RFI Work Plan for Operable Unit 1100

Environmental Restoration Program

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A Department of Energy Environmental Cleanup Program

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Los Alamos
NATIONAL LABORATORY

LA-UR-94-1097

Executive Summary

RFI Work Plan for OU 1100

EXECUTIVE SUMMARY

Purpose

The primary purpose of this Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan is to determine the nature and extent of contamination from releases of hazardous waste or hazardous constituents in Operable Unit (OU) 1100 and to determine the need for corrective action using risk-based decision analysis. Second, this document satisfies part of the regulatory requirements contained in Los Alamos National Laboratory's (the Laboratory's) permit to operate under RCRA. OU 1100 includes all of Technical Areas (TAs) 53 and 72 and former TA-20. These technical areas are located in Los Alamos and Santa Fe counties. Within these technical areas, there are 83 potential release sites (PRSs), which are located entirely on land owned by the Department of Energy (DOE).

Module VIII of the RCRA permit, known as the HSWA Module (the portion of the permit that responds to the requirements of the Hazardous and Solid Waste Amendments [HSWA]), was issued by the Environmental Protection Agency (EPA) to address potential corrective action requirements for SWMUs at the Laboratory. These permit requirements are addressed by the DOE's Environmental Restoration (ER) Program at the Laboratory. This document describes the sampling plans that will be followed to implement the RFI at OU 1100, and, together with 3 other work plans submitted to the EPA in May 1994 and 19 work plans already submitted, meets the requirement set forth in the HSWA Module to address a cumulative percentage of the Laboratory's SWMUs in RFI work plans by May 23, 1994.

Installation Work Plan

The HSWA Module required the Laboratory to prepare an installation work plan (IWP) to describe the Laboratory-wide system for accomplishing the RFI, corrective measures studies (CMSs), and corrective measures, a requirement satisfied by the Installation Work Plan for Environmental Restoration originally submitted to the EPA in November 1990. That document is updated annually, and the most recent revision was published in November 1993. The IWP identifies the Laboratory's PRSs, describes their aggregation into 24 operable units, and presents the Laboratory's overall management plan and technical approach for meeting the requirements of the HSWA Module. When information relevant to this work plan has already been provided in the IWP, the reader is referred to the 1993 version of that document.

Both the IWP and this work plan address radioactive materials and other hazardous substances not subject to RCRA. Sites that potentially contain or may have released only non-RCRA materials are called areas of concern (AOCs). The term PRS is the inclusive term for both solid waste management units (SWMUs) and AOCs. It is understood that the language in this work plan pertaining to subjects outside the scope of RCRA is not enforceable under the Laboratory's operating permit.

Background

TA-20 was used by the Laboratory during the Manhattan Project beginning in 1944. This site was used to perform tests related to the development of initiators (devices used to generate neutrons needed to initiate nuclear chain reactions). These tests utilized high explosives and small amounts of radioactive and hazardous materials. Following World War II, the firing sites at TA-20 were occasionally used to conduct various explosives tests. All experimental operations at TA-20 ceased in 1948, at which time the access road to TA-20 was extended to provide access to Los Alamos. In anticipation of public access to TA-20, extensive cleanup operations were undertaken in 1948 to remove contaminated structures and materials.

TA-53 is the location of the Los Alamos Meson Physics Facility (LAMPF), a 0.5-mile-long proton accelerator and associated experimental and support facilities used for research with subatomic particles. Construction of LAMPF began in 1967 and LAMPF became fully operational in 1974. TA-53 has expanded considerably since initial operations began. Major facilities added during this period include the Los Alamos Neutron Scattering Center and the Ground Test Accelerator.

TA-72 is primarily a land reserve, but does include the small-arms firing range used by the Laboratory's security force and two municipal supply wells. The firing range has been active since 1966 and includes several structures associated with former TA-20.

The area comprising OU 1100 includes the Mesita de los Alamos and portions of adjacent Sandia and Los Alamos canyons. TA-53 is located on the mesita and TAs-20 and -72 are located in Sandia Canyon. The entire operable unit is underlain by volcanic deposits comprising the Bandelier Tuff. The tuff outcrops throughout the sides of the canyons that are nearly vertical, and the floors of the canyons are filled with alluvial material derived from the Bandelier Tuff and older formations. An ephemeral stream is located in Sandia Canyon. Flow upstream of OU 1100 is due primarily to effluent discharges from TA-3. An alluvial groundwater body is suspected in upper Sandia Canyon, though its presence has not been confirmed. An alluvial groundwater body does exist in Los Alamos Canyon. The piezometric surface of the main aquifer lies at a depth of approximately 1,000 ft below the Mesita de los Alamos and approximately 700 ft below Sandia Canyon. Intermediate deep perched groundwater was detected above the main aquifer in wells located in Sandia and Los Alamos canyons. It is not known it there is a hydraulic connection between the shallow and deep groundwater bodies.

The PRSs in OU 1100 consist of inactive landfills, inactive firing sites, waste and chemical product storage areas, underground storage tanks, septic systems, and surface impoundments. Many of the inactive PRSs, such as the firing sites used in the 1940s, have been entirely decommissioned and subjected to previous cleanup efforts. Some PRSs, such as underground waste storage tanks at LAMPF, are active and will remain so for the foreseeable future. Former releases at some PRSs, such as leaks from polychlorinated biphenyl (PCB) transformers, were cleaned up at the time of the release.

Former investigations to characterize levels of potential contaminants associated with environmental releases within OU 1100 are limited and consist primarily of investigations related to the surface impoundments at TA-53. These investigations have detected the presence of tritium in the vadose zone in the vicinity of the impoundments. Information concerning potential contamination at other PRSs is limited to archival data. Many PRSs are being proposed for no further action (NFA) on the basis of archival data. Other PRSs in this operable unit require some field investigations before determining if an NFA is appropriate. Some active PRSs that do not currently pose a risk have been proposed for deferred action.

Technical Approach

For the purposes of designing and/or implementing the sampling and analysis plans described in this work plan, most PRSs are grouped into aggregates, although selected PRSs are investigated individually as necessary. This work plan presents the description and operating history of each PRS or aggregate, together with an evaluation of the existing data, if any, in order to develop a preliminary conceptual exposure model for the site. For some PRSs, NFA or deferred action can be proposed on the basis of this review; these PRSs are discussed in Chapter 6. The remaining PRSs, for which RFI field work is proposed, are discussed in Chapter 5.

The technical approach to field sampling is primarily designed to establish the presence or absence of hazardous and/or radioactive constituents at concentrations of concern. Concentrations of concern are levels of constituents in environmental samples that exceed the screening action levels as defined in the IWP. A phased approach to the RFI is used to ensure that any environmental impacts associated with past and present activities are investigated in a manner that is both cost-effective and complies with the HSWA Module. This phased approach permits intermediate data evaluation, with opportunities for additional sampling, if required.

For most PRSs in OU 1100, there are no existing data and little or no historical evidence that a release has occurred. For these, the Phase I sampling strategy for OU 1100 will focus on determining the presence or absence of hazardous and/or radioactive constituents. If constituents are detected at concentrations above conservative screening action levels, a baseline risk assessment may be required, or a voluntary corrective action (VCA) may be proposed. If conducted, the baseline risk assessment will be used to determine the need for corrective action. If the data collected during Phase I are not sufficient to support a baseline risk assessment, but indicate the presence of hazardous and/or radioactive constituents above screening action levels, additional RFI Phase II sampling will be undertaken to characterize in more detail the nature and extent of the release if a VCA is not proposed.

The surface impoundments at TA-53 are active RCRA-regulated waste management units. Deferred action is proposed for these PRSs because the impoundments are subject to RCRA closure requirements for mixed waste surface impoundments. Specific technical requirements for closure are currently being developed for these impoundments. A closure plan has been submitted to the New Mexico Environment Department and is currently under review.

Data quality objectives to support the required decisions are developed for RFI Phase I sampling and analysis plans described in this work plan to ensure that the right type, amount, and quality of data are collected. Field work for many PRSs includes field surveys, which will be used to bias sampling locations by identifying the most likely areas of contamination. Sample analyses will be performed primarily in fixed analytical laboratories rather than mobile laboratories.

The body of the text in this work plan is followed by five annexes, which consist of project plans corresponding to the program plans in the IWP: project management, quality assurance, health and safety, records management, and public involvement.

Schedule, Costs, and Reports

The RFI field work described in this document requires 2 years to complete. A single phase of field work is expected to be sufficient to complete the RFI for most PRSs; however, a second phase will occur if warranted by the results of the first phase, in which case the field work will take longer than 2 years to complete.

Cost estimates for baseline activities to complete the RFI for OU 1100 are provided in Table ES-1. The estimates for costs and schedule are the latest available estimates from the fiscal year 94 baseline change proposal. These data will be updated as appropriate.

The HSWA Module specifies the submittal of monthly reports and quarterly technical progress reports. In addition, RFI phase reports will be submitted at the completion of each of the sampling phases. The RFI phase reports will serve as:

- a partial summary of the results of initial site characterization activities;
- vehicles for proposing modifications to the sampling plans suggested by the initial findings;
- work plans that describe the next phase of sampling, when such sampling is required;

TABLE ES-1

ESTIMATED COSTS OF CONDUCTING RFI OU 1100

Estimate to Complete	$2,428,000
Escalation	$ 466,000
Prior Years	$ 727,000
Total at Completion	$3,621,000

- vehicles for recommending VCA or NFA as mechanisms for delisting PRSs shown by the RFI to have acceptable health-based risk levels; and

- summary reports of the sampling plans.

At the conclusion of the RFI, a final RFI report will be submitted to the EPA.

Key milestones for the RFI are presented in Table ES-2.

TABLE ES-2

SCHEDULE FOR OU 1100 RCRA FACILITY INVESTIGATION AND CORRECTIVE MEASURES STUDY

Milestone	Date
Start RFI Work Plan	10/01/92
DOE Draft RFI Work Plan Completed	01/03/94
EPA/New Mexico Environment Department (NMED) RFI Work Plan Submitted	05/23/94
EPA/NMED Draft of Phase I Report Completed	06/07/96
EPA/NMED Draft of RFI Report Completed	11/04/98

Public Involvement

Regulations issued pursuant to HSWA and Module VIII of the Laboratory's RCRA permit mandate public involvement in the corrective action process. In addition, the Laboratory is providing a variety of opportunities for public involvement, including meetings held as needed to disseminate information, to discuss significant milestones, and to solicit informal public review of this and the other draft work plans. It also distributes meeting notices and updates the ER Program mailing list; prepares fact sheets summarizing completed and future activities; and provides public access to plans, reports, and other ER Program documents. These materials are available for public review between 9:00 a.m. and 4:00 p.m. on Laboratory business days at the ER Program's public reading room at 1450 Central Avenue in Los Alamos and at the main branches of the public libraries in Española, Los Alamos, and Santa Fe.

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ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
ALARA	As low as reasonably achievable
AOC	Area of concern
$BaCO_3$	Barium carbonate
BRET	Biological Resource Evaluations Team
$CaCO_3$	Calcium carbonate
CEARP	Comprehensive Environmental Assessment and Response Program
CEC	Cation-exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CMS	Corrective measures study
cpm	Counts per minute
D&D	Decontamination and decommissioning
DA	Deferred action
DI	Deionized
DNB	Dinitrobenzene
DNT	Dinitrotoluene
DoD	Department of Defense
DOE	Department of Energy
DQO	Data quality objective
EID	Environmental Improvement Division
EM-8	Environmental Protection Group, LANL
EMI	Electromagnetic induction
EPA	US Environmental Protection Agency
EPICS	Energetic Pion Channel and Spectrometer
ER	Environmental Restoration
ES&H	Environmental Safety and Health
ESH-8	Environmental Protection Group, LANL
ETL	Equipment Test Laboratory
FIDLER	Field instrument for detection of low-energy radiation
FY	Fiscal year
gal./day	Gallons per day
gal./min	Gallons per minute
GPR	Ground-penetrating radar
GTA	Ground Test Accelerator
HE	High explosives
HIRAB	High-Resolution Atomic Beam Facility
HMX	Cyclotetramethylene tetranitramine
HSWA	Hazardous and Solid Waste Amendments
IWP	Installation Work Plan
K_{OC}	Organic carbon partition coefficient
LAMPF	Los Alamos Meson Physics Facility
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Scattering Center
LASL	Los Alamos Scientific Laboratory

LDR	Land disposal restriction
LEP	Low-Energy Pion Channel
LOB	Laboratory-Office Building
MCL	Maximum contaminant level
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter
MRS	Medium-Resolution Spectrometer
NE	Northeast
NFA	No further action
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NTOF	Neutron Time-of-Flight
NW	Northwest
OSHA	Occupational Safety and Health Administration
OU	Operable unit
OUPL	Operable Unit Project Leader
PCBs	Polychlorinated biphenyls
PCOC	Potential contaminant of concern
PETN	Pentaerythritol tetranitrate
PMP	Project management plan
PPL	Programmatic Project Leader
PRS	Potential release site
PSR	Proton Storage Ring
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
QPPL	Quality program project leader
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetrinitramine
RF	Radio frequency
RFA	RCRA Facility Assessment
RFI	RCRA Facilities Investigation
S	South
SAL	Screening action level
SDWA	Safe Drinking Water Act
SMC	Stopped Muon Channel
SOP	Standard operating procedure
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TA	Technical area
TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TNB	Trinitrobenzene
TNT	Trinitrotoluene
TOFI	Time-of-Flight Isochronous Spectrometer
TPH	Total petroleum hydrocarbons

TSCA	Toxic Substances Control Act
TSD	Treatment, storage, and disposal
TTL	Technical team leader
UST	Underground storage tank
VCA	Voluntary corrective action
VCP	Vitrified clay pipe
VOC	Volatile organic compound
WNR	Weapons Neutron Research
XRF	X-ray fluorescence

Executive Summary

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Background Information for OU 1100

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Chapter 1

- Statutory and Regulatory Background
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- Description of OU 1100
- Document Organization

1.0 Introduction

1.1 Statutory and Regulatory Background

In 1976, Congress enacted the Resource Conservation and Recovery Act (RCRA), which governs the day-to-day operations of hazardous waste treatment, storage, and disposal (TSD) facilities. Sections 3004(u) and (v) of RCRA established a permitting system, which is implemented by the Environmental Protection Agency (EPA), or by a state authorized to implement the program, and set standards for all hazardous-waste-producing operations at a TSD facility. Under this law, Los Alamos National Laboratory (the Laboratory) qualifies as a treatment and storage facility and must have a permit to operate. The state of New Mexico, which is authorized by EPA to implement portions of the RCRA permitting program, issued the Laboratory's RCRA permit.

In 1984, Congress amended RCRA by passing the Hazardous and Solid Waste Amendments (HSWA), which modified the permitting requirements of RCRA by, among other things, requiring corrective action for releases of hazardous wastes or constituents from solid waste management units (SWMUs). EPA administers the HSWA requirements in New Mexico at this time. In accordance with this statute, the Laboratory's permit to operate (EPA 1990, 0306) includes a section, referred to as the HSWA Module, that prescribes a specific corrective action program for the Laboratory. The HSWA Module includes provisions for mitigating releases from facilities currently in operation and for cleaning up inactive sites. The primary purpose of this RCRA field investigation (RFI) work plan is to determine whether corrective actions are required for releases of hazardous waste and hazardous constituents from potential release sites (PRSs). The plan meets the requirements of the HSWA Module and is consistent with the scope of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The HSWA Module lists SWMUs, which are defined as "any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste." These wastes may be either hazardous or nonhazardous (for example, construction debris). Table A of the HSWA Module identifies 603 SWMUs at the Laboratory, and Table B lists those SWMUs that must be investigated first. In addition, the Laboratory has identified areas of concern (AOCs), which do not meet the HSWA Module's definition of a SWMU. These sites may contain radioactive materials, as well as hazardous substances not listed under RCRA. SWMUs and AOCs are collectively referred to as PRSs. The ER Program uses the mechanism of recommending no further action (NFA) for AOCs as well as SWMUs. However, using this approach for AOCs does not imply that AOCs fall under the jurisdiction of the HSWA Module.

For the purposes of implementing the cleanup process, the Laboratory has aggregated PRSs that are geographically related in groupings called operable units (OUs). The Laboratory has established 24 operable units, and a work plan has been or will be prepared for each. This work plan addresses PRSs located in three of the Laboratory's technical areas (TAs): TAs-20, -53, and -72. This work plan, together with three other work plans submitted to EPA in May 1994 and nineteen work plans submitted in 1991, 1992, and 1993, meets the schedule requirements of the HSWA Module, which is to address a cumulative total of 100% of the SWMUs in Table A and a cumulative total of 100% of the 182 priority SWMUs listed in Table B of the HSWA Module by May 1994.

As more information is obtained, the Laboratory proposes modifications in the HSWA Module for EPA approval. When applications to modify the permit are pending, the ER Program submits work plans consistent with current permit conditions. Program documents, including RFI reports and the Installation Work Plan (IWP), are updated and phase reports are prepared to reflect changing permit conditions.

The HSWA Module outlines five tasks to be addressed in an RFI work plan. Table 1-1 lists these tasks and indicates the ER Program equivalents. Table 1-2 indicates the location of HSWA Module requirements in ER Program documents.

1.2 Installation Work Plan

The HSWA Module required that the Laboratory prepare a master plan, the IWP, to describe the Laboratory-wide system for accomplishing all RFIs and corrective measures studies (CMSs). The IWP has been prepared in accordance with the HSWA Module and is consistent with EPA's interim final RFI guidance (EPA 1989, 0088) and proposed Subpart S of 40 CFR 264 (EPA 1990, 0432), which proposes the cleanup program mandated in Section 3004(u) of RCRA. The IWP was first prepared in 1990 and is updated annually. This work plan follows the requirements specified in Revision 3 of the IWP (LANL 1993, 1017).

The IWP describes the aggregation of the Laboratory's PRSs into 24 operable units (Section 3.4.1). It presents a facilities description in Chapter 2 and a description of the structure of the Laboratory's ER Program in Chapter 3. Chapter 4 describes the technical approach to corrective action at the Laboratory. Annexes I-V of the IWP contain the Program Management Plan, Quality Program Plan, Health and Safety Program Plan, Records Management Program Plan, and the Public Involvement Program Plan, respectively. The document also contains a proposal to integrate RCRA closure and corrective action and a strategy for identifying and implementing interim remedial measures. When information relevant to this work plan has already been provided in the IWP, the reader is referred to the 1993 revision of the IWP.

1.3 Description of OU 1100

OU 1100 is located in Los Alamos and Santa Fe Counties in north-central New Mexico (Figure 1-1) and consists of TAs-53 and -72, which are active, and TA-20, which is inactive (Figure 1-2). OU 1100 covers approximately 2,400 acres of mesas and canyon terrain. The currently and formerly developed areas, which contain the PRSs, cover approximately 300 acres. All of the land comprising OU 1100 is owned by the Department of Energy (DOE).

TA-53 is the location of the Los Alamos Meson Physics Facility (LAMPF), which consists of a linear proton accelerator and associated experimental and support facilities. Activities conducted at LAMPF include basic research involving

TABLE 1-1

RFI GUIDANCE FROM THE HSWA MODULE

SCOPE OF THE RFI	**ER PROGRAM EQUIVALENT**	
The RCRA Facility Investigation consists of five tasks:	**LANL Installation RI/FS* Work Plan**	**LANL Task/Site RI/FS**
Task I: Description of Current Conditions	I. LANL Installation RI/FS Work Plan	I. Quality Assurance Project Plan
A. Facility Background B. Nature and Extent of Contamination	A. Installation Background B. Tabular Summary of Contamination by Site	A. Task/Site Background B. Nature and Extent of Contamination
Task II: RFI Work Plan	II. LANL Installation RI/FS Work Plan	II. LANL Task/Site RI/FS Documents
A. Data Collection Quality Assurance Plan B. Data Management Plan C. Health and Safety Plan D. Public Involvement Plan	A. General Standard Operating Procedures for Sampling Analysis and Quality Assurance B. Technical Data Management Program C. Health and Safety Program D. Public Involvement Program	A. Quality Assurance Project Plan and Field Sampling Plan B. Records Management Project Plan C. Health and Safety Project Plan D. Public Involvement Project Plan
Task III: Facility Investigation	III.	III. Task/Site Investigation
A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification		A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification
Task IV: Investigative Analysis	IV.	IV. LANL Task/Site Investigative Analysis
A. Data Analysis B. Protection Standards		A. Data Analysis B. Protection Standards
Task V: Reports	V. Reports	V. LANL Task/Site Reports
A. Preliminary and Work Plan B. Progress C. Draft and Final	A. LANL Installation RI/FS Work Plan B. Annual Update of LANL Installation RI/FS Work Plan C. Draft and Final	A. Quality Assurance Project Plan, Field Sampling Plan, Technical Data Management Plan, Health and Safety Plan, Public Involvement Plan B. LANL Task/Site RI/FS Documents and LANL Monthly Management Status Report C. Draft and Final

* RI/FS - remedial investigation/feasibility study.

TABLE 1-2

LOCATION OF HSWA MODULE REQUIREMENTS IN ER PROGRAM DOCUMENTS

HSWA MODULE REQUIREMENTS OR RFI WORK PLANS	INSTALLATION WORK PLAN AND OTHER PROGRAM DOCUMENTS	DOCUMENTS FOR OU 1100
Task I: Description of Current Conditions		
A. Facility Background	IWP Section 2.1	
B. Nature and Extent of Contamination	IWP Section 2.4 and Appendix F	
Task II: RFI Work Plan		
A. Data Collection Quality Assurance Plan	IWP Annex II (Quality Program Plan)*	RFI Work Plan Annex II
B. Data Management Plan	IWP Annex IV (Records Management Program Plan)	RFI Work Plan Annex IV
C. Health and Safety Plan	IWP Annex III (Health and Safety Program Plan)	RFI Work Plan Annex III
D. Public Involvement Plan	IWP Annex V (Public Involvement Program Plan)	RFI Work Plan Annex V
E. Project Management Plan	IWP Annex I (Program Management Plan)	RFI Work Plan Annex I
Task III: Facility Investigation		
A. Environmental Setting	IWP Chapter 2	RFI Work Plan Chapter 3
B. Source Characterization	IWP Appendix F	RFI Work Plan Chapter 5
C. Contamination Characterization	IWP Appendix F	RFI Work Plan Chapters 4 and 5
D. Potential Receptor Identification	IWP Section 4.2	RFI Work Plan Chapters 4 and 5
Task IV: Investigative Analysis		
A. Data Analysis	IWP Section 4.2	Phase Report and RFI Report
B. Protection Standards	IWP Section 4.2	RFI Report
Task V: Reports		
A. Preliminary and Work Plan	IWP, Rev. 0	Work Plan
B. Progress	Monthly Reports, Quarterly Reports, and Annual Revisions of IWP	Phase Reports
C. Draft and Final		Draft and Final RFI Report

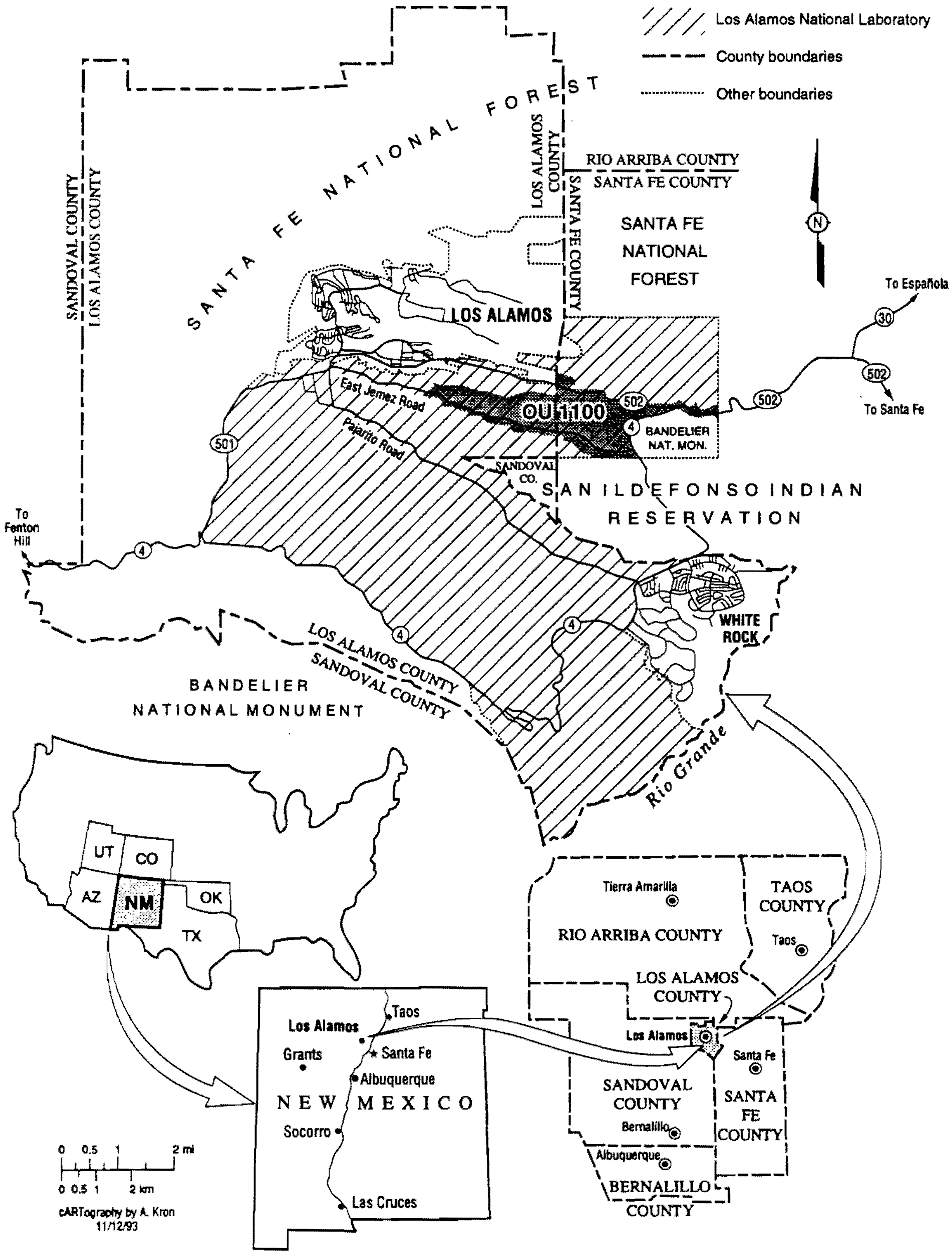

Figure 1-1. Location of OU 1100.

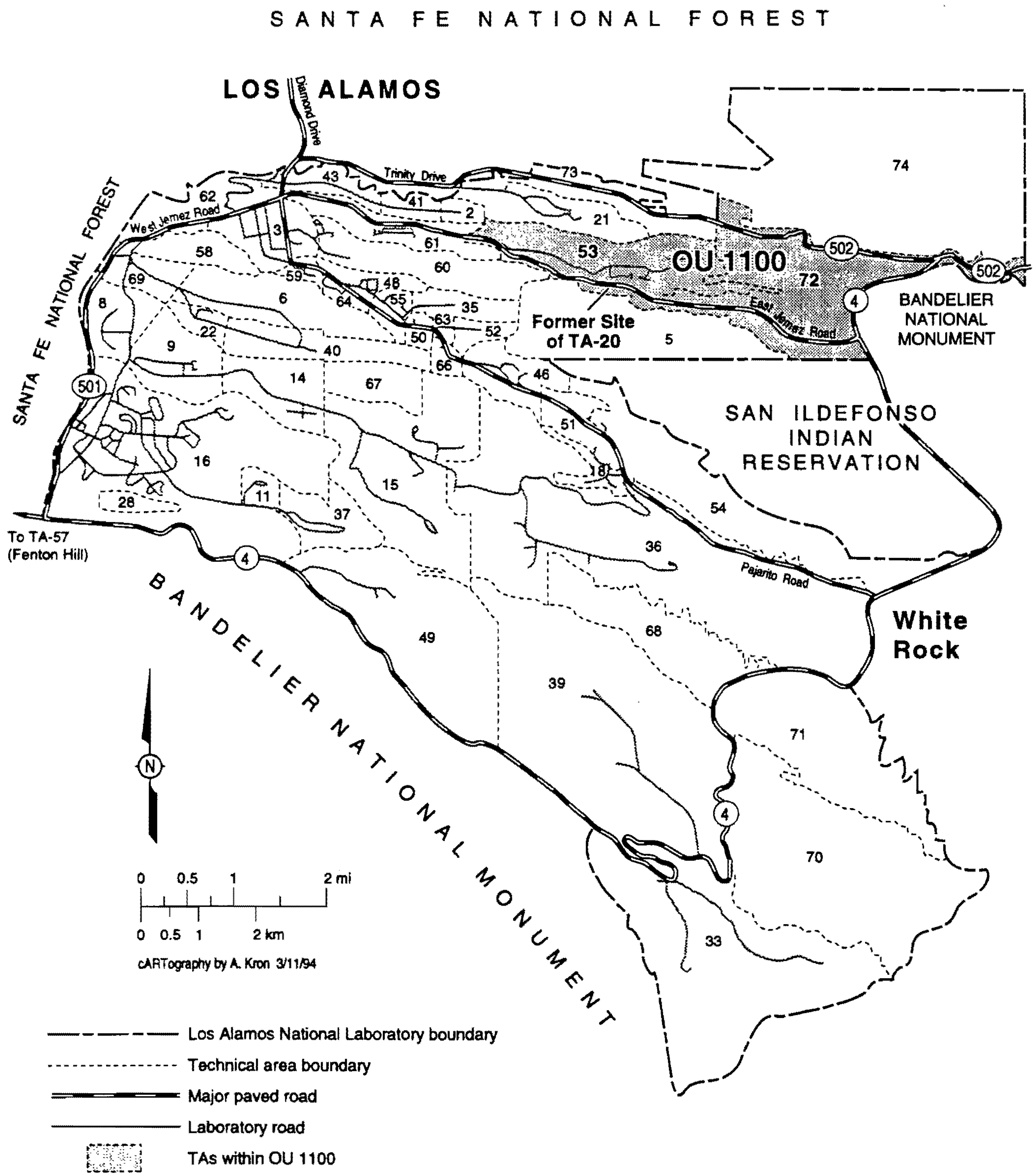

Figure 1-2. Location of OU 1100 with respect to Laboratory technical areas and surrounding lands.

subatomic particles, isotope production, radiochemistry research, solid-state physics research, and accelerator technology development. TA-72 is the location of the active small-arms firing range used by the Laboratory's security guards. TA-20 was used during and shortly after World War II. This technical area was the location of several firing sites where experiments involving the use of explosives were conducted.

Eighty-three PRSs are located within OU 1100. These include landfills, firing sites, waste and product storage areas, underground storage tanks, septic systems, outfalls, and surface impoundments. The locations of the PRSs are shown in Figures 1-3 through 1-5.

The PRSs have been aggregated into seven groups on the basis of functional use of the PRSs. These aggregates are discussed in detail in the following sections of Chapter 5: 5.1, Aggregate A - Landfills; 5.2, Aggregate B - Firing Sites; 5.3, Aggregate C - Waste and Product Storage Areas; 5.4, Aggregate D - Underground Storage Tanks; 5.5, Aggregate E - Septic Systems; 5.6, Aggregate F - Outfalls; and 5.7, Aggregate G - Surface Impoundments. The PRSs that will be investigated in Phase I of the RFI and those for which investigation has been deferred are listed, by aggregate, in Table 1-3. PRSs recommended for NFA on the basis of archival information (see Chapter 4, Section 4.6.1, and Appendix I of the IWP [LANL 1993, 1017]) are listed in Table 1-4 and described in Chapter 6.

1.4 Work Plan Organization

This work plan follows the generic outline provided in Table 3-3 of the IWP (LANL 1993, 1017). Following this introductory chapter, Chapter 2 provides background information on OU 1100, including a description and history of the technical areas and a description of past waste management practices. Chapter 3 describes the environmental setting of OU 1100. Chapter 4 describes the technical approach being used to conduct the RFI. Chapter 5 includes a description and history of each PRS being investigated in Phase I, a conceptual exposure model, data needs and data quality objectives, and a sampling plan. Chapter 6 provides a description of each PRS proposed for NFA or deferred action and the basis for that recommendation. The main body of this work plan is followed by five annexes containing project plans corresponding to portions of the IWP: project management, quality assurance, health and safety, records management, and public involvement. All relevant materials for the records management and public involvement annexes are contained in the IWP and the reader is, therefore, referred directly to the IWP.

A list of acronyms precedes Chapter 1. A glossary of unfamiliar terms is provided in the IWP (LANL 1993, 1017).

The units of measurement used in this document are expressed in both English and metric units, depending on which unit is commonly used in the field being discussed (Table 1-5). When information is derived from some other published report, the units are consistent with those used in that report.

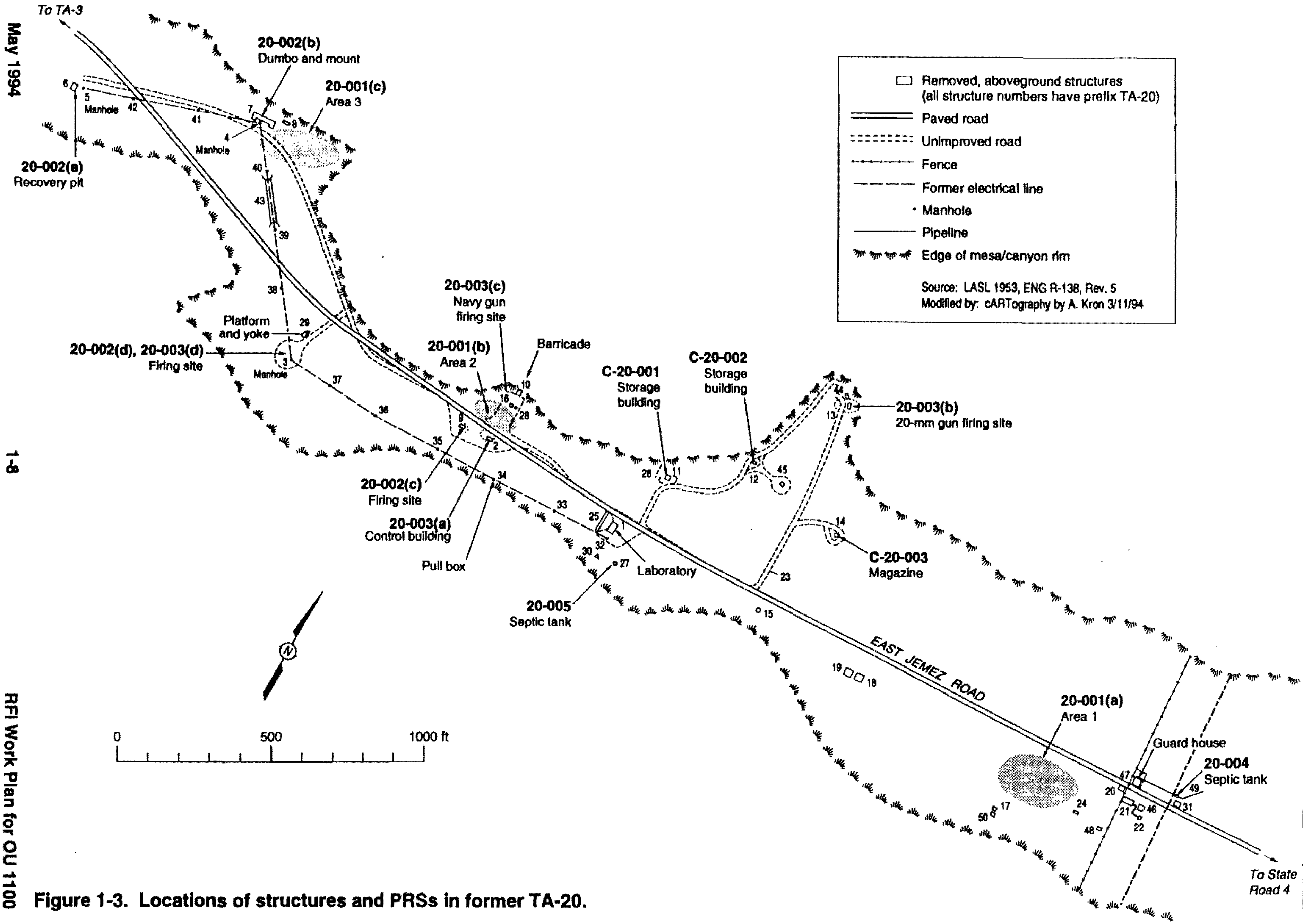

Figure 1-3. Locations of structures and PRSs in former TA-20.

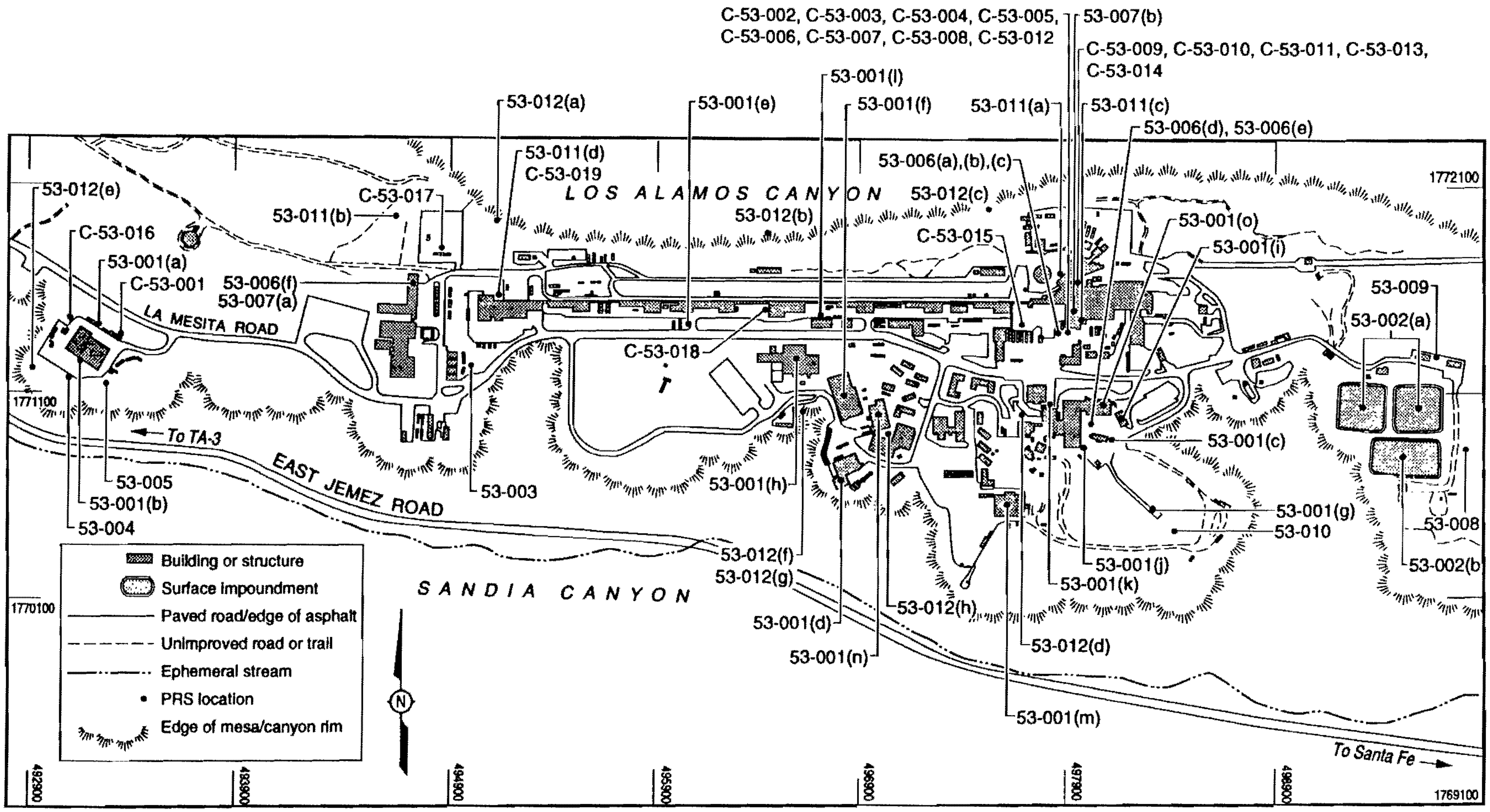

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Figure 1-4. Locations of PRSs in TA-53.

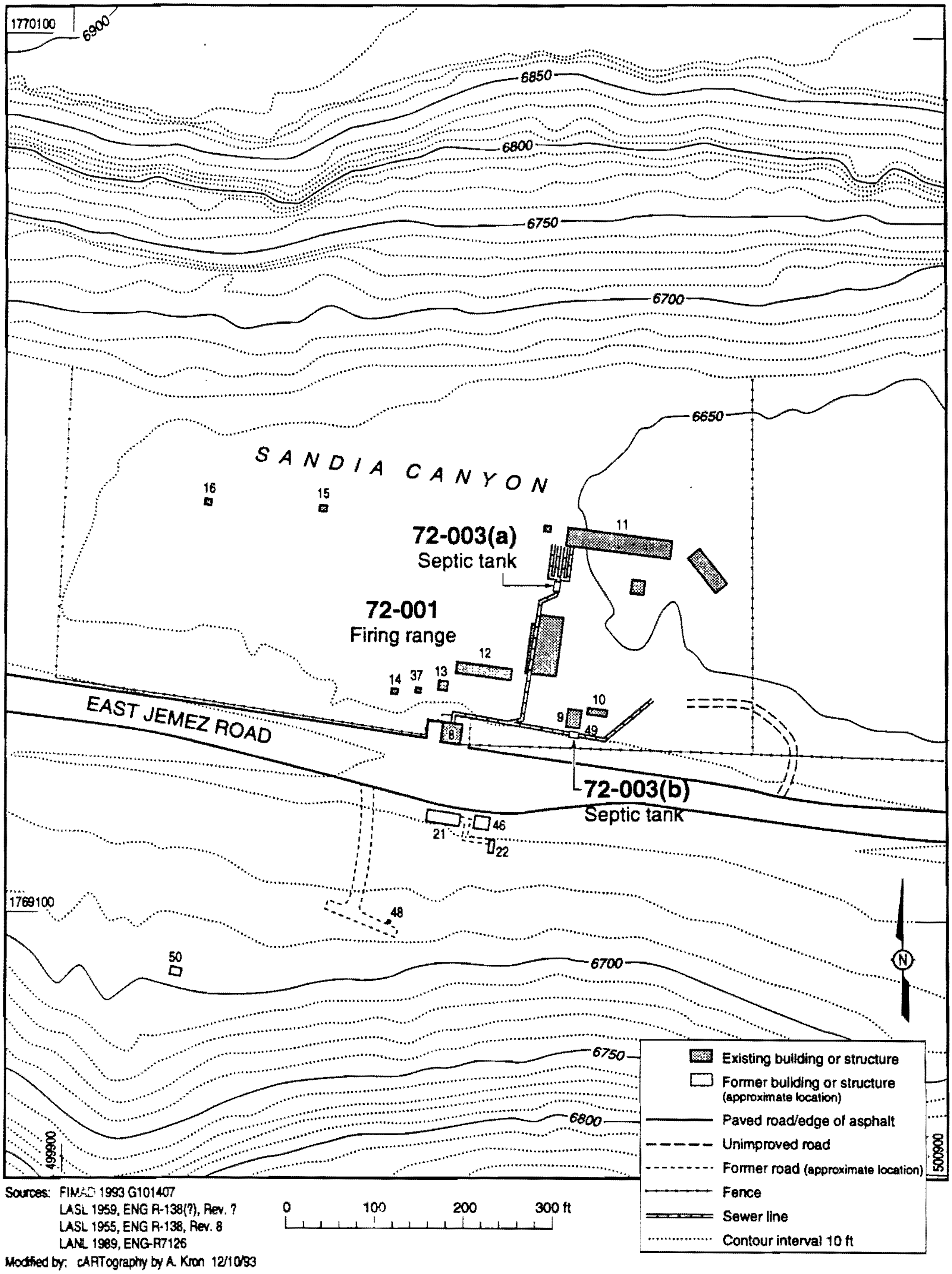

Figure 1-5. Locations of structures and PRSs in TA-72.

TABLE 1-3

OU 1100 PRSs PROPOSED FOR PHASE I INVESTIGATION OR DEFERRED INVESTIGATION

PRS No.	1988 SWMU No.	HSWA Permit Table A SWMU No.	Work Plan Figure No.	Work Plan Section No.	Description
Aggregate A - Landfills					
20-001(a)	20-001(a)	20-001(a)	1-3	5.1	Sandia Canyon landfill Area 1
20-001(b)	20-001(b)	20-001(b)	1-3	5.1	Sandia Canyon landfill Area 2
20-001(c)	20-001(c)	20-001(c)	1-3	5.1	Sandia Canyon landfill Area 3
Aggregate B - Firing Sites					
20-002(a)	20-002	20-002	1-3	5.2	Firing site
20-002(b)	20-002		1-3	5.2	Firing site
20-002(c)	20-002		1-3	5.2	Firing site
20-002(d)	20-002		1-3	5.2	Firing site
20-003(b)	20-003(b)		1-3	5.2	Gun firing site
20-003(c)	20-003(c)		1-3	5.2	Gun firing site
72-001	0-015(a)		1-5	5.2	Firing range
Aggregate C - Waste and Product Storage Areas					
53-001(a)	53-001(a)	53-001(a)	1-4	5.3	Waste accumulation area
53-001(b)	53-001(b)	53-001(b)	1-4	5.3	Waste accumulation area
53-001(c)	53-001(c)		1-4	6.4	Waste accumulation area
53-001(d)	53-001(d)		1-4	6.4	Waste accumulation area
53-001(e)			1-4	5.3	Waste accumulation area
53-001(g)			1-4	5.3	Waste accumulation area
53-001(k)			1-4	6.4	Waste accumulation area
53-005	53-005	53-005	1-4	5.3	Waste disposal pit
53-008	53-008		1-4	5.3	Boneyard
53-009	53-009		1-4	6.4	Oil storage area
53-010			1-4	5.3	Oil storage area
Aggregate D - Underground Storage Tanks					
53-006(a)	53-006(a)		1-4	6.4	Underground waste tank
53-006(b)	53-006(b)	53-006(b)	1-4	6.2	Underground waste tank
53-006(c)	53-006(c)	53-006(c)	1-4	6.2	Underground waste tank
53-006(d)	53-006(d)	53-006(d)	1-4	6.2	Underground waste tank
53-006(e)	53-006(e)	53-006(e)	1-4	6.2	Underground waste tank
53-006(f)			1-4	6.4	Underground waste tank
Aggregate E - Septic Systems					
20-004	20-004(b)		1-3	5.5	Septic system
20-005	20-004(c)		1-3	5.5	Septic system
Aggregate F - Outfalls					
53-012(e)			1-4	5.6	Outfall
Aggregate G - Surface Impoundments					
53-002(a)	53-002(a)	53-002(a)	1-4	6.2	Surface impoundment
53-002(b)	53-002(b)	53-002(b)	1-4	6.2	Surface impoundment

TABLE 1-4

OU 1100 PRSs PROPOSED FOR NO FURTHER ACTION

PRS No.	1988 SWMU No.	HSWA Permit Table A SWMU No.	Work Plan Figure No.	Work Plan Section No.	Description
Aggregate B - Firing Sites					
20-003(a)	20-003(a)	20-003(a)	1-3	6.1	Gun firing site control building
20-003(d)	20-003(d)		1-3	6.3	Firing site
C-20-001			1-3	6.3	Storage building
C-20-002			1-3	6.3	Storage building
C-20-003			1-3	6.3	Magazine
72-002	0-011(f)		1-5	6.3	Impact area
Aggregate C - Waste and Product Storage Areas					
53-001(f)			1-4	6.3	Waste accumulation area
53-001(h)			1-4	6.3	Waste accumulation area
53-001(i)			1-4	6.3	Waste accumulation area
53-001(j)			1-4	6.3	Waste accumulation area
53-001(l)			1-4	6.3	Waste accumulation area
53-001(m)			1-4	6.3	Waste accumulation area
53-001(n)			1-4	6.3	Waste accumulation area
53-001(o)			1-4	6.3	Waste accumulation area
53-004	53-004		1-4	6.3	Bead blaster
53-007(a)	53-007(a)	53-007(a)	1-4	6.1	Waste tanks
53-007(b)	53-007(b)	53-007(b)	1-4	6.1	Waste tanks
53-011(a)			1-4	6.3	PCB transformer
53-011(b)			1-4	6.3	PCB transformer
53-011(c)			1-4	6.3	PCB transformer
53-011(d)			1-4	6.3	PCB transformer
53-011(e)			1-4	6.3	PCB transformer
C-53-001			1-4	6.3	PCB oil leak
C-53-002			1-4	6.3	PCB oil leak
C-53-003			1-4	6.3	PCB oil leak
C-53-004			1-4	6.3	PCB oil leak
C-53-005			1-4	6.3	PCB oil leak
C-53-006			1-4	6.3	PCB oil leak
C-53-007			1-4	6.3	PCB oil leak
C-53-008			1-4	6.3	PCB oil leak
C-53-009			1-4	6.3	PCB oil leak
C-53-010			1-4	6.3	PCB oil leak
C-53-011			1-4	6.3	PCB oil leak
C-53-012			1-4	6.3	PCB oil leak
C-53-013			1-4	6.3	PCB oil leak
C-53-014			1-4	6.3	PCB oil leak
C-53-015			1-4	6.3	PCB oil leak
C-53-016			1-4	6.3	PCB oil leak
C-53-017			1-4	6.3	PCB oil leak
C-53-018			1-4	6.3	PCB oil leak
C-53-019			1-4	6.3	PCB oil leak

TABLE 1-4

OU 1100 PRSs PROPOSED FOR NO FURTHER ACTION (concluded)

PRS No.	1988 SWMU No.	HSWA Permit Table A SWMU No.	Work Plan Figure No.	Work Plan Section No.	Description
Aggregate E - Septic Systems					
53-003	53-003		1-4	6.3	Septic system
73-003(a)			1-5	6.3	Septic system
73-003(b)			1-5	6.3	Septic system
Aggregate F - Outfalls					
53-012(a)			1-4	6.3	Outfall
53-012(b)			1-4	6.3	Outfall
53-012(c)			1-4	6.3	Outfall
53-012(d)			1-4	6.3	Outfall
53-012(f)			1-4	6.3	Outfall
53-012(g)			1-4	6.3	Outfall
53-012(h)			1-4	6.3	Outfall

TABLE 1-5

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 (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)

REFERENCES FOR CHAPTER 1

EPA (US Environmental Protection Agency), May 1989. "Interim Final RCRA Facility Investigation (RFI) Guidance, Volume I of IV, Development of an RFI Work Plan and General Considerations for RCRA Facility Investigations," EPA/530-SW-89-031, OSWER Directive 9502.00-6D, Office of Solid Waste, Washington, DC. (EPA 1989, 0088)

EPA (US Environmental Protection Agency), April 10, 1990. Module VIII of RCRA Permit No. NM0890010515, EPA Region VI, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, EPA Region VI, Hazardous Waste Management Division, Dallas, Texas. (EPA 1990, 0306)

EPA (US Environmental Protection Agency), July 27, 1990. "Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management Facilities," proposed rule, Title 40 Parts 264, 265, 270, and 271, Federal Register, Vol. 55., pp. 30798-30884 (EPA 1990, 0432)

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. (LANL 1993, 1017)

Executive Summary

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- General Description of OU 1100
- TA-20—Sandia Canyon Site
- TA-53—Los Alamos Meson Physics Facility
- TA-72

2.0 BACKGROUND INFORMATION FOR OPERABLE UNIT 1100

2.1 General Description

Operable unit (OU) 1100 is located south and east of Los Alamos townsite (Figure 2-1). It extends from the entrance road to Technical Area (TA) 53 (at an elevation of about 7,150 ft) eastward 3.5 miles to New Mexico State Road 4, thence north along the road to State Road 502, where it narrows to essentially the width of State Road 502 as far as the boundary with San Ildefonso Pueblo land (where the elevation is about 6,100 ft). The operable unit encompasses most of Sandia Canyon on the south, Mesita de los Alamos in the center, and a portion of Los Alamos Canyon in the northeast. The northern boundary follows Los Alamos Creek eastward to the Santa Fe County line, then shifts northward up onto Los Alamos Mesa and continues eastward along New Mexico State Road 502 (commonly referred to as the Main Hill Road) to State Road 4. The southern boundary follows the south rim of Sandia Canyon. The east boundary curves along Bandelier National Monument property.

Non-DOE landowners that border the operable unit are Los Alamos County on part of the western border; San Ildefonso Pueblo sacred land on the southeast corner; and Bandelier National Monument on the east.

As shown in Figure 2-1, OU 1100 includes three TAs: TA-53, the Los Alamos Meson Physics Facility (LAMPF), is located on Mesita de los Alamos in the central portion of the operable unit; TA-72 is located in Sandia Canyon, approximately 1.5 miles west of New Mexico State Road 4; TA-20, now inactive, was located in Sandia Canyon south of TA-53 (the current TAs 53 and 72 now cover most if not all of the original TA-20 site). No past or current Laboratory activities took place within that portion of Los Alamos Canyon included in OU 1100 or the portion of Mesita de los Alamos east of LAMPF.

The following sections discuss each of the TAs within OU 1100, including history of operations and waste management practices.

2.2 TA-20 - Sandia Canyon Site

2.2.1 Site History

TA-20, located today partly within TA-53 and partly within TA-72 (see Figure 1-3), was used during the Manhattan Project by Group G-10 to test initiators (devices that generate neutrons to initiate nuclear explosions). Later, it was used briefly by Group M-4 for other types of implosion tests. The site, near the west end of Sandia Canyon, consisted of a series of firing areas that were spaced along a small road heading west from New Mexico State Road 4, the only access route.

The first facilities, constructed in the fall of 1944, included a guard post (TA-20-31), a gun facility (TA-20-16) and recovery bin (TA-20-10), two storage buildings (TA-20-18 and -19), and the "Hot Storage" shack (TA-20-11), an assembly

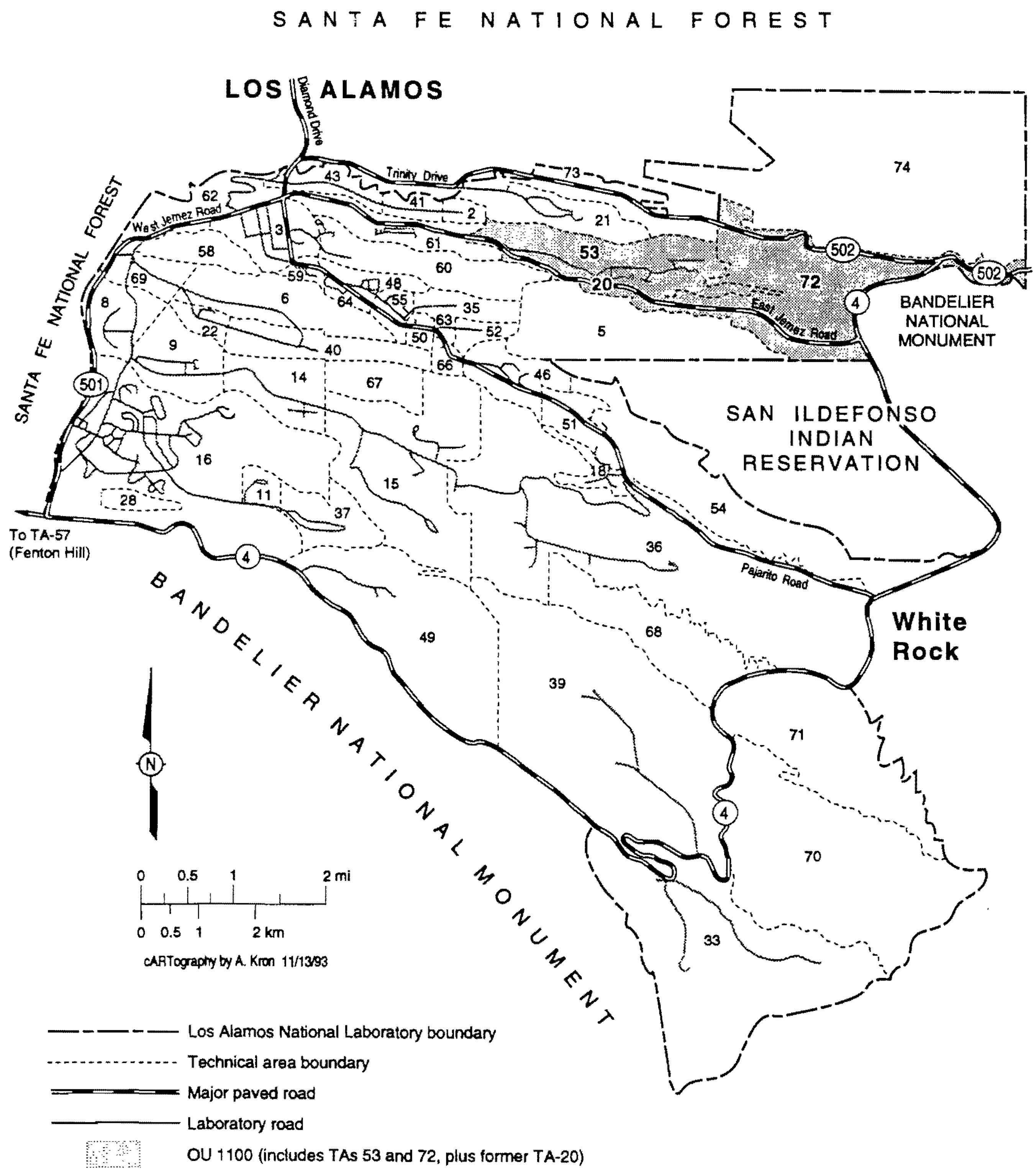

Figure 2-1. Location of OU 1100 with respect to Laboratory technical areas and surrounding lands.

building. Firing tests began here in February 1945. By March 1945, additional areas, which included a small side canyon to the north, were being developed. Initiators of various designs were tested, either by implosion or by impaction against a target, to determine the most effective design for emission of neutrons. One test method involved placing the device inside a 3-in.-diam. metal sphere that was imploded with either 25 or 200 pounds of explosives, then recovering the crushed initiator for study. Another method was to fire the device from a smooth-bore Navy gun into a recovery bin, or from a 20-mm gun into a target, as various measurements were taken (LANL 1984, 22-0015). Many geometries were tried, as were various materials in thin layers or foils. Major components included, for the devices, polonium-210, beryllium, and nickel; and steel, aluminum, and beryllium for the spheres.

In March 1945, several buildings were constructed to support these operations. These included a control building (TA-20-2) covered by a dirt berm, located across the road just south of the gun facility (LASL 1951, 22-0019); a 20-ft x 40-ft laboratory (TA-20-1) to the east of the gun facility; and a 3- to 10-kVa elevated transformer substation (TA-20-30) just south of the laboratory. An underground conduit system was put in to connect the laboratory building to the firing pit (TA-20-6), allowing shots to be detonated from the laboratory. Manholes at various points provided access to the system. A lead sink in the laboratory darkroom was connected to the building's reinforced concrete septic tank (TA-20-27), a structure having interior dimensions of 3 ft x 6 ft x 5 ft deep located about 107 ft to the southeast (LASL 1951, 22-0019). This tank was abandoned in place in 1948 and may subsequently have been removed.

A timber platform and overhead yoke (TA-20-29), built in February 1945, sat on a short side road leading to Manhole TA-20-3. The yoke was perhaps used to lift test assemblies, being near the implosion test areas. The turnaround at the road's end later became a Group M-4 firing site (LANL 1984, 22-0015).

The first implosion test was conducted in a "Dumbo," a 5-ft-diam. cylindrical steel vessel intended to contain the explosion and make recovery of fragments easier. The Dumbo was mounted on a firing pad at one end of a 91-ft-long concrete platform (TA-20-7) near the west end of TA-20. The shot, however, badly jammed the entry door on the Dumbo. A second Dumbo, built at the same time, was never used (LANL 1984, 22-0015). Instead, subsequent shots were done in a 12-ft deep, 15-ft x 15-ft steel-lined firing pit (TA-20-6) at the far west end of the site. The pit was covered with a cage of pipe overlain by steel mats, designed to contain the explosion fragments.

Neutron timing tests, conducted in the north side-canyon, used a 20-mm gun to fire initiators into a steel plate set against the cliff (DOE 1987, 0264). The facility consisted of a steel framework on a concrete mounting pad in the "20-mm hutment" (TA-20-44), built about February 1945, and a support building, the so-called 20-mm-gun building (TA-20-13), built in April.

Three magazines were built near this side canyon in March-April 1945, for storage of explosives and munitions: TA-20-12, TA-20-14, and TA-20-45. They were partly covered with dirt for protection (including TA-20-12, even though it had been built on skids for portability).

In late 1945, initiator work was transferred to a new site, TA-33. Implosion studies were then carried out at TA-20 by Group M-4, until November 1946. Several tests were done in the vicinity of manhole TA-20-3. Group M-4 probably did fewer than 10 tests in all; they used mainly steel spheres, but may have used some uranium as well (Ahlquist et al. 1985, 22-0024). Larger shots were rare, but one test using 500 pounds of high explosive (HE) underwent a low-order explosion that scattered undetonated HE for a considerable distance. M-4 personnel immediately spent several days cleaning up the area (LANL 1984, 22-0015).

TA-20 underwent an intensive radiation-monitoring and cleanup effort in the spring of 1946, during which soil contaminated with polonium was removed. (The polonium reportedly came from firing areas, from a former Indian cave in the side canyon where radioactive materials had been stored, and from several material disposal pits.) Contaminated items, such as rubber gloves, were found scattered about the area and were removed to a material disposal area at TA-21. Two structures, TA-20-18 (a storage building) and TA-20-17 (the "Cut-off Shack") were also removed (LANL 1984, 22-0015). During 1947, testing was carried out at TA-20 by various experimenters, but the nature of these experiments is not known (LANL 1985, 22-0016).

In April 1948, TA-20 was largely decommissioned to make way for a new road through the canyon for access to South Mesa and Los Alamos. Many of the remaining structures were dismantled and removed, including TA-20-10, the dirt-filled bin into which test devices had been fired for later recovery; transformer station TA-20-30; recovery pit TA-20-6; the two Dumbos; and magazine TA-20-45. (Magazines TA-20-12 and TA-20-14 were deactivated at this time, but were not destroyed until February 1960, when they were burned after having been monitored for HE, radiation, and toxic materials.)

A final 2-week site cleanup was conducted that summer, just before road construction began; it netted 60-70 pounds of HE (LANL 1984, 22-0015). (The road, first called South Mesa Road, is now East Jemez Road, also referred to as the "truck route.")

In November 1948, a vehicle security checkpoint and pass office (TA-20-21) was built beside the road, near the old 1944 guard post at the east end of former TA-20. The checkpoint was closed in 1957, when public access to Los Alamos became unrestricted. The present-day DOE small arms firing range (in TA-72) is located on the north side of the former checkpoint and uses one of the old buildings, TA-20-47 (now renumbered TA-72-8).

The Laboratory Safety Group conducted periodic follow-up searches for HE until 1973, when—after four years of finding no HE—they deemed the area safe and removed fences and warning signs. No major activities have taken place at old TA-20 since then except construction and operations at the TA-72 small arms range. A radiological survey of the remaining TA-20 structures (mainly underground structures, such as manholes, pull boxes, and footings) was performed in 1985, and some of the structures were removed at that time. A search for abandoned Septic Tank TA-20-27 turned up only a depression where it should have been. It is believed to have been removed (LANL 1985, 22-0016).

Contaminants possibly remaining at TA-20, despite the numerous cleanups and removal of structures, include trace quantities of HE, beryllium, uranium, and possibly some strontium-90 from lanthanum-140 sources. Given the short half-lives of polonium-210 and lanthanum-140 (138 days and 40 hours, respectively), we assume that none of these elements are left.

In a 1985 interview, a former Laboratory staff member mentioned that firing activities at the TA-20-16 gun site may have caused some of the cliff face to fall away, possibly burying some contamination in the debris (Ahlquist et al. 1985, 22-0012).

Although employee recollections (LANL 1984, 22-0015) suggest that landfills existed in three locations (near TA-20-7, -16, and -17), none of our searches, including a 1986 geophysical survey, found any evidence of such landfills.

2.2.2 Waste Management Practices

The decommissioning of TA-20 in 1948 produced most of the solid wastes generated by the site. Some, probably most, of the waste from the dismantling of structures was transported to material disposal areas at TA-21. Solid wastes disposed of on site before 1948 consisted mainly of contaminated metal scrap, such as old gun barrels. These are believed to have been dumped into three landfills (PRSs 20-001[a], -001[b], and -001[c])—one located near firing site TA-20-7, one near the Navy gun mount TA-20-16, and one near the Cut-off Shack (TA-20-17). There is no evidence of other disposal areas at the site. Potential contaminants of concern include beryllium, uranium, and HE.

The major liquid wastes generated at TA-20 were wastewaters that were discharged to septic systems, of which there were two at TA-20. One system (PRS 20-005), installed as part of the original test site, received sanitary wastewater and darkroom wastes. The second system (PRS 20-004) was installed in 1952 as part of the new guard facilities and is believed to have received only sanitary wastes. It is now inactive.

2.3 TA-53 - Los Alamos Meson Physics Facility

2.3.1 Site History

The Los Alamos Meson Physics Facility (LAMPF) consists of a 0.5-mile-long linear proton accelerator and associated experimental research areas, offices, laboratories, and shops (see Figure 1-4). The accelerator is used to produce subatomic particles for basic research, isotope production, radiochemistry, solid-state physics research, and accelerator technology development.

Construction of LAMPF began with site preparation in early 1967, followed by official groundbreaking in February 1968. Major construction funds became available in October 1968. The first proton beam, produced on June 10, 1970, had an energy of 5 MeV. A little over a year later, a 100-MeV beam was produced, and on June 9, 1972, the full design energy of 800 MeV was attained. The first full year of operation was 1974. LAMPF was then shut down in January 1975 to complete construction activities and to install the radiation hardening necessary for full-intensity-beam operation. After operations recommenced in April 1976, the beam current was steadily increased; 500 microamperes was reached in the fall of 1978 (LANL 1982, 22-0013) and 1.2 milliamperes by January 1983. The routine operating current level is 1 milliampere (LANL 1987, 22-0017).

The first stage of the accelerator contains three injector systems, one for each kind of particle: protons (H^+), negative hydrogen ions (H^-), and polarized H^-. The particles in each injector are formed into a beam and accelerated to an energy of 750 keV. In the second stage of the accelerator, a drift-tube-type linear accelerator accelerates the beam particles to 100 MeV. Finally, in the third stage, a side-coupled, cavity-type linear accelerator accelerates the particles to the peak energy of 800 MeV. The beams then enter a "switchyard," where they are separated by magnets into beam lines. Lines A, B, and C are directed to Experimental Areas A, B, and C, respectively. In addition, a polarized proton beam may be directed to the Los Alamos Neutron Scattering Center (LANSCE) as Line D (LANL 1982, 22-0013). As the beams strike various targets, they produce secondary particles (including pions, muons, neutrons, and neutrinos).

Experimental Area A contains two primary target cells, each of which generates two secondary beams (pions or muons). The proton beam passes through the targets to the beam stop in Area A East, where a neutrino beam is generated and is directed eastward to the neutrino experiment area (LANL 1987, 22-0017). The west end of the facility contains an area for development and maintenance of remote manipulators and, on the floor below, two hot cells with manipulators. The hot cells are used for work on radioactive components and for nuclear chemistry experimentation (LANL 1982, 22-0013).

Area A also contains the Energetic Pion Channel and Spectrometer (EPICS), the Low-Energy Pion Channel (LEP), the High-Energy Pion Channel, the Stopped Muon Channel (SMC) (LANL 1982, 22-0013), and the Time-of-Flight Isochronous Spectrometer (TOFI) (LANL 1985, 22-0014).

The former Radiobiology and Therapy Research Facility is located east of Experimental Area A. This facility was used for dosimetry, radiobiology, and therapy studies and for clinical trials of negative pions for radiation therapy. It contains a treatment room, control room, laboratories, offices, and patient-staging facilities.

Experiments using electron neutrinos generated at the Line A beam stop are carried out in the Neutrino Research Facility, a heavily shielded enclosure on the south side of the beam stop. On the north side of the beam line, immediately upstream of the beam stop, is the Radiation Damage and Isotope Production facility. Here, isotopes are prepared by inserting targets into the proton beam; and neutrons from the beam stop are used in materials radiation damage studies (LANL 1982, 22-0013).

Experimental Area B is the Nucleon Physics Laboratory, which includes the External Proton Beam Channel. This area is used to study nucleon-nucleon interactions using high-energy neutron beams. Area B also contains the Medium-Resolution Spectrometer (MRS), the High-Resolution Atomic Beam

Facility (HIRAB), and the Neutron Time-of-Flight Facility (NTOF) (LANL 1987, 22-0017).

Experimental Area C contains a high-resolution proton spectrometer used to study interactions of protons with various nuclei.

LANSCE, which includes the Weapons Neutron Research Facility/Proton Storage Ring (WNR/PSR) complex, receives beam line D, a polarized proton beam. Here, experiments are carried out in condensed matter physics, nuclear physics, biology, and national security programs using pulsed neutrons generated by the beam. The neutrino beam that exits the WNR is Line E (LANL 1982, 22-0013; LANL 1985, 22-0014).

Building TA-53-2, the Equipment Test Laboratory (ETL), contains a large hydrogen-brazing furnace shop; a radio-frequency (rf) test and assembly shop; development laboratories; a metrology laboratory containing alignment and tooling equipment; a staff shop; an assembly and staging area; and a polarized-target laboratory (LANL 1982, 22-0013). During construction, this facility was used to braze more than 1 million pounds of oxygen-free, high-conductivity copper needed for the side-coupled linear accelerator structure. Since the completion of construction, the facility has been used to assemble special components and experimental apparatus. The rf shop is used to repair and test klystrons and modulator assemblies.

Building TA-53-1, the Laboratory-Office Building (LOB), houses administrative and technical offices, a library, laboratories (including a radiochemistry lab), shops, computer facilities, and a cafeteria.

The other major operating area at TA-53, which is not related to LAMPF, is the Ground Test Accelerator (GTA) facility. The GTA is a linear accelerator that was being developed to test particle-beam weapons systems. The GTA and associated support facilities are located south of LAMPF and west of LANSCE.

2.3.2 Waste Management Practices

Wastes generated at TA-53 include liquid (cooling water, sanitary wastewater, and radioactive wastewater) and solid (hazardous wastes, radioactive wastes, and office trash).

2.3.2.1 Liquid Wastes

2.3.2.1.1 Cooling Water

The linear accelerator requires large amounts of cooling water to dissipate the heat generated from the 27 megawatts of power needed for operation—approximately 480,000 gal. per day. Of this total, about 340,000 gal. per day are evaporated to the atmosphere from three cooling towers; the remaining 140,000 gal. are discharged, as cooling-tower blowdown, to Los Alamos Canyon via three National Pollutant Discharge Elimination System (NPDES)-permitted outfalls (LANL 1990, 22-0018).

There are also cooling towers associated with the ETL, the GTA facility, and the WNR/PSR complex. Blowdown from these cooling towers is discharged to Sandia Canyon through three NPDES-permitted outfalls. In addition, noncontact cooling water from the GTA facility is discharged to Sandia Canyon through two NPDES-permitted outfalls (LANL 1990, 22-0018).

2.3.2.1.2 Sanitary Wastewater

Many of the office and laboratory facilities at TA-53 generate sanitary wastewater. With one exception, these facilities are connected to the sanitary sewer system, which, until February 1993, discharged to the two sanitary wastewater impoundments. These impoundments in turn discharged to Los Alamos Canyon through an NPDES-permitted outfall. Since February 1993, the TA-53 sanitary sewer has been discharged to the wastewater treatment facility at TA-46. The only facility generating sanitary wastewater that is not connected to the sanitary sewer is a small office trailer. This trailer discharges sanitary wastes to a holding tank that is periodically pumped out.

2.3.2.1.3 Radioactive Wastewater

The largest source of radioactive liquid waste is cooling water from the beam stops and experimental areas that has become contaminated with activation products. When necessary, this water is circulated through ion-exchange columns to remove some of the activation products. When the accelerator is operating, approximately 30 gal. per hour are discharged to one of two holding tanks to allow short-lived activation products to decay. The water is then discharged to the southernmost of the three surface impoundments at TA-53. (Before this impoundment was constructed, the water was discharged to the two sanitary waste impoundments.) A similar waste stream is generated from the magnets, beam stops, and experimental areas at PSR and WNR. This waste is also drained to holding tanks and then discharged to the south impoundment after decay of activation products (DOE 1987, 0264).

Wastewaters containing chemicals and/or radionuclides are generated by the chemistry laboratories. Such wastewaters from the laboratories in the LOB are drained to storage and neutralization tanks in the basement of that building and are periodically removed for treatment at TA-50. Similar tanks, no longer in use, are located in Experimental Area A.

2.3.2.2 Solid Wastes

Hazardous solid wastes are generated by shops and laboratories throughout TA-53. These wastes consist mainly of spent solvents, solvent-contaminated rags and wipes, spent acids, and waste oils. They are accumulated at numerous satellite accumulation areas and periodically removed for storage or disposal. A pit formerly existed near the ETL for disposal of waste oils, acids, and solvents. This pit has been removed from service and excavated.

Radioactive solid wastes, generated from operations in radiologically controlled areas, are accumulated and removed to TA-54 for disposal.

Nonhazardous, nonradioactive office trash is accumulated in dumpsters and taken to the Los Alamos County Landfill for disposal.

2.4 TA-72 - Active Firing Range

2.4.1 Site History

TA-72 is currently used as a firing range by the Laboratory security force. This range has been operational since 1966. Structures on this site include a guard house and associated structures from the former TA-20, which were abandoned in 1957 when access to East Jemez Road became unrestricted, and some structures added as part of the firing range. In addition, two Laboratory water supply wells, each with associated facilities (chlorinator and pump station), are located within TA-72.

2.4.2 Waste Management Practices

Wastes generated at TA-72 include sanitary wastewater, hazardous wastes, and office trash. Sanitary wastewater, generated from restrooms and sinks, is discharged to a septic tank. Hazardous wastes include materials used to clean weapons and solvents used in recirculating systems, which are replaced by a vendor when exhausted. Hazardous wastes, including solvent- and oil-contaminated rags, are collected at a satellite accumulation area and periodically removed for disposal. Office trash is accumulated in dumpsters and removed to the Los Alamos County landfill.

REFERENCES FOR CHAPTER 2

Ahlquist, A. J., R. W. Ferenbaugh, and L. J. Fritz, February 3, 1985. "Interview with Robert S. Fitzhugh, 2/3/85," Los Alamos National Laboratory memorandum to file. ER ID Number 00745, Los Alamos, New Mexico. (Ahlquist et al. 1985, 22-0012)

DOE (US Department of Energy), July 1987. Comprehensive Environmental Assessment and Response Program, Phase I: Installation Assessment, Los Alamos National Laboratory, Vol. 1 of 2, Draft, United States Department of Energy, Albuquerque Operations Office, Environment Safety and Health Division, Environmental Programs Branch, Albuquerque, New Mexico. (DOE 1987, 0264)

LANL (Los Alamos National Laboratory), February 1982. "LAMPF - The Clinton P. Anderson Meson Physics Facility," Los Alamos National Laboratory Report LA-LP-82-5, ER ID Number 07013, Los Alamos, New Mexico. (LANL 1982, 22-0013)

LANL (Los Alamos National Laboratory), 1984. CEARP Reference File Working Draft, ER ID Number 06112, Los Alamos, New Mexico. (LANL 1984, 22-0015)

LANL (Los Alamos National Laboratory), 1985. CEARP Files (draft), ER ID Number 06114, Los Alamos, New Mexico. (LANL 1985, 22-0016)

LANL (Los Alamos National Laboratory), November 1985. "LAMPF - Its History and Accomplishments," Los Alamos National Laboratory Report LA-UR-85-3437, ER ID Number 07412, Los Alamos, New Mexico. (LANL 1985, 22-0014)

LANL (Los Alamos National Laboratory), January 1987. "LAMPF," Los Alamos National Laboratory Report LA-UR-87-327, ER ID Number 29399, Los Alamos, New Mexico. (LANL 1987, 22-0017)

LANL (Los Alamos National Laboratory), September 1990. "Consolidated Permit Reapplication for NPDES NM 0028355," Los Alamos National Laboratory, ER ID Number 29412, Los Alamos, New Mexico. (LANL 1990, 22-0018)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C-1777, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24344, Los Alamos, New Mexico. (LASL 1951, 22-0019)

Executive Summary

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3.0 ENVIRONMENTAL SETTING

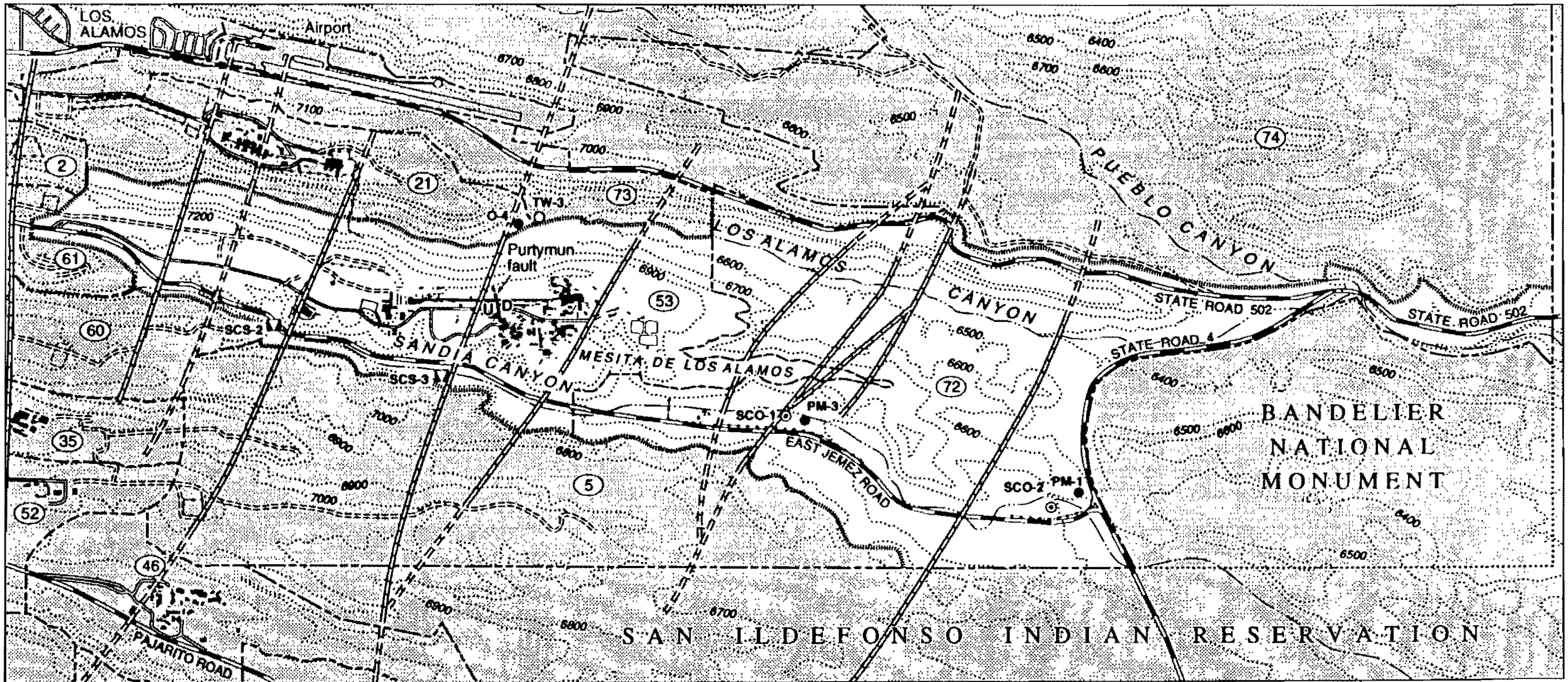
The Laboratory's environmental setting is described in Section 2.5 of the Installation Work Plan (IWP) for Environmental Restoration (LANL 1993, 1017). A discussion of the environmental setting for OU 1100 is presented in the following sections. For some sections, site-specific information is not currently available and this is stated accordingly. The site-specific information discussed focuses on that required to evaluate potential migration pathways and conceptual exposure models at OU 1100.

3.1 Physical Description

The Laboratory and the adjacent communities of Los Alamos and White Rock are situated on the Pajarito Plateau. The Pajarito Plateau consists of a series of finger-like mesas separated by deep east-west trending canyons containing ephemeral streams that drain to the east (LANL 1993, 1017).

OU 1100 includes Mesita de los Alamos and the midreach of Sandia Canyon (Figure 3-1). The PRSs located in TA-53 are associated with the Los Alamos Meson Physics Facility (LAMPF), which is located on Mesita de los Alamos, an east-west trending mesa bordered by Los Alamos Canyon to the north and Sandia Canyon to the south. The PRSs located in TA-72 and former TA-20 are situated in Sandia Canyon, which includes an ephemeral stream. (The exact boundaries of TA-20 are not known, but the approximate location can be inferred from historical engineering drawings. TA-20 was abandoned in the late 1940s when the East Jemez Road was constructed.) The canyon floors are 200 to 400 ft below the surface of the mesa. Canyon walls are steep slopes or cliffs in this area. Elevations decrease from west to east at OU 1100. TA-53 lies at an elevation ranging from 6,600 to 7,140 ft. TA-72 lies at an elevation ranging from 6,900 ft near the western boundary to 6,300 ft near the eastern boundary. The former site of TA-20 lies at an elevation ranging from 6,600 to 6,850 ft. The mesa consists of welded and nonwelded Bandelier Tuff and the Sandia Canyon floor consists of volcanic-derived alluvium, which is underlain by Bandelier Tuff and associated volcanics (LANL 1990, 0145). It can be assumed that groundwater is present in the shallow alluvium in portions of Sandia Canyon where stream flow occurs (Purtymun and Stoker 1990, 22-0002). In addition, a laterally discontinuous, perched groundwater zone is present beneath the operable unit (Environmental Protection Group 1993, 0829). The potentiometric surface of the main aquifer in the region lies beneath OU 1100 at elevations ranging between 5,700 and 5,980 ft (LANL 1990, 0145). It is unknown if the main aquifer is hydraulically connected with the shallow alluvial or intermediate-depth, perched groundwater (LANL 1993, 1017). OU 1100 lies entirely on DOE-owned land. Several public access roads are located within or border the operable unit; however, the public is not allowed into the technical areas. The East Jemez Road, a public access road, traverses former TA-20. Chapter 2 provides a description of the public access roads and the surrounding land owners.

Los Alamos County had an estimated 1991 population of approximately 18,200 (based on the 1990 US Census, adjusted to July 1, 1991). Two residential areas (Los Alamos and White Rock) and their related commercial areas exist in the county. The Los Alamos residential area has an estimated population of 11,400.



Base map sources: FIMAD 1993, G1011473
U.S.G.S. 1984, White Rock, N.M. 7.5' topo. quad.
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- Major paved road
- Secondary road
- Unimproved road
- Fence
- Ephemeral stream
- Contour interval 100 ft
- Technical area boundary
- Operable unit boundary
- Laboratory boundary
- Other political boundary
- (53) Technical area number
- Building or structure
- Approximate trace of subsurface fault, dashed where uncertain (Dransfield and Gardner 1985, 0082)
- Purtymun fault, dashed where inferred (Keller 1968, 22-0001)
- Main aquifer supply well
- Main aquifer test well
- Alluvial groundwater well
- Surface water sampling location

0 500 1000 ft

N

Figure 3-1. Topographic map showing general features of OU 1100.

The White Rock residential area has about 6,800 residents. About 40% of the people employed in Los Alamos County commute from other counties. Population estimates for 1991 place about 218,000 persons within a 50- mile radius of Los Alamos (Environmental Protection Group 1993, 0829).

3.2 Climate

Los Alamos has a semiarid, temperate mountain climate. Summers are generally sunny, with moderate, warm days with the maximum temperatures usually below 90°F, and cool nights with minimum temperatures in the 50s (°F). Winter temperatures typically range from about 15 to 25°F during the night and from 30 to 50°F during the day. Occasionally, temperatures drop to 0°F or below (Environmental Protection Group 1993, 0829).

During an average year, 58 thunderstorm days occur, mostly during the summer. The storms commonly occur during the afternoon or early evening. Of the annual precipitation, 36% normally occurs during July and August. The short, intense precipitation events cause significant surface water runoff. Stream flow in Sandia Canyon occurs as a result of these storms. Winter precipitation falls primarily as snow, with average accumulations of about 59 in. annually. Spring snowmelt runoff also commonly induces streamflow in the canyon (Environmental Protection Group 1993, 0829). These precipitation events can induce surface erosion, soil runoff, sediment runoff, and surface water transport of contaminants.

Based on measurements at the East Gate meteorological station (the closest data collection point to TA-53), the average summer monsoon (July through September) precipitation is about 8 in., while the average annual precipitation is about 16 in. The 1991 precipitation amounts measured at the East Gate station were higher than average; the total summer monsoon precipitation was about 11.72 in. and the total annual precipitation was about 20.20 in. (Environmental Protection Group 1993, 0829).

Surface winds are quite light at Los Alamos, averaging 7 mph. Wind speeds are strongest from March through June and weakest in December and January. Sustained winds exceeding 25 mph and peak wind gusts exceeding 50 mph are common during the spring. Thunderstorms can also cause brief strong winds, especially during the spring and summer. The strongest winds are generally southwesterly through northwesterly and occur in the afternoon or evening. Surface winds often vary dramatically with the time of day, location, and height above ground because of the complex terrain (Bowen 1990, 0033). The predominant winds are west to west-northwesterly at the west end of the plateau and south-southwesterly at the east end of the plateau (Environmental Protection Group 1993, 0829). On days with sunshine and light, large-scale winds, thermally driven upslope (convective) winds develop over the Pajarito Plateau. Upslope winds, which occur from the southeast and east, are generally light, less than 6 mph. Winds usually become more south-southwesterly and southerly at locations toward the Rio Grande Valley. At night, a shallow drainage wind often flows down the plateau from the west-northwest. These winds can reach speeds of 6 to 8 mph (Bowen 1990, 0033).

Detailed information regarding average wind speed and direction frequencies for the East Gate station is presented in the Laboratory's 1991 environmental surveillance report (Environmental Protection Group 1993, 0829). The frequencies are presented as wind roses. The predominant direction for all winds at the East Gate station is from the south-southwest (Environmental Protection Group 1993, 0829).

There are no meteorological stations within Sandia Canyon or other Pajarito Plateau canyons. Conditions in the canyons may be quite different than those on the mesa tops. A diurnal pattern of wind movement has been deduced from regular observations. During the day, the winds tend to blow easterly or up-canyon, whereas at night the wind movement is down-canyon or in a westerly direction.

These data imply that any airborne contaminants from the TA-53 PRSs should be dispersed mainly toward the northern and eastern boundaries of the Laboratory and over the eastern portion of the townsite. The airborne contaminants in Sandia Canyon would move both up and down the canyon.

3.3 Biological and Cultural Resources

Surveys were conducted to identify biological and cultural resources within OU 1100.

3.3.1 Biological Resources

During 1993, field surveys were conducted within the operable unit by the Biological Resource Evaluations Team (BRET) of the Environmental Protection Group (ESH-8). The surveys were conducted to provide information on biological components before site characterization, which requires surface and subsurface sampling within the active technical areas on Mesita de los Alamos and in Sandia Canyon. A report, which will contain specific information on survey methods, results, mitigation measures, and information that may aid in defining ecological pathways and site restoration, is being prepared.

