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Installation Work Plan for Environmental Restoration Program

Revision 5

November 1995

A Department of Energy
Environmental Cleanup Program

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Los Alamos
NATIONAL LABORATORY

LA-UR-95-4048

15449

EXECUTIVE SUMMARY

Background

In 1989, the US Department of Energy (DOE) created the Office of Environmental Restoration and Waste Management (EM). The goal of this office is to implement the department's policy of ensuring that its past, present, and future operations do not threaten human health, safety, or the environment. The EM Office implements procedures to meet these goals through three associate directorates: Environmental Restoration (ER), Waste Operations, and Technology Development. Among other responsibilities, the EM Office is responsible for assessing, cleaning up, and decommissioning sites at DOE facilities and at sites formerly used by DOE and its predecessors. This Installation Work Plan (IWP) describes how the DOE and the University of California (UC) are conducting the office's ER Project at Los Alamos National Laboratory (the Laboratory).

The Laboratory and the neighboring residential areas of Los Alamos and White Rock are located in Los Alamos County, north-central New Mexico, approximately 60 mi north-northeast of Albuquerque and 25 mi northwest of Santa Fe. The 43-mi^2 Laboratory site and the communities adjacent to it are situated on the Pajarito Plateau. The ephemeral and intermittent streams that drain the plateau have created numerous narrow fingerlike mesas, whose tops range in elevation from approximately 7,800 ft on the flank of the Jemez Mountains to about 6,200 ft at their eastern termination above the Rio Grande valley. The eastern margin of the plateau stands 300 to 900 ft above the Rio Grande.

Since its inception in 1943, the Laboratory's primary mission has been nuclear weapons research and development. Although the Laboratory's current mission focuses on national defense, it includes research in medium-energy physics, space nuclear systems, controlled thermonuclear fusion, lasers, nuclear safeguards, space physics, biomedicine, computational science, materials science, applied photochemistry, astrophysics, earth sciences, energy resources (including solar and geothermal), nuclear waste management research, and environmental protection and cleanup. Because of its involvement in academic and industrial research, the Laboratory has an important role in expediting the development and commercialization of emerging technologies. This mission is expected to continue into the foreseeable future.

Since the early 1970s, the Laboratory has reported the results of an environmental surveillance program that routinely samples air, water, soil, and foodstuffs throughout the Los Alamos area to determine whether contamination from Laboratory operations is present and, if so, at what levels. The data collected under this program are published annually for distribution to the public and to local, state, and federal agencies. These data indicate that Laboratory operations do not threaten human health or the environment. The ER Project at the Laboratory augments the environmental surveillance program by identifying potential threats to human health and the environment from past Laboratory operations and by mitigating them through efficient corrective actions that comply with applicable environmental regulations. Corrective actions include such measures as source containment to prevent contaminant migration, controls on future land use, and excavation and/or treatment of the source to remove hazards to health and the environment.

Statutory Basis of the ER Project

The ER Project at the Laboratory responds to two primary laws: the Resource Conservation and Recovery Act (RCRA), which is the statutory basis for the ER Project at the Laboratory, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which provides a framework for remediating sites at the Laboratory that contain certain hazardous substances not covered by RCRA. The hazardous waste provisions of RCRA govern the day-to-day operations of hazardous waste management, treatment, storage, and disposal (TSD) facilities. The law established a permitting system and set standards for all hazardous-waste-producing operations at a facility. Under this law, the Laboratory qualifies as a treatment and storage facility and must have a permit to operate. In 1984, Congress amended RCRA by passing the Hazardous and Solid Waste Amendments (HSWA). Section 3004(u) of RCRA (as amended by HSWA) mandates that permits for TSD facilities include provisions for corrective action to mitigate releases from facilities currently in operation and to investigate and clean up contamination in areas designated as solid waste management units (SWMUs).

The HSWA Module in DOE/UC's RCRA permit prescribes a specific corrective action program for the Laboratory and provides the primary guidance for the Laboratory's ER Project. The HSWA Module defines the principal requirements with which DOE/UC must comply in implementing the ER Project at the Laboratory. However, RCRA does not address several issues of concern at Los Alamos. For example, source, by-product, and special nuclear materials are exempt from RCRA's definition of solid waste and are therefore not subject to the provisions of the HSWA Module. DOE/UC recognize that these radioactive constituents are of concern and should not be separated from concerns about hazardous wastes. Thus, DOE/UC's ER Project addresses radioactive as well as other hazardous substances not regulated by RCRA. This approach is intended to implement a technically comprehensive program that covers potential concerns at sites that may contain hazardous substances not regulated under RCRA and radioactive materials regulated under the Atomic Energy Act; however, DOE/UC and Environmental Protection Agency (EPA) understand that language in this IWP pertaining to subjects outside the scope of RCRA is not enforceable under the RCRA permit.

This IWP has been prepared in accordance with the HSWA Module and with the corrective action requirements proposed for incorporation in EPA's standards for hazardous waste. EPA proposed Subpart S of 40 CFR 264 in July 1990 to implement the corrective action program mandated in Section 3004(u) of RCRA. This IWP describes how each step in the corrective action process will be implemented at the Laboratory.

The primary goal of the RCRA facility investigation (RFI) is to identify the nature and extent of contamination that could lead to exposure of human and environmental receptors. The corrective measures study (CMS) evaluates alternatives that could reasonably be implemented if characterization indicates that corrective measures are needed. Finally, the corrective measures implementation (CMI) effects the chosen remedy, verifies its efficacy, and establishes ongoing control and monitoring requirements.

Public involvement is an important component of the Laboratory's ER Project; accordingly, the ER Project is pursuing an aggressive public participation plan in which the public is provided with accurate, complete, and timely information and

early, meaningful participation opportunities. In addition, formal public meetings are held, as needed.

The HSWA Module provides a schedule for investigating the SWMUs that the EPA has selected from potential release sites (PRSs) identified by DOE/UC. DOE/UC have aggregated all PRSs to be taken through the corrective action process in 5 field units (formerly 24 operable units). These units are addressed in RFI work plans, which provide information on how each PRS will be investigated. RFI work plans have been completed for all PRSs except for the canyons that originate within or cross Laboratory boundaries. The canyons are being investigated after the mesa tops in order to more clearly identify potential contamination originating on the mesa tops. EPA is continuing its review of the work plans and field investigations in all field units. A sixth field unit leads decommissioning activities in conjunction with remediation activities for the ER Project.

The current projection for the completion of the RFI/CMS process at the Laboratory is approximately the year 2004, except for the canyons effort for which the technical approach remains undefined. This process will address the approximately 2,100 PRSs at the Laboratory in order to meet all applicable environmental regulations. The schedule also addresses the spread of effort over a period compatible with the availability of national resources, including funding.

Current risks from known PRSs are low; however, DOE/UC have implemented a site-ranking system to aid in prioritizing PRSs. This system originated with input from the EPA, the New Mexico Environment Department, DOE, Sandia National Laboratories, and UC personnel and is based primarily on human health and environmental risks from potential contamination at each PRS. Scores of the sites are updated as more information becomes available. In addition, in response to requests from local property owners, the ER Project is giving priority to field work at former Laboratory locations in the Los Alamos townsite, which are no longer owned by the DOE.

Contents of the 1995 IWP

In accordance with the provisions of the HSWA Module, this IWP is revised annually to reflect the current status of the ER Project. The intent of the IWP is to capture any changes that have occurred since release of the 1994 IWP, including changes in Laboratory and ER Project structure, changes in DOE and EPA guidance and mandates, and changes in budget and ways of doing business.

Chapter 2 describes the Laboratory and its environmental setting. Chapter 3 contains two major sections: (1) the requirements of the corrective action process and (2) the assessment strategy for conducting corrective action. A discussion of the decision process leading to no further action, accelerated cleanup, or CMS is provided. There is also a discussion of waste minimization and management.

Chapter 4 presents the ER Project's Quality Assurance Project Plan (QAPP), which, when approved by the EPA, will supersede the Generic Quality Assurance Project Plan prepared by the ER Project in 1991. This plan has been developed to be consistent with the EPA's "Interim Final Requirements for QAPPs" and to address the current quality assurance needs of the ER Project. The Records Management Plan, which describes the mechanisms to be used to track information and data throughout the ER Project, is presented in Chapter 5.

Chapter 6 provides a detailed plan for ensuring the health and safety of workers during implementation of the ER Project. The plan complies with applicable Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response requirements given in 29 CFR 1926.65 or 29 CFR 1910.120. It establishes generic health and safety requirements, procedures, and emergency actions that apply to all field operations projectwide and is intended to be used in conjunction with a site-specific health and safety plan prepared for each field project.

Chapter 7 contains the ER Project's public involvement plan. It describes the changes that have occurred in the last year that reflect increased emphasis on public outreach and public involvement in the decision-making process both at the Laboratory and project levels. The Laboratory's current approach to public involvement, including the recent formation of its Community Involvement and Outreach Office to coordinate the public participation activities of all Laboratory organizations and the Laboratory's increased outreach to Native Americans, is described.

This document also contains three appendices:

- Appendix A—Descriptions of Technical Areas at Los Alamos National Laboratory;
- Appendix B—Potential Release Sites at Los Alamos National Laboratory; and
- Appendix C—Projected Schedule and Cost for the Environmental Restoration Project at Los Alamos National Laboratory.

The appendices are followed by a table for converting metric to English units of measure.

CONTENTS

EXECUTIVE SUMMARY i

CONTENTS i

1.0 INTRODUCTION TO THE ENVIRONMENTAL RESTORATION PROJECT 1-1

1.1 Background 1-1
1.2 Description of the ER Project 1-2

1.2.1 Statutory and Regulatory Framework for the ER Project 1-3

1.2.1.1 Resource Conservation and Recovery Act 1-3
1.2.1.2 Comprehensive Environmental Response, Compensation, and Liability Act 1-4
1.2.1.3 Integration of the Provisions of RCRA and CERCLA 1-6
1.2.1.4 Integration of the Provisions of RCRA and NEPA 1-6
1.2.1.5 Other Statutes and Regulations 1-6

1.2.1.5.1 Federal Statutes 1-6
1.2.1.5.2 State Statutes 1-8
1.2.1.5.3 DOE Orders, Executive Orders, and Secretary of Energy Notices 1-9

1.2.2 Objectives of the ER Project 1-9

1.2.2.1 Project Management Objectives 1-9
1.2.2.2 Technical Objectives 1-10
1.2.2.3 Quality Assurance Objectives 1-10
1.2.2.4 Records Management Objectives 1-10
1.2.2.5 Health and Safety Objectives 1-10
1.2.2.6 Public Involvement Objectives 1-11
1.2.2.7 Procurement Plan Objectives 1-11
1.2.2.8 Site Prioritization Objectives 1-11

1.3 Structure of the ER Project 1-12

1.3.1 Organization of the Project Office 1-12

1.3.1.1 Management Team 1-12
1.3.1.2 Regulatory Compliance Manager 1-12
1.3.1.3 Project Consistency Manager 1-13
1.3.1.4 Field Project Leaders 1-13
1.3.1.5 Other Key Personnel and Functions in the ER Project 1-13

1.3.1.5.1 Contract Administration Coordinator 1-13
1.3.1.5.2 Councils 1-13

1.3.2 Field Units 1-14
1.3.3 Project Planning and Financial Control System 1-15
1.3.4 Reporting Requirements 1-16

References for Chapter 1 1-17

2.0 INSTALLATION DESCRIPTION 2-1

2.1 Geographic Setting 2-1
2.2 Mission of Los Alamos National Laboratory 2-1
2.3 History of Los Alamos National Laboratory 2-4
2.4 Environmental Setting 2-4

2.4.1 Land Use Patterns 2-4
2.4.2 Ecology 2-6

2.4.2.1 Flora 2-6
2.4.2.2 Fauna 2-6
2.4.2.3 Wetlands 2-7

2.4.3 Climate 2-10
2.4.4 Population Distribution 2-13

2.5 Geologic and Hydrologic Setting 2-14

2.5.1 Geology 2-14

2.5.1.1 Regional Setting 2-14
2.5.1.2 Stratigraphic Units 2-16

2.5.1.2.1 Santa Fe Group 2-17
2.5.1.2.2 Keres Group 2-17
2.5.1.2.3 Tschicoma Formation 2-19
2.5.1.2.4 Puye Formation 2-19
2.5.1.2.5 Totavi Formation 2-19
2.5.1.2.6 Cerros del Rio Basalts 2-19
2.5.1.2.7 Otowi Member, Bandelier Tuff 2-20
2.5.1.2.8 Cerro Toledo Rhyolite and Interbedded Sediments 2-20
2.5.1.2.9 Tshirege Member, Bandelier Tuff 2-20
2.5.1.2.10 Post-Bandelier Units 2-21

2.5.1.3 Soils 2-22
2.5.1.4 Geologic Structure 2-22
2.5.1.5 Seismicity and Volcanism 2-23
2.5.1.6 Geomorphic Processes 2-24

2.5.2 Hydrology 2-25

2.5.2.1 General Surface Water Conditions 2-25
2.5.2.2 General Groundwater Conditions 2-28

2.5.2.2.1 Perched Groundwater in Alluvium 2-28
2.5.2.2.2 Perched Water in Volcanic Sediments and Basalts 2-28
2.5.2.2.3 Main Aquifer 2-30

2.5.2.3 Hydrologic Properties and Conditions of the Bandelier Tuff 2-32

2.5.2.3.1 Effects of Physical Characteristics 2-32

2.5.2.3.2 Porosity 2-34
2.5.2.3.3 Moisture Content 2-34
2.5.2.3.4 Moisture Characteristic Curves 2-34
2.5.2.3.5 Hydraulic Conductivity 2-35
2.5.2.3.6 Joints 2-35

2.5.2.4 Movement of Moisture in the Bandelier Tuff 2-35

2.5.2.4.1 Migration of Moisture Beneath Mesa Tops 2-36
2.5.2.4.2 Migration of Moisture Beneath Canyon Bottoms 2-38

References for Chapter 2 2-40

3.0 TECHNICAL APPROACH TO ENVIRONMENTAL RESTORATION 3-1

3.1 Background 3-1

3.1.1 Potential Release Sites 3-2
3.1.2 Notification of New Units and Releases 3-2
3.1.3 Site Prioritization 3-3

3.2 ER Project Assessment Strategy 3-3

3.2.1 Decisions in the RCRA Corrective Action Process 3-3

3.2.2.1 Decision-Oriented Approach 3-3
3.2.1.2 Future Land Use Planning 3-6

3.2.2 Approach to Data Collection and Evaluation 3-7

3.2.2.1 Site-Screening Decisions 3-7
3.2.2.2 Risk-Based Decisions 3-9

3.3 RCRA Corrective Action Process 3-10

3.3.1 Requirements for the RFI 3-10
3.3.2 Accelerated Cleanup 3-11

3.3.2.1 VCAs 3-12
3.3.2.2 Expedited Cleanups 3-12

3.3.3 Requirements for Corrective Measures Studies 3-12

3.3.3.1 Corrective Measures Study Plan 3-13
3.3.3.2 Corrective Measures Study 3-15

3.3.3.2.1 Standards for Remedies 3-15
3.3.3.2.2 Media Cleanup Levels 3-15
3.3.3.2.3 Demonstation of Compliance with Media Cleanup Levels 3-16
3.3.3.2.4 Conditional Remedies 3-17

3.3.3.3 Corrective Measures Study Report 3-18

3.3.3.4 Permit Modification for Selection of Remedies 3-18

3..3.4 Requirements for Corrective Measures Implementation 3-19

3.3.4.1 Remedy Designs 3-19
3.3.4.2 Corrective Measures Progress Reports 3-20
3.3.4.3 Review of Remedy Implementation 3-20
3.3.4.4 Completion of Remedies 3-20

3.3.5 Special Situations in the Corrective Action Process 3-21

3.3.5.1 Interim Remedial Measures 3-21
3.3.5.2 Coordination of Corrective Actions with Resource Conservation and Recovery Act Closures 3-22

3.4 Waste Minimization and Management 3-22

3.4.1 Guidelines and Procedures for Waste Characterization and Classification 3-23
3.4.2 Use of Available Onsite Disposal Capacity 3-23
3.4.3 Technical Approach to Waste Disposal 3-23

3.4.3.1 Hazardous Wastes 3-23
3.4.3.2 Low-Level Mixed Wastes 3-24
3.4.3.3 Low-level Radioactive Wastes 3-24
3.4.3.4 Solid Waste Soils 3-24
3.4.3.5 Staging Areas and Temporary Storage Areas for Waste Materials 3-24
3.4.3.6 Approach to Waste Minimization, Recycling, and Reuse 3-25

3.5 Public Invovement 3-26

References for Chapter 3 3-27

4.0 QUALITY ASSURANCE PROJECT PLAN 4-1

5.0 RECORDS MANAGEMENT PLAN 5-1

5.1 Introduction 5-1

5.1.1 Organization of Records Management Plan 5-1

5.1.2 Regulatory Mandate 5-1
5.1.3 Objectives 5-1
5.1.4 Terminology 5-2

5.2. Description of the Records Management Program 5-2

5.2.1 Work Flow, Procedures, and Control 5-2
5.2.2 Plan Implementation 5-3

5.2.2.1 Structured Work Flow for Records 5-3

5.2.2.1.1 Submittal of Records 5-3
5.2.2.1.2 Records Flow 5-3

5.2.2.2 Use of Approved Procedures 5-5
5.2.2.3 Referable Information Base 5-5

5.2.3 Special Topics 5-5

5.2.3.1 RFI Work Plans 5-5
5 2.3.2 Technical Data 5-5

5.2.3.2.1 Data Validation 5-5
5.2.3.2.2 Data Analysis 5-5

5.2.3.3 Records Working Group 5-6
5.2.3.4 Administrative Record 5-6

5.3 Description of the ER Project's Information Records Management Facilities 5-6

5.3.1 Records-Processing Facility 5-6
5.3.2 Facility for Information Management, Analysis, and Display 5-6

5.3.2.1 System Capabilities 5-7
5.3.2.2 Data Acquisition and Quality Control 5-7
5.3.2.3 Configuration Management 5-7

5.3.3 Integrated Capabilities of RPF and FIMAD 5-8

5.3.3.1 Optical Disk Storage 5-8
5.3.3.2 Microfilm 5-8
5.3.3.3 File Standards and Compatibility 5-8

5.3.4 Progress in Technology 5-8

5.4 Coordination with the Quality Program 5-9

5.4.1 Records Protection Before Submittal 5-9
5.4.2 Records Protection During Submittal 5-9
5.4.3 Records Protection after Submittal 5-9

5.5 Coordination with the Health and Safety Program 5-10
5.6 Coordination with the Project Planning and Control Team 5-10
5.7 Coordination with the Public Involvement Program 5-11

5.7.1 Access to the Administrative Record 5-11
5.7.2 Public Information Repositories 5-11
5.7.3 Sensitive Documents 5-11

References for Chapter 5 5-12

6.0 HEALTH AND SAFETY PLAN 6-1

6.1 Introduction 6-1

6.1.1 Purpose and Applicability 6-1
6.1.2 Review and Approval 6-2
6.1.3 Updating and Numbering Health and Safety Documents 6-2

6.2 Background Information 6-3
6.3 Organization, Responsibilities, and Authority 6-3

6.3.1 Visitor Policy 6-3
6.3.2 Project Team Personnel 6-4

6.3.2.1 Line Managers 6-4

6.3.2.1.1 Field Project Leader 6-4
6.3.2.1.2 Field Team Manager 6-4
6.3.2.1.3 Field Team Leader 6-5
6.3.2.1.4 Other Onsite Supervisory Personnel 6-6

6.3.2.2 Field Team Members 6-6
6.3.2.3 H&S Personnel 6-7

6.3.2.3.1 Site Safety Officer 6-7
6.3.2.3.2 Industrial Hygiene Technician 6-8
6.3.2.3.3 Trenching/Excavation-Competent Person 6-8
6.3.2.3.4 Confined-Space-Entry Supervisor 6-8
6.3.2.3.5 Other Competent or Qualified H&S Personnel 6-8

6.3.2.4 Health Physics Personnel 6-9

6.3.2.4.1 Radiological Screening Personnel 6-9
6.3.2.4.2 Health Physics Technician and Radiological Control Technician 6-9

6.3.3 Project Support Personnel 6-10

6.3.3.1 Contractor/Subcontractor Representative 6-10
6.3.3.2 Field Unit H&S Representative 6-10
6.3.3.3 Registered Professional Engineer 6-11
6.3.3.4 ESH-1 Personnel 6-11

6.3.4 Stop-Activity and Stop-Work Orders 6-12

6.3.4.1 Stop Activity 6-12
6.3.4.2 Stop-Work Order 6-12

6.4 Task Hazard Analysis 6-13

6.4.1 Hazard Assessment 6-13
6.4.2 Administrative and Engineering Controls 6-14

6.4.2.1 General Administrative Controls 6-14
6.4.2.2 Required Written Programs and Permit Systems 6-15

6.5 Site Control Measures 6-16
6.6 Exposure Monitoring and Responses 6-17
6.7 Personal Protective Equipment 6-19

6.7.1 Respiratory Protective Equipment 6-20

6.8 Decontamination 6-20

6.8.1 Equipment Decontamination 6-21
6.8.2 Personnel Decontamination 6-22

6.9 Emergency and Incident Action Plan 6-23

6.9.1 Posting Requirements 6-24
6.9.2 Emergency Alerting and Site Evacuation Procedures 6-24
6.9.3 Reporting Emergencies and Incidents 6-25
6.9.4 Response Critique and Follow-Up 6-25

6.10 Training Requirements 6-26

6.10.1 HAZWOPER Requirements 6-26

6.10.1.1 General Requirements 6-26
6.10.1.2 Emergency Response Training 6-27
6.10.1.3 Pre-Job-Start H&S Briefing 6-27
6.10.1.4 Daily Tailgate H&S Meetings 6-27

6.10.2 First-Aid Requirements 6-28
6.10.3 Other OSHA Requirements 6-28
6.10.4 Laboratory Requirements 6-28

6.11 Medical Surveillance 6-28
6.12 Quality Control and Quality Assurance Plan 6-29

6.12.1 Site Inspections 6-29
6.12.2 ER/H&S Oversight Program 6-29

6.13 Record Keeping 6-30

6.13.1 Site Records 6-30
6.13.2 Employee Exposure and Medical Records 6-30
6.13.3 Employee Notification Procedure 6-32
6.13.4 Emergency/Incident Reports 6-32

References for Chapter 6 6-33

7.0 PUBLIC INVOLVEMENT PLAN 7-1

7.1 Introduction 7-1

7.1.1 Role of Public Involvement in the Environmental Restoration Project 7-1
7.1.2 The Laboratory's Current Approach to Public Involvement 7-1

7.1.2.1 Community Involvement and Outreach Office 7-1
7.1.2.2 Related Activities of Other Laboratory Organizations 7-1

7.1.2.2.1 Future Site Use Planning and Integration 7-1
7.1.2.2.2 Other Related Activities 7-2

7.1.2.3 Community Reading Room and Public Information Repositories 7-2

7.1.3 ER Project's Currect Approach to Public Involvement 7-2

7.2 The ER Project's Public Involvement Plan 7-5

7.2.1 Preparing Information on the ER Project 7-5
7.2.2 Dissemination of Information 7-6
7.2.3 Community Meetings 7-6
7.2.4 Tours of Environmental Restoration Sites 7-6
7.2.5 Education Programs 7-6
7.2.6 Public Input to Recommendations for Cleanup 7-7

References for Chapter 7 7-8

APPENDICES

APPENDIX A Descriptions of Technical Areas at Los Alamos National Laboratory

APPENDIX B Potential Release Sites at Los Alamos National Laboratory

APPENDIX C Projected Schedule and Cost for the Environmental Restoration Project at Los Alamos National Laboratory

ACRONYMS AND ABBREVIATIONS

METRIC TO ENGLISH CONVERSION TABLE

LIST OF FIGURES

1-1 Three-step corrective action process. 1-5
1-2 Organization of the ER Project. 1-12
1-3 Typical structure of field units. 1-14
1-4 ER Project command and control systems. 1-15

2-1 Location map of Los Alamos National Laboratory. 2-2
2-2 Technical areas at Los Alamos National Laboratory. 2-3
2-3 Land use map for the Laboratory and adjacent lands. 2-5
2-4 Map of wetlands for Los Alamos County 2-8
2-5 Well locations in Los Alamos County and in adjacent locales. 2-11
2-6 Wind roses at Laboratory stations during 1989. 2-12
2-7 General geographic location map showing topographical features in the vicinity of Los Alamos. 2-15
2-8 Generalized geologic section showing stratigraphy and structure from the Sierra de Los Valles across the Pajarito Plateau. 2-18
2-9 Location of the major surface water drainages in the Los Alamos area. 2-26

3-1 Decision framework for the ER Project. 3-4

5-1 Overview of records flow in the ER Project. 5-4

LIST OF TABLES

1-1 Current Environmental Permits Applicable to the ER Project 1-3

2-1 1992 Population Within 80 km of Los Alamos 2-14
2-2 Summary of Hydraulic Properties Data for Bandelier Tuff Obtained Since 1984 2-33

1.0 INTRODUCTION TO THE ENVIRONMENTAL RESTORATION PROJECT

1.1 Background

In 1989, the US Department of Energy-Headquarters (DOE-HQ) created the Office of Environmental Restoration and Waste Management (EM). The goal of this office is to implement the department's policy of ensuring that its past, present, and future operations do not threaten human or environmental health and safety (DOE 1993, 0992). The EM Office implements procedures to meet these goals through three associate directorates: Environmental Restoration (ER), Waste Operations, and Technology Development. Among other responsibilities, the EM Office is responsible for assessing, cleaning up, and decommissioning sites at DOE facilities and sites formerly used by DOE and its predecessors. As a facility operated by the DOE, Los Alamos National Laboratory (the Laboratory) is a part of this program.

The Laboratory is administered for the DOE by the University of California (UC). Since its inception in 1943, the Laboratory's primary mission has been nuclear weapons research and development. Although the Laboratory's current mission focuses on national defense, it includes research in medium-energy physics, space nuclear systems, controlled thermonuclear fusion, lasers, nuclear safeguards, space physics, biomedicine, computational science, materials science, applied photochemistry, astrophysics, earth sciences, energy resources (including solar and geothermal), nuclear waste management research, and environmental protection and cleanup. Because of its involvement in academic and industrial research, the Laboratory plays an important role in expediting the development and commercialization of emerging technologies. This mission is expected to continue into the foreseeable future. Appendix A summarizes activities at the Laboratory's 49 active technical areas (TAs), which are shown in Figure 2-2.

Many of the processes used in carrying out the Laboratory's past and present missions involve the use of hazardous and radioactive materials. During World War II and for a while thereafter, some of these materials were disposed on the Laboratory site or were otherwise released into the environment. Beginning in the 1970s, Congress enacted basic legislation to protect the environment. In that period also, the DOE and the Laboratory began to conduct surveys and to clean up areas where spills and disposal had occurred.

The current investigation being conducted at Los Alamos under DOE's ER Project is intended to definitively determine the presence or absence of hazardous and radioactive wastes and to address any sites where such materials are still found to exist. The ER Project at the Laboratory is committed to excellence in carrying out its responsibilities for investigating and remediating hazardous waste disposal sites. This updated Installation Work Plan (IWP) describes how the DOE/UC are conducting the DOE's ER Project at the Laboratory.

This document consists of seven chapters containing information required by the Laboratory's permit to operate under the Resource Conservation and Recovery Act (RCRA). The Environmental Protection Agency (EPA) is the regulatory agency that issues this permit and is responsible for its enforcement. Negotiations are under way between EPA and the New Mexico Environment Department (NMED) to conclude a work share agreement that delineates each agency's roles and responsibilities. This first chapter describes the ER Project and its management plan. Chapter 2 describes the Laboratory and its environment, and Chapter 3 describes the ER

Project's technical approach to environmental restoration, including the requirements of the corrective action process and the project's assessment strategy. Chapters 4-7 present the project's plans for quality assurance, records management, health and safety, and public involvement, respectively. In addition, this document contains three appendices that supplement information provided in Chapters 1-7. The appendices are followed by a table showing conversion of metric to English units of measure.

This plan is revised annually to reflect the current status of the ER Project at the Laboratory, future plans, and near- and long-term schedules. This version is the fifth revision.

1.2 Description of the ER Project

DOE established its ER Project as a DOE ER Major Systems Acquisition (MSA) Project. One MSA project includes the national laboratories assigned to the DOE Operations Office in Albuquerque (ER MSA AL-1). MSA AL-1 at Los Alamos includes two integrated activities: one, the Remedial Action Project, hereafter referred to as the ER Project, addresses remedial actions at the Laboratory; the other is the Decommissioning Project, which is operated as part of the Laboratory's ER Project. The DOE's Albuquerque Field Office (DOE-AL) is responsible for implementing the DOE-AL's ER Project. DOE-HQ delegates authority for conducting the DOE-AL ER Project to the DOE-AL ER Division. DOE area offices and their prime contractors execute approved assessment and remediation tasks at their installations. The DOE's Los Alamos Area Office (DOE-LAAO) is the primary line of communication with UC for day-to-day operations.

LAAO oversees MSA AL-1 at the Laboratory as part of its Environment, Safety, and Health Branch. The Laboratory's ER Project Office tracks and manages the ER Project as part of the Environmental Programs Directorate. The ER Project, including the Decommissioning Project, is conducted under the management principles outlined in DOE Order 4700.1, "Project Management System" (DOE 1992, 0823), and DOE Notice N4700.6, "Project Control System Guidelines" (DOE 1993, 1058).

In November 1989, the New Mexico Environmental Improvement Division [now New Mexico Environment Department (NMED)] issued a hazardous waste operating permit authorized under RCRA to the DOE/UC for operating the Laboratory (NMEID 1989, 0595). In addition, in March 1990, the EPA issued a Hazardous and Solid Waste Amendments (HSWA) attachment to the permit, known as the HSWA Module, which went into effect on May 23, 1990 (EPA 1990, 0306). The HSWA Module sets forth the procedural requirements for assessing and remediating sites known as solid waste management units (SWMUs). In New Mexico, EPA currently has responsibility for implementing HSWA regulations.

The purposes of the RCRA facility investigation (RFI) and the corrective measures study (CMS) are to evaluate existing and potential environmental impacts resulting from contaminated sites and to evaluate corrective measures proposed to mitigate these impacts. All corrective measures implemented at the Laboratory comply specifically with RCRA regulations and the HSWA Module; with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as appropriate; with the National Environmental Policy Act (NEPA); and with other applicable federal and state laws and regulations (Section 1.2.1.5).

Laboratory sites that are being investigated include SWMUs and areas of concern [sites that contain potentially hazardous substances (such as radionuclides) that are not regulated under RCRA], collectively called potential release sites (PRSs). Under the ER Project's original structure, the PRSs were aggregated into 24 operable units (OUs), based on geographical and other considerations. In 1994, the OUs were regrouped into 5 units, called field units, as described in Section 1.3.2. As a result of the corrective action process, all PRSs requiring remediation are remediated by means of accelerated cleanup, corrective measures implementation (CMI) after completion of a CMS, RCRA closure, or other remedial measures, as appropriate. The corrective action process is described further in Section 1.2.1.1.

1.2.1 Statutory and Regulatory Framework for the ER Project

The principal requirements for the ER Project are those derived from RCRA Sections 3004(u) and (v), the CERCLA, the Atomic Energy Act (AEA), and New Mexico state law. The ER Project must respond to RCRA requirements for assessing and cleaning up sites at active hazardous waste treatment and storage units. Section 3004(u) provides for remediation of all hazardous waste sites at a given facility regulated under RCRA. Section 3004(v) extends this requirement to contaminated properties located beyond but bordering the Laboratory boundary.

Decommissioning is conducted under the authority of the AEA. Hazardous materials are regulated both by RCRA and by CERCLA, and radioactive materials are regulated under the AEA and/or CERCLA. The hazardous constituents of mixed waste are also subject to RCRA. New Mexico's authority in the assessment and remediation process for hazardous waste is as authorized by the EPA under RCRA. DOE Order 5400.1 (DOE 1988, 0075) establishes the environmental protection program requirements, authorities, and responsibilities for DOE operations to ensure compliance with applicable federal, state, and local environmental protection laws, regulations, and executive orders. In addition, the ER Project complies with applicable Laboratory policies.

The statutes described in the following sections provide the criteria for evaluating the technical performance of the ER Project. Table 1-1 lists the current environmental permits under which the ER Project at the Laboratory operates. The scope and status of permits that control hazardous waste operations at the Laboratory are the responsibility of the Laboratory's Environment, Safety, and Health Division.

TABLE 1-1

CURRENT ENVIRONMENTAL PERMITS APPLICABLE TO THE ER PROJECT

Permit Type	Permitted Activity	Issue Date	Expiration Date	Administering Agency
HSWA Module VIII	Environmental Restoration	May 23, 1990	Dec. 31, 1999	EPA
RCRA Hazardous Waste Facility	Hazardous waste storage, treatment, and disposal	Nov. 1990	Nov. 1999	NMED

1.2.1.1 Resource Conservation and Recovery Act

The ER Project is regulated by the RCRA. The hazardous waste management provisions of RCRA, as enacted in 1976 govern the day-to-day operations of

hazardous waste generation, treatment, storage, and disposal (TSD) facilities. Sections 3004(u) and (v) of RCRA established a permitting system and set standards for all hazardous waste management operations at a TSD facility. Under this law, the Laboratory qualifies as a treatment and storage facility and must have a permit to operate.

In 1984, Congress amended RCRA by passing HSWA. Sections 201, 202, 203, 206, 207, 212, 215, and 224 of HSWA modified the permitting sections of RCRA (Sections 3004 and 3005). In accordance with these provisions of HSWA, the Laboratory's permit to operate includes a section (the HSWA Module) that prescribes a specific corrective action program for the Laboratory, which primarily focuses on the investigation and cleanup, if required, of inactive sites.

The HSWA Module specifies a three-step corrective action process (Figure 1-1):

- RFI—The goal of this step is to identify the extent of contamination at the source and the environmental pathways along which contaminants could travel to human and environmental receptors. This step is implemented by characterizing the extent of contamination in the detail necessary to determine what corrective measures, if any, need to be taken. This approach focuses on answering those questions relevant to deciding further actions in a cost-effective manner.

- CMS—If characterization indicates that corrective measures are needed, this study evaluates alternatives that might reasonably be implemented. These measures are evaluated based on their projected efficacy in reducing risks to human and environmental health and safety in a cost-effective manner.

- CMI—This step implements the remedy chosen by the regulatory authority, verifies its effectiveness, and establishes ongoing control and monitoring requirements.

This IWP has been prepared to comply with the HSWA Module of the Laboratory's RCRA permit (EPA 1990, 0306). The fundamental unit to which these requirements apply is the SWMU, defined by EPA in the HSWA Module as

> "...any discernible unit at which solid wastes have been placed at any time, irrespective of whether it was intended for the management of solid or hazardous waste. Such units include any area at or around a facility at which solid wastes have been routinely and systematically released."

1.2.1.2 Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA addresses liability, compensation, cleanup, and emergency response relating to the release of hazardous substances into the environment and cleanup of inactive hazardous waste disposal sites. Under the provisions of the National Contingency Plan, a plan prepared by EPA under CERCLA, the EPA ranks facilities throughout the nation according to their potential hazard to human and environmental health and safety. The higher-ranking facilities listed on the National Priorities List are being assessed and cleaned up first. The Laboratory is not on the National

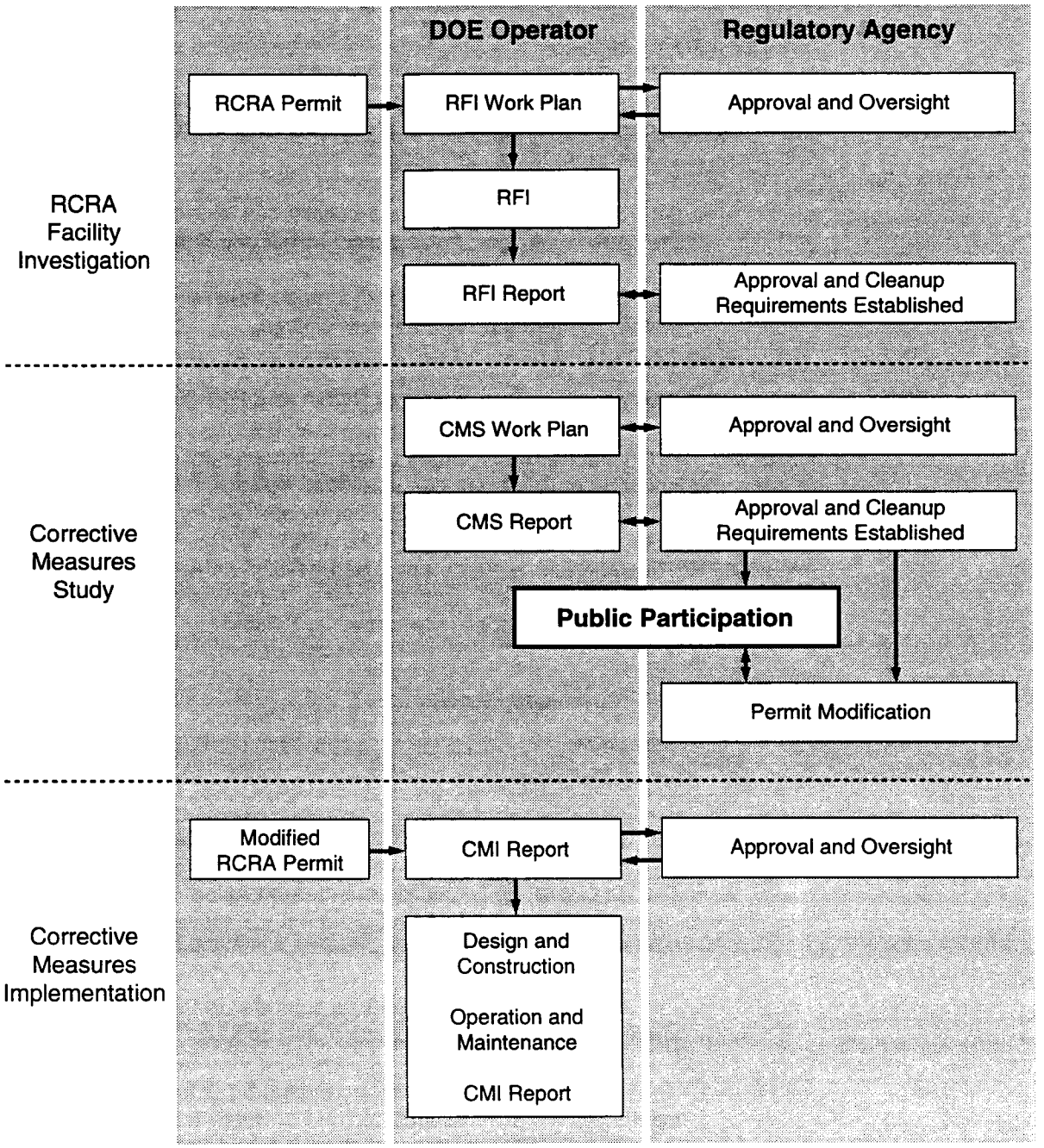

Figure 1-1. Three-step corrective action process.

Priorities List. The Laboratory is not regulated by EPA under CERCLA; however, it is striving to investigate and remediate sites suspected of being and known to be radiologically contaminated in a manner that would meet CERCLA requirements.

1.2.1.3 Integration of the Provisions of RCRA and CERCLA

Even though the Laboratory is a designated RCRA facility and is not on the National Priorities List, DOE Order 5400.4 (DOE 1989, 0078) specifies that the Laboratory conform to CERCLA requirements to the extent possible. DOE guidance resulting from Executive Order 12580, Superfund Implementation (DOE 1993, 0964), leads to the following interpretation under that guidance:

- CERCLA applies if hazardous substances are released into the environment or if a substantial threat of release exists.
- CERCLA specifies that the remediation requirement applies equally to federal and nonfederal entities.

1.2.1.4 Integration of the Provisions of RCRA and NEPA

NEPA provides a national policy to promote efforts that prevent or eliminate damage to the environment, to enrich the understanding of ecological systems and natural resources, and to establish a Council on Environmental Quality. In accordance with the provisions of DOE Order 5400.4 (DOE 1989, 0078), the ER Project has integrated NEPA procedural requirements and the RCRA process for assessing and cleaning up contaminated sites. In most cases, the primary instrument for this integration is the RFI/CMS process prescribed by RCRA.

1.2.1.5 Other Statutes and Regulations

1.2.1.5.1 Federal Statutes

The following federal acts also affect the conduct of the Laboratory's ER Project:

- The American Indian Religious Freedom Act of 1978 establishes a policy to protect and preserve for native Americans their inherent right to exercise their traditional religions.
- The Atomic Energy Act of 1948, as amended in 1954 and later years, authorizes energy research and development.
- The Clean Air Act of 1970, as amended, regulates emissions from a facility that could affect air quality. Such emissions must meet the performance standards established in this act.
- The Clean Water Act of 1972, as amended, seeks to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The Clean Water Act regulates waste discharges to navigable waters and sets pretreatment standards for hazardous waste discharges to sewer lines that lead to publicly owned treatment works.

- The Department of Energy Organization Act of 1977 vests in DOE the responsibilities of ensuring that national environmental protection goals are incorporated in energy programs; of advancing the goals of restoration, protection, and enhancement of environmental quality; and of ensuring public health and safety.

- The Department of Transportation Act of 1966 defines the US Department of Transportation's regulatory responsibility for safety in the transportation of all hazardous materials, including radioactive materials.

- The Endangered Species Act of 1973, as amended, requires federal agencies, "in consultation with and with the assistance of" the Secretaries of Interior and Commerce, to ensure that their actions are "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of the critical habitat of such species . . .".

- The Federal Facilities Compliance Act waives sovereign immunity under RCRA for federal facilities to the effect that the federal facilities are subject to enforcement actions, including fines and penalties, to the same extent as any private entity.

- The Fish and Wildlife Coordination Act ensures that fish and wildlife resources receive consideration equal to that given other values during the planning of development projects that affect water resources. Final regulations, which were proposed in 1979 and 1980 and were withdrawn in 1982, have not yet been promulgated. Meanwhile, guidance for implementing the Fish and Wildlife Coordination Act is based on court interpretations and past DOE experience.

- The National Historic Preservation Act of 1966 requires federal agencies to take into account the effects of their proposed actions on properties listed on, or eligible for, the National Register of Historic Places.

- The Occupational Safety and Health Act provides for the general welfare by ensuring that, so far as possible, every working man and woman in the nation has safe and healthful working conditions.

- The Safe Drinking Water Act, as amended, defines safety standards for public water systems. The maximum contaminant levels developed under the Safe Drinking Water Act are the levels with which drinking water must comply.

- The Toxic Substances Control Act, as amended, ensures that technological innovation and commerce in chemical substances and mixtures do not present an unreasonable risk of injury to health or the environment. The Toxic Substances Control Act provides for the identification of toxic hazards

posed by chemical substances and regulates their discharge into the environment.

1.2.1.5.2 State Statutes

This section lists state statutes that can affect the Laboratory's ER Project.

- The Air Quality Control Act of 1967 provides the basic framework for air pollution control in New Mexico.

- The Emergency Planning and Community Right-to-Know Act creates an emergency management task force to develop and distribute to emergency response personnel a comprehensive plan for assessing and managing hazardous materials spills. This plan stipulates the requirements for reporting spills and performing cleanup activities.

- The Ground Water Protection Act of 1990 provides for the regulation of hazards associated with leaks and spills from underground storage tanks, containment and remediation of pollution incidents, and funding of groundwater protection activities.

- The Hazardous Chemicals Information Act establishes state-level systems of emergency planning and notification to deal with releases of extremely hazardous substances and to provide a means whereby members of the public can learn about hazardous chemicals used in their communities and about any releases of those chemicals.

- The Hazardous Waste Act of 1977, as amended, establishes the State of New Mexico's program for hazardous waste management and control. Because this act meets federal requirements, EPA has granted the state authority to regulate site closures under RCRA (exclusive of HSWA).

- The Radiation Protection Act (1978) establishes the general rule of radiation protection. The Radiation Protection Act specifies that levels of radiation be kept as low as reasonably achievable, taking into account the state of technology and the costs of improvements in relation to public health and safety benefits and to the use of ionizing radiation in the public interest.

- The Radioactive and Hazardous Materials Act regulates the transportation of radioactive material on highways. Its requirements include a means of transportation that protects the health, safety, and welfare of the citizens and criteria for establishing the safest route.

- The Solid Waste Act of 1990 establishes a comprehensive statewide solid waste management program to regulate the reduction, storage, collection, transportation, separation, pro-

cessing, recycling, and disposal of solid waste and to promote source reduction, recycling, reuse, treatment, and transformation of solid waste.

- The Water Quality Act gives the New Mexico Oil Conservation Division exclusive authority over the prevention of water pollution resulting from oil or gas operations.

1.2.1.5.3 DOE Orders, Executive Orders, and Secretary of Energy Notices

A number of DOE Orders, Executive Orders, and Secretary of Energy Notices also apply to the ER Project. This list can be found in the 1993 version of the IWP (LANL 1993, 1017).

1.2.2 Objectives of the ER Project

1.2.2.1 Project Management Objectives

The objectives of the Laboratory's ER Project Management Plan are to

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- establish and maintain a management control system and project control procedures for efficient baseline management;
- establish at the Laboratory through the ER Project a procedural framework and schedules for developing, implementing, coordinating, and monitoring corrective actions that comply with RCRA, CERCLA, and all applicable environmental statutes;
- prioritize projects, taking into account resource availability, minimize duplication of analysis and documentation, and expedite corrective actions;
- provide both formal and informal mechanisms through which EPA, NMED, and the public can review, comment on, and participate in the corrective action review process at the Laboratory;
- record plans, procedures, costs, and other data and prepare progress and technical reports so that the knowledge and experience can be used to manage later elements in a cost-effective manner;
- ensure integration of the Decommissioning Project into the overall ER Project and provide a forum for the exchange of information among affected Laboratory organizations; and
- complete decommissioning activities at all facilities currently designated and at those that may be designated as surplus facilities in the future.

1.2.2.2 Technical Objectives

The overall technical objectives of the Laboratory's ER Project are to effectively formulate, evaluate, implement, and manage characterization, remediation, and decommissioning in a manner that fully complies with environmental regulations and protects human health and the environment. These objectives are met in a cost-effective manner by using existing technologies or through pilot studies that demonstrate the efficacy of simple corrective measures.

1.2.2.3 Quality Assurance Objectives

The intent of all quality programs is to ensure that appropriate controls are built into a program, project, or activity; that the quality of the results is known and documented; and that the effectiveness of the controls, as implemented, can be evaluated. The ER Project's Quality Assurance Project Plan (QAPP), presented in Chapter 4, has been prepared in accordance with Interim Guidelines and Specifications for Preparing Quality Assurance Program Plans (EPA 1980, 0283) and NQA-1, Quality Assurance Requirements for Nuclear Facilities (ANSI/ASME 1989, 0018), as specified by DOE Order 5700.6C (DOE 1991, 0703). The intent of the plan is to present a comprehensive, coherent quality assurance program. Personnel implement the guidelines established in the QAPP through quality assurance project plans, quality procedures, and standard operating procedures (SOPs).

1.2.2.4 Records Management Objectives

The statutory definition of "records" (44 USC 3301) includes technical data. The term is used in the Records Management Plan (Chapter 5) to reflect the need to protect all records essential to the ER Project. The specific activities implemented to achieve records management are delineated in quality procedures and SOPs developed in cooperation with the Quality Program staff.

The Records Management Plan ensures that records are managed to maintain their integrity and to ensure that ER Project actions are documented in an auditable manner. The ER Project Office has established the Records-Processing Facility to receive and process records and the Facility for Information Management, Analysis, and Display to provide program participants and the public with centralized access to information generated by the ER Project. The latter facility includes the hardware and software necessary to capture, display, and analyze data.

ER Project records, including technical data sets, are organized, indexed, and stored in a manner that provides efficient access to a diverse group of users. The information retrieval system is designed to protect the integrity of the data. The development of effective guidelines for handling record packages requires coordination with the quality, health and safety, resource planning, and public involvement programs.

1.2.2.5 Health and Safety Objectives

The ER Project is committed to performing its work in a manner that protects the health and safety of Laboratory workers and the public through compliance with all applicable federal, state, and local laws and regulations; with all applicable DOE

orders and health and safety standards for the Laboratory; and with the health and safety requirements specified in the HSWA Module.

The Health and Safety Plan (Chapter 6) describes the health and safety issues of the corrective action process; is designed to identify, evaluate, and control safety and health hazards; and provides for emergency responses appropriate to the potential hazards of waste characterization and remediation operations. Audits are regularly conducted to ensure that the Health and Safety Plan is implemented effectively.

1.2.2.6 Public Involvement Objectives

DOE and Laboratory policies require a proactive approach to disseminating and exchanging ideas affecting the general public and Laboratory employees. In addition, the HSWA Module specifies that the Laboratory develop a public involvement plan (Chapter 7) to provide public access to information pertaining to the ER Project. To satisfy these requirements, the Laboratory is implementing a public involvement plan that

- provides information about technical issues in a timely manner;
- responds to communities' concerns in a manner that encourages two-way communication between the interested parties and the Laboratory;
- reaches the broadest audiences and takes into account a variety of educational backgrounds and technical expertise;
- provides for public comment on ER Project activities as specified by regulation;
- provides a library for the general public that contains documentation on past, current, and proposed ER Project activities;
- encourages public participation as a way of increasing the public's understanding of the ER Project.

1.2.2.7 Procurement Plan Objectives

The ER Project follows the Laboratory's procurement policies and procedures set forth in Chapter 7 of the Laboratory Manual (LANL 1981, 0142), which is based on the federal acquisition regulation, the DOE's acquisition regulation, UC procurement policy, federal laws, and executive orders. Subcontracts are awarded competitively to the maximum extent practicable. Sources are selected in general accord with the procedures of the DOE's acquisition regulation handbook source evaluation board.

1.2.2.8 Site Prioritization Objectives

Los Alamos and Sandia national laboratories, together with DOE, EPA, and NMED, have developed a site prioritization system. This system provides a method for evaluating the relative risk posed by all the PRSs at each of the two laboratories. In addition, it incorporates other prioritization criteria (e.g., regulatory concerns and

potential for accelerated cleanups) to aid decision makers in allocating available resources according to the degree of risk at each site. The system was developed with input from EPA and NMED and provides for public involvement in the ranking assessment.

1.3 Structure of the ER Project

In 1993 and 1994, the Laboratory undertook major organizational changes to create a more efficient management structure, reduce the number of managers, and better respond to changes in the Laboratory's mission. In line with Laboratory-wide restructuring and with DOE requirements, the ER Project also undertook major organizational changes in 1994, the results of which are described in the following sections.

1.3.1 Organization of the Project Office

1.3.1.1 Management Team

Figure 1-2 shows the current composition of the ER Project management team. The ER Project Manager, who reports to the Program Director for Environmental Management Programs, is responsible for the effective implementation of the ER Project throughout the Laboratory. In executing his responsibilities, he is currently directly supported by six field project leaders (FPLs), a regulatory compliance manager, and a project consistency manager.

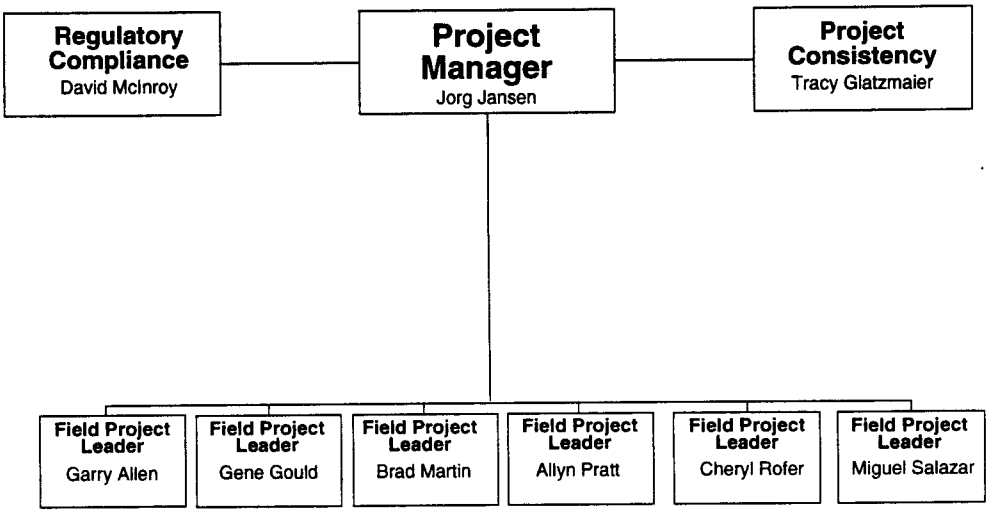

Figure 1-2. Organization of the ER Project.

1.3.1.2 Regulatory Compliance Manager

The regulatory compliance manager, a member of the management team, is the focal point for ER Project interactions with the NMED and the EPA Region 6. The

coordinator interacts directly with NMED and Region 6 and coordinates technical interactions when they are most appropriately handled at lower levels.

1.3.1.3 Project Consistency Manager

The project consistency manager, also a member of the management team, works with all field units to help ensure that consistent approaches and solutions to common problems are implemented. This manager promotes consistency in technical approaches to investigations, remediation methods and technologies, report preparation, and financial reporting. The manager works with technical specialists from all field units to identify situations that require special techniques and to foster acceptance of new methods by the field units.

1.3.1.4 Field Project Leaders

Five of the FPLs have responsibility for effectively carrying out the corrective action requirements for all PRSs. The sixth FPL has responsibility for the Decommissioning Project. The organization of the field units managed by each FPL is discussed in Section 1.3.2. The FPLs are fully accountable for budget and schedule; are responsible for all investigation and remediation of the PRSs in their field units; are members of the management team, which sets the direction for the project and conveys that direction to project personnel through their field units; and are responsible for the integration of projectwide procedures, technical approaches, contractor services, etc., in their field unit.

1.3.1.5 Other Key Personnel and Functions in the ER Project

1.3.1.5.1 Contract Administration Coordinator

The Laboratory's Business Systems Division (BUS) has assigned a contract administration coordinator to serve ER Project needs through a dedicated contract administration team assigned to the Environmental Management Division in which the ER Project resides. Having the contract administration coordinator indirect communication with an ER Project manager expedites the procurement of services required for implementing the ER Project.

1.3.1.5.2 Councils

Many disciplines represented on the field units are coordinated horizontally throughout the project by a council for each discipline. Each council has a chairperson, who calls council meetings as necessary to address projectwide issues and to develop policy proposals. The councils developed for the project are

- Earth Sciences,
- Decision Support,
- Health and Safety, and
- Document Preparation and Control.

1.3.2 Field Units

The previous structure of the ER Project, which consisted of 24 OUs, proved to be too cumbersome to provide for consistency in implementation and effective communication and to provide for accountability and cost control. The project has been simplified by combining the 24 OUs in 5 field units and a sixth field unit to address decommissioning.

A typical structure of a field unit is shown in Figure 1-3. This structure is based on the philosophy of moving many of the support functions to the field units to strengthen their ability to perform effectively. The structure increases internal control in the field units and improves the ER Project's productivity. As the figure implies, the vision is of a core technical team whose members represent all disciplines needed to address the full range of PRSs in the field unit. Likewise, a team of dedicated specialists in several support disciplines provides the required project tracking and implementation skills. The five remediation field teams prepare sampling plans, clarify site-specific technical issues with regulators, conduct investigations, evaluate results, prepare reports, and manage accelerated cleanups or CMS and CMI.

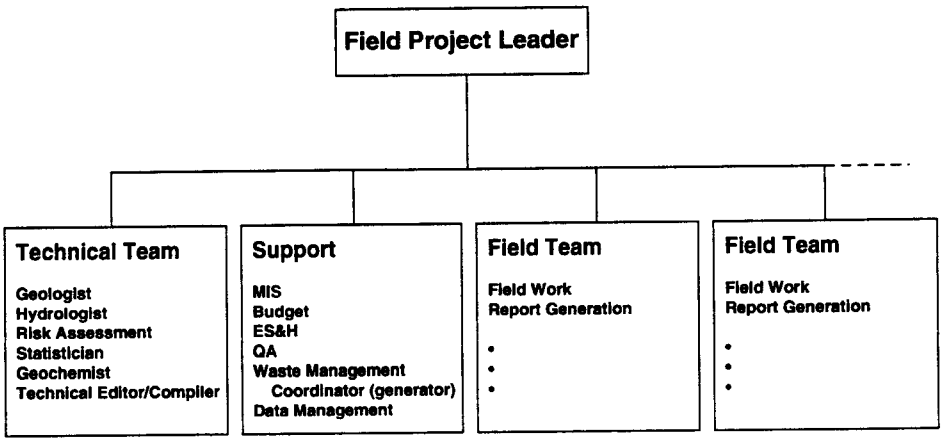

Figure 1-3. Typical structure of field units.

The ER Project's organizational structure lends itself to an efficient command and control system (Figure 1-4). The management structure can be compared to a wheel: The hub represents the central functions of the project office, where guidance, direction, and control originate. The spokes of the wheel represent the connections to the field units, typically through the field project leaders. The rim of the wheel represents the peripheral connections among the field units, which might represent the interaction of any set of specialists from all the field units, coordinating as a group representing their discipline for the entire ER Project. This management and communication structure ensures that directives, approaches, lessons learned, and issue resolution are addressed cooperatively and that they are consistently received and implemented.

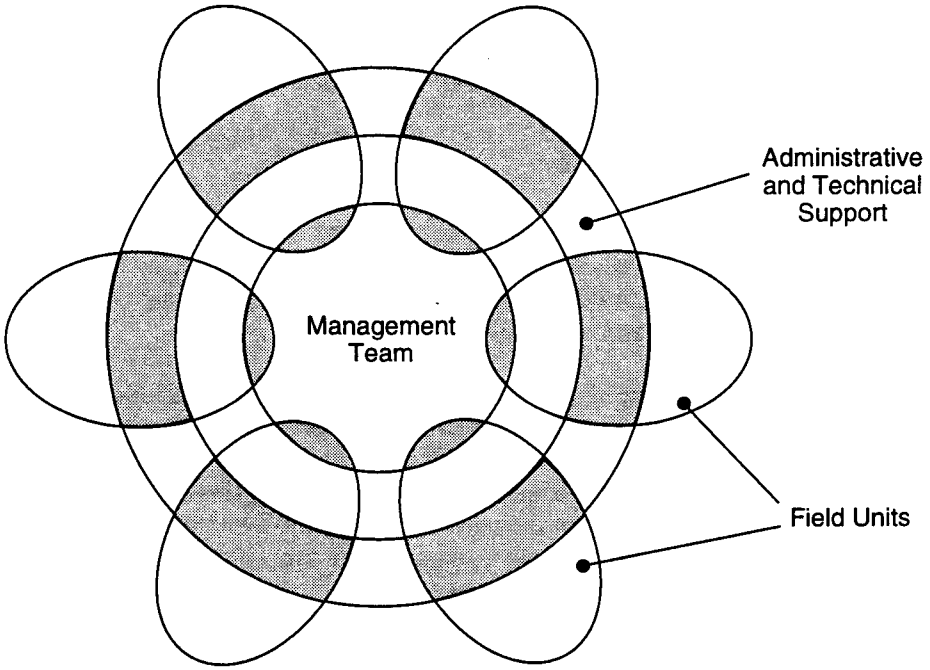

Figure 1-4. ER Project command and control systems.

1.3.3 Project Planning and Financial Control System

The ER Project's planning and control system (PPC) has been decentralized to provide direct support to the FPLs. The primary benefit for the field units is the ability to use the system for project management functions: cost and schedule planning, project tracking, resource management, and load leveling. A core group of the PPC team is also used to support the project office. The team's primary function is to integrate information from the field units on a projectwide basis. The PPC manager current reports directly to the ER Project Manager. The information consolidated in the project office is used for the current-year baseline, five-year plan, and reporting to the project manager and DOE. Both the field unit and the project office use the system for critical path analysis, what-if scenarios, and load leveling.

Each field unit team includes a cost and schedule specialist. These specialists coordinate with the core PPC team to ensure consistency in level of detail, unit costs, etc. The ER Project has integrated a cost module (Parade) with the existing scheduling software module (Finest Hour) to allow consolidation of cost and scheduling functions.

The current financial planning and control system integrates the ER Project's finances with the Laboratory's financial system. As each year's baseline plan is developed, budgets are negotiated between the project manager and the field project leaders. These negotiations allow the project to establish the baseline cost for the next fiscal year on the basis of a proposed budget.

The ER Project has integrated its financial system with the Laboratory's financial management information system to encompass all cost elements needed by the ER

Project for cost planning and reporting down to the eighth level of the work breakdown structure. As Laboratory systems are improved (time-accounting improvements, authorization controls for charging to cost accounts, etc.), the ER Project will integrate these in the financial planning and control system.

1.3.4 Reporting Requirements

The development and implementation of reporting requirements for the ER Project are mandated by DOE, NMED, and EPA through DOE/UC's permit to operate under RCRA. Appropriate DOE-LAAO and UC officials, as copermittees, sign the following certification for each deliverable to EPA.

> I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

All reporting data and documentation requirements conform to DOE Order 4700.1 and comply with applicable guidance from DOE-HQ, DOE-AL, DOE-LAAO, and internal Laboratory criteria.

To comply with applicable regulations and to keep all interested parties informed of progress made during the corrective action process, the ER Project prepares several types of plans and reports. The major plans and reports are associated with the RFI, accelerated cleanups, CMS, and CMI. In addition, periodic technical progress reports are submitted to DOE, EPA, and NMED.

In addition to the HSWA Module, it is the policy of the ER Project Office to see that all reports comply, to the extent feasible, with EPA's RFI guidance and DOE guidance regarding compliance with CERCLA. At a minimum, the reports describe the procedures, methods, and results of field investigations and include information on the type and extent of contamination, sources and migration pathways, and actual and potential receptors. The reports contain information adequate to support further corrective action decisions (e.g., comparisons with screening action level criteria). All reports are made available to the public through the Laboratory's Community Reading Room and other information repositories maintained for the public (Chapter 7).

