was stored outside next to a drainage ditch near TA-21-155. Another problem associated with outdoor storage of drums is that precipitation causes drum labels to fade or wash off. Drums with labels destroyed by the weather were observed near Buildings TA-8-43 and TA-9-35. Another concern with the storage of drums in uncovered locations is that heat expansion can lead to pressurization of drums (particularly those containing volatile substances), which increases the opportunity for leakage. Because of the mild temperatures during the Survey, such cases were not observed. A number of instances of outdoor storage of volatile materials were observed, however, which may be of concern during warmer weather.

- Storage of drums in or adjacent to drainage ditches. Storage of drums in or adjacent to drainage ditches is of concern because it greatly increases the opportunity for migration of contaminants should leakage occur. Factors of importance with respect to this practice are the condition of drums and the toxicity of the stored material. Of particular concern was an open drum of

unknown material located in a drainage ditch southwest of Building TA-21-3. In addition, 15 drums of waste dielectric oil were observed next to a drainage ditch between Buildings TA-46-1 and TA-46-42. These drums were apparently in poor condition, as evidenced by signs of leakage. With respect to storage of toxic materials, 20 drums of a variety of material were stored next to a drainage ditch by Building TA-46-76. These drums contained chlorinated solvents and dielectric oil potentially contaminated with PCBs.

Final Survey Finding: Toxic and Chemical Materials III-1 (Preliminary Survey Finding: Toxic and Chemical Materials III-1)

Potential Soil Contamination from Leaking Drums. Releases of oil and hazardous materials from drums were observed during the Environmental Survey. Evidence of drum spillage and leakage was observed in all 10 TAs that were the subject of a detailed outdoor inspection conducted by the Environmental Survey team. Specific instances of spillage observed were as follows:

- Soil staining, indicative of leakage, was observed where 43 drums were stacked near Building TA-16-517. These drums were empty but contained residuals of HE-contaminated hydraulic oil.

- Ground staining, indicative of leakage or spillage, was observed where seven drums were stored east of Building TA-53-4. These drums contained oils and solvents. Five of the drums were certified free of PCBs.

- Oil sludge, resulting from leakage of dielectric oil from drums, was observed on the concrete roadway southwest of Building TA-35-125. The drums were removed by the LANL during the Environmental Survey.

- Soil staining indicative of drum leakage was observed at the edge of Mortandad Canyon south of Building TA-35-67. This staining appeared to be the result of 4 leaking oil drums, which were noted among 16 oil drums stored on asphalt at the edge of the canyon.

- Some oil staining from minor spillage was noted at the drum storage area near Building TA-15-203. These drums, which include several containing chlorinated solvents, are stored near the edge of Water Canyon.

- Soil staining was noted in a drainage ditch located near Building TA-33-23. This staining was the result of a leaking drum of kerosene stored in the ditch.

- Soil heavily stained from drum leakage was observed at a drum storage area northwest of Building TA-33-22. This staining appeared to come from several leaking drums that were noted among 24 waste oil drums stored at the area.

- Ground staining indicative of minor spillage was observed at a drum storage area located at TA-9-38. Drums at this area are stored outside on racks and contain a variety of organic solvents.

- Soil contamination indicative of leakage was observed at four partly full waste Freon drums located in a drainage ditch south of Building TA-21-3. This ditch discharges to Los Alamos Canyon.

- Soil staining from drum leakage was noted at 20 drums stored south of Building TA-46-76. These drums, located next to a drainage ditch, contain waste oil, hydraulic fluid, and chlorinated solvents.

- Heavy soil staining and pooling of oil on the asphalt surface were observed at a drum storage area located north of the parking lot between Buildings TA-46-1 and TA-46-42. The area of soil staining extends from the edge of the asphalt storage pad into an adjacent drainage ditch. This area is used to store 15 old drums of waste dielectric oil.

- Some soil staining indicative of minor spillage was noted at four product drums stored north of Building TA-18-141. These drums contain alcohols, oil, and an unknown product. There were no drip pans under the drums.

- Soil and asphalt staining from drum leakage was observed at two drum storage areas east and north of Building TA-3-66. These two sites have over 60 drums

containing a variety of materials including oil, solvents, and suspect radioactively contaminated material.

- Much evidence of oil spillage was noted in the area behind the main Motor Pool Shop. One spilled oil drum was located next to the fence behind the shop.

As part of the Survey S&A Program, soil samples were collected from drum spill areas and analyzed for volatiles, semivolatiles, metals, radionuclides, PCB, and pesticides. The analysis confirmed the presence of contaminants such as PCB, uranium-238, methylene chloride, and anthracene. These data were used to model the Past Liquid Releases ranking unit.

Final Survey Finding: Toxic and Chemical Materials III-2 (Preliminary Survey Finding: Toxic and Chemical Materials III-2)

Potential Releases of Hazardous Liquids. A large number of underground storage tanks (USTs) at the LANL have the potential for undetected releases of hazardous and radioactive liquids to surface and subsurface soils. Tanks with the potential for undetected releases fall into one of two classes: untested tanks (or those tanks with inadequate inventory control) and unknown or unidentified tanks.

Potential environmental problems associated with these two classes are discussed below.

- Untested tanks or those tanks with inadequate inventory control. Storage of hazardous materials in these tanks is of concern because there is no means to accurately determine if the tanks are leaking. Leaks from these tanks may go undetected and, therefore, uncorrected. Those tanks of particular concern are high-volume tanks that have not been tested for tightness and that have no active inventory control program. Tanks in this category are the dielectric oil tanks at Buildings TA-15-287, TA-35-188, and TA-35-197. It is not known whether the dielectric oil in these tanks contains PCBs.

- Tanks of unknown history and location. There are several USTs of unknown history and location. These tanks are of concern because they may have leaked, or have the potential to leak, without detection. The concern over

these tanks is related to the toxicity of the tank contents, the location of the tanks, and the amount of information existing for these tanks. Of particular concern are those tanks about which very little is known. Tank TA-41-46 was identified as a fuel tank in engineering drawings, yet the Survey team could not locate anyone who knew anything of the existence of this tank. According to these drawings, the tank is located within several hundred feet of the creek in Los Alamos Canyon. Tanks TA-1-442, TA-1-443, and TA-1-444 are abandoned tanks located in the Los Alamos townsite. Both location and history of these tanks are unknown.

Final Survey Finding: Toxic and Chemical Materials III-3 (Preliminary Survey Finding: Toxic and Chemical Materials III-3)

Potential Releases of Oil and Hazardous Materials from Uncontained ASTs. A number of ASTs at the LANL used for storage of oil and hazardous materials lack any secondary containment. Thirteen of these tanks were observed by the Environmental Survey team. Eleven contained raw materials and products, and two contained waste oil.

Because of the lack of containment, any spill or leak from these tanks can be released to the environment. The potential hazard associated with these tanks depends on the toxicity of the material stored, the location of the tanks with respect to receptors, and the condition of the tanks. Several tanks were noted to be of particular concern. The 3,000-gallon dielectric oil tank south of Building TA-35-34 is located next to Mortandad Canyon. A leak from this tank would likely reach the canyon. It is unknown if this oil contains PCBs. Dielectric oil is stored in two 35,000-gallon siege tanks located west of Building TA-35-29. There is much evidence of spills and leakage around these tanks. The plywood-covered metal tanks appear to be old and their condition is unknown.

Final Survey Finding: Toxic and Chemical Materials III-4 (Preliminary Survey Finding: Toxic and Chemical Materials III-4)

Potential Releases of Oil and Hazardous Materials from Partially Contained Tanks. A number of ASTs at the LANL used for oil and hazardous materials storage have insufficient secondary containment capacity for major spills or leaks. Twelve tanks

were observed by the Environmental Survey team. The 12 tanks contained raw materials and products.