3.3.1.1 Methodology

Field surveys were conducted for compliance with the Federal Endangered Species act of 1973; the New Mexico Conservation Act; the New Mexico Endangered Plant Species Act; Executive Order 11990, Protection of Wetlands; Executive Order 11988, Floodplain Management; 10 CFR 1022; and DOE Order 5400.1 (DOE 1988, 0075).

3.3.1.2 Survey Results

The surveys were conducted to determine the presence or absence of any critical habitat for any state or federal sensitive, threatened, or endangered plant or animal species potentially occurring within OU 1100; to determine the presence of any sensitive area such as flood plains and wetlands within the areas to be sampled, the extent of such areas, and their general characteristics; and to provide additional plant and wildlife data concerning the habitat types within the operable unit. These data provide further baseline information about the biological components of the site for characterization and determination of presampling conditions. This information is also necessary to support the

National Environmental Policy Act documentation and determination of a categorical exclusion for the sampling plan for site characterization.

Surface and subsurface soil and sediment sampling are proposed. Soil samples will be collected from trenches, shallow boreholes, and the surface. Sediment samples will be collected from drainages on Mesita de los Alamos and in Sandia Canyon.

After a search was done of the ESH-8 database, which contains the habitat requirements for all state and federally listed threatened, endangered, or sensitive plant or animal species known to occur within Laboratory boundaries and surrounding areas, a habitat evaluation survey (Level 2) was conducted. A Level 2 survey is conducted when there are areas that are not highly disturbed that could potentially support threatened and/or endangered species. Level 2 survey techniques are designed to gather data on the percentage of cover, density, and frequency of both the under- and overstory components of the plant community.

The habitat information gathered through the field surveys was compared to the requirements for species of concern identified in the database search. If habitat requirements were not met, no further surveys were conducted and the site was considered cleared for impact on state and federally listed species. If habitat requirements were met, specific species surveys were conducted. The species surveys were done in accordance with pre-established survey protocols. These protocols often require certain meteorological or seasonal conditions.

In each location, all wetlands and flood plains within the survey area were noted using National Wetland Inventory Maps and field checks. Characteristics of wetlands, flood plains, and riparian areas are noted using criteria outlined in the Corps of Engineers Wetlands Delineation Manual (Army Corps of Engineers 1987, 0871).

3.3.1.3 Results

The species of concern for OU 1100 are as follows:

- northern goshawk (*accipiter gentilis* - federal candidate).
- common black hawk (*buteogallus anthracinus* - New Mexico state endangered).
- Mississippi kite (*ictinia mississippiensis* - New Mexico state endangered).
- peregrine falcon (*falco peregrinus* - federally endangered and New Mexico state endangered).
- Mexican spotted owl (*strix occidentalis lucida* - federally threatened).
- broad-billed hummingbird (*cyanthus latirostris* - New Mexico state endangered).

- willow flycatcher (*empidonax traillii* - New Mexico state endangered and federal candidate).
- spotted bat (*euderma maculatum* - New Mexico state endangered and federal candidate).
- Wright's fishhook cactus (*mammillaria wrightii* - New Mexico state endangered).
- Santa Fe cholla (*opuntia viridiflora* - New Mexico state endangered).
- grama grass cactus (*toumeya papyracantha* - New Mexico state endangered and federal candidate).
- sessile-flowered false carrot (*aletes sessiliflorus* - New Mexico state endangered).
- threadleaf horsebrush (*tetradymia filifolia* - New Mexico state endangered).
- Plank's catchfly (*silene plankii* - New Mexico state sensitive).
- Santa Fe milkvetch (*astragalus feensis* - New Mexico state endangered).
- Mathew's woolly milkvetch (*astragalus mollissimus var. mathewsii* - New Mexico state sensitive).
- Taos milkvetch (*astragalus puniceus var. gertrudis* - New Mexico state sensitive).
- cyanic milkvetch (*astagalus cyaneus* - New Mexico state sensitive).
- tufted sand verbena (*abronia bigelovii* - New Mexico state sensitive).
- Pagosa phlox (*phlox caryophylla* - New Mexico state sensitive).

3.3.1.4 Wetland Areas

One area within OU 1100 has been classified by the National Wetland Inventory as a possible palustrine wetland. There are also 11 National Pollutant Discharge Elimination System (NPDES)-permitted outfalls within OU 1100; at least 3 have wetland vegetation associated with them. These areas may be classified as jurisdictional wetlands. None of the possible jurisdictional wetlands exceed 1 acre. Flood plain maps (McLin 1992, 0825) indicate that a flood plain does exist within the operable unit. In compliance with 10 CFR 1022, a Flood Plain/Wetland Involvement Notification will be submitted to the Federal Register

Plain/Wetland Involvement Notification will be submitted to the Federal Register for public comment. RFI activities are not anticipated to adversely affect the flood plains and wetlands, if management practices outlined in Section 4.10.1.2 are followed.

3.3.2 Cultural Resources

As required by the National Historic Preservation Act of 1986 (as amended), a cultural resource survey was conducted during the summer of 1993 at OU 1100. The methods and techniques used for this survey conform to those specified in the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (National Park Service 1983, 0632).

Twenty three archaeological sites are located in the area surveyed and all are eligible for inclusion on the National Register of Historic Places under Criterion D, potential to yield research data.

The attributes of these 23 archaeological sites, which make them eligible for inclusion on the National Register, will not be affected by any RFI sampling activities proposed at OU 1100. A report documenting the survey area, methods, results, and monitoring recommendations (if any) will be sent to the New Mexico State Historic Preservation Officer for his concurrence in a "Determination of No Effect" for this project. As specified in 36 CFR 800.5(b) and following the intent of the American Indian Religious Freedom Act, a copy of this report will also be sent to the governor of San Ildefonso Pueblo and to any other interested tribal group for comment on any possible impacts to sacred and traditional places. Any comments will be documented and included in the ER files.

3.4 Geology

Section 2.6 of the IWP (LANL 1993, 1017) discusses the regional setting and general geology of the Pajarito Plateau. The Laboratory is situated on the Pajarito Plateau, which abuts the Jemez Mountains to the west and overlooks the Espanola Basin of the Rio Grande rift to the east. The Jemez Mountains are part of the Jemez volcanic field, which consists of volcanic rocks derived from numerous vents, including a giant, multistage caldera. During the Quaternary, a cataclysmic phase occurred during which the Toledo and Valles calderas were formed, 1.5 and 1.1 million years ago, respectively. Volcanic ash flow and ash fall deposits from the caldera eruption (approximately 1 million years ago) form the Pajarito Plateau. The morphology of the plateau is dominated by a relatively flat, gently eastward-sloping surface, consisting of numerous finger-like mesas separated by deep, east-southeast trending canyons (Figure 3-2) (LANL 1993, 1017).

The geologic conditions expected at OU 1100 are included in the following sections. Site-specific geologic stratigraphic and structure maps of OU 1100 do not exist. The following sections present a summary of existing information.

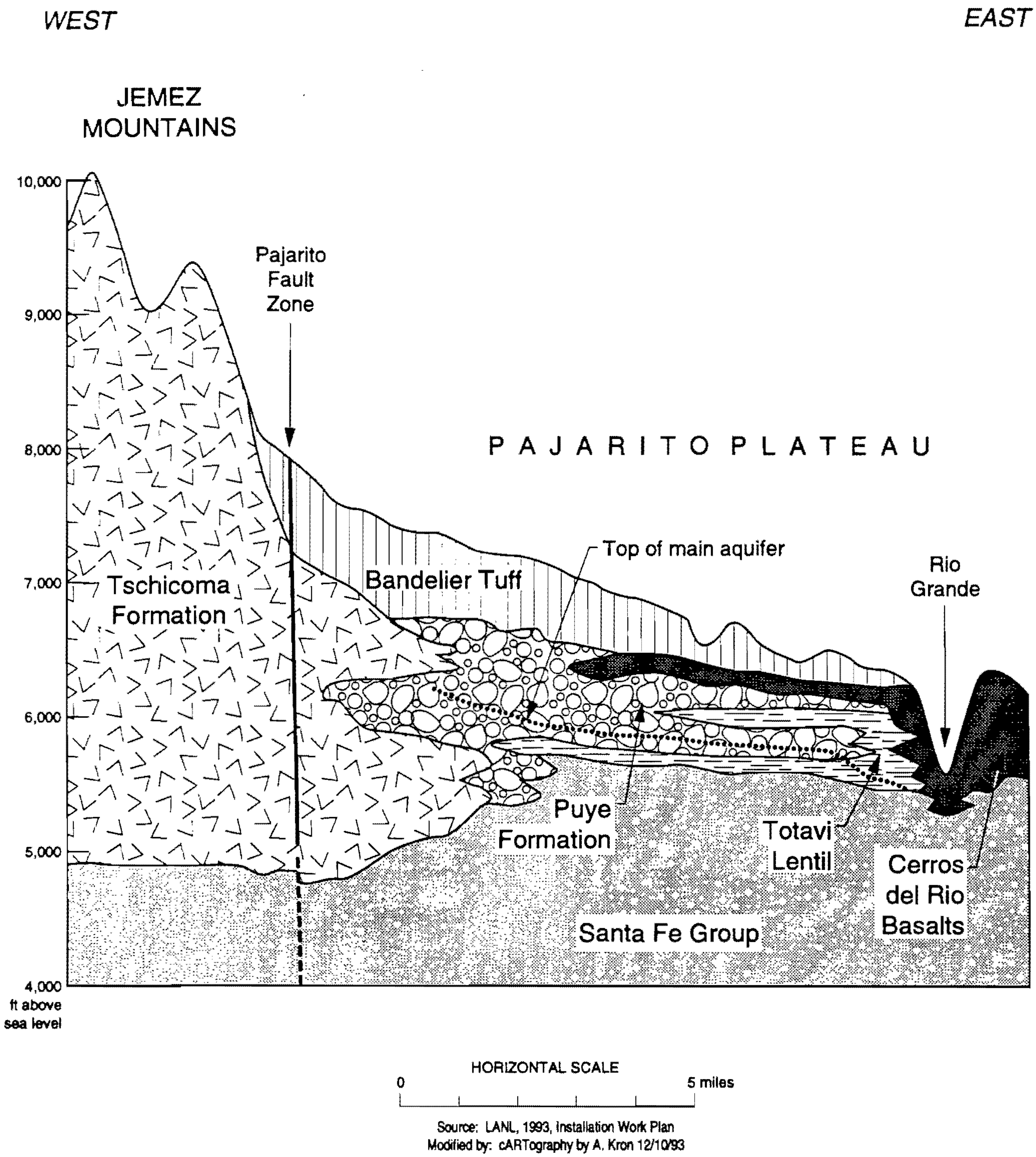

Figure 3-2. Geologic section showing stratigraphy and structure from the Jemez Mountains across the Pajarito Plateau.

3.4.1 Bedrock Stratigraphy

The stratigraphic information for OU 1100 was based on the generalized descriptions found in Section 2.6.1.2 of the IWP (LANL 1993, 1017) and previous, site-specific drilling programs in OU 1100.

The stratigraphy of the mesa was derived from information from 25 test holes located in line with the beam line of LAMPF on Mesita de los Alamos. These test holes provide stratigraphic information up to a depth of 75 ft below the surface (Keller 1968, 22-0001). In addition, eight boreholes were installed to monitor subsurface conditions near the surface impoundments (TA-53-166) (PRSs 53-002[a] and 53-002[b]) (Figure 3-3). Borehole 53-6 provides stratigraphic information to a depth of 150 ft below the surface of the mesa. Borehole 53-7 is located below the mesa, in a small side canyon that drains into Sandia Canyon, to the southwest of the impoundments, and provides stratigraphic information to a depth of 80 ft below the canyon floor (Environmental Protection Group 1992, 1075). In addition, the stratigraphy of Mesita de los Alamos can be inferred from recent geologic studies at TA-21, which provide a detailed description of the exposed rocks along the north wall of Los Alamos Canyon directly northwest of TA-53 (LANL 1993, 1076).

Additional borings have been drilled into Mesita de los Alamos to gather geotechnical information for three engineering projects. The drill logs included descriptions of the Tshirege tuff. Even though the stratigraphic information was tentative, certain information can be derived from the drill logs and reports, such as the absence of groundwater and problems with drilling and coring the tuff.

A Zia Company report (Horner 1986, 22-0003) indicated that two borings were drilled to a depth of 235 and 238.8 ft below the surface and no groundwater was encountered. These borings were drilled southeast of Building TA-53-30 near the location of PRSs 53-001(g) and 53-010. The borings were supposed to have been drilled to a depth of 300 ft, but air circulation was lost and the further advance of the borings was impractical with the equipment and time available. The report indicated that core recovery ranged from fair to very poor. The poor recovery was associated with fractured, pumiceous, and nonwelded conditions in the tuff. Surface fill ranged from 0 to 8 ft below the surface.

A subsurface investigation report of TA-53 done by Pan Am World Services, Inc. (Horner 1986, 22-0004) indicated that four borings were drilled to a depth ranging from 90 to 163.1 ft below the surface using a 6-in. diameter hollow-stem auger. No groundwater was encountered. The tuff included zones of fracturing and jointing. Surface fill ranged from 2 to 7 ft below the surface.

A report dated October 24, 1992 (Albuquerque Testing Laboratory 1972, 22-0011) by the Albuquerque Testing Laboratory, Inc. prepared for the Weapons Neutron Research Facility indicated that 10 test holes were drilled to depths ranging from 10 to 50 ft below the surface, using a rotary drill with compressed air to remove the cuttings. No groundwater was encountered. In general, poor core recovery was associated with very friable tuffs having low degree of fusion and low penetration resistance values obtained from standard penetration tests. Loss of air circulation was associated with zones of fracturing and jointing. Recovered cores and visual inspections indicated that the tuff contained vertical,

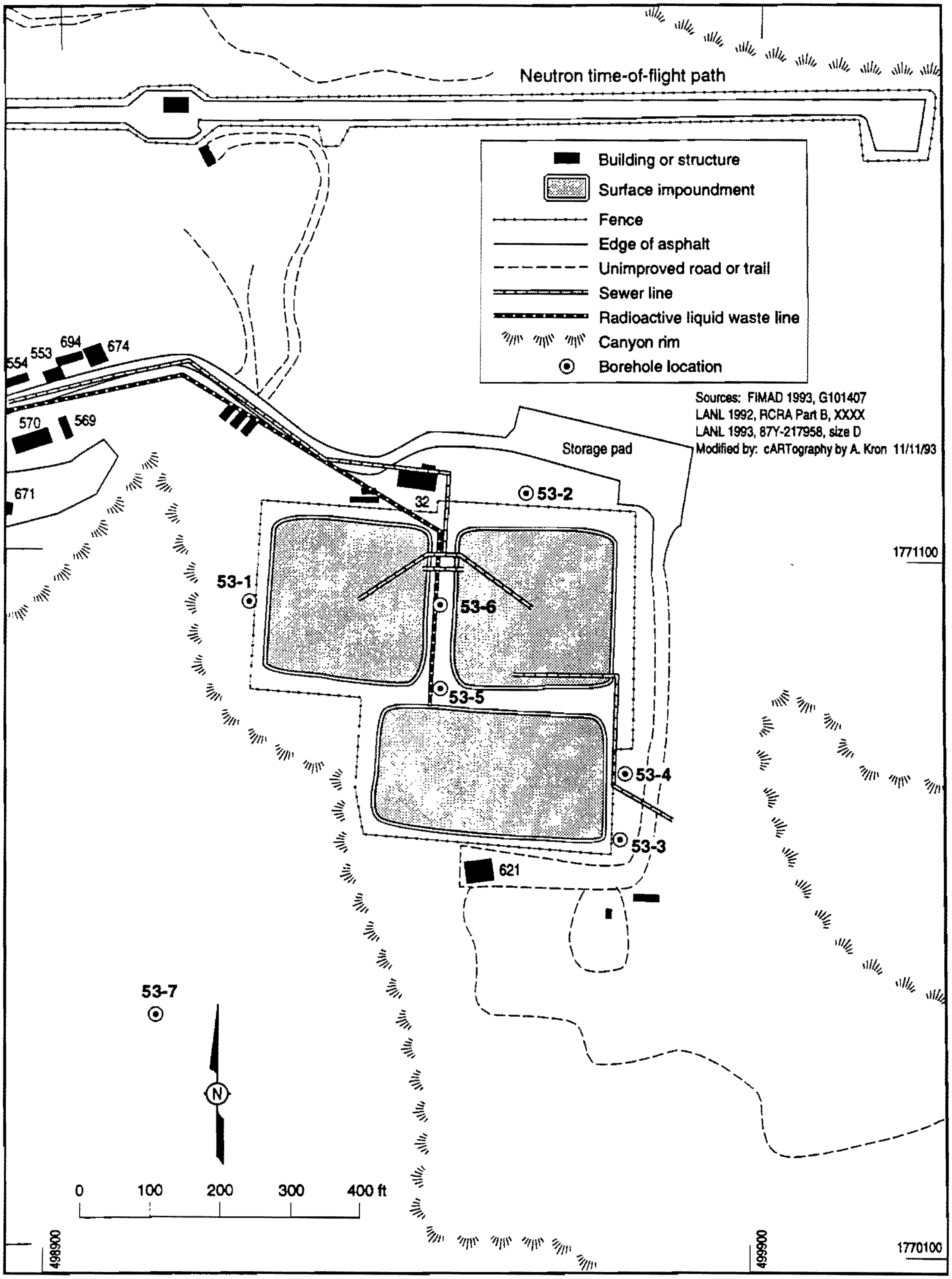

Figure 3-3. Approximate locations of boreholes near the TA-53 surface impoundments.

horizontal, and diagonal seams or fractures, and at deeper depths the fractures and seams were apparently filled with silt intrusions. Surface fill ranged from 1 to 11 ft below the surface.

The stratigraphy of rocks beneath Sandia Canyon was derived from two water supply wells, PM-1 and PM-3 (Purtymun, in preparation, 22-0005). PM-1 is located near the eastern boundary of OU 1100 in Sandia Canyon and PM-3 is located about 1 mile upgradient from PM-1 in Sandia Canyon (Figure 3-1). Additional stratigraphic information was derived from a water supply well (Otowi-4), which is located 400 ft west of Test Well 3 (TW-3) in Los Alamos Canyon directly north of Mesita de los Alamos (Figure 3-1). Otowi-4 is much deeper than TW-3 (2,806 ft compared to 815 ft) and provided more stratigraphic information (Stoker et al. 1992, 0826 and Purtymun 1984, 0196). The stratigraphic units important at OU 1100 consist of the following, in descending order: the Tshirege and Otowi members of the Bandelier Tuff, the Puye Formation, the basaltic rocks of the Cerros del Rio, the Totavi Formation, and the rocks of the Santa Fe Group (Figure 3-2).

Bandelier Tuff

Mesita de los Alamos is composed of the Bandelier Tuff, which is a rhyolitic tephra that was erupted during the formation of the Valles and Toledo calderas in the Jemez volcanic field. The Bandelier Tuff is divided into the upper Tshirege Member (formed 1.13 million years ago) and the lower Otowi Member (formed 1.5 million years ago), each associated with caldera collapse. The lower part of each unit consists of fallout pumice (tuff to lapilli tuff). The upper part of each unit is a multiple-flow compound ash-flow sheet (ignimbrite) (LANL 1993, 1017). The estimated thickness of the Bandelier Tuff at the Mesita is about 500 ft (Keller 1968, 22-0001). Based on the drill log for Otowi-4, the Bandelier Tuff extends from 28 ft below the alluvium to 183 ft below the surface of the Los Alamos Canyon floor (Stoker et al. 1992, 0826). Based on the drill log for PM-1, the Bandelier Tuff extends from the surface to 165 ft below the surface of the Sandia Canyon floor. Based on the drill log for PM-3, the Bandelier Tuff extends from 30 ft below the alluvium to 190 ft below the surface of the Sandia Canyon floor (Purtymun, in preparation, 22-0005).

Tshirege Member of the Bandelier Tuff

The Tshirege Member of the Bandelier Tuff caps Mesita de los Alamos. This member is composed of multiple flow units of crystal-rich ash-flow tuff (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 become 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 (LANL 1993, 1017). The Tshirege Member is about 300 ft thick below the east-west trending ridge at Mesita de los Alamos (Keller 1968, 22-0001). Based on the drill log for Borehole 53-7, which is located in the small side canyon south of the mesa, the Tshirege extends 43 ft below the base of the mesa (Environmental Protection Group 1992, 1075).

As explained in a TA-21 Phase 1A Report (LANL 1993, 1076), several nomenclature systems have been used to describe the units of the Tshirege Member. Previous workers identified mappable units in the Tshirege Member based on the welding and crystallization characteristics of this ash-flow sheet tuff (Baltz et al. 1963, 0024; Weir and Purtymun 1962, 0228; Crowe et al. 1978, 0041; Vaniman and Wohletz 1990, 0541; and Vaniman 1991, 22-0112). The TA-21 Phase 1A Report (LANL 1993, 1076) compares the nomenclature systems used by various workers to subdivide the Tshirege Member (Figure 3-4). There is, at present, a certain amount of confusion due to the use of these inconsistent unit names for the Tshirege Member. In part, the confusion arises because different criteria were used to identify the units. But equally important, the differences in nomenclature arise because the internal stratigraphy of the Tshirege Member varies as a function of distance from its caldera source (LANL 1993, 1076).

All the studies at Mesita de los Alamos have used the nomenclature system of Baltz et al. (Baltz et al. 1963, 0024). A detailed study of the stratigraphy of an adjacent mesa in TA-21 is provided in a TA-21 Phase 1A Report (LANL 1993, 1076); however, this report used the nomenclature system developed by Vaniman and Wohletz (Vaniman and Wohletz 1990, 0541 and Vaniman 1991, 22-0112).

The following description of the Tshirege is based on the 25 test holes at the LAMPF site and the 8 boreholes drilled near the TA-53 surface impoundments, and is based on the nomenclature system of Baltz et al. (Baltz et al. 1963, 0024). The generalized stratigraphic section of the Tshirege Member of the Bandelier Tuff below Mesita de los Alamos is shown in Figure 3-5. The five units of the Tshirege Member are present and dip gently eastward at Mesita de los Alamos. The five units are described in descending order.

<u>Unit 3</u>

Unit 3 forms the upper part of the mesa. This unit rests conformably on Unit 2b and grades down into it. Unit 3 consists primarily of light-gray, light-tan, and white nonwelded to moderately welded pumiceous tuff breccia (porosity from 30 to 60% by volume). The rock is composed of fine pumice fragments and shards and contains numerous layers of pebble and cobble-sized pumice fragments and some gray dense rhyolite. Most of the unit is relatively soft and has eroded to form smooth, round slopes with a rind of casehardened material several inches thick. The unit has eroded along the southern and extreme eastern edges of the mesa. The thickest section of Unit 3 (about 75 ft thick) occurs near the center of the east-west trending ridge along the northern edge of the mesa. This unit forms the foundation of the east end of the LAMPF beam tunnel and the experimental building (Keller 1968, 22-0001).

Based on information from the seven boreholes on the mesa, Unit 3 is not present at the east end of TA-53 at the impoundments (Environmental Protection Group 1992, 1075).

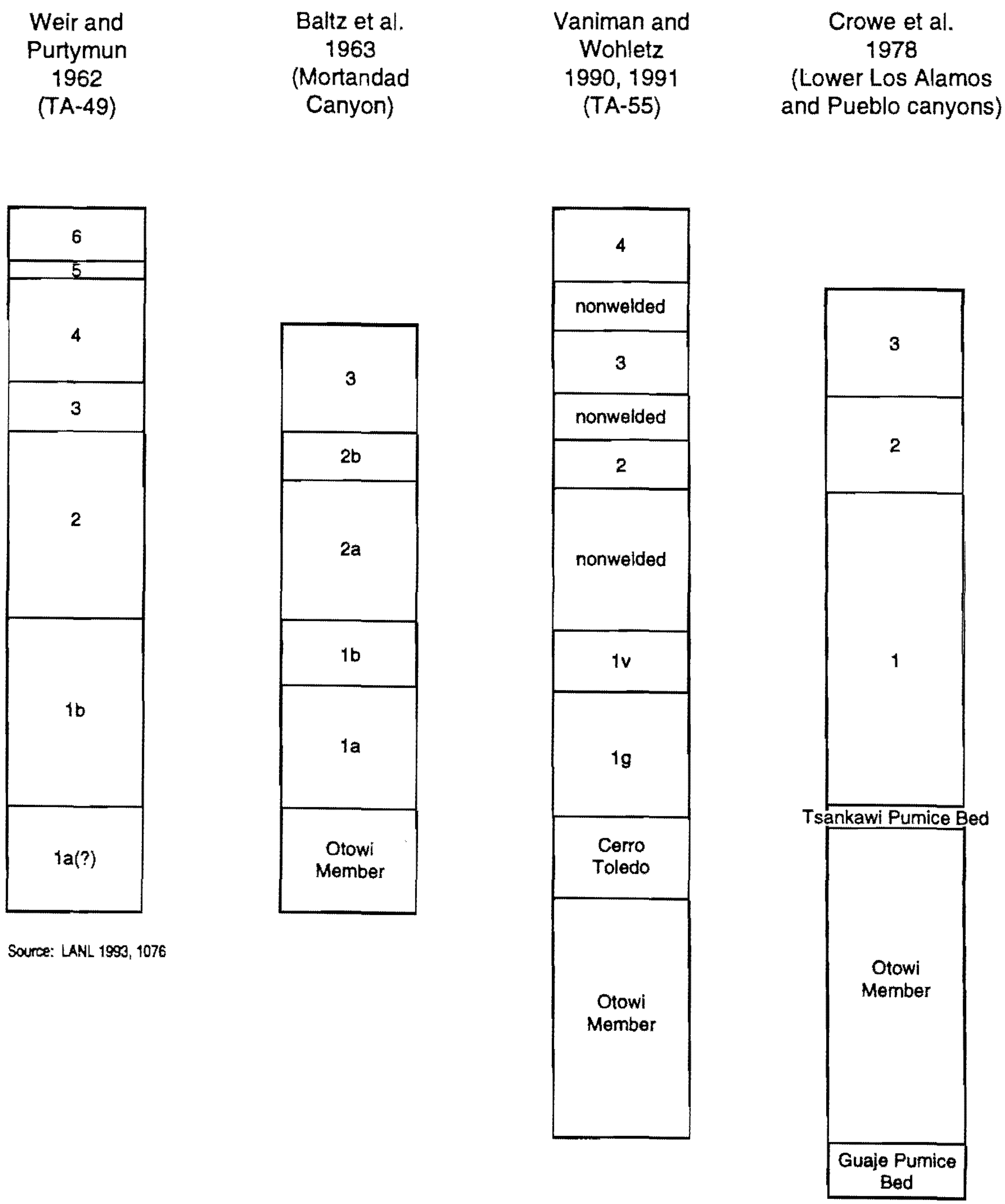

Figure 3-4. Comparison of stratigraphic nomenclatures for the units of the Tshirege Member of the Bandelier Tuff on the Pajarito Plateau.

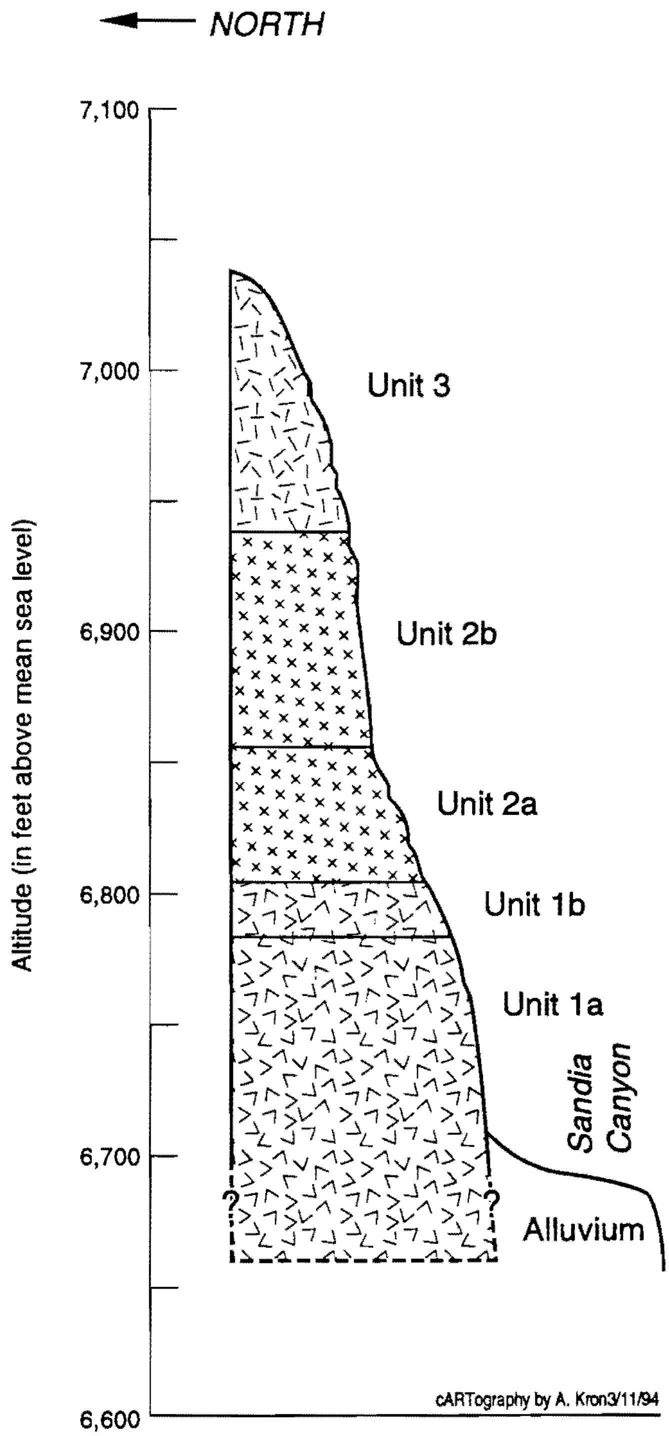

Figure 3-5. Stratigraphic section of the Tshirege Member of the Bandelier Tuff at Mesita de los Alamos (modified from Keller 1968, 22-0001).

Unit 2b

Unit 2b, which underlies Unit 3, is a light pink to brown-weathered, moderately welded tuff (porosity from 30 to 50% by volume) composed of quartz and sanidine crystals and fragments in a matrix of light-pink fine-grained ash. Some rock fragments of pumice and latite are 0.5 in. long. The unit is resistant to erosion and forms cliffs above the steep rounded slopes of basal Unit 2a. The unit ranges from 76 to 83 ft thick along the southern edge of Mesita de los Alamos, where it forms the uppermost rim of Sandia Canyon. Along Los Alamos Canyon, Unit 2b forms a cliff along the wall. Unit 2b underlies the foundation of the LAMPF beam injector building and tunnel in the western part of TA-53 (Keller 1968, 22-0001).

The drill logs from the seven boreholes near the TA-53 impoundments indicate that surface fill ranges from 0 to 3 ft above Unit 2b at this location. Only Boreholes 53-5 and 53-6 completely penetrate Unit 2b. The drill logs indicate that Unit 2b extends from 3 to 68 ft below the surface and is 65 ft thick (Environmental Protection Group 1992, 1075).

Unit 2a

Unit 2a is a light-gray pumiceous tuff consisting of moderately welded pumiceous ash containing fragments of pumice, dense rhyolite, and latite fragments as much as 3 in. long. The unit weathers to a dull gray with a casehardened rind several inches thick. It forms a steep smooth slope set back from the underlying Unit 1. The thickness ranges from 47 to 51 ft along the southern edge of Mesita de los Alamos (Keller 1968, 22-0001).

Of the boreholes near the TA-53 surface impoundments, only Borehole 53-6 completely penetrates Unit 2a. The drill log indicates that Unit 2a extends from 68 to 113 ft below the surface and is 45 ft thick (Environmental Protection Group 1992, 1075).

Unit 1b

Unit 1b rests conformably on the underlying Unit 1a and weathers to a dull grayish-brown. This unit is a tuff breccia with a fine-grained pink ash matrix similar to the underlying Unit 1a. However, the pumice fragments are smaller and 15 to 20% of the material consists of granule-sized quartz-crystal fragments and fragments of dense volcanic rocks. Unit 1b is slightly less resistant to erosion than Unit 1a and forms a ledge set back from the lower unit. At some places both units form near-vertical cliffs where they can be distinguished by a soft bed of pumice at the base of the upper unit, which weathers to a persistent notch in the cliffs. The thickness is fairly uniform, ranging from 21 to 23 ft along the southern edge of Mesita de los Alamos (Keller 1968, 22-0001).

Of the boreholes near the TA-53 surface impoundments, only Borehole 53-6 completely penetrates Unit 1b. The drill log indicates that Unit 1b extends from 113 to 133 ft below the surface and is 20 ft thick (Environmental Protection Group 1992, 1075).

Unit 1a

Unit 1a, which underlies Unit 1b, is a massive orange-weathered pumiceous tuff breccia forming a near vertical cliff above the alluvium in Sandia Canyon. This lower unit contains pumice fragments of obsidian and rhyolite in a fine glassy ash matrix. The weathered outer 1 to 3 in. of tuff is casehardened, protecting the unweathered rock from erosion. The thickness of Unit 1a varies because of the irregular erosion surface at the top of the Otowi Member upon which it rests. It may be as much as 80 ft thick near the center of Mesita de los Alamos (Keller 1968, 22-0001).

Borehole 53-6 near the TA-53 surface impoundments partially penetrates Unit 1a. The drill log indicates that Unit 1a extends from 133 ft to at least 150 ft below the surface; however, this borehole does not extend beyond 150 ft. The drill log from Borehole 53-7, located in the small side canyon below the mesa, indicates that Unit 1a extends from 1 to 24 ft below the surface (Environmental Protection Group 1992, 1075).

Tsankawi Pumice Bed

The base of the Tshirege is often marked by 1.5 to 10 ft of bedded, unconsolidated, pumice-rich ash fall tuff of the Tsankawi Pumice Bed. The Tsankawi Pumice Bed is generally poorly recognized in drill cuttings because rotary drills commonly grind the soft material into dust (LANL 1993, 1017).

The drill log from Borehole 53-7, located in the small side canyon below the mesa, reported that the Tsankawi Pumice Bed extended from 24 to 43 ft below the surface (Environmental Protection Group 1992, 1075). This 19-ft thickness is much greater than the 2 to 3 ft observed elsewhere on the Pajarito Plateau; we believe that the interval described as the Tsankawi Bed is likely to have consisted of both the Tsankawi Bed and the Cerro Toledo. The Tsankawi Bed is exposed on the north wall of Los Alamos Canyon directly north of LAMPF and is about 2 to 3 ft thick (LANL 1993, 1076).

Cerro Toledo Interval

A complex sequence of bedded tuffs informally designated as the Cerro Toledo interval commonly overlies the Otowi Member. These tuffs consist of tuffaceous sandstones and siltstones and of ash and pumice falls. These tuffs, which are not a part of the Bandelier Tuff, are intercalated between the upper and lower members of the Bandelier Tuff and are equivalent in age to the Cerro Toledo rhyolite. These tuffs crop out on the north wall of Los Alamos Canyon to the north of Mesita de los Alamos. Their distribution at other areas at the Laboratory suggests widespread deposition throughout the area; however, these tuffs commonly pinch out laterally and cannot be correlated over wide areas (LANL 1993, 1076).

Based on the drill log from Borehole 53-7, the Cerro Toledo is absent between the Tshirege and Otowi members of the Bandelier Tuff below the small side canyon south of the Mesita (Environmental Protection Group 1992, 1075). However, as noted previously, Cerro Toledo beds may have been misidentified as the Tsankawi Pumice Bed in Borehole 53-7. The thickness of the Cerro

Toledo interval exposed along the north wall of Los Alamos Canyon is approximately 10 to 30 ft (LANL 1993, 1076).

Otowi Member of the Bandelier Tuff

The Otowi Member of the Bandelier Tuff consists of the basal Guaje Pumice Bed and the overlying ash-flow units (Bailey et al. 1969, 0019). The Otowi exposed on the north side of Los Alamos Canyon south of TA-21 is described in a TA-21 Phase 1A Report (LANL 1993, 1076). The exposed portion of the Otowi consists of a simple ash-flow tuff cooling unit made up of massive, nonwelded, vitric tuff. This poorly indurated tuff crops out in shallow stream channels that incise gentle talus-covered slopes extending from the base of the canyon walls to the canyon floor (LANL 1993, 1076).

Keller (Keller 1968, 22-0001) does not depict any Otowi exposure on stratigraphic sections of the Sandia Canyon wall immediately south of Mesita de los Alamos. Borehole 53-7, located in a side canyon below the mesa, partially penetrated the Otowi. The drill log indicates that the Otowi extends from 43 ft to at least 80 ft below the surface; however, the borehole did not extend beyond 80 ft (Environmental Protection Group 1992, 1075). According to a TA-21 Phase 1A Report (LANL 1993, 1076), the total thickness of the exposed Otowi in Los Alamos Canyon is about 220 ft. At PM-1 and PM-3 in Sandia Canyon, the Otowi and the basal Guaje pumice bed extend from 165 to 190 ft below the surface and are about 160 to 165 ft thick (Purtymun, in preparation, 22-0005). The geologic log for Otowi-4 indicates that the Bandelier Tuff extends from 28 to 183 ft below the Los Alamos Canyon floor and is about 155 ft thick. However, this log does not identify specific members of the Bandelier Tuff (Stoker et al. 1992, 0826).

Puye Formation

The Puye Formation underlies the Otowi Member of the Bandelier Tuff. The stratigraphic sections below PM-3 and Otowi-4 are similar but differ from the stratigraphic section below PM-1, which is located nearer the Rio Grande. At PM-1, the Puye Formation is not interbedded with the basaltic rocks of the Cerros del Rio, but is located below the basaltic rocks of the Cerros del Rio. Whereas at PM-3 and Otowi-4, the basaltic rocks of the Cerros del Rio are interbedded with the Puye Formation, which creates an upper lens above the basalt and a thicker lower section of the Puye below the basalt (Figure 3-6). The following description of the stratigraphy is based on geologic logs from PM-3 and Otowi-4, which are located nearer the areas of concern to the RCRA facility investigation (RFI).

At PM-3 and Otowi-4, an upper lens and a lower section of the Puye Formation is separated by the basaltic rocks of the Cerros del Rio. The upper lens consists of cobbles and boulders of latite and rhyolite in a matrix of gravel, sand, silt, and clay, as well as lenses of clay and silt. At Otowi-4, the upper lens extends from 183 to 290 ft below the Los Alamos Canyon floor and is about 107 ft thick (Stoker et al. 1992, 0826). At PM-3, the upper lens extends from 190 to 215 ft below the Sandia Canyon floor and is about 25 ft thick (Purtymun, in preparation, 22-0005).

The lower section of the Puye Formation consists of cobbles and boulders of latites and rhyolites in a matrix of gravel, sand, silt, and clay, as well as thin lenses of silty sand. At Otowi-4, the lower section of the Puye underlies the basaltic rocks of the Cerros del Rio (identified as basaltic rocks of the Chino

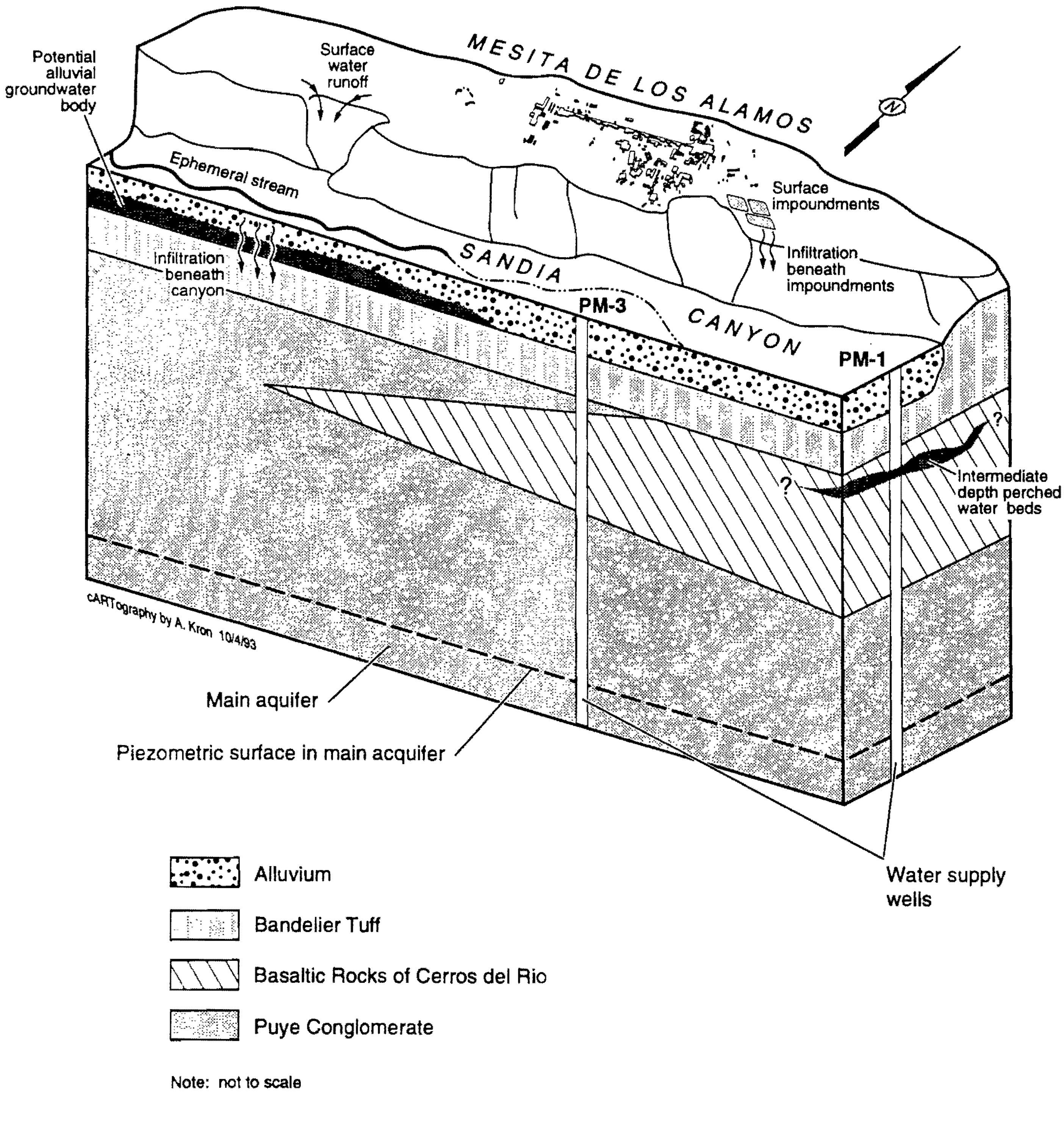

Figure 3-6. Three-dimensional hydrogeologic model of OU 1100.

Mesa in the drill log) and extends from 413 to 712 ft below the Los Alamos Canyon floor and is about 299 ft thick (Stoker et al. 1992, 0826). At PM-3, the lower section of the Puye extends from 540 to 745 ft below the Sandia Canyon floor and is about 205 ft thick (Purtymun, in preparation, 22-0005).

Basaltic Rocks of Cerros del Rio

The basaltic rocks of the Cerros del Rio consist of black to dark gray, vesicular to dense basalt, with some scoria and pumice and probably represent several basaltic flows with thin interbedded sediments. Part of this volcanic field is also known as basaltic rocks of Chino Mesa (LANL 1993, 1017). The drill logs for Otowi-4, PM-1, and PM-3 identify these rocks as the basaltic rocks of the Chino Mesa. At Otowi-4, these rocks underlie the upper lens of the Puye and extend from 290 to 413 ft below the Los Alamos Canyon floor and are about 123 ft thick (Stoker et al. 1992, 0826). At PM-3, the Cerros del Rio extends from 215 to 540 ft below the Sandia Canyon floor and is about 325 ft thick (Purtymun, in preparation, 22-0005).

Totavi Formation

This formation includes fluvial gravels, probably from an ancestral Rio Grande, and lacustrine sediments that are complexly interstratified with the upper Puye Formation (LANL 1993, 1017). At Otowi-4, the Totavi underlies the Puye Formation and consists of conglomerate including gray cobbles and boulders of quartzite, with rock fragments of granite, latite, and rhyolite in a matrix of sand, silt, and clay, and sand lenses. It extends from 712 to 810 ft below the Los Alamos Canyon floor and is about 98 ft thick (Stoker et al. 1992, 0826). At PM-3, the Totavi Formation extends from 745 to 805 ft below the Sandia Canyon floor and is about 60 ft thick (Purtymun, in preparation, 22-0005).

Santa Fe Group

According to the IWP (LANL 1993, 1017), the Santa Fe Group underlies the Totavi Formation. The Santa Fe Group is subdivided into two formations (Chamita and Tesuque, in descending order) and several members in the Espanola Basin and the northern part of Los Alamos County. 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. However, more recent investigations have suggested that some of the upper Santa Fe Group in the vicinity of Los Alamos is instead the Chamita Formation.

The Santa Fe Group consists of 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 of the production from water wells at Los Alamos is from the Santa Fe Group. Sedimentary rocks usually dominate the Santa Fe Group, although basalts constitute up to 45% of the section penetrated by the water supply wells at the Laboratory (LANL 1993, 1017). According to Keller (Keller 1968, 22-0001), the Tesuque Formation exceeds a total thickness of 2,400 ft in the area.

3.4.2 Geologic Structure

The Laboratory is situated on the Pajarito Plateau, which lies on the western margin of the Espanola Basin of the Rio Grande rift. The Pajarito fault system forms the western margin of the Espanola Basin and exhibits Holocene movement and historic seismicity. 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. These faults are exposed at the surface and cut the Bandelier Tuff. In contrast to cooling joints, these faults cross flow unit and lithologic unit boundaries, and may provide more continuous and more deeply penetrating flow paths for groundwater migration than do cooling joints (Figure 3-7) (LANL 1993, 1017).

Using seismic data, Dransfield and Gardner (Dransfield and Gardner 1985, 0082) located numerous subsurface faults at the pre-Bandelier Tuff level throughout the Pajarito Plateau (Figures 3-1 and 3-7). These normal faults trend north-northeast and have vertical displacements of at least 50 ft. The faults have estimated shallow displacements of up to 150 ft, and most of these faults have down-to-the-west displacement. One of these faults is antithetic and has as much as 100 ft of displacement at one location. Estimates of offsets at depth indicate that many of these faults sustained over 200 ft of displacement in the past, some of which occurred before the Cretaceous (Dransfield and Gardner 1985, 0082). The overlying Bandelier Tuff is not obviously displaced by these buried faults. However, based on previous fracture studies, fracture abundances and apertures increase in the Bandelier Tuff over fault projections (LANL 1993, 1017).

Other subsurface faults may be present within the Pajarito Plateau. Studies have indicated the presence of small-scale offsets along fractures in various parts of the Laboratory (LANL 1993, 1017). Also, numerous faults with less than 50 ft of displacement were strongly suggested by the seismic data but were not mapped by Dransfield and Gardner (Dransfield and Gardner 1985, 0082). Furthermore, subsurface faults may be oriented transverse to the north-north east faults delineated by Dransfield and Gardner (Dransfield and Gardner 1985, 0082). Unfortunately, there are few detailed fracture studies of the Pajarito Plateau.

3.4.2.1 Faults and Fractures

Surface Faults

The Guaje Mountain fault, the closest major surface fault, is located near the western boundary of TA-53, less than 2 miles west of TW-3 and Otowi-4. Keller (Keller 1968, 22-0001) mapped a north-south trending fault that is exposed at the surface west of the surface impoundments (TA-53-166) on Mesita de los Alamos (Figure 3-1). This fault is informally referred to as the Purtymun fault. This fault was described as a normal, strike-slip fault showing about 14 ft of displacement down-to-the-east. Slickensides in the fault zone indicated the units on the east had moved laterally about 14 ft south relative to the units west of the fault. The fault was expressed at the surface as a gouge zone 6 to 18 in. wide and stood 2 to 3 ft above the land surface for a distance of about 20 ft along the southern flank of the east-west trending ridge. This gouge zone consisted of reddish tuff that had been welded by the movement, thus forming a more competent rock

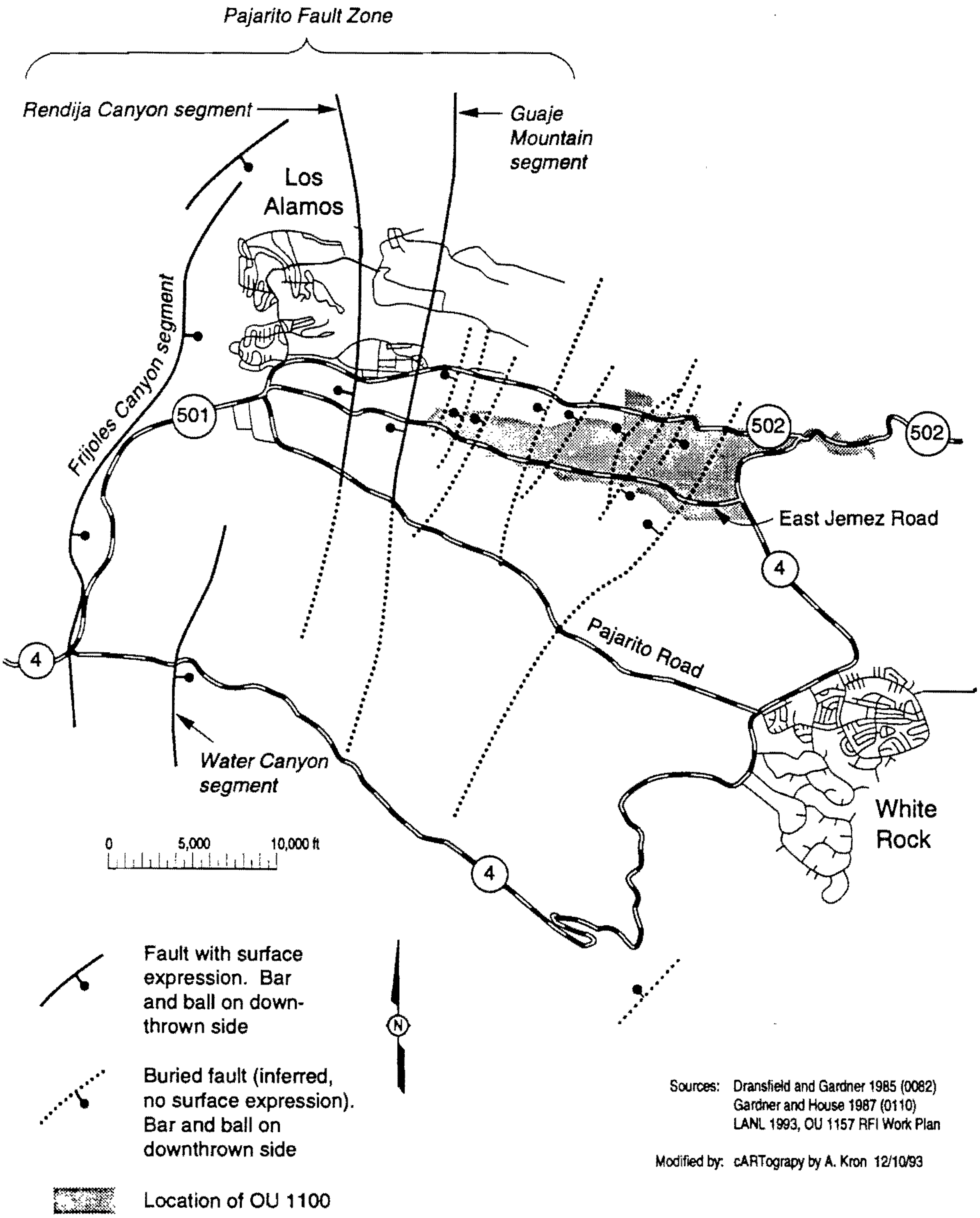

Figure 3-7. Major subsurface faults and major nearby surface faults in the vicinity of OU 1100.

than Unit 3, which forms the ridge. Along the crest of the ridge, the gouge zone narrowed and was eroded level with the land surface. The fault plane was nearly vertical as indicated by the remnants of the gouge zone in Los Alamos Canyon (Keller 1968, 22-0001).

Keller (Keller 1968, 22-0001) reported numerous joints in the Tshirege Member Units 2b and 3 on Mesita de los Alamos. The most prominent and numerous joints were nearly vertical and some were slightly open. Near-surface joints were filled with clay and weathering products of the tuff (Keller 1968, 22-0001). Numerous fractures and joints were also noted at the Mesita during the three engineering projects previously described in Section 3.4.1.

Subsurface Faults

Several subsurface faults mapped by Dransfield and Gardner (Dransfield and Gardner 1985, 0082) are located in OU 1100. Several of these faults constitute a major zone of subsurface faulting, which is bounded on the west by the Guaje Mountain fault and on the east by a northeast-trending master fault of this zone located east of TA-53. These faults parallel the northern portion of the master northeast-trending fault (Figures 3-1 and 3-7). Figures 3-1 and 3-7 show the general approximation of the faults in OU 1100, but they do not depict the exact locations of the faults. Fracture zones in the Bandelier Tuff may be associated with the underlying subsurface fractures.

Investigations at TA-21 across Los Alamos Canyon north of Mesita de los Alamos suggest the presence of a zone of fracturing throughout Subunit 2 of the Tshirege Member of the Bandelier Tuff. The fracture zone begins 1,200 ft east of TA-2 and extends eastward 7,313 ft to near the eastern end of DP Mesa. Fractures comprise a conjugate set of northwest and northeast strikes. Most of the fractures are due to brittle fracture of the tuff during its cooling contraction. Subsequent fracture extension and development was caused by tectonic adjustment of the tuff to movements over the last million years along the Pajarito Fault System that underlies the Pajarito Plateau (LANL 1993, 1076). Detailed fracture analysis along Mesita de los Alamos (TA-53) could define a similar fracture zone within the Tshirege in OU 1100.

3.4.3 Surficial Deposits

Surficial deposits within OU 1100 consist mainly of alluvium, colluvium, and landslide deposits. The following sections discuss deposits important for this RFI.

3.4.3.1 Alluvium and Colluvium

Discontinuous Quaternary alluvial units stratigraphically overlay the Bandelier Tuff on mesa tops and are deposited in canyons throughout the Pajarito Plateau. Moreover, older alluvium units occur on stream terraces on the sides of the canyons, which can be buried by colluvial deposits from canyon walls. Generally, alluvial units on the surface of the mesas are probably oldest, becoming inactive as drainages were incised into the plateau (LANL 1993, 1017).

The thickness of the alluvium at the bottom of Sandia Canyon at TA-20 is unknown. Further east of TA-20, near the eastern boundary of OU 1100, the alluvium is about 18 ft thick at observation Wells SCO-1 and SCO-2. This alluvium consisted of silty sand, and sands and gravels in a matrix of silts and clay, with clay, coarse sand, and gravel lenses. The alluvium was described as reworked tuff. The alluvium is underlain by the Bandelier Tuff (Purtymun and Stoker 1990, 22-0002).

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. The thickness of alluvium on the mesa tops is typically less than 15 ft (LANL 1993, 1017). Previous investigations do not document the presence of alluvium on Mesita de los Alamos (Keller 1968, 22-0001 and Environmental Protection Group 1992, 1075).

3.4.3.2 Soils

A general description of the soils in the Los Alamos area is found in Section 2.6.1.3 of the IWP (LANL 1993, 1017). A description of the soils on Mesita de los Alamos is found in Section 2.2.3 of the RCRA Part B Permit Application for the TA-53 surface impoundments (Environmental Protection Group 1992, 1075). The following description of the soils at OU 1100 is based on the study by Nyhan et al. (Nyhan et al. 1978, 0161). The soil in the bottom of Sandia Canyon consists of well-drained soils of the Totavi series. The eastern half of the top of Mesita de los Alamos is classified as rock outcrop, mesic land type which is found on moderately sloping to steep mesa tops and edges and consists of about 65% tuff rock outcrop with small areas of very shallow, undeveloped soil. The western half of the top of Mesita de los Alamos consists of very shallow to shallow, well-drained soils of the Hackroy series; a Hackroy rock outcrop complex; moderately deep, well-drained soils of the Nyjack series; and deep, well-drained soils of the fine-loamy Typic Eutroboralfs (Nyhan et al. 1978, 0161). In general, the prevalent soil types have not been geochemically and hydrogeologically characterized to the extent necessary for effective contaminant-transport analysis.

3.4.3.3 Erosional Processes

Erosional processes on the Pajarito Plateau are described in Section 2.6.1.6 of the IWP (LANL 1993, 1017). At OU 1100, the significant erosional processes include sediment transport by surface runoff from the mesa into adjacent canyons and from the PRSs on the canyon bottom into the stream or drainage channel in Sandia Canyon. Additional erosional processes include the potential exposure of PRSs located near the mesa edge by cliff retreat and erosion and deposition of sediments by flow in the bottom of Sandia Canyon. Minor amounts of wind erosion may also be occurring in the area. Rates of erosion and landscape change caused by these processes are unknown (LANL 1993, 1017).

Erosion rates on the mesa tops are unknown. 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 runoff is concentrated by roads and other development are especially prone to accelerated erosion. Erosion rates are higher on the south facing slopes than on the north facing slopes. However, no studies have been conducted to quantify the rates and processes of erosion on canyon sides. Estimates of long-term vertical erosion rates on mesa tops have been made based on stripping of overlying units, 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 (LANL 1993, 1017). These erosional processes may affect the long-term stability of PRSs that are left in place on the mesa, such as the surface impoundments (TA-53-166), which are located on the south side of the mesa, about 40 to 80 ft from the edge of a cliff formed by a drainage channel.

The primary erosional process at the bottom of Sandia Canyon is the movement of sediments during streamflow and floods. 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 potentially contaminated sediments through canyons are largely unknown (LANL 1993, 1017).

3.5 Conceptual Hydrologic Model

Figure 3-6 graphically depicts the general geology and hydrogeologic processes occurring within OU 1100. At most of the sites on the mesa, the dominant contaminant-transport process is surface erosion and sediment/solute transport. At sites on the mesa where large amounts of liquids were released, subsurface transport through the vadose zone may occur. At most of the sites in Sandia Canyon, the dominant contaminant-transport process is subsurface transport through the vadose zone, surface erosion, and sediment/solute transport.

An alluvial groundwater body of limited extent could potentially be present in the upper portion of Sandia Canyon in OU 1100. Alluvial groundwater is absent in the lower portion of Sandia Canyon at the eastern boundary of the operable unit (Purtymun and Stoker 1990, 22-0002). Some transport within the alluvial groundwater could potentially occur in the upper portion of Sandia Canyon. Intermediate-depth, perched groundwater is present at OU 1100 (Environmental Protection Group 1993, 0829 and Stoker et al. 1992, 0826). Connection between the shallow alluvial groundwater and the intermediate-depth, perched groundwater could potentially occur (Stephens et al. 1993, 1049). However, the lateral extent and connection between perched zones is unknown. In addition, it is unknown if the perched groundwater is hydraulically connected to the main aquifer (LANL 1993, 1017). The magnitude of the shallow alluvial groundwater and the intermediate-depth, perched groundwater is uncertain, but it is expected to be small.

Surface water drains across the Pajarito Plateau eastward from the Sierra de los Valles to the Rio Grande, and continues south to Cochiti Reservoir through the Rio Grande Valley. Surface water at OU 1100 occurs primarily as an ephemeral stream in Sandia Canyon. Typically, this surface flow is prevented from discharging across the Laboratory's eastern boundary by infiltration into the underlying alluvium and evapotranspiration. However, during periods of excessive storm runoff or snowmelt, surface flow may reach the Rio Grande (Stephens et al. 1993, 1049).

Contaminants enter the surface water drainages by surface runoff, by liquid discharges, and occasionally by air deposition (LANL 1993, 1017). Periodic natural surface runoff occurs in two modes: spring snowmelt runoff over highly variable periods of time (days to weeks) at a low discharge rate and sediment load, and summer runoff from thunderstorms over a short period of time (hours) at a high discharge rate and sediment load (Environmental Protection Group 1993, 0829). Runoff-derived contaminants are largely bound to sediment, which is carried downstream by subsequent runoff events. Effluent discharges move contaminants downstream in drainages that contain little natural water. The largest effluent-supported flow in the canyons at the Laboratory is in Sandia Canyon from the TA-3 sanitary sewage treatment plant.

With travel downstream, most of the effluent-derived metals and radionuclides become sediment bound and remain near the surface of the stream channel. Given sufficient time, these sediments eventually will be moved across the Laboratory boundary. Other contaminants are lost by evaporation or move downward into the alluvium (LANL 1993, 1017).

3.5.1 Surface Water Hydrology

Ephemeral Stream

Sandia Canyon has an ephemeral stream having a small drainage area that heads on Pajarito Plateau at TA-3. Treated effluents from the TA-3 sanitary sewage treatment plant and cooling tower blowdown from the TA-3 power plant create continual flow in the upper portion of Sandia Canyon. In OU 1100, Sandia Canyon receives storm runoff from Mesita de los Alamos and waste water discharges from TA-53 (Environmental Protection Group 1993, 0829). During peak flow events, the stream may reach the Rio Grande. The stream is depleted by evaporation, transpiration, and possibly infiltration within a short distance downstream of surface sampling point SCS-3. The surface sampling points SCS-2 and SCS-3 are located in the portion of the stream having continual flow, which extends from the western edge of the operable unit to surface water sampling point SCS-3, which is near the western edge of TA-20 (Figure 3-8).

Water quality in Sandia Canyon is mainly affected by effluent discharges from TA-3. Three surface water sampling stations, SCS-1, SCS-2, and SCS-3, are located in the reach of the canyon containing constant flow maintained by the effluents. The samples are routinely analyzed for radiochemical and chemical constituents (general groundwater quality parameters) and are reported in the Laboratory's annual environmental surveillance reports. Samples of surface waters from Sandia Canyon have been analyzed for volatile and semivolatile organics and metals (Environmental Protection Group 1993, 0829). During 1991, measurable amounts of radioactivity were detected in the samples, but the levels were below the DOE Derived Concentration Guides. (These guides limit potential exposure to the public from ingestion of water to levels below the DOE public dose limit [Environmental Protection Group 1993, 0829].) The results of

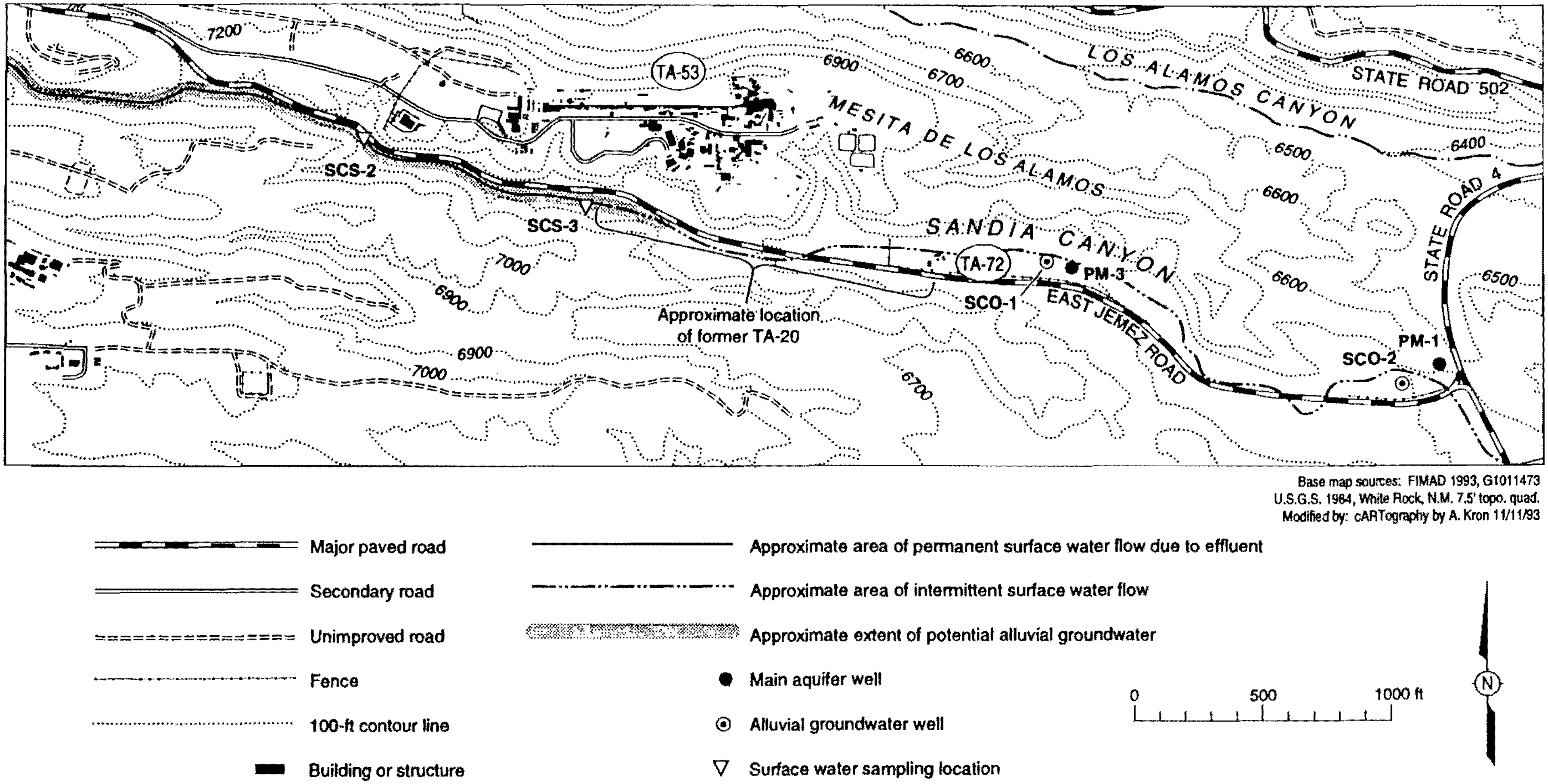

Figure 3-8. Approximate locations of surface water, surface water sampling points, potential alluvial groundwater, alluvial monitoring wells, and water supply wells in Sandia Canyon at former TA-20.

the general chemistry parameters showed some effect from the effluents. However, none of the measurements exceeded any limits for drinking water systems (such standards are not applicable to these surface waters because they are not used for drinking water) (Environmental Protection Group 1993, 0829). The results of metal analyses did not exceed any limits for drinking water systems (even though such standards are not applicable to these surface waters) (Environmental Protection Group 1993, 0829). No volatile or semivolatile organic compounds were detected in the samples (Environmental Protection Group 1993, 0829). In the past, measurable amounts of cyanide have been detected in samples collected from Sandia Canyon (LANL 1993, 1017).

Flood Plain

The elevation and location of the 100-year flood plain has been determined for all Laboratory drainages (McLin 1992, 0825). At OU 1100, the 100-year flood plain occupies an area more or less centered on the stream channel in Sandia Canyon and varies in width from 20 to 400 ft (Figure 3-9). At TA-20, most of the PRSs are located within the 100-year flood plain.

3.5.2 Hydrogeology

A brief overview of the hydrogeology of the Pajarito Plateau is presented in Section 2.6.2 of the IWP (LANL 1993, 1017). The following sections provide hydrogeological information specific to OU 1100. Groundwater in Sandia Canyon occurs as a potential body of shallow alluvial groundwater, an intermediate-depth, perched groundwater body, and a deep, main aquifer. A thorough discussion of the main aquifer underlying the Pajarito Plateau is presented in Section 2.6.6 of the IWP (LANL 1993, 1017).

The main aquifer for Los Alamos is within the siltstones and sandstones of the Tesuque Formation along the Rio Grande. It rises westward into the lower part of the Puye Conglomerate beneath the central and western part of the Pajarito Plateau (Figure 3-2). At OU 1100, the potentiometric surface of the main aquifer lies between 5,700 and 5,980 ft and is located within the Puye Conglomerate and the underlying Tesuque Formation (Purtymun 1984, 0196). Approximately 1,000 ft of unsaturated tuff and volcanic rock separate the mesa top from the main aquifer at TA-53. At TA-20, over 700 ft of unsaturated tuff and volcanic rock separate the surface from the main aquifer (LANL 1990, 0145).

In OU 1100, two water supply wells penetrate the main aquifer. PM-1 is located near the eastern boundary of OU 1100 in Sandia Canyon and PM-3 is located about 1 mile upgradient from PM-1 in Sandia Canyon (Figure 3-1). In 1989, the top of the main aquifer was about 752 and 765 ft below the canyon floor in PM-1 and PM-3, respectively. Directly north of OU 1100, two wells are located in Los Alamos Canyon. Supply well Otowi-4 was completed in 1990 and is located approximately 400 ft west of test well TW-3 (Figure 3-1). In 1990, the top of the main aquifer was about 774 ft below the surface at TW-3 (Environmental Protection Group 1993, 0829) and about 780 ft below the surface at Otowi-4 (Stoker et al. 1992, 0826).

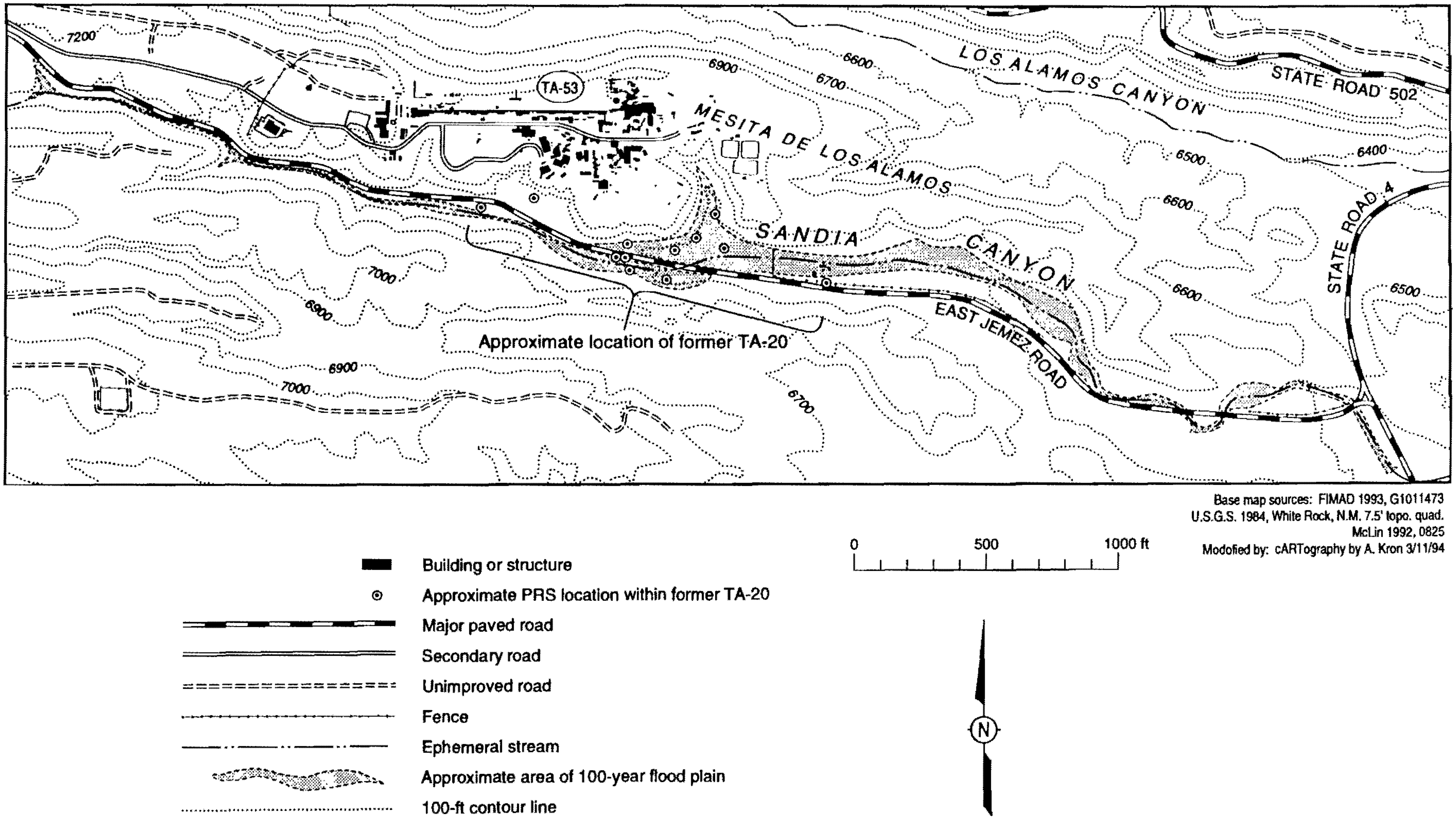

Figure 3-9. Location of 100-year flood plain and PRSs in Sandia Canyon and former TA-20.

3.5.2.1 Vadose Zone

The vadose zone hydrogeology of the Pajarito Plateau is presented in Section 2.6.3 of the IWP (LANL 1993, 1017). The summary provides the fundamental hydrogeologic properties of the Bandelier Tuff and discusses the movement of fluids and potential contaminants through the tuff (LANL 1993, 1017).

Physical characteristics of the tuff, which 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. Welding results in increased density, and in decreased porosity and hydraulic conductivity. Joints, formed by cooling of the ash flows, typically divide the tuff into irregular blocks. The major joint sets are vertical or near vertical with dips greater than 70°, and joint frequency increases with degree of welding. Joint apertures range from closed to open as much as several centimeters. The joints are commonly filled with caliche near the surface, grading downward to clay, and may be open at depths greater than 30 ft. 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. Open fractures may allow rapid water movement of liquid under saturated or near-saturated conditions (LANL 1993, 1017). Roots have been found in joints to depths of at least 30 ft, which suggest that joints may be important infiltration pathways (Stephens et al. 1993, 1049).

Based on the information presented in Section 2.6.3 of the IWP (LANL 1993, 1017), under unsaturated conditions, the Bandelier Tuff substantially impedes the movement of fluids in the subsurface. On the other hand, contaminants can move long distances along pores and fractures of the tuff in the vapor phase when moisture conditions are low. Under saturated conditions, such as below a leaking surface impoundment or tank, the fluids could move rapidly through the numerous open joints and fractures in the tuff. At depth, the role of fractures in the movement of moisture is less clear. Flow in the lower portions of the Bandelier Tuff is far more likely to be dominated by the relatively slow process of capillarity (LANL 1993, 1017).

At OU 1100, hydraulic properties were measured from 10 core samples taken from Boreholes 53-6 and 53-7, drilled near the impoundments (TA-53-166). Cores were collected from the Tshirege Member in Borehole 53-6 and from the Otowi Member in Borehole 53-7. The samples were measured for gravimetric and volumetric moisture content, density, and moisture retention characteristics. Based on these data, porosity and unsaturated hydraulic conductivity were calculated for the Tshirege and Otowi members of the Bandelier Tuff (Tables 3-1 and 3-2) (Daniel B. Stephens & Associates, Inc., 22-0008).

Unsaturated alluvium is present at the bottom of Sandia Canyon. Near the eastern boundary of OU 1100, the alluvium is about 18 ft thick. The vadose zone hydrogeology of this alluvium in Sandia Canyon has not been thoroughly characterized.

TABLE 3-1

HYDRAULIC PROPERTIES OF TUFF SAMPLES FROM BOREHOLE 53-6

Depth (ft)	Initial Gravimetric Moisture Content (%)	Initial Volumetric Moisture Content (%)	Density (g/cm^3)	Porosity (%)	Saturated Hydraulic Conductivity (cm/sec)
40	17.3	23.4	1.35	48.96	3.7×10^{-4}
60	32.1	44.0	1.37	48.25	3.5×10^{-3}
100	8.2	10.4	1.27	52.01	8.8×10^{-4}
110	14.8	21.7	1.47	44.70	7.4×10^{-5}
150	17.3	22.8	1.32	50.22	6.1×10^{-5}

TABLE 3-2

HYDRAULIC PROPERTIES OF TUFF SAMPLES FROM BOREHOLE 53-7

Depth (ft)	Initial Gravimetric Moisture Content (%)	Initial Volumetric Moisture Content (%)	Density (g/cm^3)	Porosity (%)	Saturated Hydraulic Conductivity (cm/sec)
70	14.1	17.5	1.24	53.04	1.7×10^{-4}
80	18.0	19.9	1.10	58.44	2.2×10^{-4}

3.5.2.2 Saturated Alluvium

At the Laboratory, shallow alluvial groundwater occurs in the sands, gravels, cobbles, and boulders of the canyons heading on the mountains and in the reworked and weathered clays, silts, sands, and gravels of the canyons heading on the plateau. The alluvial groundwater exists as a narrow ribbon of saturation along the canyon bottoms and is perched on the underlying silts and clays. The alluvial groundwater is of limited horizontal extent and is recharged by surface water flow consisting of intermittent runoff and effluent discharges. The horizontal extent and the thickness vary throughout the year and at times may be dry. The spring snowmelt and late summer runoff cause the water levels to rise and the groundwater to advance down the canyon. In early summer, fall, and winter, the water levels typically decline and the groundwater retreats up the canyon. These same hydrologic effects take place in response to variations in the flow of treated industrial/sanitary effluents. The water levels may vary by 10 or more feet in the course of a year (Purtymun and Stoker 1990, 22-0002). Although it is believed that there is no hydraulic connection between the alluvial aquifer and the main aquifer, there is no conclusive data to support this contention (LANL 1993, 1017).

Shallow, alluvial groundwater in Sandia Canyon in OU 1100 has not been studied in detail. However, an alluvial groundwater body can be inferred to exist in portions of Sandia Canyon where the stream flow occurs (Purtymun and Stoker 1990, 22-0002). The alluvium is probably continuously saturated to at least the surface sampling point SCS-3. It may advance beyond SCS-3 in response to the spring snowmelt and the late summer rains. No alluvial groundwater is present at SCO-1 in the lower portion of Sandia Canyon near the eastern boundary of the operable unit (Purtymun and Stoker 1990, 22-0002).

Two wells have been installed in Sandia Canyon to monitor the alluvial groundwater. These wells were installed near existing water supply wells PMs-1 and -3 (near the eastern boundary of OU 1100 west of State Road 4), as required by the HSWA Permit (Figure 3-8). SCO-1 was drilled to a depth of 79 ft, and SCO-2 was drilled to a depth of 29 ft (Figure 3-8). The alluvium was about 18 ft thick in both wells. Groundwater was not encountered in either well. Both wells were completed at a depth of 20 ft in alluvium above weathered tuff (Purtymun and Stoker 1990, 22-0002).

3.5.2.3 Perched Groundwater

Intermediate-depth, perched groundwater is described in Section 2.6.5 of the IWP (LANL 1993, 1017). Perched water has been studied in Pueblo and Los Alamos canyons. Studies have demonstrated that the surface flow from sanitary waste water in Pueblo Canyon and storm runoff in Los Alamos Canyon recharge the underlying, intermediate-depth, perched groundwater. Water moves eastward, as shown by discharges from basaltic rocks at Basalt Springs in lower Los Alamos Canyon. Early surveillance activities by the US Geological Survey and later by the Laboratory document the quality of the water from perched water bodies. The concentrations of chlorides, nitrates, and total dissolved solids have increased through time. However, it is not known if the perched groundwater is hydraulically connected to the main aquifer (LANL 1993, 1017).

Intermediate-depth, perched groundwater in Sandia Canyon has not been studied in detail. Perched groundwater was encountered at a depth of about 450 ft in PM-1 when the well was being installed in 1965. This well is located near the eastern boundary of OU 1100 in Sandia Canyon (Figure 3-1) (Environmental Protection Group 1993, 0829). This perched groundwater was located in the basaltic rocks of the Cerros del Rio and was separated from the top of the main aquifer by about 298 ft of basalt and conglomerate. Otowi-4, located just north of TA-53 in Los Alamos Canyon, also evidenced perched groundwater when it was installed in 1990 (Figure 3-1). Perched groundwater was encountered at a depth of about 253 ft, where water cascaded into the hole from a layer of large gravel within the upper member of the Puye Conglomerate above the basaltic rocks of the Cerros del Rio. This perched groundwater was separated from the top of the main aquifer by about 527 ft of conglomerate and basalt (Stoker et al. 1992, 0826). The lateral extent of the perched groundwater bodies is not known, but they are believed to be limited. It is not known if the perched groundwater at PM-1 is connected to the perched groundwater at Otowi-4.

REFERENCES FOR CHAPTER 3

Albuquerque Testing Laboratory, Inc., October 24, 1972. "Foundation Investigation for Bernard Johnson, Inc. Weapons Neutron Research Facility at Los Alamos, NM, Part 1," Albuquerque Testing Laboratory Report, ER ID No. 27615, Albuquerque, New Mexico. (Albuquerque Testing Laboratory 1972, 22-0011)

Army Corps of Engineers, January 1987. "Corps of Engineers Wetlands Delineation Manual," final report, Technical REport Y-87-1, Wetlands Research Program, Waterways Experiment Station, P. O. Box 631, Vicksburg, Mississippi. (Army Corps of Engineers 1987, 0871)

Bailey, R. A., R. L. Smith, and C. S. Ross, 1969. "Stratigraphic Nomenclature of Volcanic Rocks in the Jemez Mountains, New Mexico," in Contributions to Stratigraphy, US Geological Survey Bulletin 1274-P, Washington, DC, p. 1. (Bailey et al. 1969, 0019)

Baltz, E. H., J. H. Abrahams, and W. D. Purtymun, March 1963. "Preliminary Report on the Geology and Hydrology of Mortandad Canyon near Los Alamos, N. Mex., with Reference to Disposal of Liquid Low-Level Radioactive Waste," US Geological Survey Open File Report, Albuquerque, New Mexico. (Baltz et al. 1963, 0024)

Bowen, B. M., May 1990. "Los Alamos Climatology," Los Alamos National Laboratory Report LA-11735-MS, Los Alamos, New Mexico. (Bowen 1990, 0033)

Crowe, B. M., G. W. Linn, G. Heiken, and M. L. Bevier, April 1978. "Stratigraphy of the Bandelier Tuff in the Pajarito Plateau, Applications to Waste Management," Los Alamos Scientific Laboratory Report LA-7225-MS, Los Alamos, New Mexico. (Crowe et al. 1978, 0041)

Daniel B. Stephens & Associates, Inc., November 1991. "Laboratory Analysis of Soil Hydraulic Properties from TA-53 Impoundments Corehole #6, Corehole #7 and Corehole SIMO-1," ER ID Number 276118, Albuquerque, New Mexico. (Daniel B. Stephens & Associates, Inc., 22-0008)

DOE (US Department of Energy), November 9, 1988. "General Environmental Protection Program," DOE Order 5400.1, Washington, DC. (DOE 1988, 0075)

Dransfield, B. J., and J. N. Gardner, May 1985. "Subsurface Geology of the Pajarito Plateau, Española Basin, New Mexico," Los Alamos National Laboratory Report LA-10455-MS, Los Alamos, New Mexico. (Dransfield and Gardner 1985, 0082)

Environmental Protection Group, August 1993. "Environmental Surveillance at Los Alamos During 1991," Los Alamos National Laboratory Report LA-12572-ENV, Los Alamos, New Mexico. (Environmental Protection Group 1993, 0829)

Environmental Protection Group, June 1992. "RCRA Part B Permit Application, Surface Impoundments Technical Area 53," Volumes 1 and 2, Revision 1.0, Los

Alamos National Laboratory, Los Alamos, New Mexico. (Environmental Protection Group 1992, 1075)

Horner, K. R., August 14, 1986. "Subsurface Materials Investigation for an Advanced Hadron Facility at TA-53," Pam Am World Services, Inc. Report WO 6-5509-37, ER ID No. 27616, Los Alamos, New Mexico. (Horner 1986, 22-0004)

Horner, K. R., February 10, 1986. "Geotechnical Testing Report For The Stopped Pion Facility At TA-53," The Zia Company Report WO 6-8950-71, ER ID No. 27617, Los Alamos, New Mexico. (Horner 1986, 22-0003)

Keller, M. D., June 1968. "Geologic Studies and Material Properties Investigations of Mesita de los Alamos," Los Alamos Scientific Laboratory Report LA-3728, ER ID Number 4784, Los Alamos, New Mexico. (Keller 1968, 22-0001)

LANL (Los Alamos National Laboratory), June 14, 1993. "Phase Report IA, TA-21 Operable Unit RCRA Facility Investigation," Los Alamos National Laboratory Report LA-UR-93-2028, Los Alamos, New Mexico. (LANL 1993, 1076)

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report No. LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. (LANL 1990, 0145)

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. (LANL 1993, 1017)

McLin, S. G., August 1992. "Determination of 100-Year Floodplain Elevations at Los Alamos National Laboratory," Los Alamos National Laboratory Report LA-12195-MS, Los Alamos, New Mexico. (McLin 1992, 0825)

National Park Service, September 19, 1983. "Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines," Notice, Federal Register, Vol. 48, No. 190, p. 44716. (National Park Service 1983, 0632)

Nyhan, J. W., L. W. Hacker, T. E. Calhoun, and D. L. Young, June 1978. "Soil Survey of Los Alamos County, New Mexico," Los Alamos Scientific Laboratory Report LA-6779-MS, Los Alamos, New Mexico. (Nyhan et al. 1978, 0161)

Purtymun, W. D., and A. K. Stoker, September 1990. "Perched Zone Monitoring Well Installation," Los Alamos National Laboratory Report LA-UR-90-3230, ER ID No. 7508, Los Alamos, New Mexico. (Purtymun and Stoker 1990, 22-0002)

Purtymun, W. D., in preparation. "Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs, and Surface Water Stations at Los Alamos with Reference to Geology and Hydrology," Los Alamos National Laboratory, Los Alamos, New Mexico. (Purtymun, in preparation, 22-0005)

Purtymun, W. D., January 1984. "Hydrologic Characteristics of the Main Aquifer in the Los Alamos Area: Development of Ground Water Supplies," Los Alamos

National Laboratory Report LA-9957-MS, Los Alamos, New Mexico. (Purtymun 1984, 0196)

Stephens, D. B., P. M. Kearl, and R. W. Lee, April 21, 1993. "Hydrogeologic Review for the Environmental Restoration Program at Los Alamos National Laboratory," prepared for Los Alamos National Laboratory, by Daniel B. Stephesn & Associates, Inc., Albuquerque, New Mexico. (Stephens et al. 1993, 1049)

Stoker, A. K., S. G. McLin, W. D. Purtymun, M. N. Maes, and B. G. Hammock 1992. "Water Supply at Los Alamos During 1989," Los Alamos National Laboratory Report LA-12276-PR, Los Alamos, New Mexico. (Stoker et al. 1992, 0826)

Vaniman, D., and K. Wohletz, November 14, 1990. "Results of Geological Mapping/Fracture Studies: TA-55 Area," Los Alamos National Laboratory Memorandum EES1-SH90-17, Los Alamos, New Mexico. (Vaniman and Wohletz 1990, 0541)

Vaniman, D., July 29, 1991. "Revisions to Report EES1-SH90-17," Los Alamos National Laboratory Memorandum EES1-SH91-12, ER ID No. 29542, Los Alamos, New Mexico. (Vaniman 1991, 22-0112)

Weir, J. E., Jr., and W. D. Purtymun 1962. "Geology and Hydrology of Technical Area 49, Frijoles Mesa, Los Alamos County, New Mexico," US Geological Survey Administrative Release, Albuquerque, New Mexico. (Weir and Purtymun 1962, 0228)

Executive Summary

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4.0 TECHNICAL APPROACH

This chapter describes the overall technical approach to Phase I of the OU 1100 RFI, which follows the proposed RCRA Subpart S. This approach, modeled on DOE's streamlined approach for environmental restoration (see IWP Chapter 4—LANL 1993, 1017), combines elements of the observational approach described in Appendix G of the IWP (LANL 1993, 1017) and EPA's data quality objectives (DQO) process for designing data collection to support environmental decisions.