In addition, the Decommissioning Project prepares formal Laboratory reports upon completion of a decommissioning project. The formal report provides background information, characterization data, decommissioning methods and techniques, final survey and release data, and any lessons learned. The purpose of the final report is to capture project history and provide a formal record of completion.

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2.0 INSTALLATION DESCRIPTION

2.1 Geographic Setting

Los Alamos National Laboratory (the Laboratory) and the neighboring residential areas of Los Alamos and White Rock are located predominantly in Los Alamos County, north-central New Mexico, approximately 60 mi north-northeast of Albuquerque and 25 mi northwest of Santa Fe (Figure 2-1). The 43-mi^2 Laboratory site and the communities adjacent to it are situated on the Pajarito Plateau, which consists of a series of fingerlike mesas separated by deep canyons containing ephemeral and intermittent streams that run from west to east. Mesa tops range in elevation from approximately 7,800 ft on the flank of the Jemez Mountains to about 6,200 ft at their eastern termination above the Rio Grande valley. The eastern margin of the plateau stands 300 to 900 ft above the Rio Grande (DOE 1979, 0051). The Department of Energy (DOE) controls the area within the Laboratory's boundaries and has the option of completely restricting access.

2.2 Mission of Los Alamos National Laboratory

The Laboratory is administered for the DOE by the University of California (UC). Since its inception in 1943, the principal mission of the Laboratory has been the design, development, and testing of weapons for the nation's nuclear arsenal. This effort is supported by research programs in nuclear physics, hydrodynamics, conventional explosives, chemistry, metallurgy, radiochemistry, and biology. In addition to the weapons program, Laboratory personnel are involved in medium-energy physics; space nuclear systems; controlled thermonuclear fusion; laser research; environmental research; geothermal, solar, and fossil energy research; nuclear safeguards; biomedical research; and space physics. A map showing active technical areas at the Laboratory is shown in Figure 2-2.

In August 1977, the Laboratory site was dedicated as a National Environmental Research Park. The ultimate goal of programs associated with this research facility is to encourage environmental research that will contribute understanding of how people can best live in balance with nature while enjoying the benefits of technology. Park resources are available to individuals and organizations outside the Laboratory to facilitate self-supported research on these subjects. In 1994, the Laboratory revised its mission, as stated below:

> "The Los Alamos National Laboratory is dedicated to developing world-class science and technology and applying them to the nation's security and well-being. The Laboratory will continue its special role in defense, particularly in nuclear weapons technology, and will increasingly use its multidisciplinary capabilities to solve important civilian problems."

Included in these civilian problems is the need to remediate sites at the Laboratory contaminated by hazardous and/or radioactive waste.

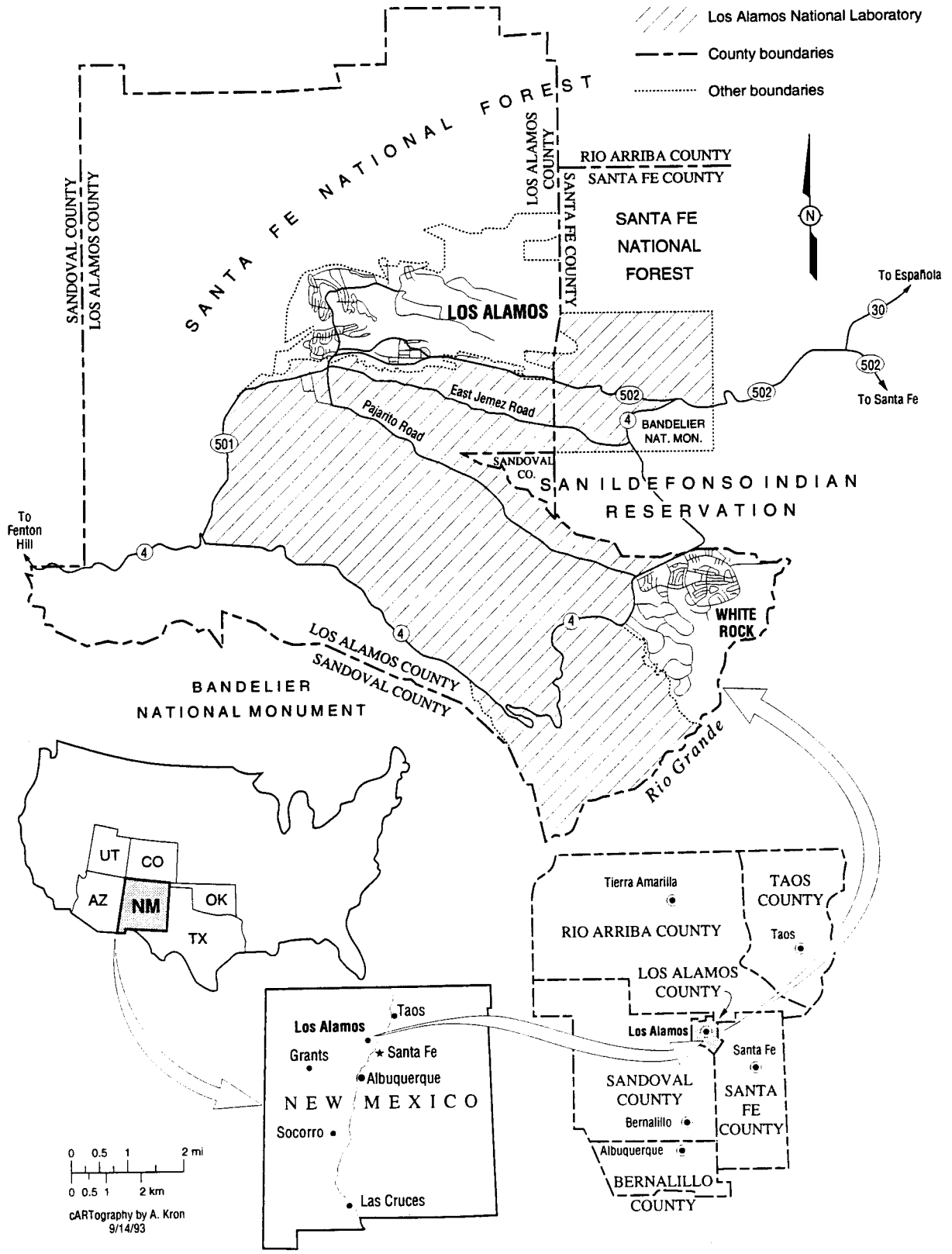

Figure 2-1. Location map of Los Alamos National Laboratory.

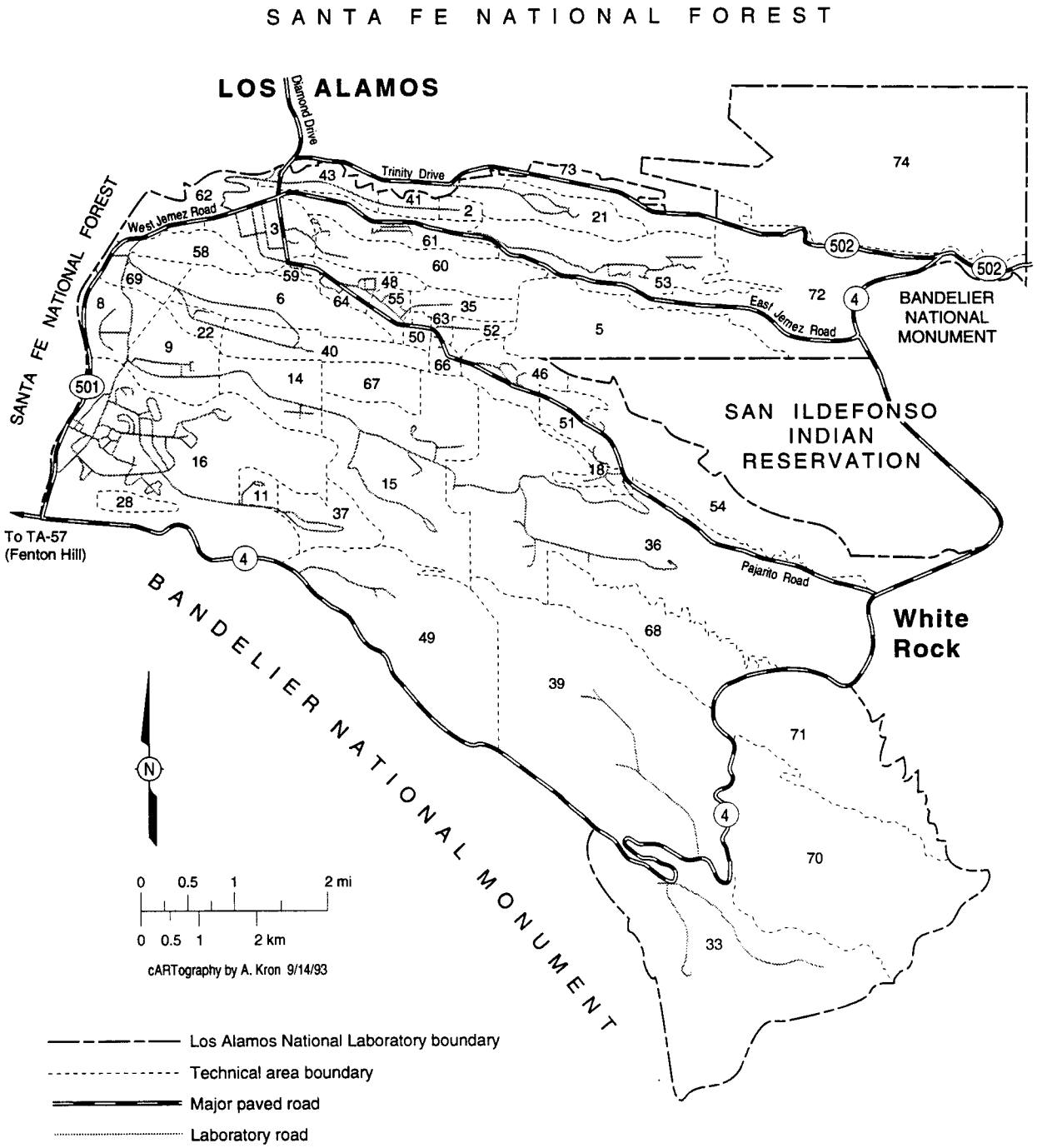

Figure 2-2. Technical areas at Los Alamos National Laboratory.

2.3 History of Los Alamos National Laboratory

In 1942, the US Army Manhattan Engineer District was established to develop the atomic bomb. The research quickly progressed to a point that necessitated a remote site for experimental work, and the Army selected the Los Alamos Ranch School for Boys as an appropriate location. The Undersecretary of War directed acquisition of the school site, which consisted of a group of some 50 log buildings on a 790-acre site northwest of Santa Fe. The project ultimately acquired an additional 3,120 privately owned acres and 45,666 acres of public land managed by the US Forest Service. In 1943, this land became known as the Los Alamos Site, later Los Alamos Scientific Laboratory.

Since its inception, the Laboratory has been operated by UC for the federal government. Research activities were established in wooden buildings south of the original Ranch School buildings in what is now downtown Los Alamos. Additional Laboratory buildings were constructed; army-style barracks, temporary and prefabricated, provided housing.

With the end of World War II and the growth of international competition, a national policy of maintaining superiority in the field of atomic energy was established. Congress chose to sustain the Los Alamos site; the Atomic Energy Commission (AEC) received control of the Laboratory from the Army and renewed the operating contract with UC. Thereafter, a major construction program was started south of Los Alamos Canyon. During subsequent years, the Laboratory continued to expand at a steady rate, first under the AEC and later under the Energy Research and Development Administration. Since 1978, the Laboratory has operated under the control of the DOE and is currently officially known as Los Alamos National Laboratory.

2.4 Environmental Setting

2.4.1 Land Use Patterns

Most Laboratory and community developments are confined to mesa tops. Large tracts of land north, west, and south of the Laboratory site are managed by the Santa Fe National Forest, Bureau of Land Management, Bandelier National Monument, General Services Administration, and Los Alamos County (Figure 2-3). The San Ildefonso Pueblo borders Los Alamos County and the Laboratory to the east.

Laboratory land is used for building sites, experimental areas, waste disposal locations, roads, and utility rights-of-way. However, these uses account for only a small part of the land. Most of the land controlled by the Laboratory serves as a buffer zone for Laboratory facilities, providing security and safety to the public, and as a reserve for future construction. The Laboratory's long-range site development plan (LANL 1994, 1171) addresses the best possible future uses of available Laboratory lands.

The public is allowed limited access to certain areas of the Laboratory site. An area north of Ancho Canyon between the Rio Grande and State Road 4 is open to hikers, boaters, and hunters, but woodcutting and vehicles are prohibited. Portions of Mortandad and Pueblo canyons are also open to the public. An archaeological site (the Otowi tract), northwest of State Road 502 near the White Rock Y, is open to the public, subject to restrictions imposed by regulations to protect cultural resources.

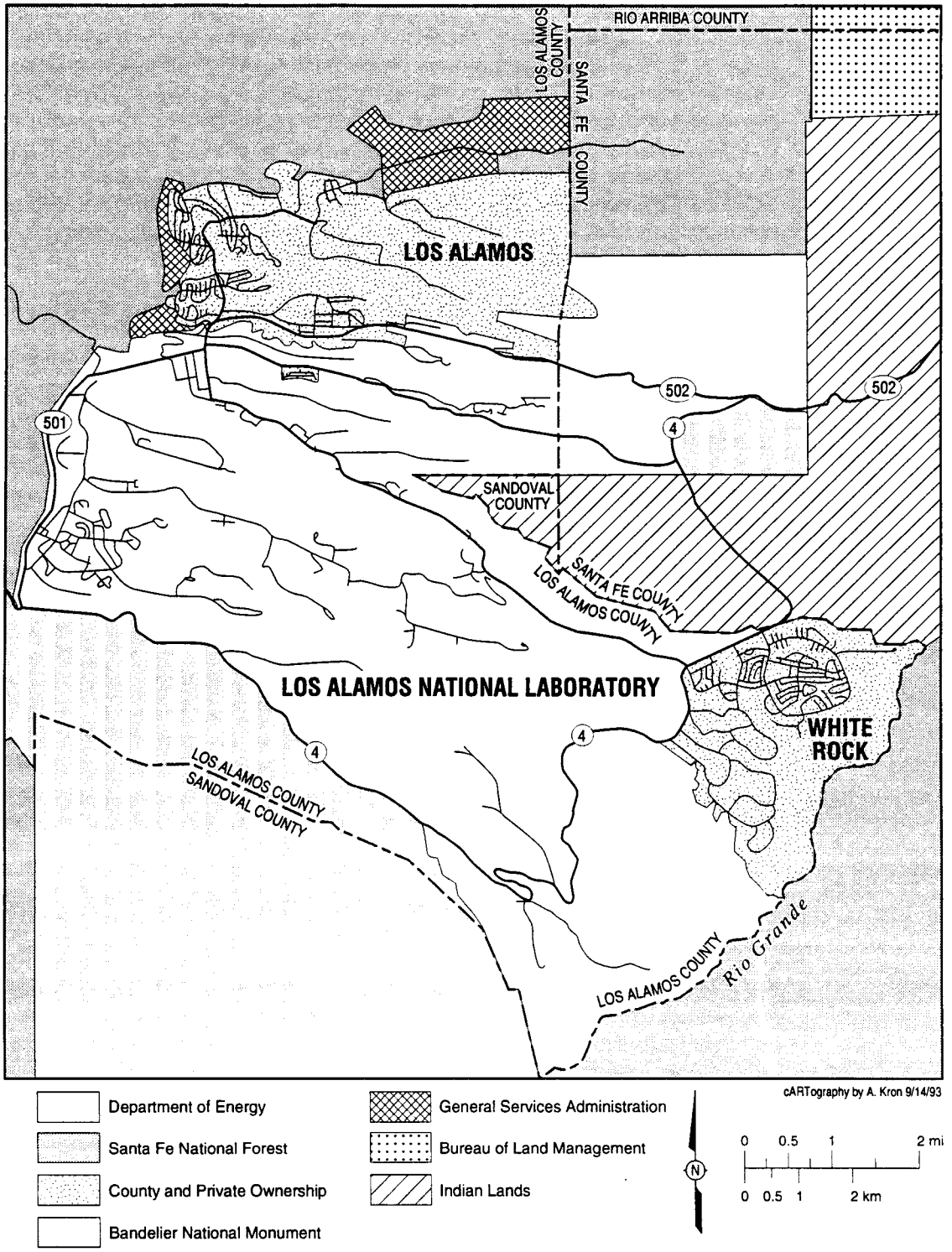

Figure 2-3. Land use map for the Laboratory and adjacent lands.

2.4.2 Ecology

Understanding of the structural and functional relationships among Los Alamos area ecosystems is limited, partly because of the wide diversity of ecosystems. This diversity has been created by the pronounced 4,920-ft elevation gradient that extends from the Rio Grande on the east to the Jemez Mountains 12 mi to the west. Many canyons, with abrupt changes in surface slope, parallel this gradient. The pronounced east-west canyon and mesa orientations, with concomitant differences in soils, moisture, and solar radiation, produce an interlocking finger effect among ecological life zones, resulting in many transitional overlaps of plant and animal communities within small areas. Section 2.5.2 provides a detailed overview of the hydrogeological environment at Los Alamos.

2.4.2.1 Flora

Six major vegetative complexes (community types) are found in Los Alamos County. A piñon-juniper forest surrounds most of the Laboratory. Within the confines of the Laboratory's border, the predominant community types are ponderosa pine woodland (6,900 to 7,500 ft in the western third of the reservation), piñon-juniper (6,200 to 6,900 ft in the central third), and juniper-grassland (5,600 to 6,200 ft in the eastern third).

Less is known about ecosystems other than the piñon-juniper woodland. Hakonson et al. (1973, 0118) provide a general description of the Laboratory and environs. Almost 900 plant species have been identified, and species lists have been prepared. Special studies have described the past and current status of the flora of the complex (Foxx and Tierney 1980, 0101; 1984, 0102; 1985, 0103). Past and present uses of the Laboratory and adjacent lands have resulted in structural changes in plant communities. Laboratory uses have had, and will continue to have, important consequences for local ecosystems. Few construction and waste disposal activities have occurred in the flood plains of canyons in and near the Laboratory. Natural wetland areas occur in some canyons, and more extensive wetlands have developed as a result of effluent outfalls.

The grama grass cactus, which is proposed for inclusion in the federal endangered species list, has been found on the dry mesa tops of Los Alamos County at elevations of about 6,000 to 6,400 ft. However, it has not been found on Laboratory property. Penalties exist for transporting plants protected under the 1985 New Mexico Rule No. NRD:85-3. Among the species protected under this rule, nine have been documented in the vicinity of Los Alamos County. To date, none has been found on Laboratory property.

2.4.2.2 Fauna

Before the Laboratory was established, Native Americans and European settlers farmed the mesas, disturbing areas that are now in various stages of succession. These areas afford suitable feeding locations for herbivores, especially deer and elk, and adjacent timbered canyon slopes provide cover for these species. Sheer canyon walls at lower elevations serve as important nesting habitats for birds of prey. Generally, larger mammals, reptiles, and invertebrates are most sensitive to variations in elevations and are confined to smaller ranges.

Information on the fauna within the Laboratory complex is largely qualitative. Species lists have been compiled from observational data and published data (DOE 1979, 0051), but the occurrence of some species has not been verified. Special studies are currently under way to provide a more comprehensive survey of vertebrate fauna.

Based on published reports and ongoing surveys, at least two federally listed animal species, the peregrine falcon (endangered) and the Mexican spotted owl (threatened), are known to inhabit Los Alamos County. The peregrine falcon establishes breeding territories near cliffs in areas of ponderosa and piñon pine. An historical aerie exists in the county, and peregrines are known to forage on Laboratory lands. Mexican spotted owls have recently been documented nesting on US Forest Service lands in Los Alamos County. Nesting Mexican spotted owls inhabit mixed-conifer and ponderosa pine-Gambel oak forest in mountains and canyons. Nesting Mexican spotted owls have not been confirmed on Laboratory lands, but surveys are still ongoing.

Other federal candidate and state-listed fauna species have been documented for Los Alamos County. They are the northern goshawk (federal candidate species) and Jemez Mountain salamander (federal candidate species and state endangered species). The northern goshawk nests primarily in dense mature or old coniferous forest. Nesting goshawks have been found on Santa Fe National Forest land in the northwest portion of Los Alamos County. Goshawk post-fledging areas and foraging areas are known to overlap Laboratory lands.

The Jemez Mountain salamander is endemic to north-central New Mexico and is known only in the Jemez Mountains. The salamander has been found in the moist upper reaches of the canyons that dissect the plateau. In 1985, one specimen was collected and recorded as having been found on Laboratory lands. During a salamander survey conducted in 1991, a Jemez Mountain salamander was found immediately adjacent (within 0.1 mi) to the Laboratory boundary on Forest Service property.

The southwestern willow flycatcher has recently been upgraded from a federal candidate species to a species proposed for the federal endangered list. This species was identified in an area of Bandelier National Monument during the early summer of 1994. Survey efforts are under way to determine its potential for inhabiting wetland areas within Laboratory boundaries.

2.4.2.3 Wetlands

Under the Resource Conservation and Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments (HWSA) Module of the Laboratory's operating permit, the Environmental Protection Agency (EPA) required a determination of all wetlands located in areas that either lie within Laboratory boundaries or that drain Laboratory land (Figure 2-4).

US Fish and Wildlife personnel mapped the wetlands around Los Alamos, using US Geological Survey (USGS) quadrangle maps as base maps and infrared high-altitude aerial maps. To cover all of the watersheds that drain the Laboratory site, five quadrangles were mapped (Frijoles, White Rock, Guaje, Valle Toledo, and Puye). In addition to the watershed of the Laboratory proper, the Seven Springs quadrangle, which gives the location of the Laboratory's geothermal site at Fenton Hill, was mapped. A detailed on-the-ground and historical analysis of single sites is

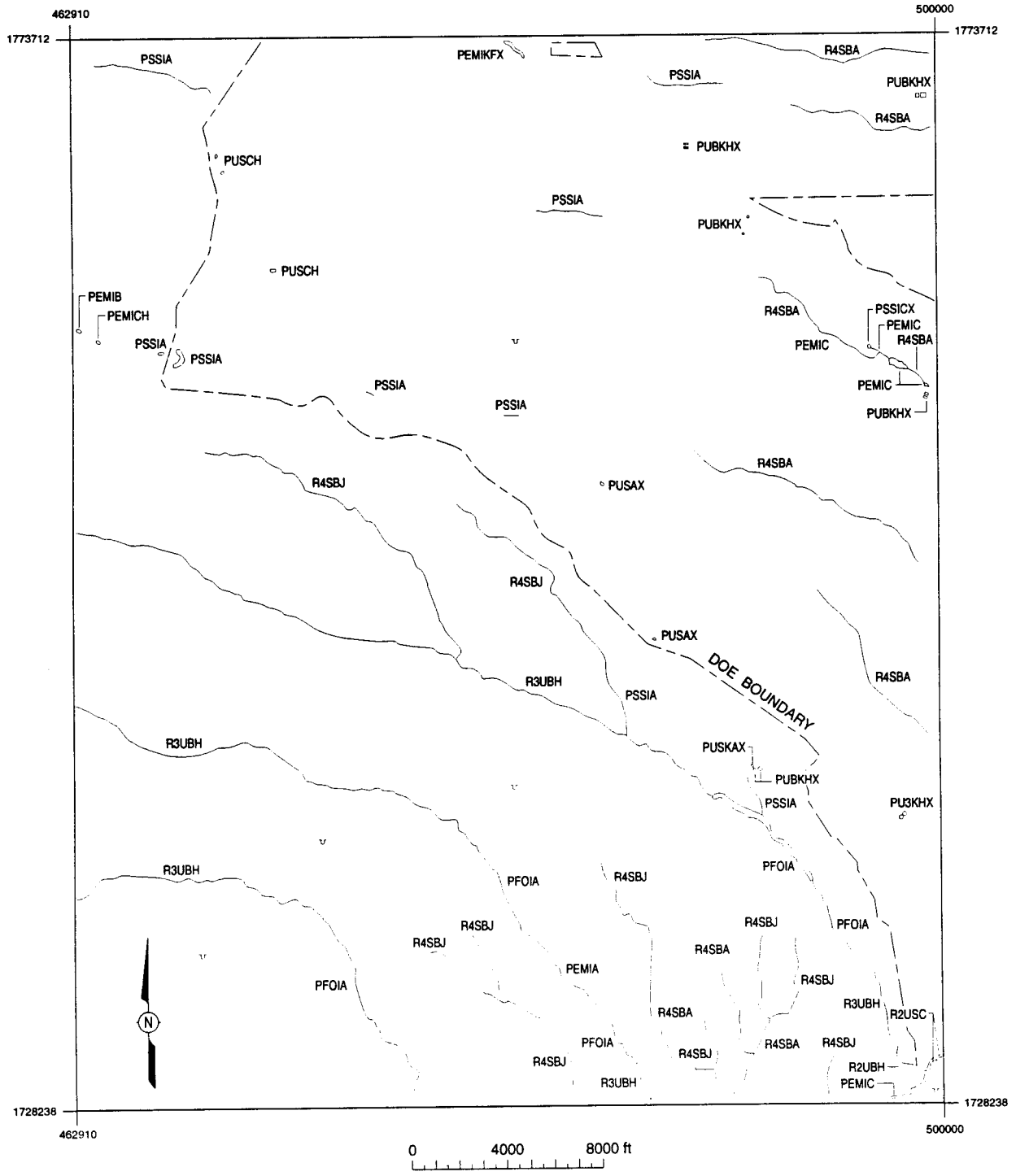

Figure 2-4. Map of wetlands for Los Alamos County.

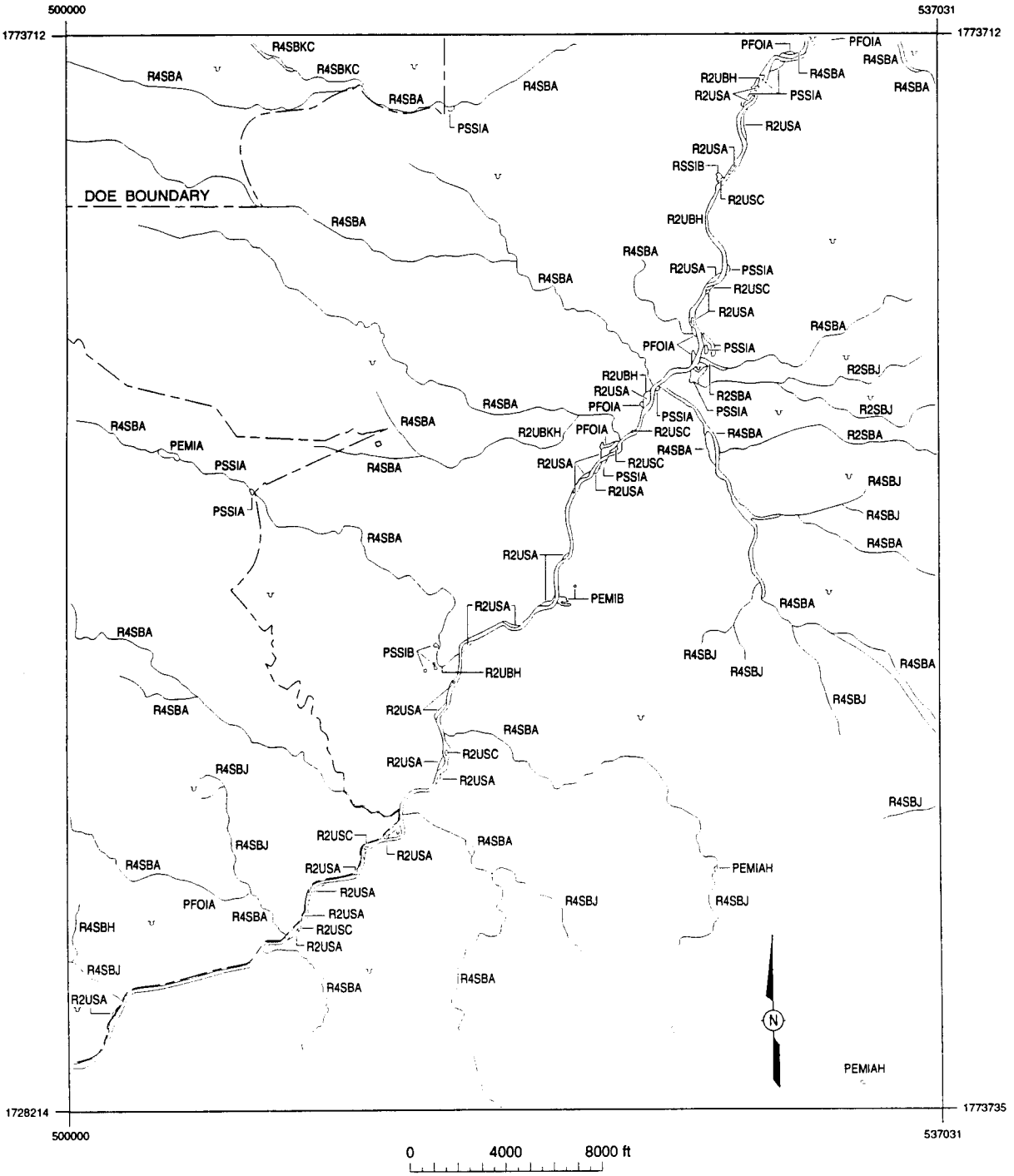

Figure 2-4. Map of wetlands for Los Alamos County.

being conducted by personnel in the Environmental Protection Group (EM-8) to delineate and characterize individual wetlands.

Wetlands within Laboratory boundaries fall primarily into two classifications: palustrine and riverine. Palustrine wetlands (ponds and marshes) have been identified in Sandia, Pajarito, and Pueblo canyons, and smaller ones have been identified in other parts of the Laboratory. Wetlands in Sandia and Pueblo canyons are primarily maintained by effluent releases. Beds of ephemeral and intermittent streams that traverse the Laboratory have been classified as temporarily flooded riverine wetlands.

Figure 2-5 shows the locations of wells in Los Alamos County and in adjacent locales. Wells LA-1, LA-3, LA-4, and LA-6 have been abandoned and plugged. The symbols on the map indicate where these wells were located.

2.4.3 Climate

Bowen (1990, 0033) has compiled and interpreted climatological data for the Los Alamos area, and this information is summarized below.

Los Alamos has a semiarid, temperate mountain climate. Forty percent of the 18-in. annual precipitation normally occurs from thundershowers during July and August. Winter precipitation falls primarily as snow, with accumulations of about 51 in. annually.

Summers are generally sunny, with moderate, warm days and cool nights. Maximum daily temperatures are usually below 90°F. Brief afternoon and evening thundershowers are common, especially in July and August. High altitude, light winds, clear skies, and dry atmosphere allow night temperatures to drop to the 50s (°F) after even the warmest day. Winter temperatures typically range from about 15°F to 25°F during the night and from 30°F to 50°F during the day. Occasionally, temperatures drop to 0°F or below. Many winter days are clear with light winds, allowing strong sunshine to make conditions comfortable even when air temperatures are cold. Snowstorms with accumulations exceeding 4 in. are common in Los Alamos, and some of these storms are associated with strong winds, frigid air, and dangerous wind chills, especially in the mountains. The climate from 1961 through 1988 had slightly cooler temperatures and higher precipitation than those recorded from 1911 through 1988 (entire record). The only significant difference between the period from 1961 through 1988 and the entire record period is the large amount of snowfall.

Because of complex terrain, surface winds in Los Alamos often vary greatly with time of day and location. With light winds and clear skies, a distinct daily wind cycle often exists: a light southeasterly to southerly upslope wind during the day and a light westerly to northwesterly drainage wind during the night (Figure 2-6, from Environmental Protection Group 1990, 0497). However, several miles to the east toward the edge of Pajarito Plateau near the Rio Grande valley, a different daily wind cycle is common: a moderate southwesterly up-valley wind during the day and either a light northwesterly to northerly drainage wind or moderate southwesterly wind at night. The predominant winds are southerly to northwesterly over western Los Alamos County and southwesterly and northeasterly toward the Rio Grande valley. Historically, no tornadoes have been reported to have touched down in Los Alamos County. Strong dust devils can produce winds up to 75 mph at isolated spots in the county,

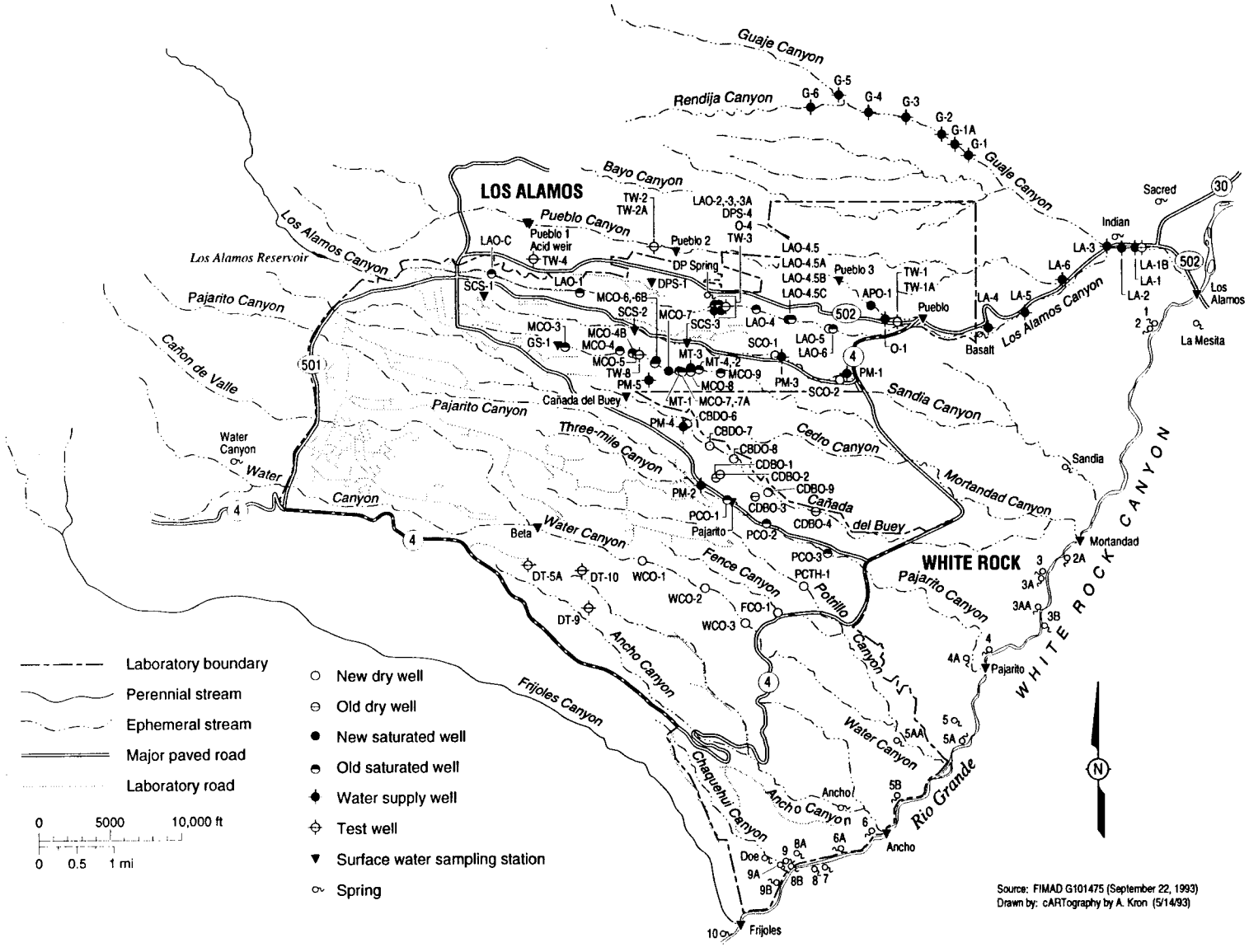

Figure 2-5. Well locations in Los Alamos County and in adjacent locales.

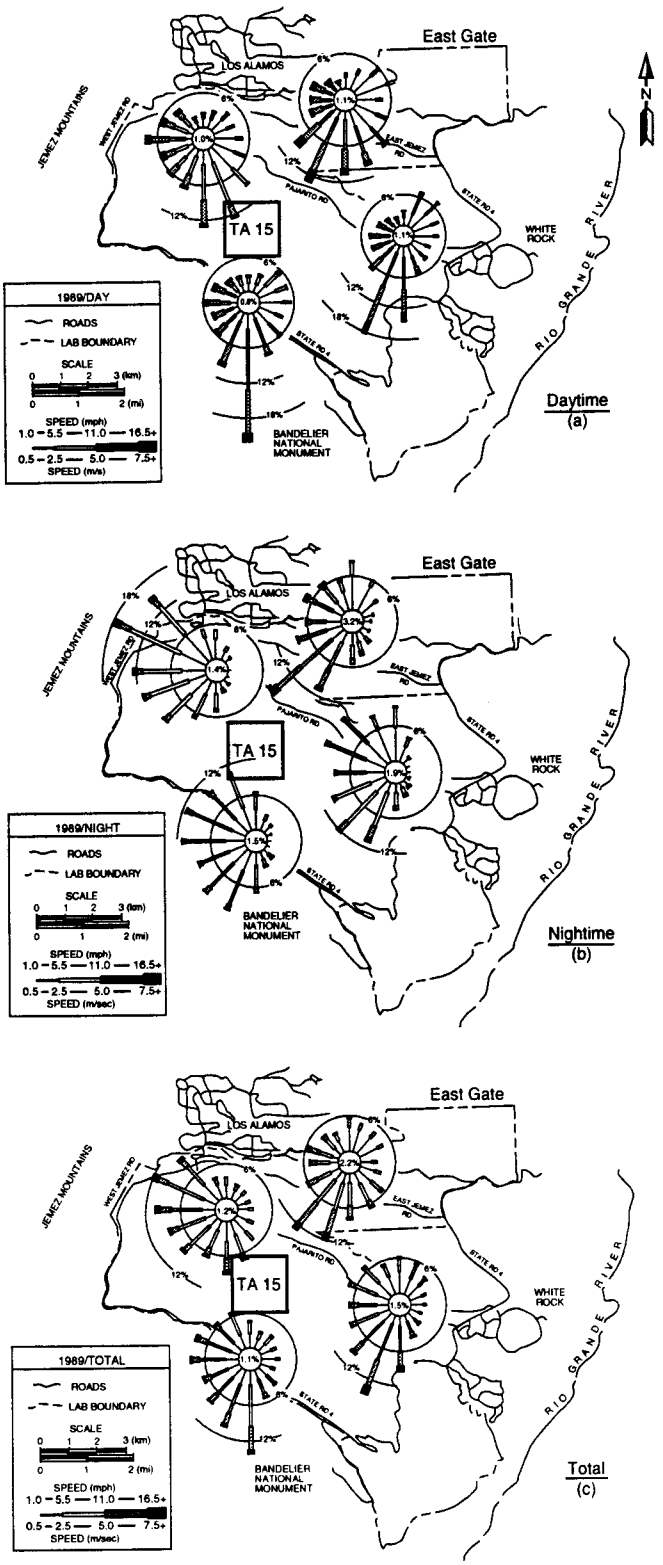

Figure 2-6. Wind roses at Laboratory stations during 1989.

especially at lower elevations. Strong winds with gusts exceeding 60 mph are common during the spring.

Lightning is common over the Pajarito Plateau. Fifty-eight thunderstorm days occur during an average year, mostly during the summer. Lightning protection is an important design factor for most facilities at the Laboratory. Hail damage can also occur. Hailstones with diameters up to 0.25 in. are common; 0.5-in.-diameter hailstones are infrequent.

The irregular terrain at Los Alamos affects atmospheric turbulence and dispersion, sometimes favorably and sometimes unfavorably. Enhanced dispersion promotes greater dilution of contaminants released into the atmosphere. The complex terrain and forests create an aerodynamically rough surface, forcing increased horizontal and vertical dispersion. Dispersion generally decreases at lower elevations, where the terrain becomes smoother and less vegetated. The frequent clear skies and light, large-scale winds cause good vertical daytime dispersion, especially during the warm season. Strong daytime heating during the summer can force vertical mixing up to 3,000 to 6,000 ft above ground level, but the effectiveness of the generally light winds in diluting contaminants horizontally is limited.

Clear skies and light winds have a negative effect on nighttime dispersion, causing strong, shallow surface inversions to form. These inversions can severely restrict near-surface vertical and horizontal dispersion. Inversions are especially strong during the winter. Drainage winds can fill lower areas with cold air, thereby creating deeper inversions, which are common toward the Rio Grande valley on clear nights with light winds. Canyons can also limit dispersion by channeling air flow. Strong, large-scale inversions during the winter can limit vertical mixing to under 3,000 ft above ground level.

Dispersion is generally greatest during the spring, when winds are strongest. However, deep vertical mixing is greatest during the summer. Dispersion is generally low during summer and autumn, when winds are light. Even though low-level winter dispersion is generally greater, intense surface inversions can cause least-dispersive conditions during the night and early morning.

During the winter, the frequencies of atmospheric dispersive capability (sampled at TA-59) are 52% unstable (Stability Classes A through C), 21% neutral (Class D), and 27% stable (Classes E and F). The frequencies are 44%, 22%, and 34%, respectively, during the summer. These stability category frequencies are based on measured vertical wind variations. Stability generally increases (the winds become less dispersive) toward the valley.

2.4.4 Population Distribution

Los Alamos County had an estimated 1992 population of approximately 18,200, based on the 1990 census adjusted to 1992 (Environmental Protection Group 1994, 1179). Two residential areas (Los Alamos and White Rock) and their related commercial areas exist in the county (Figure 2-1). The Los Alamos townsite (the original area of development that now includes the residential areas known as Eastern Area, Western Area, North Community, Barranca Mesa, and North Mesa) has an estimated population of 11,400. The White Rock area (including the residential areas of White Rock, La Senda, and Pajarito Acres) has about 6,800 residents. About 40% of the people employed in Los Alamos commute from other counties. Population data from 1990, adjusted to 1992, place about 224,000

persons within a 50-mi radius of Los Alamos (Table 2-1) (Environmental Protection Group 1994, 1179).

TABLE 2-1

1992 POPULATION WITHIN 80 KM OF LOS ALAMOS

	Distance from TA-53 (km)								
Direction	1–2	2–4	4–8	8-15	15–20	20–30	30–40	40–60	60–80
N	1	0	0	0	0	0	1,169	0	378
NNE	0	0	0	582	0	558	1,781	1,850	227
NE	1	0	0	0	326	15,860	1,039	1,170	3,965
ENE	0	0	0	2,031	1,609	2,843	2,827	1,222	2,267
E	0	0	87	26	582	1,199	728	0	1,422
ESE	0	0	0	0	0	306	24,239	1,091	1,511
SE	0	0	6,796	0	0	0	56,036	2,558	8
SSE	0	0	0	0	0	0	446	4,551	99
S	0	0	0	50	0	347	670	7,363	0
SSW	0	0	0	20	0	891	219	8,981	36,507
SW	0	0	0	0	0	0	343	4,532	0
WSW	0	0	0	0	0	343	341	2,775	225
W	0	0	0	0	0	0	0	179	144
WNW	0	1,443	6,572	0	0	0	0	0	3,359
NW	0	526	1,731	0	0	0	0	1,481	0
NNW	0	581	582	0	0	0	0	65	64
1992 Population Distribution	2	2,550	15,768	2,709	2,517	22,347	89,838	37,818	50,176

Note: Total population within 80 km of Los Alamos is 223,725.

2.5 Geologic and Hydrologic Setting

This summary of the hydrogeologic environment at the Laboratory and in the northern New Mexico region is intended to describe the major geologic, hydrologic, and hydrogeologic features and their conceptual interrelationships. It addresses the regional and installation-wide geologic setting and the hydrologic characteristics that affect surface water and groundwater occurrence and movement and their interactions as they relate to the potential for contaminant transport. The sources cited here and additional literature on the hydrology and geology of the Los Alamos region may be found in an annotated bibliography of geologic, hydrogeologic, and environmental studies related to solid waste management units at the Laboratory (LANL 1990, 0143). This bibliography was submitted to EPA in September 1990. The bibliography and the literature it describes are available for review in the Laboratory's public reading room located at 1350 Central Avenue, Suite 101, in Los Alamos.

2.5.1 Geology

2.5.1.1 Regional Setting

The Laboratory is situated on the Pajarito Plateau on the east flank of the Jemez Mountains and on the west side of the Rio Grande valley (Figure 2-7). The Jemez Mountains are part of the Jemez volcanic field, which consists of some 432 mi of

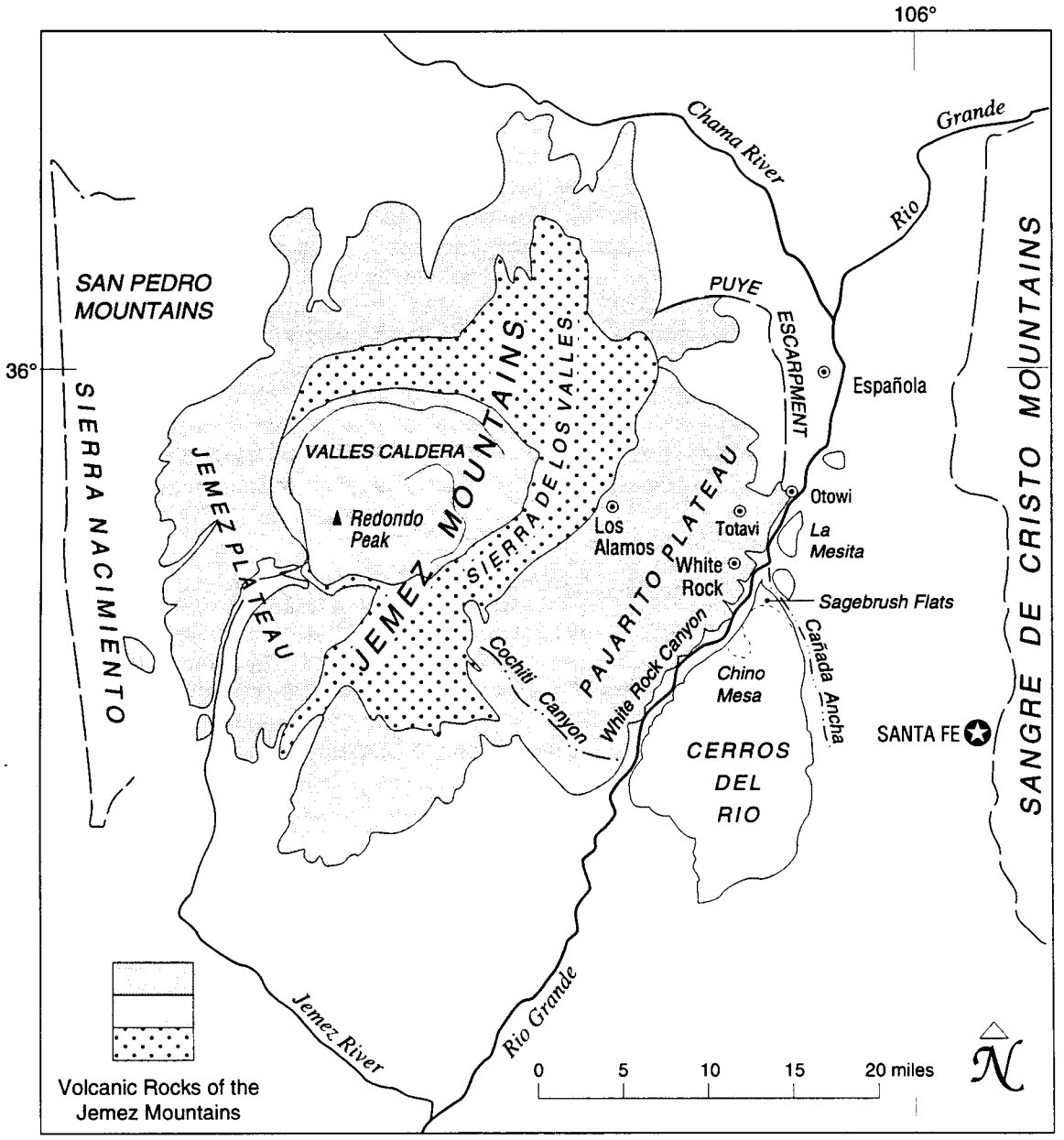

Figure 2-7. General geographic location map showing topographical features in the vicinity of Los Alamos.

volcanic rocks erupted from numerous vents, including a giant, multistage caldera (Gardner et al. 1986, 0310). The Jemez volcanic field occurs at the intersection of the Jemez lineament, a northeast-trending alignment of volcanic fields, and the Rio Grande rift, a major north-trending zone of extensional tectonics (Aldrich 1986, 0554).

Two major volcanic eruptions in the Jemez Mountains, which occurred about 1.5 and 1.13 million years ago, produced widespread and voluminous ash flow sheets: the Otowi and Tshirege members of the Bandelier Tuff (Smith and Bailey 1966, 0377; Spell et al. 1990, 0607). The morphology of the Pajarito Plateau is dominated by a gently eastward-sloping surface formed on top of the Bandelier Tuff, which is dissected by numerous steep-sided canyons. The Otowi and Tshirege members of the Bandelier Tuff were erupted concomitantly with the collapse of the Toledo and Valles calderas, respectively. Following formation of the calderas, volcanism continued with the extrusion of domes along ring fractures. The latest eruption in the Jemez Mountains occurred about 130,000 years ago, producing the El Cajete pumice and Banco Bonito rhyolite flow (Gardner et al. 1986, 0310; Self et al. 1988, 0500). Vestiges of volcanic activity continue today, as evidenced by solfataric and hot spring activity both within and outside of the Valles caldera (Goff et al. 1989, 0774). Studies of P-wave arrival time delays suggest the presence of partially molten rock beneath the Valles caldera, possibly the remnants of the cooling Bandelier magma chamber (Roberts et al. 1991, 0775).

The Pajarito Plateau is in the western part of the Española basin of the Rio Grande rift, a major tectonic feature of the western United States. The Española basin lacks distinct major faults on its eastern margin, but faults of major vertical offset may exist in the Precambrian rocks of the Sangre de Cristo uplift (Vernon and Riecker 1989, 0558; Biehler et al. 1991, 0528). The western margin is characterized by a prominent zone of major faults, which cuts Miocene to Quaternary rocks of the Jemez volcanic field (Smith et al. 1980, 0776; Gardner and Goff 1984, 0719; Goff et al. 1990, 0557). These border faults exerted strong control on the location and development of the volcanic field (Gardner and Goff 1984, 0719; Gardner et al. 1986, 0310).

Rocks formed before the rift developed are exposed around the margins of and underlie the Española basin. These rocks consist of Mississippian to Permian marine limestones, sandstones, and shales; Mesozoic marine to terrestrial sandstones and shales; and Eocene sandstones, shales, and freshwater limestones. Precambrian rocks—predominantly quartzite, granitic gneiss and schist, and greenstone—are exposed in the cores of the flanking Sangre de Cristo, Nacimiento, and Brazos uplifts (Kelley 1978, 0641). The earliest sediments deposited in the Tertiary Española basin are those of the Abiquiu, Picurís, and Los Piños formations, which consist of tuffaceous sandstones and volcaniclastic conglomerates derived largely from volcanic highlands to the north and northeast. These units range in age from about 28 to 17 million years old (Baldridge et al. 1980, 0527; May 1984, 0536; Ingersoll et al. 1990, 0533).

2.5.1.2 Stratigraphic Units

Beneath a veneer of soils and alluvial deposits, the mesas of the Pajarito Plateau are immediately underlain by the Bandelier Tuff of Pleistocene age, which is exposed in the canyon walls and is penetrated by numerous drill holes. Beneath the Bandelier Tuff, a sequence of interstratified sedimentary and volcanic rocks of Miocene to

Pleistocene age occur, which have been penetrated by water supply wells and which have been studied where they outcrop in canyons on the margins of the Pajarito Plateau. These rock units include volcanic rocks of the Paliza Canyon Formation, Tschicoma Formation, and the Cerros del Rio volcanic field, and sedimentary deposits of the Puye Formation, the Totavi Formation, the Cochiti Formation, and the Santa Fe Group. These units are briefly discussed below. Figure 2-8 is a generalized geologic cross section from west to east of the Laboratory's geologic setting.

2.5.1.2.1 Santa Fe Group

The Santa Fe Group of Miocene and early Pliocene age (formed 18 to 4.5 million years ago) is a thick series of terrestrial conglomerates, sandstones, and mudstones, with minor limestones, evaporites, volcanic tuffs, and intercalated basalts. These rocks are the most extensive units filling the Rio Grande rift, and most production from water wells at Los Alamos is from the Santa Fe Group (Griggs and Hem 1964, 0313; Purtymun 1984, 0196). Sedimentary rocks usually dominate the Santa Fe Group, although basalts constitute up to 45% of the section penetrated by water supply wells at the Laboratory (Purtymun et al. 1984, 0713). In the Española basin and underlying the northern part of Los Alamos County, the Santa Fe Group is subdivided into two formations (Tesuque and Chamita formations) and several members, which reflects the diversity of the coalesced alluvial fans deposited in the Española basin (Galusha and Blick 1971, 0108; Ingersoll et al. 1990, 0533). Early investigators inferred that all Santa Fe Group rocks exposed around the flanks of the Pajarito Plateau and intersected by water wells beneath the plateau belonged to the Tesuque Formation (Griggs and Hem 1964, 0313; Cooper et al. 1965, 0495), although more recent investigations suggest that some of the upper Santa Fe Group in the vicinity of Los Alamos is instead Chamita Formation (Turbeville et al. 1989, 0221).

2.5.1.2.2 Keres Group

Two formations of the Keres Group (Bailey et al. 1969, 0019; Gardner et al. 1986, 0310), may be important in the pre-Bandelier Tuff subsurface in the southern parts of the Laboratory. These are the Paliza Canyon and Cochiti formations, each about 13 million to about 6 or 7 million years old. The St. Peter's Dome area lies about 3 mi from the southern boundary of the Laboratory and was a major center of Keres Group volcanism (Goff et al. 1990, 0557). Large volumes of Paliza Canyon andesite were erupted from the St. Peter's dome center and spread to the east and north. It appears that some of the volcanic units encountered in wells at TA-49 (Weir and Purtymun 1962, 0228) may be Paliza Canyon lavas that have been misidentified as Tschicoma and Cerros del Rio units, as discussed below.

Beneath the southern Pajarito Plateau, sedimentary deposits of the Cochiti Formation compose the Miocene basin fill and are therefore laterally equivalent to the sedimentary rocks of part of the Santa Fe Group and possibly also to those of the Puye Formation (Section 2.5.1.2.4) to the north (Gardner et al. 1986, 0310). The Cochiti Formation consists predominantly of basin fill gravels derived from the volcanic centers of the southern and central Jemez Mountains volcanic field. The transition between the Cochiti, Santa Fe, and Puye formations probably occurs somewhere beneath Los Alamos County; however, it is very poorly defined.

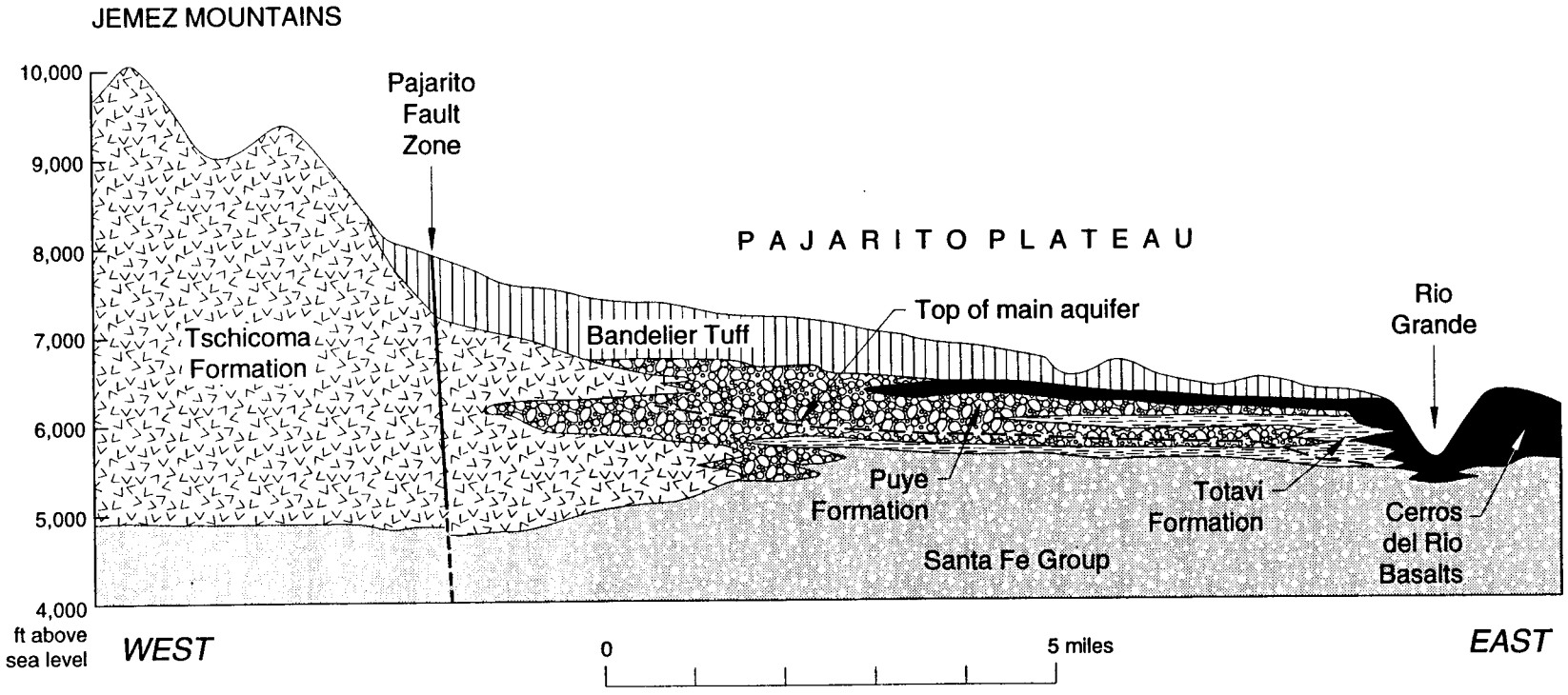

Figure 2-8. Generalized geologic section showing stratigraphy and structure from the Sierra de Los Valles across the Pajarito Plateau.

2.5.1.2.3 Tschicoma Formation

The Tschicoma Formation consists of a sequence of dacitic domes and lavas that were erupted from vents in the central to northeastern Jemez Mountains between about 7 and 3 million years ago (Gardner et al. 1986, 0310). These volcanic rocks outcrop extensively in the mountains immediately west of the Laboratory and are reported in the subsurface beneath the western and southern part of the Laboratory (Weir and Purtymun 1962, 0228; Griggs and Hem 1964, 0313; Dransfield and Gardner 1985, 0082).

2.5.1.2.4 Puye Formation

The Puye Formation consists of a Pliocene-to-Pleistocene fanglomerate that was shed eastward from Tschicoma volcanic centers in the northeastern Jemez volcanic field between about 4 and 1.7 million years ago. Earlier workers [e.g., Griggs and Hem (1964, 0313)] included the Totavi Lentil, now considered a separate formation (Section 2.5.1.2.5), as part of the Puye Formation. Most of the Puye conglomerates contain cobbles of dacitic to andesitic composition in a volcanic sand matrix. The beds include stream flow deposits, debris flow deposits, volcanic ash and block flow deposits, and ash fall and pumice fall deposits (Waresback and Turbeville 1990, 0543). The Puye Formation is best exposed north of the Laboratory, but lithologically similar rocks have been penetrated in drill holes as far south as Frijoles Mesa (Weir and Purtymun 1962, 0228; Dransfield and Gardner 1985, 0082). Under parts of the Laboratory, the Puye Formation is interstratified with basalts of the Cerros del Rio volcanic field. In Los Alamos water supply wells, the top of the main aquifer is usually within the Puye Formation.

2.5.1.2.5 Totavi Formation

Immediately beneath the fanglomerates of the Puye Formation, unconformably overlying the Santa Fe Group, is a section of poorly consolidated fluvial gravels, which Griggs originally named the Totavi Lentil of the Puye Formation (Griggs and Hem 1964, 0313). The gravels contain clasts that differ lithologically from those in the Puye, including abundant well-rounded cobbles and boulders of quartzite, granite, and pegmatite that record a source area distant from the Jemez Mountains; this unit probably represents axial channel gravels of an ancestral Rio Grande. Waresback and Turbeville (1990, 0543) redefined these fluvial gravels as a separate formation, the Totavi Formation, which also includes lacustrine sediments that are complexly interstratified with the upper Puye Formation ("old alluvium" of Griggs and Hem 1964, 0313). In some water supply wells beneath the Laboratory, the Totavi was reported between the Santa Fe and the Puye, occurring at lower elevations in the eastern wells (Cooper et al. 1965, 0495; Purtymun et al. 1983, 0712; Purtymun et al. 1984, 0713). The presence of the Totavi at these levels suggests that Rio Grande river gravels were deposited on erosional surfaces, a setting analogous to Quaternary terraces of the Rio Grande in the Española basin described by Dethier et al. (1988, 0773) before deposition of the Puye fans, which unconformably overlie older formations.

2.5.1.2.6 Cerros del Rio Basalts

Basaltic flows, breccias, and scoria of the Cerros del Rio occur in the subsurface beneath much of the Pajarito Plateau (Dransfield and Gardner 1985, 0082) and

outcrop in the east and southeast parts of Los Alamos County (Griggs and Hem, 1964, 0313). These volcanic rocks are associated with the Pliocene-to-Pleistocene Cerros del Rio basalt field east of the Rio Grande, and rocks from this field have been dated at 4.6 to 2.0 million years old (Gardner et al. 1986, 0310). The youngest lava flows in this area occurred between the two Bandelier Tuff eruptions, 1.5 and 1.13 million years ago ("basaltic andesite of Tank Nineteen" described by Smith et al. (1980, 0776). Part of this volcanic field is also known as basaltic rocks of Chino Mesa (Griggs and Hem 1964, 0313). The top of the main aquifer beneath the Laboratory is locally within this section of basaltic rocks.