Because the tanks are only partially contained, major spills or leaks (e.g., most of the tank contents) could result in releases to the environment. The potential hazard associated with these tanks depends on the toxicity of the material stored, the location of the tanks with respect to receptors, the condition of the tanks, and the capacity of the tanks compared to the containment capacity. Two 31,000-gallon dielectric oil tanks at Building TA-3-550 are located above a 21,000-gallon collection sump. The Environmental Survey noted that this sump was filled mostly with oily water, presumably rainwater. The sump was observed to have only about 12 inches of freeboard, significantly less than its empty capacity. These tanks are located next to Twomile Canyon, and a major release would likely overflow the sump and flow into the canyon. Spill containment upgrades planned for these tanks include construction of a new bentonite-lined containment basin. In addition, earthen dikes will be constructed to divert run-on away from the tanks (Salgado, 1987).

Final Survey Finding: Toxic and Chemical Materials III-5 (Preliminary Survey Finding: Toxic and Chemical Materials III-5)

Potential Soil Contamination from Spills and Leakage of Dielectric Oil at TA-35. Activities at the LANL involving high-voltage equipment require the use of large quantities of dielectric oil. Operations involving the storage and transfer of this oil have resulted in spillage and leakage at TA-35.

Transfer of dielectric oil from storage tanks to the Marx Generator in Building TA-15-276 has resulted in overflow and spillage into Mortandad Canyon. Similarly, transfer of oil from the Marx tanks in Building TA-35-125 to USTs has resulted in spillage, as indicated by the area above the underground tanks being heavily stained. Oil spilled during transfer operations flows to a gunite-lined surface impoundment, where accumulation of precipitation runoff causes the oil to overflow to Mortandad Canyon. Dielectric oil at Buildings TA-35-29 and TA-35-86 is stored in several 35,000-gallon Marx and siege tanks. These plywood-covered metal tanks show signs of leakage. In addition, the area around Tank TA-35-154 is heavily stained from oil spilled during transfer operations. The surface runoff control culverts in this area are

stained with oil, indicating that oil spilled in this area has been carried by runoff to Mortandad Canyon.

As part of the Survey S&A Program, soil samples were collected and analyzed for pesticides, PCB, radionuclides, and volatiles. The analysis confirmed the presence of contaminants such as acetone, DDD, and uranium-238. These data were used to model the Past Liquid Releases ranking unit.

Final Survey Finding: Toxic and Chemical Materials III-6 (Preliminary Survey Finding: Toxic and Chemical Materials III-6)

Potential for Releases of Asbestos to the Environment. Of the asbestos on-site, that used as insulation on exterior steam lines is of particular concern since the steam lines are exposed to the elements and friable asbestos could easily be dispersed.

Steam lines of this type were observed in poor condition at TA-16-515 (an unused site) and were observed in good condition in TA-21 (an active area). Exterior steam lines are being inventoried by the site asbestos inspection, although the emphasis of that assessment is on worker health and safety concerns.

Abandoned buildings with loose asbestos and open doorways are of secondary concern as a source of asbestos to the environment. This situation was observed at TA-16-517.

Although the probability of such an event is low, catastrophic destruction (by fire or explosion) of a building containing asbestos could produce a substantial release of asbestos to the environment.

8.1.7 Radiation

There are no Category I, II, or III Final Survey Findings for Radiation at the LANL.

8.1.8 Quality Assurance/Quality Control

There are no Category I, II, or III Final Survey Findings for Quality Assurance/Quality Control at the LANL.

8.1.9 Inactive Sites and Releases

The following constitute the Final Survey Findings for Inactive Sites and Releases at the LANL. There are no Category I or II Final Survey Findings for Inactive Sites and Releases. The Category III Final Survey Findings are provided below.

Final Survey Finding: Inactive Sites and Releases III-1 (Preliminary Survey Finding: Inactive Sites and Releases III-1)

Contamination of Soil by Radioactive and Chemical Liquid Wastes. Former radioactive and chemical liquid waste disposal practices at the LANL have contaminated surface and/or subsurface soils, or potentially have resulted in such contamination, with unknown levels of residual contaminants possibly continuing to affect the environment.

Approximately 175 disposal sites have been identified at the LANL that received liquid effluents in the past which were contaminated with radionuclides or chemicals, or both. These sites were evaluated based on type of waste they received, quantity of waste, duration of use, location relative to public access, and potential for contaminant migration. Based on this review, the 11 sites listed below were noted to be of particular concern:

- Material Disposal Area T (MDA-T) in TA-21
- Liquid waste disposal in TA-10
- Stormwater collection basins in TA-35
- Pond east of Buildings 89 to 93 in TA-16
- Plating shop outfall from Building 92 in TA-16
- Backfilled ponds adjacent to former Buildings 30 to 34 in TA-16
- Plating shop outfall from Building 52 in TA-22
- Sumps 69 and 70 in TA-46
- Septic tank 59 in TA-8
- Overflow from a cooling tower (TA-21-143) in TA-21
- HE processing outfall from Building 34 in TA-22

The following paragraphs provide specific information on each of these sites.

Material Disposal Area T in TA-21

Past disposal of 18 million gallons of raw and treated process effluent at MDA-T has resulted in radioactive contamination to a depth of at least 100 feet and in surface soil contamination in an area accessible to the public that is outside the disposal site.

MDA-T is an inactive liquid waste disposal site which consisted of four subsurface absorption beds, approximately 100 shafts, and one pit. Use of this area began in 1945. It is unclear when it stopped receiving wastes.

Records indicate the following waste was disposed of in this area: uranium-233, plutonium-238 and 239, americium-241, mixed fission products, and tritium. The largest amounts were disposed of between 1945 and 1952, when MDA-T received 14 million gallons of untreated waste from the plutonium processing conducted at DP West in TA-21. The concentration of the plutonium in this waste was estimated at 60 counts per minute and the average fluoride concentration was 160 parts per million. However, waste with average concentrations of plutonium of 7,000 counts per minute was received between 1951 and 1952.

Studies have shown vertical movement of radioactive contaminants to a depth of 100 feet (the depth limit of the investigation) and horizontal movement in terms of surface soil downgradient of the disposal area. In the soil sampling, cesium-137 and strontium-90 were found at levels in excess of 7,000 times background while plutonium-239 was found at 100 times background. High levels of tritium were also found.

Further investigation of this area is planned under Phase II of the Comprehensive Environmental Assessment and Response Program (CEARP).

Liquid Waste Disposal in TA-10

Former liquid waste disposal practices at the TA-10 "Tank Farm" area in Bayo Canyon have potentially contaminated subsurface soils with radioactive wastes and other hazardous constituents. Liquid wastes were discharged to the surface and

subsurface soils, and to the ephemeral stream in Bayo Canyon. Although the site has been closed for approximately 25 years and ownership transferred to Los Alamos County, the level of information concerning the extent of the residual contamination may be insufficient to ensure that the restricted-use agreement is adequate.

The restricted-use agreement between the LANL and the county disallows disturbance of contaminated soils within the demarcated area. However, there is a potential for pulsed migration of residual contamination outside the demarcated restricted zone, driven by:

- the ephemeral stream, which transects the restricted zone, and/or
- seasonal pore water or perched groundwater.

Furthermore, there are no data on possible nonradiological contaminants that may remain at the former disposal site. These chemicals, such as nitric, hydrochloric, hydrofluoric, and sulfuric acids; metals; and reportedly smaller volumes of organic solvents were disposed of at the site.

Stormwater Collection Basins at TA-35

Two stormwater collection basins on the southern side of TA-35 receive runoff that is potentially contaminated with PCBs and/or radionuclides due to the prevalence of past spills and areas of stained soil in the operational area of the TA.

Two elongated stormwater collection basins are located south of Buildings TA-35-236, 34, and 110. Based on the review of aerial photographs, these basins have existed in TA-35 for at least 20 years. Past operations in TA-35 include manufacturing radioactive sources using materials such as strontium-90, neptunium-237, germanium hydride, beryllium salts, and plutonium oxalate aerosols. Also, PCB-contaminated oil has been used extensively in this TA (DOE-AO, 1986). The two basins apparently have been long-time recipients of surface water runoff from the process area where spills may have occurred and consequently they may have become contaminated. The western basin is approximately 60 feet long, 10 feet wide, and 8 feet deep. A breakthrough has occurred in the easternmost basin, which allows stormwater to flow down the side of the canyon.