The RFI serves as a screen, focusing the site investigation on areas where there is evidence of a release or likelihood of a release that may pose a threat to human health or the environment. During Phase I, data on the types and concentrations of constituents in the environmental media at each PRS or PRS aggregate are collected. Constituent levels are then compared with background concentration distributions and screening action levels (SALs—see Section 4.2). On the basis of this comparison, individual PRSs or their aggregates may be recommended for no further action (NFA), further characterization, voluntary corrective action (VCA), or a corrective measures study (CMS).

This chapter is divided into ten sections. Section 4.1 describes the rationale for aggregating PRSs into groups. Sections 4.2 and 4.3 define and discuss SALs and VCAs, respectively. In Section 4.4, the decision analysis process to be applied to the PRSs is discussed. Section 4.5 presents background information on the conceptual exposure models for the aggregates and provides generic information on sources of environmental release at the PRS aggregates, potential environmental pathways, and potential effects. Section 4.6 discusses the potential remediation alternatives for OU 1100. Sections 4.7 - 4.9 discuss the sampling strategies, field operations, and analytical procedures that will be used. Finally, Section 4.10 discusses the mitigation of impacts on identified biological and cultural resources.

4.1 Aggregation of PRSs

The PRSs in OU 1100 have been aggregated, on the basis of function, into seven groups: landfills, firing sites, waste and product storage areas, underground storage tanks, septic systems, outfalls, and surface impoundments. The aggregations are shown in Table 4-1.

4.2 Screening Action Levels

SALs are media-specific concentration levels for potential contaminants of concern (PCOCs) derived using conservative health-based criteria (see Chapter 4 and Appendix J of the IWP—LANL 1993, 1017). In most cases, SALs for nonradiological PCOCs are calculated using the methodology in Proposed Subpart S to 40 CFR 264 (EPA 1990, 0432) for calculation of action levels. Radiological SALs are based on an annual incremental dose (10 mrem/yr) from a single radioactive constituent via all pathways in a residential-use exposure scenario.

TABLE 4-1

PRS AGGREGATES FOR OU 1100

PRS No.	Description
Aggregate A - Landfills	
20-001(a)	Sandia Canyon landfill Area 1
20-001(b)	Sandia Canyon landfill Area 2
20-001(c)	Sandia Canyon landfill Area 3
Aggregate B - Firing Sites	
20-002(a)	Firing site
20-002(b)	Firing site
20-002(c)	Firing site
20-002(d)	Firing site
20-003(a)	Gun firing site control building
20-003(b)	Gun firing site
20-003(c)	Gun firing site
20-003(d)	Firing site
C-20-001	Storage building
C-20-002	Storage building
C-20-003	Magazine
72-001	Firing range
72-002	Impact area
Aggregate C - Waste and Product Storage Areas	
53-001(a)	Waste accumulation area
53-001(b)	Waste accumulation area
53-001(c)	Waste accumulation area
53-001(d)	Waste accumulation area
53-001(e)	Waste accumulation area
53-001(f)	Waste accumulation area
53-001(g)	Waste accumulation area
53-001(h)	Waste accumulation area
53-001(i)	Waste accumulation area
53-001(j)	Waste accumulation area
53-001(k)	Waste accumulation area
53-001(l)	Waste accumulation area
53-001(m)	Waste accumulation area
53-001(n)	Waste accumulation area
53-001(o)	Waste accumulation area
53-004	Bead blaster
53-005	Waste disposal pit
53-007(a)	Waste tanks
53-007(b)	Waste tanks
53-008	Boneyard
53-009	Oil storage area
53-010	Oil storage area
53-011(a)	PCB transformer
53-011(b)	PCB transformer
53-011(c)	PCB transformer
53-011(d)	PCB transformer
53-011(e)	PCB transformer

TABLE 4-1

PRS AGGREGATES FOR OU 1100
(concluded)

PRS No.	Description
Aggregate C - Waste and Product Storage Areas	
C-53-003	PCB oil leak
C-53-004	PCB oil leak
C-53-005	PCB oil leak
C-53-006	PCB oil leak
C-53-007	PCB oil leak
C-53-008	PCB oil leak
C-53-009	PCB oil leak
C-53-010	PCB oil leak
C-53-011	PCB oil leak
C-53-012	PCB oil leak
C-53-013	PCB oil leak
C-53-014	PCB oil leak
C-53-015	PCB oil leak
C-53-016	PCB oil leak
C-53-017	PCB oil leak
C-53-018	PCB oil leak
C-53-019	PCB oil leak
Aggregate D - Underground Storage Tanks	
53-006(a)	Underground waste tank
53-006(b)	Underground waste tank
53-006(c)	Underground waste tank
53-006(d)	Underground waste tank
53-006(e)	Underground waste tank
53-006(f)	Underground waste tank
Aggregate E - Septic Systems	
20-004	Septic system
20-005	Septic system
53-003	Septic system
73-003(a)	Septic system
73-003(b)	Septic system
Aggregate F - Outfalls	
53-012(a)	Outfall
53-012(b)	Outfall
53-012(c)	Outfall
53-012(d)	Outfall
53-012(e)	Outfall
53-012(f)	Outfall
53-012(g)	Outfall
53-012(h)	Outfall
Aggregate G - Surface Impoundments	
53-002(a)	Surface impoundment
53-002(b)	Surface impoundment

If a regulatory standard exists for a constituent, that standard will be used as the SAL rather than the calculated value. In addition, characterization of radiological constituents will include consideration of DOE's ALARA (as low as reasonably achievable) requirements, even if the concentration levels are below derived action levels or regulatory criteria.

SALs are tools for efficiently discriminating between problem and nonproblem sites so that resources can be used effectively; they are not cleanup criteria. Cleanup criteria are based on site-specific risk evaluations and ALARA requirements. SALs may be used as surrogate cleanup levels in some instances, but in most cases cleanup levels will be higher than SALs. For example, if the site will never be a residential one, the site-specific land-use (e.g., recreational) scenario, which allows higher levels of constituent concentrations in soil than the conservative residential-use scenario, could be used to calculate cleanup levels.

4.3 Voluntary Corrective Actions

Voluntary corrective action is an obvious, feasible, and effective remedy for a site where contaminants of concern have been identified and direct remediation—that meets treatment and disposal restrictions and other limiting criteria—is more cost-effective than completing the RFI/CMS process. A VCA may be proposed at any stage of the RFI. Implementation requires a change control process approved by DOE. After DOE approval, a VCA plan will be prepared and submitted to EPA, the New Mexico Environment Department (NMED), and the public for a 60-day comment period. After resolution of comments, the VCA will be implemented.

4.4 Decision Analysis

The decision logic on which RFI/CMS activities will be based is illustrated in Figure 4-1. The first step is to formulate a conceptual model for the site on the basis of archival information and the results of field reconnaissance work, which provide an initial list of PCOCs at a PRS or PRS aggregate.

As shown in the figure, in some cases NFA or deferred investigation may be recommended after this first step. The criteria for a recommendation of NFA based on archival information are discussed in Section 4.6.1, and the details are described in Appendix I and Section 4.1 of the IWP (LANL 1993, 1017). OU 1100 PRSs recommended for NFA or deferred investigation on the basis of archival information are discussed in Chapter 6.

For many PRSs in OU 1100, the archival information indicates that contaminants of concern are not likely to be present but is insufficient to support a recommendation of NFA. For these PRSs, and others for which virtually no information exists, screening assessments will be conducted to determine the presence or absence of contaminants of concern. PRSs shown by this means to pose no hazard to human health or the environment can be recommended for NFA. By eliminating nonproblems early, through use of archival data and screening assessments, resources can be more efficiently and effectively channeled toward remediation of PRSs that do present hazards.

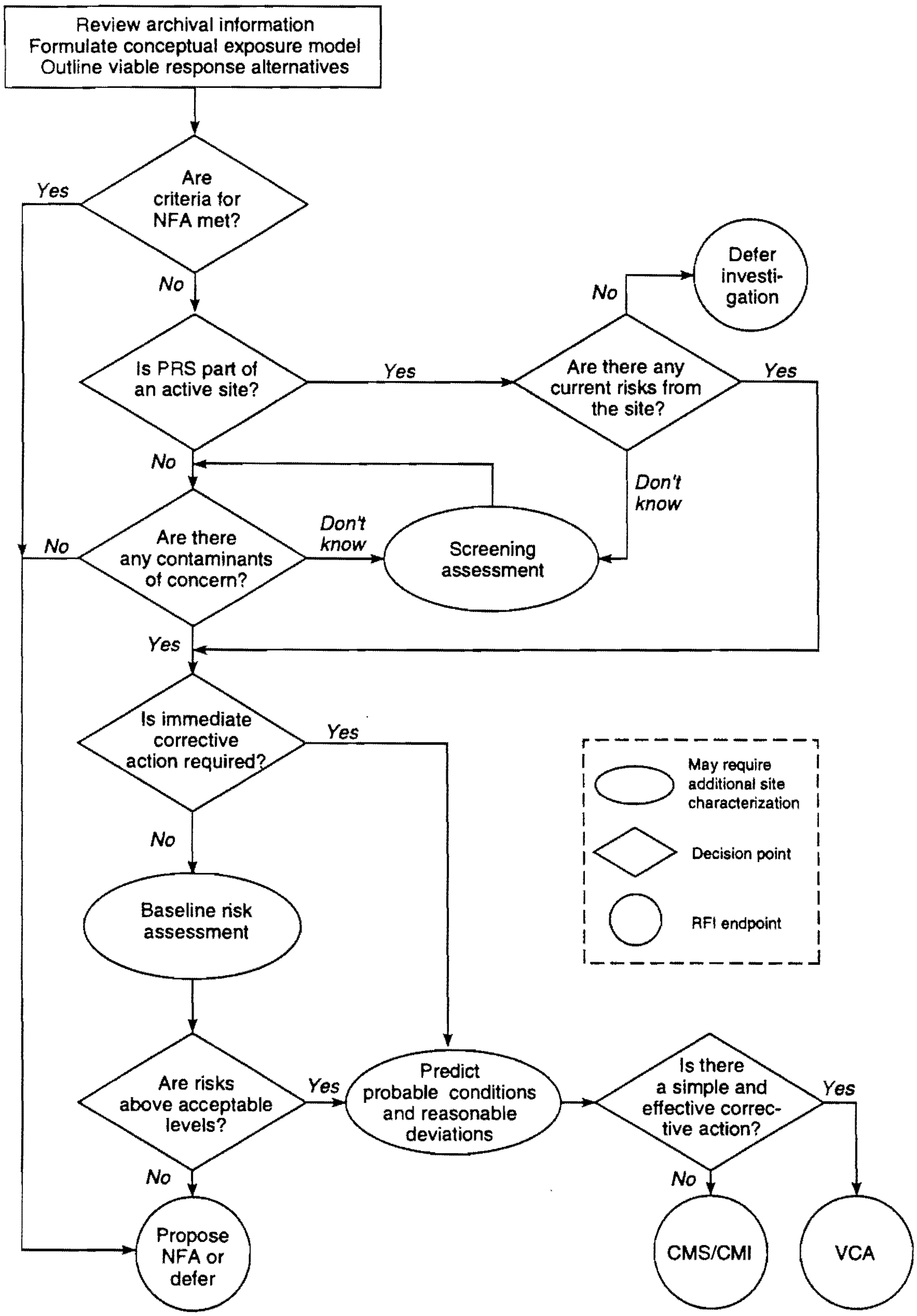

Figure 4-1. Decision logic for site investigations.

The two sampling strategies used in screening assessments are reconnaissance sampling and preliminary baseline-risk-assessment sampling. Reconnaissance sampling is the gathering of data for comparison with background concentration distributions and SALs; from these comparisons it can be determined whether any PCOCs exist at a PRS for which there is little or no historical information. Preliminary baseline-risk-assessment sampling is collection of samples from PRSs for which already-available data indicate the likelihood that contamination is present; this type of sampling provides enough data to estimate exposure concentrations of contaminants of concern, which will be used in conducting a baseline risk assessment (guidance on estimating exposure concentrations is provided in Appendix K of the IWP [LANL 1993, 1017]). Because of the nature of expected contamination, we plan to do reconnaissance sampling for the Phase I investigations at OU 1100.

The maximum concentrations found of PCOCs will be compared with background concentrations and with SALs, in accordance with the protocols given in Section 4.1.4 and Appendix H of the IWP (LANL 1993, 1017). Those constituents found in concentrations greater than background and SALs will be identified as contaminants of concern. If constituent concentrations are at or below background concentration distributions or SALs at a given PRS, that PRS may be recommended for NFA.

If contaminants of concern are identified by the screening assessment, the next step will be to determine whether the concentrations at the PRS are such that immediate attention is indicated. If they are, and if there is an obvious, feasible, and effective remedy, a VCA will be implemented. If immediate attention is not indicated—which we expect to be the case for most if not all PRSs at OU 1100—the next step will be to perform a baseline risk assessment; the results will determine whether NFA, VCA, or a CMS will then be performed.

Additional characterization data may be required for the baseline risk assessment and CMS. If Phase I investigations establish that contaminants of concern are present in subsurface or surface soils at concentrations above background levels and SALs, and there is not sufficient data to conduct a baseline risk assessment, a Phase II investigation will be conducted. The Phase II investigation will be designed to gather the information needed for a baseline risk assessment and for evaluation, selection, and implementation of a remediation alternative. Sampling will be directed toward more fully characterizing the nature and extent of contamination at the site.

Whereas Phase I sampling is biased toward areas expected to be contaminated, and samples are analyzed for a broad spectrum of constituents (unless the constituents present are well characterized), Phase II analyses will focus on constituents identified as contaminants of concern. The biased sampling will also provide data on maximum expected concentrations. This information will be useful for identifying potential treatment and disposal options.

4.5 Conceptual Exposure Models for OU 1100

A general conceptual model was developed to identify potential contaminant migration pathways and any potential human receptors (see IWP Appendix K, LANL 1993, 1017). The model identifies historical sources of contamination, historical migration and conversion, potential current sources of contamination, release mechanisms, contact media, and exposure routes for each PRS. This information is used to help identify appropriate media and locations for sampling; decide the magnitude of sampling and the analytical methods needed to accurately characterize the PRSs; and determine whether the PRS poses a threat to human health or the environment. The elements considered in developing the conceptual exposure model (historical sources of potential contamination, PRS creation mechanisms, migration pathways and conversion mechanisms, potential release mechanisms, and exposure routes) are identified in Table 4-2.

The aggregate-specific conceptual models presented in this work plan (see Chapter 5) are formulated on the basis of available PRS information only. They will be refined (or new ones will be developed) on the basis of the data gathered during the RFI.

4.5.1 Generic Source Information

This section discusses the PCOCs at OU 1100 (see Table 4-3) and the physical, chemical, and radiological properties that influence their mobility and/or degradation in the environment.

4.5.1.1 Potentially Hazardous Chemicals

4.5.1.1.1 Explosive Constituents

Soils and sediments at the landfills (Aggregate A) and at the firing sites (Aggregate B) may contain contaminants of concern from explosives operations. At the landfills, the buried waste is expected to consist exclusively of gun barrels and other metal scrap from the initiator tests, which could be contaminated with HE.

At the firing sites, the primary explosive used was Composition B (composed of 60% cyclotrimethylene-trinitramine [RDX] and 40% 2,4,6-Trinitrotoluene [2,4,6-TNT]). Therefore, the constituents that may be found at these locations include RDX and TNT (the residual parent explosives); cyclotetramethylenetetranitramine [HMX] (the production impurity of RDX); 1,3-dinitrobenzene [1,3-DNB], 1,3,5-trinitrobenzene [1,3,5-TNB], 2,4-dinitrotoluene [2,4-DNT], and 2,6-dinitrotoluene [2,6-DNT] (the production impurities of TNT); and 2-amino-4,6-dinitrotoluene [2-amino-4,6-DNT] and 4-amino-2,6-dinitrotoluene [4-amino-2,6-DNT] (the products of TNT environmental degradation).

In addition to its presence as a production impurity, HMX may have been used as an explosive; and RDX may be present as a production impurity of HMX. Other explosives that may have been used include PETN [pentaerythritol tetranitrate] and tetryl. The production impurities of PETN (pentaerythritol trinitrate, dipentaerythritol hexanitrate, and tripentaerythritol acetonitrate) have never been detected in the environment (Layton et al. 1987, 16-0035) and are not considered. There are virtually no production impurities of consequence in tetryl. Equilibrium distributions among eight compartments (i.e., air, air particles, biota, upper soil, lower soil, groundwater, surface water, and sediments) of an

TABLE 4-2

SUMMARY OF CONCEPTUAL EXPOSURE MODEL ELEMENTS

Pathways/Mechanisms	Concepts/Hypotheses
Historical Sources	Operations/processes that contributed to the creation of the PRS (storage areas, etc.).
PRS Creation Mechanisms	Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, leaching, dumping, or disposing into the environment.
Migration Pathway/ Conversion Mechanisms	
Atmospheric particulate dispersion	Limited to contaminants in surface soils. Entrainment and deposition are controlled by soil properties, surface roughness, vegetation cover, terrain, and atmospheric conditions.
Volatilization	Vaporization of volatile organic compounds in surface soils, subsurface soils, surface water, perched water, or groundwater.
Surface water/runoff	Precipitation that does not infiltrate or evaporate will become surface runoff. Surface runoff may resuspend contaminants and may carry them beyond the operable unit boundaries. Contaminated surface runoff may infiltrate the canyon bottom and/or shallow groundwater.
Groundwater	Groundwater may carry contaminants within the aquifer beyond the operable unit boundary or discharge contaminants to surface water via springs and seeps.
Sediments	Constituents may be transported by surface runoff in solution, by sorption to suspended sediments, or by mass movement of heavier bed sediments. Surface soil erosion and sediment transport is a function of runoff intensity and soil properties. Contaminants dispersed on the soil surface can be collected by surface water runoff and concentrated in sedimentation areas of drainages. Erosion of drainage channels can extend the area of contaminant dispersal. Surface runoff carried into the canyons may infiltrate sediments of channel alluvium.
Infiltration (percolation)	Infiltration of surface soils depends on the rate of precipitation or snowmelt, antecedent soil water status, depth of soil, and soil hydraulic properties. Infiltration of tuff depends on the unsaturated flow properties of the tuff. Joints and fractures in the tuff may provide additional pathways for infiltration of subsurface zones.
Potential Release Mechanisms	
Leaching	Storm water/snowmelt can dissolve potential contaminants from soil or other solid media, making them available for contact. The water solubility of contaminants and their relative affinity for soil or other solid media affects the ability of leaching to cause a release. Leaching and subsequent resorption can extend the area of contamination.
Soil erosion	The erosion of surface soils depends on soil properties, vegetation cover, slope and aspect, exposure to the force of the wind, and intensity and frequency of precipitation.

TABLE 4-2

SUMMARY OF CONCEPTUAL
EXPOSURE MODEL ELEMENTS
(concluded)

Pathways/Mechanisms	Concepts/Hypotheses
Potential Release Mechanisms (continued)	
Soil erosion (continued)	Soil may be lost through erosion in some locations and gained through deposition in others. Storm-water runoff can mobilize soils and sediments, making them available for contact. Storm intensity/frequency, physical properties of soils, topography, and ground cover determine the effectiveness of erosion as a release mechanism. Erosion may enlarge the contaminated area.
Mass wasting	This process is extremely slow.
Resuspension (wind suspension)	Wind suspension of contaminated soil/sediment as dust makes contaminants available for contact via inhalation/ingestion. Physical properties of soil (e.g., silt content, moisture content), wind speed, and size of exposed ground surface determine the effectiveness of wind suspension as a release mechanism. Wind suspension can enlarge the area of contamination and create additional exposure pathways (such as deposition on plants followed by plant consumption by humans/animals). Manual or mechanical movement of contaminated soil during construction or other activities makes contaminated soil available for dermal contact, ingestion, and inhalation as dust.
Excavation	The method of excavation (e.g., type of equipment used), the physical properties of the soil, the weather conditions, and the magnitude of the excavation activity (depth and total area of the excavation) influence the degree to which excavation may act as a release mechanism. Excavation can increase or decrease the size of the contaminated area, depending on how the excavated material is handled. Excavation activities may move subsurface contamination to the surface and may generate dust. Excavation activities may liberate VOCs in subsurface soils.
Exposure Routes	
Inhalation	Vapors, aerosols, and particulates (including dust) can be inhaled. Physical and chemical properties of inhaled airborne contaminants influence the degree of retention in the body.
Ingestion	Contaminants may be ingested along with soil, water, food, and/or dust.
Direct contact	Some contaminants will be absorbed through the skin if the skin comes in contact with contaminated soil, sediments, tuff, rubble, or surface water. The matrix effect (the type of media in which the contaminant is situated may affect its bioavailability).
External penetrating radiation	External, or whole body, radiation can occur through exposure to gamma-ray-emitting radionuclides that may be present in soil—either directly from the soil or from re-entrained dusts.

TABLE 4-3

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1100

Aggregate	Chemical Constituents			Radionuclides
	Explosive	Inorganic	Organic	
A - Landfills				
20-001	X[a]	Ba, Be, Cd, Ni	NA	Sr-90, U-238, Ra
B - Firing Sites				
20-002	X[a]	Ba, Be, Cd, Ni	NA	Sr-90, U-238, Ra
20-003	NA	Be, Cd, Ni	NA	Sr-90, Ra
72-001	NA	Pb	NA	NA
C - Waste and Product Storage Areas				
53-001 (a, b, e, g), 53-005	NA	X[b]	VOCs, PCBs, TPH	NA
53-001(c, d, k)	NA	NA	VOCs	NA
53-008	NA	Pb	NA	X[d]
53-009, 53-010	NA	NA	Psuedocumene, SVOCs, TPH	NA
D - Underground Storage Tanks				
53-006 (a, b, c, d, e)	NA	NA	NA	X[c]
53-006 (f)	NA	X[b]	VOCs, SVOCs	X[d]
E - Septic Systems				
20-004, 20-005	NA	X[b], CN	VOCs, SVOCs	NA
F - Outfalls				
53-012(e)	NA	X[b]	VOCs, TPH, PCBs	NA
G - Surface Impoundments				
53-002	NA	X[b]	VOCs, SVOCs	X[c]

CN: Cyanide
NA: Not applicable
Ba: Barium
Be: Beryllium
Cd: Cadmium
Ni: Nickel
Pb: Lead
PCBs: Polychlorinated biphenyls. Specific PCBs have not been identified. Thus, PCBs will be screened for using EPA Method 8080.
SVOCs: Semivolatile organic compounds. Specific SVOCs have not been identified. Thus, SVOCs will be screened for using EPA Method 8270.
Sr: Strontium
TPH: Total petroleum hydrocarbons
U: Uranium
VOCs: Volatile organic compounds. Specific VOCs have not been identified. Thus, VOCs will be screened for using EPA Method 8240.
X[a]: Composition B (constituents, production impurities, products of environmental degradation): 1,3-Dinitrobenzene (1,3-DNB), 1,3,5-Trinitrobenzene (1,3,5-TNB), 2,4-Dinitrotoluene (2,4-DNT), 2,6-Dinitrotoluene (2,6-DNT), 2-amino-4,6-Dinitrotoluene (2-amino-4,6-DNT), 4-amino-2,6-Dinitrotoluene (4-amino-2,6-DNT), cyclotetramethylenetetranitramine (HMX), cyclotrimethylenetrinitramine (RDX), 2,4,6-Trinitrotoluene (2,4,6-TNT).
X[b]: Specific metal constituents have not been identified. Thus, all metals will be screened for using EPA Methods 6010 and 7470.
X[c]: Accelerator-produced activation products: tritium (H-3), beryllium-7 (Be-7), cadmium-109 (Cd-109), cesium-134 (Cs-134), cobalt-56, -57, -58, -60 (Co-56, -57, -58, -60), manganese-54 (Mg-54), rubidium-83 (Rb-83), scandium-46 (Sc-46), selenium-75 (Se-75).
X[d]: Specific radionuclides have not been identified. Thus, all radionuclides will be screened for using DOE Method 1983, except for plutonium-239, which uses radiochemical separation and alpha spectrometry.

environmental landscape in two ecoregions (western and southeastern) demonstrate that explosive constituents will reside primarily in the subsurface soil and groundwater (Layton et al. 1987, 16-0035).

4.5.1.1.2 Inorganic Constituents

Inorganic constituents possibly present at OU 1100 may be traced to the burial of metal scrap and gun pieces within landfills (Aggregate A) and to activities at firing sites (Aggregate B), such as initiator development shots (PRS 20-002) and initiator tests (PRS 20-003) in which guns were fired into soil berms or into steel plates set against the cliff face. Inorganic constituents may also be present in waste oils, acidic wastes, and other materials stored at waste and product storage areas (Aggregate C), and in wastes discharged to underground storage tanks (Aggregate D), surface impoundments (Aggregate G), and septic systems (Aggregate E). In addition, trace quantities of inorganic constituents may also have been released to the environment in outfalls (Aggregate F).

The constituents that may be present at OU 1100 are listed below, with a summary of the important factors affecting their mobility. In general, because soil conditions at OU 1100 are expected to be those associated with low mobility, such constituents should be found in soil near the point of release.

Cyanide. Cyanide may be present in the soil as hydrogen cyanide, soluble alkali metal salts, or as immobile metallocyanide complexes. The fate of cyanide in soils and/or sediments is pH-dependent. Although adsorption is probably insignificant compared with volatilization, soluble metal cyanide in solution may adsorb to suspended solids and sediments. As with other metal compounds, the adsorption of metal cyanides increases with increasing amounts of iron oxide, clay, and organic material. Unlike other metal compounds, metal cyanide is not more mobile in an acidic environment; rather, its adsorption increases as acidity increases (Syracuse Research Corporation 1992, 1054).

Barium. The primary factors influencing barium mobility are the cation-exchange capacity (CEC) and the calcium carbonate ($CaCO_3$) content of the soil (Clement International Corporation 1990, 0874). In soils with high CEC (e.g., finely textured mineral soils [clays] or soils with a high organic matter content), the mobility of barium is limited by adsorption. In soils having a high $CaCO_3$ content, barium mobility is limited by the formation and subsequent precipitation of barium carbonate ($BaCO_3$). Thus, in soils with a high CEC or calcium carbonate content, barium may be expected to be found near the soil surface.

Beryllium. Beryllium is expected to have limited mobility in most soil types. Beryllium tightly adsorbs to soils by displacing divalent cations that share common sorption sites (Syracuse Research Corporation 1992, 0872). It is also geochemically similar to aluminum and may be expected to adsorb onto clay surfaces at low pHs. Thus, in most soils, beryllium may be expected to be near the surface.

Cadmium. Cadmium is more mobile in the environment than most other heavy metals. The most important factors affecting cadmium mobility in the soil environment are CEC; content of organic matter, oxides, oxygen, and carbonate and clay minerals; and pH (Life Systems, Inc., 1992, 1053). In general, cadmium will be more mobile in acidic soils with a low CEC and little organic matter and/or carbonate and clay minerals.

Lead. The mobility of lead in soils is governed by the amount of lead, the soil pH, the soil organic matter content, the presence of inorganic colloids and iron oxides, and ion-exchange characteristics (Clement International Corporation 1993, 1055).

Nickel. Nickel is strongly adsorbed to soil. Soil pH was found to be the most important factor affecting sorbed and nonexchangeable nickel. In alkaline soils, adsorption, which limits nickel's availability and mobility in soils, may be irreversible (Syracuse Research Corporation 1992, 1096).

Silver. Silver used in photographic processing operations is released as silver thiosulfate, which is highly mobile in the soil environment and is extremely stable and mobile under neutral or alkaline conditions (Kasunic et al. 1985, 0134).

4.5.1.1.3 Organic Constituents

At OU 1100, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) may have been released to the environment if leaks or spills occurred from waste and product storage areas (Aggregate C), underground storage tanks (Aggregate D), surface impoundments (Aggregate G), or septic systems (Aggregate E). The mobility of these constituents depends principally on vapor pressure, water solubility, and K_{OC} value (ability to bind with organic matter): mobility increases as vapor pressure and solubility increase and as K_{OC} decreases.

Halogenated and nonhalogenated VOCs have relatively high vapor pressures. For those that have low water solubility, volatilization (from solution, soils, and/or sediments) will be a significant transport mechanism, whereas for those having high water solubility, leaching will be the more significant transport mechanism.

The K_{OC} value of a constituent may mitigate its tendency to leach to lower soil horizons. Thus, volatile organic compounds having a high K_{OC} value will tend to remain in the soils or sediments.

SVOCs have lower vapor pressures than VOCs. Because of this, even when water solubility is low (as is the case with most of the SVOCs potentially present at OU 1100, which consist of polychlorinated biphenyls [PCBs] or petroleum hydrocarbons) volatilization is not a significant transport mechanism. These compounds are also characterized by high K_{OC}, and they are thus expected to have low mobility. Solvents released to the environment may act as carriers for these constituents, increasing their mobility.

4.5.1.2 Radionuclides

The radioactive contaminants of concern potentially present at OU 1100 (see Table 4-4) fall into two general categories. The first consists of materials involved in tests at TA-20 (PRSs 20-001, 20-002, and 20-003) and includes polonium-210, lanthanum-140, depleted uranium (uranium-238), and strontium-90. Of these, polonium-210 and lanthanum-140 have half-lives of less than one year. The

TABLE 4-4

DECAY CHARACTERISTICS OF RADIOACTIVE POTENTIAL CONTAMINANTS OF CONCERN AT OU 1100

Radionuclide	Half-Life	Decay Product	Half-Life
Beryllium-7	53.28 days	Lithium	Stable
Cadmium-109	453 days	Silver-109	Stable
Cesium-134	2.062 years	Barium-134	Stable
Cobalt-56	78.5 days	Iron-56	Stable
Cobalt-57	271 days	Iron-57	Stable
Cobalt-58	70.8 days	Iron-58	Stable
Cobalt-60	5.27 years	Nickel-60	Stable
Lanthanum-140	40.2 hrs	Cerium-140	Stable
Manganese-54	312.5 days	Chromium-60	Stable
Polonium-210	138.38 days	Lead-206	Stable
Rubidium-83	86.2 days	Krypton-83	Stable
Scandium-46	83.8 days	Titanium-46	Stable
Selenium-75	120 days	Arsenic-75	Stable
Silver-110m	252 days	Cadmium-110	Stable
Sodium-22	2.601 years	Neon-22	Stable
Strontium-90	29 years	Yttrium-90[a]	64 hours
Tritium	12.33 years	Helium-3	Stable
Uranium-238	4.468 x 10^9 years	Thorium-234[b]	24.1 days
Yttrium-88	106.6 days	Strontium-88	Stable
Zinc-65	243.8 days	Copper-65	Stable
Zirconium-88	83.4 days	Yttrium-88	106.6 days

a. Yttrium-90 decays after 64 hours to zirconium-90, which is stable.
b. The thorium-234 decay series is presented in tabular format as follows:

Radionuclide	*Half-Life*	*Decay Product*
Thorium-234	*24.1 days*	*Protoactinium-234*
Protoactinium-234	*6.70 hours*	*Uranium-234*
Uranium-234	*2.44 x 10^5 years*	*Thorium-230*
Thorium-230	*7.7 x 10^4 years*	*Radium-226*
Radium-226	*1,600 years*	*Radon-222*
Radon-222	*3.824 days*	*Polonium-218*
Polonium-218	*3.05 minutes*	*Lead-214*
Lead-214	*26.8 minutes*	*Bismuth-214*
Bismuth-214	*19.8 minutes*	*Polonium-214*
Polonium-214	*163.7 micro-seconds*	*Lead-210*
Lead-210	*22.3 years*	*Bismuth-210*
Bismuth-210	*3.5 x 10^6 years, 5.01 days*	*Thallium-206, Polonium-210*
Thallium-206, Polonium-210	*4.2 minutes, 138.38 days*	*Lead-206 (stable)*

second category includes activation products from the linear accelerator at TA-53 (PRSs 53-002, 53-006, and 53-008). As shown in Table 4-4, most of the activation products have relatively short half-lives (less than one year).

The amount of a radionuclide that may be onsite depends on the original concentration released, the half-life, and the parent-daughter relationships. It is unlikely that radionuclides having half-lives of less than one year are present unless they were released recently or are daughters of long-lived parents. Those radionuclides having longer half-lives (e.g., uranium-238, strontium-90, cesium-134, cobalt-60, sodium-22, and tritium) are likely to be present.

The ingrowth of radioactive decay products should also be considered. As shown in Table 4-4, all of the decay products, with the exception of strontium-90, uranium-238, and zirconium-88, are stable. However, yttrium-90, the decay product of strontium-90, decays after 64 hours to zirconium-90, which is stable. Yttrium-88, the decay product of zirconium-88, decays after approximately 107 days to strontium-88, which is stable. Thus, the only radioactive decay product of potential concern is thorium-234, the decay product of uranium-238.

4.5.2 Potential Environmental Pathways

Chemical or radionuclide contaminants of potential concern at OU 1100 may have been released to the environment through burial of wastes in landfills, tests at firing sites, spills or leaks at storage areas, and discharges or leaks from liquid waste management systems. These constituents could have migrated to other locations via surface, subsurface, or atmospheric transport. The relative importance of each of these pathways and detailed site-specific information on the mechanisms associated with each form the basis for the sampling strategies presented in Section 4.7 (and, by extension, the sampling plans presented in Chapter 5).

4.5.2.1 Surface Transport

The PRSs in OU 1100 are located either on Mesita de los Alamos or in Sandia Canyon. Active erosional processes on the Pajarito Plateau are addressed in Section 2.6.1.6 of the IWP (LANL 1993, 1017). At OU 1100, episodic periods of snowmelt and storm-water runoff can produce significant erosion, sediment transport, and deposition. Sediment accumulations >3 ft resulting from a single event have been measured in the active channel in Potrillo Canyon; however, no sediment budget analysis has been performed on the Pajarito Plateau.

Both surface runoff and erosion are generally accelerated over areas where the natural soil surface has been disturbed, such as roads, firing site pads, burial pits, and open landfills (Graf 1975, 13-0009; Nyhan and Lane 1986, 0159). In addition, overland flow velocities (discharges) increase proportionally to the square root of the angle of the slope, and as velocities increase, greater amounts of sediment—and any associated contaminants—will be transported away from their original disposal site. On gentle slopes, greater *vertical* migration of contaminants will occur because of the increased infiltration of surface water.

There are wide variations in slope within OU 1100. On the mesa tops and canyon bottoms, where slopes are generally less than 2%, water flow is expected to be gradual and to preferentially deposit sediment and contaminants in small catchment basins where the terrain levels out into a drainage. The canyon walls range in slope from 30 to 90%. Drainages down these walls may carry significant quantities of sediment and contaminants to the canyon bottom.

The canyon rims erode primarily by undercutting and subsequent breaking away of blocks of volcanic tuff along natural joints and fractures. On north-facing canyon slopes, the vegetation—fairly mature ponderosa pine, juniper, and scrub oak in a thin sandy soil—indicates long-term stability of the slope, whereas the steeper, south-facing canyon slopes are characterized by very scant pinon pine, juniper, and scrub oak. Although erosion of these exposed south-facing slopes probably proceeds at a faster rate than that of north-facing slopes, it is unlikely that there has been significant change in the past 50 years. In other words, erosion of these slopes is not a significant contributor to the contaminant concentrations in Sandia Canyon.

Investigations within Los Alamos canyon systems have shown that a significant fraction of transported constituents are particulates moved by surface runoff, whereas a lesser fraction moves as solutes in the water (Nyhan and Hakonson 1976, 16-0038). Several radionuclides, including isotopes of plutonium and uranium, and many organic chemicals adsorb to soil particles. Many of these species preferentially adsorb to the smaller fractions, whose CEC and specific surface area are greater than those of the larger fractions. In Los Alamos area canyons, the <53-µm (silt-to-clay) particles typically have total plutonium concentrations 10 times higher than those of the 2- to 23-mm particles (Nyhan and Hakonson 1976, 16-0038). Hydrologic studies indicate that the silt-to-clay fraction is also the most mobile, readily moving with storm-water and snowmelt runoff. On the other hand, the coarser fractions make up the bulk of total soil mass in canyon alluvium. This material has also been demonstrated to be mobile during summer storm events (ESG 1981, 0424).

The Phase I sampling plan considers these surface transport mechanisms at OU 1100 and their potential for causing secondary contamination of channel sediments. Under current and potential future land-use scenarios, receptors could be exposed to these sediments through ingestion, dermal contact, and/or inhalation.

4.5.2.2 Atmospheric Transport

None of the PRSs within OU 1100 consist of or contain air-emission facilities (stacks, vents, etc.). Any atmospheric transport of surface contamination at this operable unit, therefore, would be mainly by resuspension of previously deposited surface contamination and its conveyance to downwind locations. However, few of the PRSs are expected to have contaminated surface soil that could be eroded by the wind. Because many are subsurface (landfills, septic tanks, underground storage tanks), associated soils would be exposed to wind erosion only if the site were disturbed by excavation. A number of the surface PRSs (e.g., waste storage areas) are located on paved areas with little potential for wind erosion. In others, vegetation covers the soil surface, significantly reducing the potential for resuspension/transport of constituents.

4.5.2.3 Subsurface Transport in the Vadose Zone

The water table in the alluvial groundwater body in Sandia Canyon, if similar to those of adjacent canyons, varies seasonally in depth, depending on the amount of percolation of water from precipitation and from the stream channels. Any constituents present in the vadose zone between the land surface and the groundwater body could be moved downward by such percolation and could eventually reach the water table. (Because most of the slopes are gentle and the alluvial material is highly permeable, percolating water will tend to move vertically downward rather than laterally within the vadose zone.) The extent of such movement depends on the solubility of the constituents, their ability to sorb on soil particles, the mobility of unbound soil particles, and the flux rate of percolating water. Subsurface constituent sources within the zone of annual water table fluctuation could be releasing constituents directly to either the saturated zone or the vadose zone.

The depth to the main aquifer beneath Mesita de los Alamos (TA-53) is approximately 1,000 ft. As with the Sandia Canyon sites, constituents present in the vadose zone could be moved downward by infiltrating precipitation. In general, however, there is much less potential for migration to groundwater from the TA-53 sites because of the greater depth to groundwater and the lower hydraulic conductivity of the underlying tuff. For this reason, during Phase I investigations at TA-53, subsurface transport in the vadose zone will not be considered a pathway of concern except for one of the PRS aggregates. The one PRS aggregate at which subsurface contamination is known to exist is Aggregate G (surface impoundments). For this aggregate, infiltration of precipitation does not appear to be the only mechanism for transport through the vadose zone. Rather, wastewater discharges and/or surface impoundment leaks are probably the primary mechanism. The extent of migration caused by these mechanisms will depend on the same four factors mentioned above—in this case, the rate-of-flow factor being that of the discharge or leakage.

4.5.2.4 Subsurface Transport in the Saturated Zone

The water table in the saturated alluvium reflects the slope of the land surface, which is nearly flat. The velocity of this groundwater has not been determined; it could vary seasonally in response to changes in the configuration of the water table. Any soluble constituents that are not reactive with the alluvium (such as nitrates or chlorides) would move at approximately the same rate as the groundwater. Most materials that are sorbed (such as the majority of radioactive elements) will move at a slower rate; the exception is constituents sorbed to particles of the <53-µm soil-size fraction, which will continue to be carried along by the groundwater flow (ESG 1981, 0424). Further, constituents sorbed to particles of the <2-µm size fraction can migrate through the saturated zone at rates similar to those of nonretarded constituent species (Penrose, et al. 1990, 0174). Concentrations of all constituents dissolved in groundwater will decrease with distance from their sources as they become dispersed, diluted, or (in the case of reactive constituents) sorbed.

4.5.3 Potential Impacts

Because OU 1100 is currently used for Laboratory operations, onsite workers represent the only potentially exposed population at the present time. To identify the presence of PCOCs at the site, the screening assessment sampling plans compare soil or sediment samples with background concentrations and SALs. (As mentioned in Section 4.2, SALs are based on a conservative, residential exposure scenario.) If soils are found to be contaminated (concentrations of PCOCs are above background and SALs) in Phase I or Phase II, the potential for human exposure to these contaminants will generally be quantified in a baseline risk assessment. (Alternatively, a VCA may be undertaken using appropriate cleanup levels, which will be determined by site-specific exposure assumptions.) Human exposure is estimated through a model of the reasonably maximum exposed individual, defined using assumptions of current and future land use (EPA 1989, 0305).

Refer to Section 4.3 of the 1993 IWP (LANL 1993, 1017) for ER programmatic guidance on probable land-use scenarios. Depending on site-specific parameters (e.g., types of contaminants present, migration potential), different worst-case exposure scenarios may apply. For PRSs where two scenarios may be applicable, the baseline risk assessment will include two analyses to determine the more conservative scenario. For any baseline risk assessment, the 95% upper-confidence limit on arithmetic average concentration of PCOCs in exposure areas, either surface or subsurface soils, is sufficient to determine receptor exposures.

If a baseline risk assessment is deemed necessary, the appropriate land-use scenario will be determined and used as input. For the foreseeable future, land use at OU 1100 will probably be the same as at the present time. Under this scenario of continued Laboratory operations, onsite workers (individuals who work on or near the site) and construction/maintenance workers (individuals who would be exposed to surface and subsurface soils through excavation) are estimated to be the most likely reasonably maximum exposed individuals. Onsite workers are assumed to be exposed routinely to contaminated surface media. For this reason, baseline risk assessments done for PRSs having only surface contamination will use the onsite worker scenario for evaluations of both current and future risks. These assumptions are based on the expected extent of contamination and will be refined at the time of the risk assessment.

For PRSs in OU 1100 that have both surface and subsurface contamination, the construction/maintenance worker scenario is considered to be the most conservative. These PRSs will be evaluated for future risks by baseline risk assessment using that scenario (current risks for construction/maintenance workers are evaluated by means of the Environment, Safety, and Health [ES&H] Questionnaire Program [LANL-AR-1-10], which requires approval for any groundbreaking or soil-disturbing projects). The ES&H committee determines whether federal, state, or local regulations apply to the project (including Occupational Safety and Health Administration [OSHA] regulations) and assesses compliance.

Onsite workers may become exposed to contaminants of concern through inhalation of dust and volatile compounds, incidental ingestion of soil and dust, dermal contact, and/or whole-body radiation. Construction/maintenance workers may be exposed through inhalation of fugitive dust or volatile compounds, incidental ingestion of contaminated soils, direct dermal contact with contaminated soils, and/or whole-body radiation (see Table 4-2).

4.6 Potential Remediation Alternatives

This section presents all remediation alternatives (other than the VCAs described in Section 4.3) that are under consideration for the PRSs in OU 1100. The Phase I investigations will guide the decisions concerning remediation alternatives for some PRSs, and will guide the design of Phase II investigations or CMSs for others.

4.6.1 No Further Action

The OU 1100 PRSs proposed for NFA on the basis of archival information are listed in Table 1-4 and discussed in Chapter 6. Appendix I of the IWP (LANL 1993, 1017) describes the procedure for using archival information to determine whether a PRS meets the criteria for NFA (the PRS never existed; is closed; will be addressed by a program other than the ER Program; or presents no significant health, safety, or other type of risk).

Consistent with the decision logic presented in Figure 4-1, additional PRSs may be proposed for NFA following Phase I or Phase II investigations. The criteria to be used for these sites are as follows:

Criterion 1. There is no evidence of any unmitigated contaminant release from the PRS.

Criterion 2. It has been established (on the basis of Phase I data or other reliable data) that the concentrations of the PCOCs are below background levels and SALs. This conclusion has taken into account the combined effects of multiple contaminants as well as ALARA requirements for radioactive contaminants.

Criterion 3. A baseline risk assessment has shown that the risk due to exposure to all contaminants by all pathways is less than 10^{-6} for carcinogens, and the hazard index is less than 1 for noncarcinogens. ALARA requirements for radioactive contaminants have also been considered.

4.6.2 Soil Removal and Treatment and/or Disposal

This alternative applies to areas of limited soil contamination, such as firing sites or surface drainages having contaminated sediments. It would involve excavation of soils having contamination that exceeds the site-specific cleanup levels established during the CMS. Depending on the nature of contamination and the type of disposal facility used, the removed soil may be either treated and disposed of or disposed of directly without treatment.

Soils requiring treatment would be treated in accordance with the type of contamination. In general, any treatment should reduce the volume, toxicity, and/or mobility of a waste. For wastes to be disposed of in a RCRA land disposal unit, the treatment must also meet RCRA land-disposal-restriction (LDR) standards.

4.6.3 Excavation

This alternative could apply to areas where wastes have been buried. Such buried waste materials or contaminated subsurface structures (e.g., septic tanks) and any surrounding contaminated soil would be excavated, containerized, and treated or disposed of as appropriate. Treatment and disposal would be as described in Section 4.6.2.

4.6.4 Containment

This alternative applies to contaminated soil or buried waste areas for which infiltration, surface runoff, and/or resuspension have been identified as migration pathways. Various technologies exist for containing contaminants and thereby preventing further migration. The specific technology chosen will depend on the identified contaminant migration pathway.

Capping can be used to prevent migration by infiltration (using impervious caps of compacted soils, concrete, asphalt, or synthetic membranes) or resuspension (using caps of coarse soils or vegetation).

Surface water diversion techniques (grading, terraces, ditches, or berms) can be used to prevent migration by surface transport.

In general, containment is not a preferred remediation alternative because it does not reduce contaminant toxicity and volume, and its long-term effectiveness is limited. Containment may be appropriate for PRSs at OU 1100 where the contaminants of concern are radionuclides having short half-lives (containment could retard contaminant migration until the radionuclides had decayed to concentrations below levels of concern).

4.7 Sampling Strategies for PRS Aggregates

4.7.1 Statistical Basis

The principal goal of reconnaissance investigations, such as those performed in Phase I, is to detect contamination present over a substantial portion of a relatively small area. Whether the area should be investigated further is decided on the basis of the highest concentration of a particular constituent of concern measured in the collected samples. (A single concentration above background levels and SALs will be taken as sufficient reason for further investigation, perhaps leading to a Phase II sampling program.) For some situations, it is reasonable to assume that the presence of constituent concentrations above background and SALs is equally likely at any location within the area. Examples include judgmental sampling in a stream channel, within a drain field, or beneath a tank. The probability that a particular sample will contain constituents above prespecified background levels and SALs can be determined using the following equation:

$$P = 1 - (1-f)^N$$

where	P=	probability that a particular sample concentration > a prespecified concentration
	f=	fraction of area contaminated above a prespecified concentration
	N=	number of samples required

(Field duplicates should not be counted in applying this equation, which assumes N independent observations.)

Table 4-5, which is based on this equation, shows the number of samples required for various combinations of P and f (LANL 1993, 1017). For example, five sampling locations can provide at least a 95% probability of detecting contamination that affects at least half of the area, but a lower probability (75%) of detecting contamination that affects only 30% of the area. In determining values for P and f for individual PRSs, the prespecified concentration in all cases is any concentration that exceeds background levels and SALs. Professional judgment was then used to estimate the other factors: for P, the consequences of failing to detect contamination if it is actually present (considering the toxicity of the PCOCs and the expected extent of contamination); and for f, the expected distribution of PCOCs in the sampled media (considering the nature of historical releases, the likelihood of pinpointing their locations, the effect of site disturbances after the release, and the potential for transport and migration of PCOCs).

4.7.2 Phase I Sampling Strategies

4.7.2.1 Sampling Strategy for Landfills (Aggregate A)

No data are available for any of the OU 1100 landfills that indicate the presence of contaminants of concern. (Recall that a contaminant of concern is defined as a constituent present at concentrations above background and SALs.) Although it is possible that metal scrap contaminated with explosives or radionuclides used in the initiator tests could have been disposed of in these areas, it is also possible that the disposal sites were excavated and the scrap removed during 1948 cleanup activities (see Chapter 5, Section 5.1).

For these reasons, Phase I investigations of the landfills (Aggregate A) will initially consist of geophysical surveys to locate these sites, if possible, and to ascertain the presence of buried materials. If these surveys show that buried materials are present, a sampling plan will be devised for Phase II (no sampling or other intrusive activities will be done in Phase I in this case, because of the potential for encountering buried explosives).

If, on the other hand, the geophysical surveys do not reveal the presence of buried wastes, the survey data will be studied for evidence of former disposal

TABLE 4-5

SAMPLE SIZES FOR RECONNAISSANCE SAMPLING

Probability Detection	Fraction of Site Affected									
	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05
0.51	2	2	2	2	2	4	4	5	7	14
0.54	2	2	2	2	3	4	4	5	8	16
0.57	2	2	2	2	3	4	4	6	9	17
0.60	2	2	2	3	3	5	5	6	9	18
0.63	2	2	2	3	3	5	5	7	10	20
0.66	2	2	3	3	4	5	5	7	11	22
0.69	2	2	3	3	4	6	6	8	12	23
0.72	2	3	3	3	4	6	6	8	13	25
0.75	2	3	3	4	4	7	7	9	14	28
0.78	3	3	3	4	5	7	7	10	15	30
0.81	3	3	4	4	5	8	8	11	16	33
0.84	3	4	4	5	6	9	9	12	18	36
0.87	3	4	4	5	6	10	10	13	20	40
0.90	4	4	5	6	7	11	11	15	22	45
0.93	4	5	6	7	8	12	12	17	26	52
0.96	5	6	7	8	10	15	15	20	31	63
0.99	7	8	10	11	13	21	21	29	44	90

areas that have been excavated. If none are found, NFA will be proposed. If some such areas are located, Phase I will include soil sampling at those areas; samples will be analyzed and compared with background levels and SALs to determine whether contaminants of concern are present.

In the event that no contaminants of concern are found, nor any evidence of other risks (such as multiconstituent), NFA will be proposed (see Section 4.1.4 of the IWP [LANL 1993, 1017]). In the event that constituent concentrations in the soils are found to be above background and SALs, either a VCA (Section 4.3) will be done or, if it proves more cost-effective, further data will be collected for a baseline risk assessment of the landfills. (The Phase I report will set out the proposed Phase II investigation, presenting the rationale for either a VCA or a baseline risk assessment.)

4.7.2.2 Sampling Strategy for Firing Sites (Aggregate B)

All the PRSs in this aggregate potentially contain surface contamination from explosive testing of devices (PRS 20-002) or from projectiles (PRSs 20-003 and 72-001). These PRSs and their downstream environs will be sampled to determine whether any PCOCs are present in concentrations exceeding background levels and SALs, either at the sites themselves or in areas where sediments have been deposited by surface runoff from the sites.

The course of action following sample analysis will be the same as that described for Aggregate A.

4.7.2.3 Sampling Strategy for Waste and Product Storage Areas (Aggregate C)

The waste accumulation and product storage areas proposed for Phase I investigations consist of outdoor satellite storage areas [PRSs 53-001(a, b, e, g)], a former waste disposal pit (53-005), a boneyard (53-008), and an oil storage area (53-010). The remaining PRSs within this aggregate are proposed for NFA or deferred investigation (NFA for those at which no evidence of a release was found; deferred investigation for active sites at which sampling would disturb structures and/or ongoing operations).

Those storage areas that will be investigated during Phase I will undergo visual inspection as well as the soil sampling needed for a screening assessment. Samples will be collected at locations of suspected releases and at downstream sediment accumulation areas. The samples will be analyzed, and the analytical results used, in the same way as described for Aggregate A.

4.7.2.4 Sampling Strategy for Underground Storage Tanks (Aggregate D)

Five of the six underground storage tanks in Aggregate D (PRSs 53-006 [b,c,d,e, and f]) are actively receiving wastes, either waste water containing activation products from the linear accelerator and target areas at TA-53 (-006[b-e]) or wastes from laboratory sinks at TA-53-1 (-006[f]). The sixth tank, PRS 53-006(a), reportedly received spent ion-exchange resins contaminated with activation products. Although not actively receiving wastes, this tank probably still contains stored wastes. Because of the currently-in-use status (either receiving or storing wastes) of these tank systems, because they pose no current risk, and because investigations could not be conducted without disturbing structures and ongoing operations, we propose deferred investigation for all the PRSs in this aggregate.

4.7.2.5 Sampling Strategy for Septic Systems (Aggregate E)

This aggregate consists of two active and two inactive septic systems. None of the available data for these systems indicate the presence of contaminants of concern, either in the septic tanks or in the associated drain fields. The active systems (PRSs 53-003 and 72-003[a]) have been recommended for NFA because there is no evidence that these systems have received anything but sanitary wastes.

The older, inactive septic systems (PRSs 20-004 and 20-005) may have received occasional releases of hazardous constituents in the past, an issue that is addressed in Chapter 5. We do not anticipate that these systems will contain concentrations of hazardous constituents above background levels and media-specific SALs, however; for this reason, the Phase I investigations will consist of screening assessments to establish the presence or absence of contaminants of concern.

All components of the systems will be sampled: the tank (if present), the drain field, associated soils, and outfalls (if present). The locations of these components will be established through engineering surveys and geophysical surveys. Samples of subsurface soils will be collected from trenches. The samples will be analyzed, and the analytical results used, in the same way as described for Aggregate A.

4.7.2.6 Sampling Strategy for Outfalls (Aggregate F)

This aggregate consists of eight outfalls permitted under the Laboratory's National Pollutant Discharge Elimination System (NPDES) permits. All but one have been proposed for NFA because there is no evidence of release of hazardous constituents. The remaining outfall (PRS 53-011[e]) may have received hazardous constituents, but because these—if present—are not expected to exceed SALs or background levels, we propose reconnaissance sampling for this PRS during Phase I.

The sampling locations will be selected to provide data on the presence or absence of PCOCs in soils and sediments downstream from this outfall. Samples will be collected from sediment catchments on the mesa, between the outfall and the edge of the canyon, where any contaminated sediments would be expected to accumulate. The possible presence of contaminants of concern in the canyon bottom will be investigated as part of the Canyons Operable Unit (OU 1049).

4.7.2.7 Sampling Strategy for Surface Impoundments (Aggregate G)

This aggregate consists of three surface impoundments that are currently regulated under RCRA as interim-status, mixed-waste surface impoundments. Two of the impoundments are currently undergoing RCRA closure, and the third is expected to undergo closure in the near future. Because closure operations will include characterization of potential contamination of these PRSs, RFI activities will be deferred until completion of closure.

4.7.3 Phase II Investigations

For OU 1100 PRSs where no contaminants of concern are found during Phase I investigations, NFA will be recommended—except for those for which groundwater sampling is indicated (see below). A Phase II investigation will be required for any PRS where contaminants of concern are found, unless the Phase I data are sufficient for baseline risk assessment or for implementing a VCA.

For sites requiring Phase II data for a baseline risk assessment, the Phase II investigation must provide data adequate for estimating exposure concentrations of the contaminants of concern. For sites slated for VCA, the Phase II investigation must provide data adequate for establishing the extent to which contamination exceeds cleanup levels.

The presence of any potential contaminants—even below SALs—makes the possibility of contamination of underlying shallow groundwater (if such water is present) a concern. The SALs for soil are based on exposure to surface and shallow subsurface soil and do not consider migration of contaminants from soil to groundwater. SALs for soil that are based on migration of contaminants to groundwater can be developed using conservative models for such migration (Vocke 1993, 1073). These SALs will be used for PRSs that are located in canyon bottoms; concentrations of PCOCs that are above background (or above detection limits, in the case of constituents for which the background concentration is zero) will be compared with these SALs to determine whether a Phase II groundwater investigation is necessary.

4.8 Phase I Field Operations

The Phase I sampling plans (described in Chapter 5) will be implemented by means of three principal operations: field surveys, sampling, and field screening. Each will be carried out in compliance with Standard Operating Procedures (SOPs) that have been formally adopted by the ER Program (see *Environmental Restoration Standard Operating Procedures*—LANL 1992, 0688) or are in the process of formal adoption (see Appendix B).

4.8.1 Field Surveys

Field surveys, which help identify sampling locations, include radiological surveys, land surveys, geophysical surveys, and geomorphic surveys.

4.8.1.1 Radiological Surveys

Radiological surveys will be used for PRSs at which radionuclides may be present, to quickly pinpoint areas of potential contamination for biased reconnaissance sampling.

The radiological survey methods to be used will depend on the specific PCOCs expected. At TA-20, the radionuclide most likely to be present is U-238. The presence of U-238 contamination at TA-20 PRSs will be tested for using instruments designed to detect the low-energy gamma radiation emitted by this element (MCA-465/Fidler Instrument System), in accordance with LANL-ER-SOP-10.04. Strontium-90, which may also be present at TA-20, will be tested for using a micro-R meter with a beta window, in accordance with the SOPs contained in Appendix B. At TA-53, the principal radionuclides suspected are beta- and gamma-emitting activation products. Gross beta-gamma contamination will be tested for using a micro-R meter or a Geiger-Mueller detector (depending on the levels of radiation encountered), in accordance with SOPs contained in Appendix B.

4.8.1.2 Land Surveys

Land surveys are used to establish the locations and geographic coordinates of features important to the RFI, such as septic tanks, drainlines, leach fields, outfalls, and PRS boundaries. The locations of features that have been removed or are below the land surface will be established through engineering surveys (based on coordinates determined from review of available drawings, maps, and photographs). Engineering surveys will also be used to establish coordinates for features that have been located in the field but have no existing coordinates. All land surveys will be conducted according to approved Laboratory procedures (LANL 1993, 22-0116).

Technical personnel carrying out land surveys at OU 1100 will also cooperate with the Laboratory Facilities Engineering Division to identify the positions of all subsurface utilities near each PRS (electrical, water, gas, air, telephone, and vacuum lines).

4.8.1.3 Geophysical Surveys

Some of the PRSs in OU 1100 (Aggregates A and E—Landfills and Septic Systems) contain buried metallic objects and/or underground structures whose exact locations are not known and cannot be established by land surveys. The locations of these objects and structures must be known before sampling locations can be decided on. Geophysical survey methods, including electromagnetic induction, magnetometry, and ground-penetrating radar, can be used to detect the presence of near-surface buried metallic materials or of nonmetallic materials whose physical properties are different from those of the surrounding soils. The particular method selected and how it is applied will depend on the expected size and depth of the subsurface object and on the physical characteristics of both the object and the surrounding soils. General procedures for all geophysical surveys are contained in LANL-ER-SOP-03.02 (*General Surface Geophysics*). The specific data requirements for Phase I geophysical surveys at OU 1100 are addressed in the sampling plans for Aggregates A and E (Chapter 5).

4.8.1.4 Geomorphic Surveys

At several PRSs, contaminants may have been transported by surface runoff. Sampling will therefore be focused on sediment catchments likely to have received contaminated runoff. Geomorphic surveys, which are used to identify drainage patterns, channels, and areas of erosion and sediment deposition, will provide data on the basis of which specific sampling locations can be selected. Guidance for conducting geomorphic surveys is contained in LANL-ER-SOP-03.08 (*Geomorphic Characterization*).

4.8.2 Sampling of Soils, Sediments, and Wastes

The Phase I sampling activities for OU 1100 PRSs will include collection of surface and subsurface soil and sediment samples and, possibly, samples of septic tank wastes.

Soil samples will be collected from the locations judged most likely to contain any PCOCs from operations at the PRS, and sediment samples will be collected from catchment areas receiving runoff from the PRS. Any inactive septic tanks located will be investigated, and if liquid and/or sludge are present, these will be sampled.

At some PRSs, trenches will be dug to observe subsurface conditions, locate subsurface structures, and collect subsurface samples (other subsurface samples will be collected from hand-augered boreholes).

The following SOPs will be used for sample collection:

- LANL-ER-SOP-03.10, Trenching and Logging
- LANL-ER-SOP-06.09, Spade and Scoop Method for Collection of Soil Samples
- LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler
- LANL-ER-SOP-06.15, Coliwasa Sampler for Liquids and Slurries
- LANL-ER-SOP-06.24, Sample Collection from Split-Spoon Samplers and Shelby Tube Samplers

Quality control (QC) samples will also be collected, to ensure that the quality objectives specified in the Quality Assurance Project Plan (Annex II) have been met. The type and minimum number of such samples are specified in the generic QAPP (LANL 1991, 0412), as incorporated in Annex II. The proposed numbers of quality control samples for Phase I are presented in Table 4-6.

To enhance our understanding of variability among samples we have increased the number of field duplicate samples from 1 in 20 (as recommended in the QAPP) to 1 in 10. The specific numbers of field duplicates, rinsate blanks, and field blanks that will be collected are tabulated in Chapter 5. (Reagent blanks and trip blanks will be submitted with each shipment in accordance with the QAPP, but are not identified in the Chapter 5 sampling plans.)

TABLE 4-6

RECOMMENDED LEVEL OF QUALITY CONTROL SAMPLES FOR FIELD SAMPLING

Sample Type	Applicable Matrix	Sample Frequency
Field duplicate	Soil	1 per 10 samples
Rinsate blank	Soil	1 per 20 samples
Matrix spike	Soil	1 per 20 samples
Matrix spike duplicate	Soil	1 per 20 samples

4.8.3 Field Screening

Field screening is measurement, in the field, of gross levels of PCOCs in samples. During Phase I, samples will be field-screened for radioactivity, HE, and organic vapors. This information will be used to ensure compliance with health and safety requirements for field activities. (Refer to the Health and Safety Plan [Annex III] for specific details on field screening requirements.) Field screening results may also be used to make decisions in the field concerning sample analysis. For example, if the field screening results indicate higher-than-expected levels of PCOCs, the number and/or types of laboratory analyses may be modified.

4.8.3.1 Radiological Screening

All field samples will be screened onsite for gross alpha and gross beta-gamma radioactivity: gross alpha by means of a hand-held alpha scintillation detector and a rate meter, gross beta-gamma by means of a hand-held Geiger-Mueller detector (or other appropriate detector) and a rate meter. Procedures for radiological screening are included in Appendix B.

4.8.3.2 High-Explosives Screening

All samples collected from the TA-20 landfills and firing sites could contain HE, and will be field-screened using the Los Alamos M-1 Explosives Field Test Kit. This screening will provide a semi-quantitative measurement of HE concentrations.

4.8.3.3 Organic-Vapor Screening

Some of the OU 1100 PRSs are suspected of being contaminated with VOCs. All samples from those PRSs will be field-screened using an organic-vapor analyzer, with either a photoionization detector or a flame ionization detector, to obtain an indication of gross VOC levels.

4.9 Analytical Procedures

To ascertain the concentrations of PCOCs, samples collected during Phase I will be analyzed in a mobile laboratory and in analytical laboratories.

4.9.1 Mobile Laboratory

The ER Program is preparing mobile laboratories where environmental samples can be analyzed for radiological and nonradiological constituents. To date, mobile laboratories have been used mainly to screen radiological samples before shipment to an offsite analytical laboratory. In Table 4-7, stipulated mobile laboratory detection limits for various constituents are compared with SALs.

To conclusively prove the presence or absence of PCOCs, laboratory detection limits should be at least 1/10 of the SALs. As shown in Table 4-7, the detection limits for some constituents are not adequate for confirming the presence or absence of contaminant-level concentrations. In addition, the mobile laboratories have not been fully qualified to provide data equivalent to that from an offsite analytical laboratory. (The Laboratory is seeking such qualification.) Thus, at present, any proposals for NFA must be supported by data from an offsite analytical laboratory.

4.9.2 Analytical Laboratory

The results of analysis of samples in offsite analytical laboratories will be compared with SALs and background levels. The general classes of constituents listed in Table 4-3 were evaluated to identify the specific chemical and radiological constituents that are PCOCs at OU 1100. Table 4-8 gives SALs and background concentrations for these constituents, which include VOCs and SVOCs (chemicals known to have been used at PRSs and RCRA hazardous constituents in wastes known or suspected to have been present at PRSs); explosives known or suspected to have been used at PRSs, as well as their degradation products; metals known to have been used; and radionuclides known to have been used and identified by previous sampling.

Laboratory analytical methods will be selected that are capable of determining whether PCOCs are present at levels above SALs and background. If a method having a quantitation limit below the SAL and/or background level for a particular PCOC is not available, the method having the lowest quantitation limit will be used. In such a case, comparison with the SAL and background level cannot be a basis for screening assessment decisions; a baseline risk assessment will be needed.

4.10 Mitigation of Impacts on Biological and Cultural Resources

The biological and cultural resource surveys (Section 3.3) identified critical species and sensitive areas in OU 1100. Measures will be taken to minimize the effects of RFI activities on these species and areas.

TABLE 4-7

COMPARISON OF MOBILE LABORATORY DETECTION LIMITS WITH SCREENING ACTION LEVELS

Potential Contaminant	Mobile Laboratory Detection Limits (soils)		Screening Action Levels (soils)
Inorganics	XRF[a] (ppm)		(ppm)
Arsenic	0.4		0.4
Barium	10		5,600
Beryllium	ND[b]		0.16
Cadmium	2		80
Chromium	8		80,000; 400[c]
Copper	6		3,000
Cyanide	ND[b]		1,600
Lead	3		500
Mercury	30		24
Nickel	13		1,600
Silver	1		400
Uranium	10		240
Volatiles	GC/HALL/PID[d] (ppb)		(ppb)
Acetone	50		8,000,000
Benzene	10		670
Carbon tetrachloride	10		210
Tetrachloroethane	10		5,900
Toluene	10		890,000
Trichloroethene	10		3,200
Vinyl chloride	10		13
Xylenes	10		160,000,000
Semivolatiles	(ppb)		(ppb)
Polychlorinated biphenyls	60		90
Total petroleum hydrocarbons	500		
Radionuclides	Gross a/b (pCi/g)	Gross g (pCi/g)	(pCi/g)
Beryllium-7		3.6	ND[b]
Cadmium-109		2.5	ND[b]
Cobalt-56, -57, -58, -60		0.4-0.5	40; 0.9[e]
Cesium-137	4		4
Manganese-54		0.6	3.4
Plutonium-238	55		27
Plutonium-239	55		24
Rubidium-83		0.9	ND[b]
Scandium-46		2.0	ND[b]
Selenium-75		0.6	ND[b]
Strontium-90	55		8.9
Thorium-232	55		0.88
Uranium-233	55		86
Uranium-235	55		18
Uranium-238	55		59

a. X-ray fluorescence (XRF).
b. No detection limit or SAL established.
c. SAL is 80,000 for chromium III and 400 for chromium VI.
d. Gas chromatography/Hall electrolytic conductivity detector/photoionization detector.
e. SAL is 40 for cobalt-57, 0.90 for cobalt-60. SALs not established for cobalt-56 or cobalt-58.

TABLE 4-8

SCREENING ACTION LEVELS AND BACKGROUND CONCENTRATIONS FOR POTENTIAL CONTAMINANTS OF CONCERN FOR OU 1100

Constituent	SOIL			
	CAS[a] No.	SAL[b] (mg/kg)	Background in Soil[c] (mg/kg)	Background in Tuff[c] (mg/kg)
Inorganics				
Barium	7440-39-3	5,600	125 - 829	<48 - 414
Beryllium	7440-41-7	0.16	1.0 - 4.4	0.4 - 7.5
Cadmium	7440-43-9	80	<1.0 - 1.7	<1.0
Chromium[d]	7440-47-32	400	<1.6 - 71.1	<0.9 - 49.8
Copper	7440-50-8	3,000	<159 - <457	<261 - <444
Lead	7439-92-1	500	<14 - 56	<14 - 57
Nickel	7439-92-1	1,600	1.6 - 19[e]	
Silver	7440-22-4	400	<1.6 - <7.5	<1.7 - <2.9
Uranium	7440-61-1		1.5 - 6.7	2.9 - 10.1
Cyanide	57-12-5	1,600		
Explosives				
1,3-Dinitrobenzene	99-65-0	8		
1,3,5-Trinitrobenzene	99-35-4	4		
2,4-Dinitrotoluene	121-14-2	1		
2,6-Dinitrotoluene	606-20-2	1		
2-Amino-4,6-DNT				
4-Amino-2,6-DNT				
HMX	2691-41-0	4,000		
RDX	121-82-4	64		
2,4,6-TNT	118-96-7	40		
PETN	78-11-5	1,600		
Tetryl	479-45-8	800		
Radionuclides				
Beryllium-7				
Cadmium-109				
Cesium-134		1.90		
Cobalt-56				
Cobalt-57		40.0		
Cobalt-58				
Cobalt-60		0.9		
Manganese-54		3.40		
Polonium-210				
Radium-226		0.73		
Radium-228		1.6		
Rubidium-83				
Scandium-46				
Selenium-75				
Silver-110m				
Sodium-22		1.30		
Strontium-90		8.90		
Tritium		1.5×10^7		
Uranium-238		59.0		
Yttrium-88				

TABLE 4-8

SCREENING ACTION LEVELS AND BACKGROUND CONCENTRATIONS FOR POTENTIAL CONTAMINANTS OF CONCERN FOR OU 1100 (concluded)

	SOIL			
Constituent	CAS[a] No.	SAL[b] (mg/kg)	Background in Soil[c] (mg/kg)	Background in Tuff[c] (mg/kg)
Volatile Organics				
Acetone	67-64-1	8,000		
Benzene	71-43-2	0.67		
n-Butyl alcohol	71-36-3			
Carbon disulfide	75-15-0	7.4		
Carbon tetrachloride	56-23-5	0.21		
Chlorobenzene	108-90-7	67		
Cyclohexanone	108-94-1			
1,2-Dichlorobenzene	95-50-1			
Ethyl acetate	141-78-6			
Ethyl benzene	100-41-4	3,100		
Ethyl ether	60-29-7			
Isobutanol	78-83-1			
Methanol	67-56-1	40,000		
Methylene chloride	75-9-2	5.6		
Methyl ethyl ketone	78-93-3	4,000		
Methyl isobutyl ketone	108-10-1	510		
Nitrobenzene	98-95-3			
Pyridine	110-86-1			
Tetrachloroethylene	127-18-4	5.9		
Toluene	108-88-3	890		
1,1,1-Trichloroethane	71-56-6	1,000		
1,1,2-Trichloroethane	71-55-6	6.3		
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1			
Trichloroethylene	79-01-6	3.2		
Trichlorofluoromethane	75-69-4			
o-Xylene	95-47-6	160,000		
m-Xylene	108-38-3	160,000		
p-Xylene	106-42-3	160,000		
Semivolatile Organics				
o-Cresol	95-48-7	4,000		
m-Cresol	108-39-4			
p-Cresol	106-44-5	4,000		
Ethylene glycol	107-21-1	160,000		
PCB	1336-36-3	0.09		
Total petroleum hydrocarbons				
1,2,4-Trimethylbenzene	95-63-6			

a. Chemical Abstract Service (CAS).
b. Screening action level (SAL). If no value is given, SAL was not reported in 1993 IWP (LANL 1993, 1017).
c. Except as noted otherwise, data reported by Longmire, Duffy, and Reneau (Longmire et al. 1993, 0958).
d. SAL is for hexavalent chromium.
e. Data reported by Ferenbaugh, Gladney, and Brooks (Ferenbaugh et al. 1990, 0099).

4.10.1 Biological Resources

A survey for sensitive and endangered plant species will be performed for any critical habitats in OU 1100 for which sampling activities are proposed. We will inform the Biological Resources Evaluation Team (BRET) of specific sampling locations, so that the need to survey for a particular plant species can be evaluated. (Note: all plant species were looked for during the habitat evaluation survey in the summer of 1992. But because of the different seasonal flowering or emergence dates of various species, it is not certain that all protected species present were emergent and identifiable at the time of the survey.)

The habitat evaluation and previous data on OU 1100 indicate that at least two species of sensitive or endangered animals have potential for occurrence within or near the operable unit: the northern goshawk (*accipiter gentilis*) and the spotted bat (*euderma maculatum*). Other animal species are not considered because habitat components suitable for them have not been identified within the OU or because they have not been found in more suitable habitats within the Laboratory.

The northern goshawk is found in dense, mature, or old-growth coniferous forest. In Los Alamos County, they nest primarily in ponderosa pine (*pinus ponderosa*)/ gambel oak (*quercus gambelii*), ponderosa pine/gray oak (*quercus grisea*), and mixed conifer (*abies concolor-pseudotsuga menziesii*) habitats (Kennedy 1988, 1098), all of which are represented in OU 1100. Possible breeding pairs have been observed in TAs -53 and -72 (Travis 1992, 0869). The following measures will be taken to avoid adversely affecting this species:

1. Any sampling scheduled between May and October that requires the use of machines will be cleared with the BRET; the BRET will be contacted at least 60 days before sampling begins so that possible nest sites in and around the sampling area can be checked.

2. If sampling will disturb any area over 0.10 acre, the BRET will be contacted so that a presampling site-specific survey can be done.

3. Removal of any tree (live or snag) will first be cleared with the BRET.

The spotted bat is found in pinon-juniper, ponderosa pine, mixed conifer, and riparian habitats. Its two critical requirements are a source of water and roost sites (caves in cliffs or rock crevices). Although OU 1100 is likely to have a sufficient number of roost sites, water sources appear limited. (Suitable water is defined as small ponds or pools of slowly moving water.) To date, no spotted bats have been mist-netted on Laboratory property. OU 1100 was not scheduled for mist netting in the summer of 1992. Because of the nature and extent of the proposed site characterization in the canyon bottoms, spotted bats are unlikely to be affected if small caves are not disturbed and water sources in the canyon bottoms are not altered.

4.10.2 Best Management Practices

Measures will be taken to ensure that all plant and animal species, including nonsensitive species, are affected to the least extent possible by RFI activities.

Because off-road driving is especially harmful to plants and soil crust, vehicular travel will be restricted to existing roads whenever possible. If off-road travel is required, the BRET will be contacted to monitor the activity. Revegetation, if required at the site, will be carried out using the list of native plants suitable for OU 1100 (to be included in the final biological assessment report).

Several raptors breed in OU 1100 (Travis 1992, 0869). Travis reports substantiated observations of breeding pairs of American kestrel (*falco sparverius*), flammulated owl (*otus flammeolus*), great horned owl (*bubo virginianus*), and redtail hawk (*buteo jamaicensis*). Zone-tailed hawk (*buteo albonotatus*) and turkey vulture (*cathartes aura*) are, respectively, probable and confirmed breeders in TAs -53 and -72. Potential raptor nesting and roosting areas include ponderosa pine forest, mixed conifer forest, and steep cliffs with small caves and rock crevices, all of which are found in OU 1100. From May to September, nesting sites will be kept as free as possible from additional noise, heavy equipment, and activities that could be viewed as harassment. The BRET will be contacted 60 days before sampling to identify potential nesting sites.

4.10.3 Cultural Resources

All monitoring and avoidance recommendations contained in the *Cultural Resource Survey Report for OU 1100* (Albertson and Hoagland, in preparation, 22-0114) and in the *Traditional and Cultural Places Consultation Report* (Larson, in preparation, 22-0115) will be followed by all personnel involved in sampling activities. ESH-8 archaeologists will be contacted 30 days before initiation of any groundbreaking activities so that monitoring and avoidance recommendations can be verified.

REFERENCES FOR CHAPTER 4

Albertson, V. H. and S. R. Hoagland, in preparation. "Environmental Restoration Program, Operable Unit 1100, Cultural Resources Survey Report," Los Alamos National Laboratory, Los Alamos, New Mexico. (Albertson and Hoagland, in preparation, 22-0114)

Clement International Corporation, April 1992. "Toxicological Profile for Barium and Compounds," prepared under Contract No. 205-88-0608 for Agency for Toxic Substances and Disease Registry, US Public Health Service, Washington, DC. (Clement International Corporation 1990, 0874)

Clement International Corporation, February 1993. "Toxicological Profile for Lead," prepared for US Department of Health and Human Services under Contract No. 205-88-0608, Washington, DC. (Clement International Corporation 1993, 1055)

EPA (US Environmental Protection Agency), December 1989. "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)," Interim Final, EPA 540/1-89/002, Office of Emergency and Remedial Response, Washington, DC. (EPA 1989, 0305)

EPA (US Environmental Protection Agency), July 27, 1990. "Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management Facilities," proposed rule, Title 40 Parts 264, 265, 270, and 271, Federal Register, Vol. 55., pp. 30798-30884. (EPA 1990, 0432)

ESG, April 1981. "Hydrologic Transport of Sediments, *in* Environmental Surveillance at Los Alamos During 1980," Los Alamos National Laboratory Report LA-8810-ENV, Los Alamos, New Mexico. (ESG 1981, 0424)

Ferenbaugh, R. W., E. S. Gladney, and G. H. Brooks, Jr., October 1990. "Sigma Mesa: Background Elemental Concentrations in Soil and Vegetation, 1979," Los Alamos National Laboratory Report LA-11941-MS, Los Alamos, New Mexico. (Ferenbaugh et al. 1990, 0099)

Graf, W. L., October 1975. "The Impact of Suburbanization on Fluvial Geomorphology," Water Resources Research, Vol. 11, No. 5., ER ID Number 12465, Los Alamos, New Mexico. (Graf 1975, 13-0009)

Kasunic, C. A., R. W. Ferenbaugh, and E. S. Gladney 1985. "Silver Transport in Canon de Valle," Environmental Surveillance at Los Alamos During 1984, Los Alamos National Laboratory Report LA-10421-ENV, Los Alamos, New Mexico. (Kasunic et al. 1985, 0134)

Kennedy, P. L., 1988. "Habitat Characteristics of Copper's Hawk and Northern Goshawks Nesting in New Mexico," *Proceedings of the Southwest Raptor Management Symposium and Workshop,* sponsored by the National Wildlife Federation, Port City Press, Inc., Baltimore, Maryland. (Kennedy 1988, 1098)

LANL (Los Alamos National Laboratory), May 1991. "Generic Quality Assurance Project Plan," Rev. 0, Environmental Restoration Program, Los Alamos, New Mexico. (LANL 1991, 0412)

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. (LANL 1993, 1017)

LANL (Los Alamos National Laboratory), October 30, 1992. "Survey Procedures Manual," Rev. 1, Facilities Engineering Division, ER ID Number 14990, Los Alamos, New Mexico. (LANL 1992, 22-0116)

Larson, B. M., in preparation. "Traditional and Cultural Places Consultation Report," Los Alamos National Laboratory, Los Alamos, New Mexico. (Larson, in preparation, 22-0115)

Layton, D., B. Mallon, W. Mitchell, L. Hall, R. Fish, L. Perry, G. Snyder, K. Bogen, W. Malloch, C. Ham, and P. Dowd, December 1987. "Conventional Weapons Demilitarization: A Health and Environmental Effects Data-Base Assessment, Explosives and Their Co-Contaminants Final Report, Phase II." Lawrence Livermore National Laboratory, ER ID Number 14703, Livermore, California. (Layton et al. 1987, 16-0035)

Life Systems, Inc., December 1992. "Toxicological Profile for Cadmium," prepared for US Department of Health and Human Services under Contract No. 205-88-0608, Washington, DC. (Life Systems, Inc., 1992, 1053)

Longmire, P., C. Duffy, and S. Reneau, 1993. "Preliminary Background Elemental Concentrations in Bandelier Tuff and Selected Soil Series, 1993," unpublished report, Los Alamos National Laboratory, Los Alamos, New Mexico. (Longmire et al. 1993, 0958)

Nyhan, J. W. and T. E. Hakonson, 1976. "Soil Plutonium in the Los Alamos Environs and at the Trinity Site," Proceedings of an Actinide-Sediment Reactions Working Meeting, Battelle Northwest Laboratories Report BNLW-2117, ER ID Number 11755, Richland, Washington. (Nyhan and Hakonson 1976, 16-0038)

Nyhan, J. W., and L. J. Lane, May 1986. "Erosion Control Technology: A User's Guide to the Use of the Universal Soil Loss Equation at Waste Burial Facilities," Los Alamos National Laboratory Manual No. LA-10262-M, Los Alamos, New Mexico. (Nyhan and Lane 1986, 0159)

Penrose, W. R., W. L. Polzer, E. H. Essington, D. M. Nelson, and K. A. Orlandini, February 1990. "Mobility of Plutonium and Americium Through a Shallow Aquifer in a Semiarid Region," *Environmental Science & Technology*, Vol. 24, pp. 228–234. (Penrose et al. 1990, 0174)

Syracuse Research Corporation, December 1992. "Toxicological Profile for Beryllium," prepared under Contract No. 205-88-0608 to Clement International Corporation Agency for Toxic Substances and Disease Registry, US Public Health Service, Washington, DC. (Syracuse Research Corporation 1992, 0872)

Syracuse Research Corporation, December 1992. "Toxicological Profile for Cyanide," prepared for US Department of Health and Human Services under Contract No. 205-88-0608, Washington, DC. (Syracuse Research Corporation 1992, 1054)

Syracuse Research Corporation, December 1992. "Toxicological Profile for Nickel," prepared for the US Department of Health and Human Services, Washington, DC. (Syracuse Research Corporation 1992, 1096)

Travis, J. R., October 1992. "Atlas of the Breeding Birds of Los Alamos County, New Mexico, Pajarito Ornithological Survey," Los Alamos National Laboratory Report LA12206, Los Alamos, New Mexico. (Travis 1992, 0869)

Vocke, R. W., October 22, 1993. "Guidance: Technical Assumptions for Data Collection and Evaluation," Los Alamos National Laboratory Memorandum EM-13:93-V853, Los Alamos, New Mexico. (Vocke 1993, 1073)

Executive Summary

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- Outfalls
- Surface Impoundments

5.0 EVALUATION OF POTENTIAL RELEASE SITES

5.1 Aggregate A - Landfills

5.1.1 Description and History

Figure 5-1 shows the locations of the three PRSs that make up Aggregate A. All three are landfills that were used from 1945 to 1948, and all may subsequently have been excavated. Information on these PRSs, which were designated 20-001(a), (b), and (c) in the SWMU Report (LANL 1990, 0145), is summarized in Table 5-1.

The locations and probable contents of these landfills were described in a Laboratory memo documenting an April 1965 inspection in Sandia Canyon (LASL 1965, 22-0063). Area 1 (PRS 20-001[a]), located south of East Jemez Road and slightly west of the active firing range, was relatively small (probably not more than 5 ft deep); it was used to bury metal scrap, some of it contaminated. Area 2 (PRS 20-001[b]) was located near an old gun-mount base (Structure TA-20-16); it was described as a trench that had been excavated by bulldozer and used to bury gun barrels. Area 3 (PRS 20-001[c]), located near a Dumbo and mount (Structure TA-20-7) at the west end of TA-20, was an excavated trench in which several 3- to 5-in.-bore guns, cut into sections, had been buried.

An August 1993 site inspection revealed no visible evidence of the landfills. At Area 1, which is gently sloping and sparsely forested, the only evidence of past activities is an 8- by 12-ft graded space and the wood debris and plaster remnants of a small structure (possibly TA-20-17). Evidence of staking from previous investigations and surveys is also visible.

Area 2 is partially covered on the south side by the embankment for East Jemez Road. The northern portion is gently sloping. The only visible object is an orange angle-iron stake from a previous survey, which probably identifies the location of Structure TA-20-16.

Area 3, a gently sloping grassy area, has patches of badly weathered asphalt that may be remnants of the original TA-20 access road. The only other evidence of past activities is a 4- by 4-ft concrete box with a hinged steel lid, most likely a manhole (probably Structure TA-20-4) that was used for electrical wiring; and an orange angle-iron stake marking the probable location of Structure TA-20-7.

TABLE 5-1

PRS AGGREGATE A - LANDFILLS

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Potential Contaminants of Concern
20-001(a)	Landfill Area 1	None	Inactive	1945-1948	HE, U-238, metals, Sr-90, Ra
20-001(b)	Landfill Area 2	None	Inactive	1945-1948	HE, U-238, metals, Sr-90, Ra
20-001(c)	Landfill Area 3	None	Inactive	1945-1948	HE, U-238, metals, Sr-90, Ra

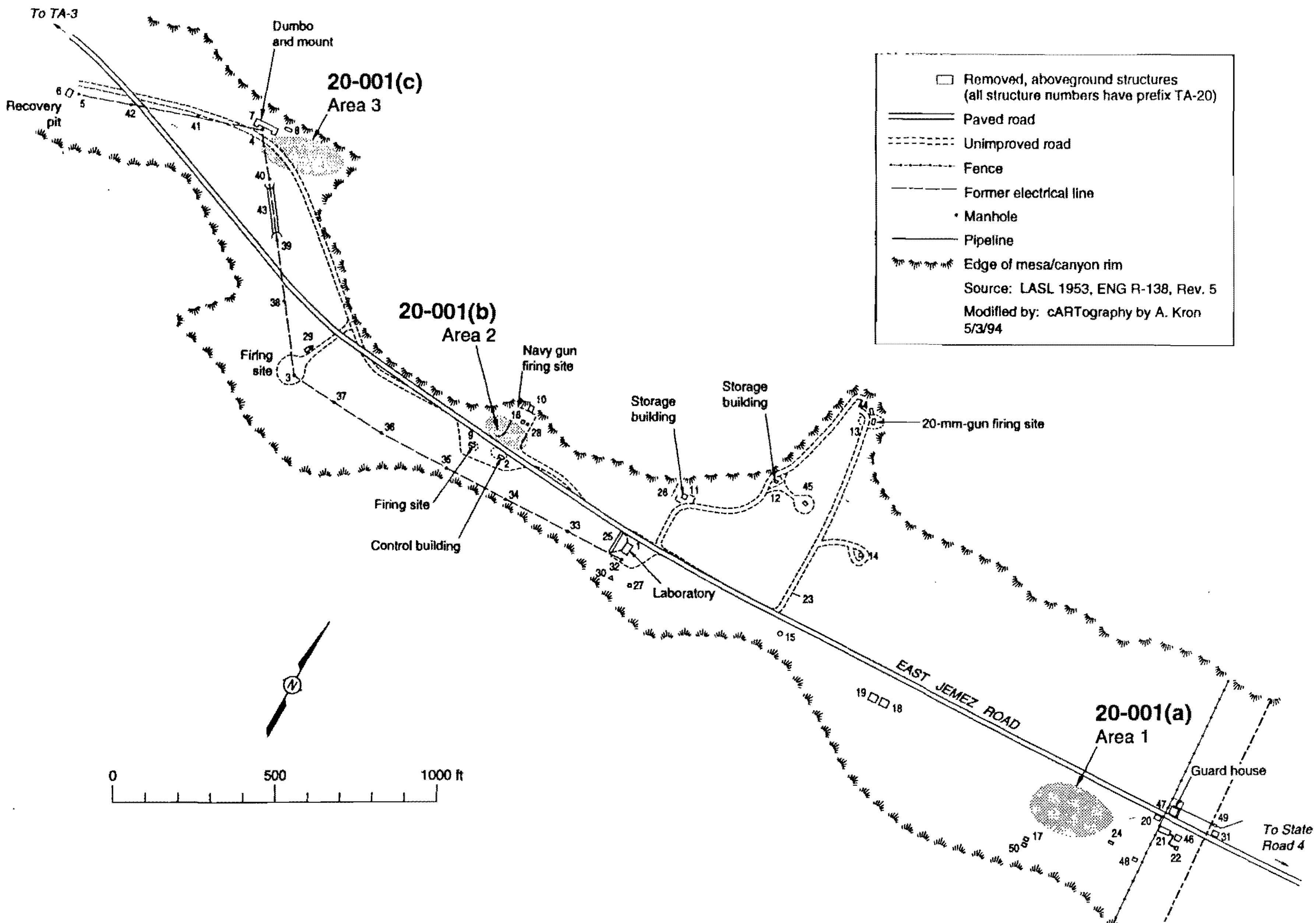


Figure 5-1. Locations of PRSs in Aggregate A.

Records (Courtwright 1962, 22-0031; Reider 1962, 22-0068; Drake and Courtwright 1966, 22-0039; Ahlquist 1985, 22-0025) indicate that the landfills were excavated and the contents removed during a 1948 cleanup. A 1948 Laboratory memo (Buckland 1948, 22-0029) that describes the cleanup effort in Sandia Canyon states, "Three burial grounds excavated. Ground checked negative after debris removal." Cleanup included removal of high-explosives (HE) debris, electrical wire, scrap wood, and discarded building material. Other documentation (LANL 1984, 22-0015) states that contaminated material removed from TA-20 included several "burial grounds."