2.5.1.2.7 Otowi Member, Bandelier Tuff

The Otowi Member of the Bandelier Tuff underlies the Tshirege Member in the subsurface beneath much of the Pajarito Plateau and outcrops in many of the canyons (Griggs and Hem 1964, 0313). The Otowi Member is mostly a nonwelded ash flow tuff (ignimbrite) that was erupted from the Jemez Mountains 1.5 million years ago (Spell et al. 1990, 0607). It is highly porous and poorly indurated and is composed of multiple flow units. Where it outcrops, cooling joints are typically absent because of relatively low emplacement temperatures and the lack of induration. The Guaje Pumice Bed generally occurs at the base of the Otowi Member and consists of sorted pumice fragments that average 0.8 to 1.6 in. in size (Crowe et al. 1978, 0041).

2.5.1.2.8 Cerro Toledo Rhyolite and Interbedded Sediments

An interbedded sequence of rhyolitic tuffs and sediments commonly occurs between the Otowi and Tshirege members of the Bandelier Tuff. The rhyolitic tuffs were erupted between 1.5 and 1.2 million years ago, predominantly from the Cerro Toledo domes in the northeastern Jemez Mountains (Heiken et al. 1986, 0316). Beneath the Pajarito Plateau, the sediments are epiclastic sands and sandy gravels that lithologically resemble Puye Formation fanglomerates. At the Laboratory, deposits in this interval have sometimes been referred to as "Tsankawi pumice" or "Tsankawi member." These units may play an important role in the migration of water in the subsurface beneath the Laboratory (Stoker et al. 1991, 0715).

2.5.1.2.9 Tshirege Member, Bandelier Tuff

The most widespread rock unit on the Pajarito Plateau is the Tshirege Member of the Bandelier Tuff (Griggs and Hem 1964, 0313), which was erupted from the Valles caldera in the Jemez Mountains about 1.13 million years ago (Spell et al. 1990, 0607). The Tshirege Member is composed of multiple flow units of crystal-rich ignimbrite and displays significant variations in welding and alteration, both in a single stratigraphic section and with varying distance from the caldera. Individual units tend to be more welded and thicker to the west. Flow units are locally separated by volcanic surge deposits of well-sorted, fine-grained, cross-bedded crystal and pumice fragments. Vapor phase alteration, caused by postemplacement cooling and migration of entrained magmatic gases, occurs in much of this unit. The base of the Tshirege Member is often marked by 1.5 to 10 ft of bedded, unconsolidated, pumice-rich ash fall tuff of the Tsankawi Pumice Bed (Bailey et al. 1969, 0019; Crowe et al. 1978, 0041). The Tsankawi Pumice Bed is generally poorly recognized in drill bit cuttings because rotary drills commonly grind the soft materials into dust.

The Tshirege Member has been subdivided into a sequence of mappable units based either on erosional characteristics (Weir and Purtymun 1962, 0228; Baltz et al. 1963, 0024; Purtymun and Kennedy 1971, 0200) or on primary cooling units (Crowe et al. 1978, 0041). These units have been correlated over large distances on the Pajarito Plateau. However, the boundaries between the units are not always distinct in the field and can be difficult to recognize in drill holes, causing investigators to place the contacts between units at different locations. Furthermore, in the absence of geologic mapping in the intervening areas, the validity of the correlations is uncertain.

Stratigraphic features in the tuff, such as volcanic surge deposits, may locally provide a preferential migration pathway for moisture and contaminants in the subsurface (Purtymun 1973, 0710; Crowe et al. 1978, 0041). Purtymun (1973, 0710) noted increased rates of vapor phase migration of tritium away from storage shafts at TA-54 along a stratigraphic boundary that includes surge layers. Individual flow units in the Tshirege Member contain vertical cooling joints that may or may not cross flow unit boundaries. In ash flow tuffs, cooling joint spacing varies primarily with the thickness of the unit, emplacement temperature, substrate temperature, and topography. Joint density tends to be greatest in welded tuff and least in nonwelded tuff. Hydraulic conductivities are generally greatest in the fractured, welded parts of ash flow tuffs and least in the nonwelded parts (Crowe et al. 1978, 0041).

2.5.1.2.10 Post-Bandelier Units

Stratigraphically overlying the Bandelier Tuff are discontinuous Quaternary alluvial units that occur as thin deposits (typically less than 15 ft thick) on mesa tops and as deposits in canyons. Alluvial fans consisting mostly of dacite debris are being shed over the Bandelier Tuff at the western boundary of the Laboratory. Well-sorted to poorly sorted sandy and gravelly alluvium occurs in the major drainages of the Pajarito Plateau, ranging up to at least 70 ft thick in some drill holes (Baltz et al. 1963, 0024). Additional, older alluvium occurs on stream terraces on the sides of the canyons, which can be buried by colluvial deposits from the canyon walls. The distribution of alluvial deposits on the mesas has not been mapped, but these deposits are most widespread on the western part of the Pajarito Plateau. Post-Bandelier alluvial units represent a range of ages from 1.1 million years ago to the present. Generally, alluvial units on the surface of the mesas are probably oldest, becoming inactive as drainages were incised into the plateau. Those units lowest in the drainages grade into the active alluvium along canyon bottoms.

The alluvial sediments in the canyon bottoms probably record a complex history of erosion and deposition, in part related to regional climatic changes. In Cabra Canyon, immediately north of Los Alamos, several cycles of erosion and deposition of sediment have occurred over the last 6,000 years, during which most of the previously stored sediment was eroded (Gardner et al. 1990, 0639). Similar cycles of erosion and deposition have been documented in many parts of the southwestern United States, and the older alluvial units in the vicinity of Los Alamos may also record the effects of regional climatic changes (Dethier et al. 1988, 0773).

The mesas of the Pajarito Plateau are also covered in part by deposits of the El Cajete pumice, erupted from El Cajete crater in the Jemez Mountains. Deposits of pumice on the mesas have not been mapped, but at the Laboratory they are generally most common to the south, and the axis of the volcanic dispersal plume is south of Los Alamos County. Available data suggest that the El Cajete pumice is 130,000 to 170,000 years old (Self et al. 1988, 0500).

2.5.1.3 Soils

A large variety of soils have developed on the Pajarito Plateau as the result of interactions of the underlying bedrock, slope, and climate (Nyhan et al. 1978, 0161). The mineral components of the soils are in large part derived from the Bandelier Tuff, but dacitic lavas of the Tschicoma Formation, basalts of the Cerros del Rio volcanic field, and sedimentary rocks of the Puye Formation are locally important. Alluvium derived from the Pajarito Plateau and from the east side of the Jemez Mountains contributes to soils in the canyons and also to those on some of the mesa tops. Layers of pumice derived from El Cajete in the Jemez Mountains and windblown sediment derived from other parts of New Mexico are also significant components of many soils on the Pajarito Plateau.

Soils formed on the tops of mesas on the Pajarito Plateau include the Carjo, Frijoles, Hackroy, Nyjack, Pogna, Prieta, Seaby, and Tocal series. These soils typically have loam or sandy loam surface horizons and clay or clay loam subsurface horizons. Some, including the Frijoles, Hackroy, and Seaby soils, contain abundant pumice. Others, including the Prieta soils, contain abundant wind-deposited sediment. Soils on the mesas can vary widely in thickness and are typically thinnest near the edges of the mesas, where bedrock is often exposed. Soils formed from alluvial and colluvial deposits include the Potrillo, Puye, and Totavi series and are generally loose and sandy. The slopes between the mesa tops and canyon bottoms often consist of steep rock outcrops and patches of shallow, undeveloped colluvial soils. South-facing canyon walls are steep and usually have little or no soil material or vegetation; in contrast, the north-facing walls generally have areas of very shallow, dark-colored soils and are more heavily vegetated (Nyhan et al. 1978, 0161).

Soil-forming processes extend along fractures in bedrock, and coatings of clay and calcium carbonate on fractures record the transport of water to significant depths in the tuff. For example, at TA-54, Area G, calcium carbonate has been observed as deep as 39 ft and clay coatings as deep as 46 ft below the ground surface (Purtymun et al. 1978, 0207). Roots have also been observed at similar depths along fractures in core holes and pits, suggesting that these soil-forming processes continue at depth today.

2.5.1.4 Geologic Structure

As mentioned earlier, the Laboratory is on the Pajarito Plateau, which lies at the western margin of the Española basin of the Rio Grande rift, a major tectonic feature of the North American continent. The Pajarito fault system forms the western margin of the Española basin and exhibits Holocene movement and historic seismicity (Gardner and House 1987, 0110; Gardner et al. 1990, 0639; Gardner and House 1994, 0720). The fault system is made up of over 65 mi of mapped fault traces and connects with regional structures that extend at least as far as Cochiti to the south and Taos to the northeast (Gardner and House 1987, 0110).

Within Los Alamos County, the Pajarito fault system consists of three active, or potentially active, fault segments: the Frijoles Canyon, Rendija Canyon, and Guaje Mountain segments. The Frijoles Canyon fault segment is a zone of faulting over 0.25 mi in width, whose major scarp forms the western boundary of the Laboratory. Near the southwestern corner of the Laboratory, the major scarp of the Frijoles Canyon segment is over 410 ft high in rocks about 1 million years old. Movement on this fault segment is normal-oblique, and the fault's eastern side is relatively

downdropped. Where exposed north of Los Alamos Canyon, the Rendija Canyon and Guaje Mountain faults are characterized by zones of gouge and breccia, generally 100 to 150 ft wide. Both fault segments produce visible offsets of stratigraphic horizons and are dominantly normal-oblique faults, whose west sides are downdropped. There are some indications of strike-slip movements on the Guaje Mountain fault segment (Wachs et al. 1988, 0502; Aldrich and Dethier 1990, 0017; Gardner et al. 1990, 0639). The youngest movements on the Guaje Mountain segment have been constrained to between roughly 4,000 and 6,000 years ago (Gardner et al. 1990, 0639). Displacement on the Guaje Mountain and Rendija Canyon faults apparently decreases south of Los Alamos Canyon, and narrow zones of faulting are replaced by wide (over 300 ft) zones of intense brecciation and fracturing superimposed on the network of cooling joints in the Bandelier Tuff (Vaniman and Wohletz 1990, 0541). In contrast to cooling joints, these tectonic fractures cross flow unit and lithologic unit boundaries; thus, tectonic fractures may provide more continuous and more deeply penetrating flow paths for groundwater migration than do cooling joints.

Dransfield and Gardner (1985, 0082) integrated a variety of data to produce structure contour and paleogeologic maps of the pre-Bandelier Tuff surface beneath the Pajarito Plateau. Their maps reveal that subsurface rock units are cut by a series of down-to-the-west normal faults; the overlying Bandelier Tuff is not obviously displaced by these buried faults. However, where detailed fracture studies have been done on the plateau, they have shown that fracture abundances and apertures increase in the Bandelier Tuff over fault projections, which indicates the tectonic fracturing mentioned above (Vaniman and Wohletz 1990, 0541). In addition, small-scale offsets along fractures have been observed in various parts of the Laboratory, including Area G at TA-54 (Rogers 1977, 0216), which suggest additional unmapped fault zones. Unfortunately, detailed fracture studies on the Pajarito Plateau are few.

2.5.1.5 Seismicity and Volcanism

The Laboratory lies within a region that possesses a long and rich history of volcanic and tectonic activity dating from the distant past into the Late Pleistocene and present, respectively. Volcanism began in the Jemez Mountains volcanic field more than 13 million years ago and continued without significant hiatus up through about 130,000 years ago (Gardner et al. 1986, 0310). Reports of questionable reliability describe what were apparently phreatic explosions and possible associated earthquakes within the volcanic field around 100 years ago (Santa Fe *Daily New Mexican* 1882, 0780). Regardless, given the long history of spatially focused, geologically continuous volcanic activity, future volcanism can be expected. Although volcanic activity directly affecting the Laboratory may prove unlikely, sufficient data to quantify the probabilities and nature of future volcanism are lacking.

Direct effects of future seismicity at the Laboratory are likely, although quantification of probabilities is not possible at present. Numerous small earthquakes are recorded in the Los Alamos area and northern New Mexico each year (Sanford et al. 1979, 0540; Cash and Wolff 1984, 0530; Gardner and House 1987, 0110). Since establishment of the Laboratory, several earthquakes of Richter magnitude 3 to 4 have shaken Los Alamos (Gardner and House 1987, 0110). Recent work has shown that three fault segments in Los Alamos County are seismically active and that they are capable of generating large earthquakes of about 7 or more on the Richter scale (Gardner and House 1987, 0110; House and Cash 1988, 0132; Gardner et al. 1990, 0639; Gardner and House 1994, 0720). Unknown at this time are how frequently these large earthquakes occur and what their potential is for generating surface

rupture and mass wasting (occurrences such as rockfalls and landslides, which are not caused primarily by the movement of water) within the confines of the Laboratory.

2.5.1.6 Geomorphic Processes

Significant geomorphic processes active on the Pajarito Plateau include (1) erosion of mesa top soils by run-off, (2) retreat of canyon walls by rockfall and landsliding, (3) colluvial transport on sloping portions of canyon walls, and (4) erosion and deposition of sediments by streams in the canyon bottoms. Few data exist on the rates of erosion and landscape change caused by these different processes on the Pajarito Plateau. Estimates of long-term vertical erosion rates on mesa tops have been made based on stripping of overlying units (Purtymun and Kennedy 1971, 0200), but these estimates may be of limited value because the resistant, cliff-forming units may be eroded primarily by lateral cliff retreat rather than by vertical erosion. Erosion rates vary considerably on the mesa tops; the highest rates occur in and near drainage channels and in areas of locally steeper slope gradient, and the lowest rates occur on relatively gently sloping portions of the mesa tops removed from channels. Areas where run-off is concentrated by roads and other development are especially prone to accelerated erosion.

The rates and processes of erosion may differ significantly between the north and south slopes of canyons. Given current vegetation and climate, the more extensive exposures of bedrock on south-facing sides and greater soil cover on north-facing sides suggest that erosion rates of fine-grained material that can be transported by run-off are higher on the drier, less-vegetated, south-facing sides of canyons, although this material is largely retained on the north-facing slopes. However, no studies have been conducted to quantify the rates and processes of erosion on canyon sides.

Cliff faces retreat primarily by dislodgement of blocks bounded by joints and, to a lesser extent, by large-scale landsliding, including the formation of huge toreva blocks in White Rock Canyon. At present, the rates of cliff retreat have not been documented. Neither is it known to what extent cliff retreat rates may vary with climatic changes, with evolution of the canyons, or with proximity to side drainages.

Thicknesses, detailed stratigraphy, and ages of alluvium in canyon bottoms are, in general, poorly known, and therefore the rates of deposition, erosion, and transport of sediments through canyons are largely unknown. Available studies that have examined alluvial stratigraphy on the Pajarito Plateau reveal multiple cycles of extensive erosion of sediment, followed by renewed deposition, in the past 6,000 years (Gardner et al. 1990, 0639). At Cabra Canyon, north of Los Alamos, the last few hundred years has been marked by the net accumulation of sediment in the canyon bottom (Gardner et al. 1990, 0639), but it is not known how long this sediment will stay in storage before being mobilized by floods and transported downcanyon. It is possible that these erosional cycles are climatically driven and regional in extent, but more extensive data from additional canyons are needed before this determination can be made. On a longer time scale, evidence from the adjacent Española basin does suggest a strong climatic control on periods of alluviation and canyon incision over the last million years (Dethier et al. 1988, 0773).

2.5.2 Hydrology

2.5.2.1 General Surface Water Conditions

The Rio Grande is the master stream in north-central New Mexico. All surface water drainage and groundwater discharge from the plateau ultimately arrives at the Rio Grande. The Rio Grande at Otowi, just east of Los Alamos, has a drainage area of 14,300 mi^2 in southern Colorado and northern New Mexico. The discharge for the period of record has ranged from a minimum of 60 cubic feet per second (cfs) in 1902 to 24,400 cfs in 1920. The river transports about 1 million tons of suspended sediments past Otowi annually.

Essentially all Rio Grande flow downstream of the Laboratory passes through Cochiti Reservoir, which began filling in 1976. It is designed to provide flood control, sediment retention, recreation, and fishery development. Flood flows are temporarily stored and released at safe rates. The dam is expected to trap at least 90% of the sediments carried by the Rio Grande.

Figure 2-9 shows the location of the major surface water drainages in the Los Alamos Canyon. Los Alamos surface water occurs primarily as ephemeral streams in canyons cut into the Pajarito Plateau. Only four of the canyons contain perennial reaches inside Laboratory boundaries: Pajarito, Water, Ancho, and Chaquehui canyons. Of these four reaches, only Pajarito Canyon occurs upstream (to the west) of any Laboratory facilities or effluent discharge points. Other perennial reaches occur outside Laboratory lands in the drainage areas of Guaje, Los Alamos, Sandia, Pajarito, Water (and its tributary, Cañon de Valle), Ancho, and Chaquehui canyons.

Within Laboratory boundaries, perennial reaches in the lower portions of Ancho and Chaquehui canyon are close enough to the Rio Grande that they extend to the Rio Grande without being depleted. In lower Water Canyon, the perennial reach is very short, extends into an intermittent reach that is also short, and does not extend to the Rio Grande. In Pajarito Canyon, about 1 mi east of State Road 501, a spring sometimes called Homestead Spring feeds a perennial reach a few hundred yards long, followed by an intermittent reach that flows varying distances, depending on climate conditions. (The lower part of DP Canyon also contains a short perennial reach sustained by discharge from DP Spring; however, at present, it is unknown whether the origin of the springflow is natural or artificial.)

Essentially all other reaches of canyons within the Laboratory's boundaries are ephemeral; that is, they flow naturally only briefly in response to precipitation or snowmelt in the immediate locality. Some other reaches are intermittent, especially those that flow during part of the year as the result of snowmelt. This snowmelt recharges the alluvial perched groundwater, and discharge from the perched systems supports intermittent stream flow for a somewhat longer period.

Springs between elevations of 7,900 and 8,900 ft mean sea level on the flanks of the Jemez Mountains supply base flow throughout the year to the upper reaches of Cañon de Valle and in Guaje, Los Alamos, Pajarito, and Water canyons (Purtymun 1975, 0194). These springs discharge water perched in the Bandelier Tuff and Tschicoma Formation at rates from 2 to 135 gal./min (Abeele et al. 1981, 0009). The volume of flow from the springs is insufficient to maintain surface flow within more than the western third of the canyons before it is depleted by evaporation, transpiration, and infiltration into the underlying alluvium.

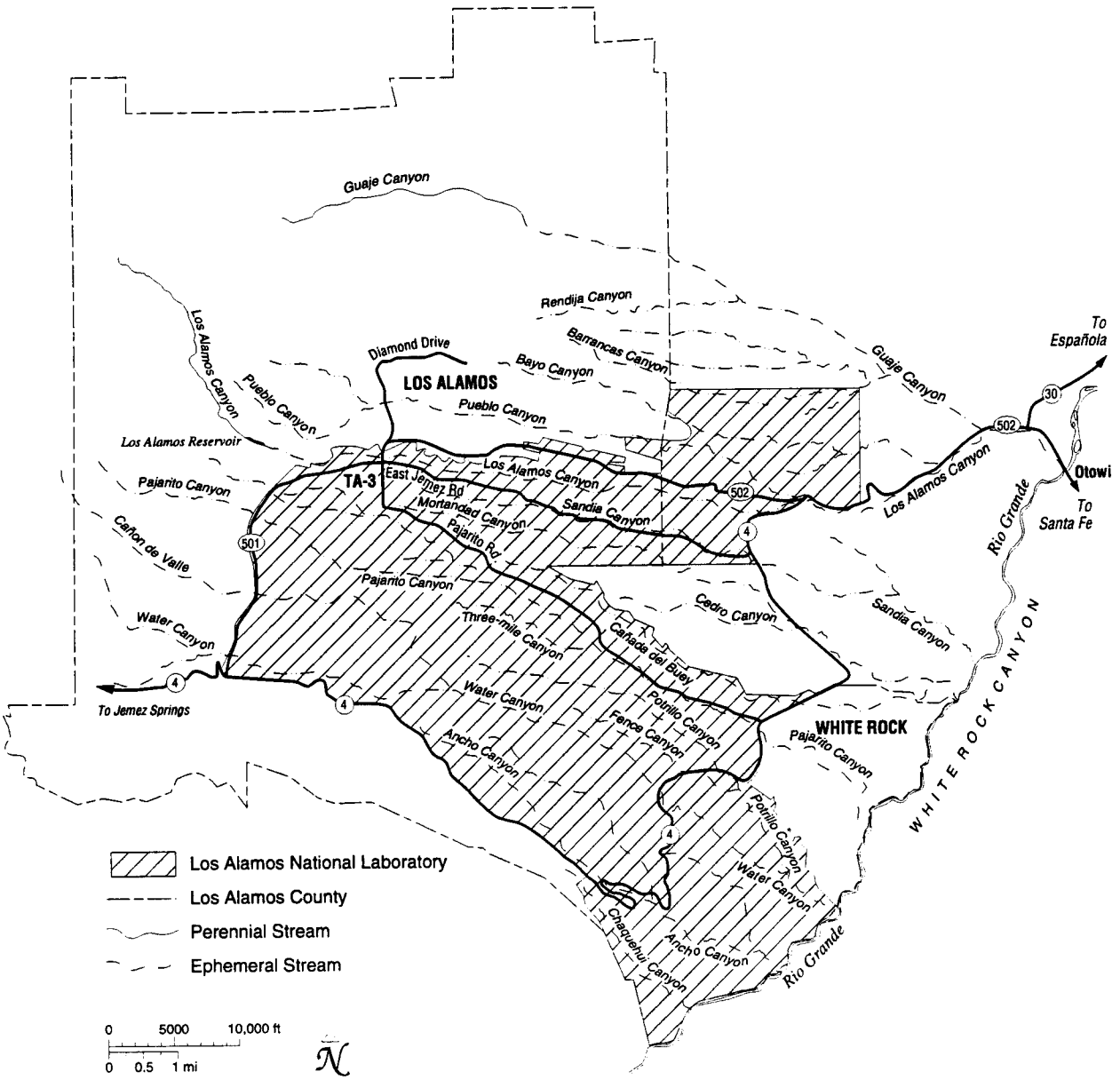

Figure 2-9. Location of the major surface water drainages in the Los Alamos area.

Eleven drainage areas, with a total area of 82 mi^2, pass through the Laboratory's eastern boundary. Run-off from heavy thunderstorms and heavy snowmelt reaches the Rio Grande several times a year in some drainages. Los Alamos, Pajarito, and Water canyons have drainage areas at the east boundary of greater than 10 mi^2. Pueblo Canyon has 8 mi^2; the rest have less than 5 mi^2. Theoretical maximum flood peaks range from 24 cfs for a 2-yr frequency to 686 cfs for a 50-yr frequency (McLin 1992, 0825). The overall flooding risk to community and Laboratory buildings is low because nearly all the structures are located on the mesa tops, from which run-off drains rapidly into the deep canyons. Further discussion of natural surface flow characteristics by drainage may be found in Revision 3 of the Installation Work Plan (LANL 1993, 1017).

Contaminants enter the surface water drainages by surface run-off, by liquid discharges, and occasionally by air deposition (Becker et al. 1985, 0029; Becker 1986, 0027). Run-off-derived contaminants are largely bound to sediments; their rate of downstream travel is governed by the scouring and carrying power of subsequent run-off events (Lane et al. 1985, 0140). Given sufficient time, these sediments eventually will be moved across the Laboratory boundary.

Nearly every drainage has received liquid industrial or sanitary effluents discharged from the Laboratory. The effluent discharges determine the flow and water quality characteristics in drainages that contain little natural water. With travel downstream, most of the effluent-derived metals and radionuclides become sediment-bound and remain near the surface of the stream channel; other contaminants, such as nitrate, are lost by evaporation or move downward into the alluvium. Detailed field investigations in Mortandad Canyon, for example, demonstrate that generally more than 99% of the total inventory of transuranic radioactivity discharged from the treatment plant effluents is associated with sediments in or immediately adjacent to the stream channel (Stoker et al. 1991, 0715).

In canyons that have received treated, low-level radioactive effluents (Acid-Pueblo, DP-Los Alamos, and Mortandad canyons) concentrations of radioactivity in the alluvium are generally highest near the treated effluent outfall and decrease downstream in the canyon as the sediments and radionuclides are transported and dispersed by other treated industrial effluents, sanitary effluents, and surface run-off.

A study of transport of plutonium by snowmelt run-off published in 1990 (Purtymun et al. 1990, 0215) includes the finding that most plutonium moved by run-off in Los Alamos and Pueblo canyons that reached the Rio Grande is transported with sediments—about 57% with suspended sediments and 40% with bed sediments. A total of about 600 mCi of plutonium was carried to the Rio Grande by 5 snowmelt run-off events studied during the years 1975 to 1986.

A regional plutonium analysis for the Rio Grande upstream of Elephant Butte Reservoir shows that fallout contributes about 90% of the total plutonium moving through the drainage system in any given year (Graf 1993, 1161). The remaining 10% is from releases at Los Alamos. The contribution to the plutonium budget from Los Alamos is associated with relatively coarse sediment, which often behaves as bedload in the Rio Grande (Graf 1993, 1161).

Environmental monitoring for chemical and radiochemical quality in surface water began with USGS investigations (Purtymun 1964, 0183; 1975, 0194; Purtymun and Kunkler 1967, 0202; Purtymun 1967, 0188) and has been continued by the Laboratory (ESG until 1971; Environmental Protection Group 1993, 0829).

2.5.2.2 General Groundwater Conditions

Groundwater occurs in three modes in the Los Alamos Area: (1) water in shallow alluvium in some of the larger canyons, (2) perched groundwater (groundwater body above a less permeable layer that separates it from the underlying main aquifer by an unsaturated zone), and (3) the main aquifer of the Los Alamos area.

2.5.2.2.1 Perched Groundwater in Alluvium

Intermittent and ephemeral streamflows in the canyons of the Pajarito Plateau have deposited alluvium that ranges in thickness to as much as 100 ft. The alluvium in canyons that head on the Jemez Mountains is generally composed of sands, gravels, pebbles, cobbles, and boulders derived from the Tschicoma Formation and Bandelier Tuff on the flank of the mountains. The alluvium in canyons that head on the plateau is comparatively more finely grained, consisting of clays, silts, sands, and gravels derived from the Bandelier Tuff. Saturated hydraulic conductivity of the alluvium typically ranges from 10^{-2} cm/s for a sand to 10^{-4} cm/s for a silty sand (Abeele et al. 1981, 0009).

In contrast to the underlying volcanic tuff and sediments, the alluvium is quite permeable. Ephemeral run-off in some canyons infiltrates the alluvium until downward movement is impeded by the less permeable tuff and sediments, which results in a buildup of a shallow alluvial groundwater body. Depletion by evapotranspiration and movement into the underlying rocks limit the horizontal and vertical extent of the alluvial water (Purtymun et al. 1977, 0206). The limited saturated thickness and extent of the alluvial groundwater preclude its use as a viable source of municipal and industrial supply to the community and the Laboratory. Lateral flow of the alluvial perched groundwaters is in an easterly, downcanyon direction. Tracer studies in Mortandad Canyon have shown that the velocity of water ranges from about 60 ft/day in the upper reach to about 7 ft/day in the lower reach of the canyon (Purtymun 1974, 0192).

The water quality in the alluvial perched groundwaters is variable, depending on the location and history of effluent discharges. In Mortandad Canyon, for example, plutonium concentrations fluctuate up and down in response to variations in treatment plant effluent and storm run-off water, which cause some dilution of the shallow alluvial perched groundwater. Tritium concentrations have fluctuated almost in direct response to the average annual concentration of tritium in the TA-50 effluent, with a lag time of about 1 year (Environmental Protection Group 1992, 0740).

Purtymun (1975, 0194; 1973, 0191) has written reviews of alluvial perched groundwaters by drainage area. The results of an extensive monitoring study of the alluvial perched groundwater in Mortandad Canyon are presented by Abrahams et al. (1962, 0231), Baltz et al. (1963, 0024), Purtymun (1973, 0191), Purtymun (1974, 0192), Purtymun et al. (1977, 0206), Purtymun et al. (1983, 0209), and Stoker et al. (1991, 0715).

2.5.2.2.2 Perched Water in Volcanic Sediments and Basalts

Perched water bodies occur in the conglomerates and basalts beneath the alluvium in the mid- and lower reaches of Pueblo and Los Alamos canyons and in the lower reach of Sandia Canyon. Depth to perched water ranges from about 90 ft in the

midreach of Pueblo Canyon to about 450 ft in lower Sandia. The vertical and lateral extent of the perched groundwaters, the nature and extent of perching units, and the potential for migration of perched water to the main aquifer is not yet fully understood by investigators. Only the body in lower Pueblo and Los Alamos canyons has been studied in some detail.

Patterns of chemical quality and water level measurements indicate that the lower perched groundwater in Pueblo Canyon is hydrologically connected to the stream in Pueblo Canyon (Abrahams and Purtymun 1966, 0014). Water from this perched groundwater discharges at the base of the basalt at Basalt Spring, which is off the Laboratory site in lower Los Alamos Canyon on the San Ildefonso Pueblo. The rate of movement of the perched groundwater in this vicinity has been estimated at about 60 ft/day or about 6 mo from recharge to discharge (Abrahams and Purtymun 1966, 0014).

It is unknown whether the perched water systems are hydraulically interconnected. Available data, however, suggest that most of the systems are of limited extent: testing of the perched system in mid-Pueblo Canyon depleted the perched groundwater after about an hour's pumping at 2 to 3 gal./min (Weir et al. 1963, 0395). Perched water was encountered in mid-Los Alamos Canyon during the drilling of the Otowi 4 supply well (Stoker et al. 1992, 0826), but it was not reported in an adjacent well (Test Well 3) located 300 ft to the east. (However, Test Well 3 was drilled with a cable tool rig in 1947, and the driller may not have noticed the perched groundwater if it was present.)

Measurements of tritium in perched groundwater at intermediate depths demonstrate that recharge to those depths has occurred during the last several decades. The levels of tritium in those locations are high enough to be attributed to recharge of surface water contaminated by effluent or other releases from Laboratory operations.

These observations have been made at four locations in Pueblo and Los Alamos canyons. For several years, tritium has been observed in Test Well 2A in Pueblo Canyon at levels between 2,000 and 3,000 pCi/L. Starting in 1991, low-detection-limit tritium measurements have consistently revealed tritium at levels of about 150 pCi/L in samples from Test Well 1A, located in lower Pueblo Canyon near its confluence with Los Alamos Canyon, and in Basalt Spring, located in Los Alamos Canyon just downstream from its confluence with Pueblo Canyon. The measurements at these three locations are consistent with previous understanding. The intermediate perched groundwater has long been known to be affected by effluents discharged into Pueblo Canyon, starting with measurements made by the USGS in the 1950s and 1960s (Abrahams et al. 1961, 0015).

The most recent observation of tritium in intermediate-depth groundwater was made in Well LADP-3, completed in 1993 by the ER Project in the middle reach of Los Alamos Canyon about 1 mi downgradient of TA-2, the Omega Reactor site (Broxton and Eller 1995, 1162). Well LADP-3 encountered perched water at a depth of about 320 to 330 ft, just at the contact of the Otowi Tuff and the Puye Conglomerate. Samples of water from that well contained about 6,000 pCi/L.

Some perched water occurs in volcanics on the flanks of the Jemez Mountains offsite to the west of the Laboratory. This water discharges in several springs (including American and Armistead springs) and provides flow for the gallery in Water Canyon. The gallery contributed to the Los Alamos water supply for 41 years, producing 23 to 96 million gal. annually.

2.5.2.2.3 Main Aquifer

The main aquifer of the Los Alamos area is the only aquifer capable of large-scale municipal water supply (Purtymun 1984, 0196). In 1989, water for the Laboratory, the communities of Los Alamos and White Rock, and Bandelier National Monument was supplied from 11 deep wells in 3 well fields. The wells are located on the Pajarito Plateau and in Los Alamos and Guaje canyons east of the plateau. Municipal and industrial water supply during 1992 was 1.43 billion gal. Yields from individual wells ranged from about 175 to 1,400 gpm (Stoker et al. 1992, 0826). Purtymun (1984, 0196) summarizes the hydraulic characteristics of the aquifer as determined during aquifer tests and during periods of production of supply wells and test holes.

The surface of the main aquifer rises westward from the Rio Grande within the Santa Fe Group into the lower part of the Puye Conglomerate beneath the central and western part of the plateau. The depths to water below the mesa tops range from about 1,200 ft along the western margin of the plateau to about 600 ft at the eastern margin. The main aquifer is separated from the water in the alluvium and perched water in the volcanics by 350 to 620 ft of tuff and volcanic sediments (Environmental Protection Group 1993, 0829). The main aquifer exhibits artesian conditions in the eastern part along the Rio Grande (Purtymun 1984, 0196). Continuously recorded water level data collected in test wells since the fall of 1992 indicate that, throughout the plateau, the main aquifer responds to barometric and earth tide effects in the manner typical of confined aquifers.

The exact source of recharge to the main aquifer is unknown. Cushman (1965, 0042) suggested three sources of recharge: infiltration of run-off in canyons, underflow from the Valles Caldera through the Tschicoma Formation, and infiltration on mesas. However, a large quantity of hydrologic, structural, and geochemical data indicate that the caldera may not serve as an appreciable source of recharge to the main aquifer (Conover et al. 1963, 0246; Griggs and Hem 1964, 0313; Goff 1991, 1020). Furthermore, natural recharge through undisturbed Bandelier Tuff on the mesa tops is believed to be insignificant (Purtymun and Kennedy 1971, 0200; Kearl et al. 1986, 0135), and few or no data exist to support an evaluation of canyon run-off as a recharge source. It is inferred that major recharge of the main aquifer occurs from the west because the piezometric surface slopes downward to the east. Water level elevations suggest that groundwater flows from the Jemez Mountains east and east-southeast toward the Rio Grande, where a part is discharged into the river through seeps and springs (Purtymun et al. 1980, 0208). Springs fed by the main aquifer discharge an estimated 4,300 to 5,000 acre-ft of water annually into White Rock Canyon along an 11-mi reach between Otowi Bridge at State Road 502 and the mouth of Rito de Frijoles (Cushman 1965, 0042).

The hydraulic gradient of the aquifer averages about 60 to 80 ft/mi within the Puye Conglomerate but increases to 80 to 100 ft/mi along the eastern edge of the plateau as the water in the aquifer enters the less permeable sediments of the Santa Fe Group. The rate of movement of water in the upper section of the aquifer varies, depending on the materials in the aquifer. Aquifer tests indicate that the movement ranges from 20 ft/yr in the Tesuque Formation to 345 ft/yr in the more permeable Puye Conglomerate (Purtymun 1984, 0196).

In an effort to better understand the nature of recharge to the main aquifer in the Los Alamos area, a series of isotope and age-dating measurements on selected water samples has been initiated by Laboratory and other DOE researchers. The study is attempting to apply a range of geochemical and geochronological techniques to help

identify potential sources and ages of water in the main aquifer. Samples have been collected from the test wells and from the water supply wells that penetrate the main aquifer. Investigators are using a variety of radioactive and stable isotope measurements. At present, a number of measurements of carbon-14 and low-level tritium measurements are available that permit some preliminary estimates of the age of the water in the main aquifer at various locations.

"Age of water" means the time elapsed since the water, as precipitation, entered the ground to form recharge and became isolated from the atmosphere. The precipitation at the time of entry into the ground is assumed to have contained atmospheric equilibrium amounts of both tritium and carbon. Radioactive carbon-14 comes mainly from natural sources. Tritium comes from both natural sources and fallout from nuclear weapons testing in the atmosphere.

Preliminary interpretation of the results of 7 carbon-14 analyses indicates that the minimum age of water in the main aquifer ranges from about 1,000 years under the western portion of the Pajarito Plateau, increasing as it moves eastward, to about 30,000 years near the Rio Grande. These values are consistent with the general understanding of the Los Alamos main aquifer, based on physical and geologic conditions, which indicate flow from west to east, with major recharge occurring from the west.

Several measurements of tritium by extremely low-detection-limit analytical methods appear to show the presence of some recent recharge (within the last 40 years) in water samples taken from 5 wells in the main aquifer at locations near Los Alamos. Another 30 wells show no apparent influence of recent recharge on the main aquifer. The levels measured range from less than a percent to less than a hundredth of a percent of current drinking water standards and are less than levels that could be detected by the EPA-specified analytical methods normally used to determine compliance with drinking water regulations.

The first location is Test Well 1, located in Pueblo Canyon near the confluence with Los Alamos Canyon. Consistent analytical results indicate that tritium is present at this location; however, the pathway mechanisms are not yet understood. This well has been suspected for several years of having a well-bore leakage or other communication from the surface, as inferred from other types of data (Abrahams et al. 1961, 0015). One possible route of communication is along the ungrouted cable-tool-installed casing. Another possibility is a downward movement through the rock beneath the canyon.

The second location is in Los Alamos Canyon near its confluence with the Rio Grande. An observation well (LA-1A), an old water supply well (LA-2), and a domestic well show the presence of tritium.

The third location is at Test Well 8 in Mortandad Canyon. Test Well 8 is located about a mile downstream of the outfall of the Laboratory's radioactive liquid waste treatment plant at TA-50. The well was sampled at the end of 1993 as part of the Environmental Surveillance Program. The well was completed in 1960 to a depth of 1,065 ft. The upper part of the well penetrates shallow alluvial perched groundwater that contains the residual contaminants discharged by the TA-50 treatment plant. Tritium levels in the alluvial groundwater in the vicinity of Test Well 8 have been about 100,000 pCi/L in the last few years, ranging to as much as 1,000,000 pCi/L in the mid-1970s.

At least three possible pathways exist by which tritium in Mortandad Canyon could move toward the main aquifer: (1) migration down the wellbore outside the steel casing because cable tool drilling does not include an annular seal, (2) saturated movement through fractures or faults, and (3) movement in unsaturated flow through the vadose zone (the vadose zone is the zone between the land surface and the main aquifer). Tritium is known to be migrating downward in the unsaturated zone beneath the alluvial perched groundwater in Mortandad Canyon, based on measurement of cores collected to a depth of 100-200 ft at locations farther west (Stoker et al. 1991, 0715).

2.5.2.3 Hydrologic Properties and Conditions of the Bandelier Tuff

At the central portion of the Laboratory, there is in excess of 1,000 ft of unsaturated volcanic tuff, sediments, and basalts of the Bandelier Tuff, the Puye Conglomerate, and the basaltic rocks of Chino Mesa. Numerous investigations focusing on hydrologic characterization of the upper 100 ft of the Bandelier Tuff have been conducted in the Los Alamos area since the 1950s (e.g., Abrahams et al. 1961, 0015; Weir and Purtymun 1962, 0228; Abrahams 1963, 0011; Purtymun and Koopman 1965, 0201; Purtymun and Kennedy 1971, 0200; Purtymun et al. 1978, 0207; Abeele et al. 1981, 0009; Kearl et al. 1986, 0135; Purtymun et al. 1989, 0214; Stoker et al. 1991, 0715). The vadose zone below about 100 ft has not been adequately characterized.

Most of the investigations of the hydrogeologic properties of the Bandelier Tuff have been conducted on samples of crushed or disturbed tuff. Hydrologic property tests conducted since the mid-1980s largely have been on undisturbed cores (e.g., Kearl et al. 1986, 0135; Stoker et al. 1991, 0715). To aid the reader in evaluating the variablity in hydraulic properties, a summary of hydraulic properties measured in undisturbed cores from the Bandelier Tuff is presented in Table 2-2.

Table 2-2 includes measured values for bulk density, porosity, and saturated hydraulic conductivity. The values for residual saturation, alpha, and N are the parameters for van Genuchten's formulation of the moisture characteristic curve (van Genuchten 1980, 1193):

$$\tilde{\theta} = \frac{\theta - \theta_r}{\theta_s - \theta_r} = \frac{1}{\left[1 + |\alpha h|^N\right]^M}$$

where

$\tilde{\theta}$	effective saturation,
θ	volumetric moisture content,
θ_s	saturated moisture content,
θ_r	residual moisture content,
h	suction,
α, N	van Genuchten fitting parameters,
M	= 1-1/N.

2.5.2.3.1 Effects of Physical Characteristics

Physical characteristics of the tuff that affect fluid flow result primarily from the degree of welding and jointing. The degree of welding, which varies markedly within and between tuff units, influences the nature and variability of hydrologic characteristics.

TABLE 2-2

SUMMARY OF HYDRAULIC PROPERTIES DATA FOR BANDELIER TUFF OBTAINED SINCE 1984[a]

	Bulk Density (g/cm^3)	Porosity (%)	Ksat (cm/sec)	van Genuchten Parameters: Residual Saturation (%)[b]	α	N
Tshirege Member						
Minimum	0.94	34.6	5.6×10^{-6}	0.0	0.0011	1.152
Median	1.18	48.8	1.1×10^{-4}	2.3	0.0056	1.696
Harmonic Mean			5.8×10^{-5}			
Maximum	1.49	74.2	3.9×10^{-3}	7.9	0.2312	2.877
Number of Observations	43	63	85	32	32	32
Tsankawi Pumice						
Minimum	0.90	36.7	4.7×10^{-5}	0.0	0.0005	1.106
Median	1.25	46.0	6.8×10^{-4}	0.23	0.0187	1.481
Harmonic Mean			1.7×10^{-4}			
Maximum	1.60	65.6	4.3×10^{-3}	7.28	0.0513	1.890
Number of Observations	18	12	9	9	9	9
Otowi Member						
Minimum	0.98	40.3	1.1×10^{-5}	0.0	0.0039	1.388
Median	1.18	44.0	2.7×10^{-4}	2.5	0.0060	1.653
Harmonic Mean			1.3×10^{-4}			
Maximum	1.49	59.0	7.8×10^{-3}	12.1	0.0185	2.307
Number of Observations	31	25	25	21	21	21

a. Samples represent a compilation by D. Rogers and B. Gallaher (1995, 1182) of available hydraulic property determinations on undistributed core samples taken between 1984 and 1992. Field and laboratory data from USGS work in the 1950s and 1960s and air/water injection tests conducted by Bendix Corporation in the mid-1980s (Kearl et al. 1986, 0135) are not included in the compilation because of concerns relating to the comparability of different measurement techniques.

b. Mose cores with θ_r >10 are omitted because of the absence of thermocouple psycrometer measurements at high matric suctions.

Welding results in increased density, decreased porosity, and decreased hydraulic conductivity of the rock matrix (Purtymun and Koopman 1965, 0201). However, welded tuffs tend to be more highly fractured (jointed) than nonwelded tuff, and the overall permeability of the welded tuff may be locally enhanced (Crowe et al. 1978, 0041).

2.5.2.3.2 Porosity

Porosity measurements by Abrahams (1963, 0011) range from 20% to 60% by volume, generally decreasing with increasing degree of welding. Measurements reported by IT Corporation (1987, 0327) are higher, from approximately 39% to 74%. A great deal of the high porosity occurs when pumice fragments are incorporated in the tuff. The higher porosities are comparable to those of the upper ranges found in fine clays. Such high porosities, however, are unusual for indurated materials. Extreme changes in porosity over a short vertical distance have been observed (Abrahams 1963, 0011).

2.5.2.3.3 Moisture Content

A number of hydraulic properties of the Bandelier Tuff vary with changing moisture content. The tuff is only partially saturated throughout the Laboratory, even beneath stream channels containing alluvial perched groundwater systems. The moisture contents of the tuff beneath mesa tops are very low, typically less than 5% by volume (Abrahams 1963, 0011). Abrahams shows that tuff moisture content is higher beneath disturbed soils than beneath undisturbed soils and, generally, moisture content decreases with depth. At sites with relatively high near-surface moisture contents, the volumetric moisture content decreases rapidly with depth to less than 5% (Abrahams 1963, 0011). Moisture contents of the tuff beneath the canyon bottoms are considerably higher than those beneath the mesas and typically range from 20% to 50% by volume (Weir and Purtymun 1962, 0228; Stoker et al. 1991, 0715). Field studies in Mortandad, Sandia, and Potrillo canyons show that moisture content varies greatly with depth, depending on texture (Stoker et al. 1991, 0715; Environmental Protection Group 1993, 0829). Generally, moisture content decreases with depth below stream channels.

2.5.2.3.4 Moisture Characteristic Curves

The relationship between moisture content and soil-water potential has been obtained from more than 60 undisturbed mesa top and canyon bottom cores at TA-54 (Rogers and Gallaher, 1995, 1182). The data indicate residual moisture content (0% to 4%). Purtymun and Stoker (1987, 0204) indicate that at TA-49 specific retention (residual moisture content) ranged from 11% to 27%. Detailed analyses in Mortandad Canyon show that there are significant differences in moisture retention characteristics between and within formational units (Stoker et al. 1991, 0715). Abrahams (1963, 0011) determined the energy relationship with moisture content of a moderately welded tuff. The saturated moisture content of the tuff was about 41% by volume. When moisture contents are below about 4%, there is no movement of water; from about 4% to 8%, moisture is redistributed by diffusion; from about 8% to 23%, distribution is governed by gravity and capillarity; and above 23%, movement is controlled by gravity only (Abrahams 1963, 0011).

2.5.2.3.5 Hydraulic Conductivity

Hydraulic conductivity is the parameter that describes rate of flow of fluid through a porous medium in response to a hydraulic gradient; it is a function of both the fluid and the medium. Saturated hydraulic conductivities have been measured for tuff many times under laboratory and field conditions, with values ranging from 1.9 x 10^{-5} to 2.3 x 10^{-2} cm/s (0.054 to 6.5 ft/day), comparable to those of silty sand. In general, nonwelded tuff has greater saturated conductivity than welded tuff, and horizontal conductivities are greater than vertical conductivities (Abrahams 1963, 0011). Unsaturated hydraulic conductivities may be many orders of magnitude lower, typically ranging from 10^{-6} to 10^{-11} cm/s (Stoker et al. 1991, 0715; Rogers and Gallaher 1995, 1182), depending on in-situ moisture contents.

2.5.2.3.6 Joints

Joints formed by cooling of the ash flows or by later faulting typically divide the tuff into irregular blocks. The major joint sets are vertical or nearly vertical, with dips greater than 70°, and joint frequency increases with the degree of welding and proximity to faults (Vaniman and Wohletz 1990, 0541). Joints and fractures in moderately welded tuffs generally terminate in nonwelded tuffs (Baltz et al. 1963, 0024). The joints are often vertically limited to a single ash flow or ash fall unit (Purtymun and Kennedy 1971, 0200). Joint apertures range from closed to open as much as 15 cm (Wohletz, in preparation, 1183). The joints are commonly filled with caliche near the surface, grading downward to clay, and may be open to depths greater than 30 ft (Purtymun et al. 1978, 0207; Abeele et al. 1981, 0009). Examination of cores obtained from horizontal drilling beneath a waste disposal site at TA-54 showed that about 80% of the joints were filled or plated with clay or secondary mineralization (Purtymun et al. 1978, 0207). Fracture apertures at TA-54 are typically small, with median values of about 3 mm; median fracture spacing is 1.9-4.0 ft (Reneau and Vaniman, in preparation, 1181). Reneau and Vaniman note the general absence of clay illuviation in any fractures to depths greater than 10-20 ft within an excavated pit at TA-54.

2.5.2.4 Movement of Moisture in the Bandelier Tuff

The movement of moisture in the Bandelier Tuff is governed by a complex interaction of many factors. Climatic and site-specific land use factors control the supply of moisture available for infiltration, and hydrogeological characteristics control the redistribution of moisture in the tuff.

Perhaps the most significant aspect of the tuff is its ability to imbibe water, i.e., act as a sponge. Most of the pore spaces in the tuff are of capillary size and have a strong tendency to hold water against gravity by surface tension forces. Thus, a slug of water entering dry tuff is slowed or retained by capillary tension forces.

Water moves through the tuff in two ways: (1) by liquid and vapor movement through the pores of the tuff and (2) by movement through open, interconnected joints (Abrahams 1963, 0011). When moisture content is low, movement in the vapor (gaseous) phase becomes more preponderant, and liquid movement through the rock matrix is extremely slow. Water entering open, interconnected joints might move rapidly downward through the joints; however, to maintain continuous flow through the fractures, it is likely that large volumes and a continuous supply of water

are necessary because of the sponge effect of the adjacent tuff that forms the wall of the fracture. The existence of a low-permeability coating on the wall of the fracture, on the other hand, could increase the travel depth of water flowing through fractures (Thoma et al. 1992, 0827). If the joints are not continuous through contacts between subunits of the tuff, the water might be perched above the contact and would tend to move laterally, potentially to the walls of canyons. These factors are discussed as they pertain to subsurface contaminant transport beneath the mesa tops and canyon bottoms.

2.5.2.4.1 Migration of Moisture Beneath Mesa Tops

The natural moisture content of the tuff forming the mesas between the canyons is generally less than 5% by volume at depths greater than a few tens of feet, the zone affected by seasonal inputs of moisture and evapotranspiration. Weir and Purtymun (1962, 0228) attributed the low moisture content to the protective cap of clay soil derived by weathering of the tuff near the surface, low rainfall, and high evapotranspiration. The existence of low moisture content is further supported historically by the absence of weathering below 10 m (Wheeler et al. 1977, 0828) and the overall absence of perched water in the tuff at potential perching horizons.

Kearl et al. (1986, 0135) concluded that vapor phase transport is the predominant transport mechanism controlling the potential subsurface movement of contaminants beneath the mesa top at TA-54. They also conclude that there is no interconnection or movement of liquid water in the interval of Bandelier Tuff examined (upper 100 ft of the Tshirege Member). Other laboratory analyses on cores of moderately welded tuff support the possibility of vapor phase dominance at most mesa top locations (Abrahams 1963, 0011).

From a waste containment perspective, the possibility of vapor phase dominance is significant: in extremely dry rock, only contaminants existing in a gaseous state, such as tritium or volatile organic solvents, migrate through the rock matrix. Other radionuclides and metals can be removed from their original location only under wetter conditions, when the uninterrupted movement of liquid water (i.e., capillarity) is more predominant.

Few definitive field measurement techniques exist by which to quantify natural recharge through mesa tops. One exception is the use of natural tracer profiles to infer recharge rates by comparing them with analytical solute transport solutions. As an alternative, the flux of liquid water through the rock matrix that could eventually become recharge can be estimated as being approximately equal to the unsaturated hydraulic conductivity, assuming that flow is downward and at steady state.

In-situ hydraulic conductivities for tuff beneath the mesa top Material Disposal Area (MDA) L at TA-54 were computed by Rogers and Gallaher (1995, 1182) from laboratory analyses of five undisturbed Bandelier Tuff cores obtained from three separate coreholes. Computed in-situ unsaturated hydraulic conductivities (i.e., fluxes) range from 3.0 x 10-12 to 1.5 x 10^{-1} cm/sec (3.7 x 10^{-5} to 1.9 x 10^{-1} ft/yr). For uniform flow through media with spatially varying hydraulic conductivity, the average hydraulic conductivity lies between the harmonic and arithmetic mean hydraulic conductivity (de Marsily 1986, 1163). The arithmetic and harmonic mean hydraulic conductivities for this set of cores are 4.7 x 10^{-9} and 8.7 x 10^{-12} cm/sec (5.8 x 10^{-2} and 1.1 x 10^{-4} ft/yr). At the moisture conditions and calculated unsaturated hydraulic conductivities at MDA L, the rates of water movement in the upper part of the mesa top are estimated to lie between 1.2 and 0.002 ft/yr, based on the assumption that

there are no "fast paths" of water movement, such as fracture flow, to significant depths.

These calculated rates, which are relatively low, imply very little water movement from the mesa tops to the main aquifer under natural conditions, which probably also applies to a one-time spill of contaminants at the land surface. Because of geochemical interaction between the rock and dissolved constituents, the rate of constituent movement (except for movement of constituents that are highly soluble) should be lower than that of water.

The greatest concern about subsurface migration at mesa tops is the potential for a large volume of contaminants to be chronically released in the vicinity of open and interconnected joints, which could occur beneath a surface impoundment or a leaky chemical storage tank. The movement of water through joints would negate the protection provided to the groundwater when water moves only through pores in the tuff (Abrahams 1963, 0011).

Filled fractures strongly inhibit moisture movement. Open fractures are effective barriers to liquid phase unsaturated flow but may provide preferential flow paths for vapor transport or rapid movement of liquid under saturated or near-saturated conditions (Abeele et al. 1981, 0009). Roots have been found in joints to depths of at least 42 ft (Weir and Purtymun 1962, 0228), which suggests that joints may be important local infiltration pathways. Several fracture zones at TA-54 show an increase in moisture content relative to adjacent porous media (Kearl et al. 1986, 0135).

Although fractures have a local effect on infiltration in the upper portions of the mesas, it is less clear to what depth they play a role, for three key reasons. First, water passing through a fracture system has a tendency to be "wicked" into the adjacent rock matrix by capillary suction forces in the tuff, provided the fracture/rock interface is not sealed with material of low permeability (Thoma et al. 1992, 0827). Analytical and numerical modeling at TA-54 indicates that transient infiltration pulses in fractures likely affect only the very near surface before being imbibed by the adjacent tuff (Rosenberg et al. 1993, 1180). Second, most of the open fractures occur in the moderately welded to welded Tshirege Member of the Bandelier Tuff, and the underlying nonwelded Otowi Member is significantly less fractured (Baltz et al. 1963, 0024). Flow in the lower portions of the Bandelier Tuff, therefore, is far more likely to be dominated by the relatively slow process of capillarity.

Finally, although fractures may initially provide a pathway for movement of water into the mesas, they may later play a role in removing water (as water vapor) from within the mesa. Under low barometric pressure conditions, air transfers from the tuff to the atmosphere through boreholes (Purtymun et al. 1974, 0651). Barometric and air pressure variations along the canyon walls could cause the exchange of gas and water vapor between the atmosphere and the mesas, especially via interconnected fractures and joints, which are highly permeable to air. Air transfer has been documented in boreholes penetrating the tuff at TA-49 (Purtymun et al. 1974, 0651) and has been observed elsewhere on the plateau; however, studies at TA-54 have been inconclusive (Abeele et al. 1981, 0009; Kearl et al. 1986, 0135).

In conclusion, the combination of the Bandelier Tuff's low moisture content beneath the mesa tops, its associated hydraulic characteristics, and its thickness provides the main aquifer a substantial degree of protection from the mesa tops. At suspected waste sites at which contaminated liquids have not been disposed, the risks to the

main aquifer are quite low. Detailed characterization of the subsurface probably is not warranted for most such sites. Site-specific conditions must always be considered, however, before making such a determination. At waste sites with large potential contaminant source terms, such as material disposal areas, phased subsurface investigations should be conducted to verify that the waste is sufficiently contained.

Waste disposal activities that chronically released large volumes of and highly contaminated liquids or that contained volatile contaminants have the potential for migration within the mesas and should also be investigated for subsurface transport. Open fractures may be a key factor in determining whether contaminants migrate to deeper sections of the tuff or travel laterally to release areas on the mesa walls. All of these subsurface investigations should initially focus on the upper 100 to 200 ft of the vadose zone.

2.5.2.4.2 Migration of Moisture Beneath Canyon Bottoms

The canyons with alluvial perched groundwaters are presumed to present a greater potential for downward movement than do the mesa tops because there is a constant driving force and because the moisture content of the tuff below the saturated alluvium is significantly higher than that beneath the mesas. Additionally, the depth to the main aquifer in the canyons is several hundred feet less than from the adjacent mesa tops. The effect of this greater potential for fluid flow, though, is somewhat compensated by the general lack of highly concentrated contaminant sources in the canyon bottoms.

Recent investigations provide some important information on the movement of moisture and contaminants in the unsaturated tuff. The best field evidence that can be used to estimate potential downward rates of movement beneath canyon bottoms is obtained from corehole data collected by Stoker et al. (1991, 0715) in Mortandad Canyon. Because treated liquid radioactive effluents have been discharged to the canyon for almost 30 years, the radioactive constituents in effluent from the Laboratory serve as accurate tracers for fluid and contaminant migration studies.

The basic conclusions of the Mortandad study regarding the movement of radioactive contaminants below the alluvial perched groundwater are (1) soluble and particulate radioactive constituents have moved less than about 10 ft into the unsaturated zone beneath the alluvial perched groundwater and (2) tritium, as tritiated water, has moved at least 150 ft below the alluvial perched groundwater to a total depth of 195 ft. Tritium concentrations in Corehole MCM-5.9 (the deepest corehole drilled so far in the canyon) decrease by a factor of about 100 between 150 and 195 ft, suggesting the possibility that tritium has not moved much deeper in the almost 30 years since effluents were first released from the TA-50 treatment plant (Stoker et al. 1991, 0715). The tritium data suggest a downward rate of movement of at least 6 ft/yr. However, this conclusion must be considered tentative until additional, deeper coreholes can confirm the pattern.

Recent drilling of Characterization Well LADP-3 in Los Alamos Canyon has shown that Laboratory-derived tritium has migrated to depths of at least 330 ft beneath the canyon bottom (Broxton and Eller 1995, 1162). Because the history of tritium releases to the canyon is uncertain, it is difficult to calculate a downward rate of contaminant movement at this location.

Stoker et al. (1991, 0715) evaluated the moisture content in tuff beneath the alluvial perched groundwater in Mortandad Canyon. Most values for gravimetric moisture content in the Tshirege tuff beneath the alluvial perched groundwater ranged from 10% to 30%, corresponding to about 20% to 60% of saturation. Several peaks occurred at higher values, approaching 90% of saturation near the contact with or in the Tsankawi tuff and fluvial Cerro Toledo rhyolite deposits on the top of the Otowi member of the tuff at depths around 100 ft. In the Otowi tuff, the gravimetric moisture content decreased and leveled off at about 12% to 18%, which corresponds to 20% to 40% saturation. A similar pattern occurred in a corehole farther downstream in Mortandad Canyon, past the end of the alluvial perched groundwater (Stoker et al. 1991, 0715), and also in Sandia and Potrillo canyons (Environmental Protection Group 1993, 0829).

The data suggest that there are complex variations in hydrologic properties in the layers from the base of the Tshirege through to the top of the Otowi tuff that significantly affect the movement of moisture in the unsaturated zone. There is also a suggestion that moisture conditions in the Otowi tuff become very uniform, with only moderate differences in magnitude, depending on whether there are saturated conditions in overlying layers (Environmental Protection Group 1993, 0829). Additional field data and theoretical interpretation are required to confirm the patterns and quantify movement.

References for Chapter 2

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3.0 TECHNICAL APPROACH TO ENVIRONMENTAL RESTORATION

3.1 Background

The Environmental Restoration (ER) Project's approach to implementing the corrective action process at Los Alamos National Laboratory (the Laboratory) is to use a modified version of the Department of Energy's (DOE's) streamlined approach. This approach incorporates elements of data quality objectives (DQOs), risk assessment, and EPA's Superfund Accelerated Cleanup Model to facilitate the rapid cleanup of potential release sites (PRSs) (EPA 1993, 1264). Both the technical approach and decision logic are tied to the Environmental Protection Agency's (EPA's) regulations and guidance. For any given site, the ultimate objective of the approach is to reach a point at which no further action is necessary. The approach stresses

- use of conceptual models and early identification of potential response actions based on existing information to assess sites,
- phased site characterization to close sites as early as possible, and
- integration of the phases of the corrective action process [Resource Conservation and Recovery Act (RCRA) facility investigation (RFI), corrective measures study (CMS), and corrective measures implementation (CMI)] to collect data applicable to all three phases and to apply engineering analysis as early as possible in the process.

Defined below are several terms used frequently in this chapter that carry meanings specific to ER Project decision processes and risk assessment:

Background level Naturally occurring concentrations of a certain constituent in soils. The concentrations represent the results of the statistical analysis chosen to describe distributions of certain constituents observed in the background soils. Background levels may also describe certain anthropogenic compounds (i.e., nuclear fallout or organic chemicals associated with urban activities).

Chemical Any naturally occurring or man-made chemical, including radionuclides.

Chemical of concern A chemical that is identified as a concern as the result of performing a human health or ecological risk assessment.

Chemical of potential concern (COPC) A chemical that is potentially a human health risk based on available information and measured concentrations at the site. The chemical remains a potential concern until exposure pathways and receptors are evaluated in a site-specific human health risk assessment.

Cleanup level A concentration in soils based on regulatory- or risk-based criteria, at which no further action is required at a site.

Constituent Any of the elements or chemicals included in a list of analytes or hazardous substances.

Screening action level (SAL) A chemical concentration in soil or water below which there is no concern under RCRA for ingestion and inhalation, provided certain conditions are met as specified in 40 CFR 264.521 (Subpart S; EPA 1990, 0432).

3.1.1 Potential Release Sites

As part of the Hazardous and Solid Waste Amendments (HSWA) requirement for a facility-specific description, the HSWA Module contains a list of potentially contaminated sites (Section 1.2.1.1). To develop the original list, EPA Region 6, DOE, and the Laboratory conducted several investigations to identify potentially contaminated sites. Based on (1) a RCRA facility assessment conducted in 1987 by EPA Region 6 to identify potential solid waste management units (SWMUs) at the Laboratory, (2) subsequent lists from the Comprehensive Environmental Assessment and Response Program's Phase I report (DOE 1987, 0264), and (3) internal records searches and interviews, approximately 1,100 units were identified in a SWMU report (International Technology Corporation 1988, 0329). EPA selected 605 of these units as SWMUs to be listed in the original HSWA Module (Section 1.2.1.1), based on the agency's preliminary assessment of the units' potential impact on human health and safety.

In 1990, the Laboratory and DOE added areas of concern (AOCs) to the total list of potentially contaminated sites. These units potentially contain hazardous substances, such as radionuclides, that are not regulated under RCRA or HSWA but are being addressed by DOE's ER Project. All field information collected for this effort was obtained by extensive research of maps and archives. The term (PRS refers to SWMUs and AOCs collectively. Each PRS bears a unique alphanumeric identifier keyed to the technical area in which it is found.