Pond East of Buildings 89 to 93 in TA-16

Process wastes containing HEs, solvents, and possibly metals from drains in Buildings 89, 90, 91, 92, and 93 were disposed of in a pond east of the buildings, potentially leaving residual contaminants in the sediments.

Buildings 89, 90, 91, and 93 were used for processing HE in the 1950s. Plating operations took place in Building 92. The drains from these buildings reportedly discharged to a natural depression east of this group of buildings. The potential exists for HE, solvent, and possibly metal contaminants from the process wastewater to have accumulated in the pond sediments. A 1957 map of TA-16 depicts this area as a pond, and at the time of the Survey the pond contained water. However, according to LANL personnel, the pond dries out seasonally. The pond is approximately 150 feet in diameter.

Plating Shop Outfall from Building 92 in TA-16

Untreated plating shop wastes were potentially discharged to a drainage swale north of Building 92 and residual contaminants may remain as a source of surface soil contamination.

An area north of Building 92 is suspected of receiving untreated plating shop wastes from operations that took place in Building 92. This building was used in the 1950s and according to a LANL utility line map available during the Survey, an outfall from Building 92 was located on the opposite side of the road. This area is a natural drainage swale and at the time of the Survey, no evidence of an outfall pipe was noted; however, observations were hindered by snow cover.

Backfilled Ponds Adjacent to Former Buildings 30 to 34 in TA-16

Effluent from HE machining operations in Buildings 30, 31, 32, 33, and 34 was discharged to four ponds that have been backfilled, potentially creating elevated levels of HE in the pond sediments.

High explosive machining work was conducted in the 1950s in a complex of buildings numbered 30 to 34. The types of HE used are unknown but at a minimum likely included TNT. Apparently, the wastewater from these operations was disposed of in four ponds adjacent to the buildings. The complex of buildings has been removed and the four ponds backfilled. Although some photographs of this work are available, there is no record indicating removal of the sediments, which were probably contaminated with HE. Thus, potential HE contamination remains in the subsurface soils.

Plating Shop Outfall from Building 52 in TA-22

Soils along the drainage from Building TA-22-52 are potentially contaminated as a result of past discharges from that building of etching and plating operations waste. Etching and plating operations were conducted in this building from 1953 to 1984.

These operations as well as photoprocessing and other contributions from the Shops building include sodium hydroxide, hydrogen peroxide, sodium thiosulfate; ferric chloride; thallium; sodium carbonate; perchloroethylene; inorganic constituents such as beryllium, gold, lead, cyanide, nickel, copper, zinc, and cadmium; and acids such as sulfuric, hydrochloric, chromic, hydrofluoric, and phosphoric. The volumes discharged are unknown.

The vegetation in the outfall drainage area appeared stressed during the Survey. Numerous dead pines were observed.

Sumps 69 and 70 in TA-46

Two inactive sumps that potentially received wastewater from a laboratory and shop building or a test building are located on the edge of the mesa and may contain contaminants that could leach into subsurface soils or break out on the wall of Canyon del Buey.

Information on the use of two sumps, 69 and 70, is very limited but judging from their location, they may have received waste from Building 58, a laboratory and shop building, or from Building 16, a test building used in the design of a nuclear rocket reactor known as the Rover Program. Potentially the waste may have been

contaminated with general laboratory chemicals such as solvents and various reagents or may have contained uranium, since Building 16 is known to be moderately contaminated with this radionuclide (DOE-AO, 1986). The sumps are very close to the wall of the Canyon del Buey and their wastes may have leached into subsurface soils and/or migrated to the canyon side. The sumps are approximately 3 feet in diameter and 8 feet deep. The two sumps are connected, with the overflow from Sump 70 entering Sump 69 (Lugar, 1987). According to the 1983 LANL structure location plan for TA-46, both sumps have been abandoned since 1973, which correlates with the time the Rover Program ended and limited radioactivity cleanup work was conducted at the TA (DOE-AO, 1986).

Septic Tank 59 in TA-8

Septic Tank 59 in TA-8 potentially received HE-contaminated waste from laboratories involved in development of explosives, and residual contaminants may remain as a source of pollution to surrounding soils.

TA-8 was first used as a gun-firing site to test projectiles, some containing uranium cover, and later used to develop HE (DOE-AO, 1986). Wastewater from the old part of TA-8 apparently was disposed of in septic tanks, one of which is abandoned but still in place. The buildings themselves are posted with signs indicating that they are contaminated with HE and radioactivity; therefore, the drains and associated septic tank are likely to be contaminated as well. It is uncertain whether the tank was connected to a drainfield. The topography in the vicinity of Tank 59 allows surface-water runoff to accumulate and periodically results in flooding. Although the tank has been inactive for years, it contained an estimated 3 to 4 feet of liquid in June 1987, according to observations made by the Survey S&A team (Lugar, 1987). Thus, the tank apparently receives stormwater, and during flooding conditions, contaminants may be released from the bottom sludges in the tank and result in surface soil and/or subsurface soil contamination.

Overflow from a Cooling Tower (TA-21-143) in TA-21

The cooling water in Tower 143 was contaminated with plutonium and possibly contained chromium, which through regular overflow incidents and drift loss

potentially contaminated surface soils in the TA and on the wall of Los Alamos Canyon.

The plutonium contamination was caused by plutonium processing conducted in Buildings TA-21-2, 4, and 5. The cooling water was reportedly contaminated in 1952 and 1953. Overflow from the tower was reported to be 30,000 to 40,000 gallons/week, with a high of 150,000 gallons/week in the summer (DOE-AO, 1986). Presumably, this water was released over the edge of the mesa into Los Alamos Canyon and the potential exists for surface soils to be contaminated with residual levels of plutonium. Furthermore, corrosion control additives used in the cooling tower may have included chromates, in which case residual levels of chromium may be present in the surface soils too.

TA-21 is currently being addressed by the LANL under Phase II of the CEARP; therefore, soil S&A will not be performed as part of the Survey.

HE Processing Outfall from Building 34 in TA-22

These two outfall/drain tile systems may have contaminated soils in the marshy area located north of Building 34 in TA-22. This potential contamination may have been caused by the discharges from liquid wastes originating in the building which housed a photo laboratory and a chemistry laboratory that was involved with HE research and shape fabrication. The waste constituents reportedly are acetone; HE consisting of PETN, possibly RDX and HMX; and silver and other inorganics. Volumes or discharge rates were not reported but are not believed to have been excessively high due to the nature of the discharge mechanism -- clay drain tiles which allow the liquid wastes to leach into the soils.

There were also several other items of concern noted during the Survey which may provide additional contamination to the soils of this marshy area. A half-buried 55-gallon drum of unknown contents or origin was observed in the southeast area of the marsh. The northern end of the marsh contained concrete rubble and other miscellaneous debris. These may be indicative of past burial activities in this marsh.

As part of the Survey S&A Program, surface soil, subsurface soil, pond water, sediment, and sludge samples were collected and analyzed for volatiles,

semivolatiles, HE, radionuclides, metals, and PCB/pesticides. The analysis confirmed the presence of contaminants such as acetone, 1,2-dichloroethane, americium-241, and uranium-235. These data were used to model the Former Liquid Disposal ranking unit.

Final Survey Finding: Inactive Sites and Releases III-2 (Preliminary Survey Finding: Inactive Sites and Releases III-2)

Lack of Cleanup of Past Spills and Releases. Past spills and releases that have occurred at the LANL have potentially resulted in surface soil contamination, yet in many cases actions to clean up these areas have not been initiated; therefore, hazardous, toxic, and/or radioactive contaminants may remain as a source of pollution.