5.1.2 Conceptual Exposure Model for Aggregate A

The conceptual exposure model for the PRSs in Aggregate A is shown in Figure 5-2. This model is based on archival information only and will be refined or modified on the basis of data gathered during the RFI.

5.1.2.1 Existing Information on Nature and Extent of Contamination

Potential contaminants of concern (PCOCs) at these PRSs are all of those associated with the firing sites at TA-20: HE, uranium-238, metals (including beryllium, cadmium, and nickel), strontium-90, and radium (see Section 5.2.2.1). Past and current sources of these PCOCs include metal scrap and debris, and any soil contaminated by leaching from these. Although some or most of these materials may have been removed during the 1948 cleanup, and limited environmental sampling was done, the nature and extent of possible contamination have not been reliably characterized.

In August and September of 1986, four areas in Sandia Canyon were surveyed geophysically, using magnetometry, in an attempt to find evidence of the former disposal sites (Weston 1986, 22-0069). Although these surveys produced several diffuse magnetic anomalies, neither the presence of metal nor the locations of the landfills could be positively established.

Surface radiation surveys (using portable gamma radiation survey meters) were also performed in 1986, on the north side of East Jemez Road. At a location surveyed in the vicinity of Structure TA-20-7, which is near PRS 20-001(c), radiation was within the background range for the Los Alamos area (12 to 18 μR/hr) (VanEtton 1986, 22-0072). In 1989 another survey (Scholl 1989, 0485), which used both phoswich and laboratory analytical techniques, was conducted in the following locations (see Figure 5-1):

TA-20-3
TA-20-6
TA-20-7
TA-20-11
TA-20-13
TA-20-16
TA-20-17
TA-20-37

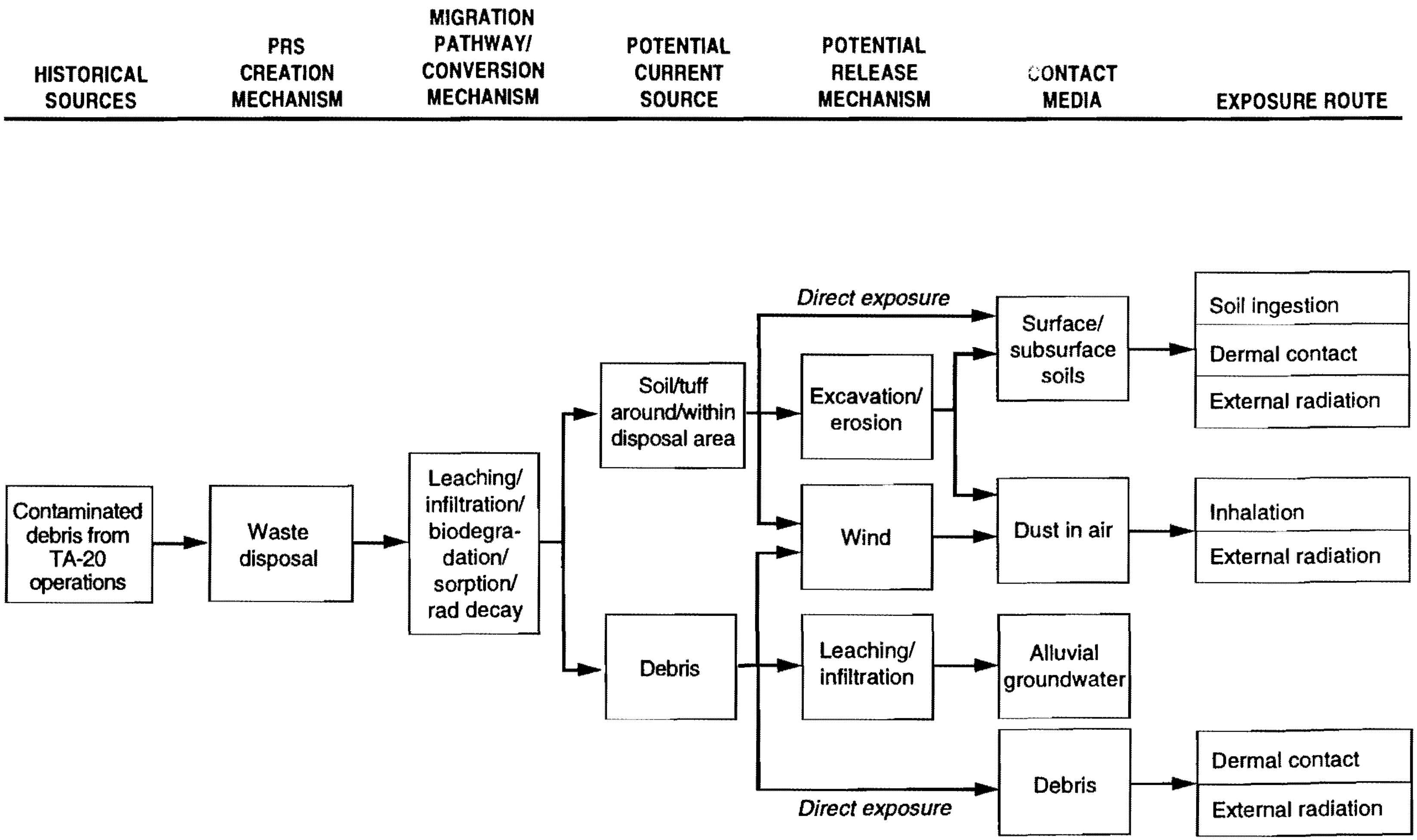


Figure 5-2. Conceptual exposure model for PRS Aggregate A.

The results of this survey also revealed background levels of radiation, except in the case of three samples that showed above-background concentrations of depleted uranium; but none of these samples came from areas near the probable landfill locations.

Area 1 was investigated as part of a DOE Headquarters Environmental Survey in 1987. The report (DOE 1987, 22-0113) notes that Area 1 was believed to be located across from the active firing range; and that a depression, approximately 5 ft deep, was observed at the end of an unimproved road (such a depression had not been noted during the 1986 geophysical survey).

On the basis of existing environmental sampling data and what is known about site operations, it is possible that contaminated debris and soils remain at Aggregate A PRSs. Although radionuclides were not detected in excess of background levels at the surface, they could be present in the subsurface. However, of the radioactive PCOCs (uranium-238, radium, and strontium-90), it is unlikely that any remain, with the possible exception of depleted uranium. Past documentation indicates that radioactive sources used at TA-20 were removed: the radium-beryllium source (Source No. 131, 10 millicuries) was identified and returned to the "Lab property people" (Buckland 1946, 22-0028); and the "RaLa" source was found during the 1948 cleanup and "removed" by the Laboratory's Health Physics Group (Buckland 1948, 22-0029). (It is unknown whether "RaLa" meant "radium-lanthanum" or "radioactive lanthanum," i.e., lanthanum-140). The results of the radiation surveys, which showed background levels of gamma radiation near two of the three probable landfill locations, support the conclusion that these sources were not buried in the landfills. Because strontium-90 was probably associated only with the lanthanum source, it would have been removed as well. Finally, lanthanum-140 and polonium-210 are not considered PCOCs for Aggregate A because, although they may have been present when the site was active, their short half-lives (40 hours and 138 days, respectively) would preclude their presence at these PRSs.

5.1.2.2 Potential Routes of Exposure to Contaminants

Currently, the only potential receptors for this aggregate are the onsite workers at TA-72. These workers could be exposed to PCOCs in buried debris and subsurface soils through external radiation or dermal contact during excavation or other intrusive activities, or through soil ingestion during or after such activities. These exposure scenarios are based on the assumption that surface contamination is not present and that only intrusive activities would bring contamination to the surface—an assumption that is consistent with the results of environmental sampling already done in this area.

Of these possible exposure routes, the one of most concern is dermal contact. The results of past radiation surveys indicate that the potential for external radiation is minimal. Exposure from groundwater is not being considered during Phase I, because the pathway is not included in the current land-use scenario.

5.1.3 Application of the DQO Process

The decision strategy for the RFI is presented in Section 4.4. The DQO process (described in the IWP, LANL 1993, 1017) was used in designing the Phase I screening assessments, which are a major component of this strategy, to ensure that the appropriate amount, type, and quality of data are collected.

5.1.3.1 Statement of the Problem (DQO Step 1)

It is known that contaminated debris was buried at this aggregate. Historical data suggest that the PRSs were cleaned up, but the extent of cleanup is unknown. If cleanup did not in fact take place, and if the debris is still present, the landfills could be an ongoing source of soil and groundwater contamination as well as a potential source of exposure through direct contact. If the debris was removed, it is still possible that subsurface soils are contaminated.

5.1.3.2 Identification of Decisions (DQO Step 2)

In Phase I of the RFI, we will gather environmental data to support decisions concerning three major questions (geophysical surveys will be used to gather data on the first two, and field screening and reconnaissance sampling for the third):

- Is buried debris present in any of the areas designated as probably encompassing the sites formerly used for disposal of wastes (see Section 5.1.4.2)?
- If the landfills have been removed, can their former locations be established?
- Are PCOCs present in concentrations that exceed SALs, either as single constituents or in combination with other PCOCs? If they are, they are considered contaminants of concern. (For details on the generic decision logic for screening assessments, see the IWP, Section 4.1.4 and Appendix J.)

If buried debris or contaminants of concern are found, Phase II investigations will be done to further characterize the site, or a VCA may be implemented.

This step will be carried out individually for each of the PRSs in this aggregate.

5.1.3.3 Data Inputs (DQO Step 3)

The primary data needed for the Phase I investigation are (1) geophysical data that indicate the presence or absence of buried debris and/or the locations of former (excavated) landfills; and (2) chemical and radiological data from which the types and concentrations of PCOCs can be ascertained (only if landfills are found to have been excavated will such data be collected in Phase I).

Geophysical data will be obtained by means of ground-penetrating radar (GPR), electromagnetic induction (EMI), and magnetometry surveys. Magnetometry, which detects subsurface magnetic anomalies (which may be caused by buried metal) can indicate the presence or absence of debris. GPR can then provide further characterization.

If no debris is found, GPR and EMI will be used to locate the boundaries of the excavated landfills. Subsurface soil samples from within those boundaries will be analyzed for chemical and radiological PCOCs.

5.1.3.4 Boundaries (DQO Step 4)

The potential boundaries of the Phase I RFI for this aggregate include, first, the horizontal boundaries of (a) the areas selected for study (the study area for each landfill, whether still in place or excavated, is the larger area within which the landfill is most likely to be located—estimated on the basis of both historical data and professional judgment); and (b) the landfills themselves, determined from geophysical survey data. Second, the boundaries include the vertical extent of contaminated soil and debris within each identified landfill area.

The horizontal boundaries of the study areas are as follows:

- PRS 20-001(a) was located south of East Jemez Road, west of TA-72, north of former Structure TA-20-17, and west of former Structure TA-20-24. The area believed most likely to encompass this PRS is shown as a shaded region in Figure 5-1. We have designated a 280- by 170-ft rectangle around that region as our study area.

- PRS 20-001(b) was located near former Structure TA-20-16, north of East Jemez Road, and south of TA-53 (Figure 5-1). The area believed most likely to encompass this PRS is shown as a shaded region in Figure 5-1. We have designated a 170- by 90-ft rectangle around that region as our study area.

- PRS 20-001(c) was located southeast of former structures TA-20-7 and TA-20-8 (Figure 5-1). The area believed most likely to encompass this PRS is shown as a shaded region in Figure 5-1. We have designated a 300- by 130-ft rectangle around that region as our study area.

The rectangular "study areas" will be surveyed geophysically over their entire extent to determine the boundaries of the actual landfill areas contained within them (which are expected to be much smaller). It is the actual landfill areas that are designated for soil sampling and analysis.

The vertical boundary is defined by the depth at which contamination is most likely to be present. If the landfills have been excavated and debris removed, the highest levels of PCOCs would be expected at the bottom of the excavation (this depth is not known, but will be determined by examination of the subsurface soil profile).

5.1.3.5 Decision Rules (DQO Step 5)

As shown in Figure 5-3, initial decisions will be based on the results of geophysical (magnetometry and GPR) surveys. If these suggest the presence of buried debris, the geophysical data will be evaluated to develop a Phase II

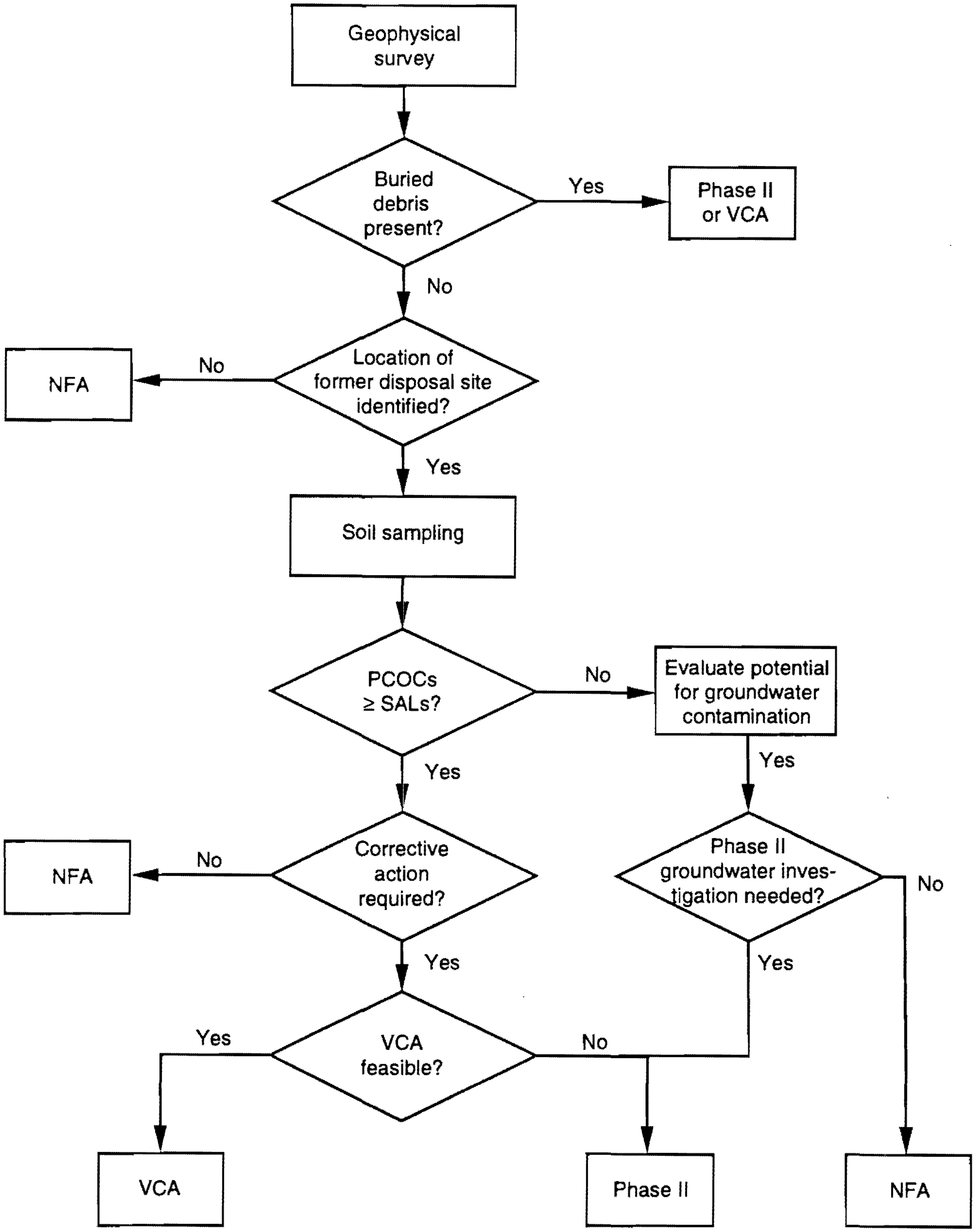


Figure 5-3. Decision logic for PRS Aggregate A.

sampling approach. (Further sampling will not be done as part of Phase I in this case, because of the possibility of encountering buried explosives.) Alternatively, it may be decided to proceed directly to a VCA.

If, on the other hand, the results of the geophysical surveys suggest that formerly disposed-of wastes have been removed, the survey data—which include data showing detected differences between native soil and backfill—will be used to identify the former locations of the excavated landfills. Subsurface soil samples will be collected from within each and will be analyzed for PCOCs. If PCOCs are present at levels above background, the potential for groundwater contamination will be evaluated (see Section 4.7.3). If contaminants are identified, or if a potential for contamination of groundwater is indicated, a Phase II characterization will be developed, including a groundwater investigation, to obtain the data needed for a baseline risk assessment.

In the event that (1) the surveys yield no evidence of buried debris or of excavated landfills, or (2) analysis of samples identifies no contaminants of concern and no potential for groundwater contamination, NFA will be recommended.

This decision step will be carried out for each PRS individually.

5.1.3.6 Design Criteria (DQO Step 6)

Historical data indicate that the landfills were used for disposal of relatively large metal objects (e.g., sections of Naval gun barrels). For this reason, the magnetometer surveys will be designed to detect ferrous metal objects having at least one dimension measuring 1 ft or more and buried up to 5 ft deep. Because of the nature of geophysical surveys, it is not possible to express the probability of detection in quantitative terms.

On the basis of professional judgment of the likely minimum dimensions of the landfills, the GPR and EMI surveys will be designed to detect disturbed areas measuring approximately 400 ft^2 and having a vertical depth of about 5 ft. If the landfills were excavated, we assume that they were backfilled with material sufficiently different from the native soils for the interface between the two to be identifiable by geophysical survey. Again, it is not possible to express the probability of detection in quantitative terms.

Soil contamination, if present, would have resulted from leaching of contaminants from buried wastes. If those wastes were uniformly contaminated, the distribution of contamination in the soils should be fairly uniform. However, because it is likely that some of the wastes were not contaminated at all, we have selected 30% as the fraction of the site expected to be contaminated. High levels of contamination are not expected, and therefore the consequences of failing to detect contamination that is present are not great. At this low level of risk, we allow for a 10% probability that contamination will be present but undetected by selecting a 90% probability of detecting contamination if at least 30% of the sampled area is contaminated. This sampling design criterion requires collection of seven samples (see Table 4-5).

Table 5-2 summarizes the DQO specifications for Aggregate A.

5.1.4 Phase I Sampling and Analysis Plan

5.1.4.1 Field Surveys

5.1.4.1.1 Land Surveys

Land surveys will be used to demarcate, in the field, the boundaries of the study areas, surface features, geophysical survey grids, and sample collection locations.

TABLE 5-2

DQO SUMMARY FOR AGGREGATE A

DQO Step 1: Statement of the Problem	• Contaminated debris is known to have been buried in this aggregate • Effectiveness of cleanup is not known • Contamination could be present in surface soils, subsurface soils, and/or groundwater
DQO Step 2: Identification of Decisions (to be followed for each PRS individually)	• Establish presence/absence of buried wastes • Establish presence/absence of previously excavated disposal areas • Establish presence/absence of contaminants of concern
DQO Step 3: Data Inputs	• Geophysical data indicative of subsurface anomalies • Chemical and radiological data on types and concentrations of PCOCs in subsurface soils
DQO Step 4: Boundaries	• Horizontal and vertical boundaries of study areas, demarcated on the basis of historical data • Landfill (or former landfill) areas, identified from geophysical survey data and field observations of soil profiles
DQO Step 5: Decision Rules (to be followed for each PRS individually)	• Evaluate geophysical data to determine whether buried wastes are still present • If buried wastes are present, go to Phase II investigation or implement VCA • If buried wastes are not present, evaluate geophysical data to locate former (excavated) disposal areas; sample soil to determine effectiveness of previous cleanup • If background levels are exceeded, evaluate potential for groundwater contamination • If SALs are exceeded or groundwater contamination is possible, go to Phase II investigation
DQO Step 6: Design Criteria	• High probability of detecting buried items having at least one dimension measuring 1 ft or more, to a maximum depth of 5 ft • High probability of locating excavated landfill having a surface area of about 400 ft^2 and a depth of about 5 ft • 90% probability of detecting soil contamination if at least 30% of the sampled area is contaminated.

5.1.4.1.2 Geophysical Surveys

The magnetometry, GPR, and EMI surveys will all use a 10-ft by 10-ft grid, which meets the sampling design criterion.

5.1.4.2 Sampling and Analysis

Soil sampling at Aggregate A PRSs will be biased toward locations expected to have the highest concentrations of PCOCs. The geophysical survey results will be used, to the extent possible, to bias horizontal sampling locations; and field observations of soil profiles to bias vertical sampling locations.

After the geophysical surveys have been completed, one to four trenches will be cut (by backhoe) across each area designated as a former landfill, from the surface to the backfill/native-soil interface. The number of trenches will depend on the estimated area of the landfill in question, as determined by the geophysical survey. For each PRS, seven sampling locations in the trenches will be selected, to meet the design criteria of DQO Step 6 (see Table 4-5), and soil samples will be collected using the spade and scoop method (see LANL-ER SOP-06.09). Samples will be collected from the trench floor (the top of the native soil profile), where the highest concentrations of PCOCs are expected. (If the backfill/soil interface cannot be identified, the trench will be excavated to a maximum depth of 10 ft, and samples will be collected at that depth.) If either alluvial groundwater or bedrock is encountered before 10 ft, the excavation will be stopped, and soil samples will be collected from the interval immediately above the water table or bedrock surface.

The lithology will be observed and described as each trench is excavated.

All samples will be field screened for radioactivity and HE, using Laboratory-approved standard operating procedures (SOPs), to identify gross concentrations of PCOCs. All samples will be analyzed in an onsite mobile laboratory for gross alpha, beta, and gamma radioactivity. Samples sent to an offsite analytical laboratory will be analyzed for all potential contaminants of concern (hazardous and radioactive).

Table 5-3 summarizes the sampling and analyses planned.

5.2 Aggregate B - Firing Sites

5.2.1 Description and History

Aggregate B includes both the inactive TA-20 firing sites and the active firing range used by the Laboratory's protective force. Table 5-4 summarizes basic information on the PRSs in this aggregate, and Figure 5-4 shows the location of each.

TABLE 5-3
SUMMARY OF PHASE I SAMPLING AND ANALYSES FOR PRS AGGREGATE A

PRS No.	PRS Type	Phase I Approach	Field Surveys			Samples				Field Screening				Mobile Lab			Laboratory Analysis										
			Land Survey	Geophysical Survey	Radiation Survey	Sampled Media	Structure	Surface	Subsurface *	Gross Alpha	Gross Gamma/Beta	Organic Vapor	High Explosive	Gross Alpha	Gross Beta	Gross Gamma	Gamma Spectroscopy	Total Uranium	Isotopic Uranium	Strontium-90	VOCs	SVOCs	HE	Metals	PCB	TPH	Cyanide
20-001(a)	Landfill	Reconnaissance	X	X		Soil	0	0	7	X	X		X	X	X	X	X	X	X	X			X	X			
20-001(b)	Landfill	Reconnaissance	X	X		Soil	0	0	7	X	X		X	X	X	X	X	X	X	X			X	X			
20-001(c)	Landfill	Reconnaissance	X	X		Soil	0	0	7	X	X		X	X	X	X	X	X	X	X			X	X			

* Number of samples is based on assumption that one former landfill site will be located at each PRS. Seven samples will be collected at each area to meet sample design criteria.

TABLE 5-4

PRS AGGREGATE B - FIRING SITES

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Potential Contaminants of Concern
20-002(a)	Recovery Pit	TA-20-6	Inactive, removed	1945-1948	HE, U-238, Sr-90, Ra, metals
20-002(b)	Dumbo and Mount	TA-20-7	Inactive, removed	1945-1948	HE, U-238, Sr-90, Ra, metals
20-002(c)	Firing Site	TA-20-9	Inactive, removed	1945-1948	HE, U-238, Sr-90, Ra, metals
20-002(d)	Firing Site	TA-20-3	Inactive, removed	1945-1948	HE, U-238, Sr-90, Ra, metals
20-003(b)	20-mm Gun Firing Site	TA-20-13, TA-20-44	Inactive, removed	1945-1948	Sr-90, Ra, metals
20-003(c)	Navy Gun Firing Site	TA-20-10, TA-20-16	Inactive, removed	1945-1948	Sr-90, Ra, metals
72-001	Firing Range	TA-72-11	Active	1966-Present	Lead

5.2.1.1 PRS 20-002 - Firing Sites

The SWMU Report (LANL 1990, 0145) identified only one firing site, designated PRS 20-002. Three other such sites were subsequently identified, during the archival review, and the four have been redesignated PRSs 20-002(a), (b), (c), and (d). Their locations are shown in Figure 5-4.

5.2.1.1.1 PRS 20-002(a) - Recovery Pit

PRS 20-002(a), located south of East Jemez Road at the far west end of TA-20, is a steel-lined pit (Structure TA-20-6) that was used to contain initiator test shots, facilitating recovery of the initiators. It was used following failure of the shot containment tank called a "Dumbo" (PRS 20-002[b]) (LANL 1984, 22-0015). The pit was completed in April 1945 and removed in April 1948 (LANL undated, 22-0051). An engineering drawing (LASL 1951, 22-0052) shows that its inside dimensions were 14 ft 8 in. by 14 ft 8 in. by 12 ft deep. The walls and floor consisted of 0.75-in.-thick steel plate backed by 12-in. by 12-in. timbers. Another drawing (LASL 1951, 22-0053) shows a steel framework covering the pit, overlain by a mat of 0.25-in.-diameter steel rods spaced 1 in. apart. The framework and mat, presumably installed to contain debris from the shots, failed after the first few shots according to a 1947 Laboratory memo (Bradbury 1947, 22-0027).

An August 1993 site visit revealed no surface evidence of Structure TA-20-6. The appearance of this area is described in Section 5.1.1, Area 3 (PRS 20-001[c])

5.2.1.1.2 PRS 20-002(b) - Dumbo and Mount

At this firing site, a 5-ft-diameter cylindrical steel tank (Dumbo) was used to contain an explosive test so that shot fragments could be recovered. The tank was mounted on a firing pad at one end of a 91-ft x 14-ft concrete platform

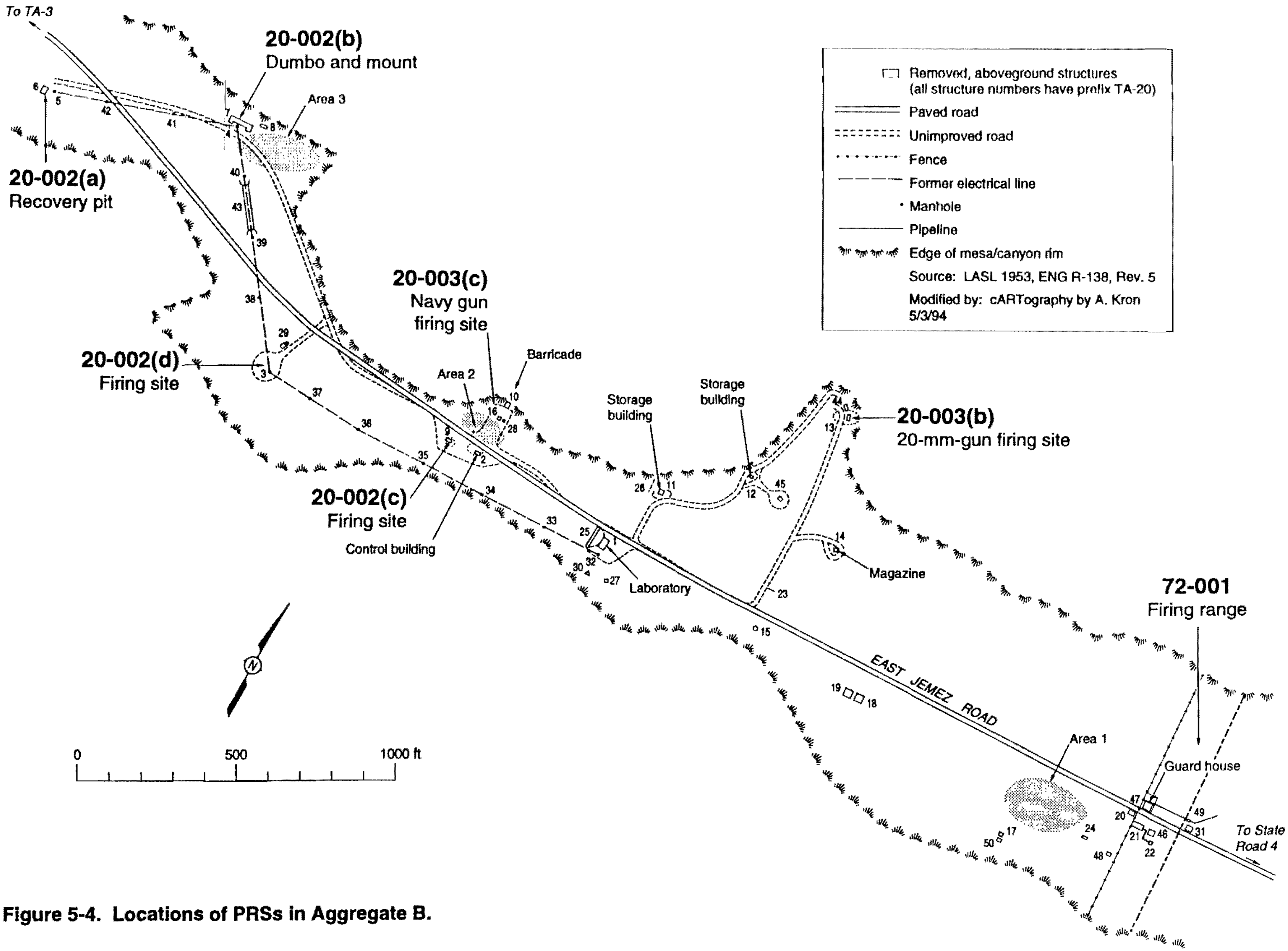


Figure 5-4. Locations of PRSs in Aggregate B.

(Structure TA-20-7, near the west end of TA-20) (see Figure 5-4). An engineering drawing (LASL 1951, 22-0054) shows Structure TA-20-7 as equipped with rail tracks, along which a work platform could be moved to provide access to the Dumbo. The Dumbo was used only once because of the difficulty of opening the tank after the shot was imploded (DOE 1987, 0264). A second Dumbo, which had been built and installed on the firing pad at the other end of the concrete platform (Bradbury 1947, 22-0027), was never used.

The Dumbos, constructed in April 1945, were removed in April 1948 (LANL undated, 22-0051). Although the SWMU Report (LANL 1990, 0145) suggests that they may have been disposed of in the Area 3 landfill (PRS 20-001[c]), this is inconsistent with a 1948 memo that indicates the Dumbos were still present after the landfills reportedly had been removed (Buckland 1948, 22-0029).

An August 1993 site visit revealed no surface evidence of Structure TA-20-7. The appearance of the area is described in Section 5.1.1, Area 3 (PRS 20-001[c]).

5.2.1.1.3 PRS 20-002(c) - Firing Site

PRS 20-002(c) was identified in an engineering drawing (LASL 1951, 22-0055) as a firing point near the center of TA-20 (Structure TA-20-9, a foundation ramp and bin). This drawing shows electrical conduit running from the control building (Structure TA-20-2) to Structure TA-20-9, and another drawing (LASL 1951, 22-0056) shows Structure TA-20-9 bordered on three sides by an earth berm—both features that would be expected at a firing site. In addition, a 1947 Laboratory memo (Bradbury 1947, 22-0027) describes a firing point located adjacent to the control building that was used for charges of up to 50 pounds.

An August 1993 site visit revealed no evidence of past activities or structures associated with this firing site. The appearance of the area is described in Section 5.1.1, Area 2 (PRS 20-001[b]).

5.2.1.1.4 PRS 20-002(d) - Firing Site

PRS 20-002(d), located near Structure TA-20-3 (a manhole), was identified as a firing site on the basis of descriptions of TA-20 activities. An engineering drawing (LASL 1951, 22-0057) shows the layout of an electrical detonation system that has three manholes associated with it. Two of these manholes, Structures TA-20-4 and TA-20-5, are known to be located at firing sites (Structure TA-20-4 next to Structure TA-20-7 and Structure TA-20-5 next to Structure TA-20-6). The third manhole is Structure TA-20-3, which, it follows, would also be part of a firing site. Further, historical data for TA-20 indicate that Group M-4 did several implosion tests near Structure TA-20-3.

An August 1993 site visit revealed no visible evidence of past activities. The area is a gently sloping grassland with scattered areas of dense brush and occasional older trees.

5.2.1.2 PRS 20-003 - Gun Firing Sites

The SWMU Report (LANL 1990, 0145) identified four gun firing sites, PRSs 20-003(a), (b), (c), and (d). Later investigation revealed that two of these, (a) and (d), were never used for gun firing; these two sites have been recommended for NFA (see Chapter 6). The other two sites, 20-003(b) and (c), were used in the past for neutron timing, initiator, and equation-of-state tests. Their locations are shown in Figure 5-4.

5.2.1.2.1 PRS 20-003(b) - 20-mm-Gun Firing Site

This PRS is identified in the SWMU Report (LANL 1990, 0145) as Structure TA-20-13, a 20-mm-gun building located in a canyon on the north side of TA-20. It actually consisted of two buildings (Structures TA-20-44 and TA-20-13). An engineering drawing (LASL 1951, 22-0058) shows Structure TA-20-44 as a wood-frame building having interior dimensions of approximately 16 ft by 16 ft by 8 ft high and equipped with concrete gun mounts. Built in February 1945, this structure was moved to TA-4 in March 1948 (LANL undated, 22-0051).

Structure TA-20-13, which was adjacent to TA-20-44, was described in a 1947 Laboratory memo (Bradbury 1947, 22-0027) as a workshop. It appears, in fact, to have been a control building from which the gun in TA-20-44 could be fired. Two engineering drawings (LASL 1951, 22-0058 and LASL 1951, 22-0059) show this structure as a 16-ft by 16-ft wood-frame building whose north wall (which faced TA-20-44) was covered with 0.5-in-thick steel plate; an electrical conduit trench ran between the two structures.

Approximately 450 ft to the south of these two buildings was a magazine, Structure TA-20-45. The layout of these structures, shown in an engineering drawing (LASL 1951, 22-0058), indicates that guns were fired into a side canyon branching from the north wall of Sandia Canyon. According to one report (DOE 1987, 0264), the guns were fired at steel plates set against the cliffs.

An August 1993 site visit revealed that all surface structures had been removed (several concrete foundations remained). The rock faces of the north wall of Sandia Canyon, which are nearly vertical in many locations, are pitted with holes of various sizes. It is possible that some of these holes were produced by impact from the guns, but the natural geomorphology of the tuff also gives rise to such pitting; and weathering of the rock face over the past 50 years makes it difficult if not impossible to distinguish between the two. The valley floor consists of relatively flat grassland with dense brush and trees at the north end.

5.2.1.2.2 PRS 20-003(c) - Navy Gun Firing Site

PRS 20-003(c), located near the center of TA-20, is identified in the SWMU Report (LANL 1990, 0145) as a gun site, Structure TA-20-16. An engineering drawing (LASL 1951, 22-0060) shows this structure as a gun mount consisting of a 10-ft by 10-ft concrete pad with a steel plate surface. Constructed around August 1944, this structure was removed in April 1948 (LANL undated, 22-0051). A nearby structure, TA-20-10, an earth-bermed timber frame filled with tamped earth, was built around January 1945 (LANL undated, 22-0051) on the slope at the toe of the canyon wall. Another drawing (LASL 1951, 22-0058) shows this structure to be 30 ft long. At the end nearest the gun, it was 12 ft wide and 10 ft high; and at the far end it was 20 ft wide and 5 ft high. From the layout of these structures (LASL 1951, 22-0060), it appears that the gun was fired into the earth-filled bin. Presumably the projectile could be recovered. An engineering drawing (LASL 1951, 22-0055) that shows the layout of electrical conduits suggests that firing of the gun was controlled from Building TA-20-2.

Structure TA-20-10 was apparently removed in April 1948 (LANL undated, 22-0051). The means of soil disposal is not known. An August 1993 site visit revealed that the southern portion of the area had been covered by the East Jemez Road embankment. The northern portion is gently sloping grassland with scattered areas of dense brush. The only evidence of previous activities is an orange angle-iron survey stake, probably marking the former location of Structure TA-20-16.

5.2.1.3 PRS 72-001 - Active Firing Range

Since 1966, TA-72 has been used as a small-arms firing range by the Laboratory's protective force contractor. It includes PRS 72-001, a 175-ft by 250-ft firing range surrounded by earth berms; an adjacent skeet range; and some administrative buildings (upgraded in 1990 and 1991). PRS 72-001 is located at the west end of TA-72 in Sandia Canyon (see Figure 5-4).

5.2.2 Conceptual Exposure Model for Aggregate B

The conceptual exposure model for the PRSs in Aggregate B are shown in Figures 5-5 and 5-6. This model is based on archival information only and will be refined or modified on the basis of data gathered during the RFI.

5.2.2.1 Existing Information on Nature and Extent of Contamination

The sources for the PCOCs at Aggregate B (see Table 5-4) include residuals from explosive tests and spent bullets and, secondarily, soils contaminated by these sources through runoff or leaching. On the basis of historical data, contamination is expected to be minor. The initiator tests conducted at TA-20 were not expected to release contamination to the environment, with the exception of the explosives. The tests were designed to implode or impact the initiators so that they could be recovered for study; in normal circumstances, the hazardous and radioactive materials within the initiators should not have been released to the environment. Hazardous materials included HE (Composition B, tetryl, pentolite, and barynol), beryllium, nickel, and cadmium (Critchfield 1945, 22-0033; Critchfield 1945, 22-0034; Critchfield 1945, 22-0035; Critchfield 1945, 22-0036). As described for Aggregate A, strontium-90 and radium may also be present, from radioactive sources used during site operations.

Other implosion tests conducted later at the site could have left contaminants behind, including uranium and HE. A former Laboratory staff member reported (Ahlquist et al. 1985, 22-0024) that steel spheres were frequently used in these shots, but that uranium may have been used as well.

Sandia Canyon has been surveyed frequently for HE over the past 45 years (Buckland 1946, 22-0028; Buckland 1948, 22-0029; Courtwright 1962, 22-0031;

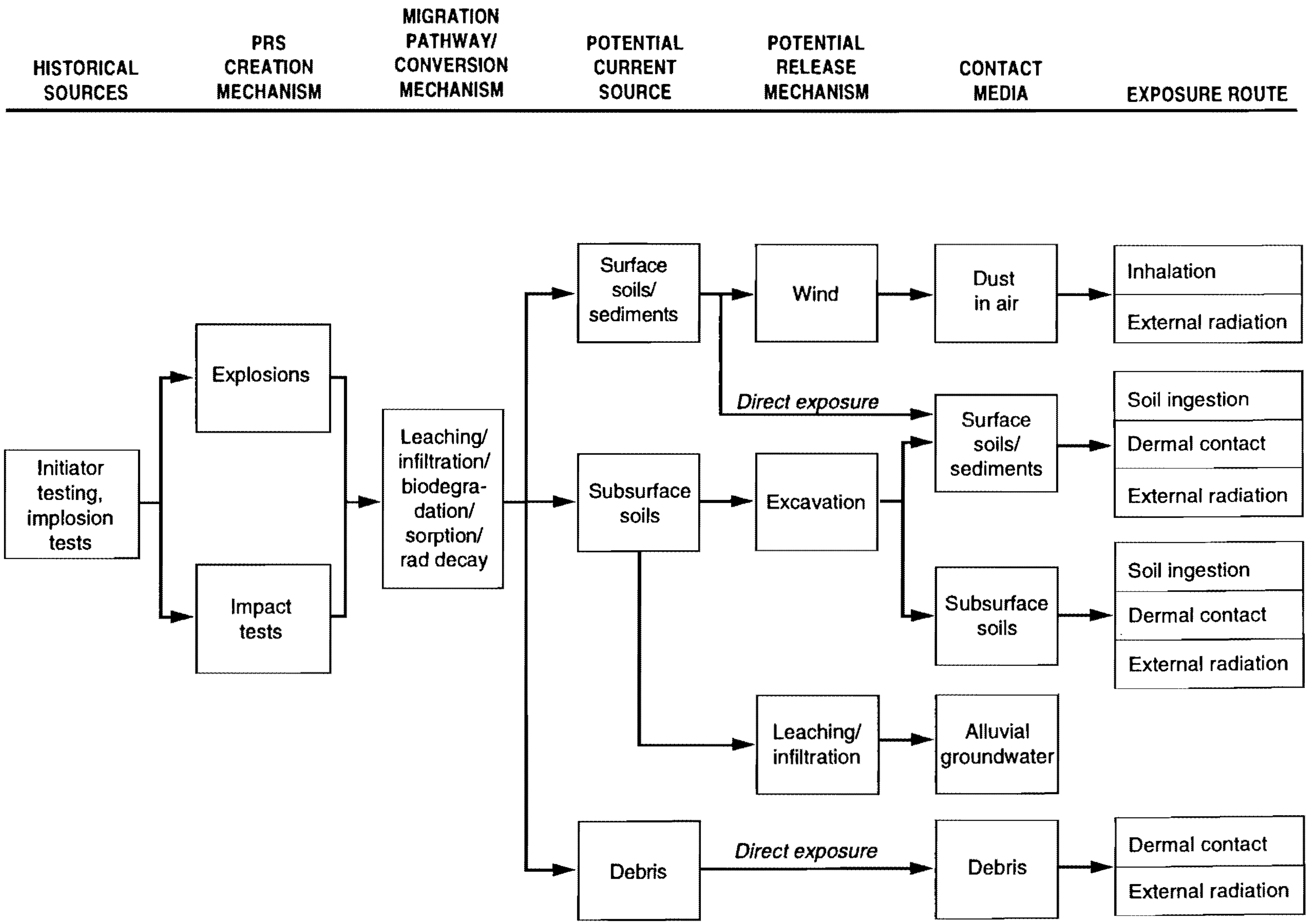


Figure 5-5. Conceptual exposure model for PRS Aggregate B—TA-20 former firing sites and gun firing sites.

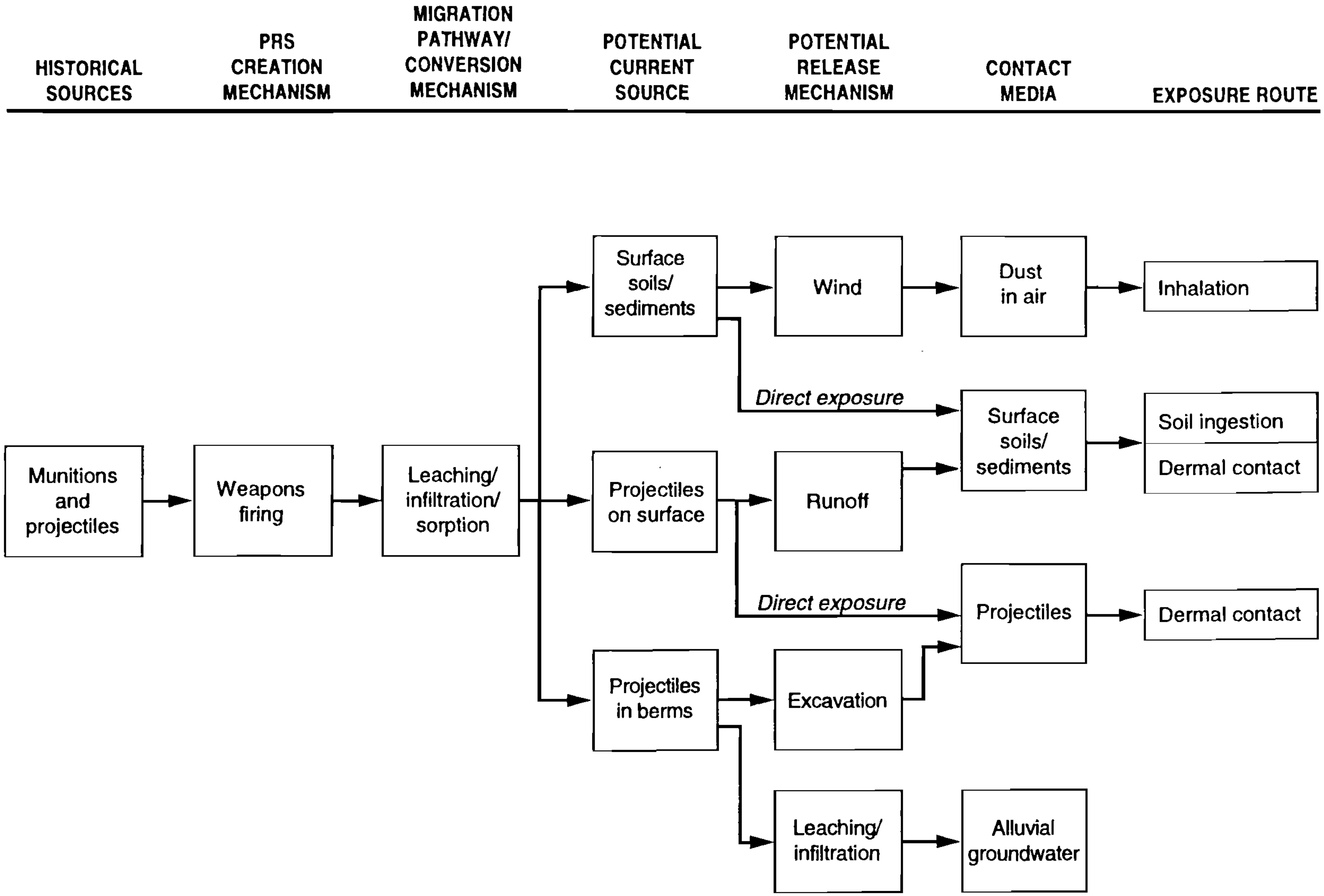


Figure 5-6. Conceptual exposure model for PRS Aggregate B—TA-72 active firing range.

Campbell 1962, 22-0030; Davis 1962, 22-0037; Drake and Courtwright 1964, 22-0038; Drake and Courtwright 1966, 22-0039; Drake and Courtwright 1967, 22-0040; Drake and Courtwright 1969, 22-0041), and there have been numerous cleanups. Large pieces of HE or other materials are not expected to be present, therefore, and contamination with fragments of HE is expected to be minimal. Any PCOCs are expected primarily in contaminated soil. Environmental sampling has been limited, but HE and radioactive contamination were identified at PRSs 20-002(a) and (d).

5.2.2.1.1 PRS 20-002(a)

This recovery pit, designated Structure TA-20-6, was removed in 1948. The soils in and around the site of this former structure may contain metals (beryllium, nickel, and possibly others), radionuclides (primarily uranium), and HE (historical data indicate that Composition B was the primary explosive used, but that tetryl, pentolite, and barynol were also used—Critchfield 1945, 22-0034).

As part of the Los Alamos Characterization Program, environmental samples were taken at this site in 1985 and analyzed for HE, uranium, beryllium, and gross alpha and beta radioactivity. Preliminary results of phoswich radiation surveys of soils near Structure TA-20-6 revealed some readings higher than background, but these were attributed to internal equipment temperature fluctuations or to external disturbances. In one soil sample, a uranium concentration of 10.16 mg/kg was found. The reported background range for uranium in soils at the Laboratory was 3 to 7 mg/kg (Scholl 1989, 0485).

5.2.2.1.2 PRS 20-002(b)

These two steel tanks, or "Dumbos," were surveyed radiologically, as reported in a 1946 Laboratory memo (Littlejohn 1946, 22-0066). The unused Dumbo had a negative count on both the exterior and interior surfaces; the used Dumbo showed 3,000 to 5,000 cpm on the rim and over 20,000 cpm on the interior. A 1986 radiation survey of the former site of the Dumbos (VanEtton 1986, 22-0072) revealed only background levels.

The area around former Structure TA-20-7 was surveyed in 1985 as part of the Los Alamos Characterization Program. Preliminary results of phoswich radiation surveys of soils revealed some readings higher than background, but these were attributed to internal equipment temperature fluctuations or to external disturbances. Soil samples did not reveal uranium above background (Scholl 1989, 0485).

5.2.2.1.3 PRS 20-002(c)

This firing site, located near Structure TA-20-9, is shown on an engineering drawing (LASL 1951, 22-0055) as a pad bordered on three sides by an earth berm. Historical data indicate that it was used for shots carrying up to 50 pounds of HE (Bradbury 1947, 22-0027). No historical data could be found concerning site contamination. It is assumed that any visible contamination (e.g., fragments) would have been removed during the 1948 Sandia Canyon cleanup, but, given the nature of the explosives tests, area soils could be contaminated with HE residuals.

5.2.2.1.4 PRS 20-002(d)

This firing site, located near Structure TA-20-3 (an electrical conduit manhole that is part of the detonation system), apparently was used for fewer than 10 shots in all. But the Comprehensive Environmental Assessment and Response Program (CEARP) Working Papers (LANL 1984, 22-0015), using historical documentation, report that one shot containing 500 pounds of Composition B underwent a low-order explosion (i.e., did not detonate completely) and scattered undetonated HE over a wide area. A 1962 Laboratory memo (Courtwright 1962, 22-0031) describes two cleanup efforts related to this incident: one conducted immediately after the incident and a second one that was part of the 1948 Sandia Canyon cleanup, when a crew of 10 or 12 spent two weeks searching the area and found 60 to 70 pounds of explosives. The memo also describes an inspection of Sandia Canyon firing sites in September 1962, when one small (golf-ball size) piece of Composition B explosive was found near Structure TA-20-3. As a result, the area was posted on the south side of East Jemez Road with "Danger - Explosives - Keep Out" signs, and the location of Structure TA-20-3 was entered into engineering records. Periodic inspections of the firing sites were recommended (Campbell 1962, 22-0030); significant findings of inspections from 1964 - 1975 are summarized below.

<u>April 1, 1964</u>. A 250-ft-radius area around Structure TA-20-3 was inspected (Drake and Courtwright 1964, 22-0038). No explosives were found, but it was noted that cleanup of TA-20 was incomplete. A steel pull box was discovered at Structure TA-20-3, and east of the structure several concrete pull boxes, exposed conduits, a fence, and high-line fittings were found.

<u>July 7, 1966</u>. A 300-ft-radius inspection around Structure TA-20-3 turned up explosives weighing about 25 grams (approximately 50 ft west of survey marker BC No. 926). It was recommended that the warning signs be retained (Drake and Courtwright 1966, 22-0039).

<u>July 10, 1967</u>. More explosives, weighing about 15 grams, were found about 55 ft west of survey marker BC No. 926 during a 400-ft-radius inspection around Structure TA-20-3. The warning signs were retained, and reinspection of the site was recommended for 1969 (Drake and Courtwright 1967, 22-0040).

<u>June 6, 1969</u>. During this reinspection, a 300-ft radius around Structure TA-20-3 was surveyed. Two small pieces of explosives were found, approximately 35 ft west of survey marker BC No. 926 (in the same general area as those found in 1967). The warning signs were retained (Drake and Courtwright 1969, 22-0041).

<u>April 8, 1971</u>. This inspection (Courtwright 1971, 22-0032; Drake 1971, 22-0042) did not turn up any explosives. In the belief that the point of diminishing returns had been reached, it was recommended that the warning signs be removed and inspections discontinued (Drake and Courtwright 1969, 22-0041).

<u>May 3, 1973</u>. The site was checked again, and again no explosives were found (Drake 1973, 22-0043). The recommendation that the warning signs be removed was renewed.

June 5, 1975. The final inspection of this series found no explosives (Drake et al. 1975, 22-0044). A recommendation was made to remove the signs warning of explosives and any remaining debris and parts of structures (pull boxes, conduit, etc.). A biennial inspection schedule was recommended.

When the site was investigated in 1985, under the Los Alamos Characterization Program, preliminary results of phoswich radiation surveys of soils near Structure TA-20-3 revealed some readings higher than background; these were attributed to internal equipment temperature fluctuations or to external disturbances. Two soil samples analyzed for uranium had concentrations of 52.48 and 33.25 mg/kg, significantly higher than the reported background range of 3 to 7 mg/kg for soils at the Laboratory (Scholl 1989, 0485).

5.2.2.1.5 PRS 20-003(b)

All structures associated with this PRS were removed in 1948, before construction of East Jemez Road. The area around the 20-mm-gun building (Structure TA-20-13) was investigated in 1985 under the Los Alamos Characterization Program. Preliminary results of phoswich radiation surveys of soils near Structure TA-20-13 revealed no readings higher than background and soil samples yielded no uranium concentrations higher than the reported normal background range (Scholl 1989, 0485). It should be noted, however, that sampling was done only around the 20-mm gun building and not in the projectile impact area near the canyon wall.

5.2.2.1.6 PRS 20-003(c)

Structures associated with the Navy gun firing site were removed in 1948, before construction of East Jemez Road. The area around the gun mount (Structure TA-20-16) was investigated in 1985 under the Los Alamos Characterization Program; preliminary results of phoswich radiation surveys of soils near Structure TA-20-16 revealed no readings higher than background, and soil samples showed uranium levels within the normal background range (Scholl 1989, 0485). It is not known whether the area sampled included potentially contaminated soil from Structure TA-20-10.

5.2.2.1.7 PRS 72-001

Lead is known to be present at this active firing range. Bullets are scattered around the base of the berms and the cliffs, and lead shot from skeet shooting is visible on the ground surface. No information could be found on lead levels in the soils.

5.2.2.2 Potential Routes of Exposure to Contaminants

Currently, the only potential receptors for this aggregate are the onsite workers at TA-72. These workers could become exposed to PCOCs in firing site debris, projectiles, and/or contaminated surface soils and channel sediments, through external radiation, ingestion, inhalation, or dermal contact. (Exposure to PCOCs in groundwater is not a consideration during Phase I, because this pathway is not included in the current land-use scenario.)

Of these possible exposure routes, those of greatest concern are dermal contact, ingestion, and inhalation. The results of past radiation surveys indicate that the potential for direct radiation is minimal. The Phase I investigation results will be the basis for evaluating the potential for exposure by these routes and the need for Phase II investigations.

5.2.3 Application of the DQO Process

The decision strategy for the RFI is presented in Section 4.4. The DQO process (described in the IWP, LANL 1993, 1017) was used in designing the Phase I screening assessments, which are a major component of this strategy, to ensure that the appropriate amount, type, and quality of data are collected.

5.2.3.1 Statement of the Problem (DQO Step 1)

The activities conducted at this aggregate—HE and projectile-impact tests and firing of small arms—could have caused contamination of surface and subsurface soils. Historical data suggest that potentially contaminated surface debris (e.g., pieces of HE) has been cleaned up, but contamination could still be present in soils and fine particulates. The current use of lead bullets and shot at PRS 72-001 creates a further potential for surface contamination. The Phase I investigation will determine whether contaminants of concern are present at any of these PRSs. If any are found, further investigation (and remediation, if necessary) will follow.

5.2.3.2 Identification of Decisions (DQO Step 2)

The Phase I investigation will include field screening and reconnaissance sampling to determine whether PCOCs exist in soils and sediments at these PRSs. If any are found, further site characterization will be done (Phase II), or it may be decided to proceed directly to a VCA. If no contaminants of concern are identified, NFA will be recommended. This step will be carried out individually for each of the PRSs in this aggregate.

5.2.3.3 Data Inputs (DQO Step 3)

The primary data needed for the Phase I investigation are chemical data on the types and concentrations of PCOCs in soils and/or sediments at each PRS. These data will be obtained by collecting and analyzing samples of surface and subsurface soils and sediments.

5.2.3.4 Boundaries (DQO Step 4)

The boundaries of the investigation are those that define the areas potentially affected by contaminants, especially those most likely to be contaminated. These will vary among the PRSs as a function of differences in physical characteristics and past activities (see Section 5.2.5.3). For example, at PRS 20-003(b), the area most likely to be contaminated cannot easily be defined; and at PRS 72-001, the most contaminated area is certainly within the active firing range (exposure of employees using the firing range is assumed to be controlled by current safety procedures and will not be considered in the Phase I investigation).

5.2.3.4.1 Horizontal Boundaries

PRSs 20-002(a-d). Samples will be collected within that area of specified radius around the firing site judged to have been affected by firing activities, i.e., the area likely to harbor PCOCs dispersed by explosions from the firing site.

PRS 20-003(b). There may be contamination around the projectile impact zone. However, historical data are inadequate for accurately locating the impact zone. Because the drainage channel is assumed to be the area most likely to have received contamination from this zone (any contamination present in the cliff wall impact zone should have been transported by runoff to the channel), and because the canyon bottom is a more likely place for potential receptor exposure than the walls, the channel and the canyon bottom areas will be used to draw the boundaries of the Phase I RFI for this PRS.

PRS 20-003(c). The area most likely to have contaminated soil is that within the earth-bermed impact zone. The berm structure was dismantled in 1948, but the fate of the associated soils is not known; it is assumed that they were either spread around the site or removed for burial offsite. Because the first assumption is the more conservative, the Phase I RFI boundaries will be established as those likely to include contaminated soils still present onsite.

PRS 72-001. Investigations in the active firing range part of this site will be deferred unless that area is shown to pose an immediate risk. The conceptual model (Figure 5-6) indicates that transport of contamination offsite by runoff presents the greatest potential for exposure of personnel other than those at the firing range. For this reason, the boundaries of the Phase I RFI will circumscribe those areas of the PRS outside and adjacent to the firing range that receive drainage from the range.

5.2.3.4.2 Vertical Boundaries

The vertical boundaries for the investigation will be based on the expected depth of contamination. For firing site locations where contamination is expected to result from surface deposition, the vertical boundaries will be from the soil surface to 3 ft below the surface (this depth will allow for the possibility of some vertical migration). As described in Section 4.5.1.1.1, equilibrium-distribution studies of explosives in the environment have shown that explosives would be present primarily in the subsurface.

Samples will be collected from two depth intervals: 0 to 6 in. (representing the soils to which receptors are most likely to become exposed under current conditions); and 2.5 to 3 ft (representing soils in which constituents migrating from the surface are likely to reside, and to which receptors could be exposed through excavation or other intrusive activities).

For firing test locations (i.e., where explosions took place), the vertical boundaries will be deeper—the top 5 ft of soil—because the explosions could have driven contamination into the subsurface (5 ft is the maximum depth associated with likely exposure scenarios, such as excavation for construction activities). For drainage channels, the vertical boundaries will be from the surface to the soil/bedrock interface (or to a maximum depth of 5 ft), which allows for vertical mixing during runoff as well as for migration from leaching.

Subsurface samples will also be collected to evaluate the potential for groundwater contamination.

5.2.3.5 Decision Rules (DQO Step 5)

As shown in Figure 5-7, Phase I sampling will generate data on PCOC concentrations in soils and sediments at each PRS. If these concentrations indicate the presence of any contaminants of concern, further action will be required. If contamination is limited and well defined, and the site poses a current risk (i.e., immediate action is appropriate), a VCA may be recommended. Otherwise, a Phase II characterization will be developed to obtain the data needed for a baseline risk assessment. The potential for groundwater contamination will be evaluated if PCOCs are above background, which may lead to a Phase II groundwater investigation (see Section 4.7.3).

If no contaminants of concern and no potential for groundwater contamination are identified at a PRS, NFA will be recommended.

5.2.3.6 Design Criteria (DQO Step 6)

The design criterion for soil sampling is a 90% probability of detecting contamination if a minimum percentage (10 to 30%) of the soil within the study area boundaries (defined by DQO Step 4) is contaminated. The 90% value is based on the judgment that high levels of contamination are unlikely at these PRSs given the nature of past activities and the fact that cleanups have been done. For this reason, the consequences of failing to detect contamination if it is present are not great; at this low level of risk, by selecting 90% for the design criterion, we allow for a 10% probability that contamination will be present but undetected. The specific value that will be used for the potentially contaminated fraction of each PRS will depend on site-specific conditions and will be enhanced through biased sampling (see Section 5.2.4.2).

Table 5-5 summarizes the DQO specifications for this aggregate.

5.2.4 Phase I Sampling and Analysis Plan

5.2.4.1 Field Surveys

5.2.4.1.1 Land Surveys

Land surveys will be used to demarcate, in the field, the study boundaries, surface features, and sample collection locations.

5.2.4.1.2 Geomorphic Surveys

These surveys will provide data for generating maps of the drainages and sediment catchments that are to be sampled.

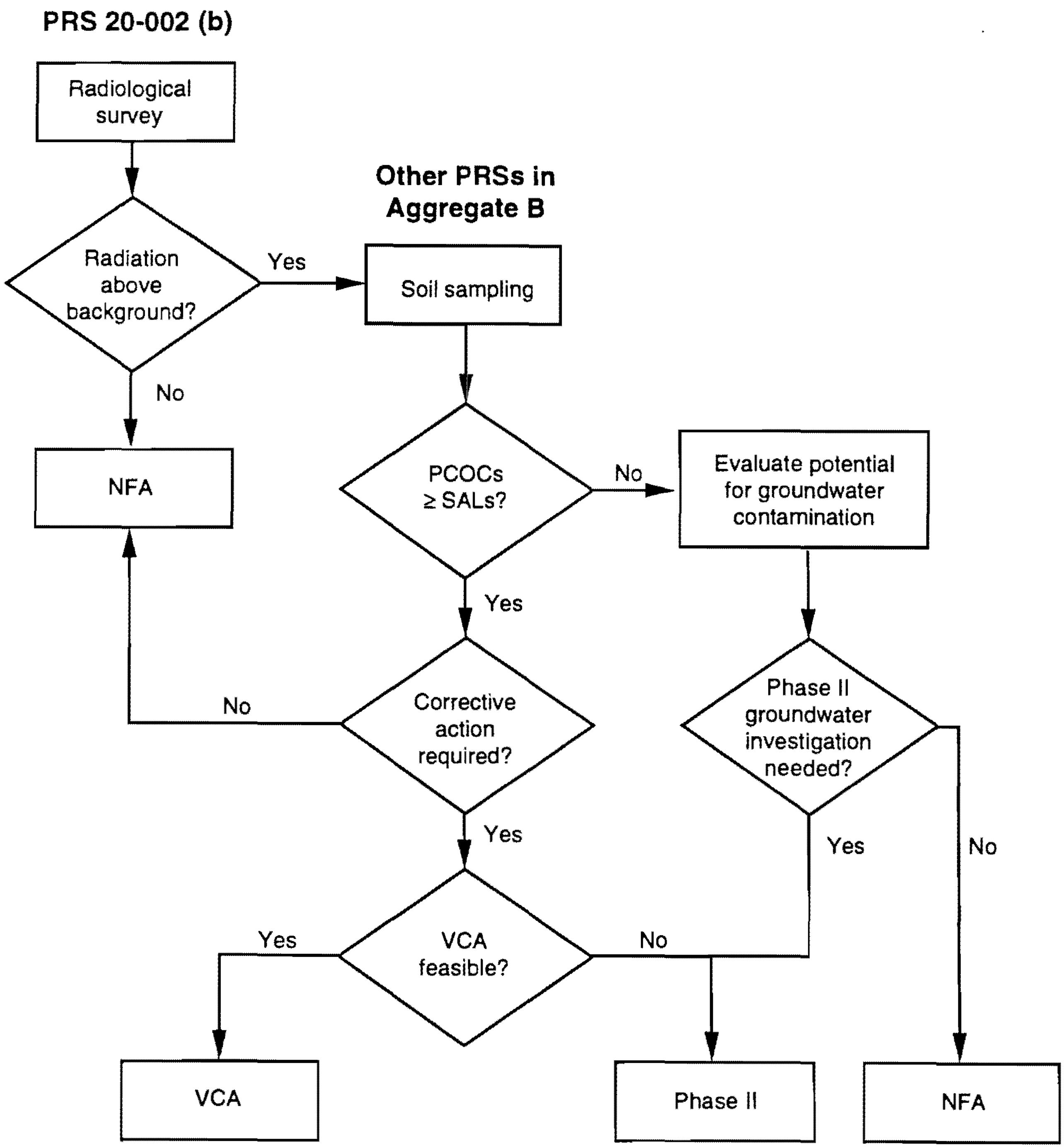


Figure 5-7. Decision logic for PRS Aggregate B.

TABLE 5-5

DQO SUMMARY FOR AGGREGATE B

DQO Step 1: Statement of the Problem	• Contaminants of concern may be present in surface soils, subsurface soils, and groundwater • Effectiveness of previous cleanups is unknown
DQO Step 2: Identification of Decisions (to be followed for each PRS individually)	Establish presence/absence of contaminants of concern using field screening and reconnaissance sampling
DQO Step 3: Data Inputs	Chemical data on types and concentrations of PCOCs in surface and subsurface soils
DQO Step 4: Boundaries	• Horizontal boundaries: - Firing sites - horizontal boundaries defined by areas within which firing debris was dispersed - Gun firing site PRS 20-003(b) - horizontal boundaries defined by area receiving runoff from impact area - Gun firing site PRS 20-003(c) - horizontal boundaries defined by area likely to have been used for disposal of soil from impact area - Firing range - horizontal boundaries defined by areas associated with greatest current risk of exposure • Vertical boundaries defined by expected depth of contamination
DQO Step 5: Decision Rules (to be followed for each PRS individually)	• If contaminants are present, go to Phase II investigation or, if contamination is limited, well defined, and poses a current risk, implement a VCA • If no contamination (including groundwater assessment) is present, recommend NFA
DQO Step 6: Design Criteria	90% probability of detecting soil contamination if 10 to 30% of sampled area (depending on PRS) is contaminated

5.2.4.1.3 Radiation Surveys

Each PRS having radiological PCOCs will be surveyed for radiation using a field instrument (e.g., FIDLER or phoswich) capable of detecting low-energy gamma emissions. The surveys, which will be performed according to Laboratory-approved SOPs, will verify the results of previous surveys and collect data that can be used to bias sampling locations.

5.2.4.2 Sampling and Analysis

Soil sampling at Aggregate B PRSs will be biased toward locations expected to have the highest concentrations of PCOCs. The radiation survey results will be used, to the extent possible, to bias horizontal sampling locations.

Using Laboratory-approved SOPs, all samples will be field-screened for radioactivity and HE, to identify gross concentrations of PCOCs, and will be analyzed for gross alpha, beta, and gamma radioactivity in an onsite mobile laboratory. Samples sent to an offsite analytical laboratory will be analyzed for all PCOCs (hazardous and radioactive). Quality control samples will be collected in accordance with the QAPP (Annex II). Table 5-6 summarizes the sampling and analysis plan.

TABLE 5-6
SUMMARY OF PHASE I SAMPLING AND ANALYSES FOR PRS AGGREGATE B

PRS No.	PRS Type	Phase I Approach	Field Surveys				Samples				Field Screening				Mobile Lab			Laboratory Analysis										
			Land Survey	Geophysical Survey	Radiation Survey	Geomorphic Survey	Sampled Media	Structure	Surface	Subsurface	Gross Alpha	Gross Gamma/Beta	Organic Vapor	High Explosive	Gross Alpha	Gross Beta	Gross Gamma	Gamma Spectroscopy	Total Uranium	Isotopic Uranium	Strontium-90	VOCs	SVOCs	HE	Metals	PCB	TPH	Cyanide
20-002(a)	Firing Site	Reconnaissance	X		X		Soil	0	11	11	X	X		X	X	X	X	X	X	X	X			X	X			
20-002(b)	Firing Site	Reconnaissance	X		X		Soil	0	4*	4	X	X		X	X	X	X	X	X	X	X			X	X			
20-002(c)	Firing Site	Reconnaissance	X		X		Soil	0	8	16	X	X		X	X	X	X	X	X	X	X			X	X			
20-002(d)	Firing Site	Reconnaissance	X		X		Soil	0	8	16	X	X		X	X	X	X	X	X	X	X			X	X			
20-003(b)	Gun Firing Impact Area	Reconnaissance	X		X	X	Soil	0	3	6	X	X		X	X	X	X	X			X				X			
20-003(c)	Gun Firing Impact Area	Reconnaissance	X		X		Soil	0	6	6	X	X		X	X	X	X	X			X				X			
72-001	Firing Range	Reconnaissance	X			X	Soil	0	7	0	X	X		X	X	X	X								X			

* Number of samples will be based on results of radiation survey; 4 surface and subsurface samples assumed for planning purposes.

5.2.4.2.1 PRS 20-002(a) - Steel-Lined Pit

Several factors were considered in deciding on the area to be sampled.

(1) Because this pit was designed to contain fragmented materials from explosives tests (it originally had a steel mesh cover), we expect that debris from the tests, if present, would be found over a smaller area than if the tests had been above ground.

(2) As described in Section 5.2.3.4 (DQO Step 4), the boundaries for sampling should be established by determining the areas most likely to be contaminated. In the case of firing sites, PCOC concentrations are expected to decrease with distance from the firing point. Data from an active above-ground Laboratory firing site showed concentrations of uranium and barium (an HE residue) decreasing rapidly to a distance of about 200 ft, then remaining relatively constant to a distance of 750 ft (the limit of the region sampled) (DOE 1989, 0425).

(3) The probability of locating the firing pit must also be considered. We believe that its location can be estimated, to within 50 ft, from engineering drawings.

(4) Finally, the influence of site disturbances is a factor. It is probable that surface soils around the firing pit were disturbed during removal of the pit.

On the basis of these factors, we defined the horizontal boundary of the sampling area as a 100-ft-radius circle around the estimated location of the pit (see Figure 5-8). A circle of this size should encompass the area that would contain the highest concentrations of PCOCs, allowing for uncertainty in the location of the pit and for the possibility that some of the soil surrounding the pit was removed when the pit was excavated. We defined the vertical boundaries, on the basis of the source of contamination, as the surface to 3 ft below the surface (see Section 5.2.3.4.2). We judge that at least 10% of the soils within these horizontal and vertical boundaries would contain PCOCs from firing activities. To meet the design criterion for this PRS (a 90% probability of detecting contamination over 10% of the sampled area), 22 samples will be collected (see Table 4-5); these will be taken from two depths at each of 11 locations: 0 to 6 in., using the spade and scoop method (LANL-ER-SOP-06.09); and 2.5 to 3 ft, using a hand auger (LANL-ER-SOP-06.10).

5.2.4.2.2 PRS 20-002(b) - Dumbos

Because only one Dumbo was used, for a single test, the explosion would not have dispersed any contamination. Only the interior of the used Dumbo was known to be radiologically contaminated (see Section 5.2.2.1.2). The Dumbos and associated structures were removed in 1948; it is not known whether any contaminated soil was also removed, but some general site contamination may have been caused by handling of the test debris.

As described in Section 5.2.3.4 (DQO Step 4), the boundaries for sampling (i.e., the study area) should be established by determining the areas most likely to be

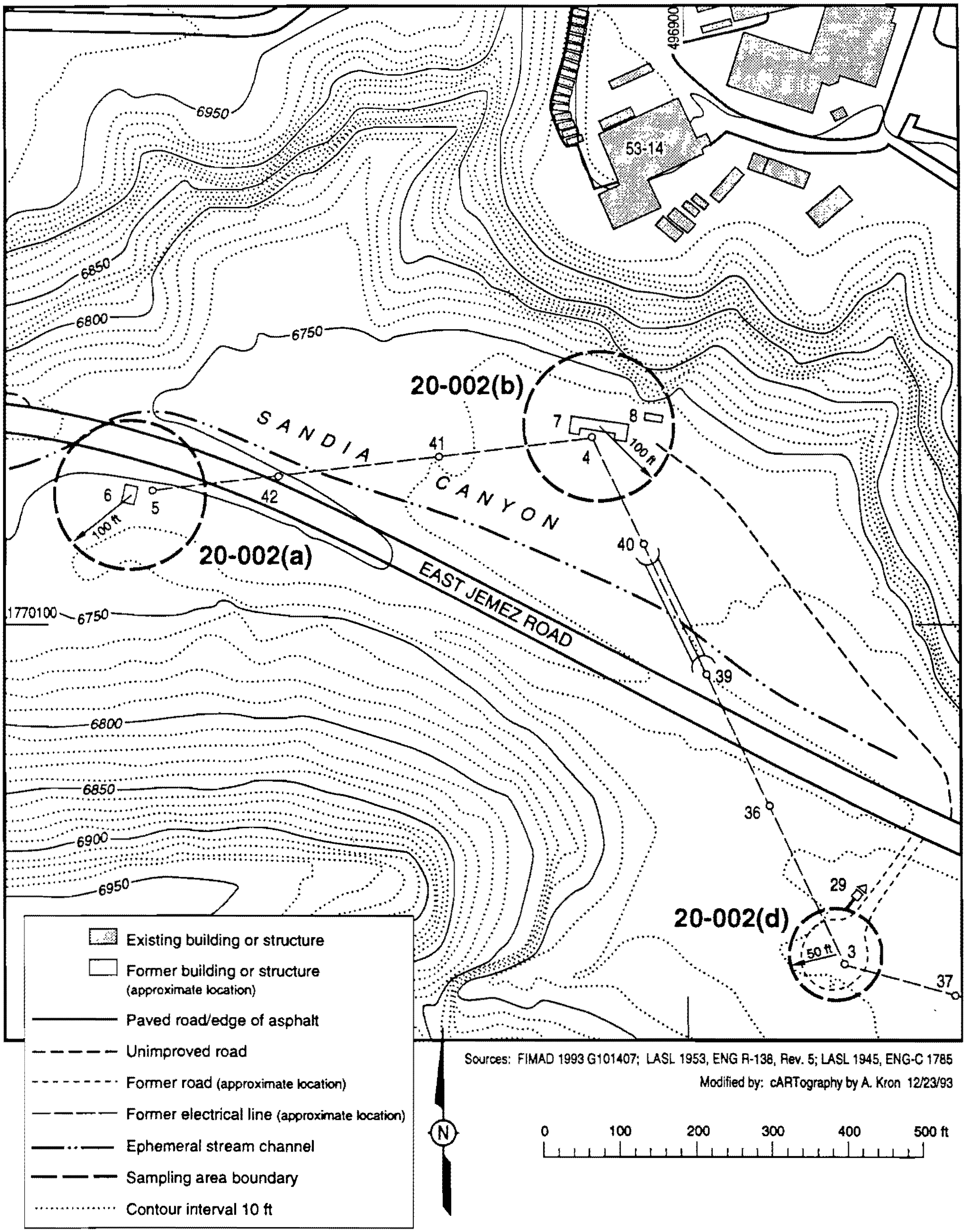


Figure 5-8. Sampling areas for PRSs 20-002(a), 20-002(b), and 20-002(d).

contaminated. We believe that the location of the 91-ft x 14-ft concrete platform (Structure TA-20-7) on which the shot took place can be determined (to within 50 ft) from engineering drawings. When the site was in its original condition, the highest levels of soil PCOCs would have been expected at the edge of this platform. Given the possibility that some soil was removed when the platform was removed, the highest levels of PCOCs would now be expected in the areas closest to the original location of the platform that still have undisturbed soil. We estimate that soil removal extended no more than 10 ft beyond the edge of the concrete platform, but there is no data on the actual extent. On the basis of this information, we defined the study area as a 100-ft-radius circle around Structure TA-20-7 (see Figure 5-8).

Because only a small fraction of the study area is expected to contain PCOCs, a reconnaissance sampling program having a high probability (e.g., 90%) of detecting contamination would require a great number of samples (see Table 4-5). Such a program did not appear justified in light of the low potential for contamination (the site was used only once, the test shot was contained in the Dumbo, and the site was later cleaned up). On the other hand, we do not recommend NFA because a previous radiation survey (although inconclusive) identified above-background readings.

The Phase I approach we propose is to resurvey the study area radiologically, using a 10- by 10-ft grid, which will produce approximately 300 readings. We will then collect surface soil samples at biased locations (those having radiation levels above background), from the 0- to 6-in. depth interval, using the spade and scoop method (LANL-ER-SOP-06.09), and from the 2.5- to 3-ft depth interval using a hand auger (LANL-ER-SOP-06.10). If no above-background readings are obtained during the radiation survey, NFA will be recommended.

5.2.4.2.3 PRS 20-002(c) - Firing Pad Bordered on Three Sides by Earth Berm

As described in Section 5.2.3.4 (DQO Step 4), the boundaries for sampling should be established by determining the area most likely to have been contaminated by site activities. Assuming, as for other such sites, that PCOC concentrations will decrease with distance from the firing point, the highest concentrations would be expected within the bermed area. In addition to this assumption, we considered the probability of accurately locating the firing point and the influence of site disturbances in establishing the boundaries of the sampling area.

We believe that the location of the firing point can be determined with a high degree of certainty (to within 50 ft) from engineering drawings. The berm is no longer present, but an engineering drawing (LASL 1951, 22-0056) indicates that its diameter was about 60 ft. It is not known whether, during removal of the berm, soil was also removed from the site (or possibly spread over the site). If soil was removed, we would expect to find the highest PCOC concentrations at the edge of the area from which soil was removed. If soil was not removed, the highest concentrations would be beneath the surface of the firing point.

To allow both for the uncertainty in locating the firing point and for the possibility that soils were removed from the site, we established the horizontal boundary of the sampling area as a 100-ft-radius circle centered on the expected location of the firing point (Figure 5-9). The vertical boundaries were defined as the surface to 5 ft below the surface (see Section 5.2.3.4.2).

We estimate that if soils were removed along with the berm, at least 10% of the soils remaining within these horizontal and vertical boundaries would potentially be contaminated; and if soil was not removed, but was buried, at least 25% would potentially be contaminated. To cover both of these possibilities, we will use the more conservative sampling design criterion: a 90% probability of detecting contamination over 10% of the sampled area. This criterion requires collection of at least 22 samples (see Table 4-5). We will collect samples from three depths at each of eight locations: 0 to 6 in., using the spade and scoop method (LANL-ER-SOP-06.09); 2.5 to 3 ft (3 ft is the estimated maximum depth of soil cover, based on the dimensions of the berm and the area of the site), by hand auger (LANL-ER-SOP-06.10); and 4.5 to 5 ft, by hand auger.

5.2.4.2.4 PRS 20-002(d) - Firing Site

Apparently used by Group M-4 for implosion tests following the war, this site reportedly was the location of a low-order shot involving 500 pounds of Composition B and has undergone extensive surface cleanup. No containment features, such as berms, can be found on drawings. As described in Section 5.2.3.4 (DQO Step 4), the boundaries for sampling should be established by determining the area most likely to have been contaminated by site activities. Given the nature of operations at this site, both surface and subsurface contamination could be present.

Again using the assumption that PCOC concentrations decrease with distance from the firing point, we would expect contamination from surface deposition of particulates to be highest in the area immediately around the test point. Even though the site was cleaned up, the extent of cleanup is not known (contaminated surface soils may remain). Subsurface contamination resulting from contaminants being driven into the ground by the explosion would be expected beneath the firing point.

Historical data will allow us to locate the firing point with a high degree of certainty (to within 50 ft). In addition, this site has undergone very little disturbance. For these reasons, we have established a circle with a radius of 50 ft around the firing point as the horizontal boundary of the sampling area (see Figure 5-8). The vertical boundaries are from the surface to 5 ft below the surface (see Section 5.2.3.4.2).

The distribution of PCOCs in surface soils, and of PCOCs that have been subsequently leached from the surface into subsurface soils, will have a greater areal extent than PCOCs that were driven into the subsurface by explosions at the firing point. These distribution differences imply different design criteria for sampling. We would expect at least 25% of the soil within the horizontal and vertical boundaries to potentially contain contamination from surface deposition and at least 10% to potentially contain contamination from explosions at the firing point. To cover both of these expected distributions, we will use the more conservative sampling design criterion: a 90% probability of detecting contamination if at least 10% of the sampled area is contaminated. This criterion

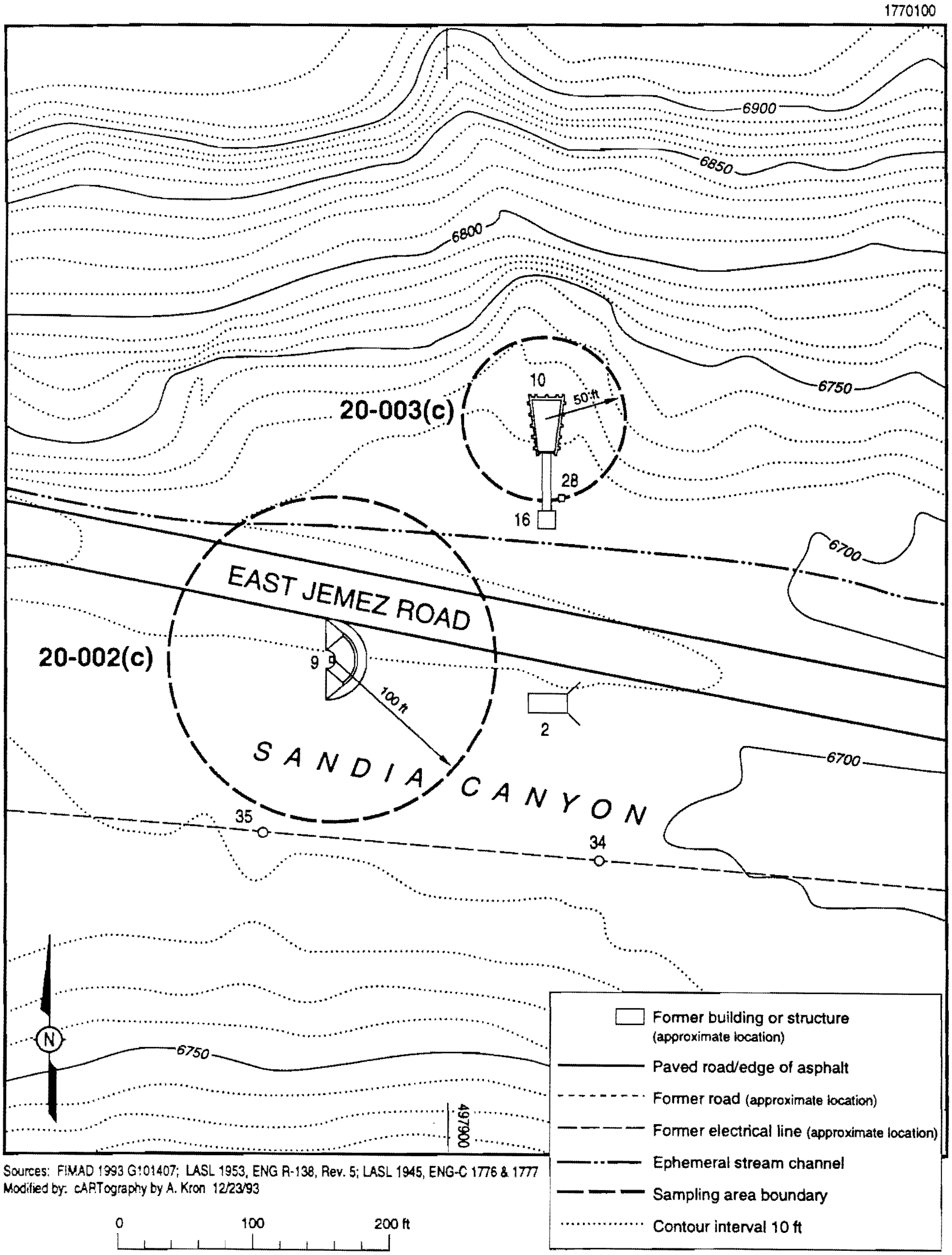


Figure 5-9. Sampling areas for PRSs 20-002(c) and 20-003(c).

requires collection of at least 22 samples (see Table 4-5). We will collect samples from three depths at each of eight locations: 0 to 6 in., using the spade and scoop method (LANL-ER-SOP-06.09); 2.5 to 3 ft, by hand auger (LANL-ER-SOP-06.10); and 4.5 to 5 ft, by hand auger.

5.2.4.2.5 PRS 20-003(b) - 20-mm-Gun Site

In the case of this PRS, the guidance of DQO Step 4 would be very difficult to follow, because the area most likely to have received contamination is the cliff face against which steel plates were set as targets for the gun tests. On the other hand, much of the contamination from this impact area would have migrated via the drainage channel to downstream locations. For this reason, we have established the boundaries of the sampling area to encompass the drainage channel for the canyon (Figure 5-10).

The design criterion for sampling of sediments in catchment basins is a 90% probability of detecting contaminants if at least 30% of the sediments are contaminated (the 30% value is based on the expected distribution of PCOCs in sediments). This criterion requires collection of nine samples (see Table 4-5); these will be collected from the first three areas identified as sediment catchments downstream of the suspected impact area. The sampling locations will be selected on the basis of geomorphic survey results.

The samples will be taken, by hand auger (LANL-ER-SOP-06.10), from three depths at each location: the top 12 in. of the soil profile, a 12-in. section at the mid-depth of the profile, and the bottom 12 in. At each location, the surface sample will be collected first. Then the sampler will be advanced to the soil/bedrock interface, and a sample will be collected from immediately above bedrock. (If bedrock has not been encountered by a depth of 5 ft, the sample will be collected at 5 ft.) The mid-depth sample will be collected from a second hole immediately adjacent to the first, at a depth halfway between the surface and bedrock (or, if bedrock was not encountered, at a depth of 2 - 3 ft).

The lithology will be logged from the first borehole, as the hole is drilled.

5.2.4.2.6 PRS 20-003(c) - Navy Gun Firing Site

The soil most likely to have been contaminated from operations at this site is that within the earth-bermed impact area. It is not known what was done with the soil within the berm when the structure was dismantled in 1948, but the more conservative assumption would be that it was disposed of on the site. From the dimensions of the berm, we estimate that the volume of soil in question, if spread to a depth of 1 ft, would require an area of approximately 60 x 60 ft.

We considered these factors, as well as the probability of accurately determining the former location of the berm, in establishing a circular area of 50-ft radius around the berm as the horizontal boundary of the sampling area (see Figure 5-9). The vertical boundaries are defined as the surface to 3 ft below the surface (see Section 5.2.3.4.2). If the estimated volume of soil was disposed of on site, it would make up approximately 15% of the soil within the horizontal and vertical boundaries. Allowing for vertical migration of contaminants by leaching, we estimate that at least 25% of the soil within the boundaries is potentially

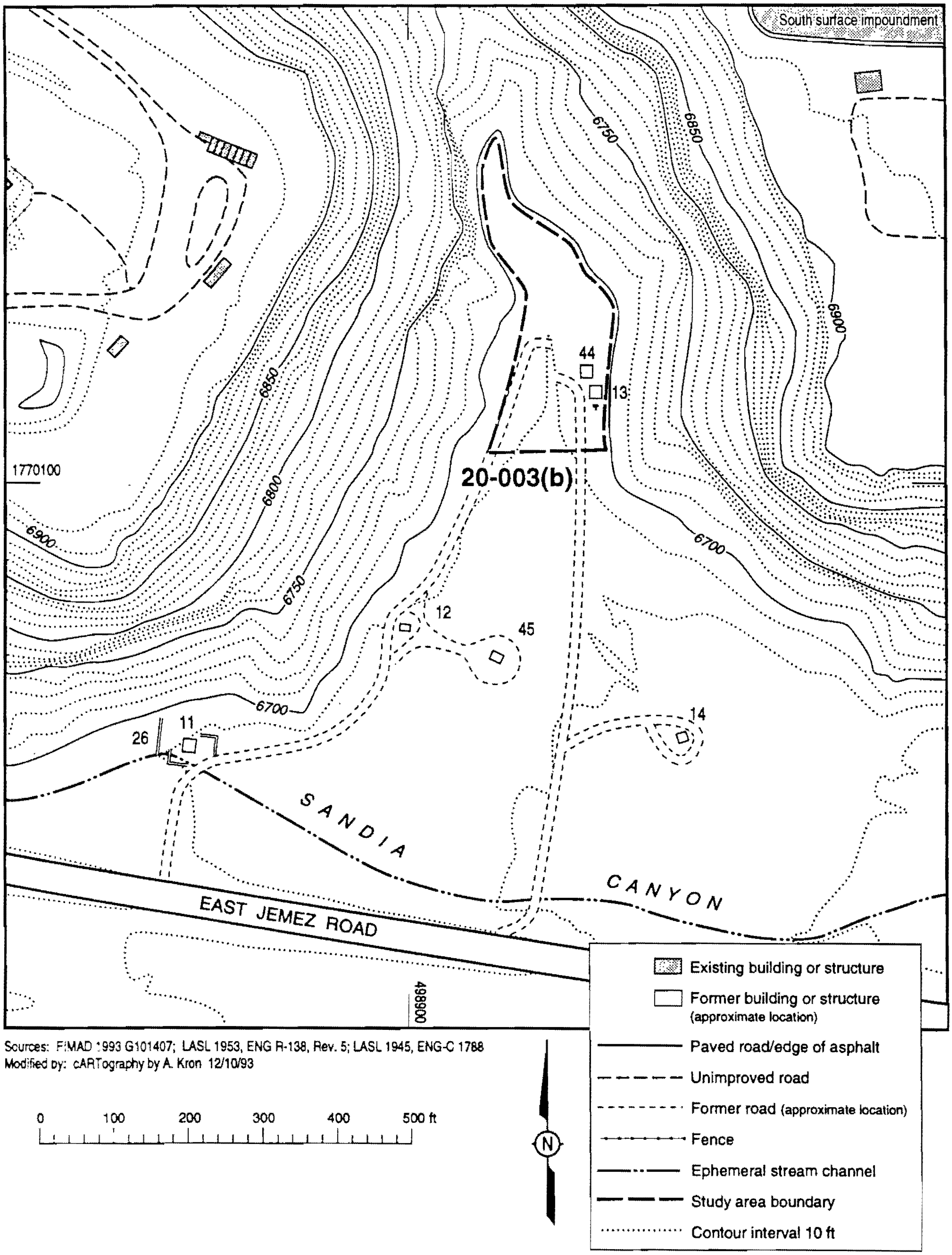


Figure 5-10. Study area for PRS 20-003(b).

contaminated. For this reason, we have selected as the sampling design criterion for this PRS a 90% probability of detecting contamination if at least 25% of the sampled area is contaminated. This criterion requires collection of at least 11 samples (see Table 4-5). Samples will be collected from two depths at each of six locations (not to include the canyon wall): 0 to 6 in., using the spade and scoop method (LANL-ER-SOP-06.09); and 2.5 to 3 ft, using a hand auger (LANL-ER-SOP-06.10).