From time to time, as additional data about PRSs at the Laboratory become available, the Laboratory initiates a formal process for modifying the list of potentially contaminated sites contained in the HSWA Module. In March of 1993, the Laboratory submitted its first request for a permit modification to EPA. That modification, approved in May 1993, and subsequent Class I permit modifications for newly discovered PRSs increased the total number of SWMUs to 1098 as of October 1995. Two Class III permit modifications to remove SWMUs that require no further action were submitted to EPA but have not yet been approved. When approved, the total number of SWMUs will decrease to 950. The list of total PRSs being addressed by the ER Project currently stands at 2,102.

A current data base listing of all PRSs is provided in Appendix B. As new information becomes available, the list is updated to reflect the current status of each PRS in the project. A detailed discussion of each PRS is found in the 23 RFI work plans prepared between 1990 and 1994, which are available in the Laboratory's Community Reading Room and other information repositories (Section 7.1).

3.1.2 Notification of New Units and Releases

If new sites are identified during the RFI process, environmental surveillance, audits, or other activities, DOE /UC must notify EPA of a proposed new SWMUs within 15 days of its discovery. This notification identifies the new SWMU, and DOE/UC must propose the schedule for corrective action for the new SWMU. Guidance is provided in Administrative Procedure (AP) LANL-ER-AP-04.1, "Identification, Documenta-

tion, and Reporting of Newly Discovered Potential Release Sites for the Environmental Restoration Program," in accordance with Section F of the HSWA Module.

Discovery of new releases of hazardous materials from existing SWMUs or sites previously identified as needing no further action (NFA) must be reported to EPA within 24 hours of discovery. For the purposes of the ER Project, a release is considered to exist when hazardous wastes are found in concentrations that exceed human-health- or environmental-risk-based screening concentrations. This procedure is described in detail in "Reporting of Newly Identified Releases from Solid Waste Management Units," LANL-ER-AP-04.2, to meet the requirements of Section G of the HSWA Module.

3.1.3 Site Prioritization

Los Alamos and Sandia national laboratories, together with the DOE, EPA, and NMED, have developed a system for prioritizing sites that provides an efficient method for evaluating the relative risk posed by each of the PRSs at the two laboratories. The process also incorporates other prioritization criteria concerning regulatory compliance and the potential for accelerated cleanup to aid decision makers in allocating available resources according to the degree of risk at each PRS. The methodology provides for public involvement in the ranking assessment.

3.2 ER Project Assessment Strategy

The technical approach to planning, collecting, and evaluating data for environmental restoration at Los Alamos is based on EPA's DQO process and risk-based decision making (EPA 1994, 1187; 1989, 0305; Environmental Restoration Project Decision Support Council 1995, 1271). This approach recognizes that focusing characterization of a site on the data required to support a series of well-defined decisions will streamline the decision-making process and, at the same time, will diminish the likelihood of making incorrect decisions. Using this approach, the ER Project collects data to support decision making with a known and acceptable level of uncertainty so that the corrective action process can move forward.

The Laboratory's approach uses a decision framework that provides for phased site investigations, early identification of important problems to facilitate site prioritization, and timely implementation of corrective actions. The general decision framework adopted by the ER Project is illustrated in Figure 3-1. Decision points in the general framework depend on a number of statistical and risk-based technical assumptions (Section 3.2.2).

3.2.1 Decisions in the RCRA Corrective Action Process

3.2.1.1 Decision-Oriented Approach

Progress during the RCRA corrective action process is demarcated by several decision points during the RFI and CMS processes. Many of these decisions require collecting and assimilating environmental data. The Laboratory's technical approach to environmental restoration begins with decision criteria that are sufficiently explicit to guide the design of field investigations and the evaluation of the resulting data. Decisions required during the RFI include

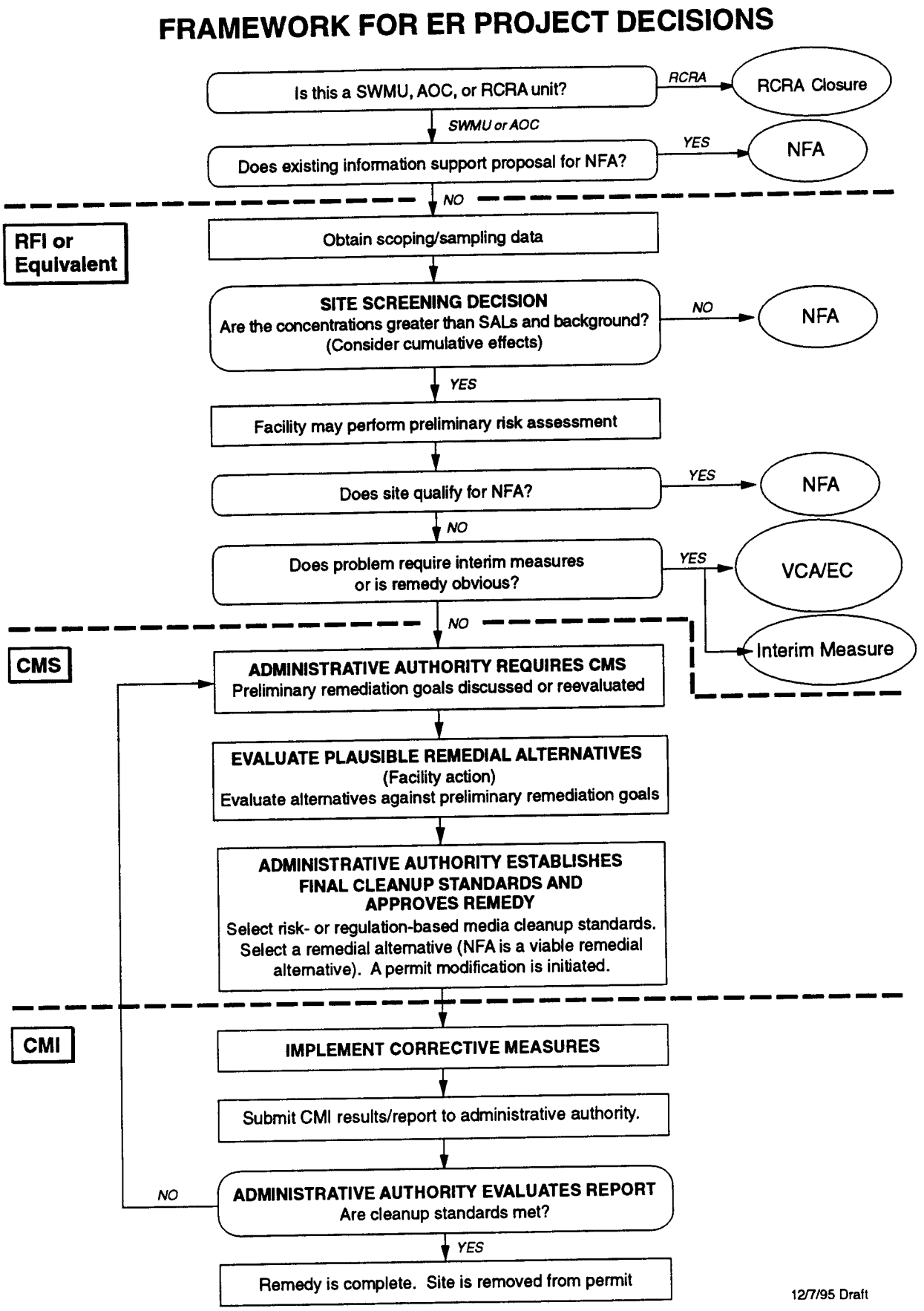

Figure 3-1. Decision framework for the ER Project.

- determining whether contaminants have been released to the environment—the site-screening decision,
- determining whether corrective action is required for the site—a risk-based decision that may be made before or after a CMS has been initiated, and
- determining whether a formal CMS is required to select and design an appropriate corrective action.

The first step in this decision-oriented approach is to develop a site conceptual model and technical approach based on existing information. Depending on the nature and complexity of the site and the quality of existing information, it may be possible to propose a site for no further action (NFA). The remaining sites fall into the following categories:

- sites where accelerated cleanup (Section 3.3.2) is possible,
- sites where CMS and CMI are expected, and
- sites for which existing information is not adequate to support a decision concerning potential outcomes that include NFA, accelerated cleanup, and further investigation.

If a site is identified as a possible candidate for an accelerated cleanup or CMS/CMI based on the initial review of historical information, a Phase I investigation, designed to collect data to support this decision, is conducted. For many sites, existing data are not adequate to make this decision. The Phase I investigation then involves collecting data to support a screening assessment or a risk management decision. For those sites that are likely candidates for NFA, the Phase I screening investigation is aimed at confirming or denying the existence of a release to the environment at concentrations sufficient to require further investigation. A Phase I risk-based investigation is aimed at assessing risk to human health or the environment.

Designs for data collection to support screening decisions have generally used biased sampling to determine whether chemicals are present at levels of potential concern. Samples taken from areas deemed most likely to have been affected by historical activities are analyzed for a broad range of potential contaminants. The most frequent criterion used for the screening decision is the presence of chemicals in environmental media above SALs.

Additional information for Phase I analysis is obtained by maximizing the use of field screening instruments. When appropriate, sampling designs make extensive use of field screening techniques (geophysics, remote sensing, field analytical instruments, etc.) to focus sampling and to give adequate coverage while reducing the number of samples needed for laboratory analysis.

Those sites that are not eligible for NFA based on the results of Phase I investigations or expedited cleanup (EC) (Section 3.3.2.2) may require a baseline risk assessment to determine whether a significant risk to human health or the environment exists. Risk assessments are focused on those chemicals identified as chemicals of potential concern (COPCs) for the site during initial review of historical information or results from Phase I investigation. Current and future land use scenarios for each site are evaluated to identify the most likely receptor populations. Realistic exposure

scenarios relevant to those populations are derived to complete the risk assessment. For those sites requiring remediation, risk-based remediation goals will be developed based on the exposure scenarios developed.

3.2.1.2 Future Land Use Planning

A key component of the ER Project's future land use strategy is the recognition that DOE and the Laboratory will control most of the Laboratory site for the foreseeable future. Some areas are being considered for transfer to Los Alamos County, and other areas, principally buffer areas, may be reduced in size. However, the Laboratory is an active DOE facility whose Site Development Plan for its 43-mi^2 area covers the next 20 years (LANL 1994, 1171) and the Laboratory's mission requires the continued use of most of these lands.

DOE and the Laboratory have the responsibility for determining future land use within Laboratory boundaries for the period specified in the long-range plan (LANL 1994, 1171). DOE and the Laboratory may seek input from their stakeholders on future land use. The results will be provided to EPA and NMED as reference information. Land uses designated by DOE and the Laboratory include, but are not limited to, industrial, recreational, and residential. These terms are not intended to represent zoning areas as they relate to city planning zones.

Human exposure scenarios developed for risk assessments can be combined under individual land use categories. Exposure scenarios include, but are not limited to, industrial, recreational, and residential. These scenarios describe and determine the risk approach that will be used at a PRS and, therefore, will determine in part the potential remediation goals for the site. EPA has approval authority for the exposure scenario and may require that a different exposure scenario (one other than that proposed by DOE and the Laboratory) be considered when evaluating remedial alternatives. Public input will be sought in determining the exposure scenario.

Institutional controls are inherent in all land use scenarios except for the residential scenario. EPA must be satisfied that these controls are adequate for a specific site at which they are used. For land remediated to levels above residential, a deed restriction will be entered in the Laboratory's property management system.

Site-specific land use assumptions and exposure scenarios will be considered in establishing preliminary remediation goals and media cleanup standards, as well as in risk assessments, to estimate the reduction of risk that could be realized by a potential corrective action. Target risk and dose levels will be set following EPA and DOE guidance. Following EPA guidance, preliminary remediation goals and media cleanup standards for nonradioactive carcinogens will be derived using EPA's target incremental risk range of 10^{-4} to 10^{-6}. A target hazard index value of 1 is used for noncarcinogens. Hazardous constituents and radionuclide cleanup levels will be

evaluated based on total overall risk from a site. If radionuclides are the only contaminant of concern, the cleanup will be conducted under the jurisdiction of DOE in accordance with DOE orders.

3.2.2 Approach to Data Collection and Evaluation

3.2.2.1 Site-Screening Decisions

Sites with sufficient archival information to document that the site does not present a threat to human health or the environment are proposed for NFA without additional RFI field work. Investigators use their knowledge of the processes used in the past at a particular site to focus sampling and analysis on chemicals associated with those processes rather than perform a full scan on all samples. When information on historical processes indicates that certain contaminants were never handled at a site, analyses for those chemicals are not performed.

Sampling plans for site-screening decisions can incorporate directed sampling based on professional judgment and/or the results of field surveys when this approach is more likely than purely random sampling approaches to increase detection of contaminants. Comparison with background levels and SALs is used to identify chemicals of potential concern and to determine the need for further investigation.

Because background levels may exceed SALs for some soil chemicals, it is necessary to compare chemical concentrations at a given site with background levels. A number of statistical tests are used to compare concentrations measured at a site with background distributions. Statistical comparisons with background are documented in the ER Project Policy Paper titled "Statistical Comparison to Background" (Environmental Restoration Project Decision Support Council 1995, 1274). This document provides ER Project personnel with guidance for the selection of appropriate methods for statistical comparisons between potential release site data and naturally occurring concentrations of metals, including radionuclides, in soils. Chemicals whose concentrations are statistically indistinguishable from background should not be identified as COPCs, even if the concentrations exceed the risk-related SALs.

Chemicals that exceed background require further action only if they also exceed SALs. SALs are used to identify COPCs and to determine the need for further investigation. The SALs for chemical constituents are based on EPA Region 9's preliminary remediation goals for residential soil and tap water; however, when appropriate, certain EPA Region 9 water preliminary remediation goals (PRGs) are superseded by Native American pueblo water quality standards, New Mexico Environment Department (NMED) drinking water standards, NMED surface water standards, or EPA safe drinking water maximum contaminant levels (MCLs), respectively. The ER Project calculates SALs for chemicals that are not included in the Region 9 database. For PCBs, a SAL of 1 will be used at industrial use sites.

SALs for radioactive constituents are based on dose rather than on carcinogenic risk and are calculated using the RESRAD code. Standard residential default values are used in radionuclide models for body weight, intake rate, exposure duration, etc., and doses are summed over multiple pathways [e.g., inhalation and ingestion (produce, soil)]. Environmental parameters required by radionuclide models are set conservatively but appropriately for the Laboratory.

The target dose level used for radionuclide SALs is 10 mrem/yr, based on the following considerations: DOE has recommended that doses to the public exceeding 10 mrem/yr at DOE facilities be reported to DOE Headquarters (10 CFR, Part

834; DOE 1993, 1270); a level of 10 mrem/yr is lower than EPA's proposed rule for the cleanup of sites contaminated with radionuclides that constitute a dose of 15 mrem/yr (EPA 1993, 1272). Therefore, further investigation of sites exceeding 10 mrem/yr is consistent with regulatory mandates. The dose limit applies to multiple exposure routes, not just ingestion.

In general, the maximum observed concentrations of a chemical, rather than averages of several observations, are compared with SALs to identify COPCs. SAL comparisons are based on measured concentrations, unadjusted for natural or anthropogenic background (e.g., atmospheric fallout). In some cases, observations made on composite samples or on averages of closely related samples such as field duplicates may be compared with SALs to identify chemicals of potential concern. When screening shows that chemicals are at levels below SALs, further analyses of these constituents is not necessary.

Whenever possible, analytical methods are selected to ensure that SAL concentrations can be detected.

- When available, SW-846 methods (EPA 1990, 0967) or equivalent methods from contract laboratory procedures will be used unless another method is justified.

- If field analytical techniques are not sufficient to detect constituents at SAL concentrations or if the precision and accuracy of the screening method are not sufficient to support DQOs, fixed analytical laboratory methods approved by EPA may be used.

- If the detection limit of the fixed analytical laboratory method is above the SAL, the detection limit may be used as the trigger level to identify a COPC.

Identification of COPCs at a site indicates only that a problem may exist.

- SALs must not be used as target cleanup levels unless supported by site-specific risk calculations.

- Further action, which may take several forms, will be determined on a case-by-case basis.

  — If conditions pose an obvious threat to human health and the environment, EPA may require an interim measure and /or DOE/UC may elect to carry out an accelerated cleanup.

  — If one or a few measurements at a site is found to be above SALs and background, baseline risk assessment may be used to determine whether corrective action is required. Additional data may be required to perform a baseline risk assessment.

- When no COPCs have been identified based on comparison(s) with SALs [or other appropriate trigger level(s)], the site is proposed for NFA.

3.2.2.2 Risk-Based Decisions

Further decisions about a site (i.e., beyond screening decisions for which NFA, interim measures, or accelerated cleanup may be proposed) must take into account risks to human health and the environment posed by contamination at the site. Decisions based on comparison of individual observations with a SAL are not risk-based decisions because the exposure assumptions underlying the SAL calculation are not site-specific and because risk depends both on the extent and level of contamination.

Estimation of risks to human health and the environment must be based on reasonable site-specific exposure and land use assumptions. The ER Project considers stakeholder input when proposing cleanup levels and exposure assumptions. Risks associated with the use of alluvial aquifers and surface waters (e.g., canyon bottoms with perennial stream flow, permanent alluvial aquifers, and outfalls to canyons) are considered for Los Alamos sites when these waters may be impacted and potential exposures may occur.

The groundwater exposure pathway is not considered for most mesa-top sites because the depth to the main aquifer is about 800-1,100 ft. Potential contaminant migration to groundwater, however, may be modeled at those mesa-top sites where deep subsurface contamination is detected and where the potential for transport to groundwater exists. The decision to evaluate groundwater contamination will be determined on a case-by-case basis.

Baseline risk assessment may provide a basis for NFA at sites where COPCs have been identified. Superfund's risk assessment guidance documents provide the basic guidance for performing baseline risk assessments. For example,

- If the total carcinogenic risk and noncarcinogenic risk thresholds are not exceeded, DOE/UC may propose the site for NFA. Carcinogenic risk thresholds are established on a case-by-case basis within the range of 10^{-4} to 10^{-6} excess cancers per lifetime.

- If the dose to an individual from the site is expected to be less than 25 mrem/yr (25 mrem/yr is the DOE-approved dose limit to an individual from a single site) (DOE 1993, 1270), DOE/UC may propose the site for NFA.

Exposure estimates are based on the distribution of contamination throughout areas or volumes of contaminated media and over periods that are consistent with land use assumptions. Current EPA guidance suggests using the 95% upper confidence level for the mean concentration in such areas or in such volumes that the reasonable maximum exposure might take place. Alternative statistics, if proposed, could provide estimates of reasonable maximum exposure. In general, the areas or volumes should be consistent with the selected exposure scenario; that is, the smallest area or volume to which a receptor might be exposed over the entire exposure period determined by that scenario should be used.

3.3 RCRA Corrective Action Process

The corrective action process for the ER Project has three main phases: the RFI, CMS, and CMI. The ER Project also considers accelerated cleanup, when appropriate. The requirements for each of these phases are described briefly below.

3.3.1 Requirements for the RFI

The RFI entails preparing a work plan, which must be completed and approved by EPA before sampling begins (unless DOE/UC decide to proceed at risk), to determine whether a release to the environment has occurred. The specific requirements are described in detail in Table 1-1 of the HSWA Module, and EPA has provided specific guidance in Volume I of the interim final RFI guidance (EPA 1989, 0088).

Each RFI work plan includes a description of the overall approach, technical and analytical approaches and methods, QA procedures, and data management procedures. In addition, the HSWA Module specifically requires the concurrent development of five companion plans as part of the RFI work plan (the Project Management Plan, the Quality Assurance Project Plan, the Records Management Project Plan, the Health and Safety Project Plan, and the Public Involvement Project Plan); however, it does allow the Laboratory to deviate from the specific guidance as long as the work plan covers the essential elements discussed above.

It is the policy of the ER Project Office to adhere to Section 2, Volume I, of EPA's RFI guidance document (EPA 1989, 0088) to the extent practicable. DOE/UC RFIs also comply with the substantive requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). During the RFI, the ER Project's strategy is to assess sites, using a logical and efficient sampling program that moves from analyzing existing data, to identifying data gaps in conceptual models, to finally proposing scientifically and technically sound sampling and analysis plans that accurately characterize Laboratory waste sites. The Laboratory's ER Project has written, or will write, sampling and analysis plans for each PRS or PRS aggregate.

The RFI reports describe the results of sampling and analysis for each PRS or PRS aggregate and propose, via the assessment/decision framework discussed in Section 3.2, either NFA or further action in the form of a Phase II investigation, an accelerated cleanup, or a CMS. If the PRS or PRS aggregate is proposed for NFA, the PRS must meet at least one of the NFA criteria set by the ER Project. If the data indicate that the PRS or PRS aggregate needs further investigation, a Phase II sampling plan must be submitted in the RFI report. In the case of ECs, an EC plan and with a permit modification request will be submitted to EPA. This action will be noted will be noted in the RFI report.

In some cases where the nature and extent of contamination are found to be unacceptable during a Phase I investigation, a CMS can be proposed in the RFI report. The EPA reviews each RFI report, and the report may be negotiated with the EPA, depending on the action(s) proposed and the EPA's willingness to accept the proposal. Ultimately, the project will request a permit modification to remove from the permit those sites proposed and approved for NFA.

The ER Project, in conjunction with the EPA, has generated a list of NFA criteria. Each PRS must meet at least one of these criteria before the ER Project can propose it for no further action. Although only those SWMUs listed in the HSWA Module are officially removed from the HSWA Module by means of an NFA proposal and ultimately a permit modification, every PRS at the Laboratory will undergo the same level of investigation and same process to be removed from further consideration.

The NFA criteria are briefly discussed below. Additional information and details regarding these criteria are contained in the ER Project Policy Memo EM/ER-PCT-015 (March 28, 1995), "No Further Action Policy" (Environmental Restoration Project, 1173). A site is considered to satisfy NFA criteria if

- "the PRS has never been used for management (i.e., generation, treatment, storage, or disposal) of RCRA solid or hazardous wastes and/or constituents, radionuclides, or other CERCLA hazardous substances;
- "no release has actually occurred from the PRS to the environment;
- "the PRS is regulated or closed under a different authority which addresses corrective action; or
- "the PRS has been characterized or remediated in accordance with current applicable state or federal regulations and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of risk under the projected future land use. The determination of acceptable risk and future land use has considered stakeholder involvement."

The ER Project will use the accelerated cleanup approach to site remediation as conditions are discovered that either warrant early action or that can be remediated rapidly and cost effectively. Using this approach permits a site-specific, customized remediation to be planned, designed, and implemented without proceeding through the entire corrective action process or DOE's Title I, II, and III design and construction process.

3.3.2 Accelerated Cleanup

There are two kinds of accelerated cleanup: voluntary corrective action (VCA) and EC. The initial criteria used to evaluate candidate sites for either accelerated cleanup process are

- the potential remedy is obvious and can be readily applied;
- the remedy will be a final solution to prevent potential releases or migration of contaminants from the site in the future;
- previous sampling data and/or archival data are available to adequately identify chemicals of concern; and

- adequate treatment, storage, and disposal capacity is available for all expected waste types, including mixed (hazardous and radioactive) wastes.

3.3.2.1 VCAs

The VCA process is intended for use in assessing small-scale PRSs where contamination problems pose relatively low risk and an obvious remedy can be implemented with minimal administrative requirements and cost. Such sites are typically cleaned up as part of normal facility housekeeping or best-management practices and generally are not listed in the HSWA Module. VCAs must meet the following additional criteria:

- Cleanup levels are based on background concentrations, promulgated standards, or previously determined risk-based levels.
- Estimated cost to complete the action is typically less than $100,000.
- The estimated time to complete field activities is reasonable, generally less than 30 days.

VCA plans are submitted to DOE for approval before field activities are begun. Information copies are provided to EPA Region 6, NMED, and the public. VCA plans approved by DOE will be implemented to the extent allowed by available funding.

3.3.2.2 Expedited Cleanups

The EC process addresses only PRSs identified in the HSWA Module. The remedies are obvious but may be more complex than those for a VCA. Generally, EC units meet the five initial evaluation criteria but are likely to exceed the three VCA criteria. For example, these units may require a detailed risk assessment to establish cleanup levels before a remedy is implemented; however, the remedial method is obvious, which precludes the need for a full corrective measures study.

EC plans provide detailed information regarding site background and environmental setting, results of data analysis, rationale, tasks, and project management as set forth in a prescribed outline. ECs are subject to public involvement as required by the permit modification process, regulator review, and regulator approval of the site characterization and cleanup criteria.

The ER Project will seek EPA approval of ECs as final remedies; upon DOE concurrence, final reports will be submitted to EPA and NMED after cleanup levels have been attained.

3.3.3 Requirements for Corrective Measures Studies

The CMS process is implemented in accordance with EPA guidance (EPA 1988, 0295) when further action is specified in an RFI report. When required by EPA, DOE/UC must submit for review and approval a CMS plan that lays out the activities to be conducted during the CMS. The draft CMS plan is due at EPA within 90 days of

notification of the requirement to conduct a CMS. EPA then reviews and approves the CMS plan or suggests revisions to DOE/UC.

DOE/UC begin to implement the study within 15 days after receiving written notice that EPA has approved the CMS plan and then conducts the CMS in accordance with the approved CMS plan, which must include discussions of the processes for

- evaluating performance of the remedy(ies),
- assessing effectiveness,
- assessing the time required for implementation,
- estimating costs of implementation, and
- assessing institutional requirements.

A draft CMS report will be prepared after the CMS has been completed. The draft report is based on the results of the study, evaluating corrective measures and recommending a final corrective measure for a particular release site or groups of sites. EPA will approve the remedy proposed by DOE/UC based on how well the remedy satisfies the criteria used to select it during implementation of the CMS process. At a minimum, these criteria should address

- standards for remedies,
- criteria for selecting the remedy,
- schedules for implementing the remedy,
- media cleanup levels, and
- compliance with media cleanup levels.

A wide variety of PRSs exists at the Laboratory. Each study is tailored to the needs of each site. In many cases, site conditions may not require extensive evaluation of several alternatives, and, when the number of possible remedies is limited, the process is as focused and as streamlined as possible to expedite the cleanup process.

3.3.3.1 Corrective Measures Study Plan

The first step in the process of selecting alternatives to remedial action is to prepare a CMS plan. As the project approaches the CMS phase (as early as 1996), the ER Project will develop an outline for CMS plans for EPA review and approval. These plans will be specific to a PRS or PRS aggregate. CMS plans must be consistent with the scope of work for a CMS, Section Q, Task VI, of the HSWA Module and with proposed Subpart S (EPA 1990, 0432), as applicable.

The CMS is used to identify and develop a scheme for evaluating alternatives for final remediation of the PRSs. The CMS plan must provide sufficient information for EPA to adequately review the methods proposed for evaluating potential cleanup alternatives. Each PRS-specific CMS is unique to the environmental setting and nature of contamination at the site.

At a minimum, CMS plans must contain

- a description of the general approach to investigating and evaluating potential alternatives;
- a definition of the overall objectives of the study;
- a description of the specific remedial alternatives to be studied;
- a plan for conducting treatability (bench- or pilot-scale) studies to determine the suitability of alternatives for site restoration;
- a plan for evaluating remedial alternatives to ensure compliance with the standards for remedies as specified in EPA guidance;
- a schedule for conducting the CMS; and
- a proposed format for presenting the results (CMS report).

In addition to the requirements discussed above, DOE/UC integrate RCRA and National Environmental Policy Act compliance through the CMS process. CMS plans can be used to trigger a determination of whether an environmental assessment (EA) is required, and, if so, CMS reports can serve that function. In the event that a full environmental impact statement (EIS) is required, the CMS report serves as a support document for that effort.

After CMS plans have been approved and revised as necessary, DOE/UC will initiate the studies within 15 days. The scope and level of technical detail in each study will be adequate to allow DOE/UC to propose a remedy based on the results of the study and to allow EPA to review and approve that choice. The evaluation of the alternative(s) will be based on technical, environmental, human health, and institutional concerns.

It may be technically impractical to meet the requirements of a remedy. DOE/UC expect to minimize such situations through the use of new and innovative remedial technologies developed by the Laboratory and by others. However, if meeting the requirements of a remedy is impossible for technical reasons, DOE/UC will propose that EPA modify the permit so that additional or alternate methods may be used. This approach will be developed further.

DOE/UC will propose to EPA a schedule for implementing the proposed remedy. As appropriate, the schedule will address the following criteria, although additional factors may influence the timing of the implementation:

- extent and nature of contamination,
- DOE/UC's ability to implement the remedy,
- availability of treatment technology,
- desirability of currently unavailable technologies that may offer significant advantages,

- potential risks related to implementation of the remedy, and
- any other relevant factors.

DOE/UC recognize the need for innovative and cost-effective remedial technologies. New technologies developed at the Laboratory could offer distinct advantages over currently available technologies (e.g., downhole monitors and stabilization techniques) not fully developed at the time the remedy is selected. In such cases, DOE/UC may propose that EPA postpone selecting a remedy until these technologies are functional if there is a distinct technical, time, or cost advantage.

3.3.3.2 Corrective Measures Study

In order for DOE/UC to propose and for EPA to select a remedy for a PRS, the EPA will evaluate the proposed alternative to determine whether the alternative meets EPA guidance (EPA 1988, 0295). Because conditions vary from PRS to PRS, decision factors for each proposed remedy may be weighed differently at different PRSs.

3.3.3.2.1 Standards for Remedies

The CMS will generate data sufficient to evaluate potential remedies based on their ability to meet the following standards:

- protection of human health and the environment,
- attainment of established cleanup levels,
- control of the source of release, and
- compliance with waste management requirements.

These standards are broad and include the major technical requirements for controlling sources, conducting waste management activities, and cleaning up the environment. The Laboratory will comply with media cleanup levels to the extent practicable. In all cases, the overriding concern in selecting remedies is protecting human health and the environment.

3.3.3.2.2 Media Cleanup Levels

Media cleanup levels will include regulatory and risk-based levels that protect human health and the environment. Because existing regulatory levels primarily address drinking water, DOE/UC will use health-based risk assessments to determine the effort needed to clean up most contaminated soils and sediments. Factors to be considered in determining cleanup levels include multiple contaminants, sensitive receptors, site-specific exposures, the effectiveness of the proposed treatment, and current and future land uses.

Risk-based determinations must be consistent with EPA's risk assessment guidance (EPA 1991, 0302; EPA 1990, 0559), which states that "cleanup standards for carcinogens shall be established at levels which represent an excess upper-bound lifetime individual risk between 1×10^{-4} and 1×10^{-6}." Cleanup levels for noncarci-

nogenic toxicants will be established to allow daily exposure without appreciable risk of deleterious effects during a lifetime.

Cleanup levels may be raised or lowered, depending on the circumstances at individual sites. Such circumstances may include a determination that concentration levels of certain contaminants must be lowered to protect human health and the environment, that higher concentrations will be permitted because background levels are elevated, or that groundwater that is neither a potential source of drinking water nor hydraulically connected to a drinking water source need not meet drinking water standards. Other circumstances include determinations that the measures taken to meet specific cleanup levels would themselves cause more harm to the ecosystem than taking no action. In addition, the technical feasibility of remediation at each site will be taken into account.

DOE/UC will propose for EPA approval the specifics for compliance with established standards. This proposal will address the point of compliance, monitoring and sampling locations, analytical parameters and methods, statistical analyses, and the period required for monitoring restored sites.

Some sites at the Laboratory may require cleanup to action levels (e.g., soil excavation or some other method that physically removes the contaminant from the environment). However, there are sites at the Laboratory from which it would be impractical to physically remove all contaminants. Thus, the definition of cleanup must include other remedies that involve controlling migration of contaminants from a source.

Cleanup is considered to be any measure taken to ensure protection of human health and the environment, not necessarily the total removal of a contaminant. It may not be necessary to clean up areas of widespread, very-low-level contamination. The low levels of risk to human health and the environment resulting from low-level contamination would not be significantly reduced by cleanup because contaminant concentrations may be so close to background levels. Thus, cleanup is approached on a case-by-case basis, and it is the responsibility of DOE/UC to demonstrate to EPA that remediation would provide no significant reduction in risk.

3.3.3.2.3 Demonstration of Compliance with Media Cleanup Levels

DOE/UC will propose that EPA approve several conditions for demonstrating that implementing a remedy complies with the cleanup levels. These conditions include identifying

- the location where compliance levels must be achieved,
- the sampling and analysis plan that will be used to determine compliance,
- the statistic that will be used to compare to cleanup levels, and
- the length of time that DOE/UC must monitor a site to demonstrate that levels of contamination after cleanup do not exceed standards.

The primary limiting cleanup levels for the Laboratory will be those for soils and sediments. In general, the point of human exposure will be the likely location for

demonstrating compliance. However, it may be that the point of compliance for some sites will have to be determined on a case-by-case basis. The project may provide, subject to EPA approval, innovative and unique methods and instrumentation for monitoring compliance, including a variety of downhole sensors and high-speed analytical units for use in the field. Those methods specific to particular PRSs will be proposed in the CMS reports for the individual units.

3.3.3.2.4 Conditional Remedies

When EPA cannot select a final remedy or when DOE/UC and EPA agree that it is in the interest of the environment to delay implementation of the final remedy (e.g., to await completion of a promising development or additional disposal capacity), conditional remedies may be proposed and approved. Such remedies include prompt corrective measures that reduce risk and/or partial cleanup when total cleanup is impractical. Conditional remedies are appropriate for actively managed, financially viable facilities such as the Laboratory. When a conditional remedy is used, the site must be revisited after a pre-established period to determine whether the remedy can be considered final and can be certified as complete before the specified schedule of compliance is terminated. Several criteria must be met before implementation. These criteria include

- protecting human health and the environment,
- achieving media cleanup levels beyond the facility boundary,
- preventing further significant environmental degradation,
- implementing institutional controls,
- continuing monitoring, and
- complying with waste management standards.

DOE/UC will propose site stabilization and institutional controls as a conditional remedy for some of the large material disposal areas (MDAs), which are similar to municipal landfills. Remediating these landfills could be a complex and risky undertaking. Furthermore, the concentrations of contaminants in the MDAs that qualify for conditional remedies do not currently threaten human health, and institutional controls, which provide long-term control of access and prevent potential exposure of Laboratory workers, could be viable options at these sites. For these reasons, DOE/UC believe that a conditional remedy for these sites will protect human health. Long-term monitoring will be conducted as necessary.

When the results of the RFI support a single obvious remedy, which could include extensive pilot testing, a formal CMS need not be conducted; however, the proposed remedy must be presented to EPA either as part of an RFI report or in a separate plan. Based on the results of the RFI, DOE/UC request that the permit be modified to allow a conditional remedy. Upon EPA approval, DOE/UC will prepare a CMI plan that contains information adequate to design and implement the remedy, maintenance plans, schedule, QA program, progress reports, and a proposal for determining a complete and final remedy.

DOE/UC intend to propose in-place stabilization with long-term monitoring and institutional control as a remedial alternative for some PRSs. To ensure compliance,

sensitive and dependable instruments will be required for long-term monitoring, and DOE/UC have initiated several efforts to develop appropriate equipment, such as polymer film field sensors, optical fiber-flow optrode, fieldable Raman with fiber optics, and tritium plume detectors.

DOE/UC also realize that conditional remedies may not be final remedies. The remedy decision will be reviewed after a period of implementation to compare the performance of the conditional remedy with established remedy standards. The conditional remedy may be declared the final remedy at that time, or EPA may require further corrective action to supplement or replace the conditional remedy. Final selection of the remedy and termination of the permit must comply with the procedures described below.

3.3.3.3 Corrective Measures Study Report

Within 60 days of completing a CMS, a CMS report will be prepared and provided to EPA. At a minimum, this report must present the evaluation of alternatives consistent with the scope of work required for CMS reports as described in the HSWA Module.

The primary purpose of the CMS report is to enable DOE/UC to justify and recommend a corrective measure alternative for EPA approval. The report must include a detailed description of the remedies assessed and must describe how the proposed remedy meets the standards for remedies specified in the CMS plan. The primary criteria for developing and selecting remedy standards are

- long-term reliability and effectiveness;
- reduction of toxicity, mobility, or volume of contaminants;
- short-term effectiveness;
- implementability; and
- cost.

Within 120 days of receipt of the draft report, EPA will approve or request a revision of the CMS report. EPA's response will consider comments received from NMED and the public. DOE/UC will finalize the draft CMS report and incorporate comments received from EPA within 30 days of receipt.

3.3.3.4 Permit Modification for Selection of Remedies

The preliminary selection of remedies based on EPA's response to CMS reports is finalized by a major modification of the schedule of compliance given in the HWSA Module. The EPA can modify the permit to specify remedies selected through the CMS process. The permit modification must be conducted according to the procedure established in Section N of the HSWA Module. The modification process includes a formal public comment and revision period before written notice of the permit modification is issued.

The remedy specified may be separated into phases, but the proposed modification must include

- a description of the technical features of the remedy;
- the media cleanup levels established through the CMS process;
- requirements for achieving compliance with media cleanup levels;
- requirements for complying with waste management standards, land disposal restrictions, etc.;
- requirements for final disposition of the equipment used to implement the remedy;
- schedule and major milestones for implementing the remedy, including submission of the CMI plan; and
- reports and documentation to be submitted by DOE/UC during the implementation of the remedy.

3.3.4 Requirements for Corrective Measures Implementation

DOE/UC will prepare CMI plans after approval of the permit modification and upon EPA request. The standard outline for DOE/UC CMI plans has not yet been developed but will be submitted for approval in the future. In general, CMI plans will include

- remedy designs (i.e., detailed construction plans and specifications to implement the selected remedy);
- type and frequency of reports to be submitted on the progress of implementation;
- type of EPA reviews of implementation;
- requirements for completion of the remedy;
- determination of technical practicability; and
- verification plans.

3.3.4.1 Remedy Designs

CMI plans will contain a section that provides detailed construction plans for implementing remedies. In some cases, the technical details may have been provided in the CMS report. CMI plans may cite those specifics and propose to EPA that they be adopted in the final design. In either case, EPA approval of CMI plans will constitute approval of the remedy design and schedule. The remedy design should include

- design specifications for PRSs,
- implementation and long-term maintenance plans,

- major milestones,
- project schedule, and
- a quality assurance plan for the construction.

EPA will approve or revise CMI plans, and DOE/UC will implement the remedies as approved. The approved plans will be placed in the Laboratory's Community Reading Room. DOE/UC will provide written notice of the availability of the approved plan to all individuals on the ER Project mailing list. In addition, the cost estimate provided in the CMS report will be revised as necessary.

3.3.4.2 Corrective Measures Progress Reports

Depending on the type of remedial action being implemented, it may be necessary to provide frequent and detailed information about the effectiveness and progress of remedies. Data for these reports will be maintained in the Records-Processing Facility and will be available for public review.

The schedule and content of the progress reports will be developed in CMI plans and will thus be tailored to each PRS. The reports may include

- summaries of progress,
- problems encountered and resolutions,
- personnel changes,
- upcoming work for the next reporting period, and
- laboratory and field sampling reports.

3.3.4.3 Review of Remedy Implementation

EPA will periodically review the progress of remedies and may recommend modification of the schedule of compliance or additional remedial measures. The reviews may consist of reviews of the progress reports and visits. Because each remedy will require varying levels of EPA oversight, CMI plans will be tailored to each site according to the level of review and progress evaluation required.

3.3.4.4 Completion of Remedies

CMI plans will contain criteria to be used to demonstrate completion of remedies. Upon completion of a remedy, DOE/UC will submit a request for termination of the schedule of compliance for the corrective action. The request will contain a certification that DOE/UC have met or exceeded all of the criteria established for this purpose. The request to EPA will include verification that

- all media cleanup levels have been achieved,
- actions required for source control have been satisfied, and

- procedures for final disposition of equipment and materials associated with the remedial action have been followed.

EPA will then review the request, along with public comments, to determine whether a remedy has been completed in accordance with the requirements of the HSWA Module and CMI plan. After such determination, the EPA will modify the HSWA Module to terminate the schedule of compliance for the corrective action.

3.3.5 Special Situations in the Corrective Action Process

3.3.5.1 Interim Remedial Measures

In Section I of the HSWA Module, EPA provides for interim remedial measures. If EPA determines that a release of hazardous waste or its constituents poses a threat to human health or the environment, it can mandate that DOE/UC implement interim remedial measures to mitigate the risk. EPA can also specify a schedule (by modifying the HSWA Module) for implementing the interim measure and can require the Laboratory to prepare and submit a plan to be approved before action is initiated. No interim remedial measures have been taken to date because no imminent threats to human health or the environment have been identified. However, in the event that EPA requires an interim measure in the future, DOE/UC will modify any plan already in place accordingly. DOE/UC may at that time request EPA to modify the schedule of compliance for the corrective action.

In determining the need for interim remedial measures based on health risks, at least the following factors should be considered:

- the time required to implement a final remedy,
- actual and potential exposure of human and environmental receptors,
- actual and potential contamination of drinking water supplies and sensitive ecosystems,
- the presence of hazardous waste that may pose a threat of release,
- the presence of hazardous wastes or constituents in soil that have the potential to migrate to groundwater or surface water,
- weather conditions, and
- risks of fire, explosion, or accident.

Other kinds of interim remedial measures referred to in the HSWA Module are triggered by institutional need. The HSWA Module states, "If, for institutional reasons not related to permit work, i.e., routine construction, an interim measure is required, the permittee will submit appropriate documentation to the Administrative Authority (EPA) for approval." DOE/UC will conduct interim measures based on institutional needs consistent with the provisions of proposed Subpart S.

3.3.5.2 Coordination of Corrective Actions with Resource Conservation and Recovery Act Closures

Several SWMUs listed in the HSWA Module are subject to both the corrective action and closure provisions of RCRA (e.g., RCRA hazardous wastes were intentionally managed at these sites after November 19, 1980). DOE/UC will manage all of these sites in a manner consistent with the management of all of the other PRSs listed in the ER Project's PRS data base. As a result, the corrective action process occurs concurrently with the closure process, thereby satisfying both sets of regulations. It is understood that the NMED will maintain its role as the lead regulatory agency for these sites.

DOE/UC use this strategy for several reasons: (1) The RFI/CMS portions of the corrective action process ensure that releases are identified and mitigated as part of a final remedy (simple compliance with closure standards does not always guarantee mitigation). (2) The strategy allows for a consistent, coherent approach to environmental restoration (e.g., some PRSs are subject only to RCRA corrective action and some are subject to both corrective action and closure). (3) This strategy prevents duplication of effort. (4) The strategy is consistent with the preamble to proposed Subpart S, which states EPA's intent to allow extension of closure deadlines as necessary to complete corrective actions.

3.4 Waste Minimization and Management

The ER Project and the Waste Management Group are currently defining the overall waste management strategy and procedures for the ER Project. Key issues in the overall waste management strategy involve planning, understanding requirements, and identifying contingency actions. Key components of the waste management strategy include

- an understanding of roles and responsibilities by the ER Project and Waste Management Group;
- accurate and consistent waste volume estimates;
- clear waste characterization requirements;
- a full complement of waste storage, waste analysis, and waste treatment capabilities for all expected waste types;
- an aggressive and realistic approach to obtaining regulatory approvals of corrective action management units (CAMUs) and a mixed-waste disposal capacity; and
- effective actions to significantly reduce the waste volumes generated by ER activities (assessment, remediation, and decommissioning).

The approach to managing ER wastes in a cost-effective manner requires a strategy that combines onsite and offsite options for treatment, storage, disposal, and accelerated and simplified waste characterization procedures.

3.4.1 Guidelines and Procedures for Waste Characterization and Classification

The ER Project's administrative procedure, LANL-ER-AP-5.3, provides guidance for the disposition of different types of wastes generated by field investigations to ensure that all wastes are properly handled in full compliance with regulations.

The ER Project provides guidance that defines the data and sampling requirements needed from a site investigation to characterize waste, obtain approval for, and properly dispose of waste generated by the ER Project. Waste characterization strategy forms are reviewed by ESH and reviewed and approved by CST before any wastes are generated.

The project recognizes the need to minimize the overall volume of ER wastes and to accurately differentiate between low-level radioactive waste (which is more costly to dispose) and nonhazardous solid waste. Toward those ends, the project has developed an approach to systematically defining the radiation level at which a soil material is deemed to exceed background (Section 3.4.3.3).

3.4.2 Use of Available Onsite Disposal Capacity

When cost/benefit studies show that the costs of onsite disposal are equivalent to or lower than those for offsite disposal, the project is using the available onsite capacity to the extent possible to minimize the potential liabilities related to offsite disposal. However, even when studies indicate that new onsite disposal facilities are more cost-effective in the long term than offsite disposal, the near-term policy is to continue to use offsite disposal facilities or onsite temporary staging/storing facilities (CAMUs and temporary units) during construction of onsite facilities so as not to delay ER Project assessment or remediation activities. Once completed, new onsite facilities will be used for disposal. To ensure availability of needed waste management capacity and capability, the ER Project will annually provide plans and projections of anticipated volumes by waste types to the Waste Management Group. In addition, as field activities are conducted, information on the waste volumes generated will be captured and used to more accurately project waste volumes at similar sites.

3.4.3 Technical Approach to Waste Disposal

The investigation and remediation of PRSs will generate four types of waste: hazardous, low-level mixed, low-level radioactive, and solid wastes. The ER Project's waste management strategy for handling these is described below.

3.4.3.1 Hazardous Wastes

The Laboratory has arranged for offsite disposal of hazardous wastes (listed or characteristic) at permitted commercial facilities in the past and plans to continue to do the same for near-term generation of hazardous wastes from the ER Project. Site-specific cost/benefit studies of onsite vs. offsite disposal may be necessary to determine the best approach. The quantity of hazardous waste that will be generated by the ER Project is currently estimated to be 5,300 yd^3.

3.4.3.2 Low-Level Mixed Wastes

The ER Project is also evaluating the merits of disposing of low-level mixed waste onsite or offsite in the long term. These cost/benefit analyses include careful consideration of the use of CAMUs and temporary units. The quantity of low-level mixed wastes that will be generated by the ER Project is currently estimated to be 165,000 yd^3; however, this quantity is expected to be revised downward as new data and new assumptions are applied to this estimate.

3.4.3.3 Low-level Radioactive Wastes

An estimated 31,000 yd^3 of excavated soils will be radioactive (above background level). Additional disposal facilities may be required beyond those now planned for low-level radioactive wastes resulting from Laboratory operations. The project is working with the Waste Management Group at the Laboratory to develop new, onsite, low-level-waste-disposal capacity specifically for ER Project wastes. However, a decision on this project cannot be made until completion of the Laboratory's sitewide environmental impact statement.

3.4.3.4 Solid Waste Soils

Some excavated soil will be nonradioactive and nonhazardous. It is likely to be a portion of the volumes already estimated as mixed or low-level radioactive waste, not an additional volume of waste. These soils must be excavated because they have organics or metals above levels determined to be acceptable or consistent with the future use of a particular area. Although the soils may contain some contaminants, they need not be disposed either in a mixed-waste disposal facility or in a landfill for low-level radioactive waste, if alternatives are available. In the past, such materials were disposed in the Los Alamos County landfill or in onsite Laboratory disposal areas. Because the volumes of these wastes may be large, alternate disposal practices will be developed. In the short term, the ER Project will arrange for offsite disposal in landfills that are permitted to accept nonhazardous industrial residual wastes, such as the Conservation Services, Inc., facility in Colorado and other such facilities in New Mexico. In the longer term, the project will pursue a least-cost strategy for disposal by determining the cost of permitted solid waste landfill capacity; by developing a concept design and concept-level cost estimate for an onsite, variable-volume, solid waste landfill; and by comparing the costs of on- and offsite disposal on a net-present-value basis. If offsite disposal is less costly it will be used. If onsite disposal is more prudent, offsite disposal will be used on an interim (3- to 4-year) basis until an onsite landfill can be permitted and built.

3.4.3.5 Staging Areas and Temporary Storage Areas for Waste Materials

In some cases, the ER Project must store additional wastes from site investigations, remediations, and accelerated cleanup excavations while awaiting the characterization data needed to decide on the appropriate disposal option. Because some of the excavated soils are hazardous or mixed waste and because the 90-day period allowed by RCRA may not be sufficient to make all of the shipping arrangements, additional storage space for hazardous wastes is necessary. The ER Project will pursue a modification of its RCRA permit to allow construction of additional greater-than-90-day storage areas and will also initiate measures to convert existing permitted storage areas from operational waste to remediation waste capacity.

A more expedient solution is to begin the process of permitting additional areas as CAMUs. The ER Project recognizes certain barriers associated with implementing these CAMU options. In 1995, the UC and DOE proposed to NMED and EPA that these CAMUs be permanent disposal sites [in accordance with the final CAMU rule (EPA 1993, 1273) rather than storage areas. Sites for CAMUs would be selected based on project need and would be located in contaminated areas. The project would decide whether it was necessary to treat the wastes before disposal; therefore, some CAMUs would be proposed with treatment capability and others would not.

EPA Region 6 procedures for approving a CAMU specify that facilities provide EPA with an initial submittal containing specific information about each CAMU. The ER Project submitted this information to EPA on the sites listed below in the fourth quarter of FY94. The proposed CAMUs are relatively straightforward implementations of the CAMU concept and have a good potential for approval.

- TA-15 Firing Sites (except for the E-F site). Proposed as an engineered disposal facility, with no treatment capability, for emplacement of contaminated materials from R-16 and other sites.

- TA-16 Fabrication Area. Proposed as a disposal CAMU consisting of numerous fabrication buildings and waste ponds. The CAMU would include the whole area for burial of wastes contaminated with high explosives. Treatment, which would increase waste volume by 50%, was not included in the proposal.

The ER Project recognizes certain barriers associated with implementing these CAMU options, including time constraints for construction and approval.

3.4.3.6 Approach to Waste Minimization, Recycling, and Reuse

In conjunction with the Laboratory's waste minimization and pollution prevention program, the ER Project is developing a systematic approach to address how waste minimization and pollution prevention can be most effectively applied during ECs in the RFI/CMS process and in decommissioning projects. Initially, these issues will be addressed in waste management plans developed for site investigations in which the potential for waste segregation and/or recycling and reuse is emphasized.

As the ER Project matures, it will expand the waste minimization and pollution prevention component of the waste management plan and develop a systematic process for incorporating these components in site characterization, remediation, and decommissioning to produce checklist/decision trees for use before beginning field work. Additionally, the ER Project will develop performance measures to document successes.

The Decommissioning Project initiated and cosponsored with DOE and the Laboratory's Pollution Prevention Program Office a waste minimization value engineering for the Omega West Project. Recommendations are being incorporated in project documents. The Decommissioning Project procured and is using a contract to recycle contaminated metal. Portable compactors are also being used to minimize volumes. Contaminated reinforced concrete is being decontaminated.

The concrete will be crushed and recycled as backfill or used for other useful purposes. The rebar will be recycled as scrap metal.

3.5 Public Involvement

Both the DOE and EPA have issued guidance documents that apply to public participation in the ER Project. This guidance is derived from the requirements of RCRA as amended by HSWA, CERCLA, and EPA's guidance on corrective action (DOE 1991, 0798; EPA 1987, 0816; EPA 1988, 0294). This plan meets those criteria and includes the general requirements of the HSWA Module. The full public involvement plan for the ER Project is described in Chapter 7.

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4.0 QUALITY ASSURANCE PROJECT PLAN

To be delivered at a later date.

5.0 RECORDS MANAGEMENT PLAN

5.1 Introduction

This plan constitutes the Records Management Program for the Environmental Restoration (ER) Project at Los Alamos National Laboratory (the Laboratory). It supports environmental cleanup work conducted by the Department of Energy (DOE) and the University of California (UC) by establishing general guidelines for records management, including technical data. Specific actions for managing project records are implemented through quality procedures (QPs), administrative procedures (APs), standard operating procedures (SOPs), and management guidance documents. The guidelines have been developed in cooperation with the ER Project's quality assurance staff and the Laboratory's Computing, Information, and Communication Division staff.

5.1.1 Organization of Records Management Plan

This plan interfaces with other chapters of this Installation Work Plan mandated by the Hazardous and Solid Waste Amendments (HSWA) Module of DOE/UC's permit to operate the Laboratory under the Resource Conservation and Recovery Act (RCRA) (EPA 1990, 0306). This plan contains seven major sections: Section 5.1, the introduction, presents the organization, regulatory mandate, purpose, objectives, and terminology of the plan. Section 5.2 describes records management procedures and their implementation. The ER Project's Records-Processing Facility (RPF) and Facility for Information Management, Analysis, and Display (FIMAD) are described in Section 5.3. Sections 5.4 through 5.7 describe how records management is coordinated with the quality program, the health and safety program, project management, and public involvement activities.

5.1.2 Regulatory Mandate

The development and implementation of this plan are mandated by the HSWA Module. General requirements for data management are presented in Task II, Section B, of the HSWA Module, but many other references to technical data are made throughout the document. The manner in which documentation of work performed under the permit is managed is of primary importance. Proper records management ensures the integrity and intended function of the data and documentation submitted to the Environmental Protection Agency (EPA) and the New Mexico Environmental Department (NMED). The ER Project's records also include the publicly accessible documentation that makes up the administrative record (AR) as required by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (DOE 1991, 0560; EPA 1990, 0559).

5.1.3 Objectives

The Records Management Program Plan establishes the framework necessary to

- provide general guidelines to process, manage, store, and protect records relevant to work conducted under the HSWA Module;

- provide an ongoing tool to support the technical efforts of DOE, UC, and its ER Project contractors;
- provide an opportunity for public involvement; and
- provide a support system for management decisions throughout the life of the project.

The plan addresses project needs for all forms of technical data, project records, technical and reference literature, and other documentation. The records are collected, organized, indexed, stored, and protected with the goal of providing efficient use and retrievability to a diverse group of users. This goal applies to both manual and automated methods of handling records. The plan enhances interactions with the local community, adjacent communities, the NMED, EPA Region 6, DOE, and other parties who may have an interest in the ER Project at the Laboratory.

The objective of this framework is the effective management of records generated and/or used by the ER Project at the Laboratory, regardless of their physical form or characteristics. It is important that the plan be consistently implemented to provide an auditable and legally defensible system for records management. Coordination with other aspects of the ER Project is important for achieving useful projectwide guidelines for managing records and obtaining technical data, which, in some cases, are not reproducible.

5.1.4 Terminology

Terminology must be consistent to ensure that information is correctly conveyed to the reader of this plan. Definitions for records, technical data, information, and other terms are varied and rigorously debated. To ensure consistent use of terms, the statutory definition for "records" (44 USC 3301) is used. "Records" are ". . . books, papers, maps, photographs, machine-readable materials, or other documentary materials, regardless of physical form or characteristics, . . . appropriate for preservation . . . because of the informational value of the data in them." Thus, the term records includes technical data and is used in this document to reflect the broader scope of protecting all ER Project records. This usage is also consistent with the General Records Schedules for environmental records, as defined by the National Archives and Records Administration (1989, 0357).

5.2 Description of the Records Management Program

This plan delineates how ER Project records are handled to ensure the integrity and protection of information, efficient and cost-effective access, and legal and technical defensibility.

5.2.1 Work Flow, Procedures, and Control

The plan incorporates a threefold approach based on records control and ommitment to quality program guidelines. This approach includes the following precepts:

- structured work flow for records—records control is maintained through a structured work flow and processing procedure for records.

- use of approved procedures—auditable quality program requirements are met through the documented use of approved procedures by appropriately trained employees.

- referable information base—ER Project records are submitted to an information base accessible to ER Project participants and the public while providing records protection through a documented process of change control.

5.2.2 Plan Implementation

5.2.2.1 Structured Work Flow for Records

The RPF functions as an interim repository for records while they are being processed for the ER Project.

5.2.2.1.1 Submittal of Records

ER Project participants must submit their records to the RPF. Records must be submitted in accordance with the "Procedure for LANL ER Records Management" (LANL-ER-AP-02.1). ER records normally are used to make a decision or they document the normal and routine course of conducting ER work. Documentation pertaining to decisions, including technical data, must be submitted to the RPF for inclusion in the AR. This documentation may take the form of RCRA facility investigation (RFI) reports or similar records documenting project decisions.

Participants are required to review their records to determine whether the information represents an ER record as defined in the procedure. This determination can be made in two ways:

- ER records are those specifically identified in QPs, APs, SOPs, ER Project plans, and management guidance documents;

- ER records are those identified at the discretion of ER Project participants as essential to the project and required for the functioning and/or interests of the ER Project.

Records are reviewed for legibility, completeness, sensitivity, and appropriateness to the publicly accessible AR file. In the case of legally privileged or otherwise sensitive records, it may be necessary to summarize these records. These actions are taken with the advice and cooperation of the Laboratory's Legal Counsel/ General Law and the Facilities, Security, and Safeguards offices.

5.2.2.1.2 Records Flow

Figure 5-1 is a detailed diagram of records flow in the ER Project. The model addresses the general types of records, showing how they proceed through processing from the time of generation to final disposition.

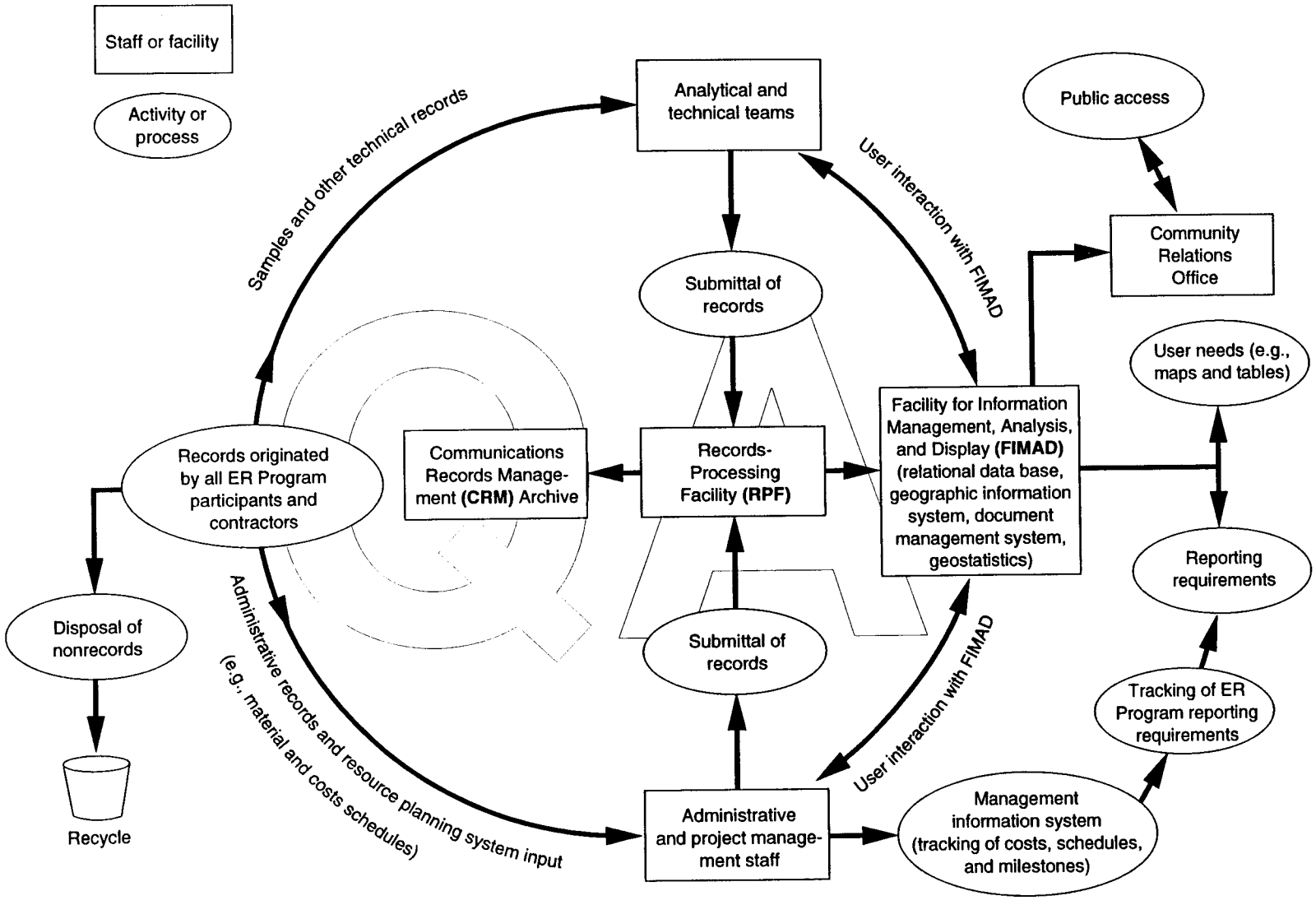

Figure 5-1. Overview of Records Flow in the ER Project.

5.2.2.2 Use of Approved Procedures

Project records are processed under auditable procedures. Personnel involved in processing records are trained and documented in the use of applicable procedures.

5.2.2.3 Referable Information Base

Records sent to the RPF and the FIMAD provide a base of information to which all project participants can refer. They include records that document ER Project activities at the Laboratory, as well as certain records originating outside the ER Project that have been submitted in accordance with the records management procedure. When the originator needs to change a record in the referable information base, he/she completes an ER record correction form (LANL-ER-AP-02.1). This process ensures that ER Project participants have access to the latest version of the record.

5.2.3 Special Topics

5.2.3.1 RFI Work Plans

This Records Management Plan is the basis for managing records for all ER field projects at the Laboratory and meets the HSWA Module requirement for a data management plan. The QPs, APs, and SOPs define records requirements for technical work and typically address such matters as how to document samples, measurements, survey locations, and activity logs. In accordance with LANL-ER-AP-02.1, project participants protect the resulting field records on site until they are submitted to the RPF.

5.2.3.2 Technical Data

5.2.3.2.1 Data Validation

The process for validating data obtained from sampling addresses replicate measurements, identifies outlying values, and explains results determined to be below contaminant detection limits. These conditions are handled in accordance with ER Project SOPs and RFI guidance (EPA 1989, 0088), if applicable. The user may develop alternative means for handling inconsistencies

in data as long as the method is documented, reproducible, and technically defensible. Any reduction of data must be documented in accordance with relevant SOPs.

5.2.3.2.2 Data Analysis

Once technical data have been submitted, they become part of the project's referable information base (Section 5.2.2.3). The FIMAD provides tools for preparing tabular and two- and three-dimensional graphical displays of data, generating maps, performing statistical analyses, and sorting data according to various parameters. This meets requirements specified in ER Project SOPs and the RCRA Corrective Action Plan (EPA 1988, 0295).