Past chemical spills and historical incidents of radioactive releases are known or suspected to have occurred in 19 TAs at the LANL. Most of these spills have potentially contaminated surface soils; some may have contaminated canyon walls. The spills were evaluated based on the date of occurrence, the type of substance involved, the potential for migration, and visual evidence of residual soil contamination or stressed vegetation noted during the Environmental Survey. As a result of this review, the four areas listed below were found to be of particular concern:

- Stained soil south of Building 207 in TA-35
- Stained soils north of Building 31 in TA-46
- Spills around Shed 197 in TA-46
- Spill at former TA-32 moving onto U.S. Department of Energy (DOE) property

Each of these areas is described in more detail in the following paragraphs.

Stained Soil South of Building 207 in TA-35

Numerous areas of dark stained soil indicative of past spills that potentially included PCB-contaminated oil exist south of Building 207 and have migrated down the wall of Mortandad Canyon.

Patches of stained soil exist throughout the area south of Building TA-35-207. The source of this contamination is believed to be spills and surface runoff from an upgradient area containing dielectric oil storage tanks. Large quantities of oil are required to operate the Marx generators located in TA-35 and in the past, the oil may have been contaminated with PCBs. Although the oil storage area is currently bermed, water that collects inside the bermed area is directed through an underground pipe to the area around Building 207. Some of the soil in and around the storage tanks is grossly contaminated with oil. At least the upper 2 feet of soil on the southern end of the bermed area is heavily discolored by oil saturation. Consequently, drainage from this area has a high probability of being contaminated.

Stained Soil North of Building 31 in TA-46

Several areas of soil stained as a result of past releases were observed north of Building 31 in TA-46 on the edge of the mesa, a location that is highly susceptible to migration down the wall of Canyon del Buey.

Activities either currently or historically associated with Building 31 have resulted in generation of radioactive wastes. In support of these activities, there has been a tank used for cleaning metal containers and components, a drum storage area, and an equipment storage area next to the building. Based on this information, a wide variety of contaminants may be in the surface soils. Building 31 is located extremely close to the edge of the mesa; consequently, contaminants from spills on the northern side of the building are highly susceptible to migration via surface water runoff down the canyon side.

Spills Around Shed 197 in TA-46

Potentially hazardous chemicals are leaking from equipment and possibly from various containers in Shed 197 and may be a source of surface soil contamination in the vicinity of a storm drain.

Shed 197 is a storage area containing equipment that has leaked in the past and that appeared to be actively leaking an oil-like substance during the Environmental Survey. A cylinder labeled "German-poisonous gas" was stored among the pieces of

electrical equipment and several drums were stored outside the shed on the pavement. Portions of the wooden walls have become stained and darkened from absorbing the substances that have been released. Past spills have also stained the ground on the southeastern corner of the shed, which is upgradient of a stormwater drain. The drain daylights outside the TA fence and stained soils were noted at the discharge point.

Spill at Former TA-32 Moving onto DOE Property

A release of an oily, dark tar-like substance was observed in the old TA-32 area. The area was adjacent to a tank and fuel pump on property that is currently owned by Los Alamos County and used by the County Road Department. The area affected by the spill included DOE property and extended down the wall of Los Alamos Canyon. Signs of vegetation stress were evident.

As part of the Survey S&A Program, soil samples were collected and analyzed for PCB/pesticides, radionuclides, volatiles, semivolatiles, and metals. The analysis confirmed the presence of contaminants such as PCB, uranium, acetone, and methylene chloride. These data were used to model the Past Liquid Releases ranking unit.

Final Survey Finding: Inactive Sites and Releases III-3 (Preliminary Survey Finding: Inactive Sites and Releases III-3)

Potential Undetected Releases from USTs of Hazardous and Radioactive Liquids to Surface and Subsurface Soils. Some USTs at the LANL formerly used for storage of petroleum products and radionuclides have been abandoned in place or removed. These abandoned and removed tanks are of concern because little is known of their potential for leakage.

- Tanks abandoned without removal of contents have a high potential for undetected leakage. The potential for environmental problems associated with these tanks is related to the age of the tanks, the time since abandonment, the amount of material remaining in the tank, and the nature and toxicity of the contents. Of particular concern are those tanks abandoned some years ago. Tanks TA-6-47, TA-8-60, TA-8-61, TA-15-48, TA-15-52, TA-18-

104, TA-35-18, TA-35-19, and TA-35-20 were all abandoned more than 13 years ago and are of unknown age and inventory. Concerns over removed tanks are related to the time period when the tanks were removed. Recent tank removals appear to be well-documented with respect to removal of residual contamination. Much less is known about tanks removed many years ago. Of particular concern are tanks TA-1-240, TA-2-29, TA-2-67, TA-16-512, and the tank farm at TA-10. These tanks were all removed 20 or more years ago and the status of residual contamination at these sites is largely unknown.

- Two tanks located at TA-21-107 and TA-21-108 formerly contained radioactive waste. The tanks are over 20 years old and are of unknown capacity. The tanks have been drained but contain a sludge which is suspected to be plutonium contaminated (personal communication with LANL personnel). The tanks are included as part of MDA-A.

Final Survey Finding: Inactive Sites and Releases III-4 (Preliminary Survey Finding: Inactive Sites and Releases III-4)

Potential Chemical and Radioactive Contamination of Surface Soils at Open Dumps and Boneyards. Chemical and radioactive wastes disposed of in open dumps and contaminated equipment stored in boneyards are a concern due to direct exposure of contaminants and have potentially resulted in surface soil contamination via resuspension and/or runoff.

Thirty open dumps and boneyards have been identified at the LANL. All open dumping areas and open storage areas have potentially resulted in environmental contamination; however, 7 of the 30 LANL sites are of particular concern as sources of pollution based on the type of wastes or contaminated equipment exposed on the surface. These seven sites are:

- Open dump MDA-M in TA-0
- Open dump MDA-Z in TA-15
- Open dump in TA-14
- Boneyard in TA-14
- Boneyard in TA-36

- Incinerator Ash Dump in TA-00L
- Open dump at G Point in TA-15

The following paragraphs provide detailed information on each of these sites.

Open Dump MDA-M in TA-0

Asbestos, potentially hazardous chemicals, and possibly radioactive wastes are exposed in the open dump MDA-M, which is not fenced to prevent access and has no controls to prevent migration of wastes via surface water runoff or resuspension.

MDA-M was opened in 1947 and remains as an uncontrolled open dump in TA-0. Although there is no inventory of wastes placed in this dump, some general waste types were observed at the dump during the Environmental Survey. These included material that resembled asbestos; numerous, unlabeled glass bottles with some containing liquids; old, discarded paint, solvent, and trash containers; and piles of concrete and metal construction rubble. In a smaller dump on the side of the road leading to MDA-M, radioactively contaminated waste had been disposed of in the past, according to LANL personnel.

No effort has been made by the laboratory to restrict access to the dump or to control migration of wastes from the disposal area. Movement of contaminants by surface water runoff is likely to have occurred. Dispersal of asbestos and other contaminants by resuspension is also a concern; however, MDA-M is in a relatively isolated location where workers are not likely to be exposed.

Open Dump MDA-Z in TA-15

Radioactively contaminated material has been disposed of in an open dump, MDA-Z, with no physical controls in place to ensure prevention of direct contact of employees of LANL with the wastes or to reduce the potential of environmental pollution, particularly surface soil contamination.

MDA-Z was used from 1965 to 1981 for disposal of debris collected from the firing sites at TA-15. Blast mats contaminated with uranium and possibly other radionuclides have been placed in this dump, along with sandbags and other firing

site debris that are potentially contaminated with uranium, beryllium, lead, and mercury. The total volume of wastes disposed of at this open dump is unknown. During the Survey, radiation measurements of up to 20,000 counts per minute were detected at MDA-Z. Contaminants from MDA-Z are available for migration into the surrounding soils by surface water runoff and/or resuspension.

Open Dump in TA-14

Potentially contaminated debris from the firing sites in TA-14 has been dumped in a drainage pathway near Buildings Q-34 and Q-40 and may be a source of contamination to surface soils down the canyonside.