5.2.4.2.7 PRS 72-001 - Active Firing Range

As described under Section 5.2.3.4, in-vestigations within the active range will be deferred if the site can be shown not to pose a current risk.

The horizontal boundary of the area to be sampled during Phase I will encompass those areas outside the range that receive drainage from the PRS. Given the relatively flat topography of the site and the lack of obvious drainage channels, runoff is assumed to be sheet flow that follows the topographic slope to the east toward the stream channel in the canyon bottom. The horizontal boundary, therefore, will consist of the downslope area to the eastern boundary of the site (see Figure 5-11). Because potential contamination is associated with surface runoff, the vertical boundaries will be from the surface to 6 in. below the surface. Sampling locations will be selected on the basis of geomorphic survey results.

The design criterion for sampling of this area is a 90% probability of detecting contaminants if at least 30% of the sampled area is contaminated. (The 30% value is based on the assumption that contamination distributed over a large area by runoff would be fairly homogeneous.) This criterion requires collection of seven surface samples (see Table 4-5) within the defined area. The samples will be taken from depths of 0 to 6 in. using the spade and scoop method (LANL-ER-SOP-06.09).

5.3 Aggregate C - Waste and Product Storage Areas

5.3.1 Description and History

Aggregate C consists of waste accumulation and product storage areas at TA-53. Information on these sites is summarized in Table 5-7.

5.3.1.1 PRS 53-001 - Waste Accumulation Areas

5.3.1.1.1 PRS 53-001(a) - Waste Accumulation Area at Building TA-53-2

Building TA-53-2, the Equipment Test Laboratory, contains laboratories and shops for fabrication, repair, and testing of equipment used at LAMPF. Two waste accumulation areas were identified as located here in the RCRA Facility Assessment (RFA) (Kearney et al. 1987, 22-0021) and in the CEARP reports (DOE 1986, 8657 and DOE 1987, 0264), but no specific locations were given. The SWMU Report (LANL 1990, 0145), citing these earlier documents, describes PRS 53-001(a) as a 55-gal. steel drum (the contents were not identified) on a

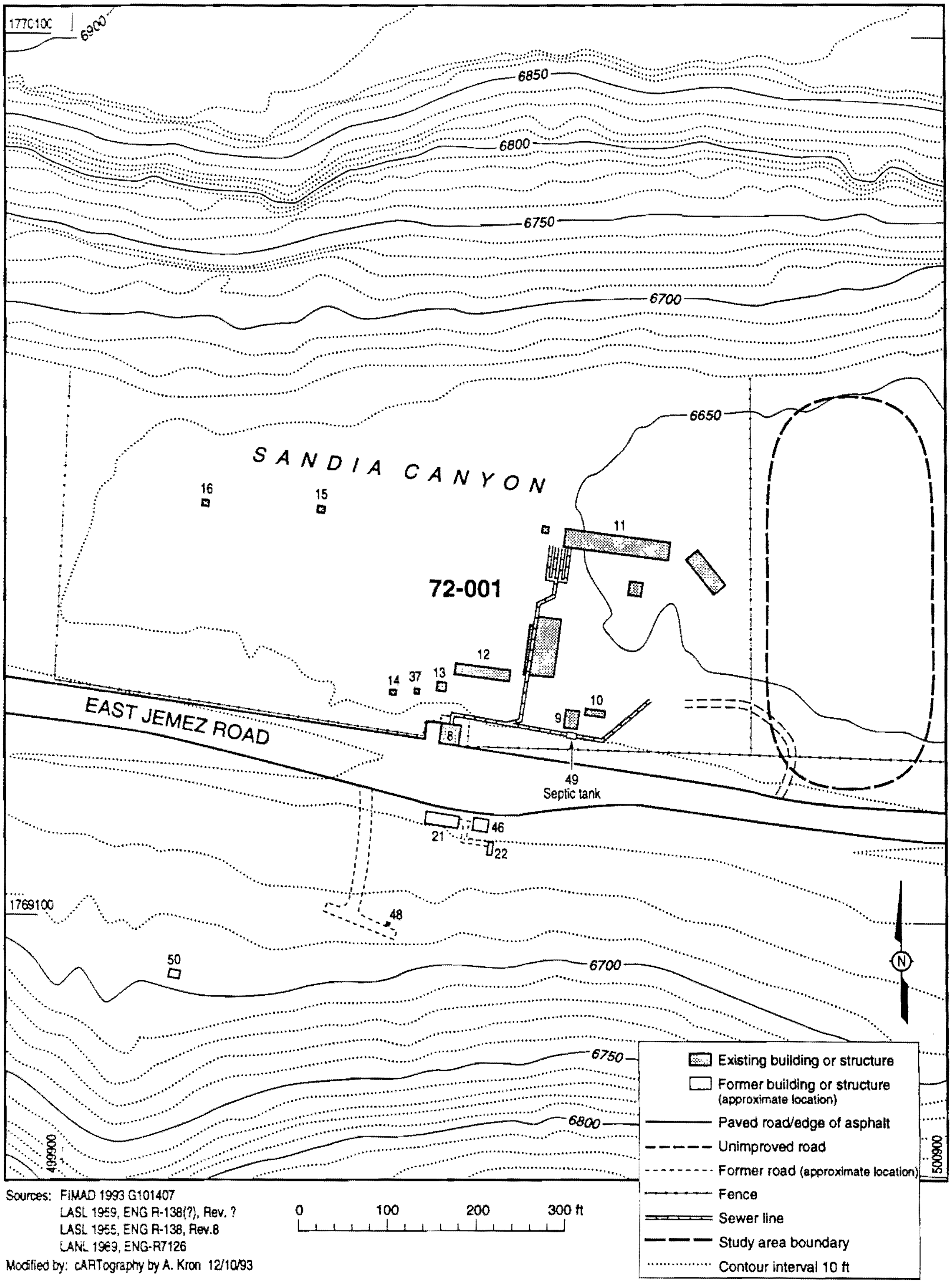


Figure 5-11. Study area for PRS 72-001.

TABLE 5-7

PRS AGGREGATE C - WASTE AND PRODUCT STORAGE AREAS

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Potential Contaminants of Concern
53-001(a)	Waste Accumulation Area	TA-53-2	Active	Approximately 1968-present	VOCs, PCBs, metals, total petroleum hydrocarbons (TPH)
53-001(b)	Waste Accumulation Area	TA-53-2	Active	Approximately 1970-present	VOCs, PCBs, metals, TPH
53-001(e)	Waste Accumulation Area	TA-53-25	Inactive, removed	Approximately 1981-1992	VOCs, TPH
53-001(g)	Waste Storage Shed	TA-53-1031	Active	Late 1980s-present	VOCs, metals, TPH
53-005	Waste Oil Pit	TA-53-2	Inactive; removed	Approximately 1970-1986	VOCs, PCBs, metals, TPH
53-008	Boneyard	NA	Active	Approximately 1972-present	Radionuclides, metals
53-010	Mineral Oil Storage Area	NA	Inactive	1989-1990	SVOCs, TPH

concrete and asphalt pad and states that stains had been observed on this pad by the EPA contractors. But it is not clear whether the pad referred to is at this site or at PRS 53-001(b) (see 5.3.1.1.2). The SWMU Report describes PRS 53-001(b) as a less-than-90-days storage site. No additional information could be found in the CEARP reports (the 1986 CEARP working draft indicated that acids and spent alcohol from repair and rebuilding operations at TA-53-2 were stored in drums, but did not identify the location of the drums; the 1987 CEARP draft report did not identify any waste storage activities associated with TA-53-2).

A series of photographs taken at TA-53 during 1989 show two waste accumulation areas at Building TA-53-2, one on the north side and one on the south. Signs were visible at the south site, identifying it as a less-than-90-day storage area. On the basis of these photographs, we have identified the north site as PRS 53-001(a) (see Figure 5-12). One photograph (LANL 1989, 22-0047) showed this site to consist of a covered concrete pad with drum-storage racks. It appeared to contain mainly product drums, but a sign identifying it as a satellite waste accumulation area was also visible. No evidence of releases (e.g., staining) was apparent in the photograph. The area has probably been in use since about 1968, when operations at TA-53-2 began; wastes seem to have been stored here through 1992, and products still are.

PRS 53-001(a) was inspected during preparation of the work plan and was found to appear much as it did in the 1989 photograph. The concrete pad has 4-in. concrete curbs and a drain spigot for rainwater on the northwest corner. At least half of the pad appears to lie on the asphalt parking lot. The site appears to be used exclusively for nonhazardous waste storage: the satellite waste accumulation sign has been replaced with one reading "new, used (non-PCB) oil." No containers of hazardous waste were present, and no evidence of releases was observed. TA-53 personnel confirmed that all hazardous waste is now stored at the south site (PRS 53-001[b]). Further confirmation comes from

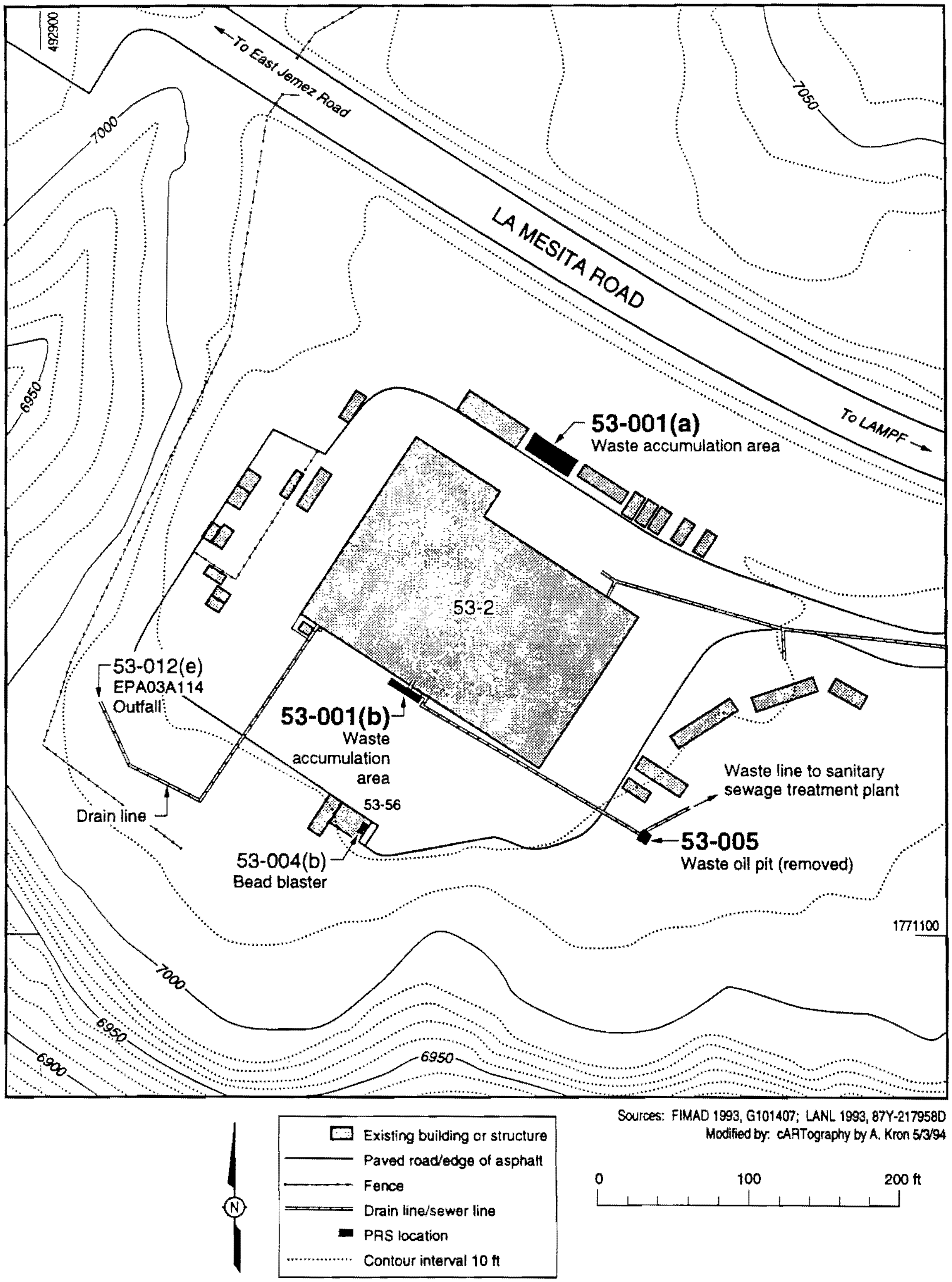


Figure 5-12. Locations of PRSs 53-001(a), 53-001(b), and 53-005.

the waste accumulation area tracking system maintained by EM-8 (LANL 1993, 22-0050), which notes that a satellite area to the north side of TA-53-2 is no longer being used.

5.3.1.1.2 PRS 53-001(b) - Waste Accumulation Area at Building TA-53-2

As noted in the discussion on PRS 53-001(a), PRS 53-001(b) was identified in the SWMU Report (LANL 1990, 0145) as a less-than-90-days storage area located at Building TA-53-2 (no specific location was given) that had previously been identified in the RFA. Materials reportedly stored at this site are spent solvents and acids.

This site was identified from the 1989 photographs (LANL 1989, 22-0048) that showed the site south of TA-53-2 (Figure 5-12) as marked by the signs required for less-than-90-days storage. The photograph shows a drum rack (at the time, six product drums and three waste drums were present) on an unbermed concrete pad. No evidence of leakage is visible in the photograph, and the asphalt beneath the pad appears clean. An engineering drawing dated April 1971 (LASL 1971, 22-0064) also shows a storage site with a drum rack in this location, identified as the trichloroethylene (TCE) and freon waste storage area. According to available records, the drums were removed from the site in 1990.

PRS 53-001(b) was inspected in September 1993, during preparation of the work plan. The drum rack had been replaced by four locked cabinets that are used for storage of hazardous products and hazardous wastes. No staining on the concrete or the underlying asphalt pavement was noted during the inspection.

5.3.1.1.3 PRS 53-001(e) - Waste Accumulation Area at Building TA-53-25

Building TA-53-25 is a technical shop located adjacent to the LAMPF accelerator building, between Sectors C and D. It was constructed around 1981 (LANL undated, 22-0051). PRS 53-001(e) was identified in the SWMU Report (LANL 1990, 0145) as a waste storage area on the east side of Building TA-53-25. Materials noted as stored here are solvents, freon, and vacuum-pump oil.

A 1989 photograph (LANL 1989, 22-0049) shows a satellite storage area on a gravel surface approximately 30 ft south (rather than east) of TA-53-25. One drum of used ethanol (labeled as hazardous waste), one of used vacuum-pump oil, and one of used freon could be identified in the photograph; no evidence of spills or leaks was visible.

The area was inspected in September 1993, during preparation of the work plan, to verify the information in the SWMU Report. No waste storage area was found at the east side of the shop. One was found on the south side, but not in the location shown in the 1989 photograph; instead, it was situated immediately south of the building on the asphalt pavement. This storage area had apparently replaced the former one. Nothing was found in the gravel area some 30 ft south of the building, which we conclude is the site of PRS 53-001(e) (see Figure 5-13). It was probably in use from about 1981 until 1992.

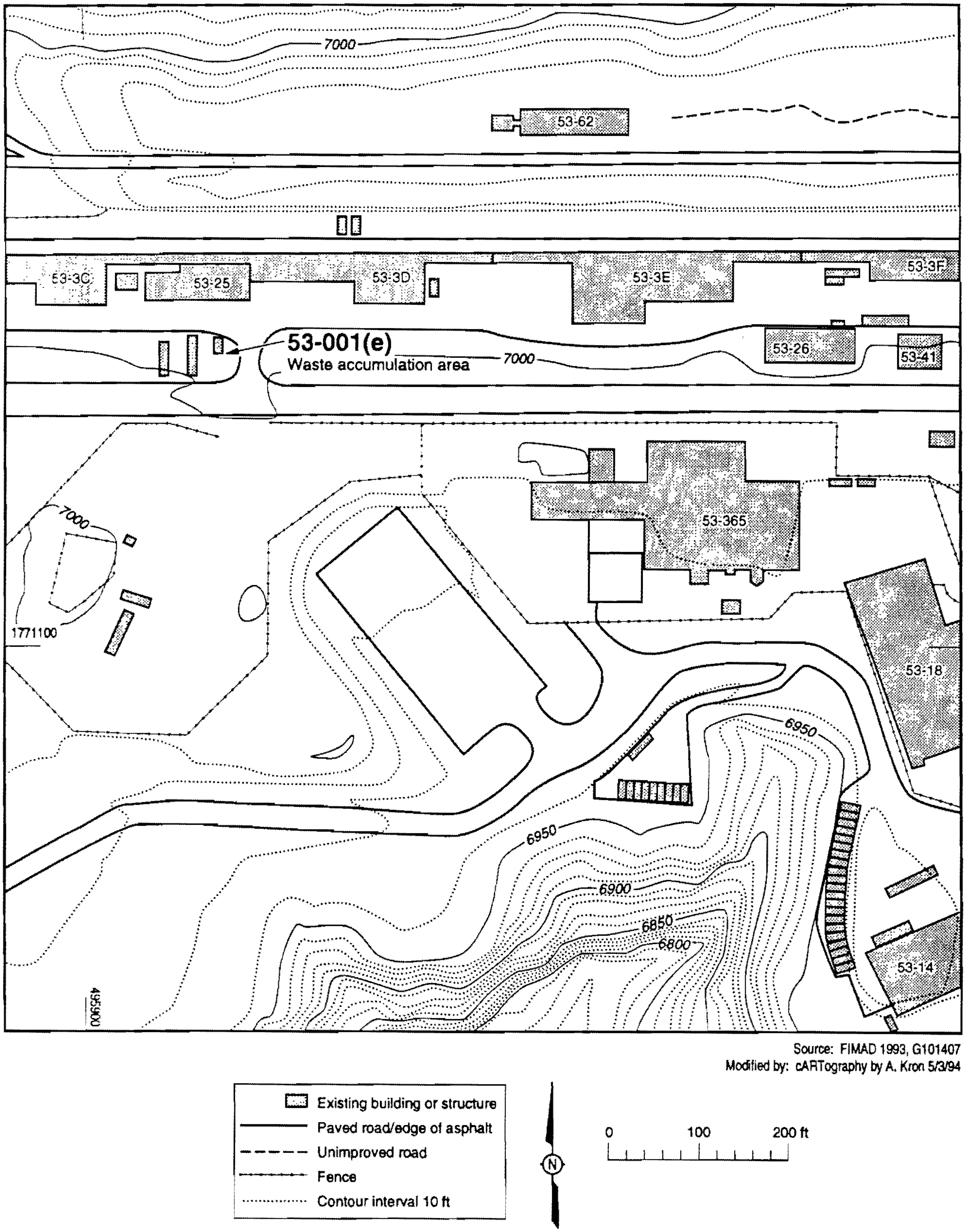


Figure 5-13. Location of PRS 53-001(e).

5.3.1.1.4 PRS 53-001(g) - Waste Storage Shed (TA-53-1031)

Building TA-53-1031 is an oil and waste storage shed located south of the LANSCE complex in a locked, fenced area (Figure 5-14). The shed is enclosed on all sides and has a concrete floor with secondary containment curbing. In the SWMU Report, PRS 53-001(g) was identified as a waste storage area in the northeast corner of Building TA-53-1031 that contained solvents, lead sheets, lead bricks, cadmium sheets, gasoline, and waste oil.

This shed was inspected during preparation of the work plan, to verify the information in the SWMU Report; the entire shed (not just the northeast corner) was being used to store 55-gal. and 30-gal. drums of various materials, such as gasoline, acetone, ethanol, hydraulic oil, hydraulic fluid, and vacuum-pump oil. The pump oil and the hydraulic oil drums were leaking, and sorbent had been spread on the floor. In addition to the lead bricks and lead sheets noted in the SWMU Report, other lead items (shaped forms, shot) were found.

The wastewater stream characterization study for Building TA-53-1031 (Santa Fe Engineering 1993, 22-0070) identified a single drain in the concrete floor; it discharged to the ground and had a locked valve on the discharge pipe. (At one time the shed apparently had an open front that allowed rainwater to enter, but the front is now closed off by sliding doors.) Inspection of the area around the discharge pipe revealed no evidence of staining or contamination.

5.3.1.2 PRS 53-005 - Waste Oil Pit

PRS 53-005 is the site of a former waste oil pit that was located east of Building TA-53-2 (Figure 5-12). An engineering drawing dated April 2, 1971 (LASL 1971, 22-0064) shows the pit, which was probably dug ca. 1970, as located approximately 80 ft southeast of the southeast corner of TA-53-2.

The 1986 Working Draft CEARP Report (DOE 1986, 8657) describes this pit as being full of a thick, brownish liquid and covered by a steel grate. It apparently was unlined and dug directly into the tuff. The pit was believed to be about 6 ft deep and to have received acids and oils. The 1987 draft CEARP Report (DOE 1987, 0264) indicates that the pit and its contents were removed in 1986. The SWMU Report (LANL 1990, 0145) states that liquid in the pit was sucked out, sampled, and stored in drums, that the pit sides were scraped out and put into drums, and that the drums were picked up for disposal by HSE-7. The effectiveness of the cleanup could not be verified because no soil sampling data could be located.

Information from engineering drawings indicates that the pit may have been used for disposal of several waste streams, including solvents and acids. An engineering drawing dated April 2, 1971 (LASL 1971, 22-0064), titled "Trichloroethylene and Freon Waste System Modifications," shows piping modifications that would route TCE and freon wastes from Room 105 of Building TA-53-2, via new 1-in. black iron pipe, to this pit. (These wastes were formerly piped to 10 55-gal. drums outside the building.) Before these modifications, the pit apparently received wastes only by dumping; no previous pipe system appears in the drawing. The drawing also shows the replacement of the pit's wooden cover by a 8-ft by 8-ft aluminum grate.

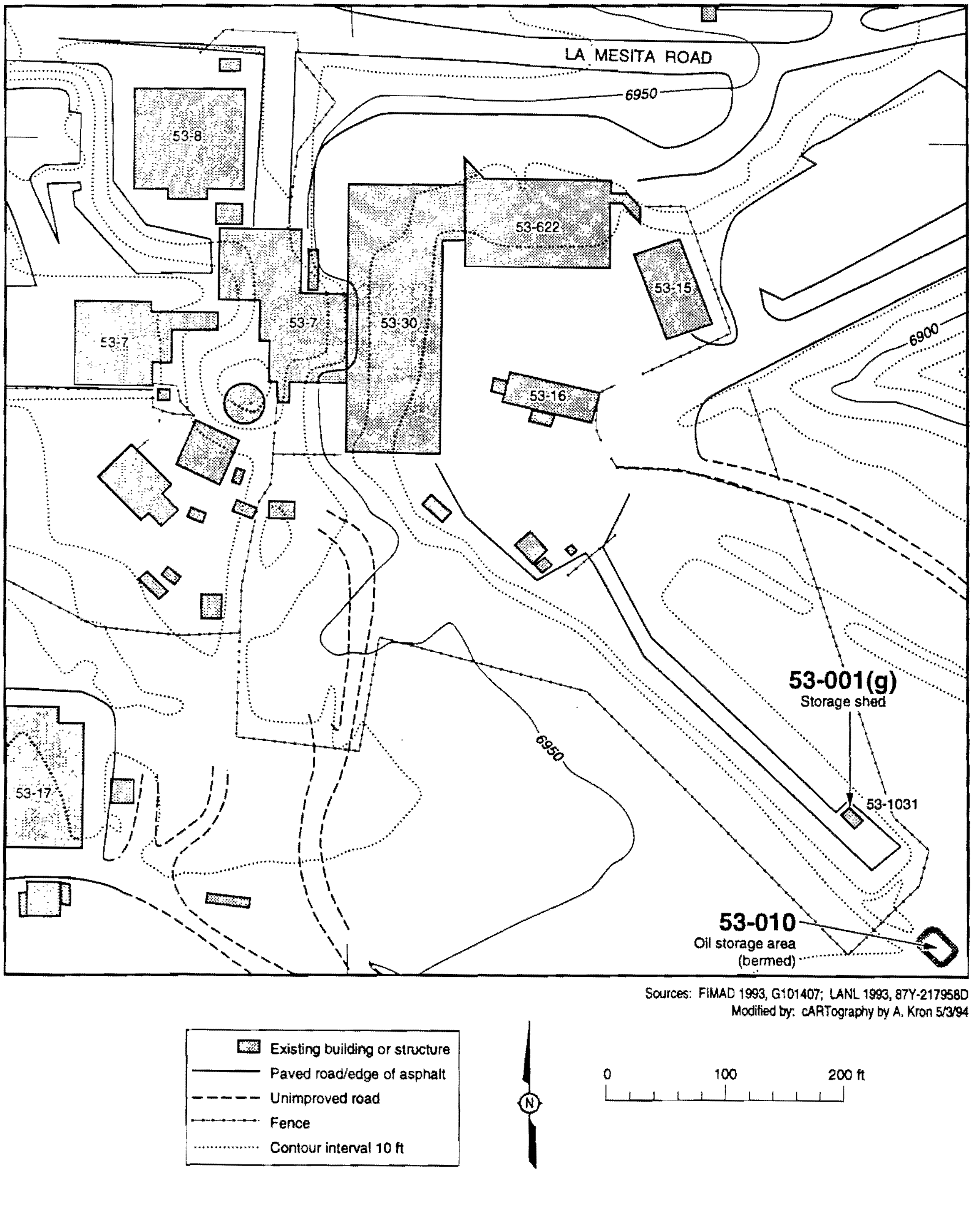


Figure 5-14. Locations of PRSs 53-001(g) and 53-010.

Another engineering drawing dated February 2, 1976 (LASL 1976, 22-0065), titled "Acid Drain Replacement Piping Installation Plan," shows further modifications to the waste system. According to this drawing, the 1-in. black iron pipe used for solvent wastes was replaced with a 2-in. stainless-steel pipe. This pipe, for acidic wastes, is shown to be connected to four sinks in Room 105.

When PRS 53-005 was inspected as part of work plan preparation, it was found to be clean. No evidence of previous releases was noted. The site is contoured and properly drained.

5.3.1.3 PRS 53-008 - Boneyard

This PRS is described in the SWMU Report (LANL 1990, 0145) as a 3- to 4-acre boneyard located near the surface impoundments (PRSs 53-002[a] and [b]). As shown in Figure 5-15, it covers an area to the north, east, and south of these impoundments, and can be accessed by road only through a locked gate. The area contained several locked trailers and drums, the contents of which are unknown but are described as radioactively contaminated. The RFA noted that no hazardous materials were present (Kearney et al. 1987, 22-0021).

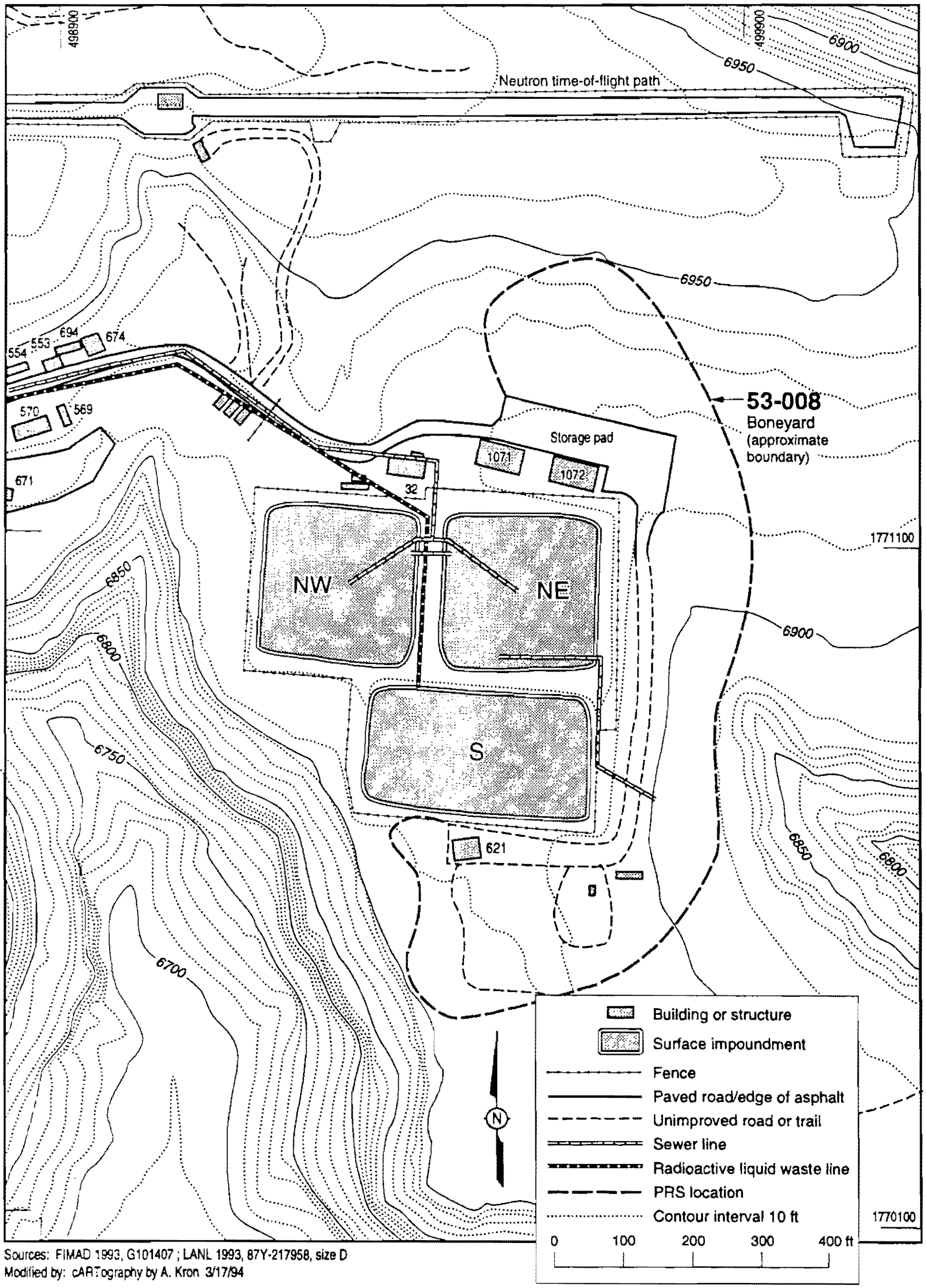
When this PRS was inspected in September 1993 in conjunction with this work plan, it was observed to contain shielding blocks (both magnetite concrete and steel), concrete, steel, and other metallic debris, two low-boy trailers, and other miscellaneous items. No hazardous materials or chemicals were observed—with the exception of Building TA-53-621, identified as a "Lead Shed," at the south end of the boneyard. Signs posted on this structure warn of potential hazards from airborne lead dust, and an SOP for entry to the building is posted on the front door.

No signs were posted in the boneyard to identify it as a radiological control area. We suspect that if any radioactive contamination is present, it is limited to reinforcing steel in the concrete shielding blocks, which may have become internally activated.

5.3.1.4 PRS 53-010 - Mineral Oil Storage Area

The SWMU Report (LANL 1990, 0145) describes this PRS as a bermed storage area southeast of TA-53-30 (see Figure 5-14), and notes that it was in use from 1989 to 1990. The report also notes that two 3,000-gal. tanks and eighteen 55-gal. drums of mineral-oil-based liquid scintillator, described as containing a small percentage of pseudocumene, were stored here when the site was active; and that all of these had been removed. In addition, two small areas of oil-stained soil had been removed and disposed of at TA-54 (Area G).

This area was inspected in September 1993, as part of work plan preparation. The storage area measured approximately 22 ft by 34 ft with 2-ft-high berms made of soil. The interior slopes of the berms and the floor were lined with a reinforced, welded geomembrane and covered with a protective layer of soil. Erosion of this layer around the top of the interior slope had exposed the synthetic liner to sunlight, causing localized deterioration (the liner over the lower portions of the berm and the floor appeared to be intact).



Sources: FIMAD 1993, G101407 ; LANL 1993, 87Y-217958, size D
Modified by: cARTography by A. Kron 3/17/94

Figure 5-15. Location of PRS 53-008.

No waste materials or containers were observed within this former storage area, nor any evidence of soil staining or visible contamination. Several circular indentations, probably imprints from the 55-gal. drums, were visible on the surface of the soil cover.

5.3.2 Conceptual Exposure Model for Aggregate C

The conceptual exposure model for the PRSs in Aggregate C are shown in Figure 5-16. This model is based on archival information only and will be refined or modified on the basis of data gathered during the RFI.

5.3.2.1 Existing Information on Nature and Extent of Contamination

5.3.2.1.1 PRS 53-001

These hazardous waste accumulation areas include one less-than-90-day area and three satellite areas. The wastes and materials formerly and/or currently stored at these sites are summarized in Table 5-8. At all of these sites, releases are either known or suspected to have occurred, from spills or leakage; evidence of such releases consists primarily of stained soil, concrete, and/or asphalt. No actual sampling data are available for any of these PRSs, but migration of PCOCs into the environment by runoff or leaching is possible.

5.3.2.1.2 PRS 53-005

The waste oil pit and its contents, which probably included solvent wastes (TCE and freon), oil and grease wastes, and acidic wastes, were removed in 1986 (DOE 1987, 0264 and LANL 1990, 0145). According to the SWMU Report (LANL 1990, 0145), analysis of the liquid in the pit showed PCB levels of 4 to 5 parts per

TABLE 5-8

WASTES AND MATERIALS STORED AT AGGREGATE C PRSs

PRS No.	Wastes/Materials Stored
53-001(a)	Solvents (alcohols and halogenated solvents), mineral oil, waste acids
53-001(b)	Solvents (alcohols and halogenated solvents), mineral oil, waste acids
53-001(e)	Solvents (alcohols and halogenated solvents), vacuum-pump oil
53-001(g)	Solvents (alcohols, acetone, and halogenated solvents), lead, cadmium, vacuum-pump oil, hydraulic oil, hydraulic fluid, gasoline
53-005	Solvents (halogenated), waste acid, mineral oil
53-008	Concrete, steel, lead
53-010	Mineral-oil-based liquid scintillator

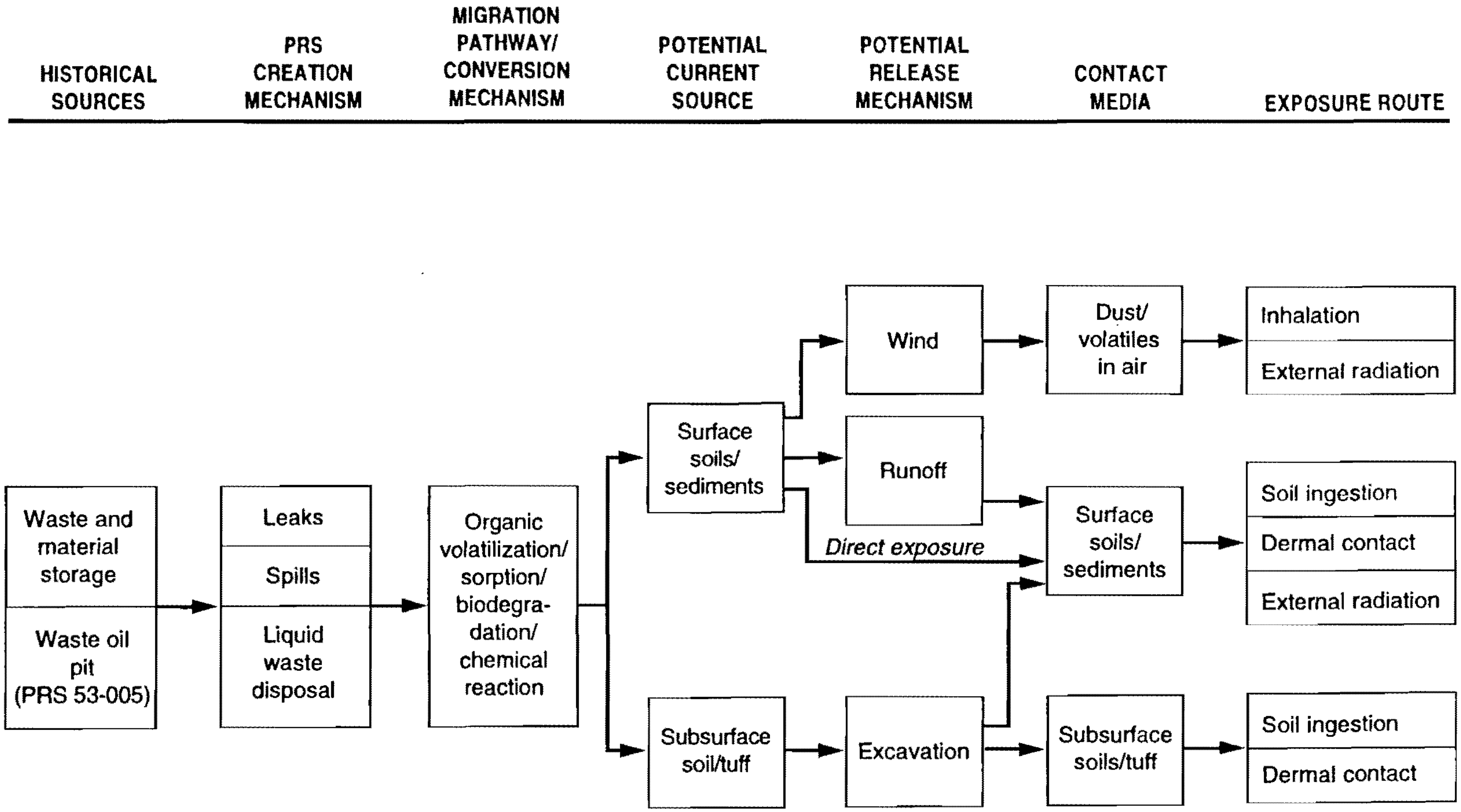


Figure 5-16. Conceptual exposure model for PRS Aggregate C.

billion. After the pit was scraped out (and the scrapings were sampled and sealed in drums), the site was back-filled and labeled with a site marker. Data from the 1986 removal could not be located. (No environmental samples were taken from either the pit or the surrounding soils after the 1986 removal.)

5.3.2.1.3 PRS 53-008

The boneyard is a storage area for used materials from LAMPF physics experiments: concrete shielding blocks, steel targets, lead shielding blocks, and other metal shielding debris. Some of these, such as the steel reinforcing bars within the concrete shielding blocks, may have been activated by the accelerator beam. No radioactive or hazardous materials other than lead (which is stored in a locked shed) are known to have been stored in this area, and the RFA team noted that no hazardous materials were found during their inspection (Kearney et al. 1987, 22-0021). No environmental sampling data exist for this site, but contamination, if present, is expected to be minor.

5.3.2.1.4 PRS 53-010

PRS 53-010 is a lined, bermed area that formerly contained two 3,000-gal. tanks and 18 55-gal. drums, all of which have been removed. The SWMU Report noted the presence of a small area of oil-stained soil (less than 1 ft^3) near one of the tanks, where a spigot had dripped, and several shallow (less than 2 in. deep) areas of soil contamination beneath drums. The contaminated soil was removed to TA-54 for disposal. The oil formerly stored at this site reportedly was mineral oil with a small percentage of pseudocumene (LANL 1990, 0145). It is not known whether it was similar to the mineral-oil-based liquid scintillator currently stored elsewhere at TA-53, which contains 30% pseudocumene and less than 0.2% dyes.

When this PRS was inspected in September 1993, rings could be seen in the soil where drums used to be. There was no evidence of staining, either on the soils inside the berm or in the drainage ditch just outside.

5.3.2.2 Potential Routes of Exposure to Contaminants

The current potential receptors for this aggregate are the onsite workers (including construction workers). These receptors could be exposed to PCOCs (from leaking waste or product containers) during intrusive activities, through dermal contact with or ingestion of soils or sediments. Exposure could also result from inhalation of volatilized PCOCs or PCOCs transported by wind erosion. The Phase I investigation results will be the basis for evaluating the potential for exposure by these routes and the need for Phase II investigations.

5.3.3 Application of the DQO Process

The decision strategy for the RFI is presented in Section 4.4. The DQO process (described in the IWP, LANL 1993, 1017) was used in designing the Phase I screening assessments, which are a major component of this strategy, to ensure that the appropriate amount, type, and quality of data are collected.

5.3.3.1 Statement of the Problem (DQO Step 1)

The PRSs in this aggregate contain numerous areas at which hazardous constituents may have been released into surface soils or onto pavements (and thence carried into subsurface soils and/or tuff, or into sediment catchments). Whether or not there have been such occurrences (and, if so, their extent) has not been thoroughly documented. Consequently, the presence of PCOCs at these PRSs cannot be either confirmed or ruled out on the basis of archival data. The Phase I investigation will be focused on establishing the presence or absence, in environmental media, of PCOCs released from the PRSs. (The environmental media to be investigated are those to which receptors could become exposed, according to the conservative exposure scenarios used for screening assessments.) If the Phase I investigation determines that contaminants of concern are present at any of these sites, further investigation (and remediation, if necessary) will follow.

5.3.3.2 Identification of Decisions (DQO Step 2)

Because of the nature of storage activities at many of these sites, limited contamination from small-scale releases is likely. The objective of the Phase I investigation will be to ascertain the presence or absence of contaminants of concern. If any are found, either a VCA will be done (soil removal may be appropriate) or, if contamination appears more widespread, a Phase II investigation will be done to gather the data for a baseline risk assessment. For sites at which activities are ongoing and that pose no immediate threat to human health or the environment, response actions would be deferred until the site is no longer active. If Phase I sampling yields no evidence of contaminants of concern, the PRS will be recommended for NFA. This step will be carried out individually for each of the PRSs in this aggregate.

5.3.3.3 Data Inputs (DQO Step 3)

The primary data needed for the Phase I investigation are chemical and radiological data on the types and concentrations of PCOCs in surface soils, subsurface soils, tuff, and drainage-area sediments. These data will be obtained by collection and analysis of samples from the waste accumulation areas and/or from downstream catchments.

5.3.3.4 Boundaries (DQO Step 4)

The boundaries of the investigation for this aggregate are those that define the areas most likely to have been contaminated by releases from the PRSs. For sites at which wastes were stored directly on the soil, the boundaries are those of the storage area itself; for sites at which wastes were stored on a paved surface, the boundaries will demarcate the downslope sediment catchments, where PCOCs are retained in soils or sediments. It is important that downslope study areas be located close enough to the PRS in question to be sure that any contamination found did come from that PRS and not from some other site.

The vertical boundaries for unpaved storage areas will be from the surface to 6 in. below the surface; these boundaries encompass the soil zone most likely to have received PCOCs from any surface releases and to which receptors are most likely to become exposed. In sediment catchments, the vertical boundaries will be from the surface to the soil/bedrock interface, or to a maximum depth of 5 ft; these boundaries take in the zone most likely to contain PCOCs, allowing for vertical mixing during runoff and vertical migration from leaching.

For the waste oil pit, the horizontal and vertical boundaries will be drawn, respectively, 12 in. beyond and 12 in. below the boundaries of excavation of the pit. Any contaminated material remaining after removal of the pit in 1986 (including native material into which PCOCs may have migrated) is expected to be within these boundaries.

Biased sampling—sampling at those specific points judged likely to contain the highest concentration of PCOCs—will be done for all sites.

5.3.3.5 Decision Rules (DQO Step 5)

As shown in Figure 5-17, Phase I sampling will generate data on concentrations of individual PCOCs in soils and sediments at each PRS. If these data indicate the presence of contamination, further action will be required. VCA may be recommended if the contamination is well defined and limited in extent, and if the site is shown to pose a current risk. Otherwise, a Phase II characterization will be developed to obtain the additional data needed for a baseline risk assessment. If no contaminants of concern are identified, NFA will be recommended.

5.3.3.6 Design Criteria (DQO Step 6)

The design criterion for soil sampling is a 90% probability of detecting contamination if a minimum percentage (20% to 50%) of the soil within the study area boundaries (defined by DQO Step 4) is contaminated. Given the nature of past activities, observation of the sites, and past cleanup efforts, we expect that contamination (if present) is small and limited in extent. For this reason, the consequences of failing to detect contamination that is present are not great. At this low level of risk, we allow for a 10% probability that contamination will be present but undetected by selecting 90% as the probability of detecting contamination. (The specific value that will be used for the potentially contaminated fraction of each PRS will depend on site-specific conditions and will be enhanced through biased sampling—see Section 5.3.4.2.)

Table 5-9 summarizes the DQO specifications for this aggregate.

5.3.4 Phase I Sampling and Analysis Plan

5.3.4.1 Field Surveys

5.3.4.1.1 Land Surveys

Land surveys will be used to demarcate, in the field, the study boundaries, surface features, and sample collection locations.

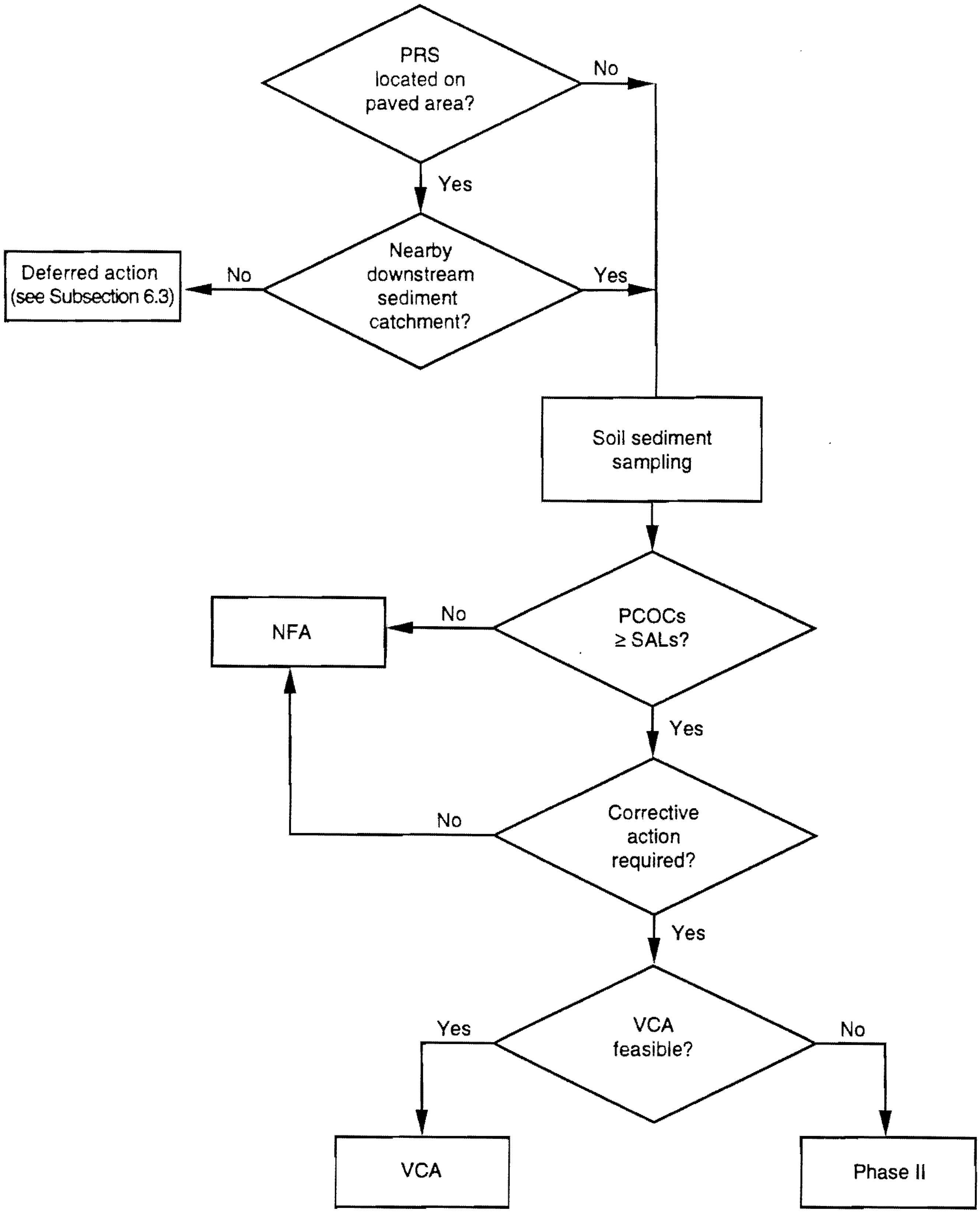


Figure 5-17. Decision logic for PRS Aggregate C.

TABLE 5-9

DQO SUMMARY FOR AGGREGATE C

DQO Step 1: Statement of the Problem	• The nature of waste accumulation/storage at these PRSs makes the likelihood of releases high • No systematic documentation of waste management practices exists, nor of whether any releases occurred historically
DQO Step 2: Identification of Decisions (to be followed for each PRS individually)	Establish presence/absence of contaminants of concern using field screening and reconnaissance sampling
DQO Step 3: Data Inputs	Chemical and radiological data on types and concentrations of PCOCs in surface and subsurface soils, tuff, and sediments
DQO Step 4: Boundaries	• Horizontal boundaries: - Surface soils at storage locations - Subsurface tuff at former disposal site - Sediments in catchments downslope of storage areas • Vertical boundaries defined by expected depth of contamination
DQO Step 5: Decision Rules (to be followed for each PRS individually)	• If contaminants are present, go to Phase II investigation or, if contamination is limited, well defined, and poses a current risk, implement a VCA • If no contaminants are found, recommend NFA
DQO Step 6: Design Criteria	• 90% probability of detecting soil contamination if 20 to 50% of sampled area (depending on PRS) is contaminated • Bias sampling to enhance probability

5.3.4.1.2 Geomorphic Surveys

These surveys will provide data for generating maps of the drainages and sediment catchments that are to be sampled.

5.3.4.1.3 Radiation Surveys

The boneyard (PRS 53-008) will be surveyed radiologically to determine whether contamination is present as a result of activation products potentially present in the concrete, steel, and other debris stored at this site. Activation products, usually short-lived, emit extremely energetic gamma photons and beta particles; for this reason, the radiation survey will principally use open-window Geiger-Mueller survey meters. Care will be taken to allow for the high background radiation levels that may be present during LAMPF operation.

5.3.4.2 Sampling and Analysis

Sampling of surface and subsurface soils and sediments at Aggregate C PRSs will be biased toward locations expected to have the highest concentrations of PCOCs. At waste accumulation areas, visible evidence of releases (e.g., soil staining) will be used to bias sampling locations; at the boneyard, the radiation survey results will be used (to the extent possible) to bias sampling.

Although radioactive PCOCs are not expected at most PRSs in this aggregate, all samples will be field-screened for radioactivity and analyzed for radioactivity in an onsite mobile laboratory. Samples will also be field screened for organic vapors to detect gross VOC contamination. Samples sent to an offsite analytical laboratory will be analyzed for all PCOCs (hazardous and radioactive). Quality control samples will be collected in accordance with the QAPP (Annex II). Table 5-10 summarizes the sampling and analyses planned.

5.3.4.2.1 PRS 53-001(a) - Waste Accumulation Area at Building TA-53-2

For this PRS, the area to be sampled is the soil bordering the north side of the storage pad (sampling is not possible on the other three sides of the pad, which are bordered by asphalt). If any PCOCs were released at this site, from overflow of the curb around the pad or from leaking of the drainage valve at the northeast corner, this area of soil is likely to have been affected. Because concentrations of PCOCs are expected to decrease with distance from the pad, the soil immediately adjacent (within 1 ft of the pad) was selected for sampling.

Any releases from the pad would probably have resulted in contamination of a large fraction (greater than 50%) of the soil within the sampling area. The sampling design criterion for this PRS, therefore, is a 90% probability of detecting contamination if at least 50% of the sampled area is contaminated. This criterion requires collection of four samples (see Table 4-5), and will be enhanced by biasing sampling locations (for example, one sample will be collected immediately below the drainage valve). All the samples will be taken from the top 6 in. of soil, using the spade and scoop method (LANL-ER-SOP-06.09).

Preliminary sampling locations are shown in Figure 5-18.

5.3.4.2.2 PRS 53-001(b) - Waste Accumulation Area at Building TA-53-2

Because the storage pad of this PRS is situated on an asphalt parking lot (see Figure 5-18), surface soils cannot be sampled. The parking lot drains to the south, to a storm drainage channel. The sediment catchments in this drainage channel, which are the likely repository of any PCOCs from the PRS, will constitute the sampling area.

Given the relatively homogeneous distribution of PCOCs expected in sediment catchments, a large percentage of the sediment is assumed to be potentially contaminated. The sampling design criterion for this PRS, therefore, is a 90% probability of detecting contamination if at least 50% of the sampled sediments are contaminated. This criterion requires collection of at least four samples (see Table 4-5). These will be taken by hand auger (LANL-ER-SOP-06.10) from the first two sediment catchments downslope of the PRS. At each catchment, samples will be collected at one location, from the top 12 in. and from the 12 in. immediately overlying the sediment/bedrock interface. If the sediments are thick enough, samples will be taken at three depths: the top 12 in., a 12-in. segment at the mid-depth of the profile, and the 12 in. just above bedrock (or at 5 ft below the surface if bedrock has not been reached). If the sediments are less than 12 in. deep, samples will be collected from the entire sediment profile (and, if necessary to obtain the required four samples, from additional catchments).

Preliminary sampling locations are shown in Figure 5-18 (the exact locations will be selected on the basis of geomorphic survey data).

TABLE 5-10
SUMMARY OF PHASE I SAMPLING AND ANALYSES FOR PRS AGGREGATE C

PRS No.	PRS Type	Phase I Approach	Field Surveys				Samples				Field Screening				Mobile Lab			Laboratory Analysis										
			Land Survey	Geophysical Survey	Radiation Survey	Geomorphic Survey	Sampled Media	Structure	Surface	Subsurface	Gross Alpha	Gross Gamma/Beta	Organic Vapor	High Explosive	Gross Alpha	Gross Beta	Gross Gamma	Gamma Spectroscopy	Total Uranium	Isotopic Uranium	Strontium-90	VOCs	SVOCs	HE	Metals	PCB	TPH	Cyanide
53-001(a)	Storage area	Reconnaissance	X				Soil		4		X	X	X		X	X	X					X			X	X	X	
53-001(b)	Storage area	Reconnaissance	X			X	Sediment		2	2	X	X	X		X	X	X					X			X	X	X	
53-001(e)	Storage area	Reconnaissance	X				Soil		4		X	X	X		X	X	X					X					X	
53-001(g)	Storage area	Reconnaissance	X				Soil		4		X	X	X		X	X	X					X			X		X	
53-005	Disposal pit	Reconnaissance	X				Soil/Tuff			4	X	X	X		X	X	X					X			X	X	X	
53-008	Storage area	Reconnaissance	X		X		Soil		11		X	X			X	X	X	X							X			
53-010	Storage area	Reconnaissance	X				Soil		6		X	X	X		X	X	X						X				X	

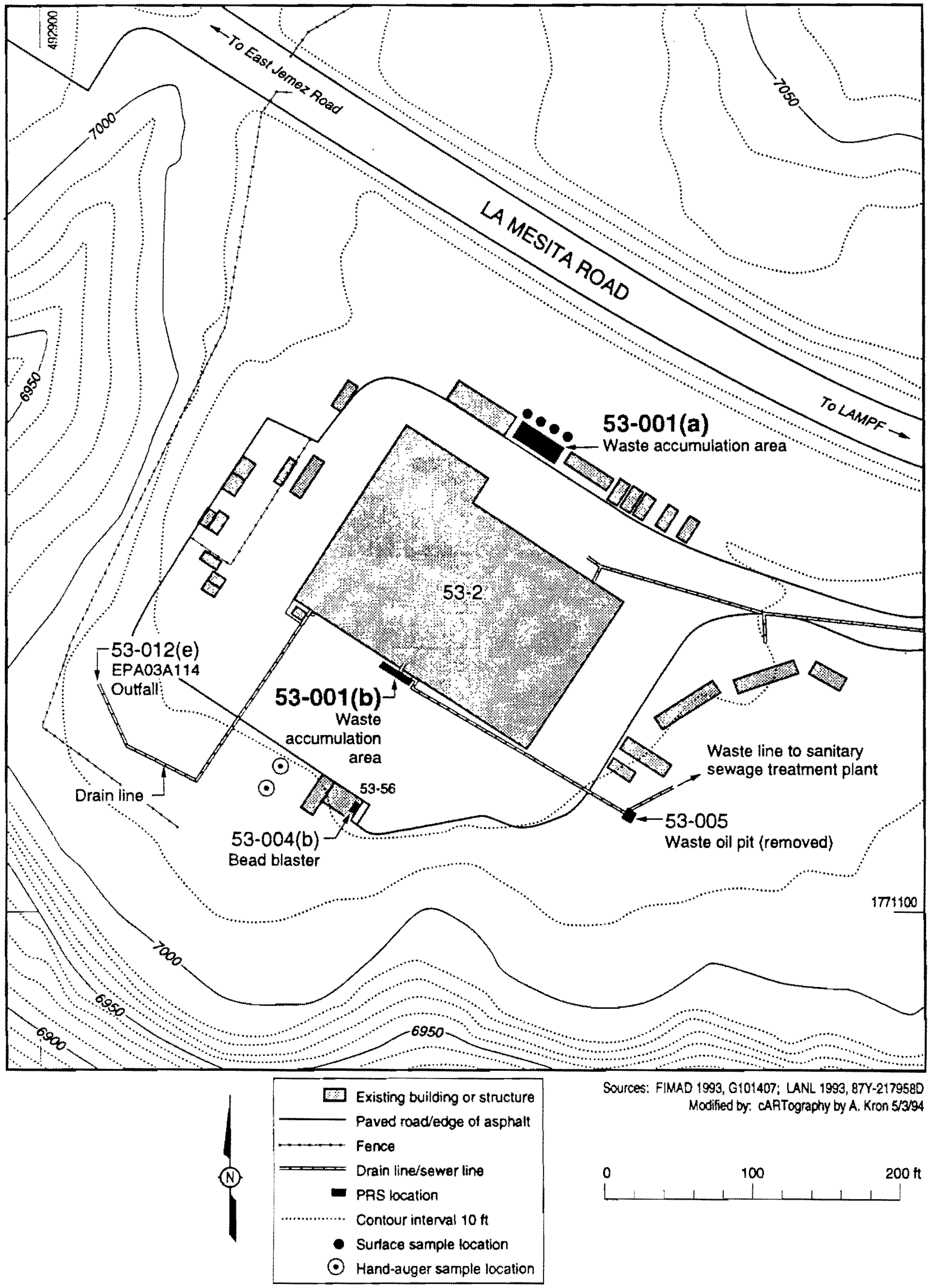


Figure 5-18. Preliminary sampling locations for PRSs 53-001(a) and 53-001(b).

5.3.4.2.3 PRS 53-001(e) - Waste Accumulation Area at Building TA-53-25

The sampling area for this small, gravelled site will be the surface soils beneath the gravel cover. Releases may have occurred from leaks or spills from the drums, and given the small area of this site, any such releases are likely to have affected a relatively large percentage of the area (more than 50%). The sampling design criterion for this PRS, therefore, is a 90% probability of detecting contamination if at least 50% of the sampled area is contaminated. This criterion requires collection of four samples (see Table 4-5); these will be taken from the 0- to 6-in. depth interval (after the gravel has been removed), using the spade and scoop method (LANL-ER-SOP-06.09).

Preliminary sampling locations are shown in Figure 5-19.

5.3.4.2.4 PRS 53-001(g) - Waste Storage Shed (TA-53-1031)

The sampling area for this PRS is the soil perimeter of the shed, which could have received PCOCs from releases overtopping the containment curb or from discharges from the drainage valve. Because contamination is expected to decrease with distance from the shed, the soils immediately adjacent to the shed (within 1 ft) will be sampled. Any releases from this PRS would probably have resulted in contamination of a large fraction (greater than 50%) of these soils. The sampling design criterion for this PRS, therefore, is a 90% probability of detecting contamination if at least 50% of the sampled area is contaminated. This criterion requires collection of four samples (see Table 4-5); it will be enhanced by biasing sampling locations (e.g., collection of one sample immediately below the drainage valve). The samples will be taken from the 0- to 6-in. depth interval, using the spade and scoop method (LANL-ER-SOP-06.09).

Preliminary sampling locations are shown in Figure 5-20.

5.3.4.2.5 PRS 53-005 - Waste Oil Pit

This pit, originally dug into the tuff, reportedly was cleaned out and backfilled with fresh soil. The area that will be sampled, therefore, is the walls and bottom of the excavation, where any contamination remaining after the cleanup is most likely to be. In each area, samples will be taken from the first 12 in. of native tuff.

Infiltration of wastes into the pit walls and bottom is expected to have resulted in a relatively homogeneous distribution of any contaminants and in potential contamination of a large fraction of the sampling area (greater than 50%). The sampling design criterion for this PRS, therefore, is a 90% probability of detecting contamination if at least 50% of the sampled area is contaminated. This criterion requires collection of four samples (see Table 4-5) and will be enhanced by biasing of sampling locations (using observations and the results of field screening for volatile organics). Two trenches will be excavated through the former pit to identify the backfill/native tuff interface, and backfill will be removed to expose the tuff at each sampling location. Samples will be collected using a split spoon (LANL-ER-SOP-06.24) or the spade and scoop method (LANL-ER-SOP-06.09), depending on the conditions of the tuff.

Preliminary sampling locations are shown in Figure 5-21.

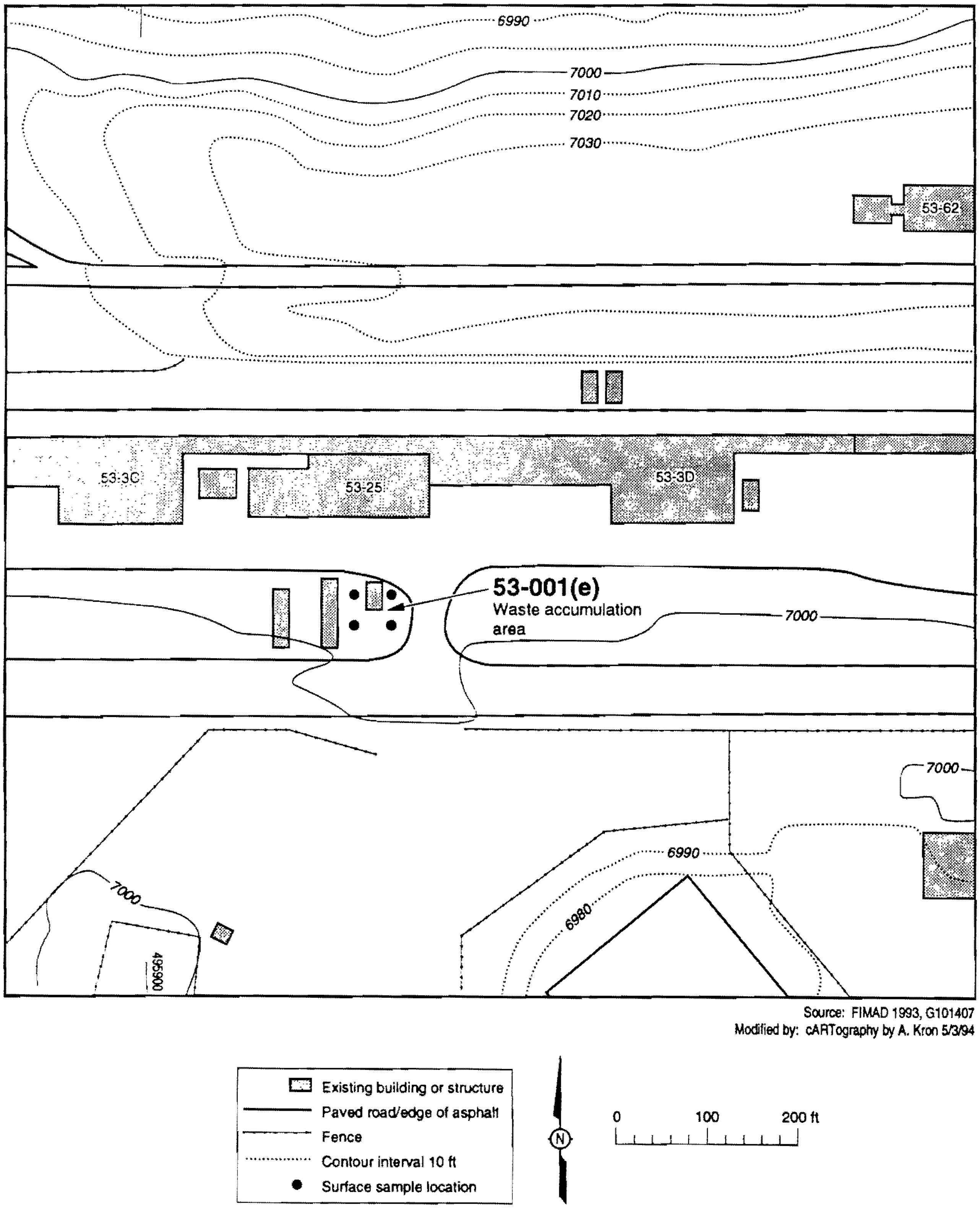


Figure 5-19. Preliminary sampling locations for PRS 53-001(e).

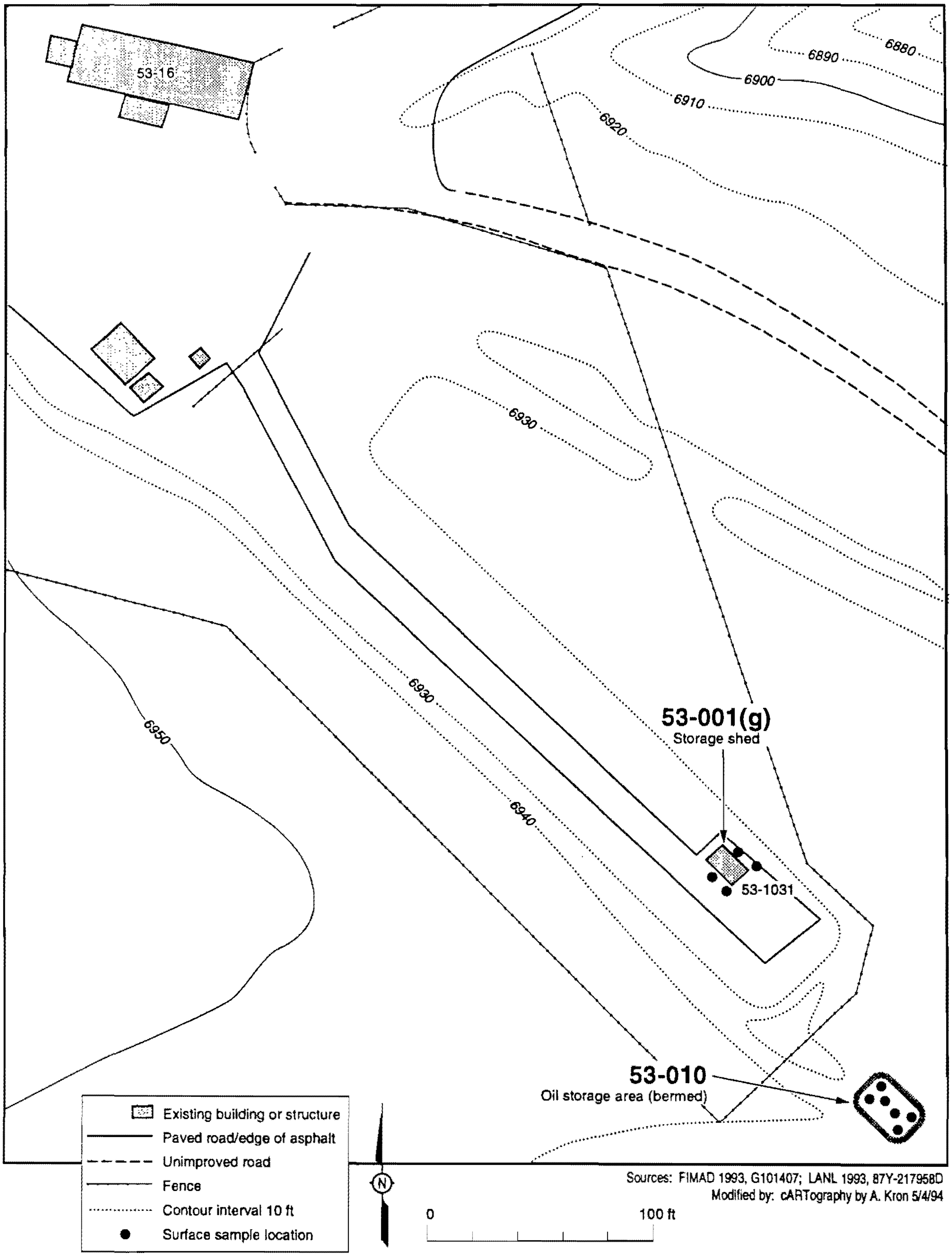


Figure 5-20. Preliminary sampling locations for PRSs 53-001(g) and 53-010.

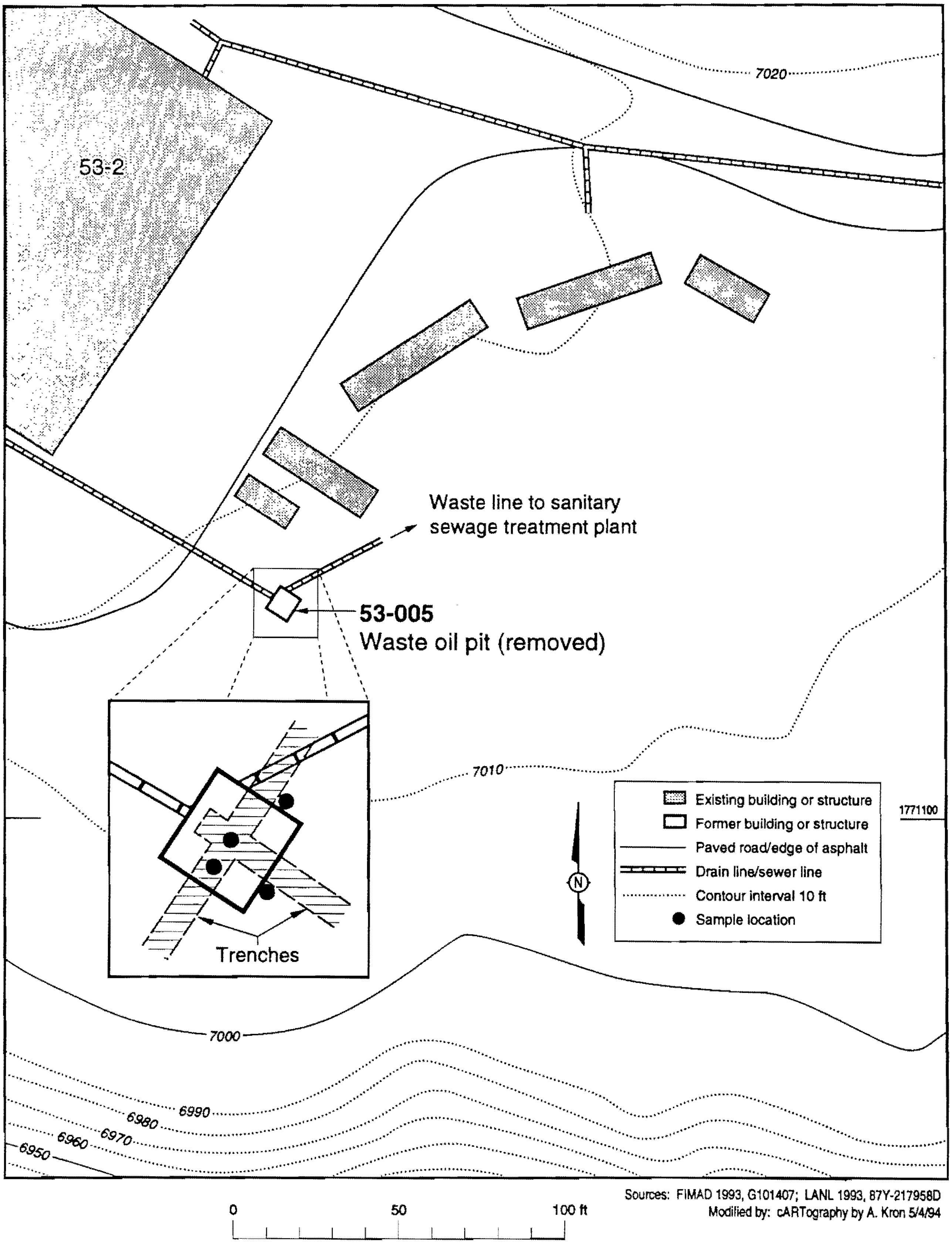


Figure 5-21. Preliminary sampling locations for PRS 53-005.

5.3.4.2.6 PRS 53-008 - Boneyard

For this PRS, the soil within the 4-acre storage yard, where any contamination from releases is most likely to reside, will constitute the sampling zone. Given the large extent of the area, we expect that the distribution of contamination in these soils will be less homogeneous than for other PRSs in this aggregate and, consequently, that a smaller fraction of the sampling area will be contaminated. On the basis of our observations and available data, we estimate the potentially contaminated fraction to be at least 20%. For this reason, we have selected a sampling design criterion with a 90% probability of detecting contamination if at least 20% of the sampled area is contaminated. This criterion requires collection of eleven samples (see Table 4-5); the sampling locations will be biased, to the extent possible, using the results of the radiation survey. The soil samples will be collected from the top 6 in. of soil, using the spade and scoop method (LANL-ER-SOP-06.09).

Preliminary sampling locations are shown in Figure 5-22.

5.3.4.2.7 PRS 53-010 - Mineral Oil Storage Area

The soil within the berm of this former storage site, where any contamination from releases is most likely to reside, will be the sampled area. Judging from descriptions of past releases (see Section 5.3.2.1) and from the low toxicity of the materials stored at this site, the areas affected by releases are likely to be very small, and the associated risk is likely to be low. To have a high probability (90%) of finding contamination that may exist over a very small fraction of the site would have required a great number of samples, which did not seem justified given the low risk associated with these conditions.

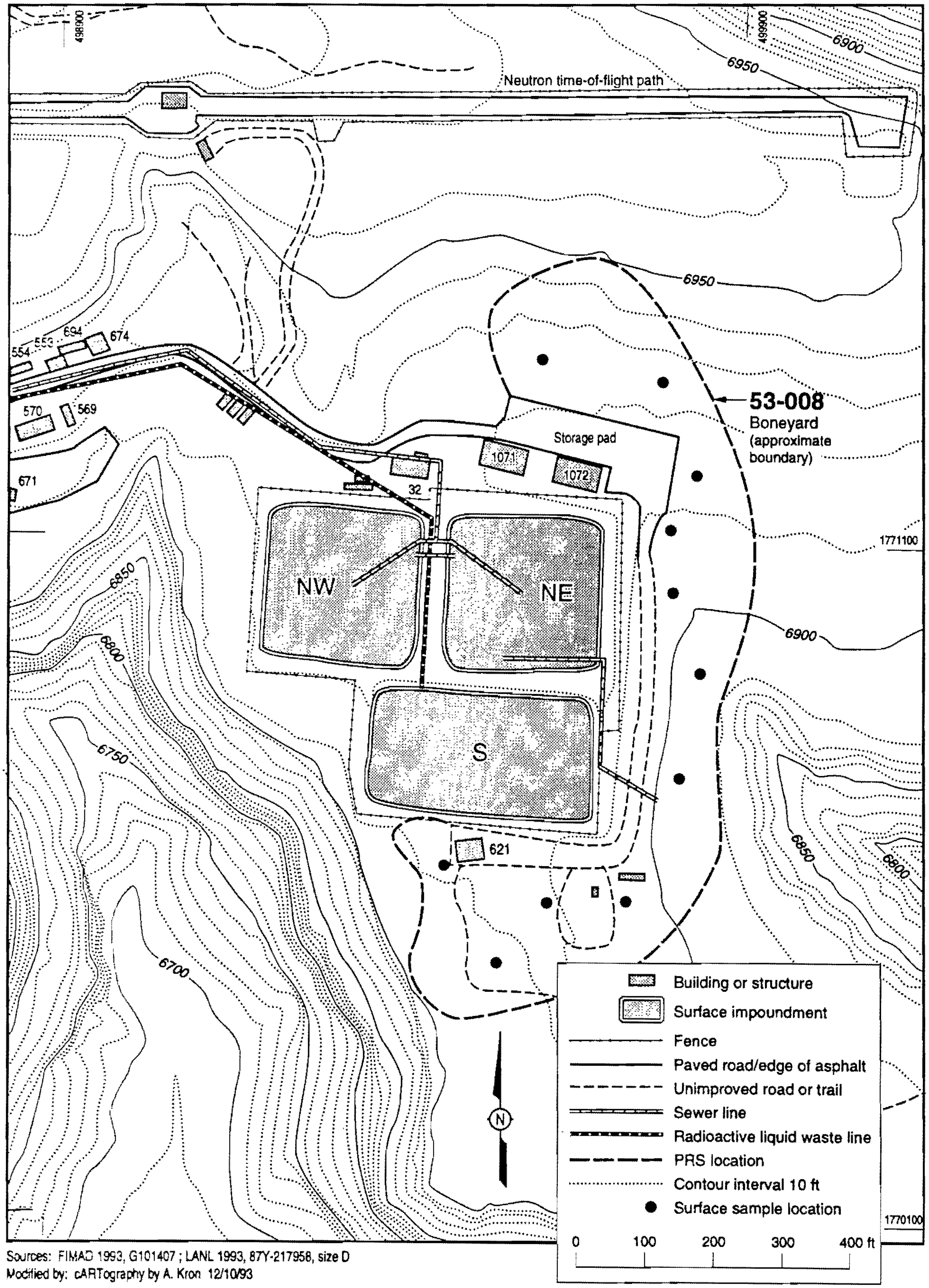
On the other hand, the possibility that a larger percentage of the site is contaminated cannot be ruled out; should that be the case, a sampling design criterion with a high probability of detection would be justified. Given the potential risk associated with releases at this site, a sampling design criterion having a 90% probability of detecting contamination if 35% of the sampled area is contaminated seems reasonable. To meet this criterion, a minimum of six samples must be collected (see Table 4-5).

The sampling locations will be biased, to the extent possible, through observation (e.g., staining and imprints in the soil that indicate the former positions of the drums.) The samples will be taken from the soil between the surface and the plastic liner, to a maximum depth of 12 in. (if the soil is deeper than 12 in., two samples will be collected, one just below the surface and one just above the liner, at each of four locations). The samples will be collected using the spade and scoop method (LANL-ER-SOP-06.09).

Preliminary sampling locations are shown in Figure 5-20.

5.4 Aggregate D - Underground Storage Tanks

Aggregate D consists of six active, underground tanks at TA-53 (PRSs 53-006[a-f]) that are used to store radioactive wastes. Because all of these tank systems are active and do not currently pose a risk to onsite workers,



Sources: FIMAD 1993, G101407 ; LANL 1993, 87Y-217958, size D
Modified by: cARTography by A. Kron 12/10/93

Figure 5-22. Preliminary sampling locations for PRS 53-008.

investigations have been deferred. The description and history of these tanks and the rationale for deferred investigation are presented in Chapter 6.

5.5 Aggregate E - Septic Systems

5.5.1 Description and History

Aggregate E comprises four septic systems. Two of these—one at TA-53 and one at TA-72—have been recommended for NFA and are described in Chapter 6. The other two, which are associated with TA-20 and will be subject to RFI, are shown in Figure 5-23. Summary information on these systems is presented in Table 5-11.

5.5.1.1 PRS 20-004 - Septic Tank TA-20-49 and Drain Line

This septic system was erroneously identified twice in the SWMU Report (LANL 1990, 0145): as SWMU 20-004 and as SWMU 72-003(b). The designator 72-003(b) has simply been added to the NFA list in Chapter 6, leaving the PRS as "officially" 20-004.

Septic tank TA-20-49, constructed to serve the new guard house (TA-20-47) on East Jemez Road, was completed in May 1952 and abandoned in February 1957 according to the ENG-7 Structure Historical Book (LANL undated, 22-0051). (Its abandonment probably coincides with the closing of the guard house, when public access to East Jemez Road was granted.) The tank appears to have been returned to service in 1966, when the firing range was opened. A 1985 memo (Montoya 1985, 22-0067) indicated that the septic tank was still active at that time and was being used by the protective force. The SWMU Report (LANL 1990, 0145) indicates that it was active until 1989 and was registered with the New Mexico Environmental Improvement Division (EID) as an Unpermitted Individual Liquid Waste System (registration number LA-10).

An engineering drawing (LASL 1959, 22-0062) for TA-20, which shows the utility location plan, shows the septic tank as located approximately 120 ft east of TA-20-47 (now TA-72-8). According to another engineering drawing (AEC 1951, 22-0023), this building was the only structure connected to the septic tank; the plan for the building shows a sink and toilet connected to the septic tank inlet pipe.

TABLE 5-11

PRS AGGREGATE E - SEPTIC SYSTEMS

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Potential Contaminants of Concern
20-004	Septic Tank and Drain Line	TA-20-49	Inactive	1952-1989	VOCs, SVOCs, metals
20-005	Septic Tank and Drain Line	TA-20-27	Inactive; probably removed	1945-1948	Metals, cyanide

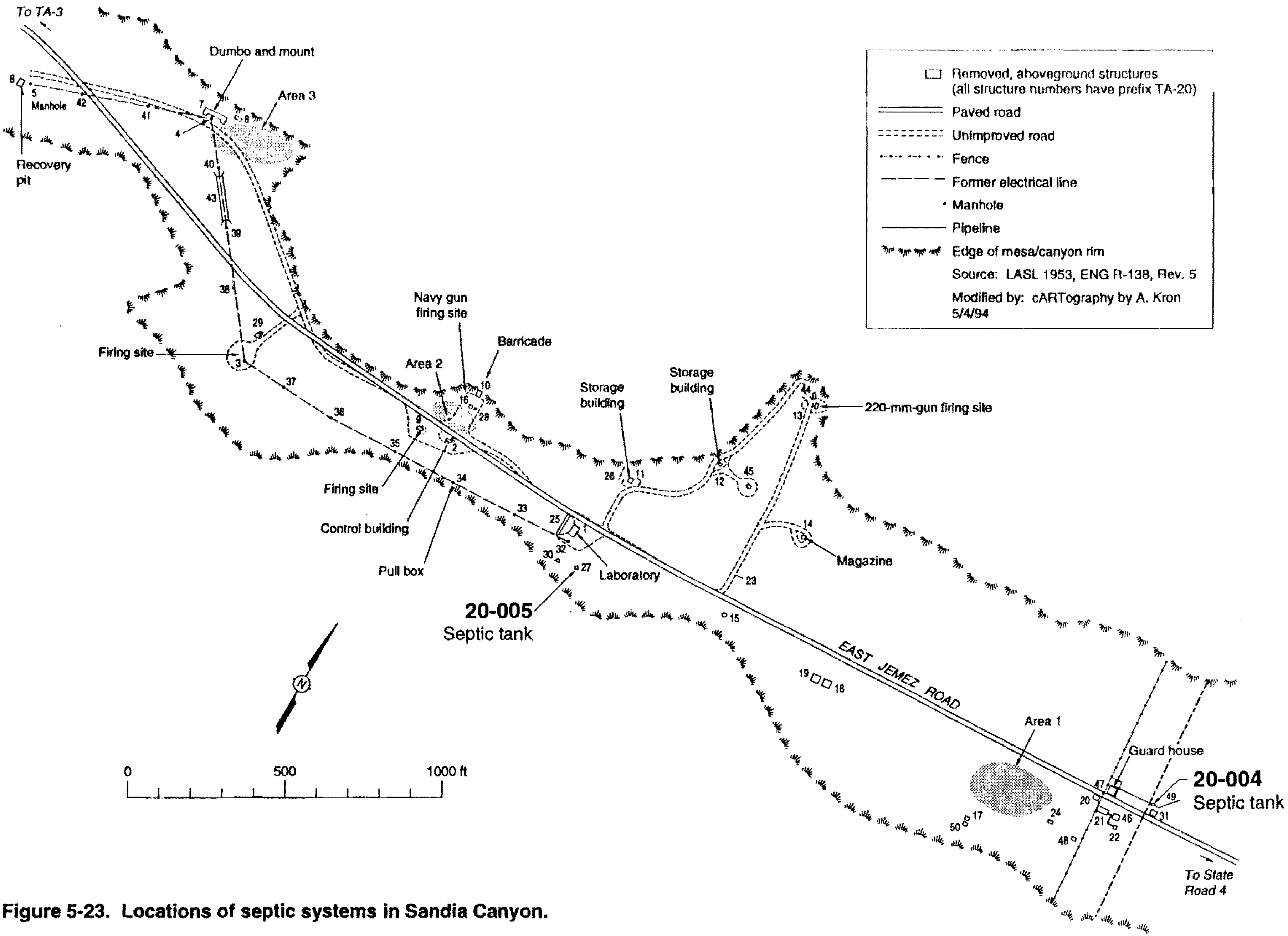


Figure 5-23. Locations of septic systems in Sandia Canyon.

Construction details for this tank are shown in another engineering drawing (AEC 1951, 22-0022). It has a single chamber made of 6-in.-thick reinforced concrete, with inside dimensions of 6 ft x 3 ft x 5 ft high. The inlet and outlet pipes were constructed of 6-in. vitrified clay pipe (VCP). The height from the bottom of the tank to the invert of the outlet pipe was 4 ft, giving the tank a capacity of 540 gal. The invert of the outlet pipe is shown to be a minimum of 4 ft below grade. It is not clear from drawing ENG-R 1158 Rev. 1 whether the outlet pipe discharged to daylight. The drawing shows the pipe running northeast from the tank and labeled "drain to open." The SWMU Report (LANL 1990, 0145) notes that this pipe was about 100 ft long but makes no mention of a leach field. The EID registration (NMEID 1989, 22-0079), which includes information on the tank's capacity (540 gal.), design flow (200 gal./day), and length and construction of the outlet pipe (100 ft long, 6-in. VCP), states that there was no leach bed. Confirmation appears to be provided by a 1987 memo (Sneesby 1987, 22-0071). It states that this septic system, which was designed to serve one or two persons, became overloaded when additional people used it; and that the overloaded drain line can discharge to the surface, causing National Pollutant Discharge Elimination System (NPDES) violations and health problems. Installation of portable toilets was recommended until upgrades could be completed.