5.2.3.3 Records Working Group

An ad hoc team of project participants may need to meet periodically to resolve special issues related to records or specific technical data. The group comprises project participants with appropriate expertise and is selected and activated as needed by the manager of the ER Project (or designee).

5.2.3.4 Administrative Record

An AR, as required under 40 CFR 300 (EPA 1990, 0559), is the body of documentation that forms the basis for making a decision about a site. It also acts as a vehicle for public participation in the process of making a decision. There is a difference between ARs and AR files. A separate body of documentation is established for each decision. To avoid the impression that a body of documentation is complete, it is called an "administrative record file" before completion of decisions and an "administrative record" upon their completion. The AR continues to serve as a historical record of the response selection, even after the statute of limitations for cost recovery action has passed.

5.3 Description of the ER Project's Information Management Facilities

5.3.1 Records-Processing Facility

The RPF receives and processes ER Project records. The RPF maintains working copies of records used in compiling site histories for potential release sites (PRSs). During processing, original records are retained at the RPF in 1-hr fire-rated equipment, as defined in the Standard for the Protection of Records of the National Fire Protection Association, Inc. (1986, 0358). Original submittals and a micrographic copy are sent to the Laboratory's Computing, Information, and Communications Division or a similar long-term storage facility to ensure compliance with NQA-1 (ANSI/ASME 1989, 0018) requirements for retention and protection. The RPF is the central location of the AR and works closely with the Laboratory's Community Involvement and Outreach Office to fill records requests by the public sector. The RPF also functions as an information repository to assist project participants in conducting their work, particularly in locating site historical information, which may influence cleanup decisions. As part of this function, it provides the capability to retrieve records based on a variety of parameters such as subjects, originators, technical areas, dates, PRSs, and structures.

5.3.2 Facility for Information Management, Analysis, and Display

The ER Project Office established the FIMAD to provide the tools, systems, and expertise needed to support the large amount of spatial and tabular data collected as part of the ER Project. This information is readily available to project participants through a variety of media, including a network of workstations and X-terms. The FIMAD taps the expertise of diverse specialists who focus on different aspects of the ER Project's data needs yet work together to solve complex problems in data storage and visualization.

5.3.2.1 System Capabilities

The FIMAD's capabilities are

- geographic analysis, which uses the ARC/INFO Geographic Information System (GIS) with ARC/View as the sophisticated graphical user interface;
- GIS capability, which is focused on data that are spatial in nature (location of buildings, roads, rivers, sample sites, boreholes, etc.);
- GIS specialists, who produce customized maps and perform complex spatial analysis (e.g., identify boreholes that penetrate the aquifer and are statistically within a certain distance of the action level);
- a database management team that uses the ORACLE relational database and focuses on specifying, constructing, and maintaining the complex database structures necessary to store a wide variety of data;
- expertise to understand the visualization and analysis needs of the ER Project and to meet these needs either by finding suitable commercial software or by developing in-house applications;
- management of photoimage data and manipulation of the data for hard copy reproduction;
- provision of efficient and appropriate computer resources to access, maintain, and analyze data; and
- maintenance of an automated backup and copy to a disaster recovery facility (currently at the RPF).

5.3.2.2 Data Acquisition and Quality Control

ER Project participants have access to FIMAD database tables so that they can review and provide updated information. Only authorized personnel, primarily members of the FIMAD staff, may modify data and then only under stringent documentation requirements. The FIMAD staff are also responsible for ensuring the quality of data originating at the FIMAD (e.g., orthophoto data and much of the GIS database). Project participants who provide data to the FIMAD for electronic conversion are responsible for the accuracy of the data they submit to the FIMAD.

5.3.2.3 Configuration Management

Configuration management is implemented as a means of accounting for, controlling, and reporting the planned and actual design of components for FIMAD. Configuration management ensures that the latest version of the whole system is always approved and accessible and meets the requirements set forth in DOE Order

5480.CM. The end product of configuration management is formal documentation of the process of systems development to permit identification of relevant configuration at any given period in the life of the ER Project. The documentation follows accepted practices for designing and developing information systems. Configuration management during development of FIMAD allows flexibility in selecting system components.

5.3.3 Integrated Capabilities of RPF and FIMAD

The ER Project uses a hybrid approach to records management that incorporates the power and functionality of imaging technology and the reliability and wide acceptance of micrographics.

5.3.3.1 Optical Disk Storage

Optical storage systems, which efficiently store enormous volumes of information, consist of hardware and software that convert hard-copy documents to digital form. Both government agencies and private industry are considering these systems; however, the technology presents some formidable issues relative to industry standards, legal acceptance, longevity of the medium, and costs. Optical disk storage is used at the FIMAD to efficiently store and disseminate information via the FIMAD network. Legal issues related to optical disk storage are accommodated through the use of micrographics, as described below.

5.3.3.2 Microfilm

Industry standards for microfilming technology are reliable and widely accepted; therefore, this technology is used for capturing most ER Project records. The ability of the human eye to read a record on microfilm compensates for the lack of hardware standards in some components of optical disk systems. Microfilm standards and legal defensibility are well established. Microfilm may also be used to transmit color graphics information or may be used as the source for digitizing project records in the future.

5.3.3.3 File Standards and Compatibility

The ER Project uses several different operating systems, including MS-DOS, Apple, UNIX, and the Virtual Memory System, that are not directly compatible. The problem of file compatibility is neither unique to the ER Project nor is it simple. This plan specifies using systems that adhere to existing standards and protocols to exchange information.

5.3.4 Progress in Technology

Changes in hardware and software technology are frequent and substantial and demand that attention be given to industry standards. How a product fulfills regulatory requirements for records retention, data access, and legal defensibility influences which products are selected. Personnel assigned to operate and maintain the RPF and the FIMAD keep abreast of industry trends and recommend conversions and/or modifications to the system, as necessary, to keep it a viable component of the ER Project.

Retention requirements for many records extend well beyond the typical life of systems currently used. Retention requirements are met by converting records, when practicable, to archive-quality micrographic media, subject to regulatory guidelines and approval. The ER Project currently uses an "indefinite" records retention period until the Laboratory's Information Resource Management Program is fully implemented.

5.4 Coordination with the Quality Program

LANL-ER-AP-02.1, approved by the quality project leader, is used for managing ER Project records. The procedure and subsequent updates are written in accordance with LANL-ER-AP-01.1, "Preparation, Review, and Approval of Administrative Procedures." The procedure is used uniformly throughout the ER Project to achieve the objectives of this plan and to fulfill the obligations defined in the HSWA Module.

5.4.1 Records Protection Before Submittal

Project participants must protect records resulting from ER Project activities. The originator should protect the records until they are submitted to the RPF in accordance with LANL-ER-AP-02.1. The protection is accomplished in a manner appropriate to the value and reproducibility of the information contained in the records.

5.4.2 Records Protection During Submittal

Because of the nature of mail services and the inherent risk of transporting documents, records may be at risk during transport. Originators must apply good judgment based on the value of information contained in the submittal. Specifically, if a document contains irreplaceable information, it should be hand-carried to the RPF to afford adequate protection until it is processed and turned over to the Computing, Information, and Communication Division for long-term protection.

5.4.3 Records Protection after Submittal

Records submitted to the RPF are processed in accordance with LANL-ER-AP-02.1 and other procedures specific to the RPF. During the processing stage, indexing information and the original record are retained at the RPF in 1-hr fire-rated equipment as defined in the Standard for the Protection of Records of the National Fire Protection Association, Inc. (1986, 0358).

Upon receipt of the records, the RPF takes the following steps:

- complete indexing for each record received;
- make a microfilm copy of the record;
- enter the indexing information and microfilm address in the ER record data base; and
- forward the original record and a microfilm copy to the Computing, Information, and Communication Division for long-term

protection; working copies of the records are made available at the RPF and are queriable on bibliographic and indexing information in the RPF's home page on the Worldwide Web (http://iosun.lanl.gov:3001/).

5.5 Coordination with the Health and Safety Program

Certain health and safety records that result from ER Project activities are included in the referable information base. This information pertains to health and safety training and medical surveillance of each person working at a PRS. Because of the personal nature of certain types of medical information, many records are appropriately maintained in the Occupational Medicine Group (ESH-2) database or by participating contractors. Training records are maintained by the ER Project Office and in some cases by the contractors. ER training records contain information regarding the completion of training, the dates of required refresher training, and the site(s) each worker visits regularly. The information fields include

- a unique identifier for each worker,
- employer,
- dates required training was completed,
- dates of required refresher training,
- site(s) worker visits regularly, and
- field unit association.

5.6 Coordination with the Project Planning and Control Team

The ER Project Planning and Control Team (PPC) coordinates, summarizes, and maintains the information in the performance measurement baseline in compliance with DOE-Albuquerque Environmental Restoration Division guidance on implementing DOE Order 4700.1 (DOE 1992, 0823) and any subsequent DOE orders pertaining to program management. The performance measurement baseline includes information on project assumptions, cost estimating, scheduling, time-phased budgets, and important project milestones and deliverables. Certain PPC documents and the monthly reports to DOE are copied to the RPF to document project decisions. Any approved changes to the performance measurement baseline are incorporated by the PPC team and field project leaders (FPLs) through a baseline change control process. These changes and the subsequent documentation are also copied to the RPF.

The software packages used by the PPC staff provide the capability for generating and analyzing the reporting documents required by the ER Project and DOE. The two primary packages are an estimating software and a program management software. The program management software includes many fields for indexing records for special reports and queries. Examples of indices include work breakdown structure, activity data sheet, PRS numbers, responsible FPL, and enforceable agreement milestone.

5.7 Coordination with the Public Involvement Program

The RPF staff works closely with the ER Project staff; Community Involvement and Outreach Office; Environmental Management Program's Policy and Public Involvement Office; Legal Counsel/General Law; Public Affairs; and Facilities, Security, and Safeguards to facilitate timely public awareness and access to ER Project documentation.

5.7.1 Access to the Administrative Record

An AR, as required under 40 CFR 300, is the body of documentation that forms the basis for making a decision at a site. It also acts as a vehicle for public participation in the process of making a decision. The AR Electronic Index (Section 5.2.3.4) is available for public use during established hours of the Laboratory's Community Reading Room (Chapter 7).

5.7.2 Public Information Repositories

The Laboratory and ER Project maintain several information repositories for public use in Los Alamos and surrounding communities. These repositories are listed in Section 7.1. In general, they contain final ER Project plans and reports expected to be of interest to the public, whereas, the RPF contains the backup documentation. Detailed information on the kinds of materials available in the public information repositories may be obtained from the points of contact given in Section 7.1.

5.7.3 Sensitive Documents

Documents not subject to public access are those that fall under sensitive categories (such as attorney work product, attorney-client privileged documents, and personal information) and documents that have no direct relevance to making a decision. However, even documents that are unavailable for public review are listed in the AR Electronic Index for the public's information at the Laboratory's Community Reading Room.

References for Chapter 5

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6.0 HEALTH AND SAFETY PLAN

6.1 Introduction

6.1.1 Purpose and Applicability

The Environmental Restoration (ER) Project at Los Alamos National Laboratory (the Laboratory) has developed a health and safety plan (HASP) to comply with applicable US Department of Energy (DOE) and federal and state occupational safety and health requirements. The HASP establishes generic health and safety (H&S) information and requirements applicable to ER field operations projectwide.

This Chapter 6 of the Installation Work Plan (IWP) is based on the HASP. The differences between this chapter and the HASP are that (1) some of the detail in the body of the HASP does not appear in this chapter, (2) the HASP contains several appendices that are cited in this chapter but have not been included in the IWP, and (3) to meet new requirements and changing project needs, the HASP is continuously updated; the changes that occur in the HASP in 1995 will be reflected in the next annual revision of the IWP.

In addition to the generic guidance published in this chapter, a site-specific health and safety plan (SSHASP) will be prepared for each field project as assigned by the field project leader (FPL). As used in this chapter, "field project" refers to investigation or cleanup of a potential release site (PRS) or group of PRSs. Each SSHASP supplements the HASP by providing additional H&S information and requirements indicated by the operations and conditions at individual project sites.

The Laboratory acknowledges that potential hazards are inherent in the performance of ER field operations. Accordingly, the Laboratory expects that work conducted under the ER Project will be performed in a safe and healthful manner that minimizes the threat and occurrence of hazards to health, property, and the environment to levels as low as reasonably achievable (ALARA). In the interest of protecting health and property (the Laboratory's personnel and property, the local public and their interests, and the personnel and equipment involved in conducting ER work), programs, plans, and procedures associated with the performance of ER field projects are subject to approval by designated Laboratory representatives before implementation. However, such approval in no way relieves ER participants from complying with specific regulatory requirements pertaining to H&S programs, plans, procedures and work practices, nor does such approval relieve ER participants from their responsibility for maintaining a safe and healthful work environment. The term "ER participants" refers to anyone performing work, including Laboratory personnel, subcontractor personnel, and their lower-tier contractors, consultants, and agents.

Furthermore, ER Project participants are responsible for conducting work in accordance with applicable federal, state, and local regulations. In some cases in this chapter and as indicated in the SSHASP, the Laboratory has chosen to invoke Occupational Safety and Health Administration (OSHA) and Laboratory requirements that ordinarily might not apply to ER field operations [e.g., OSHA's general industry standards in Part 1910 of Title 29 of the Code of Federal Regulations (DOL 1994, 1256)]. These choices were made on a case-by-case basis to maintain consistency with the Laboratory's ALARA policy and to clarify the Laboratory's

expectations with regard to interpretable requirements of the multiple agencies governing ER work.

When there is concern that implementation of work orders or H&S requirements would conflict with contract terms or could unreasonably compromise the safety or health of an individual or the environment, such concerns should be brought to the attention of the contract administrator and the field unit H&S representative (Section 6.3.3.2) immediately. Failure to comply with the terms of H&S plans may constitute cause to stop activity or to issue a stop-work order as specified in Section 6.3.4 without cost or penalty to the Laboratory.

The ER Project has provided to project participants the ER Project HASP consisting of the material in this chapter and appendices containing forms and procedures. It has also provided a model SSHASP. Both the HASP and the completed SSHASP for each project shall be kept readily available for reference by individuals performing ER field operations and shall govern the conduct of work at the applicable site(s).

6.1.2 Review and Approval

Before any work is initiated, the project team shall submit a completed SSHASP, in draft form, to the H&S representative for the field unit, who will circulate it to appropriate Laboratory personnel for review and approval. Each SSHASP submitted must be signed by an authorized representative of each ER participant-employer whose employees are subject to the terms of the SSHASP. The employer's signature on the signature page shall serve as a certification that the employer has reviewed, concurs with, and will comply with the terms of the HASP and SSHASP. After signing the signature page, the FPL shall return the SSHASP to each employer.

Additionally, each individual who needs to enter a controlled area of a site where access has been limited in accordance with a SSHASP shall sign an acknowledgment form (Appendix A of the HASP) to acknowledge that he/she has read or has been briefed on and understands the contents of the HASP and applicable SSHASP and agrees to abide by the terms of these documents.

6.1.3 Updating and Numbering Health and Safety Documents

Evolutionary changes in H&S information and requirements that apply projectwide will be incorporated in the annual updates of this document. Any exceptions or deviations from the HASP must be described along with the rationale in the applicable SSHASP.

SSHASPs may be revised at any time to include new information and changes that make the SSHASP more useful (e.g., new site data based on contaminant sampling and monitoring, recent survey information, and changes in site conditions or work practices). Once the SSHASP has been approved, revisions will be tracked using a SSHASP modification form (Appendix B of the HSAP). Modifications in a SSHASP may necessitate change in the terms or scope of a contract. Completion of a SSHASP modification form is <u>not</u> the means for modifying the scope or terms of the project contract. To modify a contract under the changes clause, the subcontractor shall notify the contract administrator and field unit H&S representative (Section 6.3.3.2) and shall not proceed with the change until all parties agree through a

change order or unless the contract administrator unilaterally directs the contractor to proceed with the change.

Generally, SSHASP modifications are completed by the site safety officer. Modifications in the SSHASP must be signed by a duly authorized representative of each party (including subcontractors and lower-tier subcontractors, consultants, or agents) affected by the modification(s) who has authority to approve of or concur with the terms of the modification(s). Changes to the SSHASP shall be communicated to affected individuals before implementation during tailgate H&S meetings (Section 6.10.1.4).

When a draft SSHASP is submitted for Laboratory review, ESH-5 will issue a unique document control number, which shall appear on the title page and in the footer of each page of the document. Each modification form shall be consecutively numbered using the SSHASP number (X), followed by a decimal point and a numeric suffix (e.g., X.01 or X.02) to indicate the modification number sequentially.

6.2 Background Information

General background information descriptive of Los Alamos (i.e., location and prevailing weather conditions) is provided in the HASP (Section 2). Background information specific to the project is provided in the SSHASP (Section 2), including the project's scope of work and descriptions of the PRS(s).

6.3 Organization, Responsibilities, and Authority

The policies and personnel roles and responsibilities provided in this section have been established by the Laboratory to clarify expectations of ER participants and to comply with the requirements of 29 CFR 1926.65(b)(2) (DOL 1994, 1257).

6.3.1 Visitor Policy

A visitor (e.g., regulatory personnel, property owners, field auditors, and the public) is anyone who arrives at the work site who is not identified as a field team member or who does not appear in Table 3-1 of the SSHASP. When a visitor arrives, the site safety officer, field team leader, or delegate, should meet with him/her to ascertain the purpose of the visit.

Visitors are not permitted to enter controlled work zones where access has been limited unless absolutely necessary. In such cases, the visitor shall be briefed per Section 6.10.1.3, shall meet all applicable requirements of the HASP and SSHASP, and may need to be accompanied by an escort at the discretion of the field team leader. If a visitor does not comply with these requirements, the field team leader, or delegate, shall request the visitor to leave the controlled zone immediately or shall limit site operations to minimize threat of harm to the visitor (e.g., have the field team take a break, reset the zone boundaries if appropriate, or temporarily discontinue any threatening task). Alternatively, if a visitor needs to observe work being performed in a controlled zone that is not readily visible from outside the zone(s), videotaping or photographing the work should be considered.

6.3.2 Project Team Personnel

6.3.2.1 Line Managers

6.3.2.1.1 Field Project Leader

The FPL is a member of the Laboratory's staff and reports to the manager of the ER Project. The FPL is the project manager as defined by "Construction Project Safety and Health Management" (DOE 1994, 1153). The FPL is the line manager for his/her field unit and may direct one or more field team managers (Section 6.3.2.1.2) or field team leaders (Section 6.3.2.1.3).

The FPL is responsible for ensuring that provisions of the HASP, SSHASP, and other applicable H&S regulations are observed for field operations under his/her management. In addition, specific health and safety responsibilities of the FPL, or his/her delegate, include

- managing H&S activities of his/her field unit;
- serving as the final authority for resolving H&S issues concerning his/her field unit;
- ensuring that the necessary SSHASPs for his/her field unit are developed and that the comments of the field unit H&S representative and any other appropriate parties have been incorporated;
- ensuring that each individual performing ER work at his/her field unit is qualified in accordance with applicable H&S requirements;
- ensuring that onsite personnel abide by applicable H&S programs, procedures, plans, and applicable regulations;
- having the authority to ban personnel who do not abide by applicable H&S requirements from performing field operations;
- conducting inspections as required by Section 6.12.1; and
- ensuring the submittal of appropriate field project H&S records to the Laboratory's Records-Processing Facility (RPF).

6.3.2.1.2 Field Team Manager

The field team manager, who may be either a Laboratory staff member or contractor, reports to the FPL and is the line manager of one or more field teams. This person is the construction manager as defined by "Construction Project Safety and Health Management" (DOE 1994, 1153). Specific H&S responsibilities of the field team manager, or delegate, include

- coordinating with the FPL to ensure that provisions of the HASP, SSHASP, and other applicable H&S regulations are implemented for assigned field operations;

- ensuring that all known tasks and personnel have been identified sufficiently in the SSHASP;

- coordinating with the FPL to ensure that each concerned party has reviewed the SSHASP for accuracy and adequacy in accordance with Section 6.1.2, that review comments are resolved, and that the SSHASP is signed before any field activities are begun;

- coordinating with the FPL to ensure that only personnel qualified in accordance with applicable H&S requirements are used to perform ER Project work;

- coordinating with the FPL and the field unit H&S representative to select qualified H&S and health physics personnel;

- coordinating with the FPL to ensure that the necessary permits have been obtained before commencing field operations;

- conducting inspections as required by Section 6.12.1;

- coordinating with the FPL to ensure that necessary H&S records are produced and kept in accordance with the SSHASP; and

- coordinating with the FPL to provide necessary H&S records to the FPL at the close of the project.

6.3.2.1.3 Field Team Leader

The field team leader, who may be either a Laboratory staff member or a contractor, reports to the field team manager (or in some cases directly to the FPL, in which case, the responsibilities of the field team manager should be delegated to the field team leader by and at the discretion of the FPL). This person is the line manager for his/her field team. He/she oversees the work of one or more supervisors assigned to the field teams, the field team members, and the site safety officer. The field team leader or delegate

- coordinates with the field team manager and/or FPL to ensure that the provisions of the HASP, SSHASP, and other applicable H&S regulations are implemented for assigned field operations;

- coordinates with the field team manager and/or FPL to ensure that only field team members and support personnel qualified in accordance with applicable H&S requirements are allowed to perform field operations;

- coordinates with the field team manager and/or FPL to ensure that field team members attend H&S briefings and daily H&S tailgate meetings before beginning field operations;

- coordinates with the field team manager and/or FPL to ensure that the necessary preventative planning and employee training for emergency situations has occurred before beginning field operations (Section 6.9);

- coordinates with the field team manager and/or FPL to ensure that site control measures and hazard prevention and mitigation controls are implemented accordingly (Sections 6.4.2 and 6.5);

- ensures that a log of field activities is maintained, especially noting site personnel and visitors who enter and exit the site;

- notifies appropriate parties when action levels are reached and when personnel exposures exceed occupational exposure levels (Section 6.6);

- in the event of an incident or emergency, functions as site incident/emergency coordinator; as necessary, arranges for immediate notification of Laboratory emergency response personnel to take control of the scene; and/or arranges for immediate notification of appropriate authorities (Section 6.9); and

- coordinates with the field team manager and/or FPL to ensure that modifications to the SSHASP have been prepared and approved per Section 6.1.3 before initiating any operational changes.

6.3.2.1.4 Other Onsite Supervisory Personnel

For field teams involving multiple employers, each employer's onsite supervisory representative is responsible for ensuring that provisions of the HASP, SSHASP, and other applicable H&S requirements are observed by his/her employees during field operations. These supervisors are responsible for cooperating with the field team leader and site safety officer to resolve H&S matters that affect site personnel and/or operations.

6.3.2.2 Field Team Members

Field team members are responsible for performing their work in a safe and healthful manner. They also are responsible for abiding by the requirements of the HASP, SSHASP, and other applicable H&S regulations and procedures and for fulfilling and maintaining their individual training and medical surveillance requirements. If there is concern that implementation of work orders or H&S requirements may unreasonably compromise the safety or health of an individual or the environment, such a concern should be brought to the attention of an immediate supervisor, the site safety officer, or the field team leader. When an H&S concern is not resolved adequately by field supervisors, the matter should be brought to the attention of the field team

manger or field unit H&S representative, and, subsequently, the FPL if necessary. If adequate resolution still has not been achieved, team members are encouraged to call the Laboratory's ESH Division hotline at 665-5010 or to contact the Los Alamos DOE Area Office at 667-5105, where they may file a complaint form (DOE F 5480.4). DOE has a policy that employees who report a health and safety problem are protected from reprisal.

6.3.2.3 H&S Personnel

6.3.2.3.1 Site Safety Officer

The site safety officer assists the field team leader in seeing that the provisions of the HASP, SSHASP, and other applicable H&S requirements are observed in the field and serves as the primary contact in the field for H&S matters. The site safety officer shall be qualified, on a project-specific basis, to recognize and evaluate hazards and to minimize and mitigate occupational H&S hazards. The site safety officer may perform other duties on the field team, provided that these duties do not compromise the performance of his/her site safety officer duties. The specific responsibilities of the site safety officer are to

- assist with developing the SSHASP;
- verify that onsite personnel have current certification of the applicable training and medical surveillance requirements of Sections 10 and 11 of the HASP and SSHASP (Sections 10 and 11);
- assist the field team leader in effectively implementing the HASP and SSHASP in accordance with applicable federal, state, and local H&S regulatory requirements;
- notify the field team leader of any onsite personnel who are not abiding by applicable H&S requirements and of potential or actual hazardous situations needing to be rectified in accordance with applicable H&S requirements;
- notify the field team manager and, subsequently, the field unit H&S representative when elements of the HASP and SSHASP are not being met and when H&S hazards are not being minimized or mitigated sufficiently;
- watch for changes in site operations and conditions that warrant hazard mitigation and/or modifications in the SSHASP;
- ensure that copies of the HASP, SSHASP, and any modification forms are current and that these documents are readily accessible onsite and as needed for ER work occurring elsewhere;
- assess the necessity of and arrange for monitoring employee exposures to H&S hazards and convey the results and known implications to the field team leader;

- notify the field team leader, the field unit H&S representative, and affected employee's(s') supervisors of the results of monitoring employee exposures (Section 6.13.3);
- monitor the levels and effectiveness of personal protective equipment and verify proper storage and maintenance of equipment;
- perform and document inspections of site operations per Section 6.12.1; and
- maintain H&S-related field project records, including a daily log of H&S-related matters concerning site operations, and provide these records to the field team manager as necessary before close of the project.

6.3.2.3.2 Industrial Hygiene Technician

The industrial hygiene technician is a designated team member who is capable of monitoring employee exposures to hazardous substances and, to the extent necessary for the site-specific work, is capable of evaluating exposure-monitoring results to determine actions necessary to protect individuals onsite. This person may be someone who is training to become a site safety officer and, with the approval of the FPL, someone to whom the site safety officer may delegate his/her responsibilities as this person is trained and qualified to perform such duties.

6.3.2.3.3 Trenching/Excavation-Competent Person

This individual is a designated team member or support person who, in accordance with 29 CFR 1910.146 (DOL 1994, 1256), is capable of identifying existing and predictable hazards in the surroundings or working conditions involving trenching or excavation that are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them [29 CFR 1926.650(b) (DOL 1994, 1257)]. This person shall have had specific training in and be knowledgeable about soils analysis, the use of protective systems, and the requirements of 29 CFR 1926 Subpart P—Excavations (29 CFR 1926.650 et seq.).

6.3.2.3.4 Confined-Space-Entry Supervisor

The confined-space-entry supervisor is a designated team member or support person who is responsible for determining whether acceptable entry conditions exist at a confined-space where entry is planned, for authorizing and overseeing entry operations, and for terminating entry in accordance with regulatory and permit requirements [29 CFR 1910.146 (b), (DOL 1994, 1256)].

6.3.2.3.5 Other Competent or Qualified H&S Personnel

Throughout 29 CFR 1926 and applicable standards of 29 CFR 1910 evoked by the Laboratory, OSHA uses the terms "competent" and "qualified" to denote specially trained and knowledgeable individuals who are required to perform certain functions. These specific standards are cited as applicable throughout the HASP and SSHASP. Whenever requirements exist in these standards for participation of a competent or

qualified person, the person shall be trained and knowledgeable about the particular regulated subject matter in accordance with 29 CFR 1926.32(f) or (m), the applicable regulatory standard, and Section 6.10.3.

6.3.2.4 Health Physics Personnel

Health physics personnel include radiological screening personnel, health physics technicians, and radiological control technicians. These field team members are the primary source of information and guidance about radiation protection. They shall ensure compliance with the radiological requirements of the SSHASP and conduct monitoring per the radiological surveillance authorization agreement issued by ESH-1 and the terms of the SSHASP. If non-ESH-1 personnel perform these roles, ESH-1 must preapprove personnel and issue a radiological surveillance authorization agreement before any work is performed.

6.3.2.4.1 Radiological Screening Personnel

Radiological screening personnel are responsible for providing health physics monitoring support for the field team. Each radiological screening person is responsible for performing health physics monitoring support in accordance with his/her radiological surveillance authorization agreement. Specific responsibilities include

- performing and documenting radiological surveys,
- performing conditional equipment release surveys,
- performing daily instrument response checks,
- ensuring that all radiation-monitoring equipment is in good working order,
- ensuring that radiological postings are maintained,
- immediately notifying ESH-1 when an employee has been contaminated above action levels,
- providing ESH-1 personnel who oversee the ER Project with a daily verbal summary of site radiological conditions and copies of all radiological survey documentation, and
- notifying ESH-1 when action levels defined in the SSHASP have been reached.

6.3.2.4.2 Health Physics Technician and Radiological Control Technician

In addition to the responsibilities of the radiation screening personnel, the responsibilities of the health physics technician and the radiological control technician include

- preparing, ensuring compliance with, and closing out radiological work permits;

- stopping work and revising the site radiological work permit when the radiological controls required do not provide adequate worker protection or contamination control;
- providing guidance on radiological decontamination of equipment and personnel; and
- performing "unconditional release" surveys for equipment (radiological control technician only).

6.3.3 Project Support Personnel

6.3.3.1 Contractor/Subcontractor Representative

A contractor/subcontractor representative is a management or health and safety professional representing an employer affected by terms of the SSHASP. This individual must have the authority to approve the terms of the SSHASP and any modification forms and to see that employees of his/her employer abide by these terms. Additional responsibilities include

- interfacing with field project line managers, other employers' supervisory personnel, and support professionals, as necessary, to coordinate implementation of HASP, SSHASP, and other applicable H&S requirements; and
- assisting with resolving H&S issues involving employees performing ER work, particularly those issues involving discrepancies between policies of multiple employers represented onsite and site-specific H&S requirements.

6.3.3.2 Field Unit H&S Representative

The field unit H&S representative may be either a Laboratory employee or a contract employee who is assigned to one or two FPLs as a technical advisor. This person provides H&S support to personnel performing ER work involving the assigned field unit(s). This person serves as liaison between the field unit personnel and the ESH Division of the Laboratory and arranges for provision of technical assistance by ESH personnel concerning industrial hygiene, operational safety, and health physics matters. This person may also be responsible on behalf of the Laboratory for implementing the ER/H&S Oversight Program (Section 6.12.2) for field unit(s) as assigned by ESH-5 management. In addition to the responsibilities of the contractor/subcontractor representative, the field unit H&S representative has responsibilities that include

- ensuring that SSHASPs for his/her field unit(s) are reviewed by appropriate ESH groups;
- verifying that known hazards, preventive measures, and mitigation controls associated with the project scope of work and tasks have been adequately incorporated in the SSHASP;

- reviewing and approving SSHASPs and modification forms for ER work at his/her assigned field unit(s); and

- verifying that field operations associated with his/her field unit(s) are conducted in accordance with applicable H&S programs, plans, and regulatory requirements.

6.3.3.3 Registered Professional Engineer

A registered professional engineer is a person who is registered as a professional engineer in the state where the excavation or trenching work is to be performed (29 CFR 1926.650 [b]) (DOL 1994, 1257).

6.3.3.4 ESH-1 Personnel

ESH-1 will designate ESH-1 personnel to provide radiological control support to the ER Project and to conduct ER/H&S oversight duties (Section 6.12.2). In cases requiring immediate involvement by ESH-1 personnel, the field team leader or delegate may request direct ESH-1 participation. Such participation may include site visitation, the frequency of which will depend on the specific operations and radiological conditions occurring at the site. The responsibilities of the ESH-1 representative include

- performing reviews to ensure that the radiological safety program is in compliance with the Laboratory's Radiation Control Manual (LANL 1994, 1196) and applicable Laboratory requirements;

- ensuring that survey methods and equipment are appropriate for the type of radiological contamination expected and for current site conditions;

- providing direct support to field health physics personnel, when requested;

- ensuring that radiological controls are implemented in accordance with the radiological work permit (if any), the SSHASP, the Laboratory's Radiation Control Manual (LANL 1994, 1196), and any other applicable Laboratory requirements;

- ensuring that radiological surveys are performed and documented in accordance with required ESH-1 procedures;

- performing radiological surveys before the start and at the completion of field activities;

- providing guidance for radiological decontamination of equipment and personnel;

- taking the actions indicated in Table 4-3 and Section 6 of the SSHASP upon notification that the action levels given in the table have been reached;

- reviewing radiological work permits for the site;
- determining and, in some cases, providing appropriate radiological postings; and
- meeting notification and reporting requirements as specified in "Occurrence Reporting and Processing of Operations Information" (DOE 1993, 1197).

These responsibilities may be performed by designated contract personnel, provided ESH-1 has approved the subcontractor's radiological safety program to perform this work, which must be submitted to the Laboratory for approval during the prebid qualification or contract negotiation period, as required, or according to applicable requirements of Section 6.4.2.2.

6.3.4 Stop-Activity and Stop-Work Orders

Any individual observing an operation that presents a clear and imminent danger to the environment or to the health and safety of site personnel, visitors, or the public has the authority to immediately notify the individuals involved and the site safety officer or field team leader. In accordance with the Laboratory's Radiation Control Manual, radiological control technicians have the responsibility and authority to stop work or to mitigate the effect of an activity if they suspect that the initiation or continued performance of the activity will result in a violation of radiological control standards or result in imminent danger or unacceptable risk.

6.3.4.1 Stop Activity

The site safety officer or the field team leader shall notify supervisors and individuals on the site of the danger. Once it has been concluded that conditions or practices exist that pose a threat to personnel or environmental safety or health, the field team leader or other onsite supervisors or managers shall take action to diminish the immediate threat of harm. Operations shall be altered or discontinued to eliminate the immediate threat of harm, and individuals shall be directed to immediately leave an area of imminent danger. Authorization to begin the activity again shall be given by the field team leader only when it has been determined that the hazard(s) has/have been sufficiently abated and there is no further threat of harm. For example, a single activity, such as removing defective equipment or removing site personnel from a section of scaffolding that is defective, may be stopped without stopping the entire field operation. The field team leader is responsible for notifying the FPL and field unit H&S representative of activity stoppage and for determining whether the incident is reportable per Section 6.9.4.

6.3.4.2 Stop-Work Order

A formal "contractual" stop-work order can be issued only by a Laboratory contract administrator. Experts from ESH Division may provide recommendations regarding the need to issue a stop-work order by notifying the field unit H&S representative or the FPL, who will contact the contract administrator to arrange for review of the matter and will proceed in accordance with applicable internal Laboratory procedures.

6.4 Task Hazard Analysis

DOE (DOE 1994, 1153; 1147) and OSHA (29 CFR 1926.65[b][4][ii][A] (DOL 1994, 1257) require that a hazard analysis be prepared for each task to be performed during the ER field project. The task hazard analysis must identify the likely radiological, safety, chemical, physical, and biological hazards and the affected personnel so that determination can be made of the corresponding exposure-monitoring and response plans, administrative and engineering controls, site control measures, personal protective equipment, medical surveillance, training, and emergency/incident response requirements to be implemented to minimize or mitigate the anticipated site hazards.

Each SSHASP shall include a task hazard analysis (Section 4 of the SSHASP) for each of the tasks described in the project scope of work (Table 2-2 of the SSHASP). Field team participants and key H&S support personnel shall be identified in Table 4-1 of the SSHASP by the role (job title) and task(s) they are expected to perform. Then each anticipated task-specific hazard shall be assessed, as described in greater detail in this section, to determine the associated qualitative probability of occurrence of the hazard and the severity of injury/illness expected to result.

6.4.1 Hazard Assessment

According to DOE (1994, 1147), hazard assessment is the process of identifying and evaluating the hazards associated with operational activities. Evaluation and identification of hazards should occur

- during preoperational planning of ER field work,
- immediately after initiation of and during performance of tasks with potential hazards,
- before changes in tasks and/or operations,
- as required by changing site conditions, and
- continually as appropriate.

The Laboratory has provided a method for evaluating and rating hazards (Appendix C of the HASP). DOE has provided a list of several assessment methods in an appendix to its HASP guidelines publication (DOE 1994, 1147). It should be clearly stated in the SSHASP which hazard assessment method is being used.

Not all contaminants at a particular site or chemical products used during field operations pose an occupational health threat. The determination of which substances are expected to pose an occupational health threat is made by the process of hazard assessment. DOE suggests that the following criteria be used to identify the hazardous substances to be assessed:

- type, nature, form, quantity, and concentration of the hazardous substance(s);
- location of the substance(s);

- conditions under which exposure to the substance(s) may occur; and
- specific hazards associated with the substance(s).

Details of the site-specific hazard assessment of each known site contaminant and chemical product to be used shall be included in Appendix B of the SSHASP, unless there are none. Of the wide variety of potential chemicals of concern at each site, Table 4-2 of the SSHASP must include only the substances expected to pose an occupational health threat, together with the resulting hazard assessment rating. The signs and symptoms of chemical exposure, if any, shall be provided in Appendix C of the SSHASP. Corresponding detection methods, protective measures, and response actions shall be provided in Section 6 of the SSHASP.

Assessment of site-specific hazards that could result from unpredictable detonation of high explosives, exposure to radiological and safety hazards, and to chemical hazards by class of chemical are included in Table 4-3 of the SSHASP. This table shall also include the administrative and engineering controls to be implemented to prevent and/or mitigate occurrence of these hazards.

The likelihood of exposure to biological and physical hazards is fairly uniform for performance of ER tasks in and around Los Alamos. General biological hazards of concern include tick bites, rodent flea bites, poison ivy, poisonous snake bites, insect bites or stings, and transmission of bloodborne pathogens when first-aid or cardio-pulmonary resuscitation (CPR) is rendered. General physical hazards of concern include lightning strikes; slips, trips, and falls from less than 4-ft elevations; heat and cold stress; altitude sickness; and animal attacks. These hazards have been assessed by ESH-5 with input from ESH-2, assuming variable exposure conditions on a projectwide basis. Results of this assessment, together with the symptoms of exposure, detection methods, protective measures, and response actions are provided in Table 1 of the HASP.

6.4.2 Administrative and Engineering Controls

As a first line of defense, DOE (1994, 1147) and OSHA (DOL 1994, 1256) require that employers implement administrative and/or engineering controls to prevent and/or mitigate hazards and protect site personnel. Secondarily, employers may require employees to use personal protective equipment (Section 6.7). This section addresses the basic administrative and engineering control requirements with which the Laboratory expects ER participants to comply. Site-specific administrative and engineering requirements shall be included in Table 4-3 of the SSHASP.

6.4.2.1 General Administrative Controls

The general work practices and administrative controls in Section 4.2.1 of the HASP are to be implemented as applicable during ER field operations. Requirements addressed in Section 4.2.1 of the HASP are

- drug and alcohol policy;
- housekeeping and sanitation;
- site controls; and

- packaging, labeling, handling, transport, and disposal of hazardous substances.

6.4.2.2 Required Written Programs and Permit Systems

In addition to these general administrative controls and the site-specific administrative controls indicated in the SSHASP, DOE (DOE 1990, 0730) and OSHA (29 CFR 1926, DOL 1994, 1256; 1257) have requirements that employers develop, implement, and maintain certain written programs and permit systems as a means for preventing or mitigating exposure to H&S hazards in the work place. The programs and permits required by these regulations are listed below and are described in Section 4.2.2 of the HASP. When the program or permit system has been addressed sufficiently in the employer's hazardous waste operations (HAZWOPER) program, it need not be repeated elsewhere. ER contractors are expected to maintain and implement these programs as they apply to the project work being performed:

- Assured Equipment-Grounding Conductor Program,
- Bloodborne Pathogens Exposure Control Program,
- Chemical Hazard Communication Program,
- Chemical-Specific Compliance Programs (OSHA-regulated substances in Subparts D and Z of 29 CFR 1926),
- Confined-Space-Entry Program (Permit Required),
- Hazardous Waste Operations Program,
- Hearing Conservation Program,
- Lockout/Tagout for Control of Hazardous Energy Sources for Personnel Safety (Red Lock Procedure) Program,
- Medical Surveillance Program,
- Personal Protective Equipment Program,
- Radiological Safety Program,
- Respiratory Protection Program,
- Spark- and Flame-Producing Operations (Hot Work/Burn Permit) Program, and
- Training Program.

Contractors are expected to submit their programs and permits to designated Laboratory representatives for review and approval before implementation. At least 30 days before the scheduled start date of an operation for which a written program is required, the program shall be submitted to the field unit H&S representative so that it can be reviewed and approved by appropriate ESH personnel. Similarly, unless indicated otherwise below, at least 30 days before the anticipated date of permit implementation, contractors shall initiate action to obtain the Laboratory's

approval of their permits, which may include a requirement that the contractor submit project-specific standard operating procedures (SOPs).

As the host organization, the Laboratory will provide contractors with the hazard assessment information necessary for preparing permits. In addition, the Laboratory, as host organization, must be provided with a copy of the contractor's terminated permit. This copy should be given to the field unit H&S representative for distribution to the appropriate ESH group(s).

6.5 Site Control Measures

The primary site control measures include controlled zones (e.g., exclusion zone, contamination reduction zone, and support zone) and support facilities (e.g., equipment-staging area, support trailer(s), equipment decontamination pad, temporary drum storage area, mobile laboratory, and wash facility). The primary objectives of site control measures during field operations are

- to prevent and limit employee exposures during ER field operations;
- to ensure that only trained and fully informed persons are able to enter controlled areas of the work site, where operational hazards are of potential concern;
- to reduce the likelihood of spread of contamination by workers or equipment into uncontrolled areas of the site;
- to confine work activities to appropriate areas, thereby minimizing the likelihood of accidental exposures; and
- to facilitate the location and evacuation of personnel in case of an emergency.

For purposes of ER work, the DOE has identified the general equivalency of radiologically contaminated areas and hazardous substance contamination zones as shown in Table 3 of the HASP.

The necessary site-specific control measures, some of which are required by applicable DOE and OSHA requirements, shall be provided in Table 5 of the SSHASP. Site maps required by OSHA shall be included in Appendix A of the SSHASP to show the intended locations of the specified controlled zones and support facilities. DOE states (DOE 1994, 1147) that, among other items, site maps should include

- site perimeter;
- direction of prevailing wind;
- site drainage points;
- natural and manmade features such as buildings, containers, impoundments, pits, ponds, and tanks; and
- locations of work zones.

Because some zone or facility locations may change as site work progresses, the site safety officer must explain current locations of zones and decontamination stations to field team members during daily H&S tailgate meetings and shall document these locations in his/her daily logbook.

Section 5 of the SSHASP also shall indicate whether each zone or facility is restricted as a radiological control area, a radioactive materials management area, or a regulated area and whether postings giving this information are required. Furthermore, whether the location of a facility is centralized onsite or localized at multiple work areas onsite, the means for demarcating each zone and other posting requirements [per 29 CFR 1926.200 and 1910.145 (DOL 1994, 1256 and 1257) shall be specified.

6.6 Exposure Monitoring and Responses

Guidance for monitoring and assessing occupational exposure to chemical, biological, physical, and radiological hazards has been provided by the DOE (DOE 1994, 1147; 1148; 1149). According to the DOE, the exposure-monitoring strategy should be developed cooperatively by the following professionals:

- an industrial hygienist who is certified by the American Board of Industrial Hygiene or who is otherwise Board-eligible or who has a minimum of three years' experience developing such strategies; and

- a health physicist who is certified by the American Board of Health Physics or who is otherwise Board-eligible or who has a minimum of three years' experience developing such strategies.

Site-specific exposure-monitoring strategies, including action levels, that meet applicable DOE and OSHA requirements shall be specified in Section 6 of the SSHASP for each project task having different requirements. Exposure-monitoring strategies, including establishment of action levels, should be determined based on the hazards that can be monitored using analytical instrumentation and published exposure limits and physical, chemical, and toxicological properties of the chemical and/or radioactive substances of concern. This information shall be included in Appendix C of the SSHASP for the chemical substances of occupational concern included in Table 4-2 of the SSHASP and is included in the Laboratory's Radiation Control Manual (LANL 1994, 1196) for radiological substances of concern. Guidance for setting action levels for exposure to chemical substances is provided by the DOE (1994, 1148; 1149) and in a publication developed by a member of the American Industrial Hygiene Association Hazardous Waste Committee (Marlowe 1994, 1155). Action levels in Section 6 of the SSHASP for monitoring exposure to radiological hazards have been set by ESH-1, unless otherwise indicated and approved by ESH-1.

Exposure monitoring shall include use of direct-reading instruments, personal dosimetry, and area sampling, as necessary, to evaluate the hazardous conditions posed by chemical and radiological substances onsite. DOE (DOE 1994, 1147) and OSHA (29 CFR 1926.65[b][4][ii][E]) (DOL 1994, 1257) require that the following information be specified in the SSHASP for each type of monitoring instrument to be used for exposure monitoring:

- procedure for calibration, maintenance, and use;
- locations and frequencies of monitoring; and
- corresponding action level(s), response actions, and rationales.

To promote greater consistency among the various ER contractors and field teams, ESH-5 has developed exposure-monitoring methods for the chemical exposure-monitoring instruments most commonly used during ER field operations. These methods are provided in the ER Project's Health and Safety Activities Manual (Environmental Restoration Decommissioning Project 1995, 1258) These methods include procedures and forms for calibration, maintenance, and use of instruments for monitoring exposure to chemicals. When OSHA has mandated methods in the chemical-specific regulatory standards included in Subparts D and Z of 29 CFR 1926 (Section 4.2.2.4 of the HASP), such methods shall be specified in Section 6 of the SSHASP. Project managers who choose to use alternative methods must provide a copy of the methods with the SSHASP for review and approval per Section 6.1.2.

Site health physics personnel shall monitor for alpha and/or beta/gamma radiation, as specified in the SSHASP and in accordance with their individual radiological surveillance authorization agreement and the Laboratory's Radiation Control Manual (LANL 1994, 1196). Health physics personnel shall use radiological instrumentation calibrated and maintained by ESH-4. Subcontractors shall abide by this requirement unless the subcontractor's radiological safety program, which must include identification of instruments and corresponding procedures, has been submitted to the Laboratory for approval during the prebid qualification or contract negotiation period, as required, or according to the applicable requirements of Section 6.4.2.2. All equipment leaving the site shall be monitored for release in accordance with the health physics representative's radiological surveillance authorization agreement.

Requirements for personal dosimetry of radiation exposure shall be determined by ESH-1 and ESH-12 personnel during the review of the draft SSHASP. Guidance for determining site-specific personal dosimetry requirements is provided in the ER Project's Health and Safety Activities Manual.

The results of exposure monitoring must be documented, and affected personnel must be informed of these results in accordance with the requirements of Section 6.13.2. Forms for recording the results of monitoring chemical exposure are included with the respective monitoring instrument method in the ER Project's Health and Safety Activities Manual. Forms for recording monitoring results for radiological exposure are provided in the Laboratory's Radiation Control Manual (LANL 1994, 1196).

Analytical laboratories analyzing samples for chemical contamination should be accredited by the Environmental Protection Agency (EPA) and/or the American Industrial Hygiene Association (AIHA). [Accreditation by the latter organization is necessary for samples collected using OSHA or National Institute for Occupational Safety and Health (NIOSH) methods.] Samples being analyzed for radiological contamination should be analyzed by the Laboratory's health physics analytical laboratory or a mobile extension thereof or as indicated in the contractor's radiological safety program, which has been approved by the Laboratory.

6.7 Personal Protective Equipment

The purpose of personal protective equipment is to shield, isolate, or secure individuals from hazards that may be encountered when administrative or engineering controls are not feasible or cannot provide adequate protection. Accordingly, before requiring field team personnel to use personal protective equipment, appropriate administrative and engineering controls shall be implemented as the first means of defense for mitigating hazards and protecting site personnel.

In accordance with applicable OSHA regulations [Subpart E of 29 CFR 1926 (DOL 1995, 1257) personnel shall not be allowed to use personal protective equipment unless the hazards for which the personal protective equipment are intended to protect against have been assessed and the appropriate personal protective equipment has been specified by a qualified H&S professional. Personal protective equipment requirements must be based on a hazard assessment (Section 6.4.1) that includes a comparative evaluation of site conditions, task-specific operations, potential hazards relative to the performance characteristics of the personal protective equipment items, and anticipated durations of use. Only radiological protective clothing (ANTI-Cs) are to be used at sites contaminated by radiation. Other disposable protective clothing (e.g., Tyvek®) may be used at sites contaminated by mixed (radiological and chemical) wastes. Task-specific personal protective equipment requirements that meet applicable OSHA requirements of Subpart E of 29 CFR 1926 shall be provided in Section 7 of the SSHASP.

Furthermore, personnel who use personal protective equipment to perform a job shall be trained to recognize the limitations of the equipment and to properly select, fit, use, inspect, maintain, and store the equipment. Such training shall occur and be documented before the user enters an area requiring the use of the personal protective equipment. To promote greater consistency among the various ER contractors and field teams and to facilitate compliance with 29 CFR 1926.65(g)(5), ESH-5 has developed a procedure that addresses limitations, selection, fitting, use, inspection, and maintenance of personal protective equipment (ER Project's Health and Safety Activities Manual). When OSHA has mandated methods in the chemical-specific regulatory standards included in Subparts D and Z of 29 CFR 1926 (Section 4.2.2.4 of the HASP), such methods shall be specified, as applicable, in Section 7 of the SSHASP. Personnel who use ANTI-Cs shall have successfully completed Radiological Worker II training (Section 10.4.4 of the HASP).

The level of protective clothing and accessories selected may be upgraded or downgraded based on new findings or change(s) in site conditions or operations. Whenever a significant change occurs, the personal protective equipment requirements shall be reassessed by the site safety officer, and a SSHASP modification form shall be issued, as necessary.

It is the responsibility of the user of personal protective equipment to inspect the equipment before and as necessary during each use. Furthermore, the user should make it a practice not to use personal protective equipment that shows signs of compromised integrity. The site safety officer shall monitor individuals in areas where personal protective equipment is required to ensure that they are properly attired.

6.7.1 Respiratory Protective Equipment

Use of respiratory protection shall occur only in accordance with the requirements of 29 CFR 1910.134, ANSI Z88.2-1992 (ANSI 1992, 1198), the HASP, and SSHASP. When respiratory protective equipment requirements are mandated by OSHA in the chemical-specific standards included in Subparts D and Z of 29 CFR 1926 (Section 4.2.2.4 of the HASP), such requirements shall be specified, as applicable, in Section 7 of the SSHASP. Personnel required to use respirators shall have certification of current training, medical fitness, and respirator fit testing in accordance with these requirements, which are listed below and are summarized in Section 7.1 of the HASP. Contractors whose employees use respiratory protective equipment to perform ER Project work shall provide documentation to support compliance with each aspect of the mandated standards:

- designated qualified person,
- implementation of administrative and engineering controls,
- use of approved equipment,
- SOPs,
- respirator user's medical status,
- training,
- fit testing,
- work area surveillance,
- cleaning and disinfection,
- inspection and repair,
- storage, and
- quality assurance.

Employers of personnel who wear respirators to perform ER Project work shall maintain and implement a current written respiratory protection program, which addresses the requirements described in Section 7.1 of the HASP. A contractor's respiratory protection program shall be submitted to the field unit H&S representative for review and approval by appropriate ESH personnel at least 30 days before the scheduled start date of field operations involving use of the respiratory protective equipment. Whenever air-supplying (Level B) respiratory protection will be used, project-specific SOPs addressing the requirements and procedures for using the Level B equipment shall be submitted similarly for review and approval by appropriate ESH personnel.

6.8 Decontamination

Decontamination involves physically removing contaminants from personnel and equipment and/or chemically converting them into innocuous waste substances.

This section has been developed to meet applicable DOE and OSHA requirements [i.e., those included in 29 CFR 1926.65(k), Subparts D and Z of 29 CFR 1926 (Section 4.2.2.4 of the HASP),å and/or the Laboratory's Radiation Control Manual (LANL 1994, 1196)]. According to the DOE, the contamination reduction zone should include separate designated areas for a personnel contamination reduction corridor and an equipment contamination reduction corridor. The contamination reduction corridor boundaries should be conspicuously marked and should have restricted entry and exit points. Personnel shall decontaminate themselves and any equipment that is contaminated or suspected of being contaminated according to the procedures specified in Section 8 of the SSHASP.

The site safety officer and health physics personnel shall monitor decontamination activities to determine their effectiveness. If procedures are found to be ineffective, these individuals shall take steps to correct any deficiencies and shall document any deviations from the SSHASP using a modification form per Section 6.1.3. The following general requirements apply to personnel and equipment decontamination processes for ER Project work:

- Personnel, equipment, and vehicles must be decontaminated before exiting the contamination reduction zone. Clothing and equipment that cannot be decontaminated sufficiently shall be properly contained and labeled before being transferred beyond the controlled work zones of the site. For sites having only radiological contamination, it is appropriate to first screen for radiological contamination to determine whether decontamination is necessary.

- If any significant contamination is encountered, personal protective equipment should be disposed rather than decontaminated for reuse (Section 8.2.2 of the HASP).

- Loose contaminants (dusts and vapors) that cling to clothing or equipment shall be removed according to the applicable decontamination procedures (e.g., using a water or water-based detergent rinse and scrub brush), except when radiation action levels are exceeded (Section 8.2.3 of the HASP).

- Care should be taken to avoid generating mixed waste during decontamination operations.

- Rinse water and waste generated onsite shall be contained and disposed according to Section 4.2.1.4 of the HASP.

6.8.1 Equipment Decontamination

Samples, sampling equipment, and mechanical equipment shall be decontaminated as specified in the site-specific waste management plan and in "Field Decontamination of Drilling and Sampling Equipment" (LANL-ER-SOP-1.08) or in a comparable procedure specified in Section 8 of the SSHASP.

When a centralized decontamination pad or facility is established for decontaminating heavy equipment (e.g., rigs, augers, loaders), Section 8 of the SSHASP shall specify site-specific procedures for addressing transport of equipment from the site

of investigation to the centralized decontamination facility in a manner that minimizes the potential for or contains the spread of contamination.

6.8.2 Personnel Decontamination

This section was developed to meet the OSHA HAZWOPER requirements of 29 CFR 1926.65(k). It may be adapted in the SSHASP for use in meeting the chemical-specific decontamination requirements of the applicable OSHA standard(s) in Subparts D and Z of 29 CFR 1926 for the substance(s) included in Table 2 of the HASP (Section 4.2.2.4), which appear in Table 4-2 of the SSHASP.

Provided in Appendix D of the HASP are two possible strategies for personal decontamination: standard and extensive. Project managers who choose to use an alternative strategy must incorporate the strategy in the SSHASP for review and approval per Section 6.1.2. Both strategies provided in the HASP include procedures, diagrams of decontamination facilities, and suggested equipment for operations involving use of Levels D, C, and B personal protective equipment. Each of the diagrams is generic because the actual positions and orientations of decontamination stations may vary, depending on day-to-day variations in site operations and conditions. Some of the stations in the standard strategy serve multiple functions, which could be allocated to separate stations, as appropriate, to adjust for day-to-day variations in site operations and conditions. The quantities of equipment listed are those that should be on hand during each day's activities at the site. Because site conditions vary, some sites have more decontamination stations than others; thus, more equipment is necessary at these sites to decontaminate personnel and environmental monitoring equipment effectively.

The following guidelines are provided for determining decontamination strategy requirements for implementation under differing site conditions:

- The standard decontamination strategy (Options 1 through 3 in Appendix D of the HASP) assumes that waste minimization is practiced and should be implemented only when site contamination is relatively low.

- The extensive decontamination strategy (Options 4 through 6 in Appendix D of the HASP) should be implemented on a contingency basis at the discretion of the site safety officer, health physics personnel, and/or ESH-5 or ESH-1. No absolute levels have been set for triggering implementation of the extensive strategy for decontamination; rather, these personnel shall monitor the extent of contamination throughout site operations and shall determine whether the standard strategy is sufficient for existing conditions.

- If there is difficulty in successfully decontaminating personnel, personal protective equipment, or environmental monitoring equipment using the standard decontamination strategy, the extensive strategy should be implemented.

Additional requirements are included in Section 8.2 of the HASP concerning

- decontamination of environmental monitoring equipment,

- disposal versus laundering of personal protective equipment, and

- special procedures for decontamination of radioactively contaminated personal protective equipment and environmental monitoring equipment.

6.9 Emergency and Incident Action Plan

This section describes the generic aspects of the emergency and incident action plan, which apply to all field operations of the ER Project. Site-specific details of this plan and the necessary equipment and supplies to execute this plan shall be included in Section 9 of the SSHASP. Any deviations or exceptions to this section shall be described in Section 9 of the SSHASP.

This section has been developed to meet the requirements of 29 CFR 1926.24 and 1926.65(l), and, as applicable, 29 CFR 1926.65(q) or 1926.35(b). It addresses contingency planning, response actions, and associated personnel and equipment requirements in the event of occurrence of an incident or emergency as defined in this section. DOE and OSHA require that this plan be rehearsed regularly as part of the overall training program for site operations [(29 CFR 1926.65(l)(3)(iv)].

Explanations and definitions for determining the category of an unplanned or uncontrolled event are provided in the ER Project's Health and Safety Activities Manual. For purposes of this section, the term "emergency" is used to refer to unplanned or uncontrolled events, such as

- situations necessitating rescue and/or administration of first-aid and/or CPR by qualified onsite responders per this section;

- situations necessitating fire fighting by qualified onsite responders per this section;

- releases of hazardous substances that cannot be responded to and adequately dealt with by qualified onsite personnel and resources per this section; and

- incidents involving local or adjacent facility operations that may influence field operations.

For purposes of ER field work, the term "incidental release" is used to refer to unplanned or uncontrolled releases of hazardous substances that can be responded to and adequately dealt with by qualified onsite personnel and resources per this section. By this definition, incidental releases are defined as a release of insufficient quantity to pose a significant H&S hazard to field personnel in the immediate vicinity, to field personnel responding defensively, or to the surrounding environment (DOE, no date, 1151). The field team leader, assisted by the site safety officer, shall direct and coordinate responses to incidental releases. These responsibilities include appropriately responding to the situations listed above, safely evacuating onsite personnel, gathering onsite personnel at the designated muster area, notifying emergency contacts, documenting that onsite personnel are accounted for at the muster area, conducting a follow-up investigation, and reporting the incident.

Releases of hazardous substances in sufficient quantity to necessitate a response either by personnel from outside the immediate release area or by other designated responders, such as the fire department or the Laboratory's Hazardous Materials Response Team (HAZMAT) (ESH-10), are considered emergencies (DOE no date, 1151; Smith and Carnes, no date, 1150). In such circumstances, onsite personnel are only allowed to take defensive actions for which they have been trained and are equipped in accordance with this section. For onsite personnel having had first-responder awareness level training (Section 10.1.2.1 of the HASP), such defensive actions are limited to evacuating the site, identifying the nature of the release, isolating and denying entry to the site, and notifying authorities of the release. For onsite personnel having had first-responder operations level training (Section 10.1.2.2 of the HASP), such defensive actions are limited to those of first-responder awareness level training, plus

- preventing exposure,
- keeping the release from spreading, and
- containing the release from a safe distance.

The field team leader, assisted by the site safety officer, shall direct and coordinate responses to emergencies in accordance with this section until offsite emergency responders arrive and implement the Incident Command System. Onsite spills or releases of hazardous substances shall be handled in accordance with applicable requirements of this section and according to an approved site-specific spill prevention control and countermeasures plan prepared in accordance with the Laboratory's Spill Prevention Control and Countermeasures Plan.

6.9.1 Posting Requirements

At the start of field operations, emergency contacts and phone numbers, reporting information, emergency equipment, and maps of the route(s) to the Los Alamos Medical Center and to the Laboratory Occupational Medicine Clinic (ESH-2) shall be posted at a location onsite where personnel may readily access the information. This site-specific information shall be included in Appendix D of the SSHASP.

6.9.2 Emergency Alerting and Site Evacuation Procedures

The field team leader and site safety officer shall determine site-specific emergency alerting procedures, evacuation procedures and routes, and locations of muster areas. This information must be included in Section 9 of the SSHASP and shall be communicated by the site safety officer or field team leader to onsite personnel during the pre-job-start H&S briefing and/or the daily tailgate H&S meetings. The Department of Transportation provides information for determining the extent of and safe distances for evacuation (DOT 1993, 1199), which shall be referenced in Appendix C of the SSHASP for each chemical substance identified in Table 4-2 of the SSHASP. Evacuation routes and muster areas should be predominantly upwind, uphill, and upstream of work areas where fire or release of chemicals or radiological contaminants might occur.

An employee alarm system shall be specified in Section 9 of the SSHASP and shall be established at the work site in accordance with 29 CFR 1926.65(l)(3)(vi) and 1926.159. Section 9 of the SSHASP shall also include means and methods for

alerting contact personnel at adjacent facilities of onsite events that could pose a threat to offsite facilities and for designated personnel at adjacent offsite facilities to alert onsite personnel of events that could pose a threat to onsite personnel or operations. The phone numbers or radio stations of contact personnel at adjacent facilities shall be given in the list of emergency contacts included in Appendix D of the SSHASP.

General procedures for site evacuation are included in Section 9.2 of the HASP, and procedures for onsite responders who are trained and equipped to respond to incidents in accordance with this section are also provided in Section 9.3 of the HASP, including procedures for

- emergency medical treatment and first aid/CPR,
- life-threatening cases,
- other cases,
- exposure to another's blood or body fluids, and
- emergency decontamination of personnel.

6.9.3 Reporting Emergencies and Incidents

The ER/ESH procedure for making notifications in follow-up to an emergency or incident is provided in the ER Project's Health and Safety Activities Manual. Accidents, emergencies, incidents, injuries, and illnesses must be reported to the FPL and/or the field unit H&S representative. In the event of an occurrence necessitating medical care, the field team leader shall arrange for notification of the key personnel listed in Appendix D of the SSHASP (i.e., other line managers, the field unit H&S representative, and the employee's manager) as soon as possible.

6.9.4 Response Critique and Follow-Up

Before normal site activities are resumed, the FPL, or his/her delegate, shall evaluate the incident or emergency to determine

- the cause;
- effectiveness of emergency/incident planning, preparedness, and response;
- how the emergency or incident could have been prevented; and
- considerations for improvements of the emergency/incident response plans.