Firing site debris from TA-14, including sandbags and blast mats, has been disposed of along the edge of a paved area and across an erosion gully that leads into Canyon de Valle. During the Survey, several 5-gallon containers and one 55-gallon drum were observed on the canyonside below this dumping area. Firing site debris is commonly contaminated with HE, metals, and possibly radionuclides; therefore, the wastes placed in this dumping area may be contaminated with one or more of these constituents. Migration of contaminants, if present, may be enhanced because the debris is directly located in a drainage pathway.

Boneyard in TA-14

Storage of radioactive metal ingots, previously used drums, and other debris in a boneyard in TA-14 may result in contamination of surface soils.

During the Survey, a boneyard was visited in TA-14, north of Buildings Q-34 and Q-40. Equipment such as an old Navy cannon and gun parts were stored in this area, along with stockmetal ingots and fourteen 55-gallon drums. Radiation measurements of up to 4,500 counts per minute were noted next to the metal ingots. The drums were once used in an experiment involving sodium, and their current condition was poor. The drums were open-topped, slightly rusted, and appeared to have burst sometime in the past. Surface soils in this boneyard are potentially contaminated as a result of this equipment and drum storage.

Boneyard in TA-36

There is a potential for surface soil contamination and direct contact by LANL workers to radioactive and toxic chemical materials stored in a boneyard in TA-36.

A boneyard in TA-36 is used for storage of radioactively contaminated equipment, old chemical containers, full cans of isopentane, and various other equipment used in tests conducted at the TA. During the Survey, field radiation measurements next to a piece of equipment known as a collimeter were up to 14,000 counts per minute, presumably due to the yellow particles seen on the equipment that were believed to be uranium. The boneyard is also used for storage of chemical containers, some full and others apparently empty. The equipment and containers stored (both in the past and currently) may be a source of contamination that workers could come into contact with or that may be washed onto surface soils.

Incinerator Ash Dump in TA-00L

Incinerator ash with unknown constituents has been dumped over the edge of the mesa into Pueblo Canyon and is a potential source of toxic contaminants to surface soils downslope via surface water runoff and erosion.

An incinerator that is now inactive once operated near the airport and was used to dispose of wastes, including combustible and metallic wastes generated by the LANL. An inventory of the wastes taken to this incinerator does not exist and the period of its operation is unclear. However, the ash from the incinerator was disposed of over the edge of the mesa and currently remains there. Fragments of metal and tin cans were evident among the piles of ash at the time of the Survey. Since the constituents of the ash are unknown, this surface dump is a potential source of contaminants that may migrate to adjacent soils.

Suspected Dump at G Point in TA-15

A source of radioactively contaminated soil is located at G Point that is available for migration to surface soils or inadvertent direct contact to LANL workers.

During the Survey, field radiation measurements taken in a depression at G Point in TA-15 found that the soil in and around this area is radioactively contaminated. No information was available from LANL personnel regarding this area; however, due to its proximity to the firing site it is reasonable to assume that the depression has been an accumulation point for contaminated soil from Firing Point G. In addition to radionuclides such as uranium, firing site debris is often contaminated with beryllium, lead, and other metals. Therefore, the dump area may be contaminated with these other types of constituents. Also, there is a potential that solvents may be present if spills occurred in the past at the nearby solvent shed.

The disposal practices of Firing Point G have resulted in radioactively contaminated soil and may present a continuing problem of contaminant migration to surface soils through surface water runoff and/or wind resuspension and a potential problem of worker exposure through inadvertent direct contact.

As part of the Survey S&A Program, surface and subsurface soil samples were collected and analyzed for PCB/pesticides, radionuclides, volatiles, semivolatiles, and metals. The analysis confirmed the presence of cesium-134, strontium-90, uranium-238, yttrium-90, and beryllium. These data were used to model the Open Dumps and Boneyards ranking unit.

Final Survey Finding: Inactive Sites and Releases III-5 (Preliminary Survey Finding: Inactive Sites and Releases III-5)

Potential Transport of Chemical and/or Radioactive Contaminants from Inactive Landfills and Burial Areas. A total of 49 inactive landfills, burial areas, and former burn pits have been identified at the LANL that either are known to contain radioactive and/or chemical waste or potentially contain residual waste which may be a source of contamination to subsurface soil and the vadose zone or, if inadequately covered in the past, may have contaminated surface soils downslope.

The closed landfills, burial areas, and formerly used burn pits at the LANL were evaluated during the Survey. Factors such as the types of waste (known or suspected), volume of waste or reported size of the area, location relative to potential migration pathways (i.e., mesa top, edge of mesa top, floor of canyon),

and history of use were reviewed. From this evaluation, 12 sites were found to be of particular concern. These sites are as follows:

1. MDA-B in TA-21
2. MDA-C in TA-0
3. Airport landfill in TA-00L
4. Two waste disposal pits in TA-39
5. Area 1 in TA-20
6. Suspected landfill in TA-33
7. Suspected landfill in TA-46
8. MDA-F in TA-6
9. MDA-N in TA-15
10. Suspected landfill known as the "Cold Dump," in TA-21
11. Suspected burn pit in TA-10
12. Three suspected disposal pits in TA-6

The following paragraphs describe each of these areas in detail.

MDA-B in TA-21

An inactive landfill on the western end of TA-21 known as MDA-B was used for disposal of radioactively and chemically contaminated waste and is a potential source of contamination to subsurface soils and the vadose zone; and, if inadequately covered in the past, contaminants may have been transported to surface soils downslope.

MDA-B is a 6-acre landfill that was opened in 1945 as the first solid waste disposal area of the LANL and closed in 1950 (Reynolds, 1987). Radioactive wastes in the landfill likely include plutonium, polonium, uranium, americium, curium, radioactive lanthanum, actinium, and mixed fission products from the reactor known as the Water Boiler. Wastes were reportedly packaged in cardboard boxes or wrapped with paper (Rogers, 1977). An inventory of the waste volume and curie content is not available. Waste chemicals deemed hazardous by LANL personnel were also placed in MDA-B and include organics, perchlorates, ethers, solvents, other spent chemicals, and corrosive gases (DOE-AO, 1986).

The volume of waste placed in MDA-B was not recorded. Also, there is uncertainty whether the landfill is one large, continuous pit or a series of six pits. During its operation, wastes in MDA-B were probably not covered daily. Also, spontaneous fires occurred (Rogers, 1977) and may be indicative of mixed radioactive and hazardous chemical waste disposal. These past operational practices may have allowed contaminants to migrate beyond the present-day fenced portion of the landfill. The location of the landfill is very close to the edge of the mesa top; therefore the canyon wall on the downslope side of MDA-B may have received contaminated runoff. In addition, wastes placed in MDA-B may be a continuing source of contamination to subsurface soils and the vadose zone.

MDA-C in TA-0

An inactive landfill known as MDA-C received radioactively contaminated wastes and free liquids that were chemically contaminated, which may result in contamination of subsurface soils, the vadose zone, and if inadequately covered in the past, surface soils downslope may also be contaminated.

MDA-C is an approximately 12-acre landfill that is fenced and located in TA-0 on the mesa near the center of the plateau. The landfill operated from 1948 to 1974 for disposal of both radioactive and chemical wastes. MDA-C consists of 7 pits and 107 vertical shafts, with the deepest waste burial recorded to be about 25 feet.

The pits were not lined, nor were most of the shafts. Radioactive wastes placed in MDA-C included uranium-233, 234, 235, 236, and 238; plutonium-239; americium-241; tritium; sodium-22; cobalt-60; strontium-90; fission products; and induced activity. The total inventory (decayed through January 1, 1973) was reported to be 49,682 curies. The types of chemical waste placed in the landfill were not specifically recorded, but included a large variety of chemicals, pyrophoric metals, hydrides, powders, and compressed gases. HEs were reportedly not disposed of in MDA-C.

The operational practices used at MDA-C were similar to those used at MDA-B, with the lack of daily cover and the occasional occurrence of spontaneous fires. Consequently, the downslope side of MDA-C, which is the head of Ten-Site Canyon, may have received contaminated runoff. Also, the waste placed in MDA-C may be a

continuing source of contamination to the subsurface soils and the vadose zone. Only recently in 1984 were surface stabilization measures completed at MDA-C by the LANL, which may help to reduce the potential for downward migration.