A note in the Laboratory Environmental Protection Group files for this tank, dated January 12, 1989, indicates that this tank was not removed when a new septic tank was installed, but was collapsed and filled in by Pan Am World Services.

When this site was inspected in September 1993, in conjunction with preparation of the work plan, the location reported to be that of the septic tank was identified.

5.5.1.2 PRS 20-005 - Septic Tank TA-20-27

PRS 20-005 was described in the SWMU Report (LANL 1990, 0145) as a removed structure, TA-20-27. According to the ENG-7 Structure Historical Book (LANL undated, 22-0051) for TA-20, the tank was constructed in February 1945 and abandoned in 1948. From engineering drawings of TA-20 facilities, it appears that the only structure connected to the septic tank was the laboratory building (TA-20-1). A plumbing drawing (LASL 1951, 22-0061) of this building shows a toilet, a restroom sink, and a darkroom sink (made of lead) connected to a 4-in. cast-iron drain line leaving the building.

One engineering drawing (LASL 1951, 22-0056) shows this tank as having 6-in.-thick concrete walls and inside dimensions of 3 ft x 6 ft x 5 ft high. The inlet and outlet pipes were 4 in. in diameter, and the height from the bottom of the tank to the invert of the outlet pipe was 4 ft, giving the tank a capacity of 540 gal. The invert of the outlet pipe is shown to be 2.25 ft below grade.

It is not known where the discharge from the septic tank went. Because the tank was reportedly located near a drainage channel, it is possible the tank had an outfall.

On the basis of available information, it is probable that this tank was removed. In 1985, the Laboratory conducted a program to remove existing structures from Sandia Canyon, which included a search for septic tank TA-20-27. The tank could not be located, and a pit-like area was found in the tuff where it should have been (LANL 1985, 22-0016). According to the report, excavation of the area surrounding the "pit" turned up no evidence of the tank or of waste lines. A soil sample collected in this area was negative for radioactivity (Scholl 1989, 0485).

The site of this PRS was inspected in September 1993, during preparation of the work plan. The area currently appears as gently sloping grassland with isolated trees and brush. The only evidence of prior activities is an orange angle-iron stake from previous surveys that bears the designation "TA-20-27" on the side.

5.5.2 Conceptual Exposure Model for Aggregate E

The conceptual exposure model for the PRSs in Aggregate E is shown in Figure 5-24. This model is based on archival information only and will be refined or modified on the basis of data gathered during the RFI.

5.5.2.1 Existing Information on Nature and Extent of Contamination

Existing information on the nature and extent of contamination for these PRSs is very limited. PCOCs include those from wastes that were discharged to the septic tanks historically, those from any wastes currently in the tanks, and those that may reside in soils affected by possible discharges from the tanks. These PCOCs consist of VOCs, SVOCs, metals, and cyanide.

5.5.2.1.1 PRS 20-004 - Septic Tank TA-20-49 and Drain Line

When this septic system was originally installed, the only active portion of TA-20 was the guard station at East Jemez Road. Sanitary wastes should have been the only wastes discharged to the system until 1966, when the firing range became active. At that time, wastes other than sanitary wastes were generated (e.g., solvents and oils from cleaning weapons), and although no documentation exists that such wastes were discharged to the sanitary system, the possibility that they were dictates that sampling be done.

5.5.2.1.2 PRS 20-005 - Septic Tank TA-20-27

The engineering drawings for the facility served by this tank (TA-20-1) indicate that the tank received sanitary wastes from a restroom and photograph-processing wastes from a darkroom. The only PCOCs associated with these wastes would be metals and cyanide. An engineering drawing (LASL 1951, 22-0061) for this site shows the drain line, but does not indicate where the drain line discharges. It is not known whether a leach field is (or was) present. It appears that the tank and associated drain lines have been removed, but whether and to what extent any decontamination was done at the time of removal is not known.

5.5.2.2 Potential Routes of Exposure to Contaminants

The primary source of potential contamination to which receptors could become exposed is subsurface soil, which may have been contaminated by past discharges from the tanks. Exposure could occur through dermal contact during excavation or other intrusive activities. A secondary source of exposure during intrusive activities is contaminated structures. Third, if—as indicated by historical records—surface soils have received discharges from these systems, either

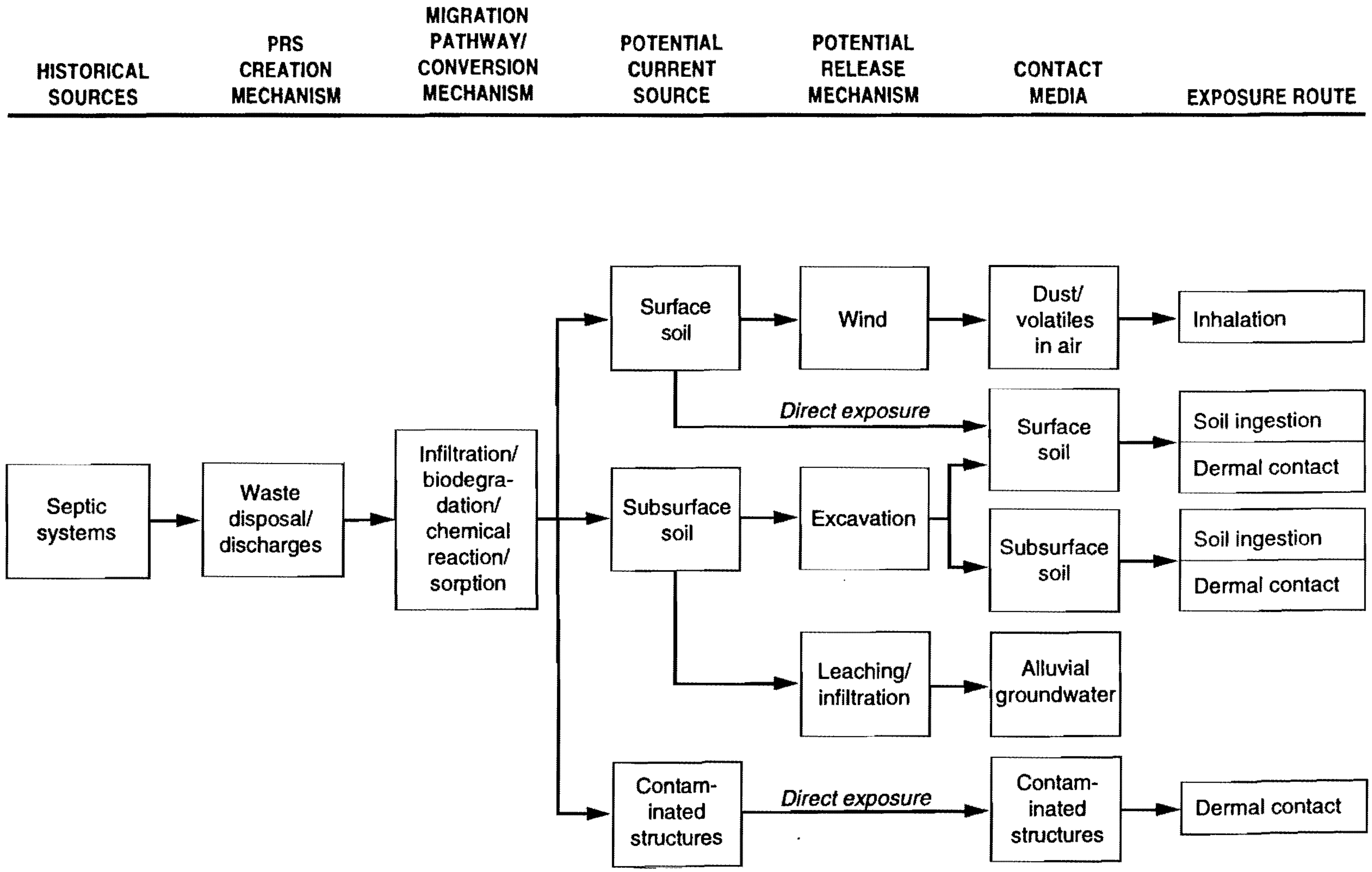


Figure 5-24. Conceptual exposure model for PRS Aggregate E.

directly or by redeposition via wind erosion or surface runoff, exposure through ingestion of or dermal contact with these soils is possible. Finally, leaching of contaminants to shallow alluvial groundwater, which is believed to exist under PRS 20-005 (and possibly PRS 20-004) could be considered an exposure pathway, but not under the current land-use scenario.

5.5.3 Application of the DQO Process

The decision strategy for the RFI is presented in Section 4.4. The DQO process (described in the IWP, LANL 1993, 1017) was used in designing the Phase I screening assessments, which are a major component of this strategy, to ensure that the appropriate amount, type, and quality of data are collected.

5.5.3.1 Statement of the Problem (DQO Step 1)

The PRSs in this aggregate were used for disposal of sanitary wastewaters that may have contained hazardous constituents. The surface and subsurface soils in the vicinity of these sites may have received PCOC-containing discharges from these systems. The Phase I investigation, therefore, will determine whether PCOCs are present in these soils; if they are, further investigation (and remediation, if necessary) will follow.

5.5.3.2 Identification of Decisions (DQO Step 2)

Reconnaissance sampling of surface and subsurface soils will be used to ascertain the presence or absence of PCOCs. If PCOCs are found, additional characterization may be done to gather the data needed for a baseline risk assessment. Alternatively, it may be possible to proceed directly to a VCA, using site-specific cleanup levels. If no PCOCs are identified, NFA will be recommended. This step will be carried out individually for each of the PRSs in this aggregate.

5.5.3.3 Data Inputs (DQO Step 3)

The primary data needed for the Phase I investigation are chemical data on the types and concentrations of PCOCs in surface and subsurface soils. These data will be obtained by collection and analysis of soil samples.

5.5.3.4 Boundaries (DQO Step 4)

The boundaries of the investigation for this aggregate are those that define the areas most likely to have been contaminated by discharges from the PRSs. The horizontal boundaries of the sampling area will encompass the leach fields (or the areas receiving discharges from outlet pipes if there are no leach fields) and the drain lines and septic tank (if present).

The vertical boundaries for outlet-pipe discharge areas will be from the surface to 2 ft below the invert of the pipe. These boundaries encompass the soil zone most likely to be contaminated and to which receptors are most likely to become exposed (for example, in the course of excavation during construction activities). The vertical boundaries for drain lines and septic tanks will be from the surface to 1 ft below the structures.

5.5.3.5 Decision Rules (DQO Step 5)

As shown in Figure 5-25, Phase I sampling will generate data on concentrations of individual PCOCs in soils at each PRS. If these data indicate the presence of contamination, further action will be required. This could take the form of a VCA if it is determined that the site poses a current risk and VCA would be more cost-effective than additional characterization. Otherwise, a Phase II characterization will be developed to obtain the additional data needed for a baseline risk assessment. The potential for groundwater contamination will be evaluated if PCOCs are above background levels, which may lead to a Phase II groundwater investigation (see Section 4.7.3).

If no contaminants of concern and no potential for groundwater contamination are identified at a PRS, NFA will be recommended.

5.5.3.6 Design Criteria (DQO Step 6)

The design criterion for soil sampling is a 90% probability of detecting contamination if at least 30% of the soil within the study boundaries (defined by DQO Step 4) is contaminated. The 90% value is based on the judgment that high levels of contamination are unlikely at these PRSs given the nature of past activities and the probability that cleanups were done. For this reason, the consequences of failing to detect contamination if it is present are not great. At this low level of risk, by selecting 90% for the design criterion, we allow for a 10% probability that contamination will be present but undetected.

Because the source of potential contamination for these PRSs is discharged wastewaters, the distribution of any contaminants near the point of discharge should be fairly uniform. We estimate the potentially contaminated fraction of the area selected for sampling to be at least 30%, allowing for the probability that a substantial percentage of that area will be unaffected by discharges. The criterion will be enhanced through biased sampling.

Table 5-12 summarizes the DQO specifications for this aggregate.

5.5.4 Phase I Sampling and Analysis Plan

5.5.4.1 Field Surveys

5.5.4.1.1 Land Surveys

Land surveys will be used to demarcate, in the field, the study boundaries, surface features, and sample collection locations.

5.5.4.1.2 Geophysical Surveys

Geophysical surveys, consisting of a combination of GPR and EMI, will be conducted to better characterize subsurface features as a means of biasing locations for sampling. At PRS 20-004, these techniques will be used on a grid encompassing the drain line and septic tank, to precisely locate these features;

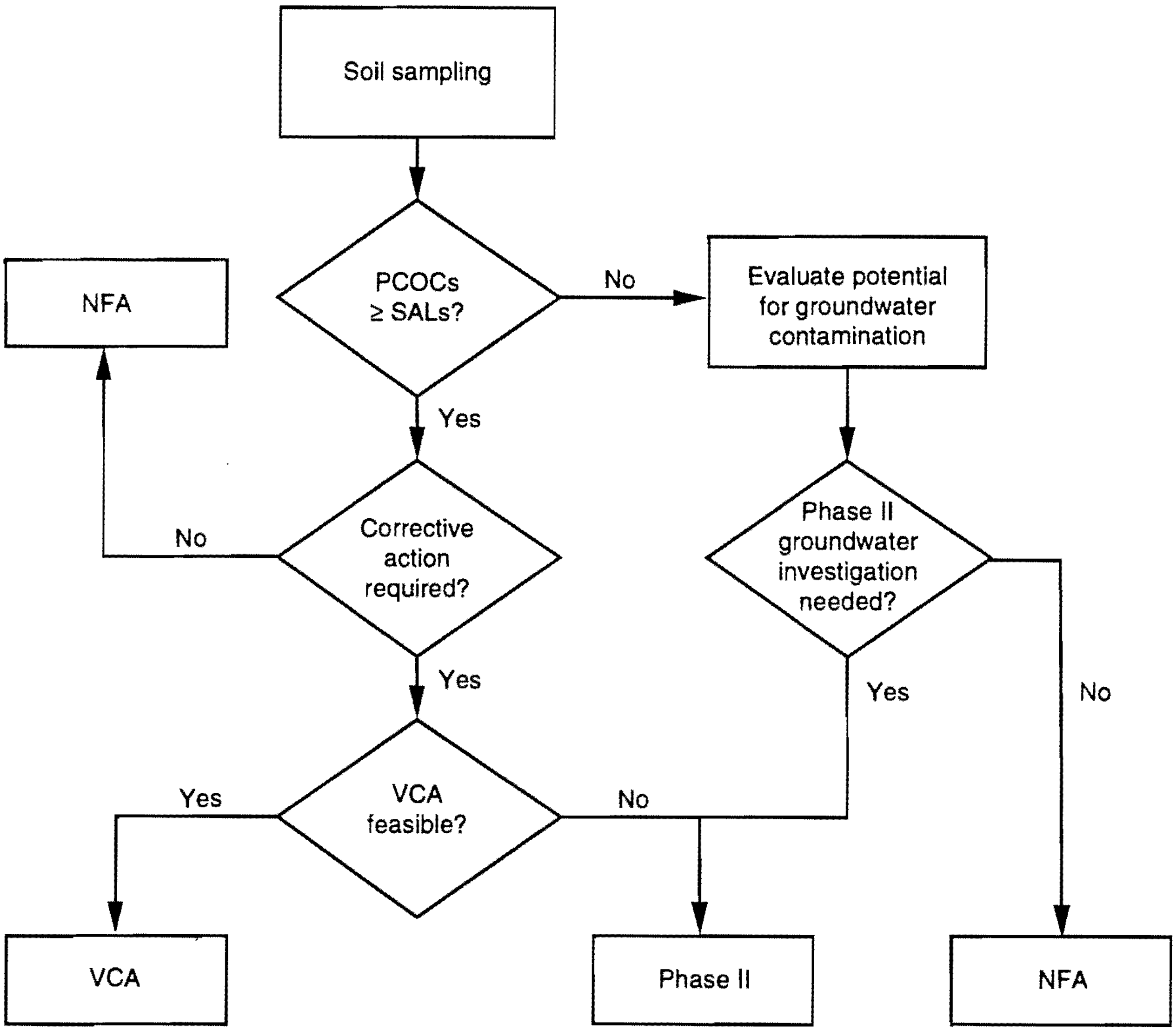


Figure 5-25. Decision logic for PRS Aggregate E.

TABLE 5-12

DQO SUMMARY FOR AGGREGATE E

DQO Step 1: Statement of the Problem	The PRSs in this aggregate were used for disposal of wastewaters that may have contained PCOCs; surface and subsurface soils in the areas of discharge could be contaminated
DQO Step 2: Identification of Decisions (to be followed for each PRS individually)	Establish presence/absence of contaminants of concern through reconnaissance sampling
DQO Step 3: Data Inputs	Chemical data on concentrations of PCOCs in surface and subsurface soils
DQO Step 4: Boundaries	• Horizontal boundaries: - discharge areas (identified from engineering drawings and geophysical surveys) - septic tank and drain lines • Vertical boundaries: soil zone most likely to contain contamination and to which receptors are most likely to be exposed
DQO Step 5: Decision Rules (to be followed for each PRS individually)	• Evaluate geophysical data to determine whether drain lines and leach fields are present • Collect soil samples in discharge areas • If contaminants are present, continue investigation (VCA or baseline risk assessment) • If SALs are exceeded or groundwater contamination is possible, go to Phase II investigation • Make separate decision for each PRS
DQO Step 6: Design Criteria	• 90% probability of detecting soil contamination if 30% of sampled area is contaminated • Bias sampling to enhance probability

and at PRS 20-005 they will be used on a uniform grid over the suspected location of the former septic tank to verify that the tank and drain line have been removed.

5.5.4.2 Sampling and Analysis

Soil sampling locations will be biased toward locations expected to have the highest concentrations of PCOCs from past discharges. The highest concentrations are expected at the discharge from the outlet pipe and/or in the leach field; these locations will be identified from the geophysical survey results. Each sampling location will encompass the range of depths expected to contain PCOCs: from the surface to a depth of 2 ft below the bottom of the outlet pipe (6 ft below the surface at PRS 20-004; 4.25 ft below the surface at PRS 20-005). Samples will also be collected beneath the outlet pipes.

Trenches and mechanically augered holes will provide access for collection of samples.

Although radiological PCOCs are not expected at the PRSs in this aggregate, all samples will be field-screened for radioactivity and analyzed for radioactivity in an onsite mobile laboratory. Samples will also be field screened for HE and VOCs.

Samples sent to an offsite analytical laboratory will be analyzed for all PCOCs. Quality control samples will be collected as specified in the QAPP (Annex II). Table 5-13 summarizes the sampling and analyses planned.

5.5.4.2.1 PRS 20-004 - Inactive Septic Tank (TA-20-49) and Associated 100-ft Drain Line

This tank, which reportedly has been collapsed and filled in, apparently was overloaded in the past, causing wastewater to discharge to the surface.

Soil contamination, if present, is expected to be found in the areas that would have received discharges from the outlet pipe. The location and characteristics of the outlet pipe will be determined by geophysical survey, augmented by trenching to verify subsurface conditions. Soil samples will be collected from two trenches located within a 10-ft radius around the end of the pipe (the exact nature of the sampling will depend on the results of the geophysical survey and trenching). Six samples will be collected, one at each of three depths in each trench. Because the outlet pipe was constructed of VCP, leakage is expected; additional samples will be collected from three locations along the pipe, using the trenches excavated to verify subsurface conditions. These samples will be taken at a depth of 1 ft below the pipe. All the samples will be collected using the spade and scoop method (LANL-ER-SOP-06.09). The total of nine samples to be collected satisfies the design criterion for this PRS (a 90% probability of detecting contamination if at least 30% of the sampled area is contaminated—see Table 4-5).

Preliminary sampling locations are shown in Figure 5-26.

If the septic tank is still present, the contents will also be sampled (if water and sludge are both present, a sample of each will be collected). The septic tank contents will be sampled using a Coliwasa sampler (LANL-ER-SOP-06.15).

5.5.4.2.2 PRS 20-005 - Inactive Septic Tank (TA-20-27) and Associated Drain Line

This tank and drain line are believed to have been removed. Whether the drain line discharged to a leach field or to an outfall is not known.

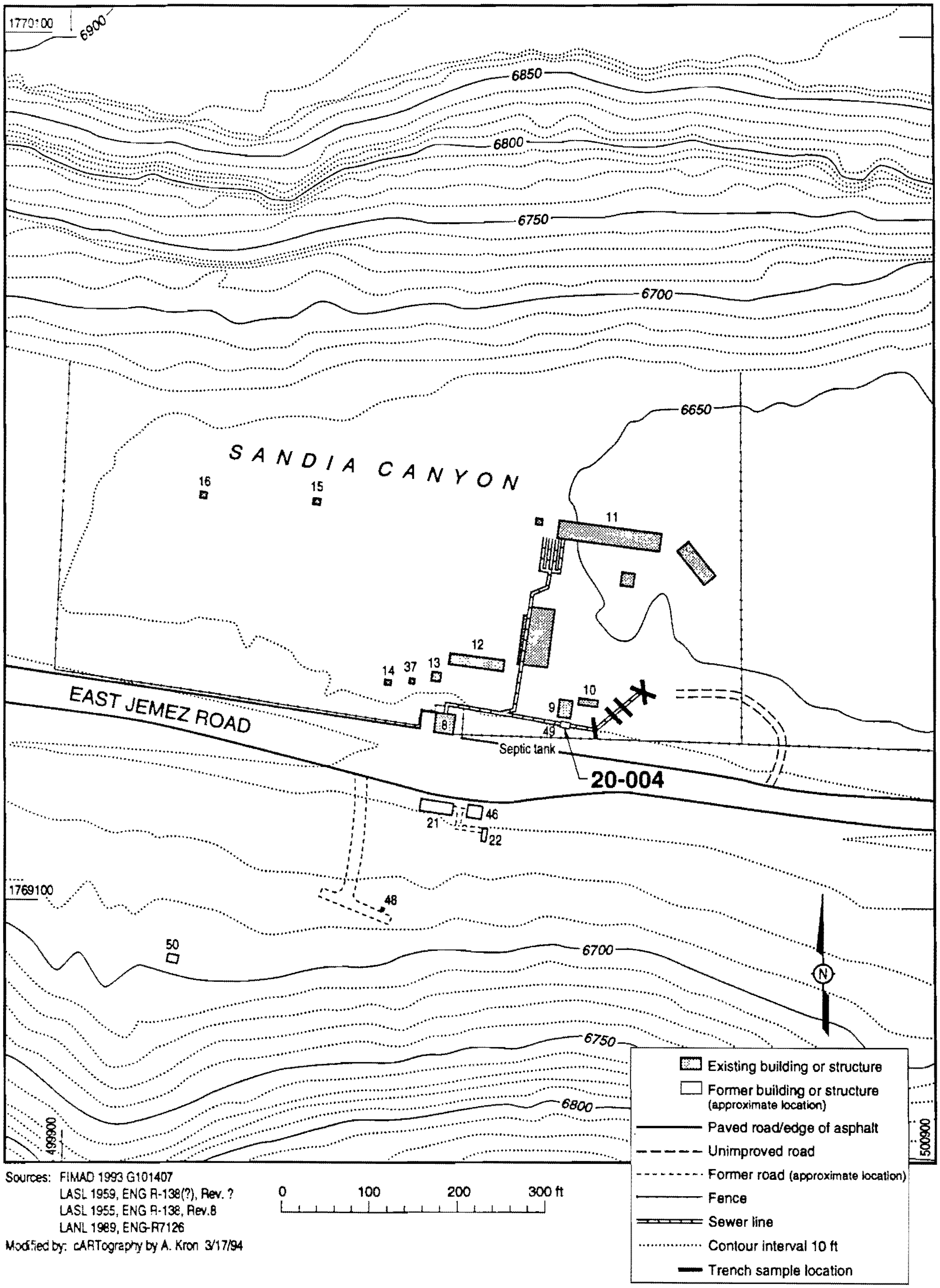
Soil contamination, if present at this PRS, is expected to be found in the areas that would have received discharges from the outlet pipe or in the leach field (if there was one). A geophysical survey will be used to determine whether these structures are present and, if they are not, to determine their former locations. The geophysical survey will be augmented by trenching to verify subsurface conditions.

If the drain line is still present and no leach field is found, soil samples will be collected from two trenches located within a 10-ft radius around the end of the outlet pipe (the exact nature of the sampling will depend on the results of the geophysical survey and trenching). Six samples will be collected, one from each of three depths, in each trench; and an additional three samples will be collected from three locations along the outlet pipe, at a depth of 1 ft below the pipe (these

TABLE 5-13
SUMMARY OF PHASE I SAMPLING AND ANALYSES FOR PRS AGGREGATE E

PRS No.	PRS Type	Phase I Approach	Field Surveys			Samples				Field Screening				Mobile Lab			Laboratory Analysis										
			Land Survey	Geophysical Survey	Radiation Survey	Sampled Media	Waste	Surface	Subsurface	Gross Alpha	Gross Gamma/Beta	Organic Vapor	High Explosive	Gross Alpha	Gross Beta	Gross Gamma	Gamma Spectroscopy	Total Uranium	Isotopic Uranium	Strontium-90	VOCs	SVOCs	HE	Metals	PCB	TPH	Cyanide
20-004	Septic System	Reconnaissance	X	X		Soil, Waste	2*	2	7	X	X	X	X	X	X	X					X	X		X			
20-005	Septic System	Reconnaissance	X	X		Soil, Waste	2*	2	7	X	X		X	X	X	X								X			X

* If septic tank is present, contents will be sampled. Sample of water and sludge will be collected if both phases are present. 2 Samples assumed for planning purposes.



Sources: FIMAD 1993 G101407
LASL 1959, ENG R-138(?), Rev. ?
LASL 1955, ENG R-138, Rev.8
LANL 1989, ENG-R7126
Modified by: cARTography by A. Kron 3/17/94

0 100 200 300 ft

Figure 5-26. Sampling locations for PRS 20-004.

samples will be collected in the trenches excavated to verify subsurface conditions). The total of nine samples will satisfy the design criterion for this PRS (see Table 4-5).

If a leach field is found, three trenches will be dug within the field, and samples will be collected from three depths in each trench (a total of nine samples).

If neither a drain line nor a leach field is found, samples will be collected from the areas expected to have received discharges (as determined from the geophysical survey and historical data). The study area selected, which is shown in Figure 5-27, is a segment of a 200-ft-radius circle centered on the estimated location of the septic tank; it extends eastward (the expected direction the drain line would have taken if there was a leach field, judging from the topography) and also some distance to the south (the expected direction of a possible shorter drain line discharging to an outfall).

Samples will be collected at nine locations within the study area, from a depth of 4 to 4.5 ft, using either a hand auger (LANL-ER-SOP-06.10) or a split spoon (LANL-ER-SOP-06.24) depending on soil conditions. If the septic tank is still present, the contents will also be sampled (if water and sludge are both present, a sample of each will be collected).

Soil samples from the trenches will be collected using the spade and scoop method (LANL-ER-SOP-06.09). The contents of the septic tank will be sampled using a Coliwasa sampler (LANL-ER-SOP-06.15).

5.6 Aggregate F - Outfalls

Aggregate F consists of eight active and inactive outfalls at TA-53 (PRSs 53-012[a]-[h]. Because there is no evidence of release from seven of these, they have been recommended for NFA (see Chapter 6). The remaining outfall, which will undergo Phase I RFI, is PRS 53-012(e). See Table 5-14 for summary information on this PRS.

5.6.1 Description and History

PRS 53-012(e) is a drain line and outfall for discharges from TA-53-2, the Equipment Test Laboratory (ETL), that operates under the Laboratory's NPDES permit (as outfall 03A114). As described in the permit application, it discharges treated cooling water from the ETL cooling tower at an average flow of 2.9 gal. per minute (LANL 1990, 22-0018).

TABLE 5-14

PRS AGGREGATE F - OUTFALLS

PRS No.	PRS Title	Structure No.	Operational Status	Period Used	Potential Contaminants of Concern
53-012(e)	Outfall 03A114	TA-53-2	Active	Approximately 1970-present	VOCs, metals, TPH, PCB

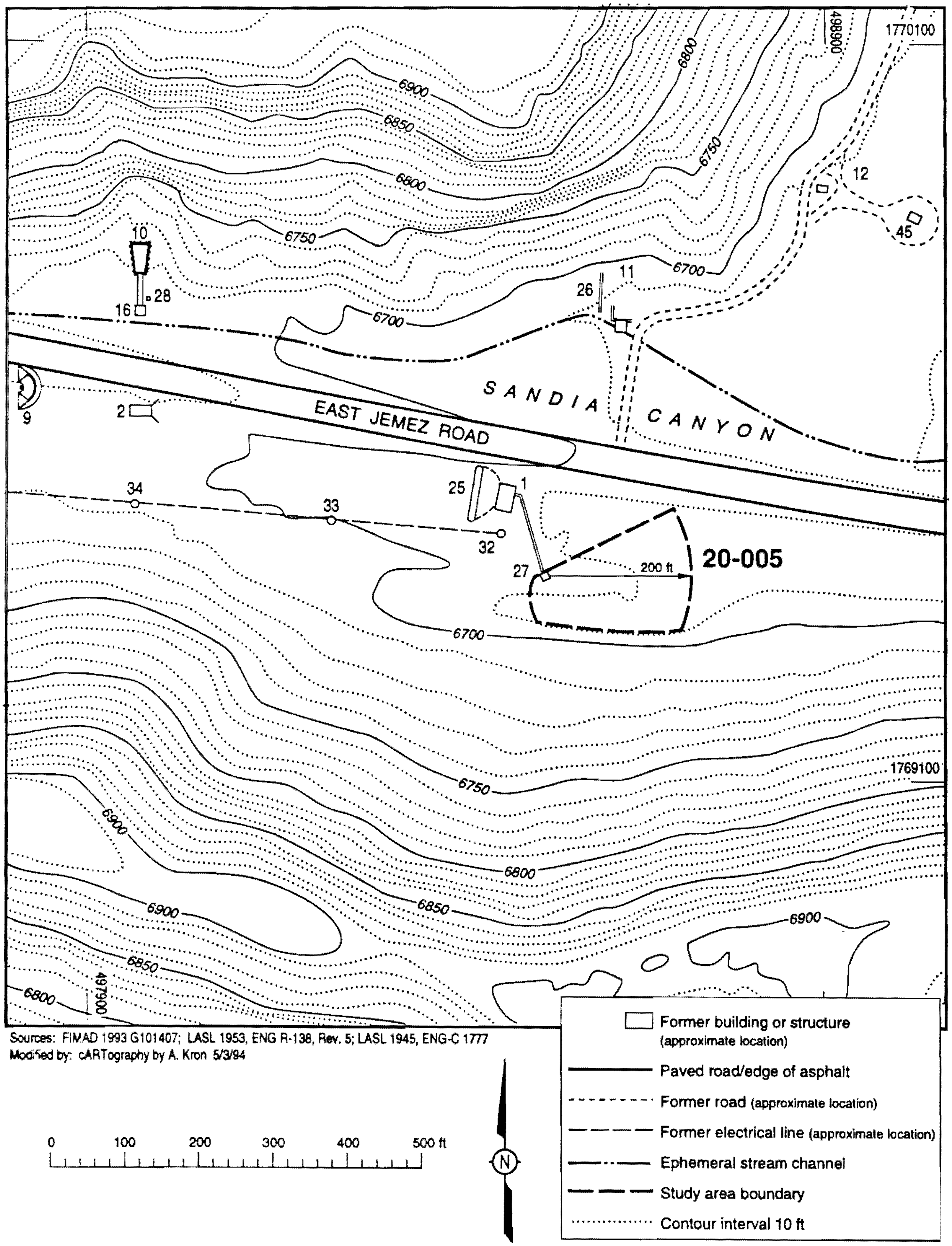


Figure 5-27. Study area for PRS 20-005.

This outfall was characterized under the TA-53 wastewater stream characterization study. The report (Santa Fe Engineering 1993, 22-0070) indicates that 12 trench drains, 2 sink drains, and a floor drain are connected to this outfall. One of the trench drains carries blowdown from the cooling tower at TA-53-2; discharges carried by the other trench drains include equipment-flushing and floor-washing wastewaters from the Klystron Lab and equipment-drainage liquid from the Furnace Room.

The various discharges drain to a sump pit outside the southwest corner of Building TA-53-2, and from there to a drain line that runs south, underneath the parking lot south of TA-53-2, to a drainage ditch. The ditch carries the discharges southwest to the rim of Sandia Canyon (Figure 5-28).

5.6.2 Conceptual Exposure Model for PRS 53-012(e)

Figure 5-29 illustrates the conceptual exposure model for PRS 53-012(e). This model is based on archival information only and will be refined or modified on the basis of data gathered during the RFI.

5.6.2.1 Existing Information on Nature and Extent of Contamination

The cooling tower blowdown would have contained constituents added to the cooling water as well as naturally occurring constituents. According to operations and maintenance staff at TA-53, these added constituents include several water treatment/conditioning chemicals (see Table 5-15). Constituents naturally present in the water will be concentrated in blowdown by evaporation of water.

As part of the NPDES permit application, outfalls under category 03A were characterized. Of the 36 outfalls in this category Lab-wide, four were sampled to develop a "worst case" composite. (Outfall 03A114 was not one of the outfalls sampled.) Results for the constituents analyzed that have SALs are presented in Table 5-16.

The composite results show chromium, nickel, and thallium present in concentrations above SALs for water. All other inorganic constituents, and all organic constituents, were below SALs. (Because these composite results are "worst case," they may not be representative of Outfall 03A114.)

TABLE 5-15

SUMMARY OF WATER CONDITIONING CHEMICALS ADDED TO TA-53 COOLING TOWERS

Purpose	Hazardous Components
Corrosion and scale inhibitor	Sodium molybdate Hydroxyethylidene diphosphonic acid
Microbicide	1-bromo-3-chloro-5,5-dimethylhydantoin
Oxygen scavenger	Sodium bisulfite

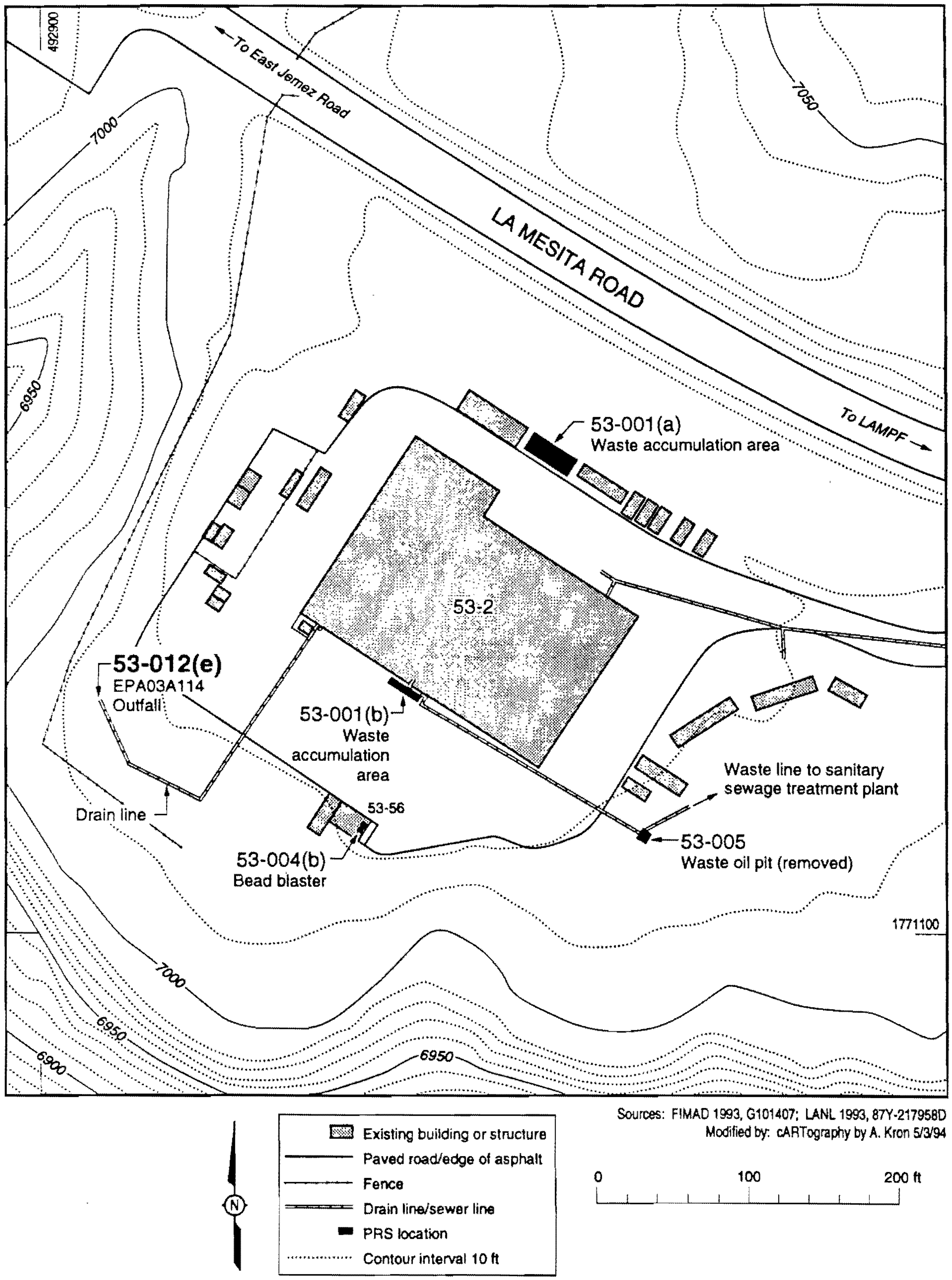


Figure 5-28. Location of PRS 53-012(e).

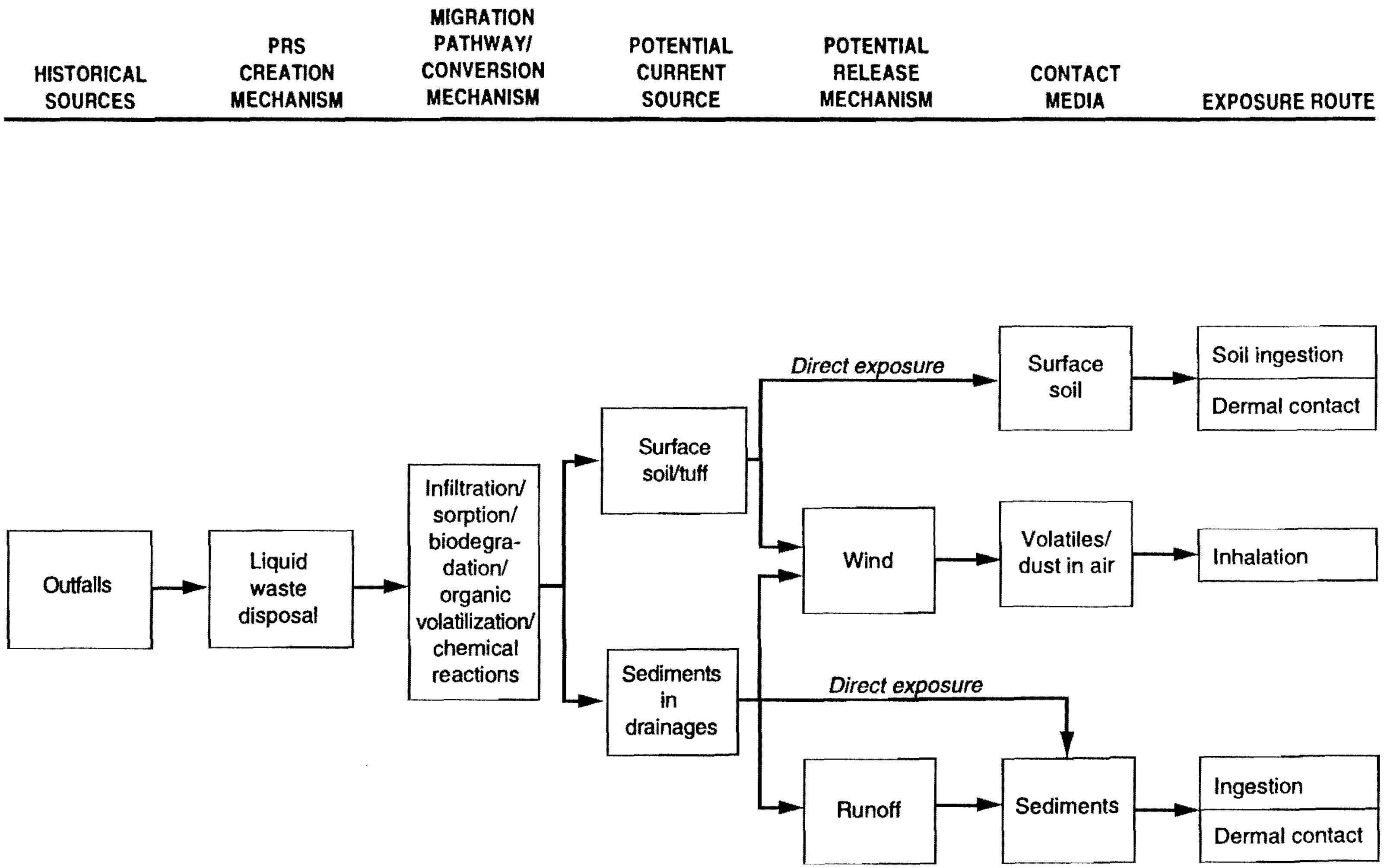


Figure 5-29. Conceptual exposure model for PRS 53-012(e).

TABLE 5-16

CONCENTRATIONS OF CONSTITUENTS IN COOLING TOWER OUTFALLS

Constituent	SAL (µg/L)	Worst Case for 03A Outfalls (µg/L)
Barium	2,000[a]	110
Manganese	3,500	50
Antimony	6[a]	<50
Arsenic	50[b]	40
Beryllium	4[a]	<100
Cadmium	5[a]	4
Chromium	50[a]	260
Copper	1,300	100
Mercury	2[a]	<0.2
Nickel	100[a]	280
Selenium	50[a]	<1
Silver	170	<10
Thallium	2[a]	510
Zinc	10,000	71
Cyanide	200[b]	33
Benzene	5[a]	<5
Bromoform	4.4	<5
Carbon tetrachloride	5[a]	<5
Chlorobenzene	100[a]	<5
Chlorodibromomethane	4.2	<5
Chloroform	100[a]	<5
Dichlorobromomethane	0.56	<5
1,1-Dichloroethane	3,500	<5
1,2-Dichloroethane	5[a]	<5
1,1-Dichloroethene	7[a]	<5
1,2-Dichloropropane	5[a]	<5
1,3-Dichloropropene	0.19	<5
Ethylbenzene	700[a]	<5
Methylbromide	49	<10
Methylchloroide	27	<10
Methylene chloride	5[a]	<5
1,1,2,2-Tetrachloroethane	1.8	<5
Tetrachloroethylene	5[a]	<5
Toluene	1,000[a]	<5
1,2-trans-Dichloroethylene	100[a]	<5
1,1,1-Trichloroethane	200[a]	<5
1,1,2-Trichloroethane	5[a]	<5
Trichloroethene	5[a]	<5
Vinyl chloride	2[a]	<10
2-Chlorophenol	170	<10
2,4-Dichlorophenol	100	<10
2,4-Dimethylphenol	700	<10
2,4-Dinitrophenol	70	<10

TABLE 5-16

CONCENTRATIONS OF CONSTITUENTS IN COOLING TOWER OUTFALLS (concluded)

Constituent	SAL (µg/L)	Worst Case for 03A Outfalls (µg/L)
p-Chloro-m-methylphenol	7,000	<10
Pentachlorophenol	1[a]	<10
Phenol	21,000	<10
2,4,6-Trichlorophenol	3.2	<10
Acenaphthene	2,100	<10
Anthracene	10,000	<10
Benzo(a)pyrene	0.1[b]	<10
bis(2-Chloroethyl ether)	0.032	<10
bis(2-Chloroisopropyl)ether	0.5	<10
bis(2-Ethylhexyl)phthalate	4[b]	<10
Butylbenzylphthalate	100[b]	<10
2-Chloronaphthalene	2,800	<10
1,2-Dichlorobenzene	600[a]	<10
Diethylphthalate	5,000[b]	<10
Dimethylphthalate	35,000	<10
Di-n-butylphthalate	3,500	<10
2,4-Dinitrotoluene	0.05	<10
2,6-Dinitrotoluene	0.05	<10
Di-n-octylphthalate	700	<10
Fluoranthene	1,400	<10
Fluorene	1,400	<10
Hexachlorobenzene	1[a]	<10
Hexachlorobutadiene	4.5	<10
Hexachlorocyclopentadiene	50[a]	<10
Hexachloroethane	25	<10
Isophorone	370	<10
Naphthalene	1,400	<10
Nitrobenzene	18	<10
N-Nitroso-di-N-propylamine	0.005	<10
N-Nitrosodiphenylamine	7.1	<10
Pyrene	1,000	<10
1,2,4-Trichlorobenzene	70[a]	<10
Chlordane	0.2[a]	<0.25
p-p'-DDT	0.1	<0.06
p-p'-DDD	0.15	<0.08
alpha-Endosulfan	1.8	<0.05
beta-Endosulfan	1.8	<0.08
PCB-1242	0.5[a]	<0.71
PCB-1254	0.5[a]	<0.71
PCB-1260	0.5[a]	<0.71

[a] SAL is maximum contaminant level (MCL) under Safe Drinking Water Act (SDWA).
[b] SAL is proposed MCL under SDWA.

The discharges from the outfall have not been sampled, nor have the sediments below the outfall. None of the available information, including the data in the NPDES permit application, suggests that discharge of cooling tower blowdown should result in the presence of contaminants of concern in sediments. At the same time, this outfall is not being recommended for NFA because of the discharges it could contain from sources other than the cooling tower. Hazardous materials, including solvents, acids, and transformer oil, are known to be used in the ETL, and hazardous constituents could have been released to sink drains and floor drains.

5.6.2.2 Potential Routes of Exposure to Contaminants

The current potential receptors for this PRS are the onsite workers (including construction workers). These receptors could become exposed to potentially contaminated channel sediments through ingestion, dermal contact, and inhalation of dusts. The potential for exposure by these routes and the need for further investigation during Phase II will be evaluated on the basis of the Phase I results.

5.6.3 Application of the DQO Process

The decision strategy for the RFI is presented in Section 4.4. The DQO process (described in the IWP, LANL 1993, 1017) was used in designing the Phase I screening assessments, which are a major component of this strategy, to ensure that the appropriate amount, type, and quality of data are collected.

5.6.3.1 Statement of the Problem (DQO Step 1)

This outfall may have received discharges of hazardous materials that could have resulted in contamination of sediments in the drainage channel below the outfall. The Phase I investigation will establish the presence or absence of contaminants in these sediments.

5.6.3.2 Identification of Decisions (DQO Step 2)

Field screening and reconnaissance sampling will be used to determine whether contaminants of concern exist in drainage channel sediments. If contaminants of concern are found, either a VCA will be implemented or further site characterization will be done to obtain the data necessary for a baseline risk assessment. If no contaminants of concern are identified, NFA will be recommended.

5.6.3.3 Data Inputs (DQO Step 3)

The primary data needed for the Phase I investigation are chemical data on the types and concentrations of PCOCs in sediments below the outfall. These data will be obtained by collection and analysis of samples from sediment catchments.

5.6.3.4 Boundaries (DQO Step 4)

The boundaries of the investigation for this PRS—those that define the area most likely to have been contaminated by releases from the PRS—should encompass the sediments that would now be contaminated from historical releases (see Figure 5-29). The location of the highest concentrations of PCOCs depends on several factors, including the age of the release, the concentration of PCOCs in the release, the history of flows in the drainage channel, and the mobility characteristics of the PCOCs. Because these factors are not well characterized, it is difficult to determine where the highest concentrations should be expected. The horizontal boundaries for this PRS, therefore, will extend from the point of discharge (the outfall) to the canyon rim. They will not include the canyon walls because those do not accumulate sediments. Sediments on the floor of Sandia Canyon will be considered in the work plan for the Canyons Operable Unit (OU 1049) and will not be part of the RFI for this PRS.

The vertical boundaries for sampling of sediment catchments will be from the surface to the soil/bedrock interface, or to a maximum depth of 5 ft. These boundaries allow for vertical mixing of sediments during runoff and vertical migration from leaching; they also encompass the depths to which receptors are most likely to become exposed (for example, during excavation for construction).

5.6.3.5 Decision Rules (DQO Step 5)

As shown in Figure 5-30, Phase I sampling will generate data on concentrations of individual PCOCs in sediments at this PRS. If these data indicate the presence of contamination, further action will be required. VCA may be recommended if the contamination is well defined and limited in extent, and if the site is shown to pose a current risk. Otherwise, a Phase II characterization will be developed to obtain the additional data needed for a baseline risk assessment. If no contaminants of concern are identified, NFA will be recommended.

5.6.3.6 Design Criteria (DQO Step 6)

The design criterion for sediment sampling is a 90% probability of detecting contamination if at least 30% of the sampled catchments are contaminated. The 90% value is based on the judgment that high levels of contamination are unlikely at these PRSs: hazardous constituents are not known to have been discharged, and any that were would have been diluted by the relatively large flow of cooling water. The consequences of failing to detect contamination if it is present, therefore, are not great. At this low level of risk, by selecting 90% for the sampling design criterion, we allow for a 10% probability that contamination will be present but undetected.

Because the source of potential contamination for these PRSs is discharged wastewaters, the distribution of any contaminants near the point of discharge should be fairly uniform. We estimate the potentially contaminated fraction of the area selected for sampling to be at least 30%, allowing for the probability that a substantial percentage of that area will be unaffected by discharges. The criterion will be enhanced through biased sampling.

Table 5-17 summarizes the DQO specifications for this aggregate.

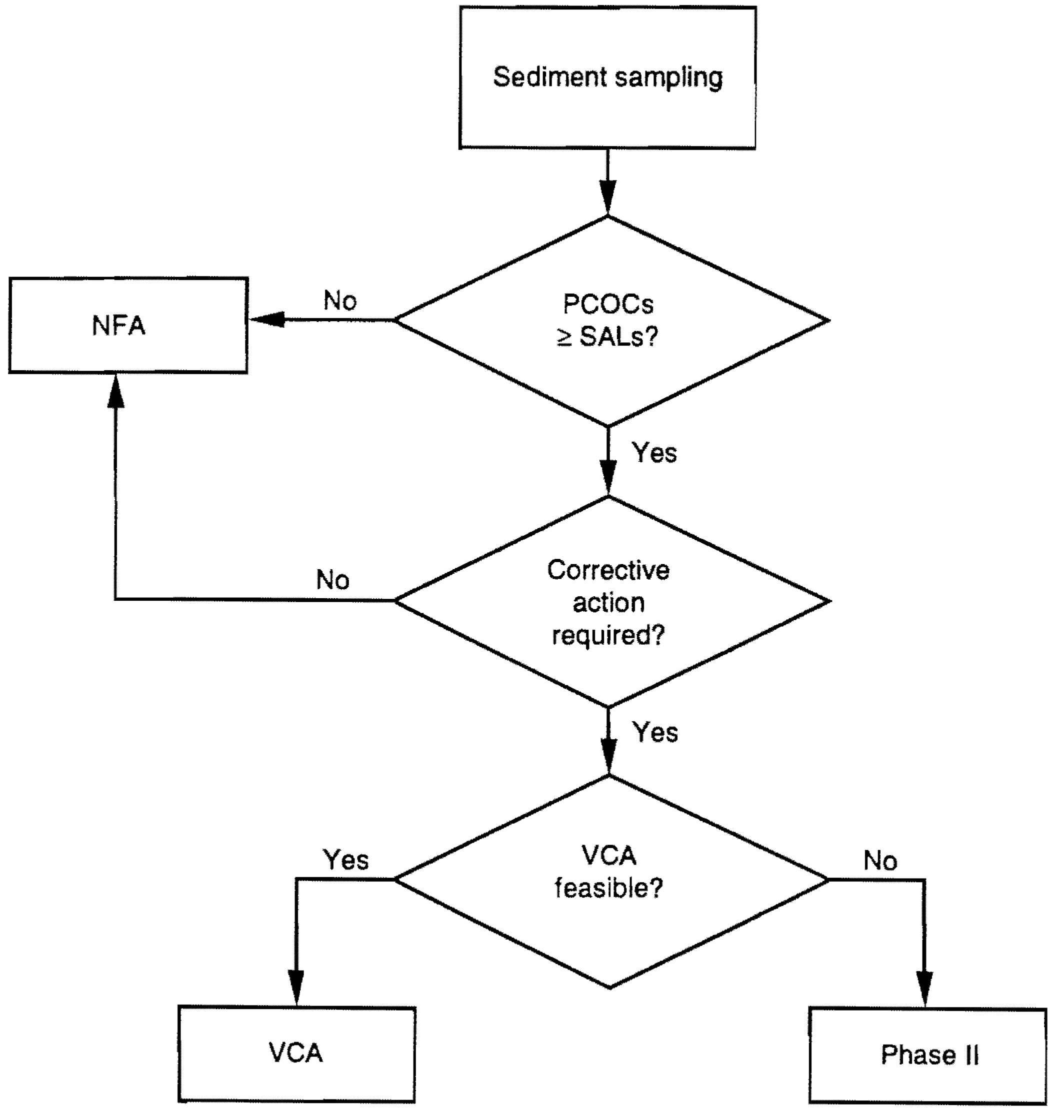


Figure 5-30. Decision logic for PRS 53-012(e).

TABLE 5-17

DQO SUMMARY FOR PRS 53-012(e)

DQO Step 1: Statement of the Problem	Hazardous constituents, which may have been present in outfall discharges, could have caused contamination of sediments below the outfall
DQO Step 2: Identification of Decisions (to be followed for each PRS individually)	Establish presence/absence of contaminants of concern using field screening and reconnaissance sampling
DQO Step 3: Data Inputs	Chemical data on concentrations of PCOCs in sediments
DQO Step 4: Boundaries	• Horizontal: drainage channel from outfall to canyon rim • Vertical: surface of sediments to bedrock (or maximum depth of 5 ft)
DQO Step 5: Decision Rules (to be followed for each PRS individually)	• If contaminants are present, go to Phase II investigation or, if contamination is limited, well defined, and poses a current risk, implement a VCA • If no contaminants are present, recommend NFA
DQO Step 6: Design Criteria	• 90% probability of detecting sediment contamination if 30% of sampled area is contaminated • Bias sampling to enhance probability

5.6.4 Phase I Sampling and Analysis Plan

5.6.4.1 Field Surveys

Field surveys include land surveys and geomorphic surveys. The land survey will be used to demarcate, in the field, the study boundaries, surface features, and sample collection locations. The geomorphic survey will be used to identify drainage patterns and locate sediment catchments for sampling.

5.6.4.2 Sampling and Analysis

The study area for this PRS consists of the drainage channel from the outfall to the canyon rim. The sediment catchments within this area, where contaminated sediments (if present) are expected to have accumulated, will be sampled. Samples will be collected at three or four sediment catchments, using a hand auger (LANL-ER-SOP-06.10). Because the vertical distribution of contamination is not known, samples will be collected at two or three depths at each location (depending on the thickness of the sediments). If three sampling depths are possible, these will be the top 12 in., a 12-in. interval at the mid-depth of the sediment profile, and a 12-in. interval immediately above the sediment/bedrock interface (or to a maximum depth of 5 ft). If only two sampling depths are possible, these will be the top 12 in. and the 12 in. just above the soil/bedrock interface. At least seven samples will be collected to meet the design criterion specified for this PRS (see Table 4-5). If the sediments are less than 12 in. deep, samples will be collected from the entire sediment profile (and, if necessary to obtain the required seven samples, from additional catchments).

Preliminary sampling locations are shown in Figure 5-31.

Although radioactive PCOCs are not expected at this site, all samples will be field-screened for radioactivity and analyzed for radioactivity in an onsite mobile laboratory. Samples will also be field screened for organic vapors to identify gross VOC contamination. Samples sent to an offsite analytical laboratory will be analyzed for all PCOCs. Quality control samples will be collected as specified in the QAPP (Annex II). Table 5-18 summarizes the sampling and analyses to be done.

5.7 Aggregate G - Surface Impoundments

Aggregate G consists of three surface impoundments: two inactive (PRS 53-002[a]) and one active (PRS 53-002[b]); all are currently regulated as interim-status mixed waste impoundments under RCRA. Because these impoundments will undergo closure under RCRA, they are recommended for deferred action (see Chapter 6).

5.8 Summary of Phase I Activities

Phase I RFI activities will be carried out at 19 PRSs and will include land surveys, geophysical surveys, radiation surveys, and reconnaissance sampling. Table 5-19 summarizes these activities, the numbers and types of samples to be collected, and the analyses to be performed.

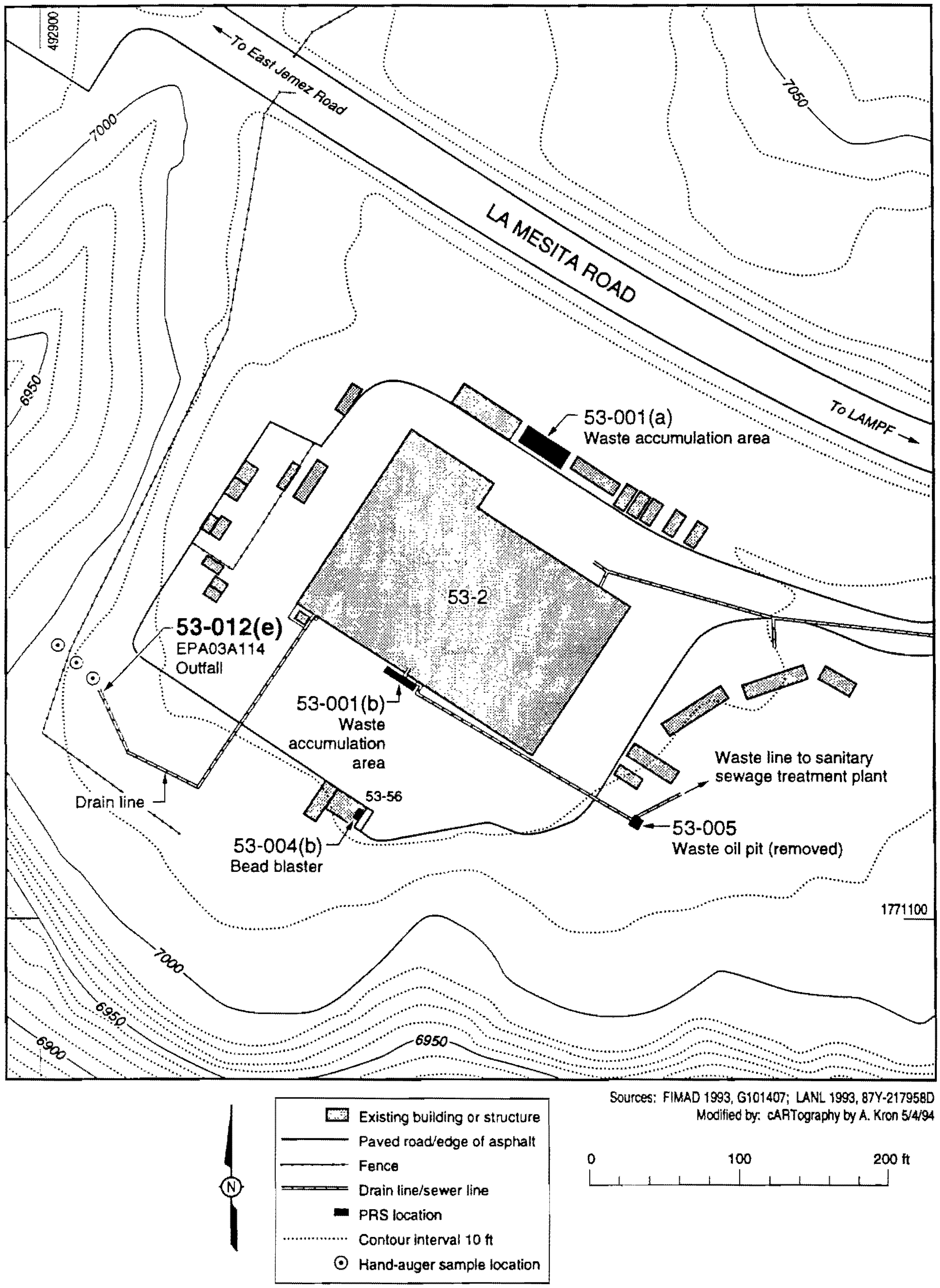


Figure 5-31. Preliminary sampling locations for PRS 53-012(e).

TABLE 5-18
SUMMARY OF PHASE I SAMPLING AND ANALYSES FOR PRS 53-012(e)

PRS No.	PRS Type	Phase I Approach	Field Surveys				Samples				Field Screening				Mobile Lab			Laboratory Analysis										
			Land Survey	Geophysical Survey	Radiation Survey	Geomorphic Survey	Sampled Media	Structure	Surface	Subsurface	Gross Alpha	Gross Gamma/Beta	Organic Vapor	High Explosive	Gross Alpha	Gross Beta	Gross Gamma	Gamma Spectroscopy	Total Uranium	Isotopic Uranium	Strontium-90	VOCs	SVOCs	HE	Metals	PCB	TPH	Cyanide
53-012(e)	Outfall	Reconnaissance	X			X	Sediment		3	6	X	X	X		X	X	X					X			X	X	X	

TABLE 5-19
SUMMARY OF PHASE I SAMPLING AND ANALYSES

PRS No.	PRS Type	Phase I Approach	Field Surveys				Samples				Field Screening				Mobile Lab			Laboratory Analysis										
			Land Survey	Geophysical Survey	Radiation Survey	Geomorphic Survey	Sampled Media	Structure	Surface	Subsurface	Gross Alpha	Gross Gamma/Beta	Organic Vapor	High Explosive	Gross Alpha	Gross Beta	Gross Gamma	Gamma Spectroscopy	Total Uranium	Isotopic Uranium	Strontium-90	VOCs	SVOCs	HE	Metals	PCB	TPH	Cyanide
20-001(a)	Landfill	Reconnaissance	X	X			Soil	0	0	7(a)	7	7		7	7	7	7	7	7	7	7			7	7			
20-001(b)	Landfill	Reconnaissance	X	X			Soil	0	0	7(a)	7	7		7	7	7	7	7	7	7	7			7	7			
20-001(c)	Landfill	Reconnaissance	X	X			Soil	0	0	7(a)	7	7		7	7	7	7	7	7	7	7			7	7			
20-002(a)	Firing Site	Reconnaissance	X		X		Soil	0	11	11	22	22		22	22	22	22	22	22	22	22			22	22			
20-002(b)	Firing Site	Reconnaissance	X		X		Soil	0	4(b)	4	7	7		7	7	7	7	7	7	7	7			7	7			
20-002(c)	Firing Site	Reconnaissance	X		X		Soil	0	8	16	24	24		24	24	24	24	24	24	24	24			24	24			
20-002(d)	Firing Site	Reconnaissance	X		X		Soil	0	8	16	24	24		24	24	24	24	24	24	24	24			24	24			
20-003(b)	Gun Firing Impact Area	Reconnaissance	X		X	X	Soil	0	3	6	9	9		9	9	9	9	9			9				9			
20-003(c)	Gun Firing Impact Area	Reconnaissance	X		X		Soil	0	6	6	12	12		12	12	12	12	12			12				12			
20-004	Septic System	Reconnaissance	X	X			Soil, Waste	2(c)	2	7	11	11	11	11	11	11	11					11	11		11			
20-005	Septic System	Reconnaissance	X	X			Soil, Waste	2(c)	2	7	11	11		11	11	11	11								11			11
53-001(a)	Storage area	Reconnaissance	X				Soil	0	4	0	4	4	4		4	4	4					4			4	4	4	
53-001(b)	Storage area	Reconnaissance	X			X	Sediment	0	2	2	4	4	4		4	4	4					4			4	4	4	
53-001(e)	Storage area	Reconnaissance	X				Soil	0	4	0	4	4	4		4	4	4					4					4	
53-001(g)	Storage area	Reconnaissance	X				Soil	0	4	0	4	4	4		4	4	4					4			4		4	
53-005	Disposal pit	Reconnaissance	X				Soil/Tuff	0	0	4	4	4	4		4	4	4					4			4	4	4	
53-008	Storage area	Reconnaissance	X		X		Soil	0	11	0	11	11			11	11	11	11							11			
53-010	Storage area	Reconnaissance	X				Soil	0	6	0	6	6	6		6	6	6						6				6	
53-012(e)	Outfall	Reconnaissance	X			X	Sediment	0	3	6	9	9	9		9	9	9					9			9	9	9	
72-001	Firing Range	Reconnaissance	X			X	Soil	0	7	0	7	7		7	7	7	7								7			
Total Samples								4	85	106	194	194	46	148	194	194	194	130	98	98	119	40	17	98	184	21	35	11
							Field Duplicates								20	20	20	13	10	10	12	4	2	10	19	3	4	2
							Rinsate Blank								10	10	10	7	5	5	6	2	1	5	10	2	0	0
							Matrix Spike											7	5	5	6	2	1	5	10	2	0	1
							Matrix Spike Duplicates											7	5	5	6	2	1	5	10	2	0	1
Total Analyses											194	194	46	148	224	224	224	164	123	123	149	50	22	123	233	30	39	15

(a) Number of samples is based on assumption of locating one suspected former landfill site at each PRS. Seven samples will be collected at each area to meet sample design criteria.
(b) Number of samples will be based on results of radiation survey; four surface and subsurface samples are assumed for planning purposes.
(c) If septic tank is present, contents will be sampled. Sample of water and sludge will be collected if both phases are present. Two samples assumed for planning purposes.

REFERENCES FOR CHAPTER 5

AEC (US Atomic Energy Commission) August 6, 1951. Engineering Drawing ENG-C 15100, Rev. 0, prepared by Black and Veatch, US Atomic Energy Commission, ER ID Number 26065, Los Alamos, New Mexico. (AEC 1951, 22-0023)

AEC (US Atomic Energy Commission), August 6,1951. Engineering Drawing ENG-C 15104, Rev. 0, prepared by Black and Veatch, US Atomic Energy Commission, ER ID Number 26066, Los Alamos, New Mexico. (AEC 1951, 22-0022)

Ahlquist, A. J., July 9, 1985. "Structure Removal," Los Alamos National Laboratory memorandum, ER ID Number 04470, Los Alamos, New Mexico. (Ahlquist 1985, 22-0025)

Ahlquist, A. J., R. W. Ferenbaugh, and L. J. Fritz, February 3, 1985. "Interview with Eric L. Peterson 2/3/85," Los Alamos National Laboratory memorandum, ER ID Number 00753, Los Alamos, New Mexico. (Ahlquist et al. 1985, 22-0024)

Bradbury, N. E., September 11, 1947. "General Background Data Concerning the Los Alamos Scientific Laboratory," Los Alamos Scientific Laboratory Memorandum LAB-A-5, ER ID Number 07006, Los Alamos, New Mexico. (Bradbury 1947, 22-0027)

Buckland, C., November 15, 1946. "Sandia Canyon," Los Alamos Scientific Laboratory memorandum, ER ID Number 5998, Los Alamos, New Mexico. (Buckland 1946, 22-0028)

Buckland, C., April 20, 1948. "Sandia Canyon, Clearing for Future Public Road, Picnic Area," Los Alamos Scientific Laboratory memorandum, ER ID Number 6001, Los Alamos, New Mexico. (Buckland 1948, 22-0029)

Campbell, C. C., November 20, 1962. "Explosive Contamination, TA-20, Sandia Canyon, and TA-27, Gamma Site," ER ID Number 05973, Los Alamos, New Mexico. (Campbell 1962, 22-0030)

Courtwright, W. C., September 28, 1962. "Inspection for Possible Explosives Contamination of TA-20, Sandia Canyon Site, and TA-27 Gamma Site," Los Alamos Scientific Laboratory memorandum, ER ID Number 05971, Los Alamos, New Mexico. (Courtwright 1962, 22-0031)

Courtwright, W. C., July 20, 1971. "Inspection of TA-10 (Bayo Canyon), TA-20, and TA-27," Los Alamos Scientific Laboratory memorandum, ER ID Number 02075, Los Alamos, New Mexico. (Courtwright 1971, 22-0032)

Critchfield, C. L., January 3, 1945. "Estimates, January through June, 1945, G-10," Los Alamos Scientific Laboratory memorandum, ER ID Number 05989, Los Alamos, New Mexico. (Critchfield 1945, 22-0033)

Critchfield, C. L., February 9, 1945. "Steering Committee Actions," Los Alamos Scientific Laboratory Meeting Minutes, ER ID Number 05991, Los Alamos, New Mexico. (Critchfield 1945, 22-0034)

Critchfield, C. L., February 13, 1945. "Steering Committee Actions," Los Alamos Scientific Laboratory Meeting Minutes, ER ID Number 05992, Los Alamos, New Mexico. (Critchfield 1945, 22-0035)

Critchfield, C. L., August 1, 1945. "Preparation Required for Experimental Work of G-10," Los Alamos Scientific Laboratory memorandum, ER ID Number 05995, Los Alamos, New Mexico. (Critchfield 1945, 22-0036)

Davis, D., Jr., August 31, 1962. Los Alamos Scientific Laboratory, ER ID Number 29397, Los Alamos, New Mexico. (Davis 1962, 22-0037)

DOE (US Department of Energy), October 1986. Comprehensive Environmental Assessment and Response Program, Phase I: Installation Assessment, Los Alamos National Laboratory, Vol. 1 of 2, Working Draft, United States Department of Energy, Albuquerque Operations Office, Environment Safety and Health Division, Environmental Programs Branch, Albuquerque, New Mexico. (DOE 1986, 8657)

DOE (US Department of Energy), October 1987. "Phase I: Installation Assessment, Los Alamos National Laboratory," Volumes 1 and 2, (draft), Comprehensive Environmental Assessment and Response Program, Albuquerque Operations Office, Albuquerque, New Mexico. (DOE 1987, 0264)

DOE (US Department of Energy), November 1987. "Environmental Survey Preliminary Report for the Los Alamos National Laboratory," Draft Preliminary, United States Department of Energy, Assistant Secretary for Environment, Safety, and Health, ER ID Number 08609, Washington, DC. (DOE 1987, 22-0113)

Drake, R. W., July 12, 1971. "Inspection of TA-20 and TA-27 for Loose Explosives: Visit to Bayo Canyon," Los Alamos Scientific Laboratory memorandum, ER ID Number 02076, Los Alamos, New Mexico. (Drake 1971, 22-0042)

Drake, R. W., May 8, 1973. "Biennial Inspection, TA's 10, 20, and 27," Los Alamos Scientific Laboratory memorandum, ER ID Number 05043, Los Alamos, New Mexico. (Drake 1973, 22-0043)

Drake, R. W., and W. C. Courtwright, May 8, 1964. "Annual Safety Inspection of TA-20 and TA-27 for Loose Explosives," Los Alamos Scientific Laboratory memorandum, ER ID Number 05976, Los Alamos, New Mexico. (Drake and Courtwright 1964, 22-0038)

Drake, R. W., and W. C. Courtwright, July 7, 1966. "Annual Inspection of TA-20 and TA-27 for Loose Explosives," Los Alamos Scientific Laboratory memorandum, ER ID Number 05985, Los Alamos, New Mexico. (Drake and Courtwright 1966, 22-0039)

Drake, R. W., and W. C. Courtwright, July 11, 1967. "Annual Inspection of TA-20 and TA-27 for Loose Explosives," Los Alamos Scientific Laboratory memorandum, ER ID Number 05986, Los Alamos, New Mexico. (Drake and Courtwright 1967, 22-0040)

Drake, R. W., and W. C. Courtwright, June 13, 1969. "Inspection of TA-20 and TA-27 for Loose Explosives," Los Alamos Scientific Laboratory memorandum, ER ID Number 02080, Los Alamos, New Mexico. (Drake and Courtwright 1969, 22-0041)

Drake, R. W., W. C. Courtwright, and J. Bacastow, June 24, 1975. "Biennial Inspection: TA-10, TA-20, and TA-27," Los Alamos Scientific Laboratory Memorandum H-3-75-251, ER ID Number 05047, Los Alamos, New Mexico. (Drake et al. 1975, 22-0044)

Kearney, A. T. and K. W. Brown & Associates, Inc., August 1987. RCRA Facility Assessment (RFA) Preliminary Review/Visual Site Inspection (PR/VSI) Report of the Los Alamos National Laboratory, Los Alamos, New Mexico, I.D. Number NM0890010515, Volume II, US Environmental Protection Agency, Region VI, ER ID Number 11654, Dallas, Texas. (Kearney et al. 1987, 22-0021)

LANL (Los Alamos National Laboratory), undated. "ENG-7 Structure Historical Book: TA-20," Los Alamos National Laboratory, ER ID Number 29404, Los Alamos, New Mexico. (LANL undated, 22-0051)

LANL (Los Alamos National Laboratory), 1984. CEARP Reference File Working Draft, ER ID Number 06112, Los Alamos, New Mexico. (LANL 1984, 22-0015)

LANL (Los Alamos National Laboratory), 1985. CEARP Files (draft), ER ID Number 06114, Los Alamos, New Mexico. (LANL 1985, 22-0016)

LANL (Los Alamos National Laboratory), June 19, 1989. Polaroid Photo No. 2, "Drum Storage Rack on the North Side of MPF-2," Los Alamos National Laboratory, ER ID Number 20502, Los Alamos, New Mexico. (LANL 1989, 22-0047)

LANL (Los Alamos National Laboratory), June 19, 1989. Polaroid Photo No. 16, "Satellite Hazardous Storage Rack South of MPF-2," Los Alamos National Laboratory, ER ID Number 20516, Los Alamos, New Mexico. (LANL 1989, 22-0048)

LANL (Los Alamos National Laboratory), June 20, 1989. Polaroid Photo No. 78, "Barrels Containing Used Ethnol, Vacuum Pump Oil and Freon; South of MPF-25," Los Alamos National Laboratory, ER ID Number 20578, Los Alamos, New Mexico. (LANL 1989, 22-0049)

LANL (Los Alamos National Laboratory), September 1990. "Consolidated Permit Reapplication for NPDES NM 0028355," Los Alamos National Laboratory, ER ID Number 29412, Los Alamos, New Mexico. (LANL 1990, 22-0018)

LANL (Los Alamos National Laboratory), April 28, 1993. "Hazardous Waste Tracking System," Los Alamos National Laboratory, ER ID Number 29415, Los Alamos, New Mexico. (LANL 1993, 22-0050)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1779, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24343, Los Alamos, New Mexico. (LASL 1951, 22-0061)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1776, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24343, Los Alamos, New Mexico. (LASL 1951, 22-0060)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1777, Rev. 1 prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24344, Los Alamos, New Mexico. (LASL 1951, 22-0055)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1778, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24345, Los Alamos, New Mexico. (LASL 1951, 22-0056)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1780, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24348, Los Alamos, New Mexico. (LASL 1951, 22-0054)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1782, Rev. 1. prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24349, Los Alamos, New Mexico. (LASL 1951, 22-0053)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1787, Rev. 2, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24353, Los Alamos, New Mexico. (LASL 1951, 22-0057)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1788, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24354, Los Alamos, New Mexico. (LASL 1951, 22-0058)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1789, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24355, Los Alamos, New Mexico. (LASL 1951, 22-0059)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C-1781, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos

Scientific Laboratory, ER ID Number 24348, Los Alamos, New Mexico. (LANL 1951, 22-0052)

LASL (Los Alamos Scientific Laboratory), May 2, 1959. Engineering Drawing ENG-R 1158, Rev. 1, Los Alamos Scientific Laboratory, ER ID Number 24363, Los Alamos, New Mexico. (LASL 1959, 22-0062)

LASL (Los Alamos Scientific Laboratory), April 21, 1965. "Probable Burial Areas: Former Sandia Canyon Site, TA-20," Los Alamos Scientific Laboratory memorandum, ER ID Number 05984, Los Alamos, New Mexico. (LASL 1965, 22-0063)

LASL (Los Alamos Scientific Laboratory), April 2, 1971. Engineering Drawing ENG-C 50165, Rev. 1, Los Alamos Scientific Laboratory, ER ID Number 23260, Los Alamos, New Mexico. (LASL 1971, 22-0064)

LASL (Los Alamos Scientific Laboratory), February 2, 1976. Engineering Drawing ENG-C 50989, Rev. 0, Los Alamos Scientific Laboratory, ER ID Number 23261, Los Alamos, New Mexico. (LASL 1976, 22-0065)

Littlejohn, G. J., November 26, 1946. "Monitoring of Sandia Equipment," Los Alamos Scientific Laboratory memorandum, ER ID Number 5997, Los Alamos, New Mexico. (Littlejohn 1946, 22-0066)

Monyoya, J. B., July 2, 1985. "Structure Removal," Los Alamos Scientific Laboratory memorandum, ER ID Number 00804, Los Alamos, New Mexico. (LASL 1985, 22-0067)

NMEID (New Mexico Environmental Improvement Division), January 20, 1989. Permit to Install or Modify an Individual Liquid Waste System, NMEID Permit Number SF890023, ER ID Number 29407, Santa Fe, New Mexico. (NMEID 1989, 22-0079)

Reider, R., October 2, 1962. "Explosive Contamination, TA-20, Sandia Canyon Site and TA-27, Gamma Site," Los Alamos Scientific Laboratory memorandum, ER ID Number 05972, Los Alamos, New Mexico. (Reider 1962, 22-0068)

Santa Fe Engineering, Ltd., 1993. "Waste Water Stream Characterization for TA-53-7, 8, 15, 16, 28, 29, 30, 34, 35, 36, 37, 368, 369, 370, 371, 372, 374, 382, 384, 534, 535, 540, 541, 573, 574, 622, 625, 634, 679, 686, 726, 734, 735, 736, 776, 777, 780, 781, 782, 783, 823, 826, 880, 1031, 1039, 1043, 1120, 1121, and 1138 at Los Alamos National Laboratory, Environmental Study, Characterization Report #33," Santa Fe Engineeering, ER ID Number 31759, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0070)

Santa Fe Engineering, Ltd., 1993. "Waste Water Stream Characterization for TA-53-2, 38, 49, 56, 410, 430, 438, 455, 461, 498, 508, 523, 607, 608, 609, 610, 707, 717, 745, 746, 814, 828, 829, 830, 831, 832, 860, 890, 1036, and 1037 at Los Alamos National Laboratory, Environmental Study, Characterization Report #27," Santa Fe Engineeering, ER ID Number 31754, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0130)

VanEtton, D., August 28, 1986. "Gamma Survey of TA's 15, 18, and 20 Disposal Sites," Los Alamos National Laboratory memorandum, ER ID Number 05267, Los Alamos, New Mexico. (VanEtton 1986, 22-0072)

Weston, R. F., November 1986. "Surface Geophysical Investigation Utilizing Magnetometry at Sandia Canyon Sites 1-4, TA-20; Pajarito Canyon, TA-18; and Area N, TA-15," Los Alamos National Laboratory, ER ID Number 1170, Los Alamos, New Mexico. (Weston 1986, 22-0069)

Executive Summary

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6.0 POTENTIAL RELEASE SITES RECOMMENDED FOR NO FURTHER ACTION OR DEFERRED ACTION

This chapter describes those PRSs that we recommend for NFA or for deferred action (DA). NFA recommendations are made in accordance with proposed Subpart S of 40 CFR 264 (EPA 1990, 0432), which stipulates that a site recommended for NFA must pose no threat to human health or the environment. A site is demonstrated to pose no threat if it meets one or more of the following criteria (see Chapter 4):

1. There is no evidence of any contaminant release from the PRS.
2. It is established that the concentrations of PCOCs are below SALs or at background levels.
3. The risk, as determined by a baseline risk assessment, is less than 10^{-6} for carcinogens and the hazard index is less than 1 for noncarcinogens.

Alternatively, a PRSs may be recommended for NFA on the basis of archival information if it is determined that the PRS is already properly closed, never existed, or comes under the jurisdiction of another regulatory program.

As discussed in Appendix I of the IWP (LANL 1993, 1017), DA may be appropriate for currently active sites or for inactive PRSs that are located within currently active areas. An active PRS may be recommended for DA if there are no credible pathways that lead offsite. PRSs listed in Module VIII of the HSWA Permit that are recommended for NFA are discussed separately (see Section 6.1), because NFA will require formal removal from the HSWA Permit through a permit modification. PRSs listed in Module VIII that are recommended for DA are discussed in Section 6.2. Unlisted PRSs recommended for NFA (which does not require a permit modification but does require DOE approval) are discussed in Section 6.3; those for DA are discussed in Section 6.4.

6.1 Listed PRSs Recommended for NFA

6.1.1 PRS 20-003(a) - Gun-Firing Site

6.1.1.1 Description and History

PRS 20-003(a), identified in the SWMU Report (LANL 1990, 0145) as Structure TA-20-2, was located near the center of TA-20. An engineering drawing (LASL 1951, 22-0093) identifies Structure TA-20-2 as a one-room control building having interior dimensions of 20 ft x 10 ft by 7.5 ft and covered by an earthen berm. The walls were lined with shelves and there was a bench at one end. Another engineering drawing (LASL 1951, 22-0056) shows electrical conduit running from this building to the firing site at TA-20-9 (PRS 20-002[c]) and to a manhole (TA-20-28) located at gun mount TA-20-16 (PRS 20-003[c]). A 1947 Laboratory memo (Bradbury 1947, 22-0027) mentions a control building adjacent to a firing point; the building appears to be Structure TA-20-2.

On the basis of this information, it can be inferred that Structure TA-20-2 was used to control tests and to shelter test personnel at the firing sites. Constructed in April 1945, the structure was removed in April 1948 (LANL 1951, 22-0052).

6.1.1.2 Justification for NFA

This structure was used as a control building rather than as a test facility. Numerous historical records were reviewed that discuss cleanup of potentially contaminated facilities at TA-20 before the opening of Sandia Canyon to the public (see Chapter 2). None of the existing information indicates that Structure TA-20-2 was ever contaminated.

6.1.2 PRS 53-007(a) - Neutralization Tank

6.1.2.1 Description and History

PRS 53-007(a) is described in the SWMU Report (LANL 1990, 0145) as a tank and sump installed in Building TA-53-1 in 1973. The tank measures 2 ft in diameter by 2 ft high, and the sump 8 ft x 8 ft x 6 ft. The tank was used to neutralize wastes (the types were not identified); these overflowed to the sump, which was periodically emptied by HSE-7.

The neutralization tank and the sump are located in the basement of D Wing of Building TA-53-1. As detailed in the wastewater stream characterization report for this building (Santa Fe Engineering 1993, 22-0107), eight cup drains, nine sink drains, an emergency eye wash/shower drain, and a floor sink (all located in the radiochemistry laboratories in D Wing) discharge to the neutralization tank.

A second tank, mounted on the wall above the floor-mounted neutralization tank, contains caustic for neutralization of wastes. Once neutralized, the wastes drain to an underground holding tank. From there, they are pumped to an outdoor transfer pad, south of D Wing, and then into tanker trucks for transport to treatment or disposal facilities. (A sump on the pad collects any spills during transfer.) According to the wastewater stream characterization report, this sump drains back into the holding tank; it can be plugged to prevent storm water from entering the waste system.

The area was inspected during preparation of the RFI work plan. It appears that the sump described in the SWMU Report is actually the underground holding tank located in the basement of D Wing, which means that this tank was counted twice in the SWMU Report—once in combination with the neutralization tank as PRS 53-007(a) and once separately as PRS 53-006(f). For this reason, we have designated the neutralization tank only as PRS 53-007(a) and the holding tank (or sump) as 53-006(f).

6.1.2.2 Justification for NFA

No evidence exists of any release from the neutralization tank. The potential for releases is limited by the tank's location inside Building TA-53-1 (any accidental release would be contained within the basement of the building).

6.1.3 PRS 53-007(b) - Inactive Storage Tanks

6.1.3.1 Description and History

The SWMU Report describes PRS 53-007(b) as two tanks located in Building TA-53-3. One tank, built in 1974, is stainless steel and measures 4 ft in diameter by 4 ft high. The other tank is fiberglass and may never have been used; its capacity is unknown. Both tanks were located below the hot cell room in Experimental Area A. The SWMU Report indicates that the tanks contained waste solvents, organics, and carcinogens. These wastes were reportedly picked up by EM-7.

During an onsite inspection for preparation of the RFI work plan, the tanks were located. Both are inactive and have been disconnected from waste lines. Staff members indicated that the tanks will be removed.

The wastewater stream characterization report for Building TA-53-3 (Santa Fe Engineering 1994, 22-0105) identified two sink drains and two cup drains in Room M202, through which liquid from a deionized (DI) resin flush system for magnets was discharged to these tanks. The wastes were then piped to a tanker-loading station outside the building (piping diagrams show that this station was probably the same as that associated with the underground radioactive-liquid-waste storage tanks designated PRSs 53-006(b) and (c), located outside Sector M. The report also notes that all of the floor drains in the vicinity of PRS 53-007(b) are connected to the radioactive liquid waste system that discharges to these tanks and to the radioactive waste surface impoundment (PRS 53-002[b]). Finally, the report states that the piping from the sink and cup drains has been plugged.

6.1.3.2 Justification for NFA

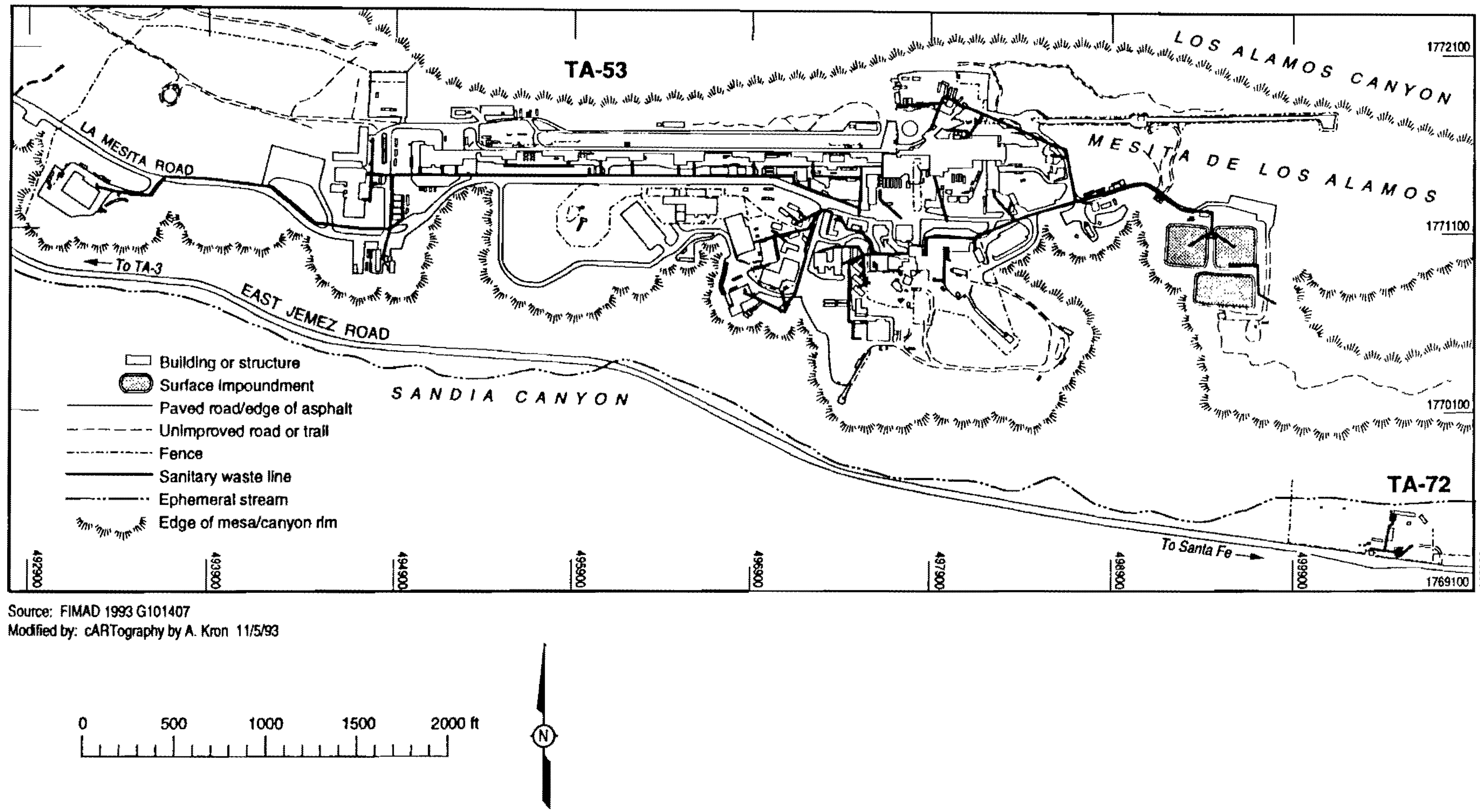
There is no evidence of any release from these tanks. Moreover, the potential for release is minimal because of the tanks' location inside the building. Secondary containment systems—floor drains connected to the radioactive liquid waste system and a catch basin in the truck-loading area outside the building—would capture any leakages. (These containment systems are considered part of PRSs 53-006[b] and [c]—see Section 6.2.2.)