Points to be considered include whether procedures are adequate and were implemented correctly and in a timely manner. Also, before resuming normal site activities, personnel must be fully trained and equipped to handle another emergency or incident, which requires restocking emergency equipment and supplies and inspecting, testing, and resetting emergency equipment and systems.

6.10 Training Requirements

Described in this section are the DOE, OSHA, and Laboratory worker H&S training requirements applicable to ER field operations. A summary of the training provided by ESH-13 is included in Table 4 of the HASP. In accordance with OSHA's training requirement in 29 CFR 1926.65(e)(1)(ii) (DOL 1994, 1257), field team personnel shall have the necessary training to perform their assigned task(s) and associated responsibilities. Before the field team leader tasks a field team member with performing an ER field duty, the site safety officer shall verify that the field team member has current certifications of required training.

Laboratory employees (including Laboratory contract employees) are eligible to take any courses offered by ESH-13 and BUS-6. ER Project contractors are responsible for implementing their own training programs. With the exception of the Laboratory-specific training described in Section 6.10.4, training offered by ESH-13 is available to ER contractors for a fee upon referral by an FPL. Training offered by BUS-6 is also available to ER contractors for a fee.

6.10.1 HAZWOPER Requirements

6.10.1.1 General Requirements

All employees working onsite exposed to safety hazards, health hazards, or hazardous substances and their supervisors and managers responsible for the site shall receive training that meets the requirements of Section 10 of the HASP before they are permitted to engage in HAZWOPER work. Employees are not permitted to participate in or supervise ER field activities until they have been trained at the level required by their job function and responsibility.

Employees and supervisors who have successfully completed the training and field experience requirements of Section 10.1.1 of the HASP shall be certified by their instructor, or the head instructor and trained supervisor, as having successfully completed the necessary training. OSHA requires that a written certificate be given to each person so certified.

Trainers shall be qualified to instruct employees about the subject matter that they are presenting. Trainers shall have the academic credentials and instructional experience necessary for teaching the subject(s) or shall have completed a training program for teaching the subject(s). Instructors shall demonstrate competent instructional skills and knowledge of the subject matter.

Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to the training requirements of Section 10.1.1 of the HASP shall not be required to provide the initial training requirements of Sections 10.1.1.1 or 10.1.1.2 of the HASP. They shall certify this equivalency and provide a copy of this certificate to the employee.

Anyone who has not been certified in accordance with Section 10.1.1 of the HASP is prohibited from engaging in ER field activities. The general HAZWOPER training requirements described in Section 10.1.1 of the HASP include

- worker training and supervised field work for periods determined by expected exposure:

- initial 40 hours of training and 24 hours of supervised field work (for areas in which contaminant concentrations may exceed exposure limits) or

- initial 24 hours of training and 8 hours of supervised field work (for areas in which contaminant concentrations are not expected to exceed exposure limits),

- management and supervisor training,
- annual refresher training,
- site safety officer requirements,
- industrial hygiene technician requirements, and
- health physics personnel requirements.

6.10.1.2 Emergency Response Training

If a project manager chooses to have onsite personnel take any action other than immediate evacuation of the site in the event of a release or substantial threat of release of a hazardous substance, onsite personnel must receive the training described in Section 10.1.2 of the HASP as applicable for the tasks to be performed. The training categories include first-responder awareness level training and first-responder operations level training. OSHA requires that personnel who have been trained in accordance with this section receive annual refresher training of sufficient content and duration to maintain their competencies or demonstrate their competency at least yearly.

6.10.1.3 Pre-Job-Start H&S Briefing

In accordance with 29 CFR 1926.65(b)(4)(iii), the site safety officer shall conduct training on the contents of the SSHASP before field work begins so that each field team member is informed of the site-specific information and requirements applicable to the scope of work. This H&S briefing shall cover the contents of the SSHASP and applicable portions of the HASP.

6.10.1.4 Daily Tailgate H&S Meetings

Before beginning field work each day, the site safety officer and field team leader shall conduct a tailgate H&S meeting. Field team members should be encouraged to discuss any health- or safety-related concerns during this meeting without fear of reprisal. Topics covered and attendance shall be documented. During these tailgate meetings, field team members shall be informed of at least the following:

- any newly identified hazards and associated monitoring and exposure control measures and results not discussed previously and

- problems or concerns (especially H&S) that have arisen since the previous tailgate meeting.

6.10.2 First-Aid Requirements

In accordance with 29 CFR 1926.50, in the absence of a hospital or clinic that is reasonably accessible in terms of time and distance to the work site (i.e., capable of rendering treatment within 4 min of occurrence of the injury or illness), a person who has a valid certificate in first-aid training from the American Red Cross, or equivalent, shall be available at the work site to render first aid. Section 9.3.1 of the HASP contains more detailed information concerning first aid.

6.10.3 Other OSHA Requirements

OSHA has numerous other standards and associated training requirements applicable to ER work. Some of these requirements apply at a programmatic level and are addressed in Section 6.4.2.2. Other training requirements apply to specific individuals who are either a competent person or a qualified person in the subject matter pertaining to their job function (Section 6.3.2.3.5), as defined by OSHA [29 CFR 1926.32(f) and (m)], respectively, and/or as defined by applicable operation- or substance-specific standards (29 CFR 1926 and/or 1910), which are cited throughout the HASP and the SSHASP. Examples of these types of training are those for confined-space entry, lockout/tagout of energized equipment, electrical safety, trenching and excavation, respiratory protection, bloodborne pathogen exposure control, etc.

Site-specific training requirements that meet the requirements of this section are dictated by the operations and conditions occurring onsite and shall be specified in Section 10 of the SSHASP or in a modification form to the SSHASP as the requirement arises.

6.10.4 Laboratory-Specific Requirements

The Laboratory has certain training requirements that are applicable to personnel who perform work for the Laboratory, which are described in Section 10.4 of the HASP and include

- general employee training,
- health and safety read training,
- health physics checklist indoctrination,
- Radiological Worker II training, and
- waste generator and waste management training.

6.11 Medical Surveillance

Before the field team leader authorizes access to areas of the site where site controls have been established (e.g., exclusion and contamination reduction zones and other regulated areas), it is the responsibility of the site safety officer to verify that personnel entering such areas have a current certification of medical fitness for duty (Appendix E of the HASP) in accordance with this section. The site-specific medical

surveillance requirements that meet applicable OSHA regulations and DOE requirements shall be specified in Section 11 of the SSHASP.

A written medical surveillance program that complies with the requirements of this section shall be implemented by employers of personnel working for the ER Project. These requirements include

- identification of active participants in the employer's medical surveillance program,
- cost and frequency of examinations,
- content of examinations,
- information to be provided to the examining physician, and
- information to be obtained from the physician, including a form provided in Appendix E of the HASP.

6.12 Quality Control and Quality Assurance Plan

6.12.1 Site Inspections

According to DOE Order 5480.9A (DOE 1994, 1153), the construction contractor shall conduct daily inspections of the work site to identify hazards and instances of noncompliance with project H&S requirements. The construction contractor responsible for this duty is the prime ER contractor or, when a prime is not involved, the contractor performing the work. The field team manager, serving as the construction manager (as defined in DOE 5480.9A and Section 6.3.2.1.2), shall conduct work site H&S inspections on at least a weekly basis. The FPL, serving as the project manager (as defined in DOE 5480.9A and Section 6.3.2.1.1), shall conduct inspections of his/her ER projects exceeding $500,000 on at least a monthly basis during periods of active construction. For projects under $500,000, the FPL shall develop and implement an inspection schedule that ensures that a representative sample of ongoing projects is inspected on at least a monthly basis.

Records of inspections noting any hazards and the corrective actions taken shall be kept. Section 12 of the SSHASP specifies the site-specific inspections to be performed by the site safety officer or other designated person and the frequency of inspections.

6.12.2 ER/H&S Oversight Program

In accordance with the record-keeping requirements of Section 6.13, ER participants shall provide access to and/or furnish to the Laboratory all documentation necessary to verify compliance with requirements of the HASP, SSHASP, or any applicable law or regulation. This support shall include maintenance of appropriate H&S records at the site as required by the HASP, SSHASP, or any applicable regulatory requirement or as deemed necessary by the FPL or field unit H&S representative.

ER participants shall support an initial programmatic verification and periodic in-process verifications of compliance with applicable requirements. The initial

programmatic verification will consist of a review of the applicable SSHASP document, including any necessary supplements [such as individual verification records for (training, medical)] and employer's program or procedure documents that verify the existence of and compliance with applicable requirements. The periodic in-process verifications, which will be conducted by the Laboratory, will include verification of ER participants' records that demonstrate compliance with the requirements of the HASP, SSHASP, and applicable regulations. These inspections will be conducted primarily at the field sites but may involve the requirement to furnish current documentation not present at the field site.

Inspections may be conducted by the FPL, his/her delegate, and/or representatives of the ESH Division. It is also expected that occasional verification by the Laboratory's Audits & Assessments Branch or the DOE may be required. The results of these inspections will be in writing and will be submitted to the Laboratory performance fee evaluation team and to appropriate Laboratory management personnel. A copy of the results will also be furnished to the affected employer(s) for resolution of discrepancies, if any.

If during the course of verification a circumstance is discovered that presents a threat of serious injury or death, notice will be promptly provided to the affected onsite supervisor and to the field team leader for action as directed in Section 6.3.4.

6.13 Record Keeping

6.13.1 Site Records

The site safety officer shall keep a daily record of H&S-related events in a bound logbook and shall verify employee training and medical surveillance records in accordance with Section 6.3.2.3.1 of the HASP. Health physics personnel shall keep records of health-physics-related events in accordance with the requirements of their radiological surveillance authorization agreement (Section 6.3.2.4). Records of all training must be maintained and available for oversight review. Site records shall be provided to the field team manager at the close of the project, who will provide them to the FPL for storage at the RPF.

6.13.2 Employee Exposure and Medical Records

Employers must retain exposure-monitoring and medical records for their employees who work on the ER Project in accordance with OSHA's standard [29 CFR 1926.33 (DOL 1994, 1257] for access to employee exposure and medical records. Medical records shall not include examination or test results but shall include the employee's name and social security number, the physician's written opinion (Section 6.11) and recommended limitations, any medical complaints related to exposure of hazardous substances, and a copy of the information provided to the examining physician by the employer (not including a copy of the OSHA standard).

Records shall be retained in accordance with the following requirements, as well as any other applicable requirements:

- To the extent permitted by law, the employer shall maintain and keep in confidence records for each employee.

- The employer shall maintain medical records for each employee for the duration of employment plus 30 years (except health insurance claims records maintained separately from the employer's medical surveillance program records, first-aid records of one-time treatments, and medical records of employees who have worked for the employer for less than 1 year and who have seen the records before termination).

- The employer shall maintain exposure records for each employee monitored per Table 6-2 of the SSHASP for 30 years.

- The employer shall ensure that each employee, upon his/her request, has access to his/her records.

- At an employee's written request, the employer shall ensure that the employee's designee has access to the employee's record(s). A sample consent form is provided in Appendix A of 29 CFR 1926.33 (DOL 1994, 1257).

- Whenever an employee or his/her designated representative requests access to an employee record, the employer shall ensure that access is provided in a reasonable time and manner. If the employer cannot provide access to the record(s) within 15 working days, before the 15th working day following the request for access, the employer shall apprise the requester of the reason for the delay and the earliest date the record(s) can be made available.

- Whenever an employee, or his/her designated representative, requests a copy of a record, the employer shall ensure that either

  - a copy of the record is provided without cost to the requester,

  - the necessary copying equipment is made available with out cost to the requester for the purpose of copying the record, or

  - the record is lent to the requester for a reasonable time to enable a copy to be made.

- Once a record has been provided without cost to the requester, the employer may charge a reasonable, nondiscriminatory administrative cost for subsequent copies of the record. However, an employer shall not charge for an initial request for a copy of new information that has been added to a record which was previously provided.

For purposes of follow-up investigation of an accident or incident, the employee's consent for the investigator(s) to access his/her records shall be obtained in accordance with 29 CFR 1926.33 (DOL 1994, 1257).

6.13.3 Employee Notification Procedure

In accordance with 29 CFR 1926.33 (DOL 1994 1257), the site safety officer is required to report dosimetry data to each monitored employee, using the form provided in the ER Project's Health and Safety Activities Manual. The form must be reviewed and acknowledged by each affected employee. The site safety officer shall provide a copy of the notification form to the subject employee and to his/her supervisor. These records shall be maintained in confidence in accordance with the requirements of Section 6.13.2. The original form shall be retained with other original site records. When it is necessary to communicate the results of exposure monitoring to others, it shall be done in a manner that does not identify the monitored employee.

This confidentiality also precludes discussing affected onsite personnel during daily tailgate meetings following receipt and evaluation of the results.

6.13.4 Emergency/Incident Records

Records of emergency or incident reports and follow-up investigations shall be processed as specified in Section 6.9.4.

References for Chapter 6

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7.0 PUBLIC INVOLVEMENT PLAN

7.1 Introduction

7.1.1 Role of Public Involvement in the Environmental Restoration Project

Under the Hazardous and Solid Waste Amendments (HSWA) portion (the HSWA Module) of Los Alamos National Laboratory's (Laboratory's) permit to operate under the Resource Conservation and Recovery Act (RCRA), the Environmental Restoration (ER) Project must adopt a community relations plan. The first edition of the project's Installation Work Plan (IWP) (LANL 1990, 0144) included the original plan. That plan has evolved into a public involvement plan, which emphasizes early public participation in developing recommendations for ER activities.

The project recognizes that the advantages of early public involvement include the potential for (1) making decisions that satisfy both the public and the organizations responsible for implementing those decisions, (2) avoiding delays resulting from public challenges to decisions made without adequate public involvement, and (3) achieving cost savings that result from making better initial decisions and avoiding delays. The current plan (Section 7.2) describes the new approach in detail.

7.1.2 The Laboratory's Current Approach to Public Involvement

7.1.2.1 Community Involvement and Outreach Office

Late in 1993, the Laboratory established a Stakeholder Involvement Office (SIO). The purpose of this office was to "coordinate and manage stakeholder involvement functions for all Laboratory activities that have significant technical or environment, safety, and health content, assuring quality control and providing direction and communication training as appropriate" (Jackson 1993, 1176). SIO established its basic program in 1994, and its initial activities are described in the 1994 IWP (LANL 1995, 1164).

On July 31, 1995, in a continuing effort to hone its approach to stakeholder involvement, the Laboratory combined an outreach element from the Public Affairs Office with SIO and changed the name to Community Involvement and Outreach Office (CIO). Effective October 1, 1995, the public involvement staff in the Environmental Management Program Office were also transferred to CIO, thus locating all of the Laboratory's public involvement efforts in a single office.

7.1.2.2 Related Activities of Other Laboratory Organizations

7.1.2.2.1 Future Site Use Planning and Integration

A related Laboratory effort that will directly affect ER Project planning for cleanup decisions is that of planning future uses of Laboratory lands. In 1994, the Los Alamos Area Office of DOE and the Laboratory undertook a joint initiative called the Future Site Use Planning Initiative and appointed a team to coordinate site, facilities, environmental, and strategic planning. The goals of future site use planning are to

- identify land and facilities needed for current and future missions of the Laboratory;
- identify opportunities for leasing or transferring surplus land and facilities to other federal agencies; tribal, state, and local governments; and the private sector; and
- provide opportunities for meaningful stakeholder involvement in these plans.

By December 1995, the integration team must deliver to DOE a report that states the team's recommendations for future site use at the Laboratory.

7.1.2.2.2 Other Related Activities

The Laboratory and DOE are undertaking a number of other public involvement activities that have some bearing on the ER Project. These include the creation in the late summer of 1995 a Citizens' Advisory Board to advise DOE and the Laboratory on a wide range of issues, including development of a sitewide environmental impact statement for the Laboratory, environmental monitoring and compliance, and groundwater protection. The board is currently developing a mission statement. Any comments pertaining to the ER Project that are received during public events related to these activities will be forwarded to the ER Project for consideration.

7.1.2.3 Community Reading Room and Public Information Repositories

The Laboratory's Community Reading Room is located in downtown Los Alamos at 1350 Central Avenue (phone: 505-665-2127). The reading room is a repository for documents about the Laboratory's activities that are of interest to the public, including documents pertaining to the ER Project. In addition, the ER Project provides its work plans and reports and other key documents to information repositories located in the main libraries in Los Alamos, Española, Santa Fe, and in the office of the governor at San Ildefonso Pueblo.

7.1.3 ER Project's Current Approach to Public Involvement

In 1993, the DOE, Laboratory, and ER Project created a working group to look at ways of increasing public participation in the ER Project. In February 1994, the working group invited members of the public to brainstorm informally about ways of obtaining more effective public participation. Out of that meeting came three important suggestions: (1) The project needs to involve the public in a dialogue instead of just handing out information at public meetings and asking for public comment on "finished drafts." (2) The project should avoid reinventing the wheel by reviewing public involvement efforts at other sites around the country. (3) The project should conduct a pilot project as a way of developing more effective public participation. The following sections describe how the project has responded.

In developing a broader approach to public participation, ER Project personnel went out to the northern New Mexico community to obtain information for planning purposes and to begin a dialogue. Teams of ER technical staff and experienced

interviewers went into the community to listen and respond to the public. In response to the question, "Tell us what you think are the most important things to be considered in setting up an effective public participation process," interviewees offered many thoughtful suggestions:

- make information easily readable (avoid jargon),
- go out into the communities to present information at informal meetings (for example, at meetings of existing community groups),
- make public involvement efforts consistent throughout the Laboratory,
- include the public in the decision-making process by providing more opportunities for interactions with decision makers and technical personnel,
- show ER work in progress (through site tours, for example), and
- be sensitive to ethnic and cultural concerns.

Interviewees' major issues and concerns included

- trust, honesty, and openness;
- positive economic impact of the Laboratory on northern New Mexico;
- environmental health concerns;
- effective public participation in environmental restoration;
- impacts of the Laboratory on the community's social structure and culture;
- cleanup issues; and
- awareness and knowledge of the ER Project.

The ER Project believes that the interviews resulted in a genuine dialogue and began the process of building personal relationships between Laboratory employees and the public. Reactions from both the community and the interviewers supported the decision to involve technical people in the interview process.

A review of public involvement programs at other sites around the country [Appendix B of the draft plan (Working Group and Lefkoff 1995, 1174)] reveals strong and consistent guiding principles, which correspond closely to comments received during the interviews of June and July 1994. Some of the principles gleaned from this review are summarized below:

- In building public trust, the facility must reach out to groups and individuals outside those who have histori-

cally taken the initiative to become involved in issues affecting the facility.

- Meaningful, interactive dialogue must replace traditional presentation formats and one-way information giving.
- Interested groups and individuals must be involved in the decision-making process early enough to allow decision makers to amend, modify, and/or develop decisions that reflect public input.
- Involving the public in decision making must be a positive, long-term way of doing business.

The ER Project developed the plan's philosophy, direction, and activities with an eye to the concerns expressed during the interviews and at a roundtable discussion held in February of 1995. The goals of the public participation plan are to

- broaden the base of involved individuals and groups beyond those previously involved in the ER Project,
- begin to build trust by focusing on personal contact, dialogue, and mutual education;
- obtain meaningful public input in decisions regarding cleanup issues; and
- learn a better, more cost-effective way of involving the public early in the ER Project.

The specific objectives of the public participation plan are to

- give the public the information it needs to understand ER cleanup issues and provide informed input;
- make information readily available to the public;
- increase contacts with the public in ways that encourage interaction, such as establishing dialogues with members of community organizations, chambers of commerce and church groups, as well as Laboratory employees outside the ER Project;
- involve the public in the cleanup process before decisions are made;
- treat the public as equals;
- ask for assistance from community members and use them as experts on their communities' concerns;
- coordinate public involvement activities for the ER Project with other related land use activities,

- develop alternatives for determining cleanup levels and site prioritization, and
- evaluate the effectiveness and efficiency of public participation activities.

The methods described in the draft plan for improving communication and trust during current activities will continue and expand with experience as the project moves through the corrective action process.

7.2 The ER Project's Public Involvement Plan

The regulatory process requires the ER Project to investigate a site, analyze the data, and then, based on the analysis, develop recommendations. These recommendations include cleanup actions and recommendations for no further action (Chapter 3). Factors in cleanup decisions include the amounts and kinds of waste to be cleaned up, the types of technologies to be used, public concerns, and the desired degree of cleanup. Cleanup actions may themselves disturb the environment and will produce wastes. Tax dollars spent in cleanup must also be considered. The ER Project needs the public's help in weighing these factors for cleanup decisions. The HSWA Module provides a staggered schedule for cleaning up contaminated sites at the Laboratory; thus, not all of the sites are in the same stage in the cleanup process.

The ER Project will provide the public with a variety of opportunities to personally observe and discuss issues as cleanup progresses. To improve its dialogue with the community, the project has replaced formal meetings, except when required by regulation, with less formal meetings with community members, such as round table discussions, site tours, and invitations to speak with interested groups and citizens. During these activities, the ER Project makes technical staff available to discuss the history and background of the potential release sites (PRSs) that are the subject of the activity, to describe the sampling and the data obtained on PRSs of interest, and to describe the risk assessment process and its relationship to various alternatives. As required by regulation, some of these meetings are held for the purpose of obtaining public comments and recommendations on certain proposed actions, which involve modifying the HSWA Module. Comments obtained at such meetings are forwarded to EPA for consideration in deciding whether to accept the project's proposals.

As recommendations for PRS actions are developed, ER Project personnel will discuss with the public the ramifications of cleanup to residential, recreational, and industrial standards. With the public's involvement, the ER Project will prioritize PRSs and discuss appropriate cleanup standards. Volunteers are being sought for in-depth discussions.

The sections below provide descriptions of the specific activities proposed for use in implementing this public participation plan.

7.2.1 Preparing Information on the ER Project

The project is preparing a variety of materials for the northern New Mexico community, including the public schools. The materials consist of newsletters, progress reports, and information sheets that include history when appropriate, site

maps, information about potential contamination, and cleanup alternatives such as no further action and accelerated cleanups. The project will attempt to make information sheets sensitive to cultural issues and will solicit comments from the public to make sure their concerns have been addressed. The project will also prepare informal handouts for tours. Information sheets and similar printed materials are translated into Spanish. If the pueblos indicate a desire for an oral translation, the project will arrange for presentations in pueblo languages. The project is currently developing a public involvement home page on the Worldwide Web through which the public can access such items as selected maps, the quarterly newsletter, information sheets, and public notices. The home page will also include an interactive question-and-answer module.

7.2.2 Dissemination of Information

The major objective of all information dissemination is to familiarize the public with the ER Project so that citizens may participate knowledgeably. To improve its ability to reach all interested parties, the project will continue to develop and maintain a contact list. Anyone who desires information about the ER Project may call, toll-free, 1-800-575-8301 to get a response from someone involved in the project. This number is published in many places.

7.2.3 Community Meetings

The project will continue to solicit invitations from community groups to attend their meetings for the purpose of sharing information and discussing the ER Project and public participation in the project, targeting such groups as traditional clubs, acequia associations, land associations, coops, Laboratory employees, and church groups. The primary goals of these meetings are personal engagement and informal group dialogue. Ideally, a two-person team consisting of a technical representative of the ER Project and an individual from the public affiliated with the community group being visited will attend these meetings. Selected Laboratory specialists also attend, as appropriate. Participants are asked to suggest other stakeholders who might be interested in participating.

7.2.4 Tours of Environmental Restoration Sites

Tours help acquaint the public with the ER Project and specific PRSs as these PRSs are addressed throughout the corrective action process. Times convenient for the public are a primary consideration in scheduling these tours. Written information supplements the discussions during the tours. These tours are open to all members of the public interested in ER Project activities. Tour participants are asked if they would like to volunteer for further involvement in ER Project activities. To guide future planning and to aid in evaluation, the project records concerns and suggestions.

7.2.5 Education Programs

ER Project staff continues to be available to visit schools and to help teachers who request assistance in developing class projects that promote students' understanding of and involvement in the ER Project. Such assistance has been enthusiastically received in the past. The project will work with the Laboratory's Science Education

and Outreach Group to develop programs for students and to provide support for existing efforts that focus on ER-related activities.

7.2.6 Public Input to Recommendations for Cleanup

Throughout the public participation process, the ER Project will ask people whether they would like to participate more actively in developing recommendations for cleanup decisions and will invite such people to working meetings for this purpose. If there is a large response, the project will work with all volunteers to develop a fair mechanism for selecting a workable number of participants. The documentation of this process will be sent to EPA.

References for Chapter 7

DOE (US Department of Energy), November 6, 1994. "Public Participation Desk Reference: Policy, Guidance and Headquarters Implementation Plan," Environmental Management, Washington, DC. (DOE 1994, 1175)

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Jackson, J. F., November 10, 1993. "Establishment of Stakeholder Involvement Office, Los Alamos National Laboratory memorandum to master management, Los Alamos, New Mexico. (Jackson 1993, 1176)

LANL (Los Alamos National Laboratory), November 1990. "Installation Work Plan for Environmental Restoration," Los Alamos National Laboratory Report LA-UR-90-3825, Los Alamos, New Mexico. (LANL 1990, 0144)

Working Group and Lefkoff (Working Group for Public Participation in Cleanup Decisions and Merle Lefkoff and Associates), 1995. "Plan for Increasing Public Participation in Cleanup Decisions for the Los Alamos National Laboratory," Environmental Restoration Project, Los Alamos National Laboratory, Los Alamos, New Mexico. (Working Group and Lefkoff 1995, 1174)

DESCRIPTIONS OF TECHNICAL AREAS AT LOS ALAMOS NATIONAL LABORATORY

The locations of the 49 technical areas (TAs) operated by Los Alamos National Laboratory (the Laboratory) in Los Alamos County are shown in Chapter 2, Figure 2-2. The main programs conducted at each of the active, developed areas are listed in this appendix.

TA-2, Omega Site

The Omega West Reactor, an 8-MW nuclear research reactor, is located at TA-2. The reactor has provided neutrons for fundamental studies in nuclear physics and associated fields.

TA-3, South Mesa Site

The main technical area of the Laboratory, TA-3 includes the Administration Building in which the Director's office and other administrative offices and laboratories for several divisions are located. Other buildings house the central computing facility, administrative offices, materials division, chemistry and materials science laboratories, physics laboratories, technical shops, cryogenics laboratories, a Van de Graaff accelerator, and the main cafeteria.

TA-6, Two-Mile Mesa South Site

Two-Mile Mesa Site is one of three sites (TA-22 and TA-40 are the other two) used in the development of special detonators to initiate high-explosive systems. Fundamental and applied research conducted at this site includes investigating phenomena associated with initiating high explosives and research in rapid shock-induced reactions.

TA-8, GT Site (or Anchor Site West)

Nondestructive testing is conducted at this site for the entire Laboratory. The test facilities maintain capability in all modern nondestructive testing techniques to ensure the quality of material ranging from test weapons components to high-pressure dies and molds. The principal activities involve radiographic techniques (using x-ray machines to 1,000,000 V and a 24-MeV betatron), radioactive isotope techniques, ultrasonic and penetrant testing, and electromagnetic test methods.

TA-9, Anchor Site East

At this site, the physical properties and feasibility of fabricating explosives are explored, and new organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.

TA-11, K Site

The facilities at this site test explosive components and systems under a variety of extreme physical environments. The facilities are arranged so that testing may be controlled and observed remotely and so that devices containing explosives or radioactive materials, as well as those containing nonhazardous materials, may be tested.

TA-14, Q Site

This firing site is used for running various tests on relatively small explosive charges and for determining the impact of fragments.

TA-15, R Site

This site is the home of PHERMEX, a multiple-cavity electron accelerator capable of producing a very large flux of x-rays for certain weapons development problems and tests. The site is also used for investigating how weapons function and systems behave in nonnuclear tests, principally by electronic recording means.

TA-16, S Site

The facilities at this site house the development, engineering design, pilot production, and environmental testing of nuclear weapons warhead systems. Other functions include stockpile production liaison; development and testing of high explosives, plastics, and adhesives; and research on process development for manufacture of items using these and other materials.

TA-18, Pajarito Laboratory Site

The fundamental behavior of nuclear chain reactions with simple, low-power reactors called critical assemblies is studied here in buildings known as kivas. Experiments are operated by remote control and are observed by closed-circuit television. The reactors are used primarily to provide a controlled means of assembling a critical amount of fissionable materials to study the effects of various shapes, sizes, and configurations. The assemblies are also used to produce large quantities of fission neutrons for experimental purposes.

TA-21, DP Site

This site has two primary research areas: DP-West, a chemistry research facility, and DP-East, a research site for high-temperature chemistry and tritium.

TA-22, TD Site

See TA-6.

TA-28, Magazine Area A

The Laboratory uses this site as one of two storage areas for explosives.

TA-33, HP Site

A major high-pressure tritium-handling facility is located at HP Site. Laboratory and office space for the Geosciences Division's hot dry rock geothermal project is also located at this site.

TA-35, Ten Site

Nuclear safeguards research and development conducted here are concerned with nondestructive techniques for detecting, identifying, and analyzing fissionable isotopes. Research in reactor safety and laser fusion also occurs at this site.

TA-36, Kappa Site

Various explosive phenomena, such as detonation velocity, are investigated at Kappa Site.

TA-37, Magazine Area C

See TA-28.

TA-39, Ancho Canyon Site

Nonnuclear weapons behavior is studied here, primarily by photographic techniques. Various phenomenological aspects of explosives, interactions of explosives, and explosions involving other materials are also investigated at this site.

TA-40, DF Site

See TA-6.

TA-41, W Site

Personnel at this site are engaged primarily in engineering design and development of nuclear components, including fabrications and evaluation of test materials for weapons.

TA-43, Health Research Laboratory

The Biomedical Research Group does research here in cellular radiobiology, biophysics, mammalian radiobiology, and mammalian metabolism. A large medical library, special counters used to measure radioactivity in humans and animals, and quarters for dogs, mice, and monkeys are also located in this building.

TA-46, WA Site

Applications for photochemistry, which include development of technology for laser isotope separation and laser enhancement of chemical processes, are investigated here. Solar energy research, particularly in the area of passive solar heating for residences, also occurs at this site.

TA-48, Radiochemistry Site

Using analytical and physical chemistry, scientists and technicians at this site study the nuclear properties of radioactive materials. Radioactive substances are measured in hot cells, which permit remote handling of radioactive materials.

TA-49, Frijoles Mesa

Frijoles Mesa has been used primarily as the site of underground hydronuclear experiments, conducted in 1960 and 1961, and as a buffer zone for nearby firing sites. The site is currently used for high-power microwave research and for training the Laboratory's hazardous devices team.

TA-50, Waste Management Site

Personnel at this site have responsibility for treating and disposing of most industrial liquid waste received from Laboratory technical areas, for developing improved methods of solid waste treatment, and for containing the radioactive materials removed by treatment. Radioactive liquid waste from most technical areas is piped to this site for treatment.

TA-51, Environmental Research Site

Experiments conducted at this facility explore waste cover and stabilization alternatives, land reclamation, contaminant movement, and ecology.

TA-52, Reactor Development Site

A wide variety of activities related to nuclear reactor performance and safety is conducted at this site.

TA-53, Meson Physics Facility

The Los Alamos Meson Physics Facility, a linear particle accelerator, is used to conduct research in areas of basic physics, cancer treatment, materials studies, and isotope production. The Los Alamos Neutron Scattering Center and the proton storage ring are also located on this site.

TA-54, Waste Disposal Site

Solid radioactive and other wastes that meet regulatory acceptance criteria are disposed at this site.

TA-55, Plutonium-Processing Facilities

These facilities process plutonium and house research in plutonium metallurgy.

TA-57, Fenton Hill Site

The Laboratory's hot dry rock geothermal project is located at Fenton Hill, where scientists have studied the possibility of producing energy by circulating water through hot, dry rock located hundreds of meters below the earth's surface. After the water is heated, it is brought to the surface to drive electric generators.

TA-59, Environment, Safety, and Health Site

Occupational health and environmental science activities are conducted at this site.

TA-60, East Jemez Road

This area contains physical support facilities for the Laboratory, including the existing landfill.

TA-63, Pajarito Road Service Site

This area contains physical support facilities operated by Johnson Controls, Inc.

TA-74, Los Alamos Airport

This area contains the DOE-owned airport that serves the Laboratory.

Potential Release Sites at Los Alamos National Laboratory

OU 1071

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
0-003	0	Yes	Container storage, Western Steam Plant	None
0-004	0	No	Container storage, 6th St. Warehouses	None
0-004	0	No	Container storage, 6th St. Warehouses	None
0-005	0	Yes	Landfill	None
0-008	0	No	Surface disposal site	None
0-010(a)	0	No	Surface disposal site	None
0-010(b)	0	No	Surface disposal site, 6th St. Warehouses	None
0-011(a)	0	Yes	Mortar impact area	Haz
0-011(c)	0	Yes	Mortar impact area	None
0-011(d)	0	Yes	Mortar impact area	Haz
0-011(e)	0	Yes	Mortar impact area	Haz
0-012	0	Yes	Underground tank, Western Steam Plant	None
0-015	0	No	Firing range, Rendija Canyon	None
0-016	0	Yes	Firing range	Haz
0-017	0	Yes	Waste lines	Rad, Haz
0-018(a)	0	Yes	Wastewater treatment plant Pueblo	Rad, Haz
0-018(b)	0	No	Wastewater treatment plant Bayo	None

OU 1071

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
0-019	0	Yes	Wastewater treatment plant, Central	None
0-024	0	No	Cistern	None
0-025	0	No	Landfill	None
0-026	0	No	Landfill	None
0-027	0	No	Storage area, DP Road	None
0-028(a)	0	Yes	Effluent discharge, golf course	None
0-028(b)	0	Yes	Effluent discharge, ball fields	None
0-029(a)	0	No	Transformer	None
0-029(b)	0	No	Transformer	None
0-029(c)	0	No	Transformer	None
0-030(a)	0	Yes	Septic system, DP Road	None
0-030(b)	0	Yes	Septic system 6th St	Rad, Haz
0-030(c)	0	No	Septic system	Haz
0-030(d)	0	No	Septic system	None
0-030(e)N	0	No	Septic system	Haz
0-030(e)S	0	No	Septic system	Haz
0-030(f)	0	No	Septic system	Haz

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
0-030(g)	0	Yes	Septic system	Rad
0-030(h)	0	No	Septic system	Rad
0-030(i)	0	No	Septic system	Haz
0-030(j)	0	No	Septic system	None
0-030(k)	0	No	Septic system	Rad
0-030(l)	0	Yes	Septic system, 6th St. Warehouses	Haz
0-030(m)	0	Yes	Septic system, 6th St. Warehouses	Haz
0-030(n)	0	No	Septic system	None
0-030(o)	0	No	Septic system	None
0-030(p)	0	No	Septic system	None
0-030(q)	0	No	Septic system	None
0-031(a)	0	No	Soil contamination beneath former service station	None
0-031(b)	0	No	Soil contamination beneath former motorpool (Two USTs)	Haz
0-032	0	No	Soil contamination beneath former motorpool (UST for used motor oil)	None
0-033	0	Yes	Warehouses, 6th Street (UST removal)	None
0-034(a)	0	No	Landfill, Eastern Area	None
0-034(b)	0	No	Landfill, Western Area	None

OU 1071

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
0-035(a)	0	No	Surface disposal	None
0-039	0	yes	Underground tanks	Haz
0-040	0	No	Underground tank	Haz
C-0-020	0	No	Mortar impact area	None
C-0-036(a)	0	No	Borrow pit 1, Bandelier NM	None
C-0-036(b)	0	No	Borrow pit 2, Bandelier NM	
C-0-036(c)	0	No	Borrow pit 3, Bandelier NM	None
C-0-036(d)	0	No	Borrow pit 4, Bandelier NM	None
C-0-037	0	No	Landfill, Bandelier NM	None
C-0-038	0	No	Surface disposal, Bandelier NM	None
C-0-041	0	No	Asphalt and tar remnant site	
19-001	19	Yes	Septic system	Haz
19-002	19	Yes	Surface disposal site	None
19-003	19	Yes	Septic tank	None
C-19-001	19	No	Soil contamination	None
26-001	26	Yes	Surface disposal site	None
26-002(a)	26	Yes	Tank and/or assoc. equip.	Rad, Haz

OU 1071

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
26-002(b)	26	Yes	Ind. or san. waste water treat.	Rad, Haz
26-003	26	Yes	Septic tank	Rad, Haz
73-001(a)	73	Yes	Landfill	Rad, Haz, HE, other
73-001(b)	73	Yes	Surface disposal site	None
73-001(c)	73	Yes	Landfill	None
73-001(d)	73	Yes	Landfill	None
73-002	73	Yes	Incinerator surface disposal	None
73-003	73	No	Steam cleaning plant	None
73-004(a)	73	Yes	Septic tank	None
73-004(b)	73	Yes	Septic tank	None
73-004(c)	73	Yes	Septic tank	None
73-004(d)	73	Yes	Septic tank	None
73-005	73	Yes	Surface disposal site	None
73-006	73	Yes	Airport building outfalls	None
C-73-001	73	No	Underground tank	None
C-73-002	73	No	Underground tank	None
C-73-003	73	No	Underground tank	None

OU 1071

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-73-004	73	No	Underground tank	None

OU 1078

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
1-001(a)	01	Yes	Septic tank 134	None
1-001(b)	01	Yes	Septic tank 135	None
1-001(c)	01	Yes	Septic tank 137	Rad
1-001(d)	01	Yes	Septic tank 138 (hillside)	Rad, Haz
1-001(e)	01	Yes	Septic tank 139	Rad, Haz
1-001(f)	01	Yes	Septic tank 140 (hillside)	Rad
1-001(g)	01	Yes	Septic tank 141	None
1-001(h)	01	Yes	Septic tank 142	None
1-001(i)	01	Yes	Septic tank 143	None
1-001(j)	01	Yes	Septic tank 149	None
1-001(k)	01	Yes	Septic tank 268	None
1-001(l)	01	Yes	Septic tank 269	None
1-001(m)	01	Yes	Septic tank 275	None
1-001(n)	01	Yes	Septic tank 276	None
1-001(o)	01	Yes	Ind. or san. waste water treat.	None
1-001(p)	01	No	Septic system	None
1-001(q)	01	No	Septic system	None

OU 1078

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
1-001(r)	01	No	Septic system	None
1-001(s)	01	Yes	Septic system	Rad, Haz
1-001(t)	01	Yes	Septic system	None
1-001(u)	01	Yes	Septic system	None
1-001(v)	01	No	Septic system	None
1-001(w)	01	No	Septic system	None
1-003(a)	01	Yes	Landfill	None
1-003(b)	01	No	Surface disposal site	None
1-003(c)	01	No	Surface disposal site	None
1-003(d)	01	Yes	Surface disposal site (Can dump)	Haz
1-003(e)	01	Yes	Surface disposal site	None
1-004(a)	01	No	Incinerator	None
1-004(b)	01	No	Incinerator	None
1-005	01	No	Incinerator	None
1-006(a)	01	Yes	Drain lines and outfall	None
1-006(b)	01	Yes	Drain lines and outfall	None
1-006(c)	01	Yes	Drain lines and outfall	None

OU 1078

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
1-006(d)	01	Yes	Drain lines and outfall	None
1-006(e)	01	No	Drain lines and outfall	None
1-006(f)	01	No	Drain lines and outfall	None
1-006(g)	01	No	Drain lines and outfall	None
1-006(h)	01	Yes	Drain lines and outfall	Haz
1-006(i)	01	No	Drain lines and outfall	None
1-006(j)	01	No	Drain lines and outfall	None
1-006(k)	01	No	Drain lines and outfall	None
1-006(l)	01	No	Drain lines and outfall	None
1-006(m)	01	No	Drain lines and outfall	None
1-006(n)	01	Yes	Drain lines and outfall	None
1-006(o)	01	Yes	Drain lines and outfall	None
1-006(p)	01	No	Drain lines and outfall	None
1-006(q)	01	No	Drain lines and outfall	None
1-006(r)	01	No	Drain lines and outfall	None
1-006(s)	01	No	Drain lines and outfall	None
1-006(t)	01	No	Drain lines and outfall	None

OU 1078

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
1-007(a)	01	Yes	Soil contamination area	None
1-007(b)	01	Yes	Soil contamination area	None
1-007(c)	01	Yes	Soil contamination area	None
1-007(d)	01	Yes	Soil contamination area	Rad
1-007(e)	01	Yes	Soil contamination area	None
1-007(f)	01	No	Soil contamination area	None
1-007(g)	01	No	Soil contamination area	None
1-007(h)	01	No	Soil contamination area	None
1-007(i)	01	No	Soil contamination area	None
1-007(j)	01	Yes	Soil contamination area	None
1-007(k)	01	No	Soil contamination area	None
1-007(l)	01	Yes	Soil contamination area	Rad
1-007(m)	01	No	Soil contamination area	None
1-007(n)	01	No	Soil contamination area	None
1-007(o)	01	No	Soil contamination area	None
1-007(p)	01	No	Soil contamination area	None

OU 1079

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
10-001(a)	10	Yes	Firing Site	Rad, Haz, HE
10-001(b)	10	Yes	Firing Site	Rad, Haz, HE
10-001(c)	10	Yes	Firing Site	Rad, Haz, HE
10-001(d)	10	Yes	Firing Site	Rad, Haz, HE
10-001(e)	10	No	Detonation Test Area	None
10-002(a)	10	Yes	Disposal pit	Rad, Haz
10-002(b)	10	Yes	Disposal pit	Rad, Haz
10-003(a)	10	Yes	Disposal pit	Rad, Haz
10-003(b)	10	Yes	Disposal pit	Rad, Haz
10-003(c)	10	Yes	Disposal pit	Rad, Haz
10-003(d)	10	Yes	Disposal pit	Rad, Haz
10-003(e)	10	Yes	Disposal pit	Rad, Haz
10-003(f)	10	Yes	Disposal pit	Rad, Haz
10-003(g)	10	Yes	Manholes	Rad, Haz
10-003(h)	10	Yes	Manholes	Rad, Haz
10-003(i)	10	Yes	Septic tank	Rad, Haz
10-003(j)	10	Yes	Tank	Rad, Haz

OU 1079

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
10-003(k)	10	Yes	Tank	Rad, Haz
10-003(l)	10	Yes	Tank	Rad, Haz
10-003(m)	10	Yes	Waste line	Rad, Haz
10-003(n)	10	Yes	Leach field	Rad, Haz
10-003(o)	10	Yes	Leach field	Rad, Haz
10-004(a)	10	Yes	Septic system	None
10-004(b)	10	Yes	Septic system	Rad, Haz
10-005	10	Yes	Surface disposal	Rad, Haz
10-006	10	Yes	Burn site	None
10-007	10	Yes	Landfill	Haz
10-008	10		Tree Rimmed Firing Point, Bayo Canyon	Haz
10-009	10		Former Bayo Landfill	Haz
C-10-001	10	No	Surface soil, 2 10x10 foot plots, Bayo Canyon	Rad
31-001	31	Yes	Outfall from sanitary Septic system	None
C-31-001	31	No	Buildings	None
32-001	32	Yes	Incinerator	None
32-002(a)	32	Yes	Septic tank	Haz

OU 1079

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
32-002(b)	32	Yes	Septic tank	Haz
32-003	32	yes	Former transformer site	Haz
32-004	32	yes	Drain line and outfall	Haz, Rad
C-32-001	32	No	Buildings	None
1-002	45	Yes	Outfall TA1 SWMU to be in TA45	Rad, Haz
45-001	45	Yes	Waste water treatment facility	Rad, Haz, HE
45-002	45	Yes	Vehicle Decontamination facility	Haz, Rad, HE
45-003	45	Yes	Waste lines	Rad, Haz
45-004	45	Yes	Sanitary Sewer Outfall	None
C-45-001	45	No	Parking lot of Former Treatment Plant	Rad, Haz

FIELD UNIT ONE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
21-001	21	No	Container storage	Rad, Haz
21-002(a)	21	Yes	Container storage	Haz
21-002(b)	21	No	Container storage	Haz
21-003	21	Yes	Container storage	Haz, other
21-004(a)	21	No	Aboveground tank	Rad, Haz
21-004(b)	21	Yes	Tank and/or assoc. equipment	Rad, Haz
21-004(c)	21	Yes	Tank and/or assoc. equipment	Rad, Haz
21-004(d)	21	No	Drain line	Rad, Haz
21-005	21	Yes	Disposal pit	None
21-006(a)	21	Yes	Disposal pit	Rad, Haz
21-006(b)	21	Yes	Disposal pit	Rad, Haz
21-006(c)	21	Yes	Disposal pit	Rad, Haz
21-006(d)	21	Yes	Disposal pit	Rad, Haz
21-006(e)	21	Yes	Surface disposal site	Rad, Haz
21-006(f)	21	No	Disposal pit	Rad, Haz
21-007	21	Yes	Incinerators	None
21-008	21	No	Incinerator	None

OU 1106

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
21-009	21	No	Waste treatment lab	None
21-010(a)	21	Yes	Waste treatment facility	None
21-010(b)	21	Yes	Waste treatment facility	None
21-010(c)	21	Yes	Waste treatment facility	None
21-010(d)	21	Yes	Waste treatment facility	None
21-010(e)	21	Yes	Waste treatment facility	None
21-010(f)	21	Yes	Waste treatment facility	None
21-010(g)	21	Yes	Waste treatment facility	None
21-010(h)	21	Yes	Waste treatment facility	None
21-011(a)	21	Yes	Waste treatment facility	Rad, Haz
21-011(b)	21	Yes	Sump	Rad, Haz
21-011(c)	21	Yes	Tank and Sump	Rad, Haz
21-011(d)	21	Yes	Aboveground tank	Rad, Haz
21-011(e)	21	Yes	Aboveground tank	Rad, Haz
21-011(f)	21	Yes	Aboveground tank	Rad, Haz
21-011(g)	21	Yes	Aboveground tank	Rad, Haz
21-011(h)	21	No	Aboveground tank	Rad, Haz

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
21-011(i)	21	Yes	Aboveground tank	Rad, Haz
21-011(j)	21	Yes	Aboveground tank	Rad, Haz
21-011(k)	21	Yes	Outfall	Rad, Haz
21-012(a)	21	Yes	Dry well	None
21-012(b)	21	Yes	Dry well	None
21-013(a)	21	Yes	Surface disposal site	Rad, Haz
21-013(b)	21	Yes	Surface disposal site	Rad, Haz
21-013(c)	21	Yes	Surface disposal site	Rad, Haz
21-013(d)	21	Yes	Surface disposal site (Cold Dump)	None
21-013(e)	21	Yes	Surface disposal site	None
21-013(f)	21	No	Surface disposal site	Rad, Haz
21-013(g)	21	No	Surface disposal site	None
21-014	21	Yes	Material disposal area (MDA A)	Rad, Haz
21-015	21	Yes	Material disposal area (MDA B)	Rad, Haz
21-016(a)	21	Yes	Material disposal area (MDA T)	Rad, Haz
21-016(b)	21	Yes	Material disposal area (MDA T)	Rad, Haz
21-016(c)	21	Yes	Material disposal area (MDA T)	Rad, Haz

OU 1106

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
21-017(a)	21	Yes	Material disposal area (MDA U)	Rad, Haz
21-017(b)	21	Yes	Material disposal area (MDA U)	Rad, Haz
21-017(c)	21	Yes	Material disposal area (MDA U)	Rad, Haz
21-018(a)	21	Yes	Material disposal area (MDA V)	Rad, Haz
21-018(b)	21	Yes	Material disposal area (MDA V) Laundry Facility	Rad, Haz
21-019(a)	21	No	Filter houses/ exhaust stacks	None
21-019(b)	21	No	Filter houses/ exhaust stacks	None
21-019(c)	21	No	Filter houses/ exhaust stacks	None
21-019(d)	21	No	Filter houses/ exhaust stacks	None
21-019(e)	21	No	Filter houses/ exhaust stacks	None
21-019(f)	21	No	Filter houses/ exhaust stacks	None
21-019(g)	21	No	Filter houses/ exhaust stacks	None
21-019(h)	21	No	Filter houses/ exhaust stacks	None
21-019(i)	21	No	Filter houses/ exhaust stacks	None
21-019(j)	21	No	Filter houses/ exhaust stacks	None
21-019(k)	21	No	Filter houses/ exhaust stacks	None
21-019(l)	21	No	Filter houses/ exhaust stacks	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
21-019(m)	21	No	Filter houses/ exhaust stacks	None
21-020(a)	21	No	Filter house	None
21-020(b)	21	No	Filter house	None
21-021	21	Yes	Systematic release (site -wide)	None
21-022(a)	21	Yes	Waste lines	Rad, Haz
21-022(b)	21	Yes	Waste lines	Rad, Haz
21-022(c)	21	Yes	Waste lines	Rad, Haz
21-022(d)	21	Yes	Waste lines	Rad, Haz
21-022(e)	21	Yes	Waste lines	Rad, Haz
21-022(f)	21	Yes	Waste lines	Rad, Haz
21-022(g)	21	Yes	Waste lines	Rad, Haz
21-022(h)	21	Yes	Waste lines	Rad, Haz
21-022(i)	21	Yes	Tank and/or assoc. equipment	Rad, Haz
21-022(j)	21	Yes	Tank and/or assoc. equipment	Rad, Haz
21-023(a)	21	Yes	Septic system	Rad, Haz
21-023(b)	21	Yes	Septic system	Rad, Haz
21-023(c)	21	Yes	Septic system	Rad, Haz

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
21-023(d)	21	Yes	Septic system	Rad, Haz
21-024(a)	21	Yes	Septic system	Rad, Haz
21-024(b)	21	Yes	Septic system	Rad, Haz
21-024(c)	21	Yes	Septic system	Rad, Haz
21-024(d)	21	Yes	Septic system VCA for rad	Rad, Haz
21-024(e)	21	Yes	Septic system	Rad, Haz
21-024(f)	21	Yes	Septic system	None
21-024(g)	21	Yes	Septic system	None
21-024(h)	21	Yes	Septic system	Rad, Haz
21-024(i)	21	Yes	Septic system	Rad, Haz
21-024(j)	21	Yes	Septic system	Rad, Haz
21-024(k)	21	Yes	Septic system	Rad, Haz
21-024(l)	21	Yes	Ind. or san. waste water treat.	None
21-024(m)	21	Yes	Drain line	None
21-024(n)	21	Yes	Drain line	Rad, Haz
21-024(o)	21	Yes	Drain line	Rad, Haz
21-025(a)	21	No	Operational facility	None

FIELD UNIT ONE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
21-025(b)	21	No	Operational facility	None
21-026(a)	21	Yes	Ind. or san. waste water treat.	Rad, Haz
21-026(b)	21	Yes	Surface disposal site	Rad, Haz
21-026(c)	21	No	Waste water treatment facility	Rad, Haz
21-026(d)	21	No	Outfall	Rad, Haz
21-027(a)	21	Yes	Ind. or san. waste water treat.	None
21-027(b)	21	Yes	Outfalls	None
21-027(c)	21	Yes	Ind. or san. waste water treat.	None
21-027(d)	21	Yes	Drain line	None
21-028(a)	21	No	Container storage	None
21-028(b)	21	No	Container storage	None
21-028(c)	21	No	Container storage	None
21-028(d)	21	No	Container storage	None
21-028(e)	21	No	Container storage	None
21-029	21	Yes	Soil contamination area	None
C-21-001	21	No	One-time spill	None
C-21-002	21	No	Non-intentional release area	None

OU 1106

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-21-003	21	No	Non-intentional release area	None
C-21-004	21	No	Non-intentional release area	None
C-21-005	21	No	One-time spill	None
C-21-006	21	No	Non-intentional release area	None
C-21-007	21	No	Non-intentional release area	None
C-21-008	21	No	One-time spill	None
C-21-009	21	No	One-time spill	None
C-21-010	21	No	Systematic leak	None
C-21-011	21	No	One-time spill	None
C-21-012	21	No	One-time spill	None
C-21-013	21	No	Disposal pit	None
C-21-014	21	No	Warehouse	None
C-21-015	21	No	Building	None
C-21-016	21	No	Storage area	None
C-21-017	21	No	Storage area	None
C-21-018	21	No	Storage area	None
C-21-019	21	No	Storage area	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-21-020	21	No	Storage area	None
C-21-021	21	No	Storage area	None
C-21-022	21	No	Laboratory	None
C-21-023	21	No	Laboratory	None
C-21-024	21	No	Warehouse	None
C-21-025	21	No	Building	None
C-21-026	21	No	Building	None
C-21-027	21	No	Machinery	None
C-21-028	21	No	Tank	None
C-21-029	21	No	Aboveground tank	None
C-21-030	21	No	Aboveground tank	None
C-21-031	21	No	Tank	None
C-21-032	21	No	Machinery and tanks	None
C-21-033	21	No	One-time spill	None
C-21-034	21	No	Tank	None
C-21-035	21	No	Aboveground tank	None
C-21-036	21	No	Aboveground tank	None

OU 1106

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-21-037	21	No	Aboveground tank	None

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-001(a)	03	Yes	<90 day storage	None
3-001(b)	03	Yes	Satellite storage area	None
3-001(c)	03	Yes	<90 day storage	None
3-001(d)	03	No	Container storage area	None
3-001(e)	03	No	<90 day storage	None
3-001(f)	03	No	Satellite storage area	None
3-001(g)	03	No	Satellite storage area	None
3-001(h)	03	No	Satellite storage area	None
3-001(i)	03	No	Satellite storage area	Haz
3-001(j)	03	No	Satellite storage area	None
3-001(k)	03	Yes	Storage pad	None
3-001(l)	03	No	<90 day storage	None
3-001(m)	03	No	Satellite storage area	Haz
3-001(n)	03	No	Satellite storage area	None
3-001(o)	03	No	Satellite storage area	None
3-001(p)	03	No	Satellite storage area	None
3-001(q)	03	No	Satellite storage area	None

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-001(r)	03	No	Satellite storage area	None
3-001(s)	03	No	Satellite storage area	None
3-001(t)	03	No	Satellite storage area	None
3-001(u)	03	No	Satellite storage area	None
3-001(v)	03	No	Satellite storage area	None
3-001(w)	03	No	Satellite storage area	None
3-001(x)	03	No	Satellite storage area	None
3-001(y)	03	No	Satellite storage area	None
3-002(a)	03	Yes	Container storage area	None
3-002(b)	03	Yes	Storage area	None
3-002(c)	03	Yes	Storage area	Haz
3-002(d)	03	Yes	Container storage area	None
3-003(a)	03	Yes	Storage area	Haz
3-003(b)	03	Yes	Storage area	
3-003(c)	03	Yes	Equipment storage area	
3-003(d)	03	No	Storage area	Other
3-003(e)	03	No	Storage area	None

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-003(f)	03	No	Storage area	None
3-003(g)	03	No	One-time spill	None
3-003(h)	03	No	Storage area	None
3-003(i)	03	No	Storage area	None
3-003(j)	03	No	Storage area	None
3-003(k)	03	No	Storage area	None
3-003(l)	03	No	Storage area	Other
3-003(m)	03	No	Storage area	None
3-003(n)	03	No	Storage area	Other
3-003(o)	03	No	Storage area	None
3-003(p)	03	No	Storage area	None
3-004(a)	03	No	Container storage	None
3-004(b)	03	No	Container storage	None
3-004(c)	03	No	Storage area	Rad, Haz
3-004(d)	03	No	Storage area	Rad, Haz
3-004(e)	03	No	Storage area	None
3-004(f)	03	No	Storage area	None

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-006	03	No	Burn site	None
3-007	03	No	Firing site	HE
3-008(a)	03	No	Firing site	None
3-008(b)	03	No	Firing site	None
3-009(a)	03	Yes	Surface disposal (soil fill)	None
3-009(b)	03	Yes	Surface disposal	None
3-009(c)	03	Yes	Surface disposal	None
3-009(d)	03	Yes	Surface disposal site	None
3-009(e)	03	Yes	Surface disposal	None
3-009(f)	03	Yes	Surface disposal	None
3-009(g)	03	Yes	Surface disposal	None
3-009(h)	03	Yes	Surface disposal	None
3-009(i)	03	Yes	Surface disposal site	None
3-009(j)	03	Yes	Surface disposal site	None
3-010(a)	03	Yes	Systematic release site	Rad, Haz
3-010(b)	03	No	Operational release	None
3-010(c)	03	No	Operational release	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-010(d)	03	No	Operational release	None
3-011	03	Yes	Systematic product release	None
3-012(a)	03	Yes	One-time spill	None
3-012(b)	03	Yes	Operational release and outfall	Rad, Haz
3-013(a)	03	Yes	Operational release	Haz
3-013(b)	03	No	Operational release	Haz
3-013(c)	03	No	Operational release	None
3-013(d)	03	No	Operational release	None
3-013(e)	03	No	Operational release	None
3-013(f)	03	No	Operational release	None
3-013(g)	03	No	Operational release	None
3-013(h)	03	No	Operational release	None
3-014(a)	03	Yes	Waste water treatment facility	Rad, Haz
3-014(a2)	03	No	Waste water treatment facility	Haz
3-014(b)	03	Yes	Waste water treatment facility	Haz
3-014(b2)	03	No	Outfall	Rad, Haz
3-014(c)	03	Yes	Waste water treatment facility	Haz

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-014(c2)	03	No	Outfall	Rad, Haz
3-014(d)	03	Yes	Waste water treatment facility	Haz
3-014(e)	03	Yes	Waste water treatment facility	Rad, Haz
3-014(f)	03	Yes	Waste water treatment facility	Haz
3-014(g)	03	Yes	Waste water treatment facility	Haz
3-014(h)	03	Yes	Waste water treatment facility	Haz
3-014(i)	03	Yes	Waste water treatment facility	Haz
3-014(j)	03	Yes	Waste water treatment facility	Haz
3-014(k)	03	Yes	Waste water treatment facility	Haz
3-014(l)	03	Yes	Waste water treatment facility	Haz
3-014(m)	03	Yes	Waste water treatment facility	Haz
3-014(n)	03	Yes	Waste water treatment facility	Haz
3-014(o)	03	Yes	Waste water treatment facility	Haz
3-014(p)	03	Yes	Waste water treatment facility	Haz
3-014(q)	03	Yes	Waste water treatment facility	Haz
3-014(r)	03	Yes	Waste water treatment facility	Haz
3-014(s)	03	Yes	Waste water treatment facility	Haz

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-014(t)	03	Yes	Waste water treatment facility	Haz
3-014(u)	03	Yes	Waste water treatment facility	Haz
3-014(v)	03	No	Waste water treatment facility	Haz
3-014(w)	03	No	Waste water treatment facility	Haz
3-014(x)	03	No	Waste water treatment facility	Haz
3-014(y)	03	No	Waste water treatment facility	Haz
3-014(z)	03	No	Waste water treatment facility	Haz
3-015	03	Yes	Outfall	Haz
3-016(a)	03	No	Septic system	None
3-016(b)	03	No	Septic system	None
3-016(c)	03	No	Septic system	None
3-016(d)	03	No	Septic system	None
3-016(e)	03	No	Septic system	None
3-016(f)	03	No	Septic system	None
3-018	03	Yes	Septic system	None
3-019	03	Yes	Septic tank	None
3-020(a)	03	Yes	Disposal pit	None

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-020(b)	03	No	Surface disposal site	None
3-021	03	Yes	Surface disposal site	Haz
3-022	03	No	Sump	Haz
3-023	03	No	Sump	Haz
3-024	03	Yes	Tank and/or assoc. equipment	None
3-025(a)	03	Yes	Tank and/or assoc. equipment	None
3-025(b)	03	Yes	Tank and/or assoc. equipment	Rad
3-025(c)	03	No	Tank and/or assoc. equipment	Rad, Haz
3-026(a)	03	No	Sump	Haz
3-026(b)	03	Yes	Sumps	Haz
3-026(c)	03	Yes	Tank and/or assoc. equipment	None
3-026(d)	03	Yes	Tank and/or assoc. equipment	Haz
3-027	03	No	Separation site	None
3-028	03	Yes	Surface impoundment	None
3-029	03	Yes	Landfill	None
3-030	03	No	Surface impoundment	None
3-031	03	Yes	Tank and/or assoc. equipment	Rad, Haz

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-032	03	Yes	Tank and/or assoc. equipment	None
3-033	03	Yes	Sump	Haz
3-034(a)	03	Yes	Tank and/or assoc. equipment Radioactive liquid waste tanks	Rad, Haz
3-034(b)	03	Yes	Tank and/or assoc. equipment	None
3-035(a)	03	Yes	Underground tank	None
3-035(b)	03	Yes	Underground storage tank	None
3-036(a)	03	Yes	Aboveground tanks	None
3-036(b)	03	No	Aboveground tanks	Haz
3-036(c)	03	Yes	Aboveground tanks	None
3-036(d)	03	Yes	Aboveground tanks	None
3-036(e)	03	No	Aboveground tank	None
3-036(f)	03	No	Aboveground tank	None
3-036(g)	03	No	Aboveground tank	None
3-036(h)	03	No	Aboveground tank	None
3-036(i)	03	No	Aboveground tank	None
3-036(j)	03	No	Aboveground tanks	None
3-037	03	Yes	Underground tank	Haz