Airport Landfill in TA-00L

The inactive landfill at the county airport received waste from the LANL, some of which was radioactively contaminated and some that was nonradioactive but potentially hazardous, and may be a potential source of contamination to surface and/or subsurface soils and the vadose zone.

The landfill, located near the Los Alamos County Municipal Airport, was opened and operated by the LANL until 1966, at which time ownership was transferred to Los Alamos County. LANL-generated waste placed in the landfill was primarily sanitary wastes from the residences in the townsite. However, reports indicate that 125 pounds of uranium were disposed of at the landfill, of which 25 pounds were recovered and taken to another LANL landfill. Also, HE and chemically contaminated wastes were possibly taken to this landfill, according to a LANL report (DOE, 1986). During the time LANL operated the landfill, open burning of wastes was allowed.

Leachate has been observed flowing out of the landfill, and during the Survey, construction debris was observed protruding from the bank of the landfill that parallels Pueblo Canyon. Consequently, the landfill may be a source of surface soil contamination. Also, through infiltration and leachate generation, the landfill may be a source of contamination to subsurface soils and the vadose zone.

Two Waste Disposal Pits in TA-39

Two pits reportedly exist in TA-39, located in Ancho Canyon, that were used for disposal of firing site debris and may be a source of contamination to subsurface or perched groundwater in the canyon. In addition to the firing site debris that was potentially contaminated with radionuclides, HE, and metals, two pits may have received other waste from the laboratory and shops in the TA.

Background information indicates that two waste disposal pits may exist north and northwest of Building 69 in TA-39. These pits are believed to be the precursor to MDA-Y, which is an active waste disposal area located farther north in Ancho Canyon. There are no reports listing actual waste types and quantities placed in the two pits; however, based on the nature of the activities in TA-39 and the current use of MDA-Y, the waste is likely to be firing site debris and general office trash with possibly a small quantity of solvents and alcohols generated in the laboratory and shops at TA-39. Also, based on current practices, the two pits are probably unlined and, during their use, probably remained open with no application of daily cover.

The location of the two pits is not well-defined. Generally, they are believed to be adjacent to, and perhaps beneath, Building 69. A portion of this area has been paved for use as a driveway and as a volleyball/basketball court. Some of the area is not paved. A streambed, which was dry at the time of the Survey, is located immediately north of the suspected waste disposal pits. Past flow in this streambed or perched shallow zones of groundwater in Ancho Canyon may be pathways of contaminant migration from these disposal pits.

Area 1 in TA-20

Radioactively contaminated metal scrap and debris may still be buried in an old covered pit or landfill, designated Area 1, in TA-20 and may be a potential source of subsurface soil contamination.

Area 1 was located at the eastern end of TA-20 in Sandia Canyon. This burial pit was apparently used only once in 1945, for the disposal of radioactively contaminated metal scrap and other debris possibly contaminated with beryllium, HE, and/or uranium. The precise location of the burial pit in Area 1 is uncertain. Based on observations made during the Survey, a depression, approximately 5 feet deep and near the end of a dirt road, was suspected to be the burial pit location.

The LANL collected soil samples in 1985 and later performed a magnetometer study in Area 1, but neither task included the depression observed during the Survey. Since the area covered during the previous LANL work was limited, it is possible that the proper location of the waste burial pit remains uncertain and that wastes are available for migration to subsurface soils.

Suspected Landfill in TA-33

In TA-33, there is a suspected landfill on the edge of the mesa top, based on observations of exposed debris that may be a source of radioactive and metal contamination to surface soils in the adjacent drainage pathway.

On the southernmost mesa top in TA-33 (Tower Area), near Building TA-33-26, metal fragments and debris were observed along the rim of the mesa that may represent an inactive landfill. This portion of TA-33 was used as a firing site, including tests on mechanisms required for the assembly of weapons. The types of waste generated from these activities typically include debris and soil that is contaminated with radioactive isotopes, usually uranium; beryllium; various other metals, such as lead; and sometimes HE. General practices at the LANL firing sites have included occasional clearing of fragments, etc. in the working area and regrading as needed. It is possible that this waste was placed along the edge of the mesa and gradually accumulated to form the suspected landfill. TA-33 is located far from the formally designated LANL landfills.

The side of the suspected landfill on the edge of the mesa is approximately 80 feet long and has an assortment of debris exposed. Rainfall and snowmelt runoff crossing this face of the landfill and entering the drainage pathway may transport contaminants down the side of Chaquehui Canyon.

Suspected Landfill in TA-46

A landfill is suspected to exist in TA-46 on the edge of the mesa draining into Canyon del Buey that is a potential source of radioactive, metal, organic, or asbestos contamination to surface soils.

Based on historical aerial photographs dating back to 1964, the CEARP Phase I report (DOE-AO, 1986), and observations made during the Survey, a landfill is suspected to exist in TA-46 along the edge of the mesa that drains into Canyon del Buey. No waste disposal records exist for this landfill. Concrete rubble, asphalt, and general construction debris were noted to be exposed down the side of the fill area. Assuming the waste placed in the fill included material generated from TA-46,

radioactively or chemically contaminated objects/debris may have been placed in this area. Also, the construction debris may have included asbestos that could gradually be exposed due to erosion or that is currently exposed on the surface.

MDA-F in TA-6

An inactive landfill known as MDA-F and other nearby disposal pits in TA-6 may be a potential source of radioactive and HE contamination to subsurface soils and the vadose zone.

MDA-F is located within TA-6. Two known locations of past waste burial are presently restricted and fenced off. Two or more other burial sites may exist in this area, as indicated by the CEARP Phase I report (DOE-AO, 1986). Reportedly, preliminary findings of a surface geophysical study conducted under the CEARP support this information, with anomalies identified outside the fenced area.

Several pits were excavated in MDA-F in 1947 for the burial of wastes and contaminated objects. These materials included classified, large metal parts; tub-alloy; HE; primacord; casings with equipment associated with a plutonium implosion weapon known as "Fatman"; and other metal parts from the laboratory (DOE-AO, 1986). The size of the additional pit(s) and the total quantity of wastes disposed of are unknown.

MDA-N in TA-15

A small landfill in TA-15, known as MDA-N, is a potential source of HE and chemical contamination to subsurface soils and the vadose zone.

According to LANL records (DOE-AO, 1986), MDA-N existed as of 1965 and was used for disposal of materials or objects that were possibly contaminated with HE or chemicals. The source of this waste was not reported, nor was other specific information on the type and quantity of waste. The landfill is estimated to occupy 0.1 acre and may be a source of contamination to subsurface soils and the vadose zone.

The landfill is covered with native soil and its boundary is not defined. The LANL performed a geophysical study in 1985 or 1986 to better identify the extent of the landfill. The results were pending at the time of the Survey.

Suspected Landfill Known as the "Cold Dump," in TA-21

Nonradioactive chemicals and hazardous wastes potentially were disposed of in a landfill in TA-21 known as the "Cold Dump" and may remain as a possible source of subsurface soil contamination.

The "Cold Dump" is presumably located on the northern side of the DP-site access road; however, the exact location and lateral extent are not known. Aerial photographs from the 1940s indicate that the landfill may have been a series of unlined trenches grouped together north of MDA-B. Presently, this area is sparsely vegetated, with barren soil and tuff bedrock exposed. Several slight depressions were observed throughout the 200-foot by 100-foot area. A larger depression, approximately 40 feet in diameter, occurs in the southeastern portion of the suspect area. These surface disturbances may be indicative of past burial practices.

Records of the waste disposal practices, volumes of material, or specific chemicals disposed of in the landfill are not available. General memos are available in CEARP files that suggest use of this area for disposal of nonradioactive chemicals. Chemicals used in TA-21 that may have been placed in this landfill include but are not limited to lithium chloride; potassium chloride; zinc chloride; calcium salts; cadmium; lead oxides; mercury; oils, some possibly containing PCBs; solvents, ethylene glycol; and phosphoric acid.