6.2 Listed PRSs Recommended for DA

6.2.1 PRSs 53-002(a) and (b) - Surface Impoundments

6.2.1.1 Description and History

PRS 53-002(a) comprises two surface impoundments: the northeast (NE) and the northwest (NW). PRS 53-002(b) is a third impoundment, the south (S). All three impoundments are identified as Structure TA-53-166. Figure 6-1 shows their location at the east end of TA-53, and Figure 6-2 gives a more detailed view of their layout.



Source: FIMAD 1993 G101407
Modified by: cARTography by A. Kron 11/5/93

Figure 6-1. Location of TA-53 surface impoundments and sanitary waste lines.

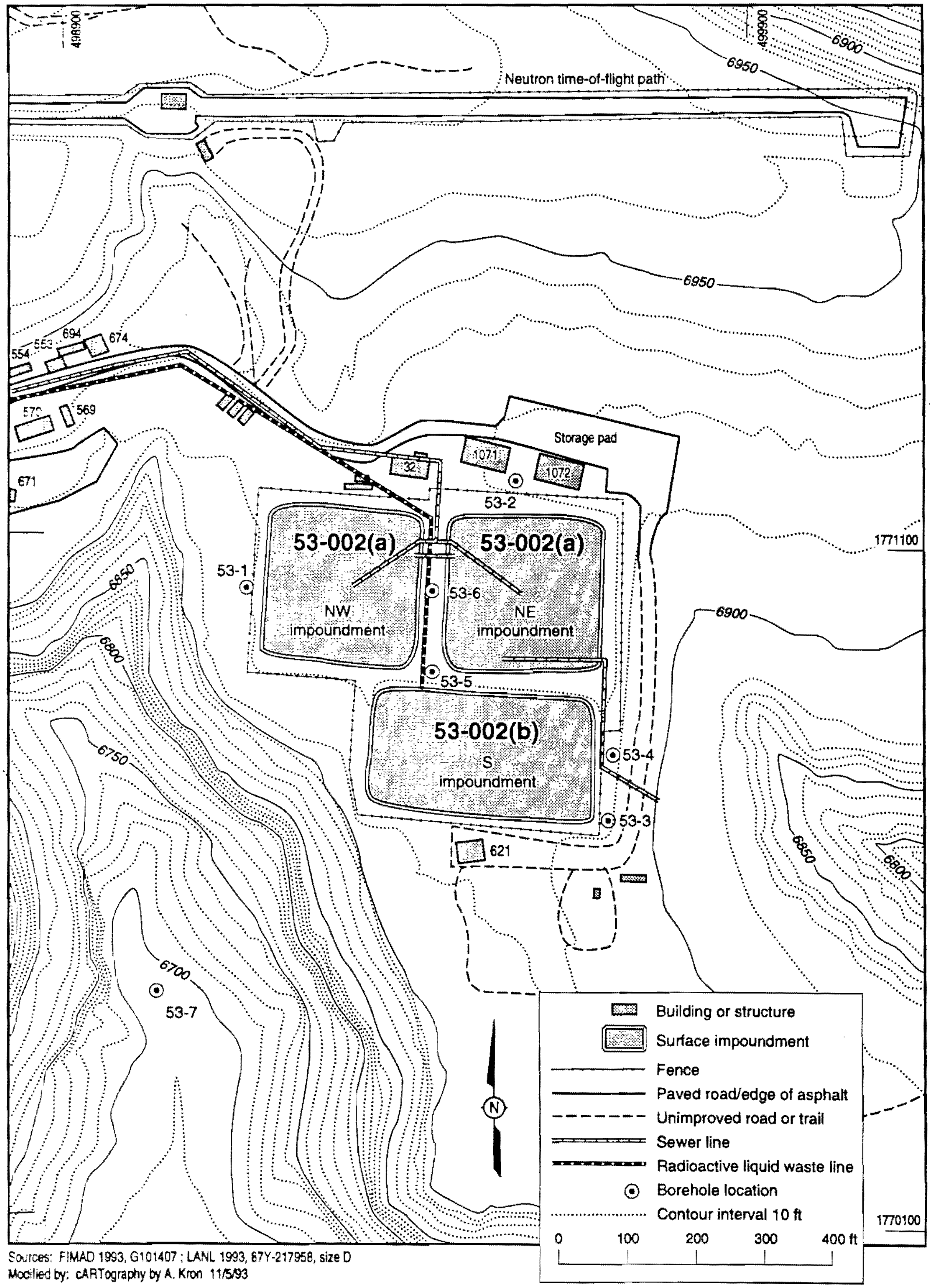


Figure 6-2. Layout of PRS 53-002 impoundments.

The NE and NW impoundments, each 210 ft x 210 ft x 6 ft deep, were constructed in 1969. Each has a storage capacity of 1,600,000 gal. (Environmental Protection Group 1992, 1075). The dikes were built of materials obtained onsite (excavated Bandelier Tuff bedrock was pulverized, placed in layers, and compacted). The floors of the impoundments are lined with a 4-in. layer of compacted bentonite clay; and a gunite liner, consisting of 4 to 6 in. of cement slurry without aggregate (shotcrete), was sprayed onto the walls (Environmental Restoration Group 1993, 22-0092).

The NE and NW impoundments were originally planned as retention impoundments for sanitary, industrial, and radioactive wastewaters generated at TA-53. After their construction, however, they were frequently filled to capacity and had to be discharged to a drainage channel south of the impoundments; the channel flowed east to a canyon that drains into Los Alamos Canyon. As the quantity of wastewater continued to increase, a third impoundment was constructed, allowing the system to function by evaporation.

The S impoundment, constructed in 1985, measures approximately 305 ft x 148 ft x 6 ft deep. It is lined with 36-mil-thick Hypalon and has a storage capacity of 2,580,000 gal. (Environmental Protection Group 1992, 1075). In 1989 it became a total-retention radioactive- liquid-waste storage impoundment, after which time the NE and NW impoundments received only sanitary wastewater (until February 2, 1993, when they were taken out of service). Sanitary wastewater from TA-53 is currently pumped to the TA-46 sanitary sewer system (Environmental Restoration Group 1993, 22-0092). The S impoundment continues to receive radioactive liquid wastewater.

The original impoundment system (NE and NW) was rated at 120,000 gal./day on a flow-through treatment basis. The piping was arranged to allow operation in any configuration, but typically the flow was from the NW impoundment to the NE impoundment. The system was designed to operate in a batch mode, discharging to Los Alamos Canyon two or three times a year via an NPDES outfall (No. 09S). Historical records indicate, however, that before the S impoundment came on line, discharges were more frequent. From January 1992 through January 1993, discharges were continuous (Environmental Restoration Group 1993, 22-0092).

The NE and NW impoundments served all the TA-53 buildings that had sanitary facilities; they received sanitary waste and small amounts of industrial waste from 1969 to 1993, and radioactive waste from 1969 to 1989. Liquid waste generated onsite was transferred to the impoundments through sanitary waste sewer lines (see Figure 6-1) or, in the case of one holding tank (TA-53-1016, or PRS 53-003), were trucked to the impoundments. Septic tank sludge from other technical areas was also trucked to these impoundments until July 1991 (Environmental Restoration Group 1993, 22-0092).

The S impoundment occasionally receives potable water to maintain liquid levels and to keep the sludge from drying out (Environmental Protection Group 1992, 1075). Sludge has never been removed from any of the surface impoundments and ranges in thickness from 3 to 18 in.

The S impoundment currently receives radioactive liquid waste from five tanks within TA-53: PRS 53-006(f), located in the basement of Building TA-53-1; PRSs 53-006(b) and (c) (TA-53-68 and -69, respectively), located south of Building TA-53-3; and PRSs 53-006(e) and (f) (TA-53-144 and -145, respectively), located near Building TA-53-7. Wastes from all but PRS 53-006(f) (which are transported by tank truck) are pumped to the impoundment through underground waste lines. All wastes are monitored for radioactivity before discharge to the impoundment, to ensure that they are within acceptable limits (Environmental Protection Group 1992, 1075).

Because the three impoundments could potentially receive mixed wastes (but there is no evidence that they ever did), they are currently regulated under RCRA as interim-status mixed-waste surface impoundments.

The NE and NW impoundments are currently undergoing RCRA closure under a plan (Environmental Restoration Group 1993, 22-0092) submitted to the New Mexico Environment Department (NMED) in February of 1993. The plan proposes sampling and analysis of the liquids and sludges, and of the soil and tuff beneath the impoundment liners, to determine whether any RCRA-regulated contaminants of concern are present (if none are, RCRA requirements for "clean closure" will be met). NMED has reviewed the plan, which is being revised.

A similar closure plan for the S impoundment is slated for preparation during 1994.

6.2.1.2 Existing Information on Nature and Extent of Contamination

In recent years, the nature and extent of contamination of these PRSs have been characterized, through sampling of the sludge and water in the surface impoundments, of the vadose zone in the immediate vicinity, and of sediments and biota downstream of the impoundment outfall.

6.2.1.2.1 Sampling and Analysis of Sludge and Water

Sludge from the NE and NW impoundments was sampled during the DOE Headquarters Environmental Survey (LANL 1989, 0425) in 1988; three composite samples from each impoundment were analyzed for volatile organic compounds (VOCs), semivolatile organics (SVOCs), metals, and gamma-emitting radionuclides.

The results indicated the presence of two VOCs (acetone and toluene), six SVOCs (benzoic acid, benzyl alcohol, fluoranthene, 2-methyphenol, 4-methylphenol, and pyrene), and several metals. Most of the organics results, however, are suspected of being false positives (LANL 1989, 0425). When the concentrations were compared with SALs for soil, all organics and metals (with the exception of beryllium) were below SALs.

More sampling was done in July 1991, by the Laboratory's Environmental Protection Group (EM-8). Grab samples of sludge and water were collected from three locations at each impoundment and analyzed for VOCs, SVOCs, and toxicity-characteristic leaching procedure (TCLP) metals. In addition, the water samples were analyzed for gross alpha and beta radioactivity, and one water sample from each impoundment was analyzed for tritium and gamma-emitting radionuclides. One sludge sample from each impoundment was also analyzed for gamma-emitting radionuclides.

Analysis of the water samples yielded no VOCs, but the sludge samples showed toluene and 4-isopropyl toluene above detection limits but below SALs for soils. One SVOC (benzoic acid, for which there is no SAL) was detected in one water sample, and three SVOCs (benzidine, di-n-butylphthalate, and bis-2-ethylhexylphthalate) were detected in sludge samples (again at levels below SALs for soils). All metals detected in water samples were below SALs for water; those found in sludge were reported as milligrams per liter and, therefore, were not directly comparable with SALs.

In April 1992, EM-8 did more comprehensive sampling, collecting grab samples of sludge from 15 locations in each impoundment by means of a uniform grid. The samples were analyzed for VOCs and SVOCs, TCLP metals, and polychlorinated biphenyls (PCBs). A sludge sample from each impoundment was also analyzed for organo-chlorine pesticides, chlorinated herbicides, pH, flash point, sulfide, and cyanide. In addition, grab samples of water were collected from one location in each impoundment and analyzed for TCLP metals; VOCs and SVOCs; PCBs; gross alpha, beta, and gamma radioactivity; and tritium.

For both sludge and water, VOC and SVOC results were similar to those from the July 1991 sampling, except more compounds were detected. VOCs detected in sludge were acetone; 2-butanone; carbon disulfide; chloroform; 4-isopropyl toluene; toluene; 1,1,1-trichloroethane; and 1,2,4-trimethylbenzene—all below SALs for soils. The only VOC detected in the water samples was acetone, from the NE and S impoundments, at levels far below the SAL. SVOCs detected in sludge were benzoic acid, bis-2-ethylhexylphthalate, and di-n-butylphthalate, all well below SALs for soil. No SVOCs were detected in the water samples.

All metals found in both sludge and water were below SALs (for soil and water, respectively). PCBs were detected in three sludge samples at approximately 1 mg/kg, which is above the SAL for soil (0.09 mg/kg) but below the EPA soil cleanup level of 10 mg/kg for unrestricted access areas [40 CFR 761.125(c)(4)(v)]. No PCBs were detected in the water samples. Several pesticides (for which no SALs exist) were present above detection limits in the sludge samples, but no herbicides; the water samples yielded no pesticides or herbicides.

6.2.1.2.2 Sampling and Analysis of the Vadose Zone

A characterization study (Environmental Restoration Group 1993, 22-0092) was carried out adjacent to the three impoundments, to determine whether a saturated zone was present and whether any contaminants had reached this zone. Analysis of tuff samples from the boreholes found no evidence of contamination. The same boreholes have subsequently been employed for an ongoing vadose-zone monitoring program to determine whether RCRA-regulated hazardous constituents have been released to this zone. (Tritium, which is not a RCRA-regulated constituent, was detected in the vadose zone but was below the SAL for soil.)

One of the boreholes has five pore-gas sample ports; five other boreholes have been cased to provide access for neutron probes to measure moisture, and one of these also has a cup lysimeter. Analysis of the pore-gas samples for VOCs has found none at or above the detection limit of 8 µg per sample tube.

The results of this monitoring program indicate that no RCRA-regulated hazardous constituents have been released from the impoundments and that no significant changes in subsurface moisture content have taken place.

6.2.1.2.3 Sampling and Analysis of the Effluent Discharge Area

Effluent discharged from the NE and NW impoundments (to prevent overflow, before the S impoundment was in existence) was channeled into a side canyon that eventually drains into Los Alamos Canyon. The length of the channel, estimated by measuring the distance from the discharge point to the edge of the mesa on a topographic site map, was approximately 450 ft (Dransfield and Gardner 1985, 0082). To ascertain the extent of radionuclide migration from these discharges, the Laboratory conducted environmental monitoring from 1979 to 1985 (ESG 1980, 0406; ESG 1982, 0620; ESG 1983, 0621; ESG 1984, 1114; ESG 1985, 0407). Samples were collected annually at eight locations (see Figure 6-3; sampling locations 1 and 2 lie in the approximate course of the drainage channel along the mesa, which was largely obliterated when the S impoundment was created). Maximum concentrations reported in sediments for the most recent sampling (i.e., 1985) were 2,190 pCi/g beryllium-7, 1,180 pCi/g cobalt-57, 1,680 pCi/g cesium-134, 5.1 pCi/g tritium, 448 pCi/g manganese-54, 8.2 pCi/g sodium-22, and 322 pCi/g rubidium-83. Although these maximum values, which are all from samples collected near the outfall, were above SALs, concentrations dropped to below SALs at downstream samples.

Water and sediment samples from the stream channel, and transpirate from trees adjacent to the channel, were collected biannually and analyzed for tritium, beryllium-7, and sodium-22. Some samples were also analyzed for other radionuclides, including cesium-134, manganese-54, cobalt-57, cobalt-60, and rubidium-83. The results of these analyses do indicate that radionuclides were carried from the impoundments via the effluent.

The effluent infiltrated the alluvium quite rapidly, usually within 1,200 to 2,400 ft from the discharge point (i.e., well above the confluence with Los Alamos Canyon). The farthest downstream point reached by surface flow was sampling point No. 5 (see Figure 6-3). Radionuclide concentrations, which decreased steadily with distance from the impoundments, fell off sharply once the effluent infiltrated the alluvium (only a small degree of migration beyond this point was noted).

Biological sampling, carried out during 1981 and 1982 as part of the monitoring program, included copepods and salamanders from the surface impoundments and insects, lizards, snakes, and small rodents from immediately surrounding areas. Of the radionuclides tested for, cesium-134 showed a lower accumulation factor than in other studies; beryllium-7 had little, if any, bioaccumulation; manganese-54 increased through the first two trophic levels, then reached equilibrium between the soil/plant levels; cobalt-57 increased from water to soil but decreased from soil to plants, with little present at higher trophic levels; and

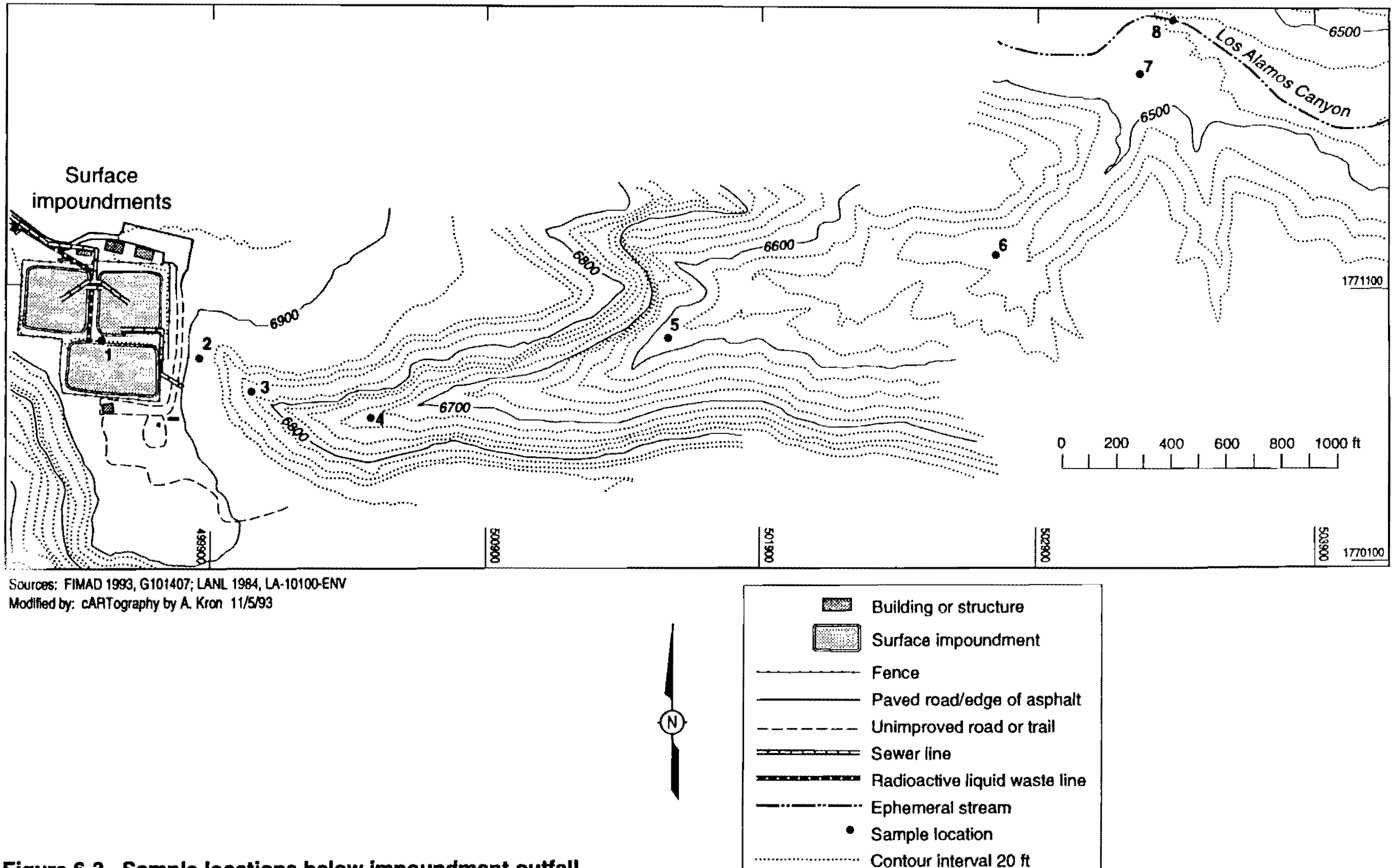


Figure 6-3. Sample locations below impoundment outfall.

rubidium-83 accumulated to the third trophic level and then decreased. These results contradicted those of other studies that showed high biomagnification. Possible explanations for the difference are the high clay content, the low pH, and the high concentrations of potassium in the soil (ESG 1982, 0620; ESG 1983, 0621). The data presented for these studies were insufficient to determine whether there was an ecological risk.

6.2.1.3 Justification for DA

Deferred action is recommended for the three impoundments because they are slated for RCRA closure in the near future. The closure plan includes sampling and analysis to collect data on which to base decisions regarding RCRA-regulated constituents that may be present, either in the sludge or in the soils and tuff beneath the impoundment liners. If these constituents are present at or below health-risk-based concentrations, RCRA closure requirements will be met. If any are present above risk-based levels, additional actions will be required as part of closure, such as removal and disposal of contaminated sludge. Alternatively, the impoundments could be closed as landfills with contamination left in place.

Closure sampling and analysis will also include non-RCRA-regulated constituents, such as radionuclides, which are known to be present in and beneath the impoundments. These data will be evaluated to determine whether additional actions are needed.

The IWP stipulates that DA can be implemented only if no current risk can be demonstrated for a PRS. The evaluation of current risk for the impoundments is based on the conceptual exposure model elements presented in Chapter 4. For these PRSs, the historical source of potential contamination is the wastewater discharged to the impoundments and the PRS creation mechanisms are discharge via the drainage channel and possible leakage through the impoundment liners. Current sources of exposure to PCOCs are the wastes in the impoundments, as well as contaminated soils, sediment, and tuff; and current release mechanisms include excavation, infiltration/leaching, runoff, and direct radiation.

As discussed earlier, analysis of samples from the impoundment wastes and from environmental media near the impoundments do not indicate a current risk. The detection of tritium in the vadose zone, while of concem because it indicates contaminant migration by infiltration, does not appear to present a risk: the only potential route of exposure is via the water supply wells located adjacent to TA-53 in Sandia and Los Alamos canyons, which are monitored periodically to ensure that the water meets drinking water standards. Any contaminants in the water would be detected by this monitoring.

We conclude, therefore, that these PRSs do not pose an unacceptable current risk and that DA is appropriate. Because the closure-related characterization will take place at approximately the same time as the RFI, deferral of RFI for these sites should not delay decisions on remediation.

6.2.2 PRSs 53-006(b), (c), (d) and (e) - Underground Storage Tanks

6.2.2.1 Description and History

PRSs 53-006(b) and (c) are identified in the SWMU Report (LANL 1990, 0145) as Structures TA-53-68 and -69, respectively, and are described as 6 ft in diameter by 18 ft long. These underground storage tanks (USTs) were installed in 1973 and are still active; they are used to store radioactively contaminated wastewater from LAMPF. As detailed in the wastewater stream characterization reports for TA-53, the major source of waste is the TA-53-3 radioactive liquid waste system, which collects wastewater from floor drains along the length of the accelerator tunnel (mainly DI water that has become tritiated [Santa Fe Engineering 1994, 22-0105]). These tanks also receive wastewater from a sink, a shower, and a clothes washer in Building TA-53-502 (Santa Fe Engineering 1993, 22-0104).

PRSs 53-006(d) and (e) are identified in the SWMU Report (LANL 1990, 0145) as Structures TA-53-144 and -145, respectively, and are described as 8-ft x 8-ft x 10-ft USTs. Installed in 1977, both tanks are active and are used to store radioactively contaminated wastewater from the Weapons Neutron Research (WNR) facility. According to the wastewater stream characterization report (Santa Fe Engineering 1993, 22-0070), these tanks receive discharges from Buildings TA-53-7 (drainage from floor drains in the beam-line, target, and experimental areas); TA-53-8 (drainage from beneath a contaminated DI pump stand); TA-53-30 (drainage from contaminated floor drains and sink drains) and TA-53-368 (discharges from an equipment room floor drain). At one time, the tanks also received drainage from the DI water system in Building TA-53-36.

The CEARP Report (DOE 1987, 0264) notes that all four of these tanks were included on the May 5, 1986, UST notification submitted to NMED. Their locations were inspected during preparation of the RFI work plan. No evidence of past releases was noted.

6.2.2.2 Justification for DA

PRSs 53-006(b), (c), (d), and (e), as active components of the liquid radioactive waste system at TA-53, are of concern because of the potential for leakage and resultant contamination of the vadose zone (and, possibly, groundwater). The sampling required to determine whether such contamination exists would necessitate intrusive activities, such as drilling, that would be difficult to perform without significantly disrupting existing current operations. Because there is no record or evidence of any releases from these PRSs, we recommend that investigations be deferred until the waste system undergoes decontamination and decommissioning.

Because DA can be implemented only in the absence of current risk, we have evaluated that risk using the conceptual exposure model elements presented in Chapter 4. The historical source of potential contamination is the radioactive liquid waste stored in the tanks, and the PRS creation mechanism is leakage from the tanks to the vadose zone. The current source of exposure to PCOCs is contaminated tuff; and current release mechanisms include excavation, infiltration/leaching, and direct radiation.

Because of administrative controls in place at the Laboratory, there is no current risk associated with excavation of potentially contaminated tuff. All excavation requires a permit, which includes evaluation of potential sources of contamination and the use of appropriate protective measures.

Available information indicates that there is also no current risk associated with infiltration to groundwater: the only potential route of exposure is via the water supply wells located adjacent to TA-53 in Sandia and Los Alamos canyons, which are monitored periodically to ensure that they meet drinking water standards. Any contaminants in the water would be detected by this monitoring. The risk of future contamination of groundwater is low, moreover, because of the great depth to groundwater and the favorable hydrologic properties of the vadose zone.

The risk from direct radiation is considered to be negligible; because the tanks are underground, potential contamination from releases would be confined to the subsurface, and direct radiation from subsurface sources should be less than that encountered in the course of normal operations (i.e., from the wastes themselves).

These PRSs, then, do not pose a current unacceptable risk. However, because the possibility of leakage cannot be ruled out, we recommend that the integrity of the tanks be evaluated through nonintrusive, nondestructive methods. (Specific integrity-evaluation methods, based on the design characteristics of the tanks and meeting radiation protection requirements, will need to be developed. These will be described, and the results documented, in the RFI Phase I report.) If any tanks are found to be leaking, intrusive activities will be undertaken in Phase II.

6.3 Nonlisted PRSs Recommended for NFA

6.3.1 PRS 20-003(d) - Firing Site

6.3.1.1 Description and History

PRS 20-003(d) was identified in the SWMU Report (LANL 1990, 0145) as a gun-firing site, Structure TA-20-29. This structure was erected in February 1945 and removed in April 1948 (LANL undated, 22-0051). Located near the center of the former TA-20, it is shown on an engineering drawing (LASL 1951, 22-0094) as a 10-ft x 10-ft wooden platform with a 15-ft x 2.3-ft extension; 8 ft above the platform was suspended a 10-in. x 10-in. wooden beam (referred to as a "yoke"), also of wood, with a large metal hook on the bottom.

The purpose of the structure is not known. It does not appear to have been associated with either of the two gun-firing sites (PRSs 20-003[b] and [c]). Given its location near Manhole TA-20-3, it seems more probable that this structure was associated with firing site PRS 20-002(d). The CEARP Report (DOE 1987,

0264) suggests that TA-20-29 is either a firing or a shot set-up area. For these reasons, PRS 20-003(d) is considered part of PRS 20-002(d).

6.3.1.2 Justification for NFA

PRS 20-003(d) is recommended for NFA on the basis that it does not exist as a separate PRS. As part of PRS 20-002(d), it will be investigated (see Chapter 5, Section 5.2.4.2.4).

6.3.2 PRSs 53-001(f), (h), (i), (j), (l), (m), (n), and (o) - Waste Accumulation Areas

6.3.2.1 Description and History

6.3.2.1.1 PRS 53-001(f) - Waste Accumulation Area at Building TA-53-18

The SWMU Report (LANL 1990, 0145) identified PRS 53-001(f) as a waste storage area on the first floor of Building TA-53-18, which contains technical shops and a high-bay experimental area. (The EM-8 tracking system [LANL 1993, 22-0050] also lists a satellite area at this location in Building TA-53-18.) Solvents, freon, epoxy, and resins were stored at this PRS, as was verified by onsite inspection during preparation of the RFI work plan.

At the time of the inspection, various wastes were found stored in 5-gal. and 30-gal. containers: epoxy and other chemicals; solvent-contaminated rags and kimwipes; oily rags; waste oil; mixtures of halogenated organics, including trichloroethane, freon, and cutting fluids; and mixtures of nonhalogenated organics, including acetone, Stoddard solvent, mineral spirits, alcohol, and ethylene glycol.

6.3.2.1.2 PRS 53-001(h) - Waste Accumulation Areas at Building TA-53-365

The SWMU Report (LANL 1990, 0145) identifies PRS 53-001(h) as four waste storage areas in the Ground Test Accelerator facility: one on the first floor at the east end of the high bay; one at the east end of the beam tunnel; one on the mezzanine; and one in Room 302.

When these areas were inspected during preparation of the RFI work plan, only two of the four areas were found to be as described. An area on the first floor at the east end of the high bay contained 30-gal. drums of trichloroethane, solvent-contaminated rags, solvent mixtures (ethanol, methanol, and acetone), oily rags, and waste oil; and the same types of wastes were found stored in an area at the east end of the beam tunnel.

No waste accumulation area was found on the mezzanine or in Room 302. The EM-8 tracking system also lists the first two areas, none on the mezzanine, and none in Room 302. It does, however, list one active and one removed satellite area in Room 303. A satellite area was found in Room 303 during the inspection; it housed two 30-gal. drums containing various solvent wastes (acetone, freon, ethanol, methylene chloride, propanol, and trichloroethane).

6.3.2.1.3 PRS 53-001(i) - Waste Accumulation Areas at Building TA-53-15

PRS 53-001(i) was identified in the SWMU Report (LANL 1990, 0145) as three waste storage areas located at TA-53-15, a laboratory facility for LANSCE. One area is identified as at the west side, one in Room 103, and one in Room 105. They were reported to contain solvents, empty reagent bottles, organics, and solvent-contaminated rags.

All three sites were inspected during preparation of the RFI work plan. The site identified as being at the west side of the building was actually located inside the building; it was not in use at the time. This area is listed in the EM-8 tracking system. It consists of two acid storage cabinets, and according to staff members, will replace the accumulation areas in Rooms 103 and 105 (the latter are satellite areas located inside chemical exhaust hoods).

6.3.2.1.4 PRS 53-001(j) - Waste Accumulation Area at Building TA-53-30

According to the SWMU Report, PRS 53-001(j) was an area at the southeast corner of Building TA-53-30, a high-bay facility for LANSCE beam-line experiments. It was used to store solvent-contaminated rags. This was confirmed during an August 1993 inspection, when 30-gal. drums of solvent-contaminated rags were found. During a second inspection in September 1993, the area was observed to be no longer in use; staff members confirmed that it was no longer needed, because nonhazardous cleaning products were being used. No staining on the asphalt was noted during these inspections.

6.3.2.1.5 PRS 53-001(l) - Waste Accumulation Area at Building TA-53-26

PRS 53-001(l) was identified in the SWMU Report as a waste storage area located outside the north wall of Building TA-53-26 (a technical shop south of TA-53-3, Sector E). It was used for storage of solvent- and freon-contaminated rags.

When the site was inspected during preparation of the RFI work plan, this waste accumulation area was found to have been replaced by a satellite area inside the building (in Room 101, south of the divider wall). It contained a single 30-gal. drum of oily rags. The EM-8 tracking system records the removal of the original satellite area and lists the new satellite area inside the building. The site of the former area, identified by staff members, was located on the asphalt outside the north wall, near the door; inspection revealed no evidence of staining.

6.3.2.1.6 PRS 53-001(m) - Waste Accumulation Area at Building TA-53-17

The SWMU Report identifies this PRS as a waste storage area in Room 103 of the Proton Storage Ring Staging building. Acetone- and ethanol-contaminated rags and kimwipes were stored in this area.

When the site was inspected during work plan preparation, a satellite accumulation area was located in Room 103; it contained one 55-gal. drum of solvent-contaminated rags.

6.3.2.1.7 PRS 53-001(n) - Waste Accumulation Area at Building TA-53-19

This PRS was identified in the SWMU Report as a waste storage area inside the west end of Building TA-53-19, which houses the Accelerator Technology Laboratory. It reportedly contained solvent-contaminated rags, acetone, ethanol, trichloroethane, and freon.

A satellite accumulation area was found inside the west end of the building, along the north wall, at the time of site inspection for the work plan. It housed several 30-gal. drums containing acetone and ethanol, freon, ethanol- and acetone-contaminated rags and kimwipes, oily rags, and waste oil. This PRS is the only waste accumulation area listed for Building TA-53-19 in the EM-8 tracking system.

6.3.2.1.8 PRS 53-001(o) - Waste Accumulation Area at Building TA-53-622

This PRS was identified in the SWMU Report as a waste storage area located in Room 317 of Building TA-53-622, which houses an office and laboratory for LANSCE. It was used for storage of photographic chemicals. During the site inspection for the work plan, photographic chemicals were found, stored in various-sized containers, in Room 317. This PRS is the only waste accumulation area listed for Building TA-53-622 in the EM-8 tracking system.

6.3.2.2 Justification for NFA

NFA is proposed for PRSs 53-001(f), (h), (i), (j), (l), (m), (n), and (o) for three reasons:

(1) There is no evidence of release to the environment.

(2) These sites are unlikely to release contaminants to the environment. Most of them (PRSs 53-001[f], [h], [i], [m], [n], and [o]) have no potential for such release because they are located within buildings. A release, should it occur, would be contained unless it were to reach a drain that discharged directly to the environment. A review of the wastewater stream characterization reports (Santa Fe Engineering 1993, 22-0070; Santa Fe Engineering 1993, 22-0103; Santa Fe Engineering 1993, 22-0106) for these buildings showed that all the drains discharge to the sanitary sewer system. Any releases from these PRSs, therefore, would be considered under PRS 53-002(a) (see Section 6.2.1).

For the two PRSs (53-001[j] and [l]) that are located outside buildings, the kinds of wastes stored—solvent- and oil-contaminated rags—make the potential for a release to the environment minimal. When these PRSs were inspected, no evidence (such as staining) was found that would suggest a release had ever occurred.

(3) Potential receptors are unlikely to be exposed to any contaminants at levels of concern. Receptors most likely to be exposed are the workers in the various buildings associated with these PRSs. All satellite accumulation areas are subject to both specific RCRA requirements and

Laboratory Administrative Requirements that are designed to minimize exposure of workers at such sites.

6.3.3 PRS 53-003 - Sanitary Waste Holding Tank

6.3.3.1 Description and History

This PRS was identified in the SWMU Report (LANL 1990, 0145) as a sanitary waste holding tank, Structure TA-53-1016. In a wastewater stream characterization report (Santa Fe Engineering 1993, 22-0102), this tank was identified as a small septic tank/leach field that received discharges from a toilet, a shower, and two sink drains in Building TA-53-442 (a small office trailer). It is registered with NMED under registration number SF890023 (NMEID 1989, 22-0079).

The metal tank measures 4 ft 4 in. in diameter x 5 ft long, has a 500-gal. capacity, and a flow of 30 gal./day (based on serving two persons at 15 gal./day each). It has no seepage trench or bed and no overflow; it is regularly pumped out.

6.3.3.2 Justification for NFA

NFA is proposed for this PRS because there is no evidence of a release. In addition, there is no evidence to suggest that the tank has ever received any wastes other than sanitary wastes. The trailer that it serves has consistently been used as an office for two to four people, and there is no evidence of any use of hazardous or radioactive materials.

6.3.4 PRS 53-004 - Bead Blaster

6.3.4.1 Description and History

According to the SWMU Report (LANL 1990, 0145), this bead blaster, used for cleaning ion-pump parts in Building TA-53-56, generated wastes in the form of spent beads and residues contaminated with radionuclides. The report also indicated that no evidence exists of releases from this PRS.

When this site was inspected as part of work plan preparation, two bead blasters were located in the vicinity of Building TA-53-56. The one that is actually in Building TA-53-56 is used only to clean nonradioactive items, which does not fit the description of PRS 53-004. The other bead blaster is in Room 105 of Building TA-53-2, located immediately north of Building TA-53-56, in the same general vicinity. We believe this is the bead blaster described in the SWMU Report. It is a small, totally enclosed unit that is used to clean radioactive parts. The radioactively contaminated spent beads are encapsulated in plaster of Paris before transfer to TA-54 for disposal.

6.3.4.2 Justification for NFA

NFA is proposed for PRS 53-004 because (1) there is no evidence of a release to the environment, either around the bead blasters or outside the buildings; (2) a release is unlikely (both bead blasters are situated inside structures that would contain a release, and the unit used for radioactive items is totally enclosed); and (3) potential receptors are unlikely to be exposed to contaminants at levels of concern. Receptors most likely to be exposed are the workers in Buildings TA-53-2 and -56. The bead blasters are operated under specific Laboratory environmental, safety, and health requirements that are designed to minimize exposure of workers.

6.3.5 PRSs 53-011(a) - (e) and C-53-001 - C-53-019 - PCB-Containing Electrical Equipment

6.3.5.1 Description

The SWMU Report (LANL 1990, 0145) identified 24 PRSs (53-011[a] - [e] and C-53-001 - C-53-019) as having a potential for release of PCBs. PRSs C-53-001 - C-53-019, which were designated PRSs on the basis of information from Laboratory transformer assessment sheets, are described in Table 6-1. PRSs 53-011(a) - (e), which were reported to be PCB transformers with moderate leaks (requiring a drip pan), are described in the remainder of this section.

6.3.5.1.1 PRS 53-011(a)

This PRS is identified in the SWMU Report as a 16- to 20-year old PCB transformer, Serial No. 5036, located at Structure TA-53-67, a unit substation at the southwest corner of Sector M, TA-53-3. The transformer is located south of Target Area A, on a mezzanine with a steel-grate floor (any leaks would drain to the parking lot south of the building). The transformer was clean, appeared to be in good condition, and showed no evidence of leakage.

6.3.5.1.2 PRS 53-011(b)

This PRS is identified in the SWMU Report as a PCB transformer, Serial No. 5043, located at Structure TA-53-196. It is a pole-mounted transformer on the north side of the utilities access road northwest of Building TA-53-1. It was clean, appeared to be in good condition, and showed no signs of leaks (any leaks would drain to the dirt road).

6.3.5.1.3 PRS 53-011(c)

This PRS is identified in the SWMU Report as a PCB transformer, Serial No. 5054, located at Structure TA-53-184. It is a roof-mounted transformer on the north side of Structure TA-53-3, north of the beam switchyard. It was clean, appeared to be in good condition, and showed no signs of leakage. A label on the transformer indicated that the PCB content of the oil was less than 50 mg/kg.

The wastewater stream characterization report for TA-53-3 (Santa Fe Engineering 1994, 22-0105) notes that two roof drains at this site discharge to

TABLE 6-1

DESCRIPTION OF PRSs C-53-001 — C-53-019 (PCB-OIL TRANSFORMERS)

PRS	Description
C-53-001	Transformer, Serial No. 16887, located at unit substation TA-53-51 at north side of Equipment Test Laboratory (TA-53-2). Old stains visible during August 21, 1985, inspection.
C-53-002	Transformer, Serial No. G859183, located at unit substation TA-53-67 at southwest corner of Sector M, TA-53-3. Small stains around bushing and gasket visible during September 21, 1985, inspection.
C-53-003	Transformer, Serial No. G83266A, located at unit substation TA-53-170 at southwest corner of Sector M, TA-53-3. Small stains around bushing and gasket visible during September 21, 1985, inspection.
C-53-004	Transformer, Serial No. G853266B, located at unit substation TA-53-171 at southwest corner of Sector M, TA-53-3. Small stains around bushing and gasket visible during September 21, 1985, inspection.
C-53-005	Transformer, Serial No. G853264A, located at unit substation TA-53-172 at southwest corner of Sector M, TA-53-3. Small stains around bushing and gasket visible during September 21, 1985, inspection.
C-53-006	Transformer, Serial No. G853267A, located at unit substation TA-53-173 at southwest corner of Sector M, TA-53-3. Small stains around bushing and gasket visible during September 21, 1985, inspection.
C-53-007	Transformer, Serial No. G853265B, located at unit substation TA-53-175 at southwest corner of Sector M, TA-53-3. Small stains around bushing and gasket visible during September 21, 1985, inspection.
C-53-008	Transformer, Serial No. PCV7106-01, located at unit substation TA-53-67 at southwest corner of Sector M, TA-53-3. Old stains on casing visible during September 21, 1985, inspection.
C-53-009	Transformer, Serial No. G85263A, located at unit substation TA-53-176 at northwest corner of Sector M, TA-53-3. Old stains on casing visible during September 21, 1985, inspection.
C-53-010	Transformer, Serial No. PCV7107-01, located at unit substation TA-53-191 at northwest corner of Sector M, TA-53-3. Old stains on casing visible during September 21, 1985, inspection.
C-53-011	Transformer, Serial No. G8532630, located at unit substation TA-53-177 at northwest corner of Sector M, TA-53-3. Old stains on casing visible during September 21, 1985, inspection.
C-53-012	Transformer, Serial No. G853267C, located at unit substation TA-53-178 at southwest corner of Sector M, TA-53-3. Small stains around bushing and gasket visible during September 21, 1985, inspection.
C-53-013	Transformer, Serial No. G853264B, located at unit substation TA-53-179 at northwest corner of Sector M, TA-53-3. Old stains on casing visible during September 21, 1985, inspection.
C-53-014	Transformer, Serial No. G853265A, located at unit substation TA-53-180 at northwest corner of Sector M, TA-53-3. Old stains on casing visible during September 21, 1985 inspection.

TABLE 6-1

DESCRIPTION OF PRSs C-53-001 — C-53-019
(PCB-OIL TRANSFORMERS) (concluded)

PRS	Description
C-53-015	Transformer, Serial No. PFH3797, located at unit substation TA-53-182 south of beam switchyard at TA-53-3. Old stains on pad visible during September 21, 1985 inspection.
C-53-016	Transformer, located at unit substation TA-53-50 northwest of Equipment Test Laboratory, TA-53-2. Small stains around bushing and gasket visible during inspection.
C-53-017	Release of approximately 3 gal. of PCB oil from capacitor at 115kV substation TA-53-70 on June 12, 1987.
C-53-018	Spill of 2 to 4 ounces of pyranol capacitor oil at Salvage Staging Area at Sector E, TA-53-3. Asphalt was removed.
C-53-019	Release of approximately one-half cup PCB oil from transformer north of Sector A on March 20, 1990.

the ground and recommends secondary containment for the transformers. Inspection of the discharge areas of the drains revealed no evidence of soil staining.

6.3.5.1.4 PRS 53-011(d)

This PRS is identified in the SWMU Report as a PCB transformer, Serial No. 5034, with a 205-gal. capacity, located at Structure TA-53-71 (a substation north of Sector A at TA-53-3). The transformer was clean, appeared to be in good condition, and showed no evidence of leakage. It was situated on a concrete pad that has a concrete curb to contain spills and a drain on the north side. The drain is equipped with a valve for discharge to the ground, but there was no evidence of oil stains on the ground at the discharge point.

6.3.5.1.5 PRS 53-011(e)

This PRS is identified in the SWMU Report as a leaking transformer at Structure TA-53-123, north of the utilities access road, about 0.25 miles east of the west end of La Mesita Road. (No serial number for the transformer was given.) When the vicinity was inspected, not only were no leaking transformers identified, but the structure (listed in Engineering Division records as a manhole containing an air-relief valve) could not be found.

6.3.5.2 History of PCB-Transformer PRSs

Historical records (Holm-Hansen 1987, 22-0080; Bailey 1990, 22-0075) indicate that transformers and other oil-filled equipment were inspected, maintained, and repaired to prevent releases. Operating procedures for leaking PCB transformers required daily inspection and containment of leaks (generally either by fastening a plastic bag around the leaking component or placing a drip pan beneath it). Procedures also required immediate notification of Pan Am World Services, Inc., Environmental Protection, in the event that any leak reached the floor or ground. Laboratory memos from 1988 and 1989 (Bailey 1988, 22-0073;

Bailey 1989, 22-0074) describe the use of a cold welding process to repair several leaking PCB transformers: TA-53-177 (PCB Serial No. 5046, PRS C-53-011); TA-53-178 (PCB Serial No. 5047, PRS C-53-012); TA-53-179 (PCB Serial No. 5048, PRS C-53-013); and TA-53-184 (PCB Serial No. 5054, PRS 53-011[c]).

Records of cleanups at PRSs C-53-017 and C-53-019 (Holm-Hansen 1989, 22-0081; Bailey 1990, 22-0076) indicate that releases of PCB-containing oil were cleaned up in accordance with EPA requirements. (No other cleanup reports were located, but it is possible that cleanup was not required at any other PRSs; we assume that if other cleanups were in fact done, they would also have followed EPA guidelines.)

The release at PRS C-53-017 was from one of the capacitors in the TA-53-70 capacitor bank. This 3.1-gal. capacitor ruptured on June 12, 1987. Same-day response included washing the footings and rack with a solvent cleaner and removing approximately 6 in. of soil from under the release site. Verification sampling indicated a need for additional cleanup of the support structures, footings, and soil. After rewashing of the structures and footings and removal of additional soil (to a depth of 1.5 ft), verification sampling showed that the structures were clean, but that the footings and soil were still contaminated above EPA cleanup levels. The footings were washed again, and the soil was excavated down to the tuff bedrock, removing 6 more inches (additional excavation could not be done without removing the footings and capacitor racks).

In October 1988, the footings were removed, and all remaining soil above the EPA cleanup level (25 mg/kg for restricted-access areas) was removed, for a total of 832 cubic yards of soil (Holm-Hansen 1989, 22-0081). Sampling and analysis confirmed that cleanup was to acceptable levels.

The release at PRS C-53-019 involved a small amount of transformer oil from a direct-current power-supply transformer (Serial No. 6184) on March 20, 1990. This transformer is located in a bermed area on a concrete pad. Previous sampling had shown PCB levels of 222 mg/kg in the transformer oil; approximately one-half cup of oil that leaked from a bushing was confined to an area of approximately 1 ft^2. It was cleaned up the same day, using the double-wash/double-rinse method specified in 40 CFR 761.123 (Bailey 1990, 22-0076).

6.3.5.3 Justification for NFA

NFA is proposed for these PRSs because their cleanup is regulated under another program: the EPA, under the Toxic Substances Control Act (TSCA), regulates the operation and maintenance of electrical equipment containing PCBs. TSCA regulations (40 CFR 761) require inspection of equipment and cleanup of releases of PCB-containing oil. Available historical information indicates that procedures were in place to meet these requirements; transformers described in the SWMU Report as leaking appear to have been repaired, and there is no evidence of releases to the environment.

6.3.6 PRSs 53-012(a), (b), (c), (d), (f), (g), and (h) - NPDES Outfalls

6.3.6.1 Description and History

6.3.6.1.1 PRSs 53-012(a) - (c) - LAMPF Cooling Tower Outfalls

These PRSs are the drainlines and outfalls that receive discharges from cooling towers TA-53-60, -62, and -64, respectively. These outfalls are permitted under the Laboratory's NPDES permit as 03A047, 03A048, and 03A049, respectively. (Category 03A designates cooling tower discharges.) The wastewater stream characterization report (Santa Fe Engineering 1993, 22-0108) for these facilities indicates that Outfalls 03A047 and 03A048 receive only cooling tower blowdown; Outfall 03A049 receives, in addition, boiler blowdown and drainage from an air compressor, via two floor drains in the utility room of Building TA-53-65.

The NPDES permit application (LANL 1990, 22-0018) lists the long-term average flow and maximum flow as 4,000 and 13,000 gal./day, respectively, for Outfall 03A047; 22,000 and 112,000 gal./day, respectively, for Outfall 03A048; and 13,000 and 66,000 gal./day, respectively, for Outfall 03A049.

Since 1971 the cooling towers have operated concurrently with the accelerator. According to operations and maintenance staff, the blowdown from these towers will contain, in addition to naturally occurring constituents, several water treatment/conditioning chemicals (see Table 6-2). Constituents naturally present in the water are concentrated in blowdown, through evaporation, by a factor of 2.5 to 3.5 (based on the rates of cooling tower makeup and blowdown reported in the permit).

As part of the NPDES permit application, cooling tower discharges were characterized. Of the 36 cooling tower outfalls in Category 03A that exist Laboratory-wide, four were sampled to develop a "worst case" composite (see Chapter 5, Section 5.6.2.1). One of these was Outfall 03A048 (Outfalls 03A047 and 03A049 were not sampled).

The constituents analyzed for included a variety of general-water-quality constituents as well as metals, VOCs, SVOCs, and pesticides. All organic

TABLE 6-2

SUMMARY OF WATER CONDITIONING CHEMICALS ADDED TO TA-53 COOLING TOWERS

Purpose	Hazardous Components
Corrosion and scale inhibitor	Sodium molybdate Hydroxyethylidene diphosphonic acid
Microbicide	1-bromo-3-chloro-5,5-dimethylhydantoin
Oxygen scavenger	Sodium bisulfite

constituents were below detection limits. Several metals were present at low levels (less than 1 mg/l).

The CEARP Report (DOE 1987, 0264) indicated some concern that radioactive contamination of cooling water discharges could be caused by leaks in heat exchangers (which probably is the reason these outfalls were included in the SWMU Report). Cooling water from Building TA-53-3 (the LAMPF accelerator building), some of which contains radionuclides, is itself cooled by water that subsequently discharges via these outfalls. But as the wastewater stream characterization report on these outfalls (Santa Fe Engineering 1994, 22-0105) makes clear, the chance for radioactive contamination of these effluents is extremely remote because of the closed-loop design of the TA-53-3 cooling water system.

Two types of closed-loop systems provide cooling water for TA-53-3. The first, called Type 01, is a two-loop system that is used for the radio frequency generators. The first loop is between the cooling towers and a heat exchanger, and the second (which carries DI water) is between the heat exchanger and the radio-frequency generators. With both loops located on the first floor of the building, above the beam, the potential for radioactive contamination of the water is very low.

The second type, called 02, is a three-loop system used for the accelerator beam area. The first loop is between the cooling towers and a series of chillers, the second between the chillers and a series of heat exchangers, and the third (DI water) between the heat exchangers and the accelerator beam area. Because of its location, the third loop contains radionuclides produced by activation from the beam. However, the water in this loop could be released to the environment via an outfall only if tube failures were to occur simultaneously in both the heat exchanger and the chiller (Santa Fe Engineering 1994, 22-0105). The possibility of such simultaneous failures is extremely low.

6.3.6.1.2 PRS 53-012(d) - Cooling Tower Outfall for Building TA-53-28

This PRS is a drainline and outfall from the cooling tower at Building TA-53-28, the Proton Storage Ring equipment building. (The SWMU Report incorrectly associated this discharge with Building TA-53-7, the WNR facility.) The outfall is permitted under the Laboratory's NPDES permit (LANL 1990, 22-0018), as Outfall 03A125; it discharges only when the cooling tower is operating, at an average flow of 1 gal./min.

According to the wastewater stream characterization report for Building TA-53-28 (Santa Fe Engineering 1993, 22-0070), the cooling tower has not been used since 1988, and future use is not anticipated. Cooling tower blowdown was the only discharge of this outfall, and like the blowdown from PRSs 53-012(a) - (c), it would have contained the water treatment/conditioning chemicals listed in Table 6-2. This outfall was not one of those sampled for the "worst case" composite (see Chapter 5, Section 5.6.2.1).

The CEARP Report (DOE 1987, 0264) noted some concern that radioactive contamination of the cooling water discharges could be caused by leaks in heat exchangers; but, as explained in the preceding section, the closed-loop cooling water systems are designed to prevent such contamination.

6.3.6.1.3 PRSs 53-012(f) and (g) - Cooling Tower Outfalls from TA-53-293 and -294

PRS 53-012(f) is the drainline and outfall through which wastewaters from the TA-53-293 cooling tower (which serves Building TA-53-19, the Accelerator Technology Laboratory), are discharged. PRS 53-012(g) is the drainline and outfall for discharges from the TA-53-294 cooling tower (incorrectly identified in the SWMU Report as TA-53-274.), which serves Building TA-53-18 (the FMIT Warehouse). Both outfalls are regulated under the permit No. 03A113.

In addition to the discharges mentioned, Outfall 03A113 receives discharge from Cooling Tower TA-53-1032, which serves Building TA-53-365 (the Ground Test Accelerator Laboratory). This cooling tower discharge was not identified in the SWMU Report, but it is discussed here as part of Outfall 03A113, under PRSs 53-012(f) and (g).

The wastewater stream characterization report for the above facilities (Santa Fe Engineering 1993, 22-0106) lists only cooling tower blowdown as discharge from these cooling towers. It contains the same naturally occurring constituents and water treatment/conditioning chemicals as the outfalls described above (see Table 6-2); the naturally occurring constituents will be concentrated by a factor of approximately 2.5 (a figure based on the rates of cooling tower makeup and blowdown reported in the NPDES permit application—LANL 1990, 22-0018). The average flow is approximately 50 gal./day from TA-53-293; 500 gal./day from TA-53-294; and 600 gal./day from TA-53-1032.

Outfall 03A113 was one of the four outfalls sampled for the "worst case" composite (see Chapter 5, Section 5.6.2.1). Results were similar to those for Outfall 03A048: all organics were below detection limits, and several metals were present at low levels.

The CEARP Report (DOE 1987, 0264) again noted some concern about the possibility of radioactive contamination of cooling water discharges caused by leaks in heat exchangers. As discussed under PRSs 53-012(a) - (c), the closed-loop cooling water systems are designed to prevent such contamination.

6.3.6.1.4 PRS 53-012(h) - Cooling Water Discharge from TA-53-19

The SWMU Report (LANL 1991, 0145) identifies PRS 53-012(h) as a nonpermitted discharge from Building TA-53-19, the Accelerator Technology Laboratory, but provides no additional information. The CEARP Report (DOE 1987, 0264) makes reference to a discharge of noncontact cooling water from Building TA-53-19, observed during the 1986 field survey, that flowed across a parking lot and joined the discharge from TA-53-293 and -294. This is the only discharge from Building TA-53-19 mentioned, and we assume it to be the same discharge listed as PRS 53-012(h) in the SWMU Report.

The CEARP Report did not elaborate on the source of the observed discharge. When the wastewater stream characterization report (Santa Fe Engineering

1993, 22-0106) for this building was reviewed, only one cooling water discharge was found: NPDES-permitted Outfall 04A133. (The 04A category of outfalls includes noncontact discharges.) The report states that this outfall, whose source of discharge was identified as DI water, has been abandoned. The NPDES permit application (LANL 1990, 22-0018) describes this outfall as discharging potable water, used to cool equipment, at an average flow of 5,000 gal./year.

As part of the NPDES permit application, category 04A outfalls were characterized for representative chemical constituents by sampling one of the 32 permitted noncontact discharges within the Laboratory (Outfall 04A133 was not sampled).

6.3.6.2 Justification for NFA

These PRSs are recommended for NFA because they come under the jurisdiction of another regulatory program. Appendix I of the IWP (LANL 1993, 1017) states that a PRS outfall may be recommended for NFA if it discharges to surface waters and has always been permitted under NPDES or began operation after 1972. This justification applies to all of the outfalls except PRSs 53-012(a-c), which probably were in operation as early as 1970, when LAMPF came into being. But discharge levels should not have been significant until 1974, when LAMPF attained full operation. The recommendation of NFA for these PRSs is based on their current status as NPDES permitted and on the nature of their discharge, which has always been restricted to cooling water and cooling tower blowdown.

Characterization of discharges from two of these PRSs, as part of the NPDES permit application, showed organics present at levels below detection limits and several metals at low levels. The concern about possible radioactive discharges from these PRSs, which appears to be the basis for their inclusion in the CEARP Report (DOE 1987, 0264), appears unfounded given the closed-loop design of the cooling water system.

6.3.7 PRS 72-002 - Mortar Impact Area

6.3.7.1 Description and History

The SWMU Report (LANL 1990, 0145) describes an "open detonation" and "mortar impact" area in the former TA-20 in Sandia Canyon. It relates that the area was used for tank practice and that HE and buried shell residuals may be present. We conclude from the description and the site identifiers that this is not one of the gun-firing sites (PRSs 20-003[b] and [c]) used for initiator testing in Sandia Canyon. The entry in the SWMU Report appears to be based on information from the CEARP Report that describes several ordnance-impact areas. The only additional information in CEARP is the statement that "an interviewee indicated that Sandia Canyon, TA-20, was used for tank practice during the war years."

To research this question, we reviewed relevant documentation such as that on the 1962 investigations of the incident in which Los Alamos County residents found a live bazooka round (which later exploded) in Pajarito Canyon. The documentation included interviews with Laboratory, Department of Defense (DoD), and Atomic Energy Commission (AEC) staff who had been at the Laboratory during World War II; one objective of the interviews was to identify all areas used as ordnance-impact areas at that time. The investigation concluded that Sandia Canyon had never been used as an ordnance-impact area (Mynard 1993, 22-0099), and for this reason this site was not included in subsequent surveys to locate unexploded ordnance.

We also reviewed documentation on a 1963 evaluation of the possible presence of an impact area in Sandia Canyon that was prompted by the discovery of signs designating the area as an impact area. A 1963 Laboratory memo (Reider 1963, 22-0101) describes the discovery of a fence that began at East Jemez Road, about 0.25 miles east of the guard station; it ran north, approximately to the canyon wall, and then west about 0.25 miles along the canyon wall. The first section of the fence bore the warning "Danger, Impact Area, Do Not Enter" in English and Spanish. The memo indicates that the fence delineated the eastern limit of the fragmentation-hazard range for explosives tests. Inspection of the fenced area turned up no evidence of ordnance impact and concluded that it was related to the firing tests conducted at PRSs 20-002 and 20-003. It was recommended that the fence and signs be removed (Burch 1963, 22-0078).

The information documenting inspections of Sandia Canyon conducted in the 1960s and 1970s does not support the idea that the site was used as an impact area. A 1991 Laboratory memo (Wagner 1991, 22-0109) describing past inspections states that mortar impact areas were inspected annually by the DOE Los Alamos Area Office and by DoD, whereas HE test areas were inspected by representatives from HSE and WX Divisions. The Sandia Canyon inspections fall into the second category (Drake and Courtwright 1964, 22-0038; Drake and Courtwright 1966, 22-0039; Drake and Courtwright 1967, 22-0040; Drake and Courtwright 1969, 22-0041; Courtwright 1971, 22-0032; Drake 1971, 22-0042; Drake 1973, 22-0043; Drake et al. 1975, 22-0044).

6.3.7.2 Justification for NFA

Information suggesting the presence of an ordnance-impact area in Sandia Canyon is apparently limited to that provided in a single interview during preparation of the CEARP Report (DOE 1987, 0264), which cannot be substantiated by other information. Our review of relevant documentation (including the 1962 survey of impact areas following the bazooka incident, the 1963 evaluation of the posted fenced area in Sandia Canyon, and records of past inspections) leads us to conclude that Sandia Canyon was not used as an impact area.

6.3.8 PRS 72-003(a) - Septic Tank TA-72-18 and Leach Field

6.3.8.1 Description and History

PRS 72-003(a) consists of an active septic tank (TA-72-18), a leach field, and connecting drainlines. The SWMU Report (LANL 1990, 0145) states that this tank, constructed in 1989, serves the active firing range.

This septic system is permitted under an EID Permit to Install or Modify an Individual Liquid Waste System, Permit SF890025 (NMEID 1989, 22-0046). The permit identifies the source of wastewater as an office building and gives the tank's capacity as 2,000 gal. and design flow as 600 gal./day (based on 40 persons at 15 gal./day each).

This septic system served the active firing range since 1989. It is known that currently it receives only sanitary wastes; and on the basis of a site inspection and a review of waste management practices (including those for gun-cleaning solvents), it is extremely unlikely that this system has ever received wastes other than sanitary wastes.

6.3.8.2 Justification for NFA

NFA is proposed for this PRS because there is no evidence of a release of hazardous constituents. Because this unit has been operational for only five years, information concerning the source of the wastes is of good quality. No data exists that would suggest the presence of any wastes other than sanitary wastes in this system. All use of hazardous materials at the firing range (e.g., for cleaning weapons) takes place in an area not connected to the sanitary sewer and is carefully controlled, including administrative controls to prevent disposal to the sanitary sewer.

6.3.9 PRS 72-003(b) - Septic Tank TA-0-276 and Drain Line

6.3.9.1 Description and History

This PRS, consisting of septic tank TA-0-276 and its associated drainline, was identified twice in the SWMU Report (LANL 1990, 0145), as 72-003(b) and as 20-004 (Septic Tank TA-20-49). TA-20-49 was later renumbered TA-0-276.

6.3.9.2 Justification for NFA

NFA is proposed for PRS 72-003(b) because it is the same site as PRS 20-004, which will undergo RFI (see Section 5.5.1.1).

6.3.10 PRS C-20-001 - Structure TA-20-11

6.3.10.1 Description and History

The SWMU Report described this PRS as the former location of a storage building (TA-20-11) and associated, radioactively contaminated soil that has been removed. Two engineering drawings (LASL 1951, 22-0061 and LASL 1951, 22-0056) show Structure TA-20-11 as a 16-ft x 16-ft wooden hut with work benches along three walls. It apparently was used for assembly of test devices that contained radioactive materials. An adjacent 36-ft x 15-ft timber barricade (TA-20-26) protected the hut from flying debris. The two structures were located north of the laboratory building (TA-20-1), next to the canyon wall. Engineering records (LANL undated, 22-0051) show that TA-20-11 was built in November 1944 and removed ca. May 1948.

A 1948 Laboratory memo (Buckland 1948, 22-0029) describes the removal of two "hot huts" and one "hot house" from Sandia Canyon. Although structure numbers are not given, it is suspected that one of these was TA-20-11. The memo states that the structures and all contents were transported to the "contaminated dump" (probably TA-21), after which the ground checked negative for radioactivity. The former location of TA-20-11 was later surveyed radiologically and sampled, as part of the 1985 Site Characterization Program. The radiological survey (done by phoswich detector) yielded no readings above background at this location, and analysis of the soil samples showed uranium present within the background range of 3 to 7 mg/kg (Scholl 1989, 0485).

6.3.10.2 Justification for NFA

We propose NFA for this PRS because there is no evidence of a release. Radiological survey of the site in 1948, after the structure was removed, picked up no indication of contamination (Buckland 1948, 22-0029); and a more recent radiological survey (1985) produced no readings above background (Scholl 1989, 0485).

6.3.11 PRSs C-20-002 and C-20-003 - Structures TA-20-12 and TA-20-14

6.3.11.1 Description and History

The SWMU Report (LANL 1990, 0145) described C-20-002 as a former storage building and C-20-003 as a former magazine, both (and associated soil) contaminated with HE. The SWMU Report gave no details regarding the nature or extent of contamination.

An engineering drawing (LASL 1951, 22-0095) shows TA-20-12 as a portable magazine, a skid-mounted wooden structure with interior dimensions of 6 ft x 6 ft x 7 ft. Engineering records (LANL undated, 22-0051) show TA-20-14 as a 9 ft x 11-ft x 7-ft wood-frame structure protected by an earth berm. According to these records, both structures, which were located south of the 20-mm gun-firing site, were completed in April 1945.

A 1959 Laboratory memo (Penland 1959, 22-0100) identifies TA-20-12 and -14 as abandoned HE-contaminated structures. The memo includes a list (dated October 5, 1959) of vacant structures that were surveyed for radioactivity (by Group H-1), for explosives (by Group H-3), and for toxicity (by Group H-5). Both structures are listed as having been surveyed for radioactivity on April 30, 1959, and found to be clean (a Laboratory memo [Blackwell 1959, 22-0077] documents the absence of any readings above background); for toxicity on May 14, 1959, and found to be clean; and for explosives on July 13, 1959, and found to be contaminated with HE. The extent of HE contamination was not discussed. A Laboratory memo of January 29, 1960 (Wingfield 1960, 22-0110) states that TA-20-12 and -14 were scheduled for demolition by burning the following month; and a memo of May 27, 1960 (Wingfield 1960, 22-0111) records the demolition of both structures on February 28, 1960.

6.3.11.2 Justification for NFA

NFA is proposed for these PRSs because there is no evidence of a release. Historical records confirm that the structures were contaminated with HE, but not with radioactive or toxic materials (LASL 1959, 22-0096). All contamination in the structures, then, would have been destroyed when they were burned (the potential for gross contamination of the structures is remote given the extensive cleanup activities that took place in Sandia Canyon in 1948). Historical records do not confirm the SWMU Report information that the soils were contaminated. Given the nature of operations at these structures (they were storage facilities only), the potential for soil contamination appears very remote.

6.4 Nonlisted PRSs Recommended for DA

6.4.1 PRS 53-001(c), (d), and (k) - Waste Accumulation Areas

6.4.1.1 Description and History

6.4.1.1.1 PRS 53-001(c) - Waste Accumulation Area at Building TA-53-16

This PRS was identified in the SWMU Report (LANL 1990, 0145) as a storage area located at the south side of Building TA-53-16, a machine shop associated with LANSCE. Solvent-contaminated rags were stored here. The SWMU Report also mentions a storage area that had previously been identified in the CEARP Report. Located southeast of TA-53-16, this area reportedly was used to store drums of ethylene glycol, organic solvents, and epoxy resins (it is also noted that epoxy resin was leaking onto the ground at this site).

Photographs taken during June 1989 show PRS 53-001(c), the area south of TA-53-16. In one photograph (LANL 1989, 22-0089), a single 55-gal. drum is visible adjacent to two flammable-materials storage cabinets. No leakage from the drum or staining on the asphalt below the drum is evident. In another photograph (LANL 1989, 22-0090), a storm drain can be seen about 40 ft southwest of the storage area; no staining or other evidence of releases is visible between the drum and the storm drain.

When the site was inspected in conjunction with work plan preparation, the satellite area could not be located. The EM-8 tracking system (LANL 1993, 22-0050) confirmed that it had been removed.

Staining was noted outside TA-53-16 during the inspection, on the asphalt in front of and to the right of the door on the south-southeast corner of the building; it extended about a foot beyond the fence on the southeast corner. It could not be determined whether this staining was associated with PRS 53-001(c).

6.4.1.1.2 PRS 53-001(d) - Waste Accumulation Area at Building TA-53-14

The SWMU Report identified this PRS as a waste storage area located outside the southwest side of Building TA-53-14 (a general laboratory facility) and listed materials stored there as solvent-contaminated rags, acetone, ethanol, trichloroethane, and freon.

This area is shown in a 1989 photograph (LANL 1989, 22-0088), identified by a satellite-accumulation-area sign. Two drums bearing hazardous waste labels are visible next to a flammable-materials storage cabinet; some staining can be seen on the asphalt surface below the cabinet, and may be present beneath the drums as well.

When the site was inspected in conjunction with work plan preparation, the satellite area could not be located. It apparently had been removed. No staining on the asphalt was noted. An addition to the TA-53-14 building, at the southwest corner, may cover the former location of this PRS.

Two indoor hazardous-waste satellite accumulation areas were noted inside the facility. One contained rags, wipes, Q-tips, and cloths contaminated with halogenated solvent; the second contained rags and wipes soaked with solvent (acetone, methanol, trichloroethylene). We assume that similar wastes had been stored at PRS 53-001(d).

6.4.1.1.3 PRS 53-001(k) - Waste Accumulation Area at Building TA-53-7

PRS 53-001(k) was identified in the SWMU Report (LANL 1990, 0145) as a waste storage area in the middle of the road at the north side of Building TA-53-7 (a beam-line experimental facility originally known as the WNR). Solvent-contaminated rags were stored at this site.

When the site was inspected for preparation of the work plan, no waste storage area was located. The EM-8 tracking system (LANL 1993, 22-0050) lists an active satellite storage area in the middle of the road on the north side of TA-53-7, and staff members confirmed that this was the former location of a solid waste dumpster. No staining on the asphalt was noted in this area, which is north of the eastern portion of TA-53-7; iron staining was noted on the asphalt north of the western portion of the facility, in an area that may formerly have contained storage drums.

6.4.1.2 Justification for DA

These PRSs are recommended for DA because a sampling program meeting the objectives specified in Section 5.3.3 (to determine whether contaminants of concern are present as a result of releases from these PRSs) is not feasible. Such a program would require sampling of surface soils at the waste storage areas and/or of sediments in downslope catchments near the sites; but the storage areas are either on pavement or beneath a building, and no sediment catchments exist near enough to the sites to rule out the potential for contamination from numerous other sources. The surface soils that are now covered by asphalt or by structures can be sampled when the site as a whole undergoes D&D. Sediments in drainages that may have been affected by site-wide activities can also be sampled at that time.

Because the IWP stipulates that DA can be implemented only in the demonstrated absence of current risk, we evaluated the risk associated with these PRSs by applying the conceptual exposure model elements developed for similar PRSs (see Section 5.3.2). The historical source of potential contamination for these PRSs is the wastes stored at these sites, and the PRS creation mechanisms are spills or leaks from the containers. Current sources of exposure to PCOCs are contaminated soils and sediments; and current release mechanisms for PCOCs include excavation, runoff, and wind erosion.

Because of administrative controls in place at the Laboratory, there is no current risk associated with excavation. All excavation requires a permit, which includes evaluation of potential sources of contamination and the use of appropriate protective measures. Inspection of these sites did not reveal any potential contamination that could pose a current risk through the agency of runoff or wind erosion.

For these reasons, we conclude that these PRSs do not pose an unacceptable current risk and that investigation can be deferred.

6.4.2 PRSs 53-006(a) and (f) - Underground Tanks

6.4.2.1 Description and History

6.4.2.1.1 PRS 53-006(a) - Underground Tank TA-53-59

This PRS is identified in the SWMU Report (LANL 1990, 0145) as an inactive UST 28 in. in diameter by 65 ft tall. It was reportedly used from 1974 until the 1980s to store spent ion-exchange resin used to treat water from LAMPF.

Additional information comes from an engineering drawing (LASL 1951, 22-0095) that shows the tank as a vertical, cylindrical structure (the dimensions are as given in the SWMU Report). The drawing suggests that this tank was designed for water treatment rather than for storage of spent resin (the inlet pipe is shown discharging at the bottom of the tank, indicating that water would flow upwards through the resin before being expelled via the outlet pipe at the top). Because the drawing was not marked "as constructed," however, it is not known whether the tank was actually constructed in this manner.

6.4.2.1.2 PRS 53-006(f) - Underground Tank at TA-53-1

The SWMU Report describes this PRS as an active, 3,000-gal. UST located in Building TA-53-1. Installed in 1972, the tank is used to store radioactive wastewater before it is removed by EM-7 for treatment or disposal.

As described in Section 6.1.2, this tank appears to be the same structure that was also called a sump, part of PRS 53-007(a), in the SWMU Report. When the basement of D wing at TA-53-1 was inspected, one tank was identified that matched the descriptions of both PRSs, 53-006(f) and 53-007(a). The wastes discharged to this tank consisted of neutralized wastes from sinks and other drains in radiochemistry laboratories (see Section 6.1.2.1). The CEARP Report notes that both these tanks were included in the UST notification submitted to NMED on May 5, 1986.

6.4.2.2 Justification for DA

These tanks are of concern because they contain radioactive wastes, although there is no evidence of any releases. If any releases have occurred, contaminants could have migrated to the vadose zone and, possibly, even to groundwater. The effort required to sample for subsurface contamination would involve intrusive activities, such as drilling, that would be difficult to implement without disrupting current operations. For these reasons, we propose that investigation of these PRSs be deferred until the facilities associated with these tanks undergo D&D.

Because DA can be implemented only if no current risk is demonstrated, we evaluated current risk by applying the conceptual exposure model elements presented in Chapter 4. The historical source of potential contamination is the radioactive wastes contained in the tanks, and the PRS creation mechanism is leakage from the tanks. The current source of exposure to PCOCs is contaminated tuff, and current release mechanisms include excavation, infiltration/leaching, and direct radiation.

Because of administrative controls in place at the Laboratory, there is no current risk associated with excavation of potentially contaminated tuff. All excavation requires a permit, which includes evaluation of potential sources of contamination and the use of appropriate protective measures.

Available information indicates that there is also no current risk associated with infiltration to groundwater: the only potential route of exposure is via the water supply wells located adjacent to TA-53 in Sandia and Los Alamos canyons, which are monitored periodically to assure that they meet drinking water standards. Contaminants in the water would be detected by this monitoring. The risk of future contamination of groundwater is low, moreover, because of the great depth to groundwater and the favorable hydrologic properties of the vadose zone.

The risk from direct radiation is considered to be negligible; because the tanks are underground, potential contamination from releases would be confined to the subsurface, and direct radiation from subsurface sources should be less than that encountered in the course of normal operations (i.e., from the wastes themselves).

These PRSs, then, do not pose an unacceptable current risk. However, because the possibility of leakage cannot be ruled out, we recommend that the integrity of the tanks be evaluated through nonintrusive, nondestructive methods. (Specific integrity-evaluation methods, based on the design characteristics of the tanks and radiation protection requirements, will have to be developed. These will be described, and the results documented, in the RFI Phase I report.) If any tanks are found to be leaking, intrusive activities will be undertaken as part of Phase II.

6.4.3 PRS 53-009 - Mineral Oil Storage Area

6.4.3.1 Description and History

PRS 53-009 is described in the SWMU Report (LANL 1990, 0145) as an earth-bermed area containing three aboveground tanks used to store liquid scintillation fluid. It was located north of the surface impoundments.

When this area was inspected in conjunction with work plan preparation, the bermed storage area was found to have been removed. In its place are two new contained storage areas, identified as Structures TA-53-1071 and TA-53-1072. These structures, each of which measures 60 ft by 30 ft, are made of 3-ft-high welded steel plates with a galvanized steel supporting framework. The walls and the floors are lined with large sheets of 1/8-in.-thick butyl rubber, to contain spills (the sheets overlap but are not welded). There was no evidence of leakage within either enclosure.

The western enclosure, TA-53-1071, contained three large, aboveground tanks, each containing 30,000 gal. of liquid scintillation oil; and 30 55-gal. drums that collectively contained 165 gal. of liquid scintillation oil. The drums were covered with a canvas tarp.

The eastern enclosure, TA-53-1072, contained four large, aboveground tanks that were empty and 141 55-gal. drums that collectively contained 7,755 gal. of liquid scintillation oil. These drums were also securely covered with canvas tarp.

6.4.3.2 Justification for DA

This PRS is recommended for DA because the site is active. Implementation of a sampling program would seriously disrupt current operations. The soil that would need to be sampled to characterize the former storage area designated a PRS is beneath this active storage area and could not easily be reached without damaging the liners. Because there is no evidence that the site poses a threat to human health or the environment, we recommend that sampling be deferred until the storage areas undergo D&D.

The IWP stipulates that DA can be implemented only in the demonstrated absence of current risk. We evaluated the risk associated with this PRS by applying the conceptual exposure model elements developed for similar PRS (see Section 5.3.2). The historical source of potential contamination is the mineral oil formerly stored at this site, and the PRS creation mechanism is spills or leaks from the containers. The current source of exposure to PCOCs is contaminated soils, and current release mechanisms include runoff and wind erosion. If any contaminated soil is present beneath the new active storage structures, the membrane liners of these structures would provide containment, making the potential for migration through runoff or wind erosion minimal.

For these reasons, we conclude that this PRS does not pose an unacceptable current risk and that investigation can be deferred.

REFERENCES FOR CHAPTER 6

Bailey, M. G., February 2, 1989. "Status of Daily PCB Transformer Inspections and Leak Repair," Pan Am World Services Inc. Memorandum PENV89-124, ER ID Number 4060, Los Alamos, New Mexico. (Bailey 1989, 22-0074)

Bailey, M. G., November 19, 1990. "Procedure for Daily Transformer Inspections," Pan Am World Services, Inc., ER ID Number 29396, Los Alamos, New Mexico. (Bailey 1990, 22-0075)

Bailey, M. G., October 4, 1988. "Status of Daily PCB Transformer Inspections and Leak Repair," Pan Am World Services, Inc. Memorandum MB88-62, ER ID Number 4062, Los Alamos, New Mexico. (Bailey 1988, 22-0073)

Bailey, M., G., March 21, 1990. "Non-Reportable Quantity PCB Release at TA-53, Sector A," Pan Am World Services, Inc. Memorandum PENV90-169, ER ID Number 29400, Los Alamos, New Mexico. (Bailey 1990, 22-0076)

Becker, N. M., 1986. "Heavy Metals in Runoff," in Environmental Surveillance at Los Alamos During 1985, Los Alamos National Laboratory Report LA-10721-ENV, Los Alamos, New Mexico. (Becker 1986, 0027)

Becker, N. M., W. D. Purtymun, and M. Maes 1985. "Movement of Depleted Uranium by Storm Runoff," in Environmental Surveillance at Los Alamos During 1984, Los Alamos National Laboratory Report LA-10421-ENV, Los Alamos, New Mexico. (Becker et al. 1985, 0029)

Blackwell, C. D., April 30, 1959. "Radiation Health Clearance of Surplus Laboratory Structures," Los Alamos Scientific Laboratory memorandum, ER ID Number 5773, Los Alamos, New Mexico. (Blackwell 1959, 22-0077)

Bradbury, N. E., September 11, 1947. "General Background Data Concerning the Los Alamos Scientific Laboratory," Los Alamos Scientific Laboratory Memorandum LAB-A-5, ER ID Number 07006, Los Alamos, New Mexico. (Bradbury 1947, 22-0027)

Buckland, C., April 20, 1948. "Sandia Canyon, Clearing for Future Public Road, Picnic Area," Los Alamos Scientific Laboratory memorandum, ER ID Number 6001, Los Alamos, New Mexico. (Buckland 1948, 22-0029)

Burch, C. A., May 21, 1963. "Impact Area - Sandia Canyon," Los Alamos Scientific Laboratory memorandum, ER ID Number 059748, Los Alamos, New Mexico. (Burch 1963, 22-0078)

Courtwright, W. C., July 20, 1971. "Inspection of TA-10 (Bayo Canyon), TA-20, and TA-27," Los Alamos Scientific Laboratory memorandum, ER ID Number 02075, Los Alamos, New Mexico. (Courtwright 1971, 22-0032)

DOE (US Department of Energy), October 1987. "Phase I: Installation Assessment, Los Alamos National Laboratory," Volumes 1 and 2, (draft), Comprehensive Environmental Assessment and Response Program, Albuquerque Operations Office, Albuquerque, New Mexico. (DOE 1987, 0264)

Drake, R. W., and W. C. Courtwright, and J. Bacastow, June 24, 1975. "Biennial Inspection: TA-10, TA-20, and TA-27," Los Alamos Scientific Laboratory Memorandum H-3-75-251, ER ID Number 05047, Los Alamos, New Mexico. (Drake et al. 1975, 22-0044)

Drake, R. W., and W. C. Courtwright, July 7, 1966. "Annual Inspection of TA-20 and TA-27 for Loose Explosives," Los Alamos Scientific Laboratory memorandum, ER ID Number 05985, Los Alamos, New Mexico. (Drake and Courtwright 1966, 22-0039)

Drake, R. W., and W. C. Courtwright, July 11, 1967. "Annual Inspection of TA-20 and TA-27 for Loose Explosives," Los Alamos Scientific Laboratory memorandum, ER ID Number 05986, Los Alamos, New Mexico. (Drake and Courtwright 1967, 22-0040)

Drake, R. W., and W. C. Courtwright, June 13, 1969. "Inspection of TA-20 and TA-27 for Loose Explosives," Los Alamos Scientific Laboratory memorandum, ER ID Number 02080, Los Alamos, New Mexico. (Drake and Courtwright 1969, 22-0041)

Drake, R. W., and W. C. Courtwright, May 8, 1964. "Annual Safety Inspection of TA-20 and TA-27 for Loose Explosives," Los Alamos Scientific Laboratory memorandum, ER ID Number 05976, Los Alamos, New Mexico. (Drake and Courtwright 1964, 22-0038)

Drake, R. W., July 12, 1971. "Inspection of TA-20 and TA-27 for Loose Explosives: Visit to Bayo Canyon," Los Alamos Scientific Laboratory memorandum, ER ID Number 02076, Los Alamos, New Mexico. (Drake 1971, 22-0042)

Drake, R. W., May 8, 1973. "Biennial Inspection, TA's 10, 20, and 27," Los Alamos Scientific Laboratory memorandum, ER ID Number 05043, Los Alamos, New Mexico. (Drake 1973, 22-0043)

Dransfield, B. J., and J. N. Gardner, May 1985. "Subsurface Geology of the Pajarito Plateau, Española Basin, New Mexico," Los Alamos National Laboratory Report LA-10455-MS, Los Alamos, New Mexico. (Dransfield and Gardner 1985, 0082)

Environmental Protection Group, June 1992. "RCRA Part B Permit Application, Surface Impoundments Technical Area 53," Volumes 1 and 2, Revision 1.0, Los Alamos National Laboratory, Los Alamos, New Mexico. (Environmental Protection Group 1992, 1075)

Environmental Restoration Group, February 1993. "Interim Status Closure Plan, Surface Impoundments, TA-53-166 Northeast and TA-53-166 Northwest, Technical Area 53," Rev. 0, Los Alamos National Laboratory, ER ID Number 29416, Los Alamos, New Mexico. (Environmental Restoration Group 1993, 22-0092)

EPA (US Environmental Protection Agency), July 27, 1990. "Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management

Facilities," proposed rule, Title 40 Parts 264, 265, 270, and 271, Federal Register, Vol. 55., pp. 30798-30884. (EPA 1990, 0432)

ESG, April 1980. Environmental Surveillance at Los Alamos During 1979, Los Alamos Scientific Laboratory Report LA-8200-ENV, Los Alamos, New Mexico. (ESG 1980, 0406)

ESG, April 1981. Environmental Surveillance at Los Alamos During 1980, Los Alamos National Laboratory Report LA-8810-ENV, Los Alamos, New Mexico. (ESG 1981, 1113)

ESG, April 1982. Environmental Surveillance at Los Alamos During 1981, Los Alamos National Laboratory Report LA-9349-ENV, Los Alamos, New Mexico. (ESG 1982, 0620)

ESG, April 1983. Environmental Surveillance at Los Alamos During 1982, Los Alamos National Laboratory Report LA-9762-ENV, Los Alamos, New Mexico. (ESG 1983, 0621)

ESG, April 1984. Environmental Surveillance at Los Alamos During 1983, Los Alamos National Laboratory Report LA-6523-ENV, Los Alamos, New Mexico. (ESG 1984, 1114)

ESG, April 1985. Environmental Surveillance at Los Alamos During 1984, Los Alamos National Laboratory Report LA-10241-ENV, Los Alamos, New Mexico. (ESG 1985, 0407)

ESG, April 1986. Environmental Surveillance at Los Alamos During 1985, Los Alamos National Laboratory Report LA-10721-ENV, Los Alamos, New Mexico. (ESG 1986, 1115)

Holm-Hansen, T., August 14, 1987. "Procedure for Daily Transformer Inspections," Pan Am World Services, Inc., THH87-97, ER ID Number 29395, Los Alamos, New Mexico. (Holm-Hansen 1987, 22-0080)

Holm-Hansen, T., March 1989. "PCB Cleanup Report for TA-53, MPF-70," Pan Am World Services, Inc., ER ID Number 8556, Los Alamos, New Mexico. (Holm-Hansen 1989, 22-0081)

LANL (Los Alamos National Laboratory), undated. "ENG-7 Structure Historical Book: TA-20," Los Alamos National Laboratory, ER ID Number 29404, Los Alamos, New Mexico. (LANL undated, 22-0051)

LANL (Los Alamos National Laboratory), June 21, 1989. Polaroid Photo No. 123, "Flammable Liquid Satellite Storage Area," Los Alamos National Laboratory, ER ID Number 20623, Los Alamos, New Mexico. (LANL 1989, 22-0088)

LANL (Los Alamos National Laboratory), June 21, 1989. Polaroid Photo No. 133, "Satellite Storage Area," Los Alamos National Laboratory, ER ID Number 20633, Los Alamos, New Mexico. (LANL 1989, 22-0089)

LANL (Los Alamos National Laboratory), June 21, 1989. Polaroid Photo No. 134, "Storm Drain 40 Feet Southwest of MPF-16," Los Alamos National Laboratory, ER ID Number 20634, Los Alamos, New Mexico. (LANL 1989, 22-0090)

LANL (Los Alamos National Laboratory), November 1989. "Los Alamos National Laboratory Sampling and Analysis Data Document," Volume 1 (Draft) EGG-ES-8204 prepared for the Department of Energy under Contract No. DE-AC07-761DO1570 by DOE Environmental Survey and Idaho National Engineering Laboratory, Idaho Falls, Idaho. (LANL 1989, 0425)

LANL (Los Alamos National Laboratory), September 1990. "Consolidated Permit Reapplication for NPDES NM 0028355," Los Alamos National Laboratory, ER ID Number 29412, Los Alamos, New Mexico. (LANL 1990, 22-0018)

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report No. LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. (LANL 1990, 0145)

LANL (Los Alamos National Laboratory), November 1992. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. (LANL 1993, 1017)

LANL (Los Alamos National Laboratory), April 28, 1993. "Hazardous Waste Tracking System," Los Alamos National Laboratory, ER ID Number 29415, Los Alamos, New Mexico. (LANL 1993, 22-0050)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1772, Rev. 1, Los Alamos Scientific Laboratory, ER ID Number 23259, Los Alamos, New Mexico. (LASL 1951, 22-0095)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1775, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24342, Los Alamos, New Mexico. (LASL 1951, 22-0093)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1778, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24345, Los Alamos, New Mexico. (LASL 1951, 22-0056)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1779, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24346, Los Alamos, New Mexico. (LASL 1951, 22-0061)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C 1785, Rev. 1, Los Alamos Scientific Laboratory, ER ID Number 24352, Los Alamos, New Mexico. (LASL 1951, 22-0094)

LASL (Los Alamos Scientific Laboratory), February 19, 1951. Engineering Drawing ENG-C-1781, Rev. 1, prepared by W. C. Krueger Architect, Los Alamos Scientific Laboratory, ER ID Number 24348, Los Alamos, New Mexico. (LANL 1951, 22-0052)

LASL (Los Alamos Scientific Laboratory), October 5, 1959. "Vacated LASL Structures," Los Alamos Scientific Laboratory, ER ID Number 06008, Los Alamos, New Mexico. (LASL 1959, 22-0096)

Mynard, C. R., August 2, 1993. "Data on SWMU 72-002 from 1990 SWMU Report," Los Alamos National Laboratory Memorandum MEE-93-279, ER ID Number 29408, Los Alamos, New Mexico. (Mynard 1993, 22-0099)

NMEID (New Mexico Environmental Improvement Division), January 20, 1989. Permit to Install or Modify an Individual Liquid Waste System, NMEID Permit Number SF890023, ER ID Number 29407, Santa Fe, New Mexico. (NMEID 1989, 22-0079)

NMEID (New Mexico Environmental Improvement Division), January 20, 1989. Permit to Install or Modify an Individual Liquid Waste System, NMEID Permit Number SF890025, ER ID Number 29406, Santa Fe, New Mexico. (NMEID 1989, 22-0046)

Penland, J. R., July 13, 1959. "HE Contamination of Abandoned Structures," Los Alamos Scientific Laboratory memorandum, ER ID Number 00806, Los Alamos, New Mexico. (Penland 1959, 22-0100)

Reider, R., May 22, 1963. "Removal of Fence, Sandia Canyon Site TA-20," Los Alamos Scientific Laboratory memorandum, ER ID Number 05975, Los Alamos, New Mexico. (Reider 1963, 22-0101)

Santa Fe Engineering, Ltd., 1993. " Waste Water Stream Characterization for TA-53-7, 8, 15, 16, 28, 29, 30, 34, 35, 36, 37, 368, 369, 370, 371, 372, 374, 382, 384, 534, 535, 540, 541, 573, 574, 622, 625, 634, 679, 686, 726, 734, 735, 736, 776, 777, 780, 781, 782, 783, 823, 826, 880, 1031, 1039, 1043, 1120, 1121, and 1138 at Los Alamos National Laboratory, Environmental Study, Characterization Report #33," Santa Fe Engineeering, ER ID Number 31759, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0070)

Santa Fe Engineering, Ltd., 1993. "Waste Water Stream Characterization for TA 53-22, 39, 43, 408, 414, 422, 432, 435, 443, 449, 462, 463, 470, 473, 482, 502, 514, 688, 689, 716, 744, 754, 804, 805, 816, 839, 843, 1050, and 1136 at Los Alamos National Laboratory, Environmental Study, Characterization Report #36," Santa Fe Engineering, ER ID Numberr 31762, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0104)

Santa Fe Engineering, Ltd., 1993. "Waste Water Stream Characterization for TA-53-44, 45, 46, 47, 411, 417, 423, 424, 425, 435, 439, 442, 445, 446, 458, 466, 467, 474, 485, 486, 491, 493, 494, 495, 512, 513, 545, 595, 597, 602, 604,642, 677, 743, 746, 747, 755, 765, 778, 803, 812, 817 818, 878, and 894 at Los Alamos National Laboratory, Environmental Study, Characterization Report #39," Santa Fe Engineering, ER ID Number 31764, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0102)

Santa Fe Engineering, Ltd., March 1994. "Waste Water Stream Characterizaton For TA 53-3, 10, 23, 25, 364, 505, 510, 552, 640, 681, 773, and 816 at Los Alamos National Laboratory, Environmental Study, Characterization Report #31, Revision 1," Santa Fe Engineering, ER ID Number XXXX, Santa Fe, New Mexico. (Santa Fe Engineering 1994, 22-0105)

Santa Fe Engineering, Ltd., November 1993. "Waste Water Stream Characterization for TA 53-1, 40, 70, 415, 416, 420, 421, 428, 450, 452, 454, 515, 524, 526, 605, 733, 809, 813, 815, and 845 at Los Alamos National Laboratory, Environmental Study, Characterization Report #29, Revision 1," Santa Fe Engineering, ER ID Number 31756, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0107)

Santa Fe Engineering, Ltd., October 1993. "Waste Water Stream Characterization for TA 53-23, 24, 26, 41, 60, 61, 62, 63, 64, 65, 413, 418, 419, 426, 427, 451, 506, 521, 527, 614, 615, 779, 808, 841, 879, 1021, and 1054 at Los Alamos National Laboratory, Environmental Study, Characterization Report #28, Revision 1," Santa Fe Engineering, ER ID Number 31755, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0108)

Santa Fe Engineering, Ltd., October 1993. "Waste Water Stream Characterization for TA 53-365, 600, 601, 603, 637, 638, 639, 676, 683, 711, 712, 713, 714, 715, 757, 758,759, 786, 787, and 867 at Los Alamos National Laboratory, Environmental Study, Characterization Report #37, Revision 1," Santa Fe Engineering, ER ID Number 31763, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0103)

Santa Fe Engineering, Ltd., October 1993. "Waste Water Stream Characterization for TA 53-6, 17, 18, 19, 31, 293, 294, 385, 400, 401, 402, 403, 404, 405, 409, 543, 577, 617, 620, 678, 708, 709, 710, 764, 833, 835, 852, 874, 888, 1032, 1038, and 1053 at Los Alamos National Laboratory, Environmental Study, Characterization Report #30, Revision 1," Santa Fe Engineering, ER ID Number 31757, Santa Fe, New Mexico. (Santa Fe Engineering 1993, 22-0106)

Scholl, J. L., April 1989. "Los Alamos Site Characterization Program Special Projects Report," (draft), prepared for Los Alamos National Laboratory by NUS, New Mexico. (Scholl 1989, 0485)

Wagner, S., April 26, 1991. "Mortar Support and Explosive Area," Los Alamos National Laboratory Memorandum HSE-13:91-313, ER ID Number 29402, Los Alamos, New Mexico. (Wagner 1991, 22-0109)

Wingfield, E. E., January 29, 1960. "Demolition of Buildings by Fire," Los Alamos Scientific Laboratory memorandum, ER ID Number 14920, Los Alamos, New Mexico. (Wingfield 1960, 22-0110)

Wingfield, E. E., May 27, 1960. "Demolition of Buildings by Burning," Los Alamos Scientific Laboratory memorandum, ER ID Number 29398, Los Alamos, New Mexico. (Wingfield 1960, 22-0111)

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Annex I

Project Management Plan

1.0 PROJECT MANAGEMENT PLAN

This annex provides the technical approach, schedule, reporting requirements, budget, organization and responsibilities for the implementation of the (RCRA) facilities investigation (RFI) for OU 1100. This project management plan (PMP) is an extension of ER Program's Management Plan described in Annex I of the IWP (LANL 1993, 1017) and follows the DOE's basic management philosophy outlined in DOE Order 4700.1, Project Management System (DOE 1987, 0069). This annex discusses the requirements for PMPs set forth in the HSWA Module (Task II, E, p. 39) of the Laboratory's permit to operate under RCRA (EPA 1990, 0306) as they pertain to OU 1100. Qualifications of key personnel, including contractors, are also provided.

1.1 Technical Approach

The technical approach to the RFI for OU 1100 is described in Chapter 4 of this work plan. This approach is based on the ER Program's overall approach to the RFI/corrective measures study (CMS) process as described in Chapter 4 of the IWP. The following key features characterize the ER Program's approach:

- use of preselected "screening action levels" as criteria to trigger voluntary corrective action (VCA) or Phase II investigations;
- site characterization based on a "sample and analysis" approach;
- use of decision analysis and cost-effectiveness studies in selecting remedial corrective measures and their remedial alternatives; and
- the application of an "observational," or "streamlined," approach to the RFI/CMS process.

The general philosophy of the RFI/CMS process is to develop and iteratively refine the OU 1100 conceptual exposure model through carefully planned stages of investigation and data interpretation. This will be followed by a study that investigates and proposes various methods for addressing potential release sites (PRSs) that are determined to need remediation. Another objective is to use the minimum data necessary to support either interim corrective measures or a CMS.

1.2 Technical Objectives

The technical objectives of this work plan, and the subsequent RFI, are to

- locate, or confirm the location of, each PRS within OU 1100;
- through Phase I investigations, identify contaminants present at each PRS and the concentrations within structures and environmental media;

- conduct VCAs and propose no further action (NFA) or Phase II investigations as appropriate;
- determine the vertical and horizontal extent of the contamination at each PRS during Phase II investigations, as may be required;
- identify contaminant migration pathways during Phase II investigations;
- acquire sufficient information to allow quantitative assessment of migration pathways and the associated risk for all PRSs carried forward to Phase II investigations; and
- determine if a CMS is required.

2.0 SCHEDULE

The plan and schedule for the RFI/CMS process were developed as a joint effort between the operable unit project leader (OUPL) and the management information system staff of the ER Program Office. The initial step was to develop and agree on an ER Program-wide work breakdown structure at the upper levels (i.e., Level 1 down through Level 6, which included all the operable units). Level 6 was expanded for OU 1100 and all the necessary activities were graphically laid out on a detailed logic diagram. All of the activities were related to each other by sequence (i.e., before, after, or in parallel with). Duration (in working days) and cost estimates (in dollars) were made for each of the activities. The schedule and cost estimate were calculated as a function of time and were calculated first as a financially unconstrained case and were then replanned to account for constrained funding, which was already allocated for fiscal year (FY) 93. Key milestones for the RFI are presented in Table I-1. A CMS is not anticipated for OU 1100, but will be scheduled if Phase II investigations indicate a need.

Implementation of RFI activities is contingent on regulatory review and approval of this work plan and on available funding. The assumptions used to generate this schedule include the following:

- Review and approval of the work plan and supporting project plans by regulatory agencies are scheduled to be completed by September 1, 1994.
- Certain tasks may be initiated before the regulatory agencies grant final approval of the work plan.
- PRSs expected to require subsequent investigations have been scheduled earlier in the RFI to allow time for data assessment and subsequent investigations.

TABLE I-1

SCHEDULE FOR OU 1100 RCRA FACILITY INVESTIGATION AND CORRECTIVE MEASURES STUDY

Milestone	Date
Start RFI Work Plan	10/01/92
DOE Draft RFI Work Plan Completed	01/03/94
EPA/New Mexico Environment Department (NMED) RFI Work Plan Submitted	05/23/94
EPA/NMED Draft of Phase I Report Completed	06/07/96
EPA/NMED Draft of RFI Report Completed	11/04/98

- The schedule assumes that an adequate number of support personnel (e.g., health and safety technicians, trained drilling contractors) will be available for conducting necessary tasks.
- EPA review and comments on phase reports/work plan modifications are assumed to take two months. Another month is allowed for Laboratory revision and EPA final approval.
- Adequate funding is available to accomplish the work shown in the plan and schedule.

3.0 REPORTING

Results of the RFI field work will be presented in four principal documents:

- ER quarterly technical reports.
- Phase reports/work plan modifications.
- RFI report.
- CMS report (as required).

These reports are summarized in the following sections. A schedule for submission of draft and final reports is presented in Table I-2.

TABLE I-2

REPORTS PLANNED FOR THE OU 1100 RFI

Type of Report and Subject	Draft Date	Final Date
ER Quarterly Technical Reports • Summary of Technical Activities and Data		03/31 (yearly) 06/30 (yearly) 09/30 (yearly) 12/31 (yearly)
Phase Reports/Work Plan Modifications • Phase I Report • Phase II Report	06/07/96	
RFI Report • Final RFI Report	11/04/98	

3.1 ER Quarterly Technical Reports

As the OU 1100 RFI is implemented, technical progress will be summarized in quarterly technical progress reports submitted by the ER Program, as required by the HSWA Module of the Laboratory's RCRA Part B operating permit (Task V, C, p. 46). Detailed technical assessments will be provided in phase reports/work plan modifications.

3.2 Phase Reports/Work Plan Modifications

Phase reports/work plan modifications will be submitted at the end of each phase for work conducted on PRSs in this operable unit. The first report will summarize Phase I results on initial site characterization and describe the proposed follow-on activities of Phase II, including any modifications to field sampling plans suggested by the Phase I results. This report will also identify any PRSs proposed for NFA. A Phase II report (as distinct from a final RFI report) will be prepared only if Phase II investigations are proposed. The standard outline for a phase report/work plan modification is presented in Section 3.5.1.2 of the IWP (LANL 1993, 1017) and may be modified as needed.

3.3 RFI Report

The RFI report will summarize all field work conducted during the duration of the RFI. The RFI report will describe the procedures, methods, and results of field investigations and will include information on the types and extent of contamination, sources and migration pathways, and actual and potential receptors. The report will also contain adequate information to support the delisting of NFA sites and corrective action decisions.

3.4 CMS Report

A CMS is not currently anticipated for OU 1100. However, if needed, the CMS report will propose methods of remediation for selected PRSs listed in the RFI report. Not all PRSs will need remediation because some will have been delisted based on recommendations made in the RFI report. The CMS report will describe the proposed remediation methods, procedures, and expected results, along with a plan, schedule, and cost estimate.

4.0 BUDGET

It is impractical (almost impossible) to separate schedule and cost because changing one affects the other. For example, the start and end dates for OU 1100 were fixed by a combination of regulations and the requirements of the ER Program Office. These schedule decisions affect the cost as a function of time.

The detailed planning, scheduling, and cost estimating were done in late FY 91 and have recently been revised as part of a baseline change proposal submitted to DOE in FY 94. As stated previously, the schedule and cost estimate were calculated first as a financially unconstrained case and were then replanned to account for constrained funding that was allocated for FY 93. DOE funding decisions are set two years in advance (in this case, for FYs 93 and 94). Therefore, the first year that OU 1100 RFI is not constrained by past budget decisions could be FY 95.

Table I-3 presents project costs for completion of the RFI for OU 1100. Each activity on the logic network was assigned one or more resources (i.e., people, materials, or equipment). Through a rate table, the resources were converted to dollars. The estimated costs are escalated for all years beyond FY 93 and do not contain contingency.

The plan, schedule, and budget (allocation) for FY 93 are now baselined by the DOE's Albuquerque Operations Office. The outyears, FY 94 through 98, are not baselined.

TABLE I-3

ESTIMATED COSTS OF COMPLETING RFI OU 1100

Estimate to Complete	$2,428,000
Escalation	$ 466,000
Prior Years	$ 727,.000
Total at Completion	$3,621,000

5.0 OU 1100 ORGANIZATION AND RESPONSIBILITIES

The organizational structure for the ER Program is presented in Chapter 3 of the IWP (LANL 1993, 1017). ER Program personnel are identified to the technical team leader (TTL) and OUPL level in Figure 3-2 of the IWP, which has been updated and is presented here as Figure I-1. Section 3.3 of the IWP identifies line authority and personnel responsibilities for each position identified in the figure. Records of qualifications and training of all personnel working on the OU 1100 RFI field work will be maintained as ER records. Summaries of their qualifications are presented in Section 6 of this annex.

The management organization for field investigations is shown in Figure I-2. The names of individuals assigned to the positions indicated in the figure have not been determined at this time. The following sections define the responsibilities of the positions identified in Figure I-2.

5.1 Operable Unit Project Leader

The responsibilities of the OUPL are to

- oversee day-to-day operations, including planning, scheduling, and reporting of technical and administrative activities;
- ensure preparation of scientific investigation planning documents and procedures;
- prepare monthly and quarterly reports for the ER Program Manager;
- coordinate with TTLs;
- oversee RFI field work and manage the field teams manager;
- oversee subcontractors, as appropriate;
- conduct technical reviews and direct preparation of final reports;
- comply with the Laboratory's technical requirements for the ER Program;
- interface with the ER quality program project leader (QPPL) to resolve quality concerns and participate with the quality assurance (QA) staff on audits; and
- comply with the ER Program requirements for health and safety, records management, and community relations.

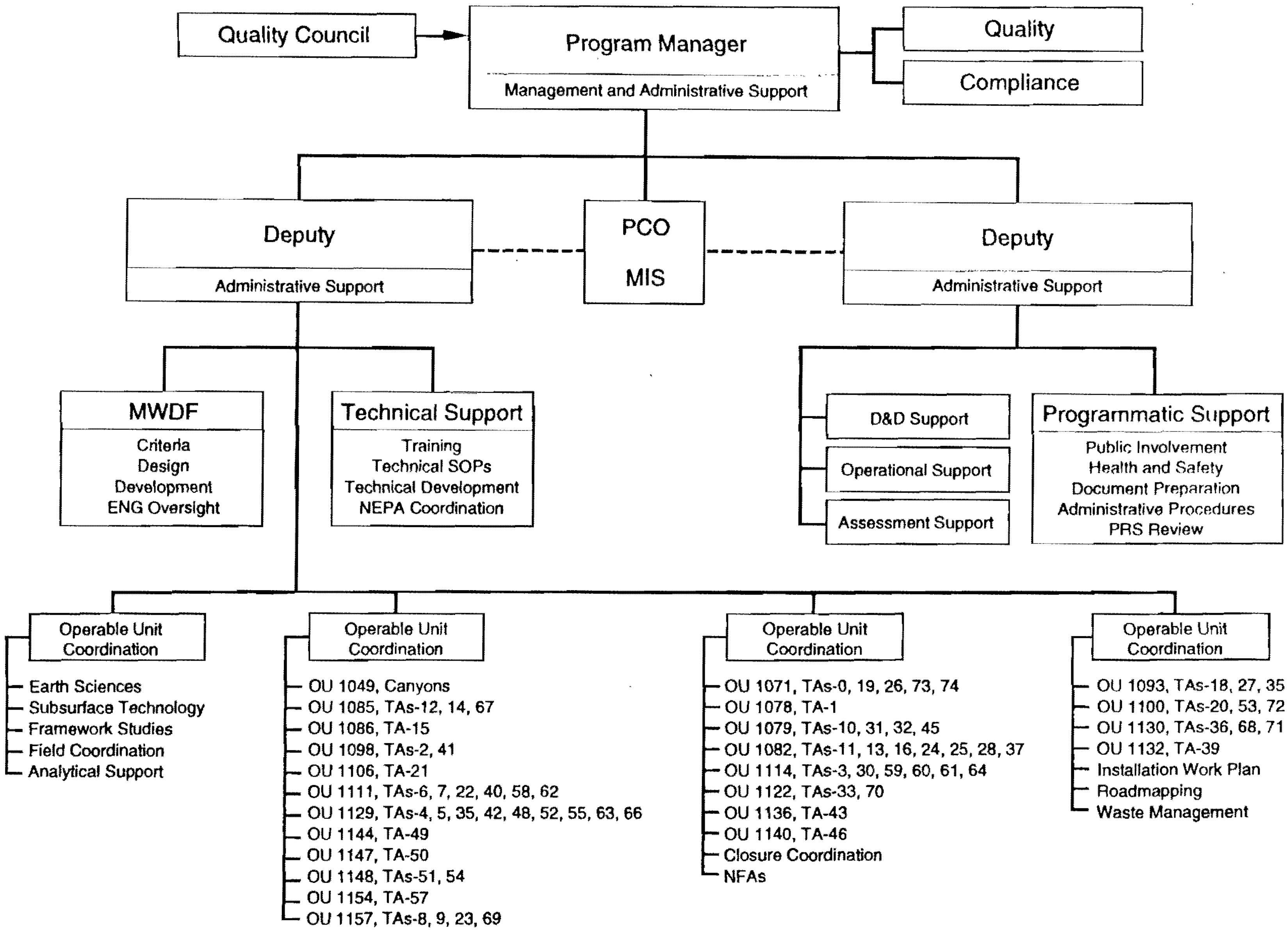

Figure I-1. Environmental Restoration Program organizational structure.

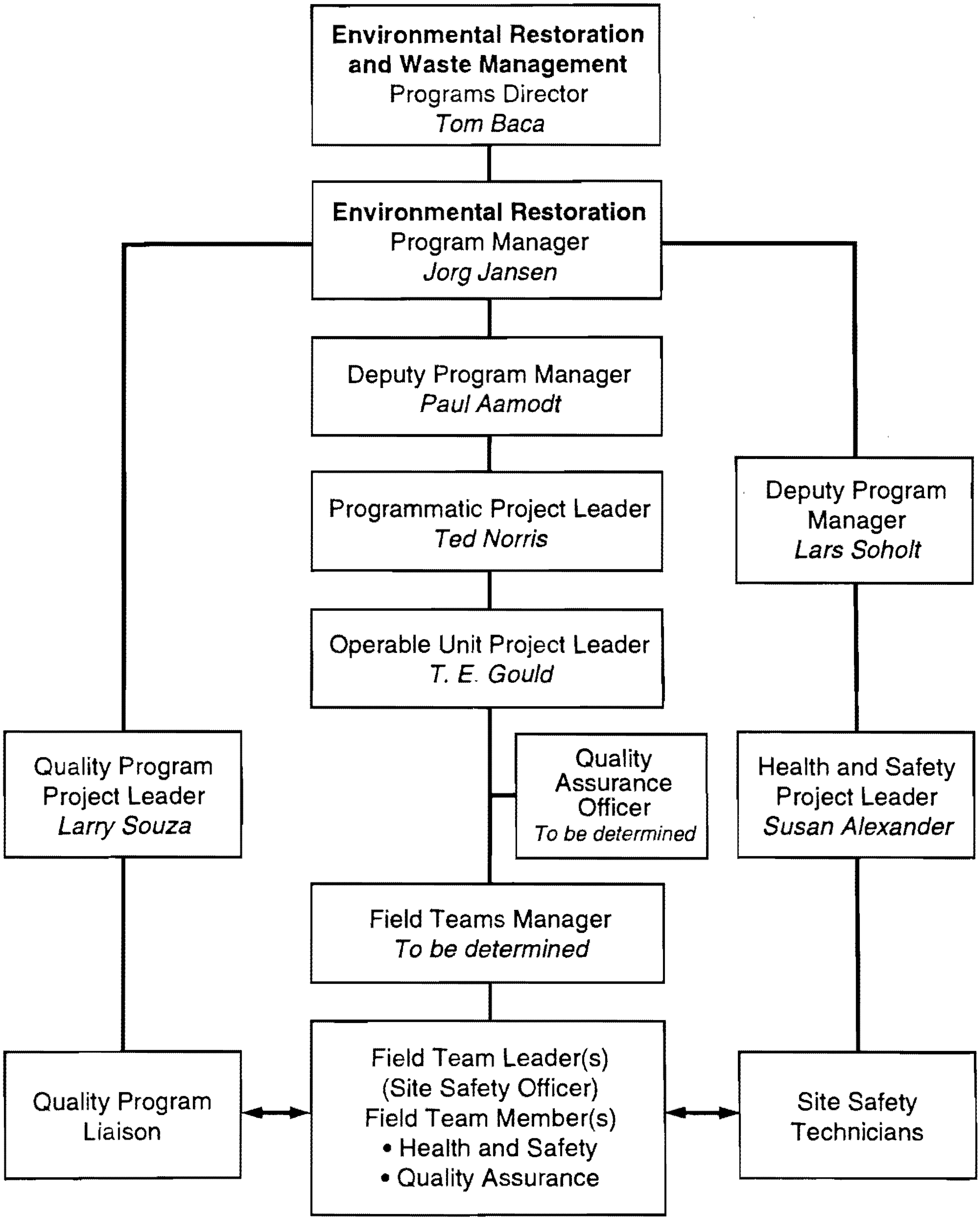

Figure I-2. OU 1100 field organization chart.

5.2 Health and Safety Project Leader

The health and safety project leader sets policies and standards of health and safety for the OU 1100 RFI and supervises the site safety officers.

5.3 Quality Assurance Officer

The quality assurance program that governs the design and implementation of the RFI for OU 1100 is described in Annex II, Quality Assurance Project Plan. The QA officer is responsible for ensuring that these plans are properly incorporated into the implementation of the field investigation, including the selection and location of sampling points, sample collection and processing, data handling, and reporting of results. As shown in the project organization chart, the QA officer reports directly to the OUPL, ensuring the independence of the QA officer from field activities. Although the field team leader has the responsibility of ensuring that all necessary procedures are followed, this independent oversight by the QA officer will provide an extra measure of assurance that the QA program is properly implemented at all stages of the investigation.

5.4 Field Teams Manager

The field teams manager directs day-to-day field operations and conducts planning and scheduling for the implementation of the RFI field activities detailed in Chapter 5.

5.5 Technical Team Leader(s)

TTLs are responsible for providing support in their discipline throughout the RFI/CMS process. During the OU 1100 RFI, the TTLs will participate in the development of the work plan; development of the individual field sampling plans; and performance of the field work, data analysis, report preparation, work plan modifications, and planning of subsequent investigations, as necessary.

The OU 1100 technical team requires these primary disciplines: hydrogeology, statistics, geophysics, geochemistry, and health physics. The composition of the technical team may change with time as the technical expertise needed to implement the OU 1100 RFI changes.

5.6 Field Team Leader(s)

The field team leaders will implement work assignments in the field from the field teams manager. Each field team leader will direct the execution of field sampling activities, using crews of field team members as appropriate. Field team leaders may be contractor personnel.

5.7 Site Safety Officer(s)

The site safety officers observe, advise, and document the execution of the health and safety aspects of the OU 1100 work. They report any procedural violations to the health and safety project leader. The site safety officers may be contractor personnel.

5.8 Field Team Member(s)

Field team members may include sampling personnel, geologists, geophysicists, hydrologists, health physicists, and other required disciplines.

All field team members require access to a site safety officer and a qualified field sampler. They are responsible for conducting the work detailed in field sampling plans, under the direction of the field team leaders. Field team members may be contractor personnel.

6.0 PERSONNEL QUALIFICATIONS

The following personnel hold key positions in the development and implementation of the RFI work plan for OU 1100. Complete resumes for these individuals are available in the ER Program files. Other project staff are identified in Appendix A.

T. E. (Gene) Gould - Operable Unit Project Leader

Mr. Gould holds a BA in history from New Mexico Institute of Mining and Technology (1972) and has earned graduate credits in accounting and business law from the College of Santa Fe. He has received additional training in program management planning and control, management skills development, and indirect cost accounting.

He has been employed at the Laboratory since May 1974, where he has held positions as assistant group leader for M-3 (Denotation Physics), assistant division leader for M-Division (Dynamic Testing), and technical coordinator for the Los Alamos ICF Program. He was appointed OUPL for OU 1100 in July 1992.

C. Joseph English - Work Plan Development Leader for OU 1100

Mr. English received a BS in Civil Engineering (1977) and an MS in Civil Engineering (1979) from Oregon State University. He has taken additional course work in hydrology and organic chemistry and has training in hazardous waste operations and emergency response.

Mr. English has been employed by ICF Kaiser Engineers since 1985 working on projects involving management of hazardous, radioactive, and mixed wastes. He has been providing support to the Laboratory ER Program since 1992. Prior to 1992, he managed Remedial Investigation/ Feasibility Study (RI/FS) projects for EPA Region 10 under the Superfund Program and managed RI/FS tasks for the US Air Force. Mr. English managed and worked on numerous radioactive and mixed waste projects at the DOE Hanford Site, including preparation of RI Work Plans, historical data reviews for inactive waste sites, RCRA Part B permit applications, RCRA closure plans, and environmental compliance assessments. From 1979 to 1985 Mr. English was employed by Battelle Pacific Northwest Laboratories and Battelle Project Management Division. Mr. English participated in waste management projects for the DOE, EPA, and US Army. He managed and worked on RIs at six Army installations, managed the FS for a Superfund site, helped initiate the CERCLA compliance program at Hanford, and managed preparation of RCRA Part B permit applications and closure plans for the Y-12 Plant.

Patrick M. Griffin - Assistant Work Plan Development Leader for OU 1100

Dr. Griffin received his BS (1971), MS (1972), and PhD (1980) from the University of California at Berkeley in Geotechnical Engineering. He has received additional training in hydrogeology, geophysical methods, waste management, and environmental regulations.

Dr. Griffin has been employed at Morrison Knudsen Corporation since 1980. During his more than 20 years of professional experience, he has participated in numerous projects related primarily to civil and geotechnical engineering, environmental restoration, and waste management. Dr. Griffin has been providing support to the Laboratory ER Program since early in 1992. Prior to that, he provided remedial design support to the DOE ER project at Weldon Spring and to the DOE Uranium Mill Tailings Remedial Action Project. He also has extensive experience with field investigation and sampling methods, and design and construction of corrective measures for contaminated mining and industrial facilities.

Julie L. Wanslow - Geologist

Ms. Wanslow received a BS in Geology (1981) and a MS in Geology (1985) from the University of Arkansas. She has received additional training in hazardous waste regulations, hazardous material sampling, and groundwater investigations.

Ms. Wanslow was employed by the Environmental Protection Agency in Dallas, Texas, from April 1985 to November 1986, where she evaluated RCRA groundwater monitoring systems/programs for regulatory compliance and technical adequacy, and conducted groundwater inspections at hazardous waste sites. From December 1986 to January 1991, she worked for the Hazardous Waste Section at the New Mexico Environment Department, where she continued to evaluate groundwater monitoring systems/programs and conduct groundwater inspections. This work included analyzing geologic and hydrogeologic data, monitoring system design, sampling programs, groundwater and soil geochemical data for evidence of contamination, and groundwater portions of RCRA permits. From February 1991 to June 1992, she worked for Advanced Sciences, Inc., at the Waste Isolation Project Plant (WIPP) in Carlsbad, New Mexico, and for the WIPP Project Office in Albuquerque, New Mexico, evaluating environmental documents for compliance with certain DOE orders and RCRA regulations. She has been employed by ICF Kaiser Engineers since June 1992, and has provided support to the Laboratory ER Program since December 1992.

Claudine A. Kasunic - Risk Assessor

Ms. Kasunic received a BS degree in Biology from New Mexico State University (1972) and an MS degree in Toxicology from the University of Arizona (1982). She has received additional training in human health and ecological risk assessment.

Ms. Kasunic is a Principal Scientist with ICF Kaiser Engineers and has been providing support to the Laboratory ER Program since 1992. She has provided input to and reviewed RFI Work Plans; developed a technical document addressing the source, environmental fate, and toxicity of PCOCs; and developed general Work Plan input on explosives. Ms. Kasunic has worked in research, industry, and consulting and for the past 8 years has prepared, critiques, and managed human health risk assessments and ecological risk evaluations. She has provided technical information related to sampling, data quality, chemical toxicity, fate and transport, exposure, and risk for the development of work plans and risk assessments.

Wilette M. Wehner - Technical Editor

Ms. Wehner received a BA from Michigan State University in journalism (1972). She was employed by Los Alamos Technical Associates, Inc. from 1974 to 1981, where she provided technical editing on such projects as an Environmental Monitoring Plan for Argonne National Laboratory-East, Proceedings of a Workshop on Atmospheric Research Needs, report of the Lunar Base Working Group, and an environmental impact statement for Idaho National Engineering Laboratory. She has been employed by ICF Kaiser Engineers, in Los Alamos, since 1991. She edited and organized an Occurrence Reporting Handbook addressing compliance with DOE orders and is currently the technical editor for RFI work plans for OUs 1093 and 1100.

Charles Randall Mynard - Designer

Mr. Mynard received a BA from University of Texas at Austin in 1968 majoring in zoology with minors in chemistry and math. He has been employed by the Laboratory since January 1977, beginning with the Illustrations Group, ISD-3, where he provided technical illustrations for nuclear reactor designs, solar, and super-conducting power systems. He was hired by Weapons Planning and Coordination Group (WPC-1) in December 1978 to do illustrations for nuclear weapon design proposals. He joined WX-4, now Technical Engineering Support (MEE-4), in June 1980 to do complex engineering drawings, computer graphics, 35 mm photography, videotaping, and provide safety support services. As safety representative for MEE-4 since 1983, he plans, schedules, conducts, and documents the group's environmental, safety, and health (ES&H) program, which includes hazard assessment, safety inspections, audits, chemical inventory, chemical waste storage and disposal, hazard communication, ES&H training, and emergency planning. He is presently providing archival research, field surveys, photography, and graphics support services to the ER Program, working on OU 1100.

REFERENCES FOR ANNEX I

DOE (US Department of Energy), March 6, 1987. "Project Management System," DOE Order 4700.1, Washington, DC. (DOE 1987, 0069)

EPA (US Environmental Protection Agency), April 10, 1990. Module VIII of RCRA Permit No. NM0890010515, EPA Region VI, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, EPA Region VI, Hazardous Waste Management Division, Dallas, Texas. (EPA 1990, 0306)

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. (LANL 1993, 1017)

Annex II

Quality Assurance Project Plan

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SIGNATURE PAGE

Approval for Implementation

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   TITLE: ER Program Manager, Los Alamos National Laboratory

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2. NAME: Larry Souza
   TITLE: Quality Program Project Leader, ER Program, Los Alamos National Laboratory

   SIGNATURE: ______________________ DATE: ________

3. NAME: Craig Leasure
   TITLE: Group Leader, Health and Environmental Chemistry Group (CST-9), Los Alamos National Laboratory

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4. NAME: Margaret Gautier
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5. NAME: Barbara Driscoll
   TITLE: Geologist, Region 6, Environmental Protection Agency

   SIGNATURE: ______________________ DATE: ________

6. NAME: Alva Smith
   TITLE: Chief of Office of Quality Assurance, Region 6, Environmental Protection Agency

   SIGNATURE: ______________________ DATE: ________

7. NAME: T. E. Gene Gould
   TITLE: Operable Unit Project Leader, Technical Engineering Support Group (ESA-4), Los Alamos National Laboratory

   SIGNATURE: ______________________ DATE: ________

INTRODUCTION

This Quality Assurance Project Plan (QAPP) for the RFI work plan for OU 1100 was written as a matrix report (Table II-1) based on the ER Program's generic QAPP (LANL 1991, 0553).

The generic QAPP describes the format for each operable unit's QAPPs. In the generic QAPP, Section 1 is the Signature Page, which is included in the front of this annex. Section 2 is a Table of Contents, which was omitted from this annex because the OU 1100 QAPP is presented as a matrix. Section 3 is the Project Description and Subsection 3.1 is the Introduction. This introduction will serve as the equivalent of Subsection 3.1 and the matrix (Table II-1) will begin with Subsection 3.2, Facility Description.

The OU 1100 QAPP matrix (Table II-1) appears as a table in which the generic QAPP criteria are listed in the first column; these criteria correspond to the sections of the generic QAPP. The second column lists the specific requirements of the generic QAPP that the OU 1100 QAPP must meet; the subsection titles and numbers in the second column correspond directly with those contained in the generic QAPP. Sections of the generic QAPP that do not contain specific requirements are not included in the matrix, e.g., Subsection 3.4. The third column lists the location of information in the IWP and/or the OU 1100 work plan that fulfills the requirements in the generic QAPP. If OU 1100 will be following the requirements in the generic QAPP, and no further information is necessary, the column will contain the phrase "generic QAPP accepted." In some cases, a standard operating procedure (SOP) and/or a clarification note are included.

TABLE II-1

OU 1100 QAPP MATRIX

Generic QAPP Criteria	Generic QAPP Requirements by Subsection	OU 1100 Incorporation of Generic QAPP Requirements
Project Description	3.2 Facility Description	Los Alamos National Laboratory (LANL) ER Program IWP, Chapter 2, and OU 1100 RFI work plan, Section 2
	3.3 ER Program	LANL ER Program IWP, Section 3.
	3.4.1 Project Objectives	OU 1100 RFI work plan, Chapters 1 and 5.
	3.4.2 Project Schedule	OU 1100 RFI work plan, Annex I.
	3.4.3 Project Scope	OU 1100 RFI work plan, Chapters 1 and 5.
	3.4.4 Background Information	OU 1100 RFI work plan, Chapters 1, 2, and 3.
	3.4.5 Data Management	LANL ER Program IWP, Annex IV.
Project Organization	4.1 Line Authority	OU 1100 RFI work plan, Annex I.
	4.2 Personnel Qualifications, Training, Resumes	OU 1100 RFI work plan, Annex I, and ER Project Files.
	4.3 Organizational Structure	LANL-ER-QPP, Section 2, and OU 1100 RFI work plan, Annex I. See **Note 1.**
Quality Assurance Objectives for Measurement Data in Terms of Precision, Accuracy, Representativeness, Completeness, and Comparability	5.0 Quality Assurance Objectives	Generic QAPP accepted.
	5.1 Level of Quality Control	Generic QAPP accepted. See **Notes 2 and 3.**
	5.2 Precision, Accuracy, and Sensitivity of Analyses	Generic QAPP accepted. See **Note 4.**
	5.3 QA Objectives for Precision	Generic QAPP accepted. See **Note 5.**
	5.4 QA Objectives for Accuracy	Generic QAPP accepted. See **Note 6.**
	5.5 Representativeness, Completeness, and Comparability	Generic QAPP accepted.
	5.6 Field Measurements	Generic QAPP accepted.
	5.7 Data Quality Objectives	OU 1100 RFI work plan, Chapter 5.
Sampling Procedures	6.0 Sampling Procedures	OU 1100 RFI work plan, Chapters 4 and 5, and ER Program SOPs.
	6.1 Quality Control Samples	Generic QAPP accepted, including ER Program SOP-01.05. See **Note 3.**
	6.2 Sample Preservation During Shipment	Generic QAPP accepted, including ER Program SOP-01.02.
	6.3 Equipment Decontamination	Generic QAPP accepted. See **Note 7.**
	6.4 Sample Designation	Generic QAPP accepted, including ER Program SOP-01.04.
Sample Custody	7.1 Overview	Generic QAPP accepted, including ER Program SOP-01.04.
	7.2 Field Documentation	Generic QAPP accepted, including ER Program SOP-01.04. See **Note 8.**
	7.3 Sample Management Facility	Generic QAPP accepted. See **Note 9.**
	7.4 Laboratory Documentation	Generic QAPP accepted.

TABLE II-1 (continued)

OU 1100 QAPP MATRIX

Generic QAPP Criteria	Generic QAPP Requirements by Subsection	OU 1100 Incorporation of Generic QAPP Requirements
	7.5 Sample Handling, Packaging, and Shipping	Generic QAPP accepted, including ER Program SOP-01.03.
	7.6 Final Evidence File Documentation	Generic QAPP accepted.
Calibrations Procedures and Frequency	8.1 Overview	Generic QAPP accepted.
	8.2 Field Equipment	Generic QAPP accepted.
	8.3 Laboratory Equipment	Generic QAPP accepted.
Analytical Procedures	9.1 Overview	Generic QAPP accepted.
	9.2 Field Testing and Screening	Generic QAPP accepted, including ER Program SOP-06.02.
	9.3 Laboratory Methods	Analytical methods will be selected to meet the specific decision requirements identified in Chapter 5 of the OU 1100 RFI work plan. Specific analytes are identified in Table 4-8 of the OU 1100 RFI work plan.
Data Reduction, Validation, and Reporting	10.0 Data Reduction, Validation, and Reporting	Generic QAPP accepted.
	10.1 Data Reduction	Generic QAPP accepted.
	10.2 Data Validation	Generic QAPP accepted. See **Notes 2 and 10.**
	10.3 Data Reporting	Generic QAPP accepted.
Internal Quality Control Checks	11.0 Internal Quality Control Checks	Generic QAPP accepted.
	11.1 Field Sampling Quality Control Checks	Generic QAPP accepted. See **Note 3.**
	11.2 Laboratory Analytical Activities	Generic QAPP accepted. OU 1100 RFI work plan, Chapters 4 and 5.
Performance and System Audits	12.0 Performance and System Audits	Generic QAPP accepted.
Preventive Maintenance	13.0 Preventive Maintenance	Generic QAPP accepted.
	13.1 Field Equipment	Generic QAPP accepted.
	13.2 Laboratory Equipment	Generic QAPP accepted.
Specific Routine Procedures Used to Assess Data Precision, Accuracy, Representativeness, and Completeness	14.0 Specific Routine Procedures	Generic QAPP accepted.
	14.1 Precision	Generic QAPP accepted.
	14.2 Accuracy	Generic QAPP accepted.
	14.3 Sample Representativeness	Generic QAPP accepted. See **Note 11.**
	14.4 Completeness	Generic QAPP accepted
Corrective Action	15.0 Corrective Action	Generic QAPP accepted
	15.1 Overview	Generic QAPP accepted, including LANL-ER-QP-01.3Q. See **Note 12.**

TABLE II-1 (concluded)

OU 1100 QAPP MATRIX

Generic QAPP Criteria	Generic QAPP Requirements by Subsection	OU 1100 Incorporation of Generic QAPP Requirements
	15.2 Field Correction Action	Generic QAPP accepted.
	15.3 Laboratory Corrective Action	Generic QAPP accepted.
Quality Assurance Reports to Management	16.1 Field Quality Assurance Reports to Management	Generic QAPP accepted. See **Note 13**.
	16.2 Laboratory Quality Assurance Reports to Management	Generic QAPP accepted.
	16.3 Internal Management Quality Assurance Reports	Generic QAPP accepted.

Note 1: Subsection 4 - Project Organization and Responsibility

The organizational structure of the ER Program is presented in Chapter 2 of the LANL ER Quality Program Plan (QPP) to the Programmatic Project Leader (PPL) level, including quality assurance functions. Annex I of the OU 1100 RFI work plan describes the organizational structure from the PPL-level down, and presents an organizational chart to demonstrate line authority.

Note 2: Subsection 5.1 - Level of Quality Control
Subsection 10.2 - Data Validation

For radiological samples, the acceptance criteria for field duplicates as presented in Table X.1 is replaced with the following:

> "RPD less than or equal to 50% for sample values greater than 10 times the Minimum Detectable Activity (MDA). Failure to achieve the RCD values will trigger corrective action, which will involve an evaluation in order to determine the probable source and the impact on sampling results. This failure will not, by itself, invalidate the results."

Note 3: Subsection 5.1.1 - Field Sampling

The types of frequency of field QC samples will be as specified in Table 4-6 of the OU 1100 RFI work plan.

Note 4: Subsection 5.2 - Precision, Accuracy, and Sensitivity of Analysis

The PQLs and MDLs for specific test methods may be greater or less than the SALs for PCOCs for each sample. Where the PQLs and/or MDLs are higher than the SALs, non-detect results will then be interpreted on a case-by-case basis to determine if additional action is needed. Where the PQLs and/or MDLs are significantly lower than the SALs, alternate test methods with higher values of

PQL/MDL (but still below the SALs) may be substituted for the methods specified in the generic QAPP for the specific PCOCs of interest.

Note 5: Subsection 5.3 - QA Objectives for Precision

Failure to achieve RCD values will trigger corrective action, which will involve an evaluation in order to determine the probable source and the impact on sampling results. This failure will not, by itself, invalidate the results.

Note 6: Subsection 5.4 - QA Objectives for Accuracy

Failure to achieve recovery values will trigger corrective action, which will involve an evaluation in order to determine the probable source and the impact on sampling results. This failure will not, by itself, invalidate the results.

Note 7: Subsection 6.3 - Equipment Decontamination

LANL-ER-SOP-01.08, once approved, will be used for equipment decontamination.

Note 8: Subsection 7.2 - Field Documentation

In addition to field notebooks and LANL ER Program forms, field data may also be collected in notebook type portable computers. Any data collected on portable computers will use appropriate hardware, software and data management procedures to ensure that all required data are entered and that the resulting electronic files are protected from subsequent undocumented changes.

Note 9: Subsection 7.3 - Sample Management Facility

Alternately, as approved by CST-9, samples may be shipped by the field team directly to an offsite analytical laboratory.

Note 10: Section 10.2.1 - Field Technical Data Validation

Validation of objective field and technical data will be performed by the OUPL or his designee.

Note 11: Subsection 14.3 - Sample Representativeness

The field sampling plans presented in Chapter 5 of the OU 1100 RFI work plan were developed to meet the sample representativeness criteria described in Subsection 14.3 of the ER Program 's generic QAPP (LANL 1991, 0412).

Note 12: Subsection 15.1 - Overview

Corrective action may also include an evaluation to determine the probable source of the deficiency and the impact on sampling results.

Note 13: Subsection 16.1 - Field Quality Assurance Reports to Management

The OU 1100 QA Officer, or designee, will provide a monthly field progress report to the ER Program Manager and the ER Quality Program Project Leader. This report will consist of the information identified in Subsection 16.1 of the ER Program's generic QAPP (LANL 1991, 0412).

REFERENCES FOR ANNEX II

LANL (Los Alamos National Laboratory), May 1991. "Generic Quality Assurance Project Plan," Rev. 0, Environmental Restoration Program, Los Alamos, New Mexico. (LANL 1991, 0412)

Executive Summary

Chapter 1
Introduction

Chapter 2
Background Information for OU 1100

Chapter 3
Environmental Setting

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Sites

Chapter 6
Potential Release Sites Proposed for No Further Action or Deferred Action

Annexes

Appendices

Annex III

Health and Safety Project Plan

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Operable Unit Health and Safety Plan (OUHSP) is to recognize potential safety and health hazards, describe techniques for their evaluation, and identify control methods. The goal is to eliminate injuries and illness; to minimize exposure to physical, chemical, biological, and radiological agents during environmental restoration (ER) activities; and to provide contingencies for events that may occur while these efforts are under way.

It is intended that project managers, health and safety professionals, laboratory managers, and regulators use this OUHSP as a reference for information about health and safety programs and procedures as they relate to this operable unit (OU). OU specific information can be found in sections 3 and 4 of this document. The other sections of this document contain general information applicable to all OUs. Detailed Site-Specific Health and Safety Plans (SSHSPs) and procedures will be prepared subsequent to this document.

The Health and Safety Division Hazardous Waste Operations (HAZWOP) Program establishes laboratory policies for health and safety activities at ER sites. The hierarchy of health and safety documents for the Los Alamos National Laboratory (the Laboratory) ER Program is as follows:

1. Installation Work Plan, Health and Safety Program Plan (IWPHSPP)
2. OUHSP
3. SSHSP

The first document is more general, while the others become increasingly more specific and detailed. While each document is written so it can stand alone, the contents and references to these and other documents should always be considered when making decisions.

1.2 Applicability

These requirements apply to all personnel at ER sites, including Laboratory employees, supplemental work force personnel, regulators, and visitors. There are no exceptions.

1.3 Regulatory Requirements

Government-owned, contractor-operated facilities must comply with Occupational Safety and Health Administration (OSHA), U.S. Environmental Protection Agency (EPA) regulations, and U.S. Department of Energy (DOE) orders. The following is a brief synopsis of hazardous waste-related requirements.

The first federal effort to address hazardous waste problems followed the passage of the Resource Conservation and Recovery Act of 1976 (RCRA).

RCRA mandated the development of federal and state programs for the disposal and resource recovery of waste materials. RCRA regulates generation, treatment, storage, disposal, and transportation of hazardous waste.

Historically, there were many hazardous waste sites abandoned. Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as "Superfund" to clean up and reclaim these sites.

The treatment and disposal of hazardous wastes posed health and safety risks to the workers engaged in these operations. These risks and the need for protecting workers engaged in hazardous waste site operations are addressed in the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Under SARA, the Secretary of Labor is required to promulgate worker protection regulations. After consulting with many organizations, including EPA, OSHA, the U.S. Coast Guard, and the National Institute for Occupational Safety and Health (NIOSH), a set of regulations was published in March 1989. This is 29 Code of Federal Regulations (CFR) Part 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER).

DOE Orders 5480.4 and 5483.1A require DOE employees and contractors to comply with federal OSHA regulations. DOE 5480.11 sets radiation protection standards for all DOE activities. The DOE Radiological Control Manual established practices for the conduct of radiological control activities at all DOE sites and is used by DOE to evaluate contractor performance.

Laboratory Director's policies "Environment, Safety, and Health" and "Environmental Protection and Restoration," both dated September 1991, require compliance with federal regulations, DOE orders, and state and local laws.

1.4 Variances From Health and Safety Requirements

When special conditions exist, the Site Safety Officer (SSO) may submit to the Health and Safety Project Leader (HSPL) a written request for variance from a specific health and safety requirement. If the HSPL agrees with the request, it will be reviewed by the Operable Unit Project Leader (OUPL) or a designee. Higher levels of management may be consulted as appropriate. The condition of the request will be evaluated, and if appropriate, the HSPL will grant a written variance specifying the conditions under which the requirements may be modified. The variance will become part of the SSHSP.

1.5 Review and Approval

This document will be effective after it has been reviewed and approved by the appropriate Laboratory subject matter experts. Signatures of approval are required.

This document will be revised at least annually. Revisions will reflect changes in the scope of work, site conditions, work procedures, site data, contaminant monitoring, or visual information technology, policies, and/or procedures. Changes must be approved by the HSPL and OUPL. A complete review will be conducted should feasibility studies or remediation be necessary.

2.0 ORGANIZATION, RESPONSIBILITY, AND AUTHORITY

This section describes the general and individual responsibilities for health and safety, roles in field organization, and organizational structure. The health and safety oversight mechanism is also provided.

2.1 General Responsibilities

The Laboratory's Environment, Safety, and Health (ES&H) Manual delineates managers' and employees' responsibilities for conducting safe operations and providing for the safety of contract personnel and visitors. The general safety responsibilities for ER activities are summarized in the IWPHSPP. Line Management is responsible for implementing health and safety requirements.

An individual observing an operation that presents a clear and imminent danger to the environment or to the safety and health of employees, subcontractors, visitors, or the public has the authority to initiate a stop-work action. The requirements, responsibilities, and basis for stop-work actions and for restarting activities is established in Laboratory Procedure (LP) 116-01.0. Any individual observing or performing operations that meet the criteria for stop-work actions shall follow the procedural steps as described in LP 116-01.0. Those with stop-work authority include employees, subcontractors, or visitors performing the affected work, ES&H discipline experts, and line managers responsible for the operation. Any other individual that observes work being performed by another individual that presents a clear and imminent danger shall follow reporting requirements as specified in LP 116-01.0. Upon initiation of stop-work actions, related activities are documented on the Stop-Work Report Form and the log for Stop-Work Reports.

Personnel conducting work for the ER Program shall comply with the Laboratory's stop-work policy and the requirements of LP 116-01.0. In addition, upon initiation of stop-work actions, ER Program personnel shall notify the SSO, the ER Program HSPL, and the OUPL.

2.1.1 Kick-Off Meeting

A health and safety kick-off meeting will be held before field work begins. The purpose of the meeting is to reach a consensus on responsibility, authority, lines of communication, and scheduling. The HSPL will organize the meeting and has the authority to delay field work until the kick-off meeting is held.

2.1.2 Readiness Review

A field readiness review must be completed by the OUPL before field activities begin. The HSPL is responsible for approving the health and safety section of the readiness review.

2.2 Individual Responsibilities

Laboratory employees and supplemental work force personnel are responsible for health and safety during ER Program activities. Figure III-1 illustrates the field work organizational chart, showing the line organization.

2.2.1 Quality, Environment, Safety and Health Assurance Division Leader

The Quality, Environment, Safety, and Health Assurance (QESHA) Division Leader is responsible for addressing programmatic health and safety concerns. He/she shall promote a comprehensive health and safety program that includes radiation protection, occupational medicine, industrial safety, industrial hygiene, criticality safety, waste management, and environmental protection and preservation.

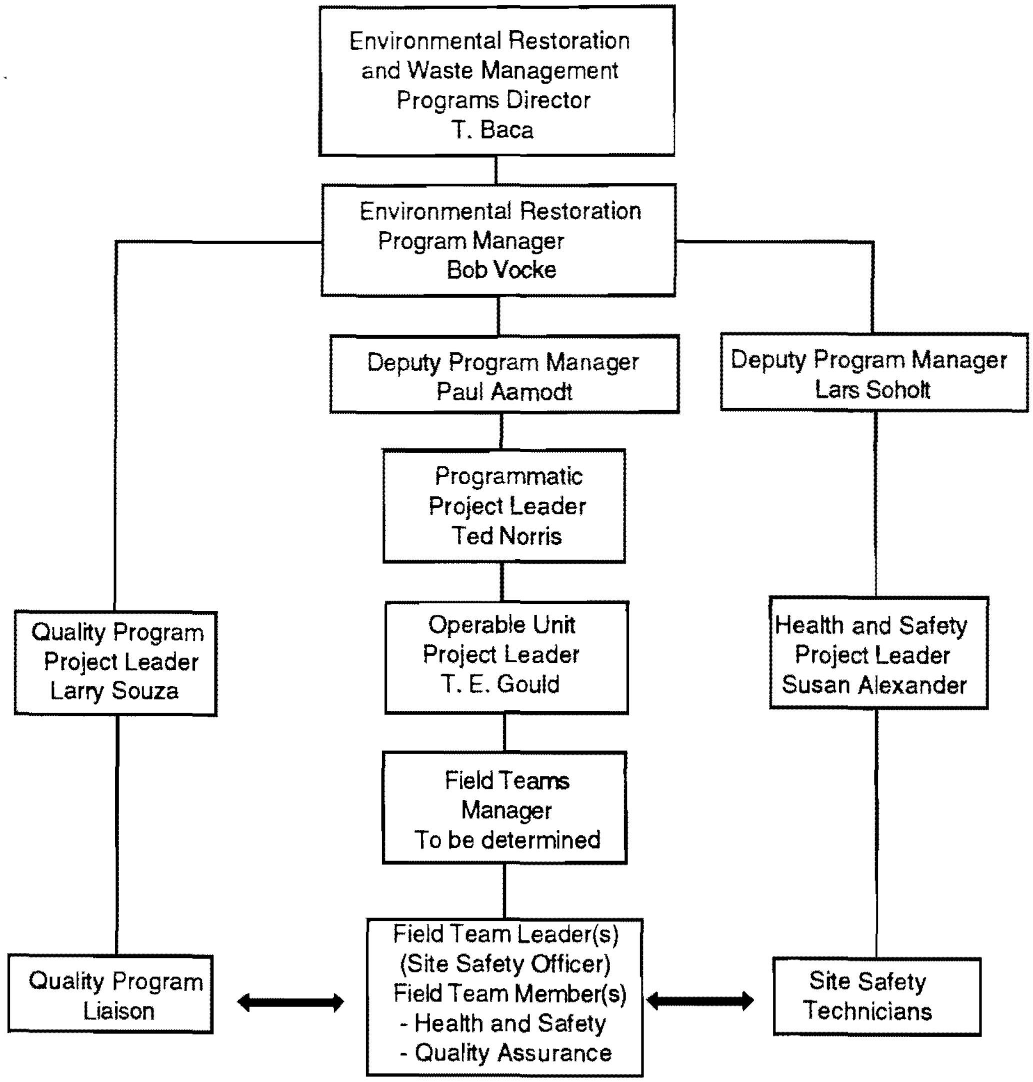

Figure III-1. OU field work organizational chart.

2.2.2 Environmental Restoration Program Manager

The ER Program Manager is responsible for implementing the overall heath and safety program plan. The program manager provides for the establishment, implementation, and support of health and safety measures.

2.2.3 Health and Safety Project Leader

The HSPL is responsible for preparing and updating the IWPHSPP. The HSPL helps the OUPL in identifying resources to be used for the preparation and implementation of the OUHSP. Final approval of the IWPHSPP, OUHSP, and SSHSP is the responsibility of the HSPL. In conjunction with the field team leaders, the HSPL oversees daily health and safety activities in the field, including scheduling, tracking deliverables, and resource utilization. The HSPL is also responsible for reviewing contractor HS plans to ensure that they meet the requirements of the OU HS plan.

2.2.4 Operable Unit Project Leader

The OUPL is responsible for all investigation activities for his/her assigned OU. Specific health and safety responsibilities include:

- preparing, reviewing, implementing, and revising OUHSPs;
- interfacing with the HSPL to resolve health and safety concerns; and
- notifying the HSPL of schedule and project changes.

2.2.5 Operable Unit Field Team Leader

The OU field team leader is responsible for:

- scheduling tasks and manpower,
- conducting site tours,
- overseeing engineering and construction activity at the sites, and
- overseeing waste management.

2.2.6 Field Team Leader

The field team leader is responsible for implementing the sampling and analysis plan, the OUHSP, and the project-specific Quality Assurance Project Plan (Annex II). He/she may also serve as the SSO. Safety responsibilities include:

- ensuring the health and safety of field team members,
- implementing emergency response procedures and fulfilling notification requirements, and
- notifying the HSPL of schedule changes.

2.2.7 Site Safety Officer

An SSO other than the field team leader may be assigned depending on the potential hazards. Contractors must assign their own SSO.

The SSO is responsible for ensuring that trained and competent personnel are on-site. This includes industrial hygiene and health physics technicians and first aid/cardiopulmonary resuscitation responders. The SSO may fill any or all of these roles.

The SSO has the following responsibilities:

- advising the HSPL and OUPL of health and safety issues;
- performing and documenting initial inspections for all site equipment;
- notifying proper Laboratory authorities of injuries or illnesses, emergencies, or stop-work orders;
- evaluating the analytical results for health and safety concerns;
- determining protective clothing (PC) requirements;
- inspecting PC and equipment;
- determining personal dosimetry requirements for workers;
- maintaining a current list of telephone numbers for emergency situations;
- providing an operating radio transmitter/receiver if necessary;
- maintaining an up-to-date copy of the SSHSP for work at the site;
- controlling entry and exit at access control points;
- establishing and enforcing the safety requirements to be followed by visitors;
- briefing visitors on health and safety issues;
- maintaining a logbook of workers entering the site;

- determining whether workers can perform their jobs safely under prevailing weather conditions;
- monitoring work parties and conditions;
- controlling emergency situations in collaboration with Laboratory personnel;
- ensuring that all personnel are trained in the appropriate safety procedures and are familiar with the SSHSP and that all requirements are followed during OU activities;
- conducting daily health and safety briefings for field team members;
- stopping work when unsafe conditions develop or an imminent hazard is perceived;
- inspecting to determine whether SSHSP is being followed; and
- maintaining first aid supplies.

2.2.8 Field Team Members

Field team members are responsible for following safe work practices, notifying their supervisor or the SSO if unsafe conditions exist, and immediately reporting any injury, illness, or unusual event that could impact the health and safety of site personnel.

2.2.9 Visitors

Site access will be controlled so that only verified team members and previously approved visitors will be allowed in work areas or areas containing potentially hazardous materials or conditions. Special passes or badges may be issued. There are two types of visitors: those that collect samples and those who do not.

Any visitors who are on-site to collect samples or split samples must meet all the health and safety requirements of any field sampling team for that site. Visitors must comply with the provisions of the SSHSP and sign an acknowledgement agreement to that effect. In addition, visitors will be expected to comply with relevant OSHA requirements, such as medical monitoring, training, and respiratory protection.

The following rules govern the conduct of site visitors who will not be collecting samples. The site visitor will:

1. Report to the SSO upon arrival at the site.
2. Login/logout upon entry/exit to the site.
3. Receive abbreviated site training from the SSO on the following topics:
   - site-specific hazards,
   - site protocol,
   - emergency response actions, and
   - muster areas.
4. Not be permitted to enter the exclusion zone or the contamination reduction zone.
5. Receive escort from SSO or other trained individuals at all times.

If a visitor does not adhere to these requirements, the SSO will request the visitor to leave the site. All nonconformance incidents will be recorded on the site log.

2.2.10 Supplemental Work Force

All supplemental work force personnel performing site investigations will be responsible for developing health and safety plans that cover their specific project assignments. As a minimum, the plans shall conform to the requirements of this OUHSP. Deficiencies in health and safety plans will be resolved before the contractor is authorized to proceed.

Contractors will adhere to the requirements of all applicable health and safety plans. Laboratory personnel will monitor activities to ensure that this is done. Failure to adhere to these requirements can cause work to stop until compliance is achieved.

Contractors will provide their own health and safety functions unless other contractual agreements have been arranged. Such functions may include, but are not limited to, providing qualified health and safety officers for site work, imparting a corporate health and safety environment to their employees, providing calibrated industrial hygiene and radiological monitoring equipment, enrolling in an approved medical surveillance program, supplying approved respiratory and personal protective equipment (PPE), providing safe work practices, and training hazardous waste workers.

2.3 Personnel Qualifications

The HSPL will establish minimum training and competency requirements for on-site personnel. These requirements will meet or exceed 29 CFR 1910.120 regulations.

2.4 Health and Safety Oversight

Oversight will be maintained to ensure compliance with regulatory requirements. The Health and Safety Division is responsible for developing and implementing the oversight program. The frequency of field verifications will depend on the characteristics of the site, the equipment used, and the scope of work.

2.5 Off-Site Work

The HSPL and OUPL will review health and safety requirements and procedures for off-site work. Alternate approaches may be used if they are in the best interest of the public and the Laboratory; they will be handled on a case-by-case basis.

3.0 SCOPE OF WORK

3.1 Comprehensive Work Plan

The IWPHSPP for ER targets OU 1100 for investigation. The initial phase is investigation and characterization, involving environmental sampling and field assessment of the areas. This OUHSP addresses the tasks in the Phase I study. Tasks for additional phases will be addressed in revisions to this document.

3.2 Operable Unit Description

OU 1100 consists of 83 potential release sites (PRSs). Twenty of these PRSs will undergo investigation during Phase I. Thorough descriptions and histories of these sites can be found in Section 5 of the Work Plan. The following is a list of the PRS aggregates. Table III-1 summarizes the PRSs, the potential hazards, and the work planned at this time.

1. Aggregate A—Sandia Canyon landfills
2. Aggregate B—Firing sites
3. Aggregate C—Waste and product storage areas
4. Aggregate D—Undeground storage tanks
5. Aggregate E—Septic systems
6. Aggregate F—Outfalls
7. Aggregate G—Surface impoundments

Table III-1. Summary of PRSs, OU 1100

Description	Tasks	Chemicals of concern	Radionuclides of concern
Aggregate A-Sandia Canyon landfills	Geophysical survey, trenching, soil sampling	Beryllium, cadmium, nickel, high explosives	Uranium-238
Aggregate B-Firing sites	Radiological survey, geophysical survey, soil sampling	Barium, beryllium, cadmium, lead, nickel, high explosives	Uranium-238
Aggregate C-Waste and product storage areas	Radiological survey, trenching, soil and sediment sampling	Solvents, lead, PCBs, scintillation fluid	Activation products including beryllium-7; sodium-22; manganese-54; cobalt-56, 57, 58, 60; cesium 134, 137
Aggregate D-Underground storage tanks	None-Actions deferred		
Aggregate E-Septic systems	Geophysical survey, trenching, soil sampling	Solvents, lead, photographic chemicals	None expected
Aggregate F-Outfalls	Soil and sediment sampling	Solvents, PCBs	None expected
Aggregate G-Surface impoundments	None-Actions deferred		

4.0 HAZARD IDENTIFICATION AND ASSESSMENT

The SSO or designee will monitor field conditions and personnel exposure to physical, chemical, biological, and radiological hazards. If a previously unidentified hazard is discovered, the SSO will contact the field team leader and the HSPL and assess the hazard. A hazard assessment will be performed to identify the potential harm, the likelihood of occurrence, and the measures to reduce risk. The assessment will be documented, reviewed, and approved by the HSPL and OUPL. Appropriate field team leaders and field team members will receive copies of the assessment, and it will be discussed in a tailgate meeting or other appropriate forum. The approved assessment will be added to this plan as an amendment.

4.1 Physical Hazards

Injuries caused by physical hazards are preventable. Some physical hazards such as open trenches, loud noise, and heavy lifting are easily recognized. Others, such as heat stress and sunburn, are less apparent. The purpose of this section is to list some anticipated physical hazards. These hazards are listed because they often occur during these types of ER activities. Some, such as altitude sickness, are more unique. For these unique physical hazards, a brief discussion is provided. For other, more common hazards, no detailed discussion is provided. Detailed information about these potential hazards can be found in Health and Safety Division HAZWOP Program documentation or almost any industrial hygiene reference book (e.g., *Fundamentals of Industrial Hygiene*, 1988).

Table III-2 lists some of the anticipated physical hazards representative of the types of hazards inherent to ER work. It is not inclusive. If additional physical hazards are identified, they will be added to this table by the SSO.

Table III-2. Physical hazards of concern, OU 1100

Hazard description	PPE	Prevention methods	Monitoring methods
Noise	Ear plugs and muffs	Engineering controls, mufflers, noise absorbers, PPE	Sound level meter, noise dosimeter
Vibration	Gloves, absorbing materials	Prevention or attenuation, isolation, increasing distance from source, PPE	Accelerometers and mechano-electrical transducers with electronic instrumentation
Energized equipment	Gloves, safety shoes, safety glasses	Lockout/tagout of equipment, PPE	Circuit test light/ meter, grounding stick
Trenching	Hard hats, safety shoes, safety glasses	Protective shoring, proper excavation access, egress, PPE	Visual, oxygen meter, determin-ing soil type
Fire/ Explosion	Hard hat, gloves, face shield, fire- resistant full-body suit	Ventilation, contain-ment of fuel source, isolation/insulation from ignition source or heat, PPE	Combustible gas meter
High explosives	Latex gloves, safety glasses, blast shields	Identification of contaminated areas, field screening, following procedures, PPE	Visual inspection, screening tests
Compressed gas cylinders	Face shield, safety shoes, gloves	Cylinders should be stored in areas protected from weather. Cylinders should be secured and stored with protective caps in place. Regulators are not to be left on stored cylinders. PPE	Visual, combustible gas meter, photo-ionization detector
Material handling	Hard hat, safety shoes, gloves	Lifting aids, correct lifting procedure, work/rest periods, PPE	Weigh or estimate weight of typical materials and set limits for lifting
Walking/ Working surfaces	Safety shoes	Clean and dry surfaces, nonskid surfacing material, PPE	Visual inspection
Pinch points/ mechanical hazards	Face shield, gloves, safety shoes	Guard interlocks, maintain guards in good condition, PPE	Visual monitoring, observation of work practices
Motor vehicle accidents	Seat belt	Defensive driving training, reduced speed during adverse conditions, PPE	Observation of work practices

Table III-2. (continued)

Hazard description	PPE	Prevention methods	Monitoring methods
Heavy equipment	Hard hat, safety shoes, gloves	Operator training. Stay clear of energized sources, PPE, backup alarm, orange vest	Observation of work practices
Heat stress	Hat, cooling vest	ACGIH work/rest regimens, PPE	Wet bulb globe thermometer
Cold stress	Hat, gloves, insulated boots, coat, face protection	ACGIH work/warm-up schedule, heated shelters, PPE	Thermometer and wind speed measurement, wind chill chart
Sunburn	Hat, safety sunglasses, full-body protection	Cover body with clothing or sunscreen, PPE	Solar load chart
Altitude sickness	None	Acclimatization ascent/descent schedule	Self-monitoring for symptoms
Lightning	None	Grounding all equipment, stop work during thunderstorms and seek shelter	Weather reports and visual observation
Flash floods	None	Seek shelter on high ground	Weather reports and visual observation

PPE = Personal Protective Equipment

4.1.1 High Explosives

Areas that may contain high explosives will be clearly identified by field team members. A fluorescent red flag will be used to mark areas suspected to contain high explosives. Materials should not be handled without proper authorization from the explosives safety expert. The following precautions will be taken with respect to explosive hazards while conducting field work:

1. The location will be monitored before sampling with an appropriate radiation detection and/or organic vapor monitor. Only use equipment UL-approved for Class I and II hazardous locations.
2. The ground will be sprayed or saturated with water before sampling to minimize the potential for sparks or particulate dispersion.

3. A nonsparking sampling device will be pushed into the ground with a minimum amount of turning during surface sampling.
4. All samples will contain at least 10% moisture before being sealed in containers.
5. All samples will be screened by trained personnel using high explosives screening procedures as described in LANL Safety Procedures for field work in Explosive Areas. The SSO will ensure that contractor procedures are equivalent to LANL high explosives procedures.
6. Sample containers will be shipped in paint cans padded with vermiculite and placed in a cooler with ice packs. Properly label the sample and exterior packaging. Try to limit the size of your samples, collect only small amounts of material.
7. Samples will be handled only in well-ventilated areas, and their exposure to light and heat will be minimized.
8. Latex gloves and safety glasses will be worn during sample collection.
9. The skin will be washed thoroughly with soap and water immediately after accidental contact.

Field personnel will not handle any material in the area unless directed by the sampling plan. This precaution will prevent contact with any high explosive fragments present in the area. Material with blue, pink, red, yellow, green, white, or orange coloration could be indicative of high explosive material.

If noticeable surface or buried high explosive residues or fragments are encountered in the immediate vicinity of a drilling location, drilling will be halted. Sample collection will continue only if a blast shield is installed or if a backhoe is used to obtain samples. This decision will be made by the field team leader and the SSO. The HSPL shall be notified before resuming field activities.

4.1.2 Altitude Sickness

Individuals coming to the Laboratory from lower elevations may experience altitude sickness. Workers coming from sea level and who are expected to perform heavy physical labor may be at highest risk. Recognition of individual risk factors and allowance for acclimatization are the keys to prevention.

At higher altitude, atmospheric pressure is reduced. There are a smaller number of oxygen molecules per unit volume and the partial pressure of oxygen is lower. A unit of work, whether performed at altitude or sea level, requires the same amount of oxygen. Oxygen flow to body tissues must remain constant to maintain that level of work. Increased respiration and cardiovascular response can only partially compensate for these factors in individuals suddenly placed at high altitude.

The factors playing a part in determining working capacity at altitude are:

- actual height (low, moderate, high altitude)
- duration of exposure
- individual factors

The Laboratory's moderate altitude (approximately 7,500 feet) will probably have an effect on prolonged endurance for unacclimatized individuals. At this level, acclimatization should be rapid (one or two weeks). Duration of exposure will dictate whether persons have an opportunity to acclimate or not. Individuals working on short-term assignments of less than two weeks will probably not acclimate.

It is not anticipated that work will require ascents of more than 200 to 300 feet at any time. Thus, too rapid ascension to high altitudes should not be a problem. It is assumed that all workers will be enrolled in a medical surveillance program. This will help identify individuals who may have existing conditions, such as respiratory or cardiovascular disease, that would put them at higher risk of altitude sickness. Each individual will adapt at a slightly different rate, but in about two weeks the impact of altitude on work capacity should be minimal.

4.2 Chemical Hazards

This section identifies and provides information on chemical contaminants that are known or are suspected to be present at this OU. When unknowns are identified, they will be added to the plan's list of chemical contaminants of concern. The SSO will be responsible for adding chemicals to this table and notifying field personnel as needed.

The SSHSP will provide information for known contaminants, which will include: American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV), immediately dangerous to life and health concentrations, exposure symptoms, ionization potential and relative response factor for commonly used instruments (re-evaluated when the particular instrument is selected), and the best instrument for screening.

Table III-3 lists the chemical contaminants of concern. This table should be used for general recognition of the chemicals to which workers may be exposed. More detailed information should be obtained from reliable references, such as *Patty's Industrial Hygiene and Toxicology* (1981).

4.3 Radiological Hazards

The principal pathways by which individuals may be exposed to radioactivity during field investigations include:

- inhalation or ingestion of radionuclide particles or vapors,
- dermal absorption of radionuclide particulates or vapors through wounds,
- dermal absorption through intact skin, and
- exposure to direct gamma radiation from contaminated materials.

Table III-4 provides the specific properties of the radionuclides of concern in this OU, including type of emission and half-life. As concentrations of these radionuclides are determined and additional radionuclides identified, the table will be updated. The SSO will be responsible for adding radionuclides to this table and notifying field personnel as needed.

Table III-3. Chemical constituents of potential concern[a]

Contaminant	Exposure limit (8-hour TWA)[b]	IDLH	Symptoms of exposure	Route(s) of exposure	Monitoring instrument: Direct method	Monitoring instrument: Indirect method
Acetone	750 ppm 1000 ppm STEL	20,000 ppm	Irritation of eyes, nose, and throat; dermatitis; dizziness	Inhalation, ingestion, skin contact	PID, FID, detector tube	Charcoal tube, GC, NIOSH Method 1300
Alcohols	Varies	Varies	Alcohols, as a class, are defatting agents. Other symptoms vary with specific chemical compound	Inhalation, absorption, ingestion, eye/skin contact	Detector tube	Varies
Barium	0.5 mg/m^3	1,100 mg/m^3	Upper respiratory irritation, gastroenteritis, muscular paralysis, eye and skin irritation	Inhalation, ingestion, skin contact	None	Sampling pump, filter, MCEF, AA, OSHA Method, NIOSH 7056
Benzene[c]	1.0 ppm 25 ppm - ceiling 50 ppm - 10 min maximum peak	3000 ppm	Eyes, nose, and respiratory system irritation; giddiness, headache, nausea, staggered gait, fatigue, anorexia, lassitude, dermatitis, bone marrow depression, carcinogen	Inhalation, absorption, ingestion, eye/skin contact	PID, FID, detector tube	Charcoal tube, GC, NIOSH Method 1500
Beryllium[c]	0.002 mg/m^3 0.005 mg/m^3 - ceiling 0.025 mg/m^3 - 30 min maximum peak		Dermatitis, pneumonitis, dyspnea, chronic cough, weight loss, weakness, chest pain, carcinogen	Inhalation, ingestion, skin contact	None	Sampling pump, filter, ICP, MCEF, AA, NIOSH Method 7102
Cadmium[c] (dust)	0.05 mg/m^3 0.6 mg/m^3 - ceiling		Pulmonary edema, dyspnea, cough, tight chest, chills, nausea, vomiting, muscle aches, diarrhea, emphysema, proteinuria, mild anemia, carcinogen	Inhalation, ingestion	None	Sampling pump, filter, MCEF, AA, NIOSH Method 7048

Table III-3. (continued)

Contaminant	Exposure limit (8-hour TWA)[b]	IDLH	Symptoms of exposure	Route(s) of exposure	Monitoring instrument	
					Direct method	Indirect method
Ethanol	1000 ppm 2000 ppm - STEL	20,000 ppm (estimated)	Liver damage, affects central nervous system, irritation to skin, eyes, and respiratory tract. Coughing, headaches, weakness, drowsiness, paralysis, unconsiousness, nausea, nervousness, rash, vomiting, disorientation, halucinations, diarrhea.	Inhalation, ingestion, eye/skin contact	FID, detector tube	Charcoal tube, GC, NIOSH Method 0127
Freon	1000 ppm 2000 ppm - STEL	10,000 ppm	Irritation, ringing in the ears, nausea, vomiting, headache, suffocation, unconsciousness, blisters, frostbite, numbness, blurred vision.	Inhalation, ingestion, skin/eye contact	None	Charcoal tube, GC, NIOSH Method 1006
Hydrochloric acid	5 ppm - ceiling	100 ppm	Inflamed nose, throat, cough, burns throat, choking, burns eyes and skin	Inhalation, ingestion, skin contact	Detector tube	Sampling pump, silica gel tube, ion chromato-graphy, NIOSH Method 7903
Lead (inorganic)	0.05 mg/m^3	700 mg/m^3	Weakness, insomnia, constipation, malnutrition, abdominal pain, tremor, anorexia, anemia, face pallor, encephalopathy	Inhalation, ingestion, skin contact	None	Sampling pump, filter, MCEF, AA, NIOSH Method 7082
Machine oil	5 mg/m^3 (Oil mist; does not consider other additives or biocides that may be present in the machine oil)	N/A	None reported	Inhalation	Aerosol photometer	Tared PVC, gravimetric, NIOSH Method 0500

Table III-3. (continued)

Contaminant	Exposure limit (8-hour TWA)[b]	IDLH	Symptoms of exposure	Route(s) of exposure	Monitoring instrument	
					Direct method	Indirect method
Methanol	200 ppm 250 ppm - STEL	25,000 ppm (estimated)	Eye irritation, headaches, drowsiness, lightheadedness, nausea, vomiting, visual disturbance, blindness.	Inhalation, absorbtion, ingestion, eye/skin contact	FID	Silica gel tube, GC, NIOSH Method 2000
Methylene chloride[c]	50 ppm		Eye, nose, throat irritation, headache, stupor, fatigue, weakness, sleepiness, lightheadedness, numb limbs; tingling, nausea; carcinogen	Inhalation, ingestion, skin contact	Detector tube	Sampling pump, Charcoal tube, GC, NIOSH Method 1005
Methyl ethyl ketone	300 ppm - STEL 200 ppm	3,000 ppm	Eye, nose, throat irritation; headache, dizziness; vomiting	Inhalation, ingestion, skin contact	PID, FID, detector tube	Sampling pump, Ambersorb tube, GC, NIOSH Method 2500
Nickel[c]	0.05 mg/m^3		Headache, vertigo, nausea, vomiting, epigastric pain, cough, hyperpnea, cyanosis, weakness, pneumonitis, delirium, convulsions, carcinogen, allergin	Ingestion, inhalation, skin contact	None	MCEF, ICP, NIOSH Method 7300
Nitric acid	2 ppm, 4 ppm - STEL	100 ppm	Irritated eyes, mucus membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion	Inhalation, absorption, ingestion, skin contact	Detector tube	Sampling pump, silica gel tube, ion chromatography, NIOSH Method 7903

Table III-3. (continued)

Contaminant	Exposure limit (8-hour TWA)[b]	IDLH	Symptoms of exposure	Route(s) of exposure	Monitoring instrument	
					Direct method	Indirect method
Particulates not otherwise regulated (metals: zinc, iron)	15 mg/m^3, total dust 5 mg/m^3, respirable fraction	N/A	None reported	Inhalation	RAM	Total dust-tared PVC, Gravimetric, NIOSH Method 0500 respirable fraction-cyclone and tared PVC, Gravimetric, NIOSH Method 0600
Perchloro-ethylene	25 ppm	500 ppm	Eye, nose, and throat irritation; nausea, flush face and neck, vertigo, dizziness, incoordination, headache, somnolence, skin erythema, liver damage	Inhalation, ingestion, eye/skin contact	PID, FID, detector tube	Charcoal tube, GC, NIOSH Method 1003
Phosphoric acid	1 mg/m^3 3 mg/m^3 - STEL	10,000 mg/m^3	Eyes, skin, supper respiratory tract irritation; skin and eye burns, dermatitis	Inhalation, ingestion, eye/skin contact	Detector tube	Silica gel tube, ion chromato-graphy, NIOSH Method 7903
Photographic processing chemicals	Varies	Varies	A variety of chemicals are used in this process	Refer to Appendix 2	Varies	Varies
Polychlorinated biphenyls[c] (Aroclor 1242 or 1254)	1 mg/m^3 (skin) (Aroclor 1242), 0.5 mg/m^3 (skin) (Aroclor 1254)		Irritated eyes, skin; chloracne, carcinogen	Inhalation, absorption, ingestion, skin contact	None	Sampling pump, GFF + Florisil tube, GC, NIOSH Method 5503

Table III-3. (continued)

Contaminant	Exposure limit (8-hour TWA)[b]	IDLH	Symptoms of exposure	Route(s) of exposure	Monitoring instrument	
					Direct method	Indirect method
Pseudocumene	25 ppm	None	Skin and eye irritation, drunkeness,weakness, lung damage, asthma, headache, anemia	Inhalation, ingestion, eye/skin contact	FID	Charcoal tube, GC, NIOSH Method 1501
Silver	0.01 mg/m^3	None	Nasal septum, throat, and skin irritation; skin ulceration, gastrointestinal irritation, blue-gray eyes and patches on skin	Inhalation, ingestion, skin contact	None	Sampling pump, filter, MCEF, ICP, NIOSH Method 7300
Tetrachloro-ethane[c]	1 ppm (skin)	N/A	Nausea, vomiting, trembling, dermatitis, carcinogen	Inhalation, ingestion, skin contact	FID	Sampling pump, charcoal tube, NIOSH 1019
Tetryl	1.5 mg/m^3	N/A	Sensitization dermatitis, itch, erythema; edema on nasal folds, cheeks, and neck; keratitis, sneezing, anemia, fatigue, cough, coryza, irritability, malaise, headache, lassitude, insomnia, nausea, vomiting	Inhalation, absorption, ingestion, eye/skin contact	None	MCEF, Colorimetric, OSHA Method
Toluene (skin)	50 ppm, 147 ppm - STEL	2,000 ppm	Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lacrimation, nervousness, muscle fatigue, insomnia, paresthesia, dermatitis	Inhalation, ingestion, skin contact	PID, FID, detector tube	Sampling pump, Charcoal tube, GC, NIOSH Method 1501
1,1,1-Trichloroethane	350 ppm 450 ppm STEL	1000 ppm	Lassitude, central nervous system depression, poor equilibrium, eye irritation, dermatitis, cardiac arrythmia	Inhalation, ingestion, skin contact	PID, FID, Detector tube	Charcoal tube, GC, NIOSH Method 1003

Table III-3. (continued)

Contaminant	Exposure limit (8-hour TWA)[b]	IDLH	Symptoms of exposure	Route(s) of exposure	Monitoring instrument	
					Direct method	Indirect method
Trichloro-ethylene[c]	50 ppm 100 ppm - STEL	1000 ppm	Headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, eye irritation, dermatitis, cardiac arrhythmias, paresthesia	Inhalation, ingestion, eye/skin contact	PID, FID, detector tube	Charcoal tube, GC, NIOSH Method 1022

[a]High explosives of concern will be added to this table.
[b]The most stringent of either the OSHA PEL-TWA or ACGIH TLV-TWA.
[c]Indicates potential human carcinogens

AA = atomic absorption
ACGIH = American Conference of Governmental Industrial Hygienists
FID = flame ionization detector
GC = gas chromatograph
GFF = glass fiber filter
ICP = inductively coupled plasma
MCEF = mixed cellulose ester filter
N/A = not available
NIOSH = National Institute for Occupational Safety and Health
OSHA = Occupational Safety and Health Administration
PEL = permissible exposure limit
PID = photoionization detector
ppm = parts per million
PVC = polyvinyl chloride
STEL = short-term exposure limit
TLV = threshold limit value
TWA = time weighted average

Table III-4. Radionuclides of concern

Radionuclide	Major radiation	DAC (μCi/mL)	Radioactive half-life	Monitoring instrument
Beryllium-7	Gamma	8×10^{-6}	53.3 days	NaI (TL) scintillation counter, Geiger-Mueller survey meter
Cadmium-109	Gamma	1×10^{-8}	1.24 years	FIDLER
Cesium-134	Beta, gamma	4×10^{-8}	2.06 years	Geiger-Mueller survey meter
Cesium-137	Gamma	5×10^{-5}	30 years	Geiger-Mueller survey meter
Cobalt-56	Beta, gamma	8×10^{-8}	78.5 days	Geiger-Mueller survey meter
Cobalt-57	Gamma	3×10^{-7}	271 days	NaI (TL) scintillation counter, Geiger-Mueller survey meter
Cobalt-58	Beta, gamma	3×10^{-8}	70.8 days	Geiger-Mueller survey meter
Cobalt-60	Beta	7×10^{-8}	5.3 years	Geiger-Mueller survey meter
Manganese-54	Gamma	3×10^{-7}	312.5 days	NaI (TL) scintillation counter, Geiger-Mueller survey meter
Polonium-210	Alpha, gamma	3×10^{-10}	138.4 days	Alpha scintillometer
Rubidium-83	Gamma	4×10^{-7}	86.2 days	NaI (TL) scintillation counter, Geiger-Mueller survey meter
Scandium-46	Beta, gamma	1×10^{-7}	83.8 days	Geiger-Mueller survey meter
Selenium-75	Gamma	3×10^{-7}	120 days	NaI (TL) scintillation counter, Geiger-Mueller survey meter
Silver-110m	Beta, gamma	4×10^{-8}	252 days	Geiger-Mueller survey meter
Sodium-22	Positron, gamma	3×10^{-7}	2.6 years	Geiger-Mueller survey meter

Table III-4. (continued)

Radionuclide	Major radiation	DAC (µCi/mL)	Radioactive half-life	Monitoring instrument
Strontium-90	Beta	2×10^{-9}	27.7 years	Liquid scintillation counter
Tritium	Beta	2×10^{-5} (Water) 5×10^{-1} (Elemental)	12.26 years	Liquid scintillation counter
Uranium-238	Alpha, gamma	2×10^{-11}	4.5×10^{9} years	Alpha scintillometer, FIDLER
Yttrium-88	Positron, gamma	1×10^{-7}	106.6 days	Geiger-Mueller survey meter
Zinc-65	Positron, gamma	1×10^{-7}	243.8 days	Geiger-Mueller survey meter
Zirconium-88	Gamma	9×10^{-8}	83.4 days	NaI (TL) scintillation counter, Geiger-Mueller survey meter

DAC = derived air concentration (DOE Order 5480.11)
FIDLER = field instrument for the detection of low-energy gamma radiation

4.4 Biological Hazards

There are several biological hazards found at Los Alamos that are not common in other parts of the country. These include, but are not limited to: rattlesnakes, wild animals, ticks, plague, hantavirus, giardia lamblia, and black widow spiders. Table III-5 summarizes some of the potential biological hazards for this OU.

4.5 Task-by-Task Risk Analysis

A task-by-task risk analysis is required by 29 CFR 1910.120 and will be included with each SSHSP. This process analyzes the operations and activities for specific hazards by task. Examples of some of the tasks that should be analyzed and documented in the SSHSP are:

- drilling,
- hand augering,
- trenching,

- septic system sampling, and
- high explosive sampling.

Other tasks should be considered for inclusion by the SSO.

Table III-5. Biological hazards of concern, OU 1100

Hazard description	PPE	Prevention methods
Snake bites (rattlesnake)	Long pants, snake leggings, boots	Wear PPE where footing is difficult to see. Avoid blind reaches
Animal bites (dog, cat, coyote, mountain lion, bear)	Long pants, boots	Avoid wild or domestic animals; do not approach or attempt to feed
Ticks (may cause Lyme disease or tick fever)	Long pants, long-sleeved shirts, boots	Perform tick inspections of team members after working in brushy or wooded areas
Rodents (deer mice may carry the hantavirus; prairie dogs and squirrels may carry plague- infected fleas)	Long pants, boots	Do not handle live or dead rodents. Avoid contact with droppings. Contact with deer mice/droppings must be reported to the SSO, Field Team Leader, and Occupational Medicine.
Human sewage (may contain pathogenic bacteria)	Disposable coveralls and gloves	When sampling in septic systems, wear protective gear and dispose of properly. Wash hands thoroughly after contact
Bloodborne pathogens (blood, blood products, and human body fluids may contain Hepatitis B virus or HIV)	Latex gloves, mouthguards, protective eyewear	Only trained personnel should perform first aid procedures. Follow laboratory bloodborne pathogen control procedures
Poisonous plants (poison ivy)	Gloves, long pants, long-sleeved shirts, boots	Recognize plants, avoid contact, wash hands and garments thoroughly after contact
Waterborne infectious agents (stream water may contain giardia lamblia)	None	Drink water only from potable sources
Spiders (brown recluse, black widow)	Gloves, long pants, long-sleeved shirt, boots	Use caution when in wood piles or dark, enclosed places

5.0 SITE CONTROL

5.1 Initial Site Reconnaissance

Initial site reconnaissance may involve surveyors, archaeologists, biological resource personnel, etc. Health and safety concerns that may be present must be addressed to protect personnel. The OUPL and HSPL will identify these concerns and institute measures to protect environmental impact assessment personnel.

5.2 Site-Specific Health and Safety Plans

Each field event within an OU requires an SSHSP. Planning, special training, supervision, protective measures, and oversight needs are different for each event, and the SSHSP addresses this variability.

The OUHSP provides detailed information to project managers, Laboratory managers, regulators, and health and safety professionals about health and safety programs and procedures as they relate to an OU. The SSHSP addresses the safety and health hazards of each phase of site operations and includes requirements and procedures for employee protection. All SSHSPs in that OU derive from the OUHSP.

The standard outline for an SSHSP follows OSHA requirements and serves as a guide for best management practice. Those performing the field work are responsible for completing the plan.

Changes to the SSHSP must be made in writing. The HSPL shall approve changes, and site personnel shall be updated through daily tailgate meetings. Records of SSHSP approvals and changes will be maintained by the SSO.

5.3 Work Zones

Maps identifying work zones will be included with each SSHSP. Markings used to designate each zone boundary (red or yellow tape, fences, barricades, etc.) will be discussed in the plan. Evacuation routes should be upwind or crosswind of the exclusion zone. A muster area must be designated for each evacuation route. Discrete zones are not required for every field event. The SSO will determine work zones. The following sections discuss the work zones.

- **Exclusion zone**. The exclusion zone is the area where contamination is either known or likely to be present or, because of work activities, will present a potential hazard to personnel. Entry into the exclusion zone requires the use of PPE.
- **Decontamination zone**. The decontamination zone is the area where personnel conduct personal and equipment decontamination. This zone provides a buffer between contaminated areas and clean areas. Activities in the decontamination zone require the use of PPE as defined in the decontamination plan. Section II contains details of the decontamination of plan.
- **Support zone**. The support zone is a clean area where the chance to contact hazardous materials or conditions is minimal. PPE other than safety equipment appropriate to the tasks performed (e.g., safety glasses, protective