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-038(a)	03	Yes	Acid tank	Rad, Haz
3-038(b)	03	Yes	Acid tank	Rad, Haz
3-038(c)	03	No	Waste lines	Rad
3-038(d)	03	No	Waste lines	Rad
3-038(e)	03	No	Waste lines	None
3-038(f)	03	No	Waste lines	Rad
3-039(a)	03	Yes	Silver recovery unit	None
3-039(b)	03	No	Silver recovery unit	None
3-039(c)	03	No	Silver recovery unit	None
3-039(d)	03	No	Silver recovery unit	None
3-039(e)	03	No	Silver recovery unit	None
3-040(a)	03	No	Storage area	None
3-040(b)	03	No	Storage area	None
3-041	03	No	Underground tank	None
3-042	03	No	Sump	Haz
3-043(a)	03	No	Aboveground tank	None
3-043(b)	03	No	Aboveground tank	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-043(c)	03	Yes	Tank and/or assoc. equipment	None
3-043(d)	03	No	Aboveground tank	None
3-043(e)	03	Yes	Underground tank	None
3-043(f)	03	No	Aboveground tank	None
3-043(g)	03	No	Aboveground tank	None
3-043(h)	03	No	Aboveground tank	None
3-043(i)	03	No	Aboveground tank	None
3-044(a)	03	Yes	Container storage	Haz
3-044(b)	03	No	Container storage	None
3-045(a)	03	Yes	Outfall (Ind. or san. waste water treatment)	Haz
3-045(b)	03	Yes	Ind. or san. waste water treatment	Haz
3-045(c)	03	Yes	Outfall	Haz
3-045(d)	03	Yes	Above Ground Storage tank (Ind. or san. waste water treatment)	None
3-045(e)	03	Yes	Outfall (Ind. or san. waste water treatment)	None
3-045(f)	03	Yes	Outfall from Drain (Ind. or san. waste water treatment)	None
3-045(g)	03	Yes	Outfall (Ind. or san. waste water treatment)	None
3-045(h)	03	Yes	Outfall (Ind. or san. waste water treatment)	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-045(i)	03	Yes	Outfall (Ind. or san. waste water treatment)	None
3-046	03	Yes	Above Ground Storage Tank (Physical, chem. &/or bio. treat.)	None
3-047(a)	03	No	Storage area	None
3-047(b)	03	No	Storage area	None
3-047(c)	03	No	Drum Storage	None
3-047(d)	03	No	Storage area	None
3-047(e)	03	No	Storage area	None
3-047(f)	03	No	Storage area	None
3-047(g)	03	No	Drum Storage	None
3-047(h)	03	No	Storage area	None
3-047(i)	03	No	Satellite storage area	None
3-047(j)	03	No	Drum Storage	None
3-047(k)	03	No	Drum Storage	None
3-048	03	No	Satellite storage area	None
3-049(a)	03	Yes	Outfall	Haz
3-049(b)	03	Yes	Operational release	Rad, Haz
3-049(c)	03	Yes	Outfall	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-049(d)	03	Yes	Outfall	None
3-049(e)	03	Yes	Outfall	None
3-050(a)	03	Yes	Exhaust emissions Off-gas scrubber of HEPA filter sys.	Rad, Haz
3-050(b)	03	No	Exhaust emissions Off-gas scrubber of HEPA filter sys.	None
3-050(c)	03	No	Exhaust Emissions Off-gas scrubber of HEPA filter sys.	None
3-050(d)	03	Yes	Exhaust Emissions Off-gas scrubber of HEPA filter sys.	Rad
3-050(e)	03	Yes	Exhaust Emissions Off-gas scrubber of HEPA filter sys.	None
3-050(f)	03	Yes	Exhaust Emissions Off-gas scrubber of HEPA filter sys.	None
3-050(g)	03	Yes	Exhaust Emissions Off-gas scrubber of HEPA filter sys.	None
3-051(a)	03	No	Soil contamination (Oil from leaking compressor)	None
3-051(b)	03	No	Soil contamination (Oil from leaking compressor)	None
3-051(c)	03	No	Soil contamination (Vacuum pump leaking)	None
3-051(d)	03	No	Soil contamination (Oil form leaking compressor)	None
3-052(a)	03	Yes	Storm drainage	Haz
3-052(b)	03	No	Storm drainage	Haz
3-052(c)	03	Yes	Storm drainage	None
3-052(d)	03	No	Storm drainage	None

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-052(e)	03	Yes	Storm drainage	Haz
3-052(f)	03	Yes	Storm drainage	Haz
3-053	03	No	Operational facility	Rad, Haz
3-054(a)	03	Yes	Outfall	None
3-054(b)	03	Yes	Outfall	Haz
3-054(c)	03	Yes	Outfall	None
3-054(d)	03	Yes	Outfall	None
3-054(e)	03	Yes	Outfall	Haz
3-055(a)	03	Yes	Outfall	None
3-055(b)	03	No	Outfall	None
3-055(c)	03	Yes	Outfall	None
3-055(d)	03	Yes	Outfall	None
3-056(a)	03	Yes	Storage area	None
3-056(b)	03	No	Container storage area	Haz
3-056(c)	03	Yes	Transformer storage area	Haz, other
3-056(d)	03	Yes	Drum Storage	None
3-056(e)	03	No	Satellite storage area	None

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
3-056(f)	03	No	Drum Storage	None
3-056(g)	03	No	Satellite storage area	None
3-056(h)	03	No	Transformer storage area	None
3-056(i)	03	No	Drum Storage	None
3-056(j)	03	No	Storage area	None
3-056(k)	03	No	Container storage area	Rad
3-056(l)	03	Yes	Drum Storage	None
3-056(m)	03	Yes	Drum Storage	None
3-056(n)	03	Yes	Drum Storage	None
3-057	03	No	Sump/Grease trap	None
3-058	03	No	Container storage	None
3-059	03	Yes	Storage area	Haz, other
C-3-001	03	No	Gas trap	None
C-3-002	03	No	One-time spill- Leak from asphalt machine	None
C-3-003	03	No	One-time spill- Stained asphalt	None
C-3-004	03	No	Miscellaneous debris	None
C-3-005	03	No	Storm Drains	Haz

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-3-006	03	No	One-time spill	Rad, Haz
C-3-007	03	No	Storage area	None
C-3-008	03	No	Storage area/ rad contaminated	None
C-3-009	03	No	Storage area	None
C-3-010	03	No	Outfall	None
C-3-011	03	No	Waste oil tank	None
C-3-012	03	No	Satellite storage area	None
C-3-014	03	No	Storage area	Rad
C-3-015	03	No	Underground dist. tank	None
C-3-016	03	No	Oil metal bin	Haz
C-3-017	03	No	Underground storage tank	None
C-3-018	03	No	Underground storage tank	None
C-3-019	03	No	Underground storage tank	None
C-3-020	03	No	Storage tank	None
C-3-021	03	No	Underground storage tank	None
C-3-022	03	No	Kerosene tanker trailer	None
30-001	30	No	Surface disposal and landfill	None

FIELD UNIT ONE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
59-001	59	Yes	Septic system	None
59-002	59	No	Container storage area	None
59-003	59	No	Sump	None
59-004	59	No	Outfall	Rad, Haz
C-59-001	59	No	PCB containing capacitors & Transformer	None
60-001(a)	60	No	Storage area (Active storage)	None
60-001(b)	60	No	Storage area (Active Storage)	None
60-001(c)	60	No	Storage area (active)	None
60-001(d)	60	No	Storage area Pesticide Shed	None
60-002	60	Yes	Storage area	None
60-003	60	No	Oil-water separator	None
60-004(a)	60	No	Storage area	None
60-004(b)	60	No	Storage area	Haz
60-004(c)	60	No	Storage area	Haz, other
60-004(d)	60	No	Storage area	Haz
60-004(e)	60	No	Storage area	Haz, other
60-004(f)	60	No	Storage area	Haz

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
60-005(a)	60	Yes	Surface impoundment -formerly 3-029(a)	Rad, Haz
60-005(b)	60	No	Drilling mud pit	None
60-006(a)	60	Yes	Septic tank	Haz
60-006(b)	60	No	Septic system	None
60-006(c)	60	No	Septic tank	None
60-007(a)	60	Yes	Systematic or intent. prod. release	Haz
60-007(b)	60	Yes	Systematic or intent. prod. release	Haz, other
C-60-001	60	No	Underground tank	None
C-60-002	60	No	Underground tank	None
C-60-003	60	No	One-time spill at pesticide shed	None
C-60-004	60	No	Underground tank	None
61-001	61	No	Storage area	None
61-002	61	Yes	Transformer storage area	Other
61-003	61	No	Burn sites	None
61-004(a)	61	Yes	Septic tank	None
61-004(b)	61	No	Septic tank	None
61-004(c)	61	No	Septic tank	None

OU 1114

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
61-005	61	Yes	Landfill	Haz
61-006	61	Yes	Waste oil tank	Haz
61-007	61	Yes	Transformer site - systematic leak	None
C-61-001	61	No	Transformer storage area- PCB leak	None
C-61-002	61	No	Subsurface Contamination	Petroleum products
64-001	64	No	Storage area	None

OU 1136

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
43-001(a1)	43	Yes	Waste lines (Pre 1981)	Haz, Rad, Mix, Sanitary
43-001(a2)	43	No	Waste lines (Post 1981)	Haz, Rad, Mix, Sanitary
43-001(b1)	43	No	Outfall	None
43-001(b2)	43	No	Outfall	Haz, Rad, Mix, Sanitary
43-002	43	Yes	Incinerator	None
43-003	43	No	Carcass Storage	None
43-004	43	No	Waste Storage	None
43-005	43	No	Radioactive liquid Storage	Rad or Mixed Liquid Waste
C-43-001	43	No	Outfall	Haz, Rad, Mix, Sanitary

FIELD UNIT TWO

OU 1085

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
12-001(a)	12	Yes	Firing site	Rad, Haz
12-001(b)	12	Yes	Firing site	Rad, Haz
12-002	12	Yes	Open burning ground	
12-003	12	No	Storage area	
12-004(a)	12	No	Radiation Test facility	Rad, Haz
12-004(b)	12	No	Pipe	Rad, Haz
C-12-001	12	No	Building	Haz, HE
C-12-002	12	No	Building	Haz, HE
C-12-003	12	No	Building	Haz, HE
C-12-004	12	No	Building	Haz
C-12-005	12	No	Building	HE
C-12-006	12	No	Pole Duplicate of 12-004(a)	
14-001(a)	14	No	Firing site	Rad, Haz
14-001(b)	14	No	Firing site	Rad, Haz
14-001(c)	14	No	Firing site	Rad, Haz
14-001(d)	14	No	Firing site	Rad, Haz
14-001(e)	14	No	Firing site	Rad, Haz

OU 1085

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
14-001(f)	14	No	Firing site	Rad, Haz
14-001(g)	14	No	Firing site	Rad, Haz
14-002(a)	14	Yes	Firing site	Rad, Haz
14-002(b)	14	Yes	Firing site	Rad, Haz
14-002(c)	14	Yes	Building	Rad, Haz
14-002(d)	14	Yes	Firing site	Rad, Haz
14-002(e)	14	Yes	Firing site	Rad, Haz
14-002(f)	14	Yes	Firing site	Rad, Haz
14-003	14	Yes	Open burning ground	Rad, Haz
14-004(a)	14	No	Storage area (still active)	
14-004(b)	14	Yes	Storage area	
14-004(c)	14	No	Storage area	
14-005	14	Yes	Incinerator (still active)	Rad, Haz
14-006	14	Yes	Tank and/or assoc. equip.	Haz, HE
14-007	14	Yes	Septic system	Rad, Haz
14-008	14	No	Landfill and surface disposal	
14-009	14	Yes	Surface disposal site	Rad, Haz

FIELD UNIT TWO

OU 1085

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
14-010	14	Yes	Sump	Rad, Haz
C-14-001	14	No	Building	Haz, HE
C-14-002	14	No	Building	Rad, Haz
C-14-003	14	No	Building	Rad, Haz
C-14-004	14	No	Building	Haz, HE
C-14-005	14	No	Building	Rad, Haz
C-14-006	14	No	Building	Haz, HE
C-14-007	14	No	Building	Haz, HE
C-14-008	14	No	Building	Haz, HE
C-14-009	14	No	Building	Haz, HE

FIELD UNIT TWO

OU 1086

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
15-001	15	No	Surface disposal	Rad, Haz
15-002	15	Yes	Disposal pit and burn site	Rad, Haz
15-003	15	Yes	Firing site (still active)	Haz, HE
15-004(a)	15	Yes	Firing site C	Rad, Haz
15-004(b)	15	Yes	Firing site A	Rad, Haz
15-004(c)	15	Yes	Firing site B	Rad, Haz
15-004(d)	15	No	Firing site C	Rad, Haz
15-004(e)	15	No	Mistakenly called firing site (actually manhole bunker)	
15-004(f)	15	Yes	Machine firing site E-F non RCRA hazard but VCA	Rad, Haz
15-004(g)	15	Yes	Machine firing site	Rad, Haz
15-004(h)	15	No	Firing site	Rad, Haz
15-004(i)	15	Yes	Detonation ground	
15-005(a)	15	No	Storage area	Rad, Haz
15-005(b)	15	No	Storage area	Rad, Haz
15-005(c)	15	No	Storage area (R-41)	Rad, Haz
15-005(d)	15	No	Storage area	
15-006(a)	15	Yes	Firing site PHERMEX (still active)	Rad, Haz

OU 1086

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
15-006(b)	15	Yes	Firing site Ector (still active)	Rad, Haz
15-006(c)	15	Yes	Firing site R-44	Rad, Haz
15-006(d)	15	Yes	Firing site R-45	Rad, Haz
15-007(a)	15	Yes	Landfill (MDA N)	Rad, Haz
15-007(b)	15	Yes	Landfill (MDA Z)	Rad, Haz
15-007(c)	15	Yes	Shaft	
15-007(d)	15	Yes	Shaft	
15-008(a)	15	Yes	Surface disposal	Rad, Haz
15-008(b)	15	Yes	Surface disposal	Rad, Haz
15-008(c)	15	Yes	Surface disposal	Rad, Haz
15-008(d)	15	Yes	Surface disposal (still active)	Haz
15-008(e)	15	No	Surface disposal	
15-008(g)	15	No	Surface disposal	Rad, Haz
15-009(a)	15	Yes	Septic system	Haz
15-009(b)	15	Yes	Septic system	Haz
15-009(c)	15	Yes	Septic tank	Haz
15-009(d)	15	No	Septic tank	

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
15-009(e)	15	Yes	Septic tank	Haz
15-009(f)	15	Yes	Septic tank	Haz
15-009(g)	15	Yes	Septic tank (still active)	Haz
15-009(h)	15	Yes	Septic tank	Haz
15-009(i)	15	Yes	Septic tank	Haz
15-009(j)	15	Yes	Septic tank	Haz
15-009(k)	15	Yes	Septic tank	Haz
15-010(a)	15	Yes	Septic system	
15-010(b)	15	Yes	Septic system	Rad, Haz
15-010(c)	15	Yes	Operational release (still active)	Haz
15-011(a)	15	Yes	Sump	Haz, HE
15-011(b)	15	Yes	Dry well	Haz
15-011(c)	15	Yes	Sump	Haz
15-012(a)	15	Yes	Surface disposal (not located)	
15-012(b)	15	Yes	Surface disposal site	Rad, Haz
15-013(a)	15	No	Underground tank	
15-013(b)	15	No	Underground tank	

FIELD UNIT TWO

OU 1086

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
15-014(a)	15	Yes	Ind. or san. wastewater treat.	Haz
15-014(b)	15	Yes	Ind. or san. wastewater treat.	Haz
15-014(c)	15	No	Ind. or san. wastewater treat.	
15-014(d)	15	No	Ind. or san. wastewater treat.	
15-014(e)	15	No	Ind. or san. wastewater treat. (active)	
15-014(f)	15	No	Ind. or san. wastewater treat.	
15-014(g)	15	No	Ind. or san. wastewater treat.	
15-014(h)	15	No	Outfall	Haz
15-014(i)	15	Yes	Outfall	Haz
15-014(j)	15	Yes	Outfall	Haz
15-014(k)	15	Yes	Outfall	Haz
15-014(l)	15	Yes	Outfall (still active)	
15-014(m)	15	Yes	Outfall (still active)	
C-15-001	15	No	Surface disposal	Rad, Haz
C-15-002	15	No	Surface disposal	
C-15-003	15	No	Surface disposal	
C-15-004	15	No	Transformers	Other

FIELD UNIT TWO

OU 1086

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-15-005	15	No	Laboratory and building	Rad, Haz
C-15-006	15	No	Building	Haz
C-15-007	15	No	Non-intentional release	Haz
C-15-008	15	No	Non-intentional release	
C-15-009	15	No	Underground tank	
C-15-010	15	No	Underground tank	Haz
C-15-011	15	No	Underground tank	Haz
C-15-012	15	No	Underground tank (still active)	
C-15-013	15	No	Underground tank	

FIELD UNIT TWO

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
18-001(a)	18	Yes	Lagoon	None
18-001(b)	18	Yes	Sewer lines	None
18-001(c)	18	Yes	Sump	None
18-002(a)	18	Yes	Firing site	None
18-002(b)	18	Yes	Firing site	None
18-002(c)	18	No	Drop tower	None
18-003(a)	18	Yes	Settling pit	Rad, Haz
18-003(b)	18	Yes	Septic system	Rad, Haz
18-003(c)	18	Yes	Septic system	Rad, Haz
18-003(d)	18	Yes	Septic system	Rad, Haz
18-003(e)	18	Yes	Septic system	Rad, Haz
18-003(f)	18	Yes	Septic system	Rad, Haz
18-003(g)	18	Yes	Septic system	None
18-003(h)	18	Yes	Septic system	None
18-004(a)	18	Yes	Waste lines containment	None
18-004(b)	18	Yes	Pit	None
18-005(a)	18	Yes	Storage area	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
18-005(b)	18	No	Storage area	None
18-005(c)	18	No	Storage area	None
18-006	18	No	Storage pipe	Rad
18-007	18	Yes	Buried armored vehicle (does not exist)	None
18-008	18	No	Underground tank (does not exist)	Haz
18-009(a)	18	No	Transformer	None
18-009(b)	18	No	Transformer	None
18-009(c)	18	No	Transformer	None
18-009(d)	18	No	Transformer	None
18-009(e)	18	No	Transformer	None
18-010(a)	18	No	Outfall	None
18-010(b)	18	No	Outfall	None
18-010(c)	18	No	Outfall	None
18-010(d)	18	No	Outfall	None
18-010(e)	18	No	Outfall	None
18-010(f)	18	No	Outfall	None
18-011	18	No	Soil containment	None

FIELD UNIT TWO

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
18-012(a)	18	Yes	Outfall	None
18-012(b)	18	Yes	Outfall	None
18-012(c)	18	No	Sump and drain lines	None
18-012(d)	18	No	Drain line	None
18-013	18	No	Waste Tank	None
C-18-001	18	No	Laboratory	None
C-18-002	18	No	Building	None
C-18-003	18	No	Storage area	None
27-001	27	Yes	Buried naval guns	None
27-002	27	Yes	Firing sites	None
27-003	27	Yes	Bazooka impact area	HE
27-004	27	No	Building	None

OU 1100

FIELD UNIT TWO

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
20-001(a)	20	Yes	Landfill	Rad, Haz
20-001(b)	20	Yes	Landfill	Rad, Haz
20-001(c)	20	Yes	Landfill	Rad, Haz
20-002(a)	20	Yes	Firing site	Rad, Haz
20-002(b)	20	Yes	Firing site	Rad, Haz
20-002(c)	20	Yes	Firing site	Rad, Haz
20-002(d)	20	Yes	Firing site	Rad, Haz
20-003(a)	20	Yes	Firing site	None
20-003(b)	20	No	Firing site	Rad, Haz
20-003(c)	20	No	Firing site	Rad, Haz
20-003(d)	20	No	Firing site	None
20-004	20	No	Septic system	Haz
20-005	20	Yes	Septic tank	Haz
C-20-001	20	No	Storage building	None
C-20-002	20	No	Storage building	None
C-20-003	20	No	Building	None
53-001(a)	53	Yes	Storage area	Haz

OU 1100

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
53-001(b)	53	Yes	Storage area	Haz
53-001(c)	53	No	Storage area	Haz
53-001(d)	53	No	Storage area	Haz
53-001(e)	53	No	Storage area	Haz
53-001(f)	53	No	Storage area	None
53-001(g)	53	No	Storage area	Haz
53-001(h)	53	No	Storage area	None
53-001(i)	53	No	Storage area	None
53-001(j)	53	No	Storage area	Haz
53-001(k)	53	No	Storage area	Haz
53-001(l)	53	No	Storage area	Rad, Haz
53-001(m)	53	No	Storage area	None
53-001(n)	53	No	Storage area	None
53-001(o)	53	No	Storage area	None
53-002(a)	53	Yes	Disposal lagoon RCRA closure	Rad, Haz
53-002(b)	53	Yes	Disposal lagoon RCRA closure	Rad, Haz
53-003	53	No	Septic tank	None

FIELD UNIT TWO

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
53-004	53	No	Operational facility	None
53-005	53	Yes	Disposal pit	Haz, other
53-006(a)	53	No	Underground tank	Rad, Haz
53-006(b)	53	Yes	Underground tank	Rad, Haz
53-006(c)	53	Yes	Underground tank	Rad, Haz
53-006(d)	53	Yes	Underground tank	Rad, Haz
53-006(e)	53	Yes	Underground tank	Rad, Haz
53-006(f)	53	Yes	Underground tank	Rad, Haz
53-007(a)	53	Yes	Aboveground tank	Rad, Haz
53-007(b)	53	Yes	Aboveground tanks (2)	None
53-008	53	No	Storage area, Boneyard	None
53-009	53	No	Aboveground tanks (3)	Haz
53-010	53	No	Container storage	Haz
53-011(a)	53	No	Transformer	None
53-011(b)	53	No	Transformer	None
53-011(c)	53	No	Transformer	None
53-011(d)	53	No	Transformer	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
53-011(e)	53	No	Transformer	None
53-012(a)	53	No	Outfall	None
53-012(b)	53	No	Outfall	None
53-012(c)	53	No	Outfall	None
53-012(d)	53	No	Outfall	None
53-012(e)	53	No	Outfall	None
53-012(f)	53	No	Outfall	None
53-012(g)	53	No	Outfall	None
53-012(h)	53	No	Outfall	None
C-53-001	53	No	Transformer	None
C-53-002	53	No	Transformer	None
C-53-003	53	No	Transformer	None
C-53-004	53	No	Transformer	None
C-53-005	53	No	Transformer	None
C-53-006	53	No	Transformer	None
C-53-007	53	No	Transformer	None
C-53-008	53	No	Transformer	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-53-009	53	No	Transformer	None
C-53-010	53	No	Transformer	None
C-53-011	53	No	Transformer	None
C-53-012	53	No	Transformer	None
C-53-013	53	No	Transformer	None
C-53-014	53	No	Transformer	None
C-53-015	53	No	Transformer	None
C-53-016	53	No	Transformer	None
C-53-017	53	No	One-time spill	None
C-53-018	53	No	One-time spill	None
C-53-019	53	No	One-time spill	None
72-001	72	No	Firing range	Haz
72-002	72	No	Firing site	None
72-003(a)	72	No	Septic system	Haz
72-003(b)	72	No	Septic system	None

OU 1130

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
15-006(e)	15	No	Not in TA-15 @TA-36	
15-008(f)	15	No	Not in TA-36	
36-001	36	Yes	Material disposal area (MDA AA)	None
36-002	36	Yes	Sump	Haz, HE
36-003(a)	36	Yes	Septic system	Rad, Haz
36-003(b)	36	Yes	Septic system	None
36-003(c)	36	Yes	Septic system	None
36-003(d)	36	No	Septic system	None
36-004(a)	36	No	Firing site	Rad, Haz
36-004(b)	36	No	Firing site	Rad, Haz
36-004(c)	36	No	Firing site	Rad, Haz
36-004(d)	36	yes	Firing site	Rad, Haz
36-004(e)	36	No	Firing site	Rad, Haz
36-004(f)	36	No	Firing site	Rad, Haz
36-005	36	Yes	Surface disposal site	Rad, Haz
36-006	36	Yes	Surface disposal site	Haz
36-007(a)	36	No	Storage area	None

FIELD UNIT TWO

OU 1130

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
36-007(b)	36	No	Storage area	None
36-007(c)	36	No	Storage area	None
36-007(d)	36	No	Storage area	None
36-007(e)	36	No	Storage area	None
36-007(f)	36	No	Storage area	None
C-36-001	36	No	Containment vessel	
C-36-002	36	No	Surface disposal	None
C-36-003	36	yes	Storm drainages	None
C-36-006(e)	36	No	Firing site	Rad, Haz

FIELD UNIT TWO

OU 1132

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
39-001(a)	39	Yes	Landfill	Rad, Haz, other
39-001(b)	39	Yes	Material disposal area (MDA Y)	Rad, Haz, other
39-002(a)	39	Yes	Storage area	None
39-002(b)	39	No	Storage area	None
39-002(c)	39	No	Storage area	None
39-002(d)	39	No	Storage area	None
39-002(e)	39	No	Storage area	None
39-002(f)	39	No	Storage area	None
39-002(g)	39	No	Storage area (still active)	None
39-003	39	Yes	Incinerator	None
39-004(a)	39	Yes	Firing site	Rad, Haz, HE, other
39-004(b)	39	Yes	Firing site	Rad, Haz, HE, other
39-004(c)	39	Yes	Firing site	Rad, Haz, HE, other
39-004(d)	39	Yes	Firing site	Rad, Haz, HE, other
39-004(e)	39	Yes	Firing site	Rad, Haz, HE, other
39-005	39	Yes	Seepage pit	Haz, HE
39-006(a)	39	Yes	Septic system	Haz

FIELD UNIT TWO

OU 1132

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
39-006(b)	39	Yes	Septic system	None
39-007(a)	39	Yes	Storage area	None
39-007(b)	39	No	Storage area	None
39-007(c)	39	No	Storage area	None
39-007(d)	39	No	Storage area	None
39-007(e)	39	No	Storage area	None
39-008	39	Yes	Firing range	None
39-009	39	No	Outfall	None

FIELD UNIT THREE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
11-001(a)	11	Yes	Firing site	Rad, Haz, HE
11-001(b)	11	Yes	Firing site	Rad, Haz, HE
11-001(c)	11	Yes	Firing site	Rad, Haz, HE
11-002	11	Yes	Burn site	Rad, Haz, HE
11-003(a)	11	No	Mortar impact area	None
11-003(b)	11	No	Firing range	Haz
11-004(a)	11	Yes	Drop tower	Rad, Haz, HE, other
11-004(b)	11	Yes	Drop tower	Rad, Haz, HE, other
11-004(c)	11	Yes	Drop tower	Rad, Haz, HE, other
11-004(d)	11	Yes	Drop tower	Rad, Haz, HE, other
11-004(e)	11	Yes	Drop tower	Rad, Haz, HE, other
11-004(f)	11	No	Drop tower	Rad, Haz, HE, other
11-005(a)	11	Yes	Septic system	Rad, Haz
11-005(b)	11	Yes	Septic system	Rad, Haz
11-005(c)	11	Yes	Ind. or san. wastewater treat.	Rad, Haz
11-006(a)	11	Yes	Sump	Rad, Haz, HE, other
11-006(b)	11	Yes	Tank and/or assoc. equip.	Rad, Haz, HE, other

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
11-006(c)	11	Yes	Tank and/or assoc. equip.	Rad, Haz, HE, other
11-006(d)	11	Yes	Tank and/or assoc. equip.	Rad, Haz, HE, other
11-007	11	Yes	Surface disposal	None
11-008	11	No	Surface disposal	None
11-009	11	Yes	Material disposal area (MDA S)	None
11-010(a)	11	No	Container storage area	None
11-010(b)	11	No	Container storage	None
11-011(a)	11	Yes	Ind. or san. wastewater treat.	Haz
11-011(b)	11	Yes	Ind. or san. wastewater treat.	Haz
11-011(c)	11	Yes	Ind. or san. wastewater treat.	None
11-011(d)	11	Yes	Ind. or san. wastewater treat.	Haz
11-012(a)	11	No	Building	Haz, HE
11-012(b)	11	No	Building	Haz, HE
11-012(c)	11	No	Building	Haz, HE
11-012(d)	11	No	Building	Haz, HE
C-11-001	11	No	Laboratory	Rad, Haz, HE
C-11-002	11	No	Laboratory	Rad, Haz

FIELD UNIT THREE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-11-003	11	No	One-time release site	None
13-001	13	Yes	Firing site	Rad, Haz, HE, other
13-002	13	Yes	Landfill	Rad, Haz, HE, other
13-003(a)	13	Yes	Septic tank same as 16-005(i)	Rad, Haz, HE
13-003(b)	13	No	Septic system	Rad, Haz, HE
13-004	13	Yes	Disposal pit	Rad, Haz, HE, other
16-001(a)	16	Yes	Tank	Haz
16-001(b)	16	Yes	Dry wells	Haz
16-001(c)	16	Yes	Tank	Haz
16-001(d)	16	Yes	Dry well	Haz
16-001(e)	16	Yes	Dry well	Haz, HE
16-003(a)	16	Yes	Sump	Rad, Haz, HE
16-003(b)	16	Yes	Sump	Rad, Haz, HE
16-003(c)	16	Yes	Sump	Haz
16-003(d)	16	Yes	Sump	Haz
16-003(e)	16	Yes	Sump	Haz
16-003(f)	16	Yes	Sump	Haz

FIELD UNIT THREE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-003(g)	16	Yes	Sump	Haz
16-003(h)	16	Yes	Sump	Rad, Haz, HE
16-003(i)	16	Yes	Sump	Haz
16-003(j)	16	Yes	Sump	Rad, Haz, HE
16-003(k)	16	Yes	Sump	Rad, Haz, HE
16-003(l)	16	Yes	Sump	Haz
16-003(m)	16	Yes	Sump	Haz
16-003(n)	16	Yes	Sump	Haz
16-003(o)	16	Yes	Sump	Haz
16-003(p)	16	No	Sump	None
16-003(q)	16	No	Sump	None
16-004(a)	16	Yes	Waste water treatment facility	Rad, Haz, HE
16-004(b)	16	Yes	Waste water treatment facility	Rad, Haz, HE
16-004(c)	16	Yes	Waste water treatment facility	Rad, Haz, HE
16-004(d)	16	Yes	Waste water treatment facility	Rad, Haz, HE
16-004(e)	16	Yes	Waste water treatment facility	Rad, Haz, HE
16-004(f)	16	Yes	Waste water treatment facility	Rad, Haz, HE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-005(a)	16	Yes	Septic tank	Haz, HE
16-005(b)	16	Yes	Decommissioned septic system	None
16-005(c)	16	Yes	Septic tank	Haz, HE
16-005(d)	16	Yes	Septic tank	Rad, Haz, HE
16-005(e)	16	Yes	Septic tank	Rad, Haz, HE
16-005(f)	16	Yes	Decommissioned septic system	None
16-005(g)	16	Yes	Burn Site	Haz, HE
16-005(h)	16	Yes	Septic tank	Haz, HE
16-005(i)	16	Yes	Septic tank same as 13-003(a)	None
16-005(j)	16	Yes	Septic tank	Rad, Haz, HE
16-005(k)	16	Yes	Septic tank	Haz
16-005(l)	16	Yes	Grease trap	Haz, HE
16-005(m)	16	Yes	Chemical pit	Rad, Haz, HE
16-005(n)	16	Yes	Septic system	None
16-005(o)	16	Yes	Septic system	None
16-006(a)	16	Yes	Septic system	Rad, Haz
16-006(b)	16	Yes	Septic system	None

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-006(c)	16	Yes	Septic system	Rad, Haz
16-006(d)	16	Yes	Septic system	Rad, Haz, HE
16-006(e)	16	Yes	Septic system	Rad, Haz, HE
16-006(f)	16	Yes	Septic system	None
16-006(g)	16	Yes	Septic tank	Rad, Haz, HE
16-006(h)	16	Yes	Pump pit	None
16-006(i)	16	Yes	Septic system	None
16-007(a)	16	Yes	Surface impoundment	Rad, Haz, HE
16-007(b)	16	No	Surface disposal site	None
16-008(a)	16	Yes	Surface impoundment	Rad, Haz, HE
16-008(b)	16	No	Surface impoundment	None
16-009(a)	16	Yes	Burn site	Haz
16-010(a)	16	Yes	Burn site	Haz, HE
16-010(b)	16	Yes	Burn site	Haz, HE
16-010(c)	16	Yes	Burn site	Haz, HE
16-010(d)	16	Yes	Burn site	Haz, HE
16-010(e)	16	Yes	Burn site	Haz, HE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-010(f)	16	Yes	Burn site	Haz, HE
16-010(g)	16	Yes	Waste water treatment facility	None
16-010(h)	16	Yes	Burn site	Haz, HE
16-010(i)	16	Yes	Burn site	Haz, HE
16-010(j)	16	Yes	Burn site	Haz, HE
16-010(k)	16	Yes	Trough	Haz, HE
16-010(l)	16	Yes	Trough	Haz, HE
16-010(m)	16	Yes	Trough	Haz, HE
16-010(n)	16	Yes	Trough	Haz, HE
16-011	16	No	Incinerator	Haz
16-012(a)	16	Yes	Container storage- Rest House	None
16-012(a2)	16	No	Container storage	None
16-012(b)	16	Yes	Container storage- Rest House	None
16-012(c)	16	Yes	Container storage- Rest House	None
16-012(d)	16	Yes	Satellite storage area	None
16-012(e)	16	Yes	Container storage- Rest House	None
16-012(f)	16	Yes	Container storage- Rest House	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-012(g)	16	Yes	Container storage- Rest House	None
16-012(h)	16	Yes	Container storage- Rest House	None
16-012(i)	16	Yes	Satellite storage area	None
16-012(j)	16	Yes	Satellite storage area	None
16-012(k)	16	Yes	Container storage- Rest House	None
16-012(l)	16	Yes	Satellite storage area	None
16-012(m)	16	Yes	Satellite storage area	None
16-012(n)	16	Yes	Satellite storage area	None
16-012(o)	16	Yes	Container storage- Rest House	None
16-012(p)	16	Yes	Container storage	None
16-012(q)	16	Yes	Container storage- Rest House	None
16-012(r)	16	Yes	Container storage- Rest House	None
16-012(s)	16	Yes	Container storage- Rest House	None
16-012(t)	16	Yes	Satellite storage area	None
16-012(u)	16	Yes	Satellite storage area	None
16-012(v)	16	Yes	Container storage- Rest House	None
16-012(w)	16	Yes	Container storage- Rest House	None

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-012(x)	16	Yes	Satellite storage area	None
16-012(y)	16	Yes	Container storage- Rest House	None
16-012(z)	16	Yes	Container storage- Rest House	None
16-013	16	Yes	Container storage	Rad, Haz
16-015(a)	16	yes	Operational facility	Haz, HE
16-015(b)	16	yes	Operational facility	Haz, HE
16-015(c)	16	No	Operational facility	Haz, HE
16-015(d)	16	No	Operational facility	Haz, HE
16-016(a)	16	Yes	Landfill	Rad, Haz, HE
16-016(b)	16	Yes	Landfill	Rad, Haz, HE
16-016(c)	16	Yes	Landfill	Haz, HE
16-016(d)	16	Yes	Surface disposal site	None
16-016(e)	16	Yes	Surface disposal site	None
16-016(f)	16	No	Landfill	None
16-016(g)	16	Yes	Surface disposal site	None
16-017	16	Yes	Abandoned building & appurtenances	Haz, HE
16-018	16	Yes	Material disposal area: RCRA closure (MDA P)	Haz, HE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-019	16	Yes	Material disposal area (MDA R)	Rad, Haz
16-020	16	Yes	Silver recovery unit	Haz
16-021(a)	16	Yes	Systematic release site	Haz
16-021(b)	16	No	Systematic leak	Haz, HE
16-021(c)	16	Yes	Ind. or san. waste water treatment	Haz, HE
16-022(a)	16	No	Underground tank	None
16-022(b)	16	No	Underground tank	None
16-023(a)	16	No	Incinerator	None
16-023(b)	16	No	Incinerator	Haz, HE
16-024(a)	16	No	Magazine	Haz, HE
16-024(b)	16	No	Magazine	Haz, HE
16-024(c)	16	No	Magazine	Haz, HE
16-024(d)	16	No	Magazine	Haz, HE
16-024(e)	16	yes	Operational facility	Haz, HE
16-024(f)	16	No	Magazine	None
16-024(g)	16	No	Magazine	Haz, HE
16-024(h)	16	No	Magazine	Rad, Haz, HE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-024(i)	16	No	Magazine	Haz, HE
16-024(j)	16	No	Magazine	Haz, HE
16-024(k)	16	No	Magazine	Haz, HE
16-024(l)	16	No	Magazine	Haz, HE
16-024(m)	16	No	Magazine	Haz, HE
16-024(n)	16	No	Magazine	Haz, HE
16-024(o)	16	No	Magazine	Haz, HE
16-024(p)	16	No	Magazine	Haz, HE
16-024(q)	16	No	Magazine	Haz, HE
16-024(r)	16	No	Magazine	Haz, HE
16-024(s)	16	No	Magazine	Haz, HE
16-024(t)	16	No	Operational facility	Haz, HE
16-024(u)	16	No	Magazine	Haz, HE
16-024(v)	16	No	Magazine	Haz, HE
16-025(a)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(a2)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(b)	16	Yes	Abandoned building & appurtenances	Rad, Haz, HE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-025(b2)	16	Yes	Abandoned building & appurtenances	Haz
16-025(c)	16	Yes	Abandoned HE building & appurtenances	None
16-025(c2)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(d)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(d2)	16	Yes	Abandoned building & appurtenances	Rad, Haz, HE
16-025(e)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(e2)	16	Yes	Abandoned building & appurtenances	None
16-025(f)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(f2)	16	Yes	Abandoned building & appurtenances	None
16-025(g)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(g2)	16	Yes	Magazine	None
16-025(h)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(h2)	16	Yes	Abandoned building & appurtenances	None
16-025(i)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(j)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(k)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(l)	16	Yes	Abandoned building & appurtenances	Haz, HE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-025(m)	16	Yes	Abandoned building & appurtenances	Rad, Haz, HE
16-025(n)	16	Yes	Abandoned building & appurtenances	Rad, Haz, HE
16-025(o)	16	Yes	Abandoned building & appurtenances	Rad, Haz, HE
16-025(p)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(q)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(r)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(s)	16	Yes	Abandoned building & appurtenances	Rad, Haz, HE
16-025(t)	16	Yes	Abandoned building & appurtenances	Rad, Haz, HE
16-025(u)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(v)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(w)	16	Yes	Abandoned building & appurtenances	Haz
16-025(x)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(y)	16	Yes	Abandoned building & appurtenances	Haz, HE
16-025(z)	16	Yes	Abandoned building & appurtenances	Rad, Haz, HE
16-026(a)	16	Yes	Outfall	None
16-026(a2)	16	Yes	Outfall	None
16-026(b)	16	Yes	Outfall	Haz

FIELD UNIT THREE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-026(b2)	16	Yes	Outfall	None
16-026(c)	16	Yes	Outfall	Haz
16-026(c2)	16	Yes	Outfall	Haz, HE
16-026(d)	16	Yes	Outfall	Haz, HE
16-026(d2)	16	Yes	Outfall	None
16-026(e)	16	Yes	Outfall	Haz, HE
16-026(e2)	16	Yes	Outfall	None
16-026(f)	16	Yes	Outfall	None
16-026(f2)	16	Yes	Outfall	None
16-026(g)	16	Yes	Outfall	None
16-026(g2)	16	Yes	Outfall	None
16-026(h)	16	Yes	Outfall	None
16-026(h2)	16	Yes	Outfall	Haz, HE
16-026(i)	16	Yes	Outfall	Haz, HE
16-026(i2)	16	Yes	Outfall (inactive)	None
16-026(j)	16	Yes	Outfall	Haz, HE
16-026(j2)	16	Yes	Outfall	Haz, HE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-026(k)	16	Yes	Outfall	None
16-026(k2)	16	Yes	Outfall	Rad, Haz, HE
16-026(l)	16	Yes	Outfall	None
16-026(m)	16	Yes	Outfall	Haz
16-026(n)	16	Yes	Outfall	Haz
16-026(o)	16	Yes	Outfall	Haz
16-026(p)	16	Yes	Outfall	Haz
16-026(q)	16	Yes	Outfall	Rad, Haz, HE
16-026(r)	16	Yes	Outfall	Haz
16-026(s)	16	Yes	Outfall	Haz
16-026(t)	16	Yes	Outfall	None
16-026(u)	16	Yes	Outfall	Haz
16-026(v)	16	Yes	Outfall	Haz
16-026(w)	16	Yes	Outfall	Haz, HE
16-026(x)	16	Yes	Outfall	None
16-026(y)	16	Yes	Outfall	Rad, Haz, HE
16-026(z)	16	Yes	Outfall	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-027(a)	16	No	Transformer	None
16-027(b)	16	No	Transformer	None
16-027(c)	16	No	Transformer	None
16-027(d)	16	No	Transformer	None
16-028(a)	16	Yes	Ind. or san. waste water treatment	None
16-028(b)	16	Yes	Ind. or san. waste water treatment	Haz
16-028(c)	16	Yes	Ind. or san. waste water treatment	Haz, HE
16-028(d)	16	Yes	Ind. or san. waste water treatment	Haz
16-028(e)	16	Yes	Ind. or san. waste water treatment	None
16-029(a)	16	Yes	Sump	Haz
16-029(a2)	16	Yes	Sump	Haz, HE
16-029(b)	16	Yes	Sump	Haz
16-029(b2)	16	Yes	Sump	Haz, HE
16-029(c)	16	Yes	Sump	Haz
16-029(c2)	16	Yes	Sump	Rad, Haz, HE
16-029(d)	16	Yes	Sump	Haz
16-029(d2)	16	Yes	Sump	Haz, HE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-029(e)	16	Yes	Sump	Haz
16-029(e2)	16	Yes	Sump	Haz, HE
16-029(f)	16	Yes	Sump	Haz
16-029(f2)	16	Yes	Outfall	Haz, HE
16-029(g)	16	Yes	Sump	Haz
16-029(g2)	16	Yes	Pump pit	None
16-029(h)	16	Yes	Sump	Haz
16-029(h2)	16	Yes	Drain line and outfall	Haz, HE
16-029(i)	16	Yes	Outfall	None
16-029(j)	16	Yes	Outfall	Rad, Haz, HE
16-029(k)	16	Yes	Sump	Haz
16-029(l)	16	Yes	Sump	Haz
16-029(m)	16	yes	Sump	Haz, HE
16-029(n)	16	yes	Sump	Haz, HE
16-029(o)	16	yes	Sump	Haz, HE
16-029(p)	16	Yes	Sump	Haz, HE
16-029(q)	16	Yes	Sump	Haz, HE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-029(r)	16	Yes	Outfall	Haz, HE
16-029(s)	16	Yes	Sump	Haz
16-029(t)	16	Yes	Sump	Haz
16-029(u)	16	Yes	Sump	Haz
16-029(v)	16	Yes	Sump	Haz, HE
16-029(w)	16	Yes	Sump	Haz, HE
16-029(x)	16	Yes	Sump	Haz
16-029(y)	16	Yes	Sump	Rad, Haz, HE
16-029(z)	16	Yes	Sump	Haz, HE
16-030(a)	16	Yes	Ind. or san. waste water treatment	Haz
16-030(b)	16	Yes	Ind. or san. waste water treatment	None
16-030(c)	16	Yes	Ind. or san. waste water treatment	None
16-030(d)	16	No	Outfall	Haz, HE
16-030(e)	16	Yes	Ind. or san. waste water treatment	None
16-030(f)	16	Yes	Ind. or san. waste water treatment	None
16-030(g)	16	No	Outfall	Haz
16-030(h)	16	Yes	Outfall	Haz

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-031(a)	16	Yes	Ind. or san. waste water treatment	Haz
16-031(b)	16	Yes	Ind. or san. waste water treatment	Haz
16-031(c)	16	Yes	Ind. or san. waste water treatment	Haz
16-031(d)	16	Yes	Ind. or san. waste water treatment	Haz
16-031(e)	16	Yes	Ind. or san. waste water treatment	None
16-031(f)	16	Yes	Ind. or san. waste water treatment	None
16-031(g)	16	Yes	Cooling tower outfall (inactive)	None
16-031(h)	16	Yes	Ind. or san. waste water treatment	None
16-032(a)	16	Yes	Sump	Rad, Haz, HE
16-032(b)	16	No	Decommissioned HE sump	None
16-032(c)	16	yes	Sump	Haz, HE
16-032(d)	16	Yes	Decommissioned HE sump	None
16-032(e)	16	Yes	Decommissioned HE sump	None
16-033(a)	16	No	Underground tank	None
16-033(b)	16	No	Underground tank	Haz
16-033(c)	16	No	Underground tank	None
16-033(d)	16	No	Tank and/or assoc. equip	None

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-033(e)	16	No	Underground tank	Haz
16-033(f)	16	No	Underground tank	Haz
16-033(g)	16	No	Underground tank	Haz
16-033(h)	16	No	Underground tank	Haz
16-033(i)	16	No	Underground tank	Haz
16-033(j)	16	No	Underground tank	Haz
16-034(a)	16	Yes	Soil contamination area	Haz, HE
16-034(b)	16	Yes	Soil contamination area	Rad, Haz, HE
16-034(c)	16	Yes	Soil contamination area	Haz, HE
16-034(d)	16	Yes	Soil contamination area	Haz, HE
16-034(e)	16	Yes	Soil contamination area	Haz, HE
16-034(f)	16	Yes	Soil contamination area	Rad, Haz, HE
16-034(g)	16	Yes	Soil contamination	None
16-034(h)	16	Yes	Soil contamination area	None
16-034(i)	16	Yes	Soil contamination area	None
16-034(j)	16	Yes	Soil contamination area	None
16-034(k)	16	Yes	Soil contamination area	Haz, HE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
16-034(l)	16	Yes	Soil contamination area	Haz, HE
16-034(m)	16	Yes	Soil contamination area	Haz, HE
16-034(n)	16	Yes	Soil contamination area	Haz, HE
16-034(o)	16	Yes	Soil contamination area	Haz, HE
16-034(p)	16	Yes	Soil contamination area	Haz
16-035	16	Yes	Soil contamination area	Haz, HE, other
16-036	16	Yes	Soil contamination area	Rad, Haz, other
16-037	16	No	Aboveground tank	None
C-16-001	16	No	Building	None
C-16-002	16	No	Building	Haz
C-16-003	16	No	Septic system (see 16-005n)	None
C-16-004	16	No	Building	None
C-16-005	16	No	Building	Haz
C-16-006	16	No	Building	Haz
C-16-007	16	No	Tank stand	None
C-16-008	16	No	Building	None
C-16-009	16	No	Building	None

FIELD UNIT THREE

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-16-010	16	No	Building	None
C-16-011	16	No	Building	None
C-16-012	16	No	Building	None
C-16-013	16	No	Storage area	None
C-16-014	16	No	Building	None
C-16-015	16	No	Building	None
C-16-016	16	No	Building	None
C-16-017	16	No	Building	Haz
C-16-018	16	No	Aboveground tank	None
C-16-019	16	No	Building	None
C-16-020	16	No	Building	None
C-16-021	16	No	Building	None
C-16-022	16	No	Building	None
C-16-023	16	No	Warehouse	None
C-16-024	16	No	Building	None
C-16-025	16	Yes	Building	None
C-16-026	16	yes	Building	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-16-027	16	No	Building	None
C-16-028	16	No	Building	Haz
C-16-029	16	No	Building	None
C-16-030	16	No	Building	Haz
C-16-031	16	No	Building	Haz
C-16-032	16	No	Building	None
C-16-033	16	No	Warehouse	None
C-16-034	16	No	Aboveground tank	None
C-16-035	16	No	Aboveground tank	None
C-16-036	16	No	Septic system	None
C-16-037	16	No	Storage area	None
C-16-038	16	No	Storage area	None
C-16-039	16	No	Building	None
C-16-040	16	No	Building	None
C-16-041	16	No	Building	None
C-16-042	16	No	Steam manhole	None
C-16-043	16	No	Steam manhole	None

OU 1082

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-16-044	16	No	Manhole	None
C-16-045	16	No	Manhole	None
C-16-046	16	No	Manhole	None
C-16-047	16	No	Transport area	None
C-16-048	16	No	Steam manhole	None
C-16-049	16	No	Building	None
C-16-050	16	No	Building	None
C-16-051	16	No	Transport area	None
C-16-052	16	No	Steam manhole	None
C-16-053	16	No	Water manhole	None
C-16-054	16	No	Steam manhole	None
C-16-055	16	No	Switch Box	None
C-16-056	16	No	Steam manhole	None
C-16-057	16	No	Steam manhole	None
C-16-058	16	No	Transport area	None
C-16-059	16	No	Electrical pit	None
C-16-060	16	No	Building	Rad, Haz, HE

FIELD UNIT THREE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-16-061	16	No	Building	None
C-16-062	16	No	Generation area	None
C-16-063	16	No	Generation area	None
C-16-064	16	No	HE scrap pick-up	Haz, HE
C-16-065	16	No	Storage area	Haz
C-16-066	16	No	Storage area	None
C-16-067	16	No	Storage area	Haz, HE
C-16-068	16	No	Building	Rad, Haz, HE
C-16-069	16	No	Building	Haz
C-16-070	16	No	Underground tank	None
C-16-071	16	No	One-time spill	None
C-16-072	16	No	Tank	Haz
C-16-073	16	No	Underground tank	Haz
C-16-074	16	No	Storage	Rad, Haz, HE
25-001	25	No	Pit	None
C-25-001	25	No	Building	None
37-001	37	No	Septic system	None

FIELD UNIT THREE

OU 1122

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
33-001(a)	33	Yes	Material disposal area (MDA E)	Rad, Haz
33-001(b)	33	Yes	Material disposal area (MDA E)	Rad, Haz
33-001(c)	33	Yes	Material disposal area (MDA E)	Rad, Haz
33-001(d)	33	Yes	Material disposal area (MDA E)	Rad, Haz
33-001(e)	33	Yes	Material disposal area (MDA E)	None
33-002(a)	33	Yes	Septic tank located at MDA K	Rad, Haz
33-002(b)	33	Yes	Sump located at MDA K	Rad, Haz
33-002(c)	33	Yes	Sump located at MDA K	Rad, Haz
33-002(d)	33	Yes	Drain line and outfall located at MDA K	Rad
33-002(e)	33	Yes	Drain line and outfall located at MDA K	None
33-003(a)	33	Yes	Material disposal area (MDA D)	None
33-003(b)	33	Yes	Material disposal area (MDA D)	None
33-004(a)	33	Yes	Septic system	Haz
33-004(b)	33	Yes	Septic system	None
33-004(c)	33	Yes	Septic system	None
33-004(d)	33	Yes	Septic system	None
33-004(e)	33	Yes	Seepage pit	None

OU 1122

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
33-004(f)	33	Yes	Septic system	None
33-004(g)	33	Yes	Outfall	None
33-004(h)	33	Yes	Outfall	None
33-004(i)	33	Yes	Outfall	Haz
33-004(j)	33	Yes	Outfall	None
33-004(k)	33	Yes	Outfall	None
33-004(l)	33	No	Outfall	None
33-004(m)	33	Yes	Septic system	None
33-004(n)	33	No	Septic system	None
33-005(a)	33	Yes	Septic system	Haz
33-005(b)	33	Yes	Septic system	Haz
33-005(c)	33	Yes	Septic system	Haz
33-006(a)	33	Yes	Firing site	None
33-006(b)	33	Yes	Firing range	None
33-007(a)	33	Yes	Firing range	None
33-007(b)	33	Yes	Firing range	None
33-007(c)	33	Yes	Firing range	Rad

FIELD UNIT THREE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
33-008(a)	33	Yes	Landfill	None
33-008(b)	33	Yes	Landfill	None
33-009	33	Yes	Surface disposal	Haz
33-010(a)	33	Yes	Surface disposal	None
33-010(b)	33	Yes	Surface disposal	None
33-010(c)	33	Yes	Surface disposal	None
33-010(d)	33	Yes	Surface disposal	None
33-010(e)	33	No	Surface disposal (Area 6)	None
33-010(f)	33	Yes	Surface disposal	None
33-010(g)	33	Yes	Surface disposal	None
33-010(h)	33	Yes	Surface disposal	None
33-011(a)	33	Yes	Storage area	None
33-011(b)	33	No	Storage area	None
33-011(c)	33	Yes	Storage area	None
33-011(d)	33	Yes	Storage area	Rad, Haz
33-011(e)	33	Yes	Drum storage	None
33-012(a)	33	Yes	Drum storage	None

FIELD UNIT THREE

OU 1122

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
33-012(b)	33	No	Satellite storage area	None
33-012(c)	33	No	Satellite storage area	None
33-012(d)	33	No	Satellite storage area	None
33-013	33	Yes	Storage area	Haz
33-014	33	Yes	Burn site	None
33-015	33	Yes	Incinerator	None
33-016	33	Yes	Sump	Haz
33-017	33	Yes	Operational release	Haz
C-33-001	33	No	Transformer	None
C-33-002	33	No	Transformer	None

OU 1140

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
46-001	46	No	Aboveground tank	None
46-002	46	Yes	Surface impoundment	Rad, Haz, other
46-003(a)	46	Yes	Septic system	None
46-003(b)	46	Yes	Septic system	None
46-003(c)	46	Yes	Septic system	None
46-003(d)	46	Yes	Septic system	Rad, Haz, other
46-003(e)	46	Yes	Septic system	None
46-003(f)	46	Yes	Septic system	None
46-003(g)	46	Yes	Septic system	None
46-003(h)	46	Yes	Operational release	None
46-004(a)	46	Yes	Waste line	None
46-004(a2)	46	Yes	Outfall	None
46-004(b)	46	Yes	Operational release	None
46-004(b2)	46	Yes	Operational release	None
46-004(c)	46	Yes	Sump	Rad, Haz, other
46-004(c2)	46	Yes	Outfall	None
46-004(d)	46	Yes	Sump	Rad, Haz, other

FIELD UNIT THREE

OU 1140

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
46-004(d2)	46	Yes	Stack emissions	None
46-004(e)	46	Yes	Sump	Rad, Haz, other
46-004(f)	46	Yes	Outfall	None
46-004(g)	46	Yes	Outfall/Stack Emissions	None
46-004(h)	46	Yes	Outfall/Stack Emissions	None
46-004(i)	46	No	Outfall	None
46-004(j)	46	No	Outfall	None
46-004(k)	46	No	Outfall	None
46-004(l)	46	No	Outfall	None
46-004(m)	46	Yes	Outfall	None
46-004(n)	46	No	Outfall	None
46-004(o)	46	No	Outfall	None
46-004(p)	46	Yes	Sump	Haz, other
46-004(q)	46	Yes	Outfall	None
46-004(r)	46	Yes	Outfall	None
46-004(s)	46	Yes	Outfall	None
46-004(t)	46	Yes	Outfall	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
46-004(u)	46	Yes	Outfall	None
46-004(v)	46	Yes	Outfall	None
46-004(w)	46	Yes	Outfall	None
46-004(x)	46	Yes	Outfall	None
46-004(y)	46	Yes	Outfall	None
46-004(z)	46	Yes	Outfall	None
46-005	46	Yes	Surface impoundment	None
46-006(a)	46	Yes	Operational release	None
46-006(b)	46	Yes	Operational release	None
46-006(c)	46	Yes	Operational release	None
46-006(d)	46	Yes	Operational release	None
46-006(e)	46	No	Surface Disposal	None
46-006(f)	46	Yes	Storage area	None
46-006(g)	46	Yes	Operational Release	None
46-007	46	Yes	Operational Release	None
46-008(a)	46	Yes	Storage area	None
46-008(b)	46	Yes	Storage area	None

FIELD UNIT THREE

OU 1140

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
46-008(c)	46	Yes	Storage area	None
46-008(d)	46	Yes	Storage area	None
46-008(e)	46	Yes	Storage area	None
46-008(f)	46	Yes	Storage area	None
46-008(g)	46	Yes	Storage area	None
46-008misc	46	No	Storage area	None
46-009(a)	46	Yes	Surface disposal	None
46-009(b)	46	Yes	Surface disposal	None
46-010(a)	46	No	Storage area	None
46-010(b)	46	No	Storage area	None
46-010(c)	46	No	Storage area	None
46-010(d)	46	Yes	Operation release	None
46-010(e)	46	No	Storage area	None
46-010(f)	46	No	Storage area	None
46-010misc	46	No	Storage area	None
C-46-001	46	No	One-time spill	None
C-46-002	46	No	Stack Emissions	None

FIELD UNIT THREE

OU 1140

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-46-003	46	No	Stack Emissions	None

OU 1129

FIELD UNIT FOUR

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
4-001	04	Yes	Firing Site	Rad, Haz, HE
4-002	04	Yes	Surface disposal	Rad, Haz, HE
4-003(a)	04	Yes	Outfall	Rad, Haz
4-003(b)	04	Yes	Outfall	Haz
4-004	04	No	Soil contamination beneath bldgs.	Rad, Haz
C-4-001	04	No	Former Building Location	None NON-Rad contaminants
5-001(a)	05	Yes	Firing Site	Haz, Rad, HE
5-001(b)	05	Yes	Firing Site	Haz, Rad, HE
5-001(c)	05	No	Firing Site	Haz, Rad, HE
5-002	05	Yes	Canyonside disposal	Rad, Haz, HE
5-003	05	Yes	Calibration chamber	Rad, Haz
5-004	05	Yes	Septic system	Rad, Haz
5-005(a)	05	Yes	French drain	Rad, Haz
5-005(b)	05	Yes	Outfall	Rad, Haz
5-006(a)	05	No	Former Building Location	HE
5-006(b)	05	Yes	Soil contamination beneath bldgs.	Rad, Haz
5-006(c)	05	Yes	Soil contamination beneath bldgs.	Haz, HE

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
5-006(d)	05	No	Former Building Location	HE
5-006(e)	05	Yes	Soil contamination beneath bldgs.	Rad, Haz, HE
5-006(f)	05	No	Former Building Location	HE
5-006(g)	05	No	Former Building Location	HE
5-006(h)	05	Yes	Soil contamination beneath bldgs.	Rad, Haz, HE
C-5-001	05	No	Former Building Location	Haz Unknown
35-001	35	No	Material disposal area (MDA W)	liquid sodium with Pu-239
35-002	35	Yes	Material disposal area (MDA X)	Haz
35-003(a)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(b)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(c)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(d)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(e)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(f)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(g)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(h)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(i)	35	Yes	Waste water treatment facility storage tanks	None

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
35-003(j)	35	Yes	Waste water treatment facility	Rad, Haz Unknown
35-003(k)	35	Yes	Waste water treatment facility	Rad, Haz Unknown
35-003(l)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(m)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(misc)	35	No	Industrial waste lines	Rad
35-003(n)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(o)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(p)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(q)	35	Yes	Waste water treatment facility	Rad, Haz
35-003(r)	35	No	Outfall	Rad, Haz
35-004(a)	35	Yes	Storage areas	Haz
35-004(b)	35	Yes	Storage areas	Haz
35-004(c)	35	No	Storage areas	Haz
35-004(d)	35	No	Container storage area	Haz
35-004(e)	35	Yes	Container storage area	Haz
35-004(f)	35	No	Container storage area	Haz
35-004(g)	35	Yes	Container storage area	Haz

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
35-004(h)	35	Yes	Container storage area	Haz
35-004(i)	35	No	Container storage area	Haz
35-004(j)	35	No	Container storage area	Haz
35-004(k)	35	No	Container storage area	Haz
35-004(l)	35	No	Container storage area	Haz
35-004(m)	35	No	Container storage area	Haz
35-004(n)	35	No	Container storage area	Haz
35-004(o)	35	No	Container storage area	Haz
35-005(a)	35	No	Surface impoundment	Haz
35-005(b)	35	No	Surface impoundment	Haz
35-006	35	Yes	Surface impoundment	Haz
35-007	35	No	Waste oil treatment	Haz
35-008	35	Yes	Surface disposal and landfill	Haz
35-009(a)	35	Yes	Septic system	Haz
35-009(b)	35	Yes	Septic system	Haz
35-009(c)	35	Yes	Septic system	Haz, Rad
35-009(d)	35	Yes	Septic system	Haz, Rad

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
35-009(e)	35	Yes	Septic system	Haz
35-010(a)	35	Yes	Sanitary lagoon & sand filters	Rad, Haz
35-010(b)	35	Yes	Sanitary lagoon & sand filters	Rad, Haz
35-010(c)	35	Yes	Sanitary lagoon & sand filters	Rad, Haz
35-010(d)	35	Yes	Sanitary lagoon & sand filters	Rad, Haz
35-010(e)	35	No	Discharge Headwall	Rad, Haz
35-011(a)	35	Yes	Underground storage tank	Haz
35-011(b)	35	No	Underground storage tank	Haz
35-011(c)	35	No	Underground storage tank	Haz
35-011(d)	35	No	Underground storage tank	None
35-012(a)	35	No	Underground storage tank	Haz
35-012(b)	35	No	Underground storage tank (inactive)	None
35-013(a)	35	Yes	Sump	Rad, Haz
35-013(b)	35	Yes	Sump	Haz
35-013(c)	35	Yes	Sump	Haz
35-013(d)	35	Yes	Sump	Haz
35-014(a)	35	Yes	Operational release	Rad, Haz

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
35-014(b)	35	Yes	Leaking Drum	"Rad, haz. const., other"
35-014(c)	35	No	Operational release	Haz
35-014(d)	35	No	Operational release	Rad, Haz
35-014(e)	35	Yes	Oil Spill	Haz
35-014(e2)	35	No	Oil Spill	Haz
35-014(e3)	35	No	Operational release	Haz
35-014(f)	35	No	Soil contamination	Haz
35-014(g)	35	Yes	Soil contamination	Haz
35-014(g2)	35	No	Soil contamination	Other
35-014(g3)	35	No	Soil contamination	Haz
35-015(a)	35	Yes	Soil contamination	Haz
35-015(b)	35	Yes	Waste oil treatment	Haz
35-016(a)	35	Yes	Drains and outfalls	Unknown
35-016(b)	35	No	Outfall	Haz
35-016(c)	35	Yes	Outfall	Unknown
35-016(d)	35	Yes	Outfall	Haz
35-016(e)	35	No	Outfall	Unknown

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
35-016(f)	35	No	Storm drain	Haz
35-016(g)	35	No	Outfall	Haz, Rad
35-016(h)	35	No	Storm drain	Rad
35-016(i)	35	Yes	Drains and outfalls	Unknown
35-016(j)	35	No	Storm drain	Haz
35-016(k)	35	Yes	Drains and outfalls	Unknown
35-016(l)	35	No	Storm drain	Rad
35-016(m)	35	Yes	Drains and outfalls	Haz
35-016(n)	35	No	Storm drain	Haz
35-016(o)	35	Yes	Drains and outfalls	Rad, Other
35-016(p)	35	Yes	Outfall	Unknown
35-016(q)	35	Yes	Drains and outfalls	Rad, Haz
35-017	35	No	Soil contamination from Reactor	Rad, Haz
35-018(a)	35	No	Transformer	Haz
35-018(b)	35	No	Former transformer site	Rad, Haz
C-35-001	35	No	Former UST site	None
C-35-002	35	No	Former UST site	None