Assuming these chemicals were disposed of in the "Cold Dump," then they may have leached into the subsurface soils. Horizontal migration toward the DP Canyon may have occurred along lateral passageways created by relief fractures in ash bedding planes.

Suspected Burn Pit in TA-10

A shallow depression in TA-10 was observed during the Survey and is suspected of being a waste burn pit that may be a residual source of radioactive, HE, or chemical contamination to subsurface soils.

According to the CEARP Phase I report (DOE-AO, 1986), a burn pit may have been used for waste disposal in TA-10 during its operation as a combined radiochemistry and firing site facility. A 1956 work order authorized excavation of a pit for disposal and subsequent burning of combustibles. It further states that residual ash and noncombustibles should be removed and disposed of at a radioactive disposal site.

TA-10 was active from 1944 to the early 1960s, at which time it was decontaminated and decommissioned with follow-up cleanup conducted in 1976. Ownership of this area has been transferred to Los Alamos County, and it is open to the public.

During the Survey, a shallow depression 2 feet deep covering an area 10 to 15 feet in diameter was observed in Bayo Canyon, east of the firing sites area. Possibly this is one of the previously used burn pits.

Three Suspected Disposal Pits in TA-6

Three areas in TA-6 are suspected of being disposal pits containing radioactively contaminated waste that may be a potential source of subsurface soil contamination.

CEARP files (DOE-AO, 1986) indicate the previous use of relatively small disposal pits within TA-6. Specifically, three were mentioned to have received weapons components contaminated with cesium-137 in the early 1950s. Other wastes may also have been disposed of at these areas. During the Survey, three shallow depressions were observed within approximately 70 feet of Twomile Mesa Road. These depressions may be indicative of the past disposal pits.

As part of the Survey S&A Program, surface and subsurface soil and soil gas samples were collected and analyzed for volatiles, semivolatiles, metals, radionuclides, PCB/pesticides, and HE. The analysis confirmed the presence of contaminants such as

uranium-238 and plutonium-239. These data were used to model the Landfills and Burn Pits ranking unit.

Final Survey Finding: Inactive Sites and Releases III-6 (Preliminary Survey Finding: Inactive Sites and Releases III-6)

Potential Soil Contamination from Inactive Firing Sites. Past use of firing sites at the LANL has resulted in radioactive, metal, and possibly HE contamination of surface soil; however, all potential firing sites have not been identified, the radial extent of contamination is not known, and some firing sites are located next to ephemeral streams or on the edge of a mesa where contaminant transport is likely to be enhanced.

Sixty-six inactive firing sites are on the LANL. Although the type of soil contaminant varies depending on the type of shots or experiments conducted at the firing site, generally the contaminants include one or more of the following: radionuclides, commonly depleted uranium; metals, such as beryllium and lead; and HE, some possibly containing barium. The frequency and duration of use would be expected to affect the concentration of contaminants in surface soil, as would the occurrence of shots that did not completely explode (i.e., "low-order" shots). The size of the HE charges used as a firing point and the presence of physical features are two major factors affecting the level and extent of surface soil contamination in the impact zone of a firing site. Information relative to these factors that influence contamination at a firing site was reviewed during the Survey and as a result, six areas were noted to be of particular concern:

- Firing Point 7 in TA-39
- South mesa test shot area in TA-33
- Firing Site in TA-5
- Asphalt Pad Firing Site in TA-6
- "Concrete Saucer" Firing Site in TA-6
- Suspected firing site in TA-8

The following paragraphs provide specific information on each of these sites.

Firing Point 7 in TA-39

Surface soils at Firing Point 7 in TA-39 are radioactively contaminated and potentially are contaminated with various metals and HE. Contaminant migration may be enhanced due to the presence of a streambed adjacent to the firing site.

Firing Point 7 in TA-39 was first used in the early 1950s to conduct experiments on virtually all types of metals, some of which required the use of HE. The firing site is located at the base of Ancho Canyon and its zone of impact extends to the top of the adjacent mesas. According to the CEARP Phase I report (DOE-AO, 1986), potential contaminants at this site include: beryllium, mercury, copper, brass, iron, lead, stainless steel, thallium, cadmium, chromium, thorium, and HE such as RDX, HMX, baratol, PETN, TATB, Composition B, and cyclotol. The date this firing site was taken out of operation was not provided in the background information.

During the Survey, LANL personnel identified uranium on surface soils at the firing site. Other small fragments and debris were also noted. A streambed is adjacent to the firing site with signs of erosion from past runoff leading off the firing pad toward the streambed. Potentially, surface contaminants are transported from the firing site via this drainage pathway.

South Mesa Test Shot Area in TA-33

Surface soils and the downslope canyon wall may be contaminated with radionuclides, metals, and/or HE from past experiments conducted at the firing sites on the south mesa of TA-33.

Beginning in 1947, the south mesa of TA-33 (TA-33-25, 26, 85, 146) was used to conduct test shots and experiments on initiators, a weapon component. The amount of HE in the shots ranged from 700 to 2,500 pounds. The types of contaminants usually associated with firing sites include uranium, beryllium, other metals such as lead, and HE. The impact zone of the firing sites on TA-33 has not been well-defined but it is recorded that shrapnel reached off-site onto the property designated the Bandelier National Monument. The date this firing site area was no longer used is not reported in the available background information.

In 1986, the LANL conducted a limited cleanup action to remove larger pieces of shrapnel and debris; however, apparently no soil removal was involved. During this effort, surface soil samples were collected; the analytical results were pending at the time of the Survey. Metallic and various other debris with unknown constituents were noted during the Survey to be scattered on the surface soils throughout the area. Drainage from this area flows off the mesa top and enters Chaquehui Canyon. The potential exists for radioactive, metal, and HE contaminants to be present in surface soils and the receiving drainage areas.

Firing Site in TA-5

A firing site located in TA-5 was decontaminated and decommissioned in 1985; however, the cleanup effort did not include the wall of the canyon which was likely part of the firing site impact zone and therefore may remain as a source of contaminants to surface soils and the ephemeral stream at the base of Mortandad Canyon.

TA-5 consisted of a firing site and other ancillary structures that were cleaned up based on radioactive contaminants in 1985. These cleanup actions were limited to the mesa top and included removal of contaminated soil; however, no cleanup or sampling has been performed on the canyonside slope. Due to the proximity of the firing site to the canyon side, it is likely that the canyon wall was part of the impact zone of the firing site and thus may be contaminated. Contaminants suspected to be present are depleted uranium metals, and various HE. There is also evidence of runoff drainage down the canyon side into Mortandad Canyon. Transport of contaminants may occur due to this migration pathway.

Asphalt Pad Firing Site in TA-6

Radioactive contamination remains in a sump and potentially in shallow subsurface soils at a firing site in TA-6 and is available for migration to subsurface soils. This firing site is located in TA-6 south of Twomile Mesa Road and west of MDA-F. This structure is an asphalt pad having a sump-like device in the central portion of its 2,500-square foot area. Previous use of this site has resulted in radioactive contamination of the sump-like structure. The surface of the pad and the surrounding area were sampled in 1978. Test results indicated uranium

contamination, and phoswich readings were 3 to 6 times background. During the Environmental Survey, radioactivity measurements taken near this sump were on the order of 200 counts per minute above background levels. The remainder of the pad area measured at or near background levels of activity. The poor condition of the pad may have allowed contaminants to migrate into the environment. The pad has developed cracks and separations over the years. Contaminants may have mobilized via precipitation through the cracks and into the subsurface soils.

"Concrete Saucer" Firing Site in TA-6

Residual radioactive, HE, or metal contamination may exist in the sediments contained in a firing site structure known as the "concrete saucer" or in surrounding soils, continuing to be available for migration.

The firing site structure known as the "concrete saucer" was designed to contain the blast fragments resulting from a test shot. The firing site was first used in 1944. The dates and frequency of its use, and the types and quantities of material in the experiments were not available.

There is a potential for contamination to the surrounding environment due to the procedures at this firing site. Blast fragments may have accumulated outside the perimeter of the concrete saucer. Contaminated liquids may have leaked out of the saucer structure and into the subsurface soils. However, no radioactivity was detected in the surrounding area during the Survey.

Suspected Firing Site in TA-8

An area of mounded soil surrounded by trenches in TA-8 may be an inactive firing site with potential surface soil contamination.

During the Survey, distinctive land surface features were noted in an area west of Buildings 1, 2, and 3 in TA-8. A mound of soil with trenches on two sides exists in this area. Inquiries revealed that this area may be an inactive firing site for up to several hundred test shots. The CEARP Phase I report (DOE-AO, 1986) indicates that TA-8 was first used in 1943 by the Ordnance Division that performed ballistics tests, some with projectiles containing uranium. Whether this mounded area is related to these

early operations is uncertain. Radioactive, metal, and/or HE contaminants may exist in the surface soils if this area was once a firing site.

As part of the Survey S&A Program, soil samples were collected and analyzed for metal, radionuclides, and HE. The analysis confirmed the presence of contaminants such as barium, cesium-137, uranium-238, and chromium VI. These data were used to model the Firing Sites ranking unit.

Final Survey Finding: Inactive Sites and Releases III-7 (Preliminary Survey Finding: Inactive Sites and Releases III-7)

Potentially Inadequate Decontamination and Decommissioning. Surface and shallow subsurface soils in the vicinity of contaminated structures that have been decontaminated and/or decommissioned may contain residual contaminants.

Two examples of decontaminated and decommissioned buildings are the GMX2 site in TA-16 and the trim building in TA-12. HE processing operations took place at both of these locations. The methods of decommissioning differed, however, as described below. Analytical data for soils indicating the residual levels of HE or other chemicals used in HE processing do not exist for either location.

GMX2 Site in TA-16

Chemical contaminants may remain in surface or shallow subsurface soils in the vicinity of the former GMX2 site in TA-16.

The buildings at the GMX2 site were once used to process HE. In the 1960s, a major decommissioning and decontamination effort was conducted, involving removal of the buildings, their waste lines, and soil contaminated with HE. LANL files contain photographs of the operation. Discussions with LANL personnel indicated that soils were excavated and removed until a concentration of 0.5 percent HE was reached. However, no analytical records are available to document that this level of cleanup was achieved or that no other contaminants were present.

As part of the Survey S&A Program, subsurface soil samples were collected and analyzed for volatiles, HE, and metals. The analysis confirmed the presence of

acetone, beryllium, copper, and toluene. These data were used to model the Potentially Inadequate Decontamination and Decommissioning ranking unit.

Trim Building in TA-12

Chemical contaminants may remain in surface and shallow subsurface soils in the vicinity of the trim building in TA-12.

Solvents and HE materials were used at the old trim building in TA-12 from 1947 until the mid-1950s. These chemicals and explosives may have contaminated the environment surrounding the trim building from storage, spillage, or small-volume disposal of contaminated effluent. The building itself was burned during decontamination and decommissioning activities in 1960. The noncombustibles were left in place. These ashes and scrap were still visible during the Environmental Survey.

Final Survey Finding: Inactive Sites and Releases III-8 (Preliminary Survey Finding: Inactive Sites and Releases III-8)

Potential for Additional, Unidentified Inactive Waste Sites. The DOE CEARP effort for the LANL facility included review of the University of California files on the laboratory but did not include the current support contractor, Pan Am World Services, and the formerly used support contractor, Zia.

Zia supported the laboratory from the 1940s to the 1980s and was responsible for maintenance activities including a paint shop, metal shop, furniture repair, etc. For some period of time, these shops were located on land in the town of Los Alamos that was historically owned by DOE (eastern end of TA-1). However, known or potential waste sites associated with these operations were not included in the CEARP effort.

Also, the CEARP effort included over 40 interviews to gather information on inactive sites. With the large number and variety of research and testing activities conducted at the laboratory over the past 40 years, additional interviews may supplement this data base which could potentially lead to identification of additional sites.

Final Survey Finding: Inactive Sites and Releases III-9 (Preliminary Survey Finding: Inactive Sites and Releases III-9)

Potential Exposure to Chemical Contaminants. Chemical contaminants may have been released to soils in the vicinity of the former TA-1 Sigma Building and if so, may present the potential for direct contact of private landowners with contaminants. Chemicals such as lead, chromium, cyanide, organic solvents, and degreasers may have been used and possibly spilled in this area.

TA-1 was opened in 1943 and used for some of the first research activities on nuclear weapons conducted at the laboratory up until 1965. In the 1950s, TA-1 was in a transition period as operations were moved to TA-3. All activities ceased in 1965 and the land was transferred to Los Alamos County and to private landowners in 1966. Gradually during this period, structures and buildings associated with TA-1 were removed.

From 1974 to 1976, a major project to identify and remove residual levels of radioactive contaminants in TA-1 was conducted. The details of this operation are described in a 1977 LANL document titled "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico" (LASL, 1977). This work did not include testing for chemical contamination.

A large amount of soil excavation and removal followed by backfilling was performed in the vicinity of D-Building, which is now the parking lot for a hotel, and along the D-Building waste line. Less soil removal took place on the western end of TA-1, including in the vicinity of the former Sigma Building. This building was used to process normal and enriched uranium and involved casting, machining, and power metallurgy (LASL, 1977). A cooling tower, drum storage areas, and incinerators also existed near the former Sigma Building. Chemicals that are suspected of being used in this area include metals such as lead, chromium, and cyanide, as well as organic solvents and degreasers.

There is a potential that chemicals exist in some soil areas and these areas remain unidentified because the previous site investigation and cleanup work addressed radioactivity only. Also, at the time of the Survey, portions of the former Sigma Building area were being developed as condominiums where earth-moving

operations may expose and spread any chemicals that may have been deposited in the early years of production.

In response to this finding presented at the closeout to the Survey, the LANL conducted a limited soil sampling effort in the vicinity of the Sigma Building and its cooling tower (HSE-8, 1987). Fourteen samples were collected; 10 surface soils and 4 shallow subsurface soils. Constituents detected using the EP Toxicity test included barium (0.03-2.7 mg/L) and lead (0.1 mg/L). The concentrations identified were below the EPA regulatory level used to classify RCRA wastes. Uranium was detected at 85 nanograms/g in one sample. This level is within the range typically found in Los Alamos County. The volatile 1,1,1-trichloroethane was detected in a soil sample at a concentration of 0.030 mg/L using the TCLP. This concentration is below that which EPA has proposed for classifying a RCRA waste.

This recent testing performed by the LANL used a leaching procedure that is designed to establish whether a substance is a hazardous waste according to the RCRA. The major concern found during the Survey regarding TA-1 is that of direct contact by construction workers or by future residents to potentially contaminated soil. Additionally, operations with heavy earth-moving machinery create fugitive dust problems that could result in an inhalation risk. These aspects of potential human exposure to toxic chemicals that may remain in the soil at TA-1 are not addressed using the RCRA leaching procedures. However, further sampling of this site has been prohibited by a lawsuit issued by the site developer.

8.2 Closed Findings and Observations

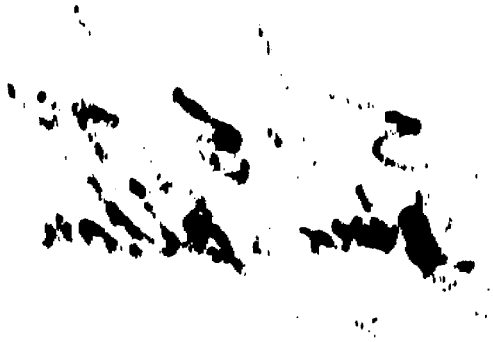
The Environmental Survey has not closed any Category I, II, or III findings for this site.

END
OF
REFILMING

Date _____

Operator _____

END OF REFILMING

Date 5/18/94

Operator