FIELD UNIT FOUR

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-35-003	35	No	Former UST site	None
C-35-004	35	No	Operational release	None
C-35-005	35	No	Operational release	Haz
C-35-006	35	No	Operational release	Haz
C-35-007	35	No	Soil contamination	Unknown
C-35-008	35	No	Leaking transformer	Haz
42-001(a)	42	Yes	Incinerator complex.	Rad
42-001(b)	42	Yes	Incinerator complex.	Rad
42-001(c)	42	Yes	Incinerator complex.	Rad
42-002(a)	42	No	Decontam. facility	Rad, Haz
42-002(b)	42	Yes	Decontam. facility driveway	Rad, Haz
42-003	42	Yes	Septic system	Rad, Haz
42-004	42	No	Canyon disposal	Rad
48-001	48	No	Air exhaust system	Rad, Haz
48-002(a)	48	Yes	Container storage area	Haz
48-002(b)	48	Yes	Container storage area	Haz
48-002(c)	48	No	Container storage area	Haz

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
48-002(d)	48	No	Container storage	Rad
48-002(e)	48	No	Container storage	Haz
48-003	48	Yes	Septic system	Rad, Haz
48-004(a)	48	Yes	Sumps and tanks	Haz
48-004(b)	48	Yes	Sumps and tanks	Rad, Haz
48-004(c)	48	Yes	Sumps and tanks	Haz
48-004(d)	48	No	Sumps and tanks	None
48-005	48	Yes	Waste lines	Haz, Rad
48-006	48	No	Septic system	None
48-007(a)	48	Yes	Drains and outfalls	Haz
48-007(b)	48	Yes	Drains and outfalls	Unknown
48-007(c)	48	Yes	Drains and outfalls	Unknown
48-007(d)	48	Yes	Drains and outfalls	Haz
48-007(e)	48	No	Outfall	Haz
48-007(f)	48	Yes	Drains and outfalls	Unknown
48-008	48	No	Transformer leak	Haz
48-009	48	No	Soil contamination	Haz

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
48-010	48	Yes	Surface Impoundment	Rad, Haz
48-011	48	No	Disposal shaft	Haz
52-001(a)	52	Yes	UHTREX equip.	Rad
52-001(b)	52	Yes	UHTREX equip.	None
52-001(c)	52	Yes	UHTREX equip.	None
52-001(d)	52	Yes	UHTREX equip.	Haz
52-002(a)	52	Yes	Septic system	Rad, Haz
52-002(b)	52	Yes	Septic system	None
52-002(c)	52	Yes	Septic system	None
52-002(d)	52	Yes	Septic system	None
52-002(e)	52	Yes	Septic system with 63-001(a)	None
52-002(f)	52	Yes	Septic system	None
52-002(g)	52	No	Septic system	None
52-003(a)	52	No	Waste treatment facility	Haz
52-003(b)	52	No	Industrial Wasteline	Haz
52-004	52	No	Evaporator	None
63-001(b)	52	Yes	Septic system	Haz

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-52-001	52	No	Former transformer site	Haz
C-52-002	52	No	Former transformer site	Haz
55-001	55	No	Cement plant	Rad
55-002(a)	55	No	Rad waste storage area	Rad
55-002(b)	55	No	Rad waste storage area	None
55-002(c)	55	No	Container Storage Area	Rad
55-003	55	No	Containment area	None
55-004	55	No	Evaporator	Rad
55-005	55	No	Filtration Unit	None
55-006	55	No	Glass Breaker	None
55-007	55	No	Thermal combustion unit	None
55-008	55	Yes	Sumps and tanks	Rad
55-009	55	Yes	Sumps and tanks	Haz
55-010	55	No	Solvent spills	Rad, Haz
55-011(a)	55	No	Storm drain	Rad, Haz
55-011(b)	55	No	Storm drain	Rad, Haz
55-011(c)	55	No	Storm drain	Rad, Haz

OU 1129

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
55-011(d)	55	No	Storm drain	Rad, Haz
55-011(e)	55	No	Storm drain	Rad, Haz
55-012	55	No	Container storage area	None
55-013(a)	55	No	Storage area	None
55-013(b)	55	No	Storage area	None
63-001(a)	63	Yes	Septic system	Haz
63-002	63	No	Container storage area	Haz

FIELD UNIT FOUR

OU 1049

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
0-001	Canyon Site	Yes	Sediment Traps	Rad, Haz
C-0-001	Canyon Site	No	Guaje Canyon	HE, Haz
C-0-002	Canyon Site	No	Rendija Canyon	HE, Haz
C-0-003	Canyon Site	No	Barrancas Canyon	HE, Haz
C-0-004	Canyon Site	No	Bayo Canyon	Rad, Haz
C-0-005	Canyon Site	No	Pueblo Canyon	Rad, Haz
C-0-006	Canyon Site	No	Los Alamos Canyon	Rad, Haz
C-0-007	Canyon Site	No	Sandia Canyon	Rad, Haz
C-0-008	Canyon Site	No	Mortandad Canyon	Rad, Haz
C-0-009	Canyon Site	No	Canada del Buey	Rad, Haz, HE
C-0-010	Canyon Site	No	Two Mile Canyon	Rad, Haz, HE
C-0-011	Canyon Site	No	Pajarito Canyon	Rad, Haz
C-0-012	Canyon Site	No	Three Mile Canyon	Rad, Haz, HE
C-0-013	Canyon Site	No	Potrillo Canyon	Rad, Haz
C-0-014	Canyon Site	No	Canon de Valle	Rad, Haz, HE
C-0-015	Canyon Site	No	Fence Canyon	Rad, Haz, HE
C-0-016	Canyon Site	No	Water Canyon	Rad, Haz, HE

FIELD UNIT FOUR

OU 1049

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-0-017	Canyon Site	No	Indio Canyon	Rad, Haz, HE
C-0-018	Canyon Site	No	Ancho Canyon	Rad, Haz, HE
C-0-019	Canyon Site	No	Chaquehui Canyon	Rad, Haz, HE

FIELD UNIT FOUR

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
2-001	02	No	Open burning ground	None
2-002	02	No	Storage area	None
2-003(a)	02	No	Reactor facility	Rad, Haz
2-003(b)	02	No	Reactor facility	Rad, Haz
2-003(c)	02	No	Reactor facility	Rad, Haz
2-003(d)	02	No	Reactor facility	Rad, Haz
2-003(e)	02	No	Holding tank (near reactor water boiler)	Rad
2-004(a)	02	No	Reactor facility	Rad, Haz
2-004(b)	02	No	Reactor facility	Rad, Haz
2-004(c)	02	No	Reactor facility	Rad, Haz
2-004(d)	02	No	Reactor facility	Rad, Haz
2-004(e)	02	No	Reactor facility	Rad, Haz
2-004(f)	02	No	Reactor facility	Rad, Haz
2-004(g)	02	No	Aboveground tank	Rad, Haz
2-005	02	Yes	Systematic leak Cooling tower blowdown—Cr^{+6}	Haz
2-006(a)	02	Yes	Ind. or san. waste water treat.	Rad, Haz
2-006(b)	02	Yes	Ind. or san. waste water treat.	Rad, Haz

FIELD UNIT FOUR

OU 1098

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
2-006(c)	02	No	Waste line	Rad, Haz
2-006(d)	02	No	Waste line	Rad, Haz
2-006(e)	02	No	Waste line	Rad, Haz
2-007	02	Yes	Septic system	Rad, Haz
2-008(a)	02	Yes	Outfall	Rad, Haz
2-008(b)	02	Yes	Ind. or san. waste water treat.	Haz
2-008(c)	02	No	Outfall	Haz
2-009(a)	02	Yes	Non-intentional release	Rad, Haz
2-009(b)	02	Yes	Non-intentional release	Rad, Haz
2-009(c)	02	Yes	Non-intentional release	Rad, Haz
2-009(d)	02	No	Non-intentional release	Rad, Haz
2-009(e)	02	No	Reactor facility	Rad, Haz
2-010	02	No	Building	Rad, Haz
2-011(a)	02	No	Storm drain and outfall	Rad, Haz
2-011(b)	02	No	Storm drain and outfall	Rad, Haz
2-011(c)	02	No	Storm drain and outfall	Rad, Haz
2-011(d)	02	No	Storm drain and outfall	Haz

FIELD UNIT FOUR

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
2-011(e)	02	No	Storm drain and outfall	Haz
2-012	02	No	Underground tank	Haz
2-013	02	No	Storage area	None
41-001	41	Yes	Septic system	Rad, Haz
41-002(a)	41	Yes	Waste water treatment facility	Rad, Haz
41-002(b)	41	Yes	Waste water treatment facility	Rad, Haz
41-002(c)	41	Yes	Waste water treatment facility	Rad, Haz
41-003	41	No	Sump	Haz
41-004	41	No	Container storage	None
C-41-001	41	No	Sump	None
C-41-002	41	No	Underground tank	None
C-41-003	41	No	Underground tank	None
C-41-004	41	No	Storm drains	Haz
C-41-005	41	No	Underground tank Mystery tank	Haz

OU 1111

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
6-001(a)	06	Yes	Septic system	Rad, Haz
6-001(b)	06	Yes	Septic system	Rad, Haz
6-002	06	Yes	Septic system	Haz, HE
6-003(a)	06	Yes	Firing site	Rad, Haz
6-003(b)	06	No	Firing site	None
6-003(c)	06	Yes	Firing site	Rad, Haz
6-003(d)	06	Yes	Firing site	Haz, HE
6-003(e)	06	Yes	Firing site	Haz, HE
6-003(f)	06	Yes	Firing site	Rad, Haz
6-003(g)	06	Yes	Firing site & building	Haz, HE
6-003(h)	06	Yes	Firing site	
6-004	06	No	Sump	None
6-005	06	Yes	Firing site (pit)	Rad, Haz
6-006	06	Yes	Storage area	Haz, other
6-007(a)	06	Yes	Material disposal area (MDA F)	Rad, Haz
6-007(b)	06	Yes	Landfill	Rad, Haz
6-007(c)	06	Yes	Landfill	Rad, Haz

FIELD UNIT FIVE

OU 1111

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
6-007(d)	06	Yes	Landfill	Rad, Haz
6-007(e)	06	Yes	Landfill	Rad, Haz
6-007(f)	06	Yes	Surface disposal	Rad, Haz
6-007(g)	06	Yes	Building & surface disposal	Rad, Haz
6-008	06	No	Underground tank	Rad, Haz
C-6-001	06	No	Building	Haz, HE
C-6-003	06	No	Building	Haz, HE
C-6-005	06	No	Building	Haz, HE
C-6-006	06	No	Building	Haz, HE
C-6-007	06	No	Building	Haz
C-6-008	06	No	Building	Haz, HE
C-6-009	06	No	Building	Haz, HE
C-6-010	06	No	Building	Haz, HE
C-6-011	06	No	Building	Haz, HE
C-6-012	06	No	Building	Haz, HE
C-6-013	06	No	Building	Haz, HE
C-6-014	06	No	Building	Haz, HE

OU 1111

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-6-015	06	No	Building	Haz, HE
C-6-016	06	No	Building	Haz, HE
C-6-017	06	No	Building	Haz, HE
C-6-018	06	No	Building	Haz, HE
C-6-019	06	No	Building	Haz, HE
C-6-020	06	No	Building	None
C-6-021	06	No	Building	Haz, HE
7-001(a)	07	Yes	Firing site	Haz, HE
7-001(b)	07	Yes	Firing site	Haz, HE
7-001(c)	07	Yes	Firing site	Haz, HE
7-001(d)	07	Yes	Firing site	Haz, HE
22-001	22	No	Building	None
22-003(a)	22	No	Satellite storage area	None
22-003(b)	22	No	Satellite storage area	None
22-003(c)	22	No	Satellite storage area	None
22-003(d)	22	No	Satellite storage area	None
22-003(e)	22	No	Satellite storage area	None

OU 1111

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
22-003(f)	22	No	Satellite storage area	None
22-003(g)	22	No	Satellite storage area	None
22-010(a)	22	Yes	Septic system	Rad, Haz
22-010(b)	22	No	Septic system	Rad, Haz
22-011	22	Yes	Disposal pit	None
22-012	22	Yes	Decontamination facility	Haz, HE
22-013	22	No	Liquid waste treatment/storage	None
22-014(a)	22	Yes	Ind. or san. wastewater treat.	Haz, HE
22-014(b)	22	Yes	Sump	Haz, HE
22-014(c)	22	No	Unit (does not exist)	None
22-015(a)	22	Yes	Drain lines and dry wells	Haz
22-015(b)	22	Yes	Sump and outfall	Haz, HE
22-015(c)	22	Yes	Outfall	Haz
22-015(d)	22	Yes	Drain line and outfall	Haz, HE
22-015(e)	22	Yes	Ind. or san. wastewater treat.	Haz, HE
22-016	22	Yes	Septic system	Rad, Haz
40-001(a)	40	Yes	Septic system	None

OU 1111

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
40-001(b)	40	Yes	Septic system	Haz, HE
40-001(c)	40	Yes	Septic system	Haz, HE
40-002(a)	40	No	Container storage area	None
40-002(b)	40	No	Container storage area	None
40-002(c)	40	No	Container storage area	None
40-003(a)	40	Yes	Firing site- RCRA Closure	None
40-003(b)	40	No	Burning area/open detonation	None
40-004	40	Yes	Oper. release	Haz
40-005	40	Yes	Sump	Haz, HE
40-006(a)	40	Yes	Firing site	Rad, Haz
40-006(b)	40	Yes	Firing site	Rad, Haz
40-006(c)	40	Yes	Firing site	Rad, Haz
40-007(a)	40	No	Storage area	Haz, HE
40-007(b)	40	No	Storage area	Haz, HE
40-007(c)	40	No	Storage area	Haz, HE
40-007(d)	40	No	Storage area	Haz, HE
40-007(e)	40	No	Storage area	Haz, HE

FIELD UNIT FIVE

OU 1111

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
40-008	40	No	HE storage area decommissioned	None
40-009	40	Yes	Landfill	Rad, Haz
40-010	40	Yes	Surface disposal site	Rad, Haz
C-40-001	40	No	Usage site	None

FIELD UNIT FIVE

OU 1144

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
49-001(a)	49	Yes	Material disposal area (MDA AB experimental shafts)	Rad, Haz
49-001(b)	49	Yes	Material disposal area (MDA AB experimental shafts)	Rad, Haz
49-001(c)	49	Yes	Material disposal area (MDA AB experimental shafts)	Rad, Haz
49-001(d)	49	Yes	Material disposal area (MDA AB experimental shafts)	Rad, Haz
49-001(e)	49	Yes	Material disposal area (MDA AB experimental shafts)	Rad, Haz
49-001(f)	49	Yes	Material disposal area (MDA AB experimental shafts)	Rad, Haz
49-001(g)	49	Yes	Material disposal area (MDA AB miscellaneous)	Rad, Haz
49-002	49	No	Operational facility (Area 10 underground chamber)	Rad, Haz
49-003	49	Yes	Leach field (Area 11 Radchem and small shot area)	Rad, Haz
49-004	49	Yes	Burn site and landfill (Area 6)	Haz
49-005(a)	49	Yes	Landfill (east of Area 10)	Haz
49-005(b)	49	No	Landfill (Area 5)	Haz
49-006	49	Yes	Sump (Area 5)	Haz
49-007(a)	49	No	Septic system (Area 6)	None
49-007(b)	49	No	Septic system (HDT area)	None
49-008(a)	49	No	Soil contamination (Area 5)	Rad, Haz
49-008(b)	49	No	Soil contamination (Area 6)	Rad, Haz

FIELD UNIT FIVE

OU 1144

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
49-008(c)	49	No	Soil contamination (Area 11)	Rad, Haz
49-008(d)	49	No	Firing sites (Bottle House area; soil contamination and underground chamber)	Rad, Haz
49-009	49	No	Underground tank (non-existent)	Haz

7OU 1144

FIELD UNIT FIVE

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
50-001(a)	50	Yes	Waste treatment facility	Rad, Haz
50-001(b)	50	No	Waste lines and manholes	Rad, Haz
50-002(a)	50	Yes	Underground tanks	Rad, Haz
50-002(b)	50	Yes	Underground tank	Rad, Haz
50-002(c)	50	Yes	Underground tank	Rad, Haz
50-002(d)	50	No	Underground tank	Haz
50-003(a)	50	No	Storage area	Rad, Haz
50-003(b)	50	No	Storage area	None
50-003(c)	50	No	Storage area	None
50-003(d)	50	No	Storage area	None
50-003(e)	50	No	Storage area	None
50-004(a)	50	Yes	Waste lines	Rad, Haz
50-004(b)	50	Yes	Underground tanks	Rad, Haz
50-004(c)	50	Yes	Waste lines	Rad, Haz
50-005	50	No	Waste treatment facility	None
50-006(a)	50	Yes	Operational release	Rad, Haz
50-006(b)	50	No	Operational release	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
50-006(c)	50	Yes	Operational release	Rad, Haz
50-006(d)	50	Yes	Effluent discharge	Rad, Haz
50-006(e)	50	No	Aboveground tank	None
50-007	50	No	Incinerator	None
50-008	50	No	Reduction site	None
50-009	50	Yes	Material disposal area (MDA C)	Rad, Haz
50-010	50	No	Decontamination facility	Rad, Haz
50-011(a)	50	Yes	Septic system	Rad, Haz
50-011(b)	50	No	Septic system	Rad, Haz
C-50-001	50	No	Transformer	None

FIELD UNIT FIVE

OU 1147

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
50-001(a)	50	Yes	Waste treatment facility	Rad, Haz
50-001(b)	50	No	Waste lines and manholes	Rad, Haz
50-002(a)	50	Yes	Underground tanks	Rad, Haz
50-002(b)	50	Yes	Underground tank	Rad, Haz
50-002(c)	50	Yes	Underground tank	Rad, Haz
50-002(d)	50	No	Underground tank	Haz
50-003(a)	50	No	Storage area	Rad, Haz
50-003(b)	50	No	Storage area	None
50-003(c)	50	No	Storage area	None
50-003(d)	50	No	Storage area	None
50-003(e)	50	No	Storage area	None
50-004(a)	50	Yes	Waste lines	Rad, Haz
50-004(b)	50	Yes	Underground tanks	Rad, Haz
50-004(c)	50	Yes	Waste lines	Rad, Haz
50-005	50	No	Waste treatment facility	None
50-006(a)	50	Yes	Operational release	Rad, Haz
50-006(b)	50	No	Operational release	None

FIELD UNIT FIVE

OU 1147

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
50-006(c)	50	Yes	Operational release	Rad, Haz
50-006(d)	50	Yes	Effluent discharge	Rad, Haz
50-006(e)	50	No	Aboveground tank	None
50-007	50	No	Incinerator	None
50-008	50	No	Reduction site	None
50-009	50	Yes	Material disposal area (MDA C)	Rad, Haz
50-010	50	No	Decontamination facility	Rad, Haz
50-011(a)	50	Yes	Septic system	Rad, Haz
50-011(b)	50	No	Septic system	Rad, Haz
C-50-001	50	No	Transformer	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
51-001	51	No	Septic system	Haz
51-002(a)	51	No	Usage site (Environmental Research Caisson)	None
51-002(b)	51	No	Usage site (Environmental Research Caisson)	None
C-51-001	51	No	Storage area	None
C-51-002	51	No	Buildings	None
54-001(a)	54	Yes	Storage area surface	Haz
54-001(b)	54	No	Storage area	Haz
54-001(c)	54	Yes	Storage area	None
54-001(d)	54	No	Storage area	Haz, other
54-001(e)	54	No	Storage area	Haz
54-001(f)	54	No	Storage area	None
54-002	54	No	Storage area (gas cylinder storage area)	Haz
54-004	54	Yes	Material disposal area (MDA H, except sh. 9)	Rad, Haz
54-005	54	Yes	Material disposal area (MDA J), Pits 1-5, Shafts 1-4)	Rad, Haz, HE, other
54-006	54	Yes	Material disposal area (All subsurface units at MDA L such as Pit A, SI B,C,D Shafts 1-28, 30-34)	Rad, Haz, HE, other
54-007(a)	54	Yes	Septic system (tank and seepage trench)	Rad, Haz
54-007(b)	54	Yes	Septic system	None

OU 1148

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
54-007(c)	54	Yes	Septic system	Haz
54-007(d)	54	No	Septic system	Haz
54-007(e)	54	No	Septic system	Haz
54-008	54	No	Underground tank	None
54-009	54	No	Aboveground tanks (treatment tanks MDA L)	Haz
54-010	54	No	Underground tank (supply wash-water tank)	None
54-012(a)	54	No	Reduction site (drum compactor)	Rad, Haz
54-012(b)	54	Yes	Reduction site	Haz
54-013(a)	54	Yes	Decontamination facility (not buildt)	None
54-013(b)	54	Yes	Disposal Pit (truck washing pit converted to Pit 19)	Rad, Haz
54-014(a)	54	No	Storage shafts (Pb stringer shafts, MDA L)	Rad, Haz
54-014(b)	54	Yes	Storage pit (Pit 9, MDA G, TRU waste)	Rad, Haz
54-014(c)	54	Yes	Storage shafts MDA G shafts 200-233)	Rad, Haz
54-014(d)	54	Yes	Storage trenches A, B, C, D	Rad, Haz
54-015(a)	54	No	Storage area (surface corrosive inhibitor)	Rad
54-015(b)	54	No	Storage area (TRU surface storage)	Rad
54-015(c)	54	No	Storage area, TRU Pad 1	Rad

OU 1148

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
54-015(d)	54	No	Storage area, TRU Pad 2	Rad
54-015(e)	54	No	Storage area, TRU Pad 3	Rad
54-015(f)	54	No	Storage area, TRU Pad 4	Rad
54-015(g)	54	No	Storage area (Pb casks near shaft 4)	None
54-015(h)	54	Yes	Storage area (drums)	None
54-015(i)	54	No	Storage area-forklift battery	None
54-015(j)	54	No	Storage area (Dome #49, mixed waste sludge)	Rad, Haz
54-015(k)	54	Yes	Storage area (TRU waste mound)	Rad
54-016(a)	54	No	Sump	None
54-016(b)	54	No	Sump	Rad, Haz
54-017	54	Yes	Disposal pits 16,22 (active before 11/19/80)	Rad, Haz
54-018	54	Yes	Disposal pits 27-33,35-37 (active after 11/19/80)	Rad, Haz, other
54-019	54	Yes	Disposal shafts (active before 11/19/80)	Rad, Haz
54-020	54	Yes	Disposal shafts (active after 11/19/80)	Rad, Haz, other
54-021	54	No	Aboveground oil storage tanks (6)	None
54-022	54	No	Transformer spill (PCB)	None

FIELD UNIT FIVE

OU 1154

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
57-001(a)	57	No	Drilling mud pits	None
57-001(b)	57	No	Drilling mud pits	
57-001(c)	57	No	Drilling mud pits	
57-002	57	No	Landfill	Haz
57-003	57	No	Storage area	None
57-004(a)	57	No	Surface impoundment	
57-004(b)	57	No	Surface impoundment	Haz
57-005	57	No	Pond filtration unit	None
57-006	57	No	Drum and Contents	Haz
57-007	57	No	Leach Field	Haz

FIELD UNIT FIVE

OU 1157

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
8-001(a)	08	No	Buildings	Rad, Haz
8-001(b)	08	No	Buildings	Rad, Haz
8-002	08	Yes	Firing site	Rad, Haz
8-003(a)	08	Yes	Septic system	Haz, HE
8-003(b)	08	Yes	Septic system	None
8-003(c)	08	Yes	Septic system	None
8-004(a)	08	Yes	Floor drain	Rad, Haz
8-004(b)	08	Yes	Drain line	Rad, Haz
8-004(c)	08	Yes	Floor drain	Rad, Haz
8-004(d)	08	Yes	Drain	Rad
8-005	08	Yes	Container storage area	Haz
8-006(a)	08	Yes	Landfill (MDA Q)	Rad, Haz
8-006(b)	08	Yes	Landfill	None
8-007	08	Yes	Silver recovery unit	None
8-008(a)	08	No	Storage area	None
8-008(b)	08	No	Storage area	None
8-008(c)	08	No	Storage area	None

OU 1157

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
8-008(d)	08	No	Storage area	None
8-009(a)	08	Yes	Ind. or san. wastewater treat.	Haz
8-009(b)	08	No	Ind. or san. wastewater treat.	None
8-009(c)	08	No	Storm drain and outfall	Haz
8-009(d)	08	Yes	Ind. or san. wastewater treat.	Haz
8-009(e)	08	Yes	Ind. or san. wastewater treat.	Haz
8-009(f)	08	No	Outfall	Haz
8-010(a)	08	No	Storage area	None
8-010(b)	08	No	Storage area	None
8-010(c)	08	No	Storage area	None
8-011(a)	08	No	Underground tank	None
8-011(b)	08	No	Underground tank	None
C-8-001	08	No	Building	None
C-8-002	08	No	Building	None
C-8-003	08	No	Building	None
C-8-004	08	No	Building	None
C-8-005	08	No	Building	None

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-8-006	08	No	Building	None
C-8-007	08	No	Building	None
C-8-008	08	No	Building	None
C-8-009	08	No	Building	None
C-8-010	08	Yes	Building	Haz
C-8-011	08	No	Building	None
C-8-012	08	No	Building	None
C-8-013	08	No	Building	None
C-8-014	08	No	Laboratory	Haz
C-8-015	08	No	Building	None
C-8-016	08	No	Building	None
C-8-017	08	No	Storage area	None
C-8-018	08	No	Storage area	None
C-8-019	08	No	Storage area	None
C-8-020	08	No	Disposal area	None
9-001(a)	09	Yes	Firing sites	Rad, Haz
9-001(b)	09	Yes	Firing sites	Rad, Haz

OU 1157

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
9-001(c)	09	Yes	Firing sites	Rad, Haz
9-001(d)	09	Yes	Firing sites	Rad, Haz
9-002	09	Yes	Burn pit	Rad, Haz
9-003(a)	09	Yes	Settling tank	Rad, Haz
9-003(b)	09	Yes	Settling tank	Rad, Haz
9-003(c)	09	Yes	Electric manhole	None
9-003(d)	09	Yes	Settling tank	Haz, HE
9-003(e)	09	Yes	Settling tank	Haz, HE
9-003(f)	09	Yes	Settling tank	None
9-003(g)	09	Yes	Settling tank	Haz, HE
9-003(h)	09	Yes	Settling tank	Haz, HE
9-003(i)	09	Yes	Settling tank	Haz, HE
9-004(a)	09	Yes	Settling tank	Haz, HE
9-004(b)	09	Yes	Settling tank	Haz, HE
9-004(c)	09	Yes	Settling tank	Haz, HE
9-004(d)	09	Yes	Settling tank	Haz, HE
9-004(e)	09	Yes	Settling tank	Haz, HE

OU 1157

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
9-004(f)	09	Yes	Settling tank	Haz, HE
9-004(g)	09	Yes	Settling tank	Haz, HE
9-004(h)	09	Yes	Settling tank	Haz, HE
9-004(i)	09	Yes	Settling tank	Haz, HE
9-004(j)	09	Yes	Settling tank	Haz, HE
9-004(k)	09	Yes	Settling tank	Haz, HE
9-004(l)	09	Yes	Settling tank	Haz, HE
9-004(m)	09	Yes	Settling tank	Haz, HE
9-004(n)	09	Yes	Settling tank	Haz, HE
9-004(o)	09	Yes	Settling tank	Haz, HE
9-005(a)	09	Yes	Septic system	Haz, HE
9-005(b)	09	Yes	Septic system	None
9-005(c)	09	Yes	Septic system	None
9-005(d)	09	Yes	Septic system	Haz, HE
9-005(e)	09	Yes	Septic system	None
9-005(f)	09	Yes	Septic system	None
9-005(g)	09	Yes	Septic system	None

OU 1157

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
9-005(h)	09	Yes	Septic system	None
9-006	09	Yes	Septic system	Rad, Haz, HE, other
9-007	09	Yes	Basket pit	None
9-008(a)	09	No	Surface impoundment	None
9-008(b)	09	Yes	Surface impoundment	Rad
9-009	09	Yes	Surface impoundment	Rad
9-010(a)	09	No	Storage area	Haz, HE
9-010(b)	09	No	Storage area	Haz, HE
9-010(c)	09	No	Storage area	None
9-011(a)	09	No	Storage area	None
9-011(b)	09	No	Storage area	Haz, HE
9-011(c)	09	No	Storage area	Haz, HE
9-012	09	No	Disposal pit	Rad, Haz
9-013	09	Yes	Material disposal area (MDA M)	Rad, Haz, HE, other
9-014	09	No	Firing site	Rad, Haz, HE
9-015	09	No	Manhole	None
9-016	09	No	Underground tank	None

FIELD UNIT FIVE

OU 1157

PRS Number	TA	HSWA SWMU	Unit Description	Potential Contaminants
C-9-001	09	Yes	Soil contamination	Haz
C-9-002	09	No	Buildings	None
C-9-003	09	No	Buildings	None
C-9-004	09	No	Building	None
C-9-005	09	No	Building	None
C-9-006	09	No	Buildings	None
C-9-007	09	No	Building	None
C-9-008	09	No	Underground tank	None
C-9-009	09	No	Non-intentional release	None
C-9-010	09	No	Burn site	None
C-9-011	09	No	Burn site	None
69-001	69	Yes	Incinerator and assoc. equip.	Haz
69-002(a)	69	No	Septic system	None
69-002(b)	69	No	Septic system	None

Projected Schedule and Cost for the Environmental Restoration Project at Los Alamos National Laboratory

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION
FY95 COST PLAN ($K)

Proposed for BCP#LANL-ER-95-023

PROJECT NAME: LOS ALAMOS NATIONAL LABORATORY

UNIVERSITY of CALIFORNIA

DATE: 28-Nov-95

WBS	TASK	PRIOR FY BCWS TOTAL	FY96 Total	Budget Year FY97	FIVE YEAR PLAN WINDOW FY98	FY99	FY00	FY01	FY02	ESTIMATE TO COMPLETE	BAC
6.1.1	FU#1	58,726	14,429	10,386	9,910	9,898	11,203	9,865	18,637	30,000	173,054
6.1.2	FU#2	26,382	6,999	5,788	5,655	5,622	6,144	5,446	6,494	1,527	70,059
6.1.3	FU#3	17,231	5,354	4,840	4,760	4,666	4,854	4,689	3,307	1,796	51,497
6.1.4	FU#4	21,606	6,466	5,026	5,432	7,814	7,153	6,005	13,262	118,116	190,880
6.1.5	FU#5	32,281	6,700	5,597	5,496	5,494	5,995	5,264	62,388	43,646	172,860
6.1.6	CLOSURES	6,611	4,360	2,864	1,650	991	2,301	2,499	2,737	0	24,012
6.2	DECOMMISSIONING	26,677	6,648	5,641	5,690	5,585	4,626	4,516	10,483	12,053	81,918
6.3.7	MANAGEMENT	64,511	12,392	8,893	8,605	8,617	9,702	8,300	14,338	33,723	169,081
6.3.8	TECH SUPPORT	50,282	1,870	1,863	1,888	1,942	1,925	1,735	1,657	4,695	67,857
6.4	SURV. & MAINTENANCE	22	0	0	0	0	0	0	0	0	22
6.6	MWDF	12,298	393	0	0	0	0	0	0	0	12,691
6	ER TOTAL	316,626	65,609	50,899	49,087	50,631	53,901	48,319	133,303	245,556	1,013,931
	CUM PLAN/PMB	316,626	382,236	433,135	482,222	532,852	586,754	635,072	768,375	1,013,931	
	ER PROGRAMMATIC MANAGEMENT RESERVE		3,094	807	1,443	307	1,317	2,426	0	5,000	14,394
	LANL INSTALLATION BUDGET BASE (IBB)		68,704	51,706	50,530	50,937	55,219	50,744	133,303	250,556	1,028,325
	ER PROGRAMMATIC CONTINGENCY REQUEST		2,296	1,985	1,374	967	1,509	1,160	7,212	13,285	29,788
	LANL PROJECT BUDGET BASE (PBB)		71,000	53,691	51,904	51,904	56,728	51,904	140,515	263,840	1,058,112
	ANTICIPATED CARRYOVER FROM FY95		-6,000				LANL Project Manager:				
	NEW BUDGET AUTHORITY: LANL FY96 w/CONTGNCY.		65,000								

FU #1: GARRY ALLEN

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A112531142	0	0	0	TA-3: Draft Rpt to EPA 3-056(c) EC R		6OCT95
A104A02008	0	0	0	TA21 V DP EPA Draft Complete Ph1		31OCT95
A102110606	0	0	0	TA21 DELIVER D&D WP Mod. to EPA Ph1		14NOV95
A104A14009	0	0	0	TA21 14.6 EPA Draft Complete Ph1		8DEC95
A103A20009	0	0	0	TA21 15.5 EPA Draft Complete Ph2 Smpl Pln		11DEC95
A104A19124	0	0	0	TA21 15.4 - 011k EPA Draft Complete PH2 Smp Plan		14DEC95
A104B05008	0	0	0	TA0: Drf IFR - RFI Rpt to EPA [PRS 0-016]		14DEC95
A104A11008	0	0	0	TA21 14.3 EPA Draft Complete Ph1		2JAN96
A104B58009	0	0	0	TA0: Drf Solvent UST RFI Rpt to EPA [PRS 0		9JAN96
A104A16008	0	0	0	TA21 14.8 EPA Draft Complete Ph1		11JAN96
A104A34008	0	0	0	TA21 16.6 EPA Draft Complete Ph1		12JAN96
A104A12009	0	0	0	TA21 14.4 EPA Draft Complete Ph1		16JAN96
A104A40008	0	0	0	TA21 16.8 MDA A EPA Draft Complete Ph1		18JAN96
A104A09009	0	0	0	TA21 14.2 EPA Draft Complete Ph1		31JAN96
A104C20007	0	0	0	TA-1: RFI Report Draft to EPA [Ag (K-P)]		15FEB96
A104A38011	0	0	0	TA21 16.7 MDA V EPA Draft Complete Ph1		22FEB96
A104A15011	0	0	0	TA21 14.7 EPA Draft Complete Ph1		23FEB96
A104A30009	0	0	0	TA21 16.4 EPA Draft Complete Ph1		29FEB96
318009	0	0	0	TA0: Drf Septic Sys 0-030(eN) RFI Rpt [Grp 0-3]		4APR96
A104B20009	0	0	0	TA0: Drf Septic Sys 030(eS) to EPA		4APR96
A104B22009	0	0	0	TA0: Drf Septic Sys 0-030(f) RFI Rpt to EPA G0-3		4APR96
A104522109	0	0	0	TA-10:Submit EPA Draft Ph Sub-Surface RFI Report		15APR96
A104530511	0	0	0	TA4M: Submit EPA Draft WP1/PH1 RFI RPT		18APR96
A104B35009	0	0	0	TA0: Drf Septic Sys 0-030(o) RFI Rpt to		5AUG96
A104522509	0	0	0	TA-32:Draft Ph II RFI Report to EPA		7AUG96

FU #1: GARRY ALLEN

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A104B09008	0	0	0	TA0: Drf Inactive WWTP RFI Rpt to EPA Grp 0-2		23SEP96
A104A27011	0	0	0	TA21 16.3 EPA Draft Complete Ph1		25OCT96
A104B13009	0	0	0	TA0: Drf LA Cnty Rec Area RFI Rpt to EPA A0-E		31OCT96
A104B27009	0	0	0	TA0: Drf Septic Sys 0-030(i) RFI Rpt to EPA		31OCT96
A104B47009	0	0	0	TA19: Drf East Gate Lab RFI Rpt to EPA		31OCT96
A104B25009	0	0	0	TA0: Drf Septic Sys 0-030(h) RFI Rpt to EPA		7NOV96
A105522204	0	0	0	TA-10:Draft Central Area CMS Due to EPA		3DEC96
A104A19114	0	0	0	TA21 15.4 011k EPA Draft Complete Ph2		2JAN97
A104B51009	0	0	0	TA73: Drf LA Airport RFI Rpt to EPA [Grp		19MAR97
A104B11009	0	0	0	TA0: Drf DP Rd Stg Area RFI Rpt to EPA [Ag 0-F]		8APR97
A104532112	0	0	0	TA-3: Sbmit EPA Drft Sgma WP2/PH1 RFI RPT		21APR97
A104A20008	0	0	0	TA21 15.5 EPA Draft Complete Ph2		14MAY97
A104B04009	0	0	0	TA0: Drf 6th St Whse Area RFI Rpt to EPA		19JUN97
A104A44011	0	0	0	TA21 17.2 EPA Draft Complete Ph1		7JUL97
A104A35011	0	0	0	TA21 16.6 MDA U EPA Draft Complete Ph1		16JUL97
A104B31009	0	0	0	TA0: Drf Septic Sys 0-030(k) RFI Rpt to EPA		31JUL97
A104A23011	0	0	0	TA21 16.2 EPA Draft Complete Ph1		27AUG97
A104A06008	0	0	0	TA21 MDA-U-DP EPA Draft Complete Ph1		4SEP97
A104B40009	0	0	0	TA0: Drf Former Service Sta RFI Rpt to		26SEP97
A104B29009	0	0	0	TA0: Drf Septic Sys 0-030(j) RFI Rpt to EPA		11NOV97
A104B49009	0	0	0	TA26: Drf D-Site RFI Rpt to EPA [Grp 26-1]		20JAN98
A104A46011	0	0	0	TA21 17.3 EPA Draft Complete Ph1		11JUN98
A104A48008	0	0	0	TA21 17.4 EPA Draft Complete Ph1		16JUN98
A104A10008	0	0	0	TA21 14.2 EPA Draft Complete Ph2		19JUN98
A104A49011	0	0	0	TA21 17.5 EPA Draft Complete Ph1		6AUG98

FU #1: GARRY ALLEN

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A105522219	0	0	0	TA-10:EPA Draft of Central Area CMS Plan Complet		19AUG98
A104532209	0	0	0	TA-3: Draft Report to EPA WP2/PH1 RFI RPT		4SEP98
A104B02009	0	0	0	TA0: Drf WSP RFI Rpt to EPA [Agg 0-A]		8SEP98
A104B16009	0	0	0	TA0: Drf Septic Sys 0-030(d) RFI Rpt to EPA		6NOV98
A104A19008	0	0	0	TA21 15.2 023c EPA Draft Complete Ph2		17DEC98
A104B60009	0	0	0	TA-43: Drf HRL Area RFI Rpt to EPA [Grp 43-		5JAN99
A104B07008	0	0	0	TA0: Drf Inactv Wst Ln RFI Rpt to EPA PRS 0-017		1FEB99
A112B43009	0	0	0	TA0: EC Rpt Drf to EPA for PRS 0-031(b) [G		10FEB99
A104B45009	0	0	0	TA0: Drf Trenches/Lndflls RFI Rpt to EPA		12JUL99
A104530711	0	0	0	TA2M: Draft WP1/Ph2 to EPA RFI RPT		7SEP99
A104A51008	0	0	0	TA21 17.6 EPA Draft Complete Ph1		27OCT99
A104B37009	0	0	0	TA0: Drf Septic Sys 0-030(p) RFI Rpt to		2NOV99
A104B33009	0	0	0	TA0: Drf Septic Sys 0-030(n) RFI Rpt to		9NOV99
A104A31008	0	0	0	TA21 16.4 EPA Draft Complete Ph2		16JUN00
A104531611	0	0	0	TA-3: Drft to EPA Dmnd/Jmz W-Ln NOD RFI RPT		19JUL00
A104A42011	0	0	0	TA21 16.8 EPA Draft Complete Ph1		11AUG00
A104532309	0	0	0	TA-3: EPA Draft Asphalt Plant WP2/PH1 RFI RPT		22NOV00
A104A53008	0	0	0	TA21 18.9 EPA Draft Complete Ph1		20DEC00
A104A52008	0	0	0	TA21 18.8 EPA Draft Complete Ph1		29DEC00
4B53009	0	0	0	TA73: Drf LA Airport RFI Rpt to EPA [Grp 7		30APR01
A104A28008	0	0	0	TA21 16.3 EPA Draft Complete Ph2		27JUN01
A104A37008	0	0	0	TA21 16.6 EPA Draft Complete Ph2		20JUL01
A104B55009	0	0	0	TA0: Drf BNM RFI Rpt to EPA [Grp 0-6]		1AUG01
A104A32011	0	0	0	TA21 16.5 EPA Draft Complete Ph1		15NOV01
A104A29008	0	0	0	TA21 16.3 EPA Draft Complete Ph2		30NOV01

RFI REPORT MILESTONES

FU #1: GARRY ALLEN

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A104A33008	0	0	0	TA21 16.5 EPA Draft Complete Ph2		16MAY02
A104A25008	0	0	0	TA21 16.2 EPA Draft Complete Ph2		26JUL02
A104A03008	0	0	0	TA21 LADP-1 EPA Draft Complete Ph1		12AUG02
A104A05008	0	0	0	TA21 LADP-5 EPA Draft Complete Ph1		28JAN03
A104A36008	0	0	0	TA21 16.6 EPA Draft Complete Ph2		27MAY03
A104A24008	0	0	0	TA21 16.2 EPA Draft Complete Ph2		9JUN03
A104A45008	0	0	0	TA21 17.2 EPA Draft Complete Ph2		12JUN03
A104A47008	0	0	0	TA21 17.3 EPA Draft Complete Ph2		12JUN03
A104A43008	0	0	0	TA21 16.8 EPA Draft Complete Ph2		24JUL03
A104A50008	0	0	0	TA21 17.5 EPA Draft Complete Ph2		31JUL03
A104A04008	0	0	0	TA21 LADP-2 EPA Draft Complete Ph1		12AUG03
A104A41008	0	0	0	TA21 16.8 EPA Draft Complete Ph2		17AUG04
A104A39008	0	0	0	TA21 16.7 EPA Draft Complete Ph2		16SEP04

FU #2: GENE GOULD

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A204587325	0	0	0	TA-18 EPA DRAFT RFI WORK PLAN COMPLETE PH2		31OCT95
A204587395	0	0	0	TA-18 EPA DRAFT COMPLETE RFI RPT		31OCT95
A204583894	0	0	0	TA-15 FIELDWORK EPA DRAFT COMPLETE RFI RPT		29DEC95
A211303055	0	0	0	TA-36: EPA DRAFT REPORT COMPLETE 36-003(A) EC		9FEB96
A204580195	0	0	0	TA-12 L-SITE AGGRGT EPA DRAFT COMPLETE RFI RPT		20FEB96
A204580295	0	0	0	TA-14 Q-SITE AGGRGT EPA DRAFT COMPLETE RFI RPT		29FEB96
A238276916	0	0	0	TA-39 PRS 39-002(A) EPA DRAFT REPORT COMPLETE		4MAR96*
A204591095	0	0	0	TA-20/72 FIRING SITES EPA DRAFT COMPLETE RFI RPT		19MAR96
A204592095	0	0	0	TA-20 LANDFILLS EPA DRAFT COMPLETE RFI RPT		19MAR96
A204593095	0	0	0	TA-53 WASTE AREAS EPA DRAFT COMPLETE RFI RPT		19MAR96
A204594095	0	0	0	TA-20 SEPTIC SYSTEMS EPA DRAFT COMPLETE RFI RPT		19MAR96
A204583795	0	0	0	TA-15 FIELDWORK EPA DRAFT COMPLETE RFI RPT		24MAY96
A204599095	0	0	0	TA-39 FIRING SITES EPA DRAFT COMPLETE RFI RPT		6JUN96
A244598595	0	0	0	TA-39 LANDFILLS RPT TEST PIT EPA DRAFT COMPLETE		6JUN96
A204594103	0	0	0	TA-36 EPA DRAFT REPORT COMPLETE RFI RPT		17SEP96
A211304055	0	0	0	TA-36: EPA DRAFT REPORT COMPLETE 36-001 EC		6DEC96
A204583695	0	0	0	TA-15 FIELDWORK EPA DRAFT COMPLETE RFI RPT		16APR97
A208276916	0	0	0	TA-39 PRS 39-006(A)EPA DRAFT REPORT COMPLETE EC		1MAY97
305055	0	0	0	TA-36: EPA DRAFT REPORT COMPLETE EC		14AUG97
A205580093	0	0	0	TA-15/36/39 FU#2 EPA DRAFT COMPLETE CMS PLN		3APR98
A205580094	0	0	0	TA-15/36/39 FU#2 EPA APPROVED CMS PLN		8SEP98
A207580096	0	0	0	TA-15/36/39 FU#2 EPA DRAFT COMPLETE CMS RPT		1MAY00
A228276916	0	0	0	TA-39 LANDFILLS MDA EPA DRAFT REPORT COMPLETE		10MAY00
A212580094	0	0	0	FU #2 PROJECT COMPLETE		29JUL03

FU #3: BRAD MARTIN

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A308508336	0	0	0	TA33:AGG.VCA.4 EPA DRAFT REPORT COMPLETE		25JAN96
A308508436	0	0	0	TA33:AGG.VCA.3 EPA DRAFT REPORT COMPLETE	1FEB96	
A312508155	0	0	0	TA33:AGG.EC.1 EPA DRAFT REPORT COMPLETE		14MAR96
A312508165	0	0	0	TA33:AGG.EC.1 EPA APPROVES EC REPORT		28MAR96
A308509236	0	0	0	TA33:AGG.VCA.2 EPA DRAFT REPORT COMPLETE		9APR96
A312507855	0	0	0	TA16:AGG.EC.3 EPA DRAFT REPORT COMPLETE		8AUG96
A312507755	0	0	0	TA16:AGG.EC.1 EPA DRAFT REPORT COMPLETE	16AUG96	
A312507865	0	0	0	TA16:AGG.EC.3 EPA APPROVES EC REPORT		22AUG96
A312507765	0	0	0	TA16:AGG.EC.1 EPA APPROVES EC REPORT		29AUG96
A312507555	0	0	0	TA16: AGG.EC 2 EPA DRAFT REPORT COMPLETE		5SEP96
A312507455	0	0	0	TA16:AGG.EC.4 EPA DRAFT REPORT COMPLETE		11SEP96
A312507565	0	0	0	TA16: AGG.EC 2 EPA APPROVES EC REPORT		19SEP96
A312507465	0	0	0	TA16:AGG.EC.4 EPA APPROVES EC REPORT		25SEP96
A308510936	0	0	0	TA46:AGG.VCA.1 EPA DRAFT REPORT COMPLETE		24JAN97
A312507955	0	0	0	TA16:AGG.EC.5 EPA DRAFT REPORT COMPLETE		14MAR97
A312509355	0	0	0	TA16:AGG.EC.6 EPA DRAFT REPORT COMPLETE		14MAR97
A312507965	0	0	0	TA16:AGG.EC.5 EPA APPROVES EC REPORT		28MAR97
A312509365	0	0	0	TA16:AGG.EC.6 EPA APPROVES EC REPORT		28MAR97
A312509055	0	0	0	TA33:AGG.EC.2 EPA DRAFT REPORT COMPLETE		18JUN97
A312509065	0	0	0	TA33:AGG.EC.2 EPA APPROVES EC REPORT		2JUL97
A308509136	0	0	0	TA33:AGG.VCA.5 EPA DRAFT REPORT COMPLETE		15JUL97
A312510755	0	0	0	TA33:AGG.EC.3 EPA DRAFT REPORT COMPLETE		16MAR98
A312511255	0	0	0	TA46:AGG.EC.1 EPA DRAFT REPORT COMPLETE		16MAR98
A312510765	0	0	0	TA33:AGG.EC.3 EPA APPROVES EC REPORT		30MAR98
A312511265	0	0	0	TA46:AGG.EC.1 EPA APPROVES EC REPORT		30MAR98

FU #3: BRAD MARTIN

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A312511455	0	0	0	TA46:AGG.EC.3 EPA DRAFT REPORT COMPLETE		16MAR99
A312511465	0	0	0	TA46:AGG.EC.3 EPA APPROVES EC REPORT		30MAR99
A308510836	0	0	0	TA33:AGG.VCA.6 EPA DRAFT REPORT COMPLETE		25JAN01
A308511036	0	0	0	TA46:AGG.VCA.2 EPA DRAFT REPORT COMPLETE		25JAN01
A308511136	0	0	0	TA46:AGG.VCA.3 EPA DRAFT REPORT COMPLETE		25JAN01
A312510355	0	0	0	TA16:AGG.EC.7 EPA DRAFT REPORT COMPLETE		14MAR02
A312511355	0	0	0	TA46:AGG.EC.2 EPA DRAFT REPORT COMPLETE		14MAR02
A312510365	0	0	0	TA16:AGG.EC.7 EPA APPROVES EC REPORT		28MAR02
A312511365	0	0	0	TA46:AGG.EC.2 EPA APPROVES EC REPORT		28MAR02

PRIMAVERA PROJECT PLANNER

Field Units 1-5 Merged Baseline

REPORT DATE 8NOV95 RUN NO. 190
14:33

START DATE 1OCT89 FIN DATE 30SEP05

DATA DATE 2OCT95 PAGE NO. 1

RFI REPORT MILESTONES

FU #4: ALLEN PRATT

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A402149M07	0	0	0	LACN: EPA DRAFT OF RFI WORK PLAN COMPLETE		30NOV95
A4045402M4	0	0	0	TA35: EPA DRAFT COMPLETE AGG D-I NFA RPT		29FEB96
A4045403M4	0	0	0	TA35: EPA DRAFT COMPLETE AGG S-W NFA RPT		11APR96
A402149M02	0	0	0	CYNS: EPA DRAFT OF CORE DOC.CMPLT. CANYONS		22MAY96
A4045405M4	0	0	0	T241: EPA DRAFT COMPLETE NFA RPT		21JUN96
A4045404M4	0	0	0	T4/5: EPA DRAFT COMPLETE NFA RPT		5AUG96
A402149M12	0	0	0	MORT: ISSUE MORT SMPL PLAN EPA/NMED/STK HLDR RVW		27SEP96
A4051129M5	0	0	0	1129: EPA DRAFT OF CMS PLAN COMPLETE		26AUG97
A404149M02	0	0	0	LACN: EPA DRAFT OF PH1 REPORT COMPLETE		22JUN98
A407112914	0	0	0	1129: EPA DRAFT; COMPLETION OF CMS		13JAN99
A4071129M3	0	0	0	1129: EPA NOTIFICATION OF CMI REQUIREMENTS		18MAR99
A404104916	0	0	0	LACN: EPA DRAFT; COMPLETION OF RFI		9MAY01
A402149M17	0	0	0	PAJA: ISSUE PAJA SMPL PLAN EPA/NMED/STK HLDR RVW		20AUG01
A405149M11	0	0	0	MORT: ISSUE EPA DRAFT MORTANDAD CMS PLAN		11OCT01
A405149M05	0	0	0	LACN: EPA DRAFT OF CMS PLAN COMPLETE		7DEC01
A402149M22	0	0	0	SAND: ISS.SAND/BUEY SMPL PLN EPA/NMED/STKHLDR RV		10JUN02
A402149M27	0	0	0	GUAJ: ISS.GUAJE/BARRSMPL PLN EPA/NMED/STKHLDR RV		23DEC02
A407149M03	0	0	0	LACN: EPA DRAFT; COMPLETION OF CMS		23APR03
A407149M04	0	0	0	LACN: EPA NOTIFICATION OF CMI REQUIREMENTS		25JUN03
A402149M32	0	0	0	WATR: ISS.WATER SMPL PLN EPA/NMED/STKHLDR RVW		8JUL03
A402149M37	0	0	0	ANCH: ISS.ANCHO SMPL PLN EPA/NMED/STKHLDR RVW		23JAN04
A405149M16	0	0	0	PAJA: ISSUE EPA DRAFT PAJARITO CMS PLAN		29JUN04
A402149M42	0	0	0	POTR: ISS.POTR/FNC SMPL PLN EPA/NMED/STKHLDR RVW		5AUG04
A405149M21	0	0	0	SAND: ISSUE EPA DRAFT SANDIA/BUEY CMS PLAN		19APR05
A405149M26	0	0	0	GUAJ: ISSUE EPA DRAFT GUAJE/BARRANCAS CMS PLAN		28OCT05

FU #4: ALLEN PRATT

TIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A405149M36	0	0	0	WATR: ISSUE EPA DRAFT WATER/DEL VALLE CMS PLAN		12MAY06
A405149M41	0	0	0	ANCH: ISSUE EPA DRAFT ANCHO/INDIO/CHAQ.CMS PLAN		23NOV06
A405149M46	0	0	0	POTR: ISSUE EPA DRAFT POTRILLO/FENCE CMS PLAN		11JUN07

RFI REPORT MILESTONES

FU #5: CHERYL ROFER

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A504563525	0	0	0	TA50: SOIL SMPLG EPA DRAFT REPRT CMPLT RFI PH1	2OCT95	
A504560252	0	0	0	TA06: +8,9,22,23+40 EPA DRAFT RPRT CMLT SOIL/SPG	24OCT95	23OCT95
A504561530	0	0	0	TA49: AREA 2/COLD CORING EPA DRAFT RPT CMPLT PH1	18JAN96	17JAN96
A504563450	0	0	0	TA50: SHALLOW BORING EPA DRFT RPRT CMPLT RFI PH1	18JAN96	
A504565235	0	0	0	TA54: MDA L EPA DRAFT COMPLETE RFI PH1	18JAN96	
A504566820	0	0	0	TA57: AREA 1 SOIL SMPLG EPA DRAFT CMPLT RFI RPT	18JAN96	
A508568957	0	0	0	TA09: MDA M EPA DRAFT REPORT COMPLETE EC REP	19APR96	
A504561630	0	0	0	TA49: AREA 1,3-6+10-12 EPA DRFT REPORT CMPLT PH1	17MAY96	
A504564686	0	0	0	TA54: MDA G EPA DRAFT RFI REPORT COMPLT RFI PH1	11JUL96	
A504564830	0	0	0	TA54: MDA H START RFI REPORT RFI PH1	2OCT96*	
A504564846	0	0	0	TA54: MDA H EPA DRAFT REPORT COMPLETE RFI PH1	17DEC96	
A504560865	0	0	0	TA40: FIRE.SITE SOIL SMPL EPA DRFT CMPLT RFI PH1	17JAN97	
A504562330	0	0	0	TA49: AREAS 5,6,11 EPA DRAFT REPORT CMPLT PH1	17JAN97	
A504569055	0	0	0	TA09: SHALLOW BORING EPA DRFT REPORT CMPLT RFI	17JAN97	
A504564881	0	0	0	TA54: MDA G&H EPA DRAFT REPORT COMPLETE RFI PH1	5MAR97	
A504569075	0	0	0	TA09: SHALLOW BORING RFI REPORT CMPLT RFI RFI		20MAR97
A504565056	0	0	0	TA54: MDA G&J EPA DRAFT OF RFI RPT CMPLT PH1	7MAY97	
A504565427	0	0	0	TA54: WATER RUNOFF EPA DRFT REPORT CMPLT RFI PH1	26MAY98	
A504563345	0	0	0	TA50: MDA C EPA DRAFT REPORT COMPLETE RFI PH1	10AUG98	
A504563240	0	0	0	TA50: BUILDNG 1 EPA DRAFT REPORT COMPLT RFI PH1	19JAN99	
A504564740	0	0	0	TA54: MDA G EPA DRAFT REPORT COMPLETE RFI PH2	3SEP99	
A504560152	0	0	0	TA06: MDA F EPA DRAFT RFI RPT COMPLT PH1 RPT		14DEC99
A504564335	0	0	0	TA50: MDA C EPA DRAFT OF RFI RPRT CMPLT RFI PH2	16JUN00	
A504562730	0	0	0	TA49: AREAS 1-4 EPA DRFT REPORT CMPL MDA AB PH1	28JUN00	
A504561775	0	0	0	TA49: SURFACE SAMPLING EPA DRFT REPORT CMPLT PH2	31JUL00	

FU #5: CHERYL ROFER

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
A504564245	0	0	0	TA50: BUILDING 1 EPA DRFT REPORT CMPLT RFI PH2		17AUG00
A505564245	0	0	0	TA50: BLDG 1 EPA DRAFT OF CMS PLAN CMPLT CMS PLN	8FEB01	
A504569240	0	0	0	TA06: +8,9,22,23+40 XP AREA EPA DRF CMPL RFI PH2	2MAY01	
A504561240	0	0	0	TA06: MDA F EPA DRAFT COMPLETE PH2 RPT	7JUN01	
A504565140	0	0	0	TA54: MDA J EPA DRAFT COMPLETE RFI PH2	31AUG01	
A505563645	0	0	0	TA50: MDA C EPA DRAFT OF CMS PLAN CMPLT CMS PLN	22MAR02	
A500569805	0	0	0	TA00: FIELD PROJECT #5 COMPLETE		19JUL04

2107 PROJECT MANAGEMENT

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION		SCHEDULED START	SCHEDULED FINISH
C130810101	0	0	0	4th Quarter Report Submitted	RC		29DEC95*
C136832018	0	0	0	Issue Final IWP Update	DP		16FEB96
C130810102	0	0	0	1st Quarter Report Submitted	RC		29MAR96*
C130810103	0	0	0	2nd Quarter Report Submitted	RC		28JUN96*
C130810104	0	0	0	3rd Quarter Report Submitted	RC		27SEP96*
C130810202	0	0	0	1st Quarter Report Submitted	RC		31MAR97*
C130810203	0	0	0	2nd Quarter Report Submitted	RC		30JUN97*
C130810204	0	0	0	3rd Quarter Report Submitted	RC		30SEP97*
C136832052	0	0	0	Issue Final IWP Update	DP		19NOV97*
C130810301	0	0	0	4th Quarter Report Submitted	RC		31DEC97*
C130810302	0	0	0	1st Quarter Report Submitted	RC		31MAR98*
C130810303	0	0	0	2nd Quarter Report Submitted	RC		30JUN98*
C130810304	0	0	0	3rd Quarter Report Submitted	RC		30SEP98*
C136832053	0	0	0	Issue Final IWP Update	DP		19NOV98*
C130810401	0	0	0	4th Quarter Report Submitted	RC		31DEC98*
C130810402	0	0	0	1st Quarter Report Submitted	RC		31MAR99*
C130810403	0	0	0	2nd Quarter Report Submitted	RC		30JUN99*
C130810404	0	0	0	3rd Quarter Report Submitted	RC		30SEP99*
C136832054	0	0	0	Issue Final IWP Update	DP		19NOV99*
C136832055	0	0	0	Issue Final IWP Update	DP		17NOV00*
C136832056	0	0	0	Issue Final IWP Update	DP		19NOV01*
C136832057	0	0	0	Issue Final IWP Update	DP		19NOV02*
C136832058	0	0	0	Issue Final IWP Update	DP		19NOV03*
C136832059	0	0	0	Issue Final IWP Update	DP		19NOV04*

ACRONYMS AND ABBREVIATIONS

AEA	Atomic Energy Act
AEC	US Atomic Energy Commission
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
ALARA	As low as reasonably achievable
ANTI-C	Radiologic protective clothing
AOC	Area of concern
AP	Administrative procedure
AR	Administrative record
ASME	American Society of Mechanical Engineers
BUS	Business Systems Division
CAMU	Corrective action management unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPR	Cardiopulmonary resuscitation
CMI	Corrective measures implementation
CMS	Corrective measures study
CRM	Communications Records Management
DOE	US Department of Energy
DOE-AL	US Department of Energy/Albuquerque Operations Office
DOE-HQ	US Department of Energy/Headquarters
DOE-LAAO	US Department of Energy/Los Alamos Area Office
DOT	US Department of Transportation
DQO	Data quality objective
EA	Environmental assessment
EC	Expedited Cleanup
EIS	Environmental impact statement
EM	Office of Environmental Restoration and Waste Management
EPA	US Environmental Protection Agency
ER	Environmental Restoration (Program)
ESG	Environmental Studies Group
ESH	Environment, Safety, and Health Division
FIMAD	Facility for Information Management, Analysis, and Display
FPL	Field project leader
FY	Fiscal year
GIS	Geographical Information System
HASP	Health and Safety Plan
HAZMAT	Hazardous materials
HAZWOPER	Hazardous Waste Operations and Emergency Response
H&S	Health and safety
HSWA	Hazardous and Solid Waste Amendments
ICRP	International Commission on Radiological Protection
IWP	Installation work plan
Laboratory	Los Alamos National Laboratory
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (the Laboratory before January 1, 1981)
MDA	Materials disposal area
MIS	Management Information System
MSA	Major Systems Acquisition
MSA AL-1	DOE Operations Office in Albuquerque

MWDF	Mixed-Waste Disposal Facility
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NFA	No further action
NIOSH	National Institute of Occupational Safety and Health
NMED	New Mexico Environment Department
OSHA	Occupational Safety and Health Administration
OU	Operable unit
PPC	Project Planning and Control Team
PRS	Potential release site
PR/VSI	Preliminary Review/Visual Site Inspection
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
QP	Quality procedure
RFA	RCRA facility assessment
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RPF	Records-Processing Facility
SAL	Screening action level
SIO	Stakeholder Involvement Office
SMO	Sample Management Office
SOP	Standard operating procedure
SSHASP	Site-specific health and safety plan
SWEIS	Sitewide Environmental Impact Statement
SWMU	Solid waste management unit
TA	Technical area
TSD	Treatment, storage, disposal
UC	University of California
USGS	US Geological Survey

APPROXIMATE CONVERSION FACTORS FOR SELECTED SI (METRIC) UNITS

Multiply SI (Metric) Unit	by	To Obtain US Customary Unit
Cubic meters (m^3)	35	Cubic feet (ft^3)
Centimeters (cm)	0.39	Inches (in.) meters
Meters (m)	3.3	Feet (ft)
Kilometers (km)	0.62	Miles (mi)
Square kilometers (km^2)	0.39	Square miles (mi^2)
Hectares (ha)	2.5	Acres
Liters (L)	0.26	Gallons (gal.)
Grams (g)	0.035	Ounces (oz)
Kilograms (kg)	2.2	Pounds (lb)
Micrograms per gram (mg/g)	1	Parts per million (ppm)
Milligrams per liter (mg/L)	1	Parts per million (ppm)
Celsius (°C)	9/5 + 32	Fahrenheit (°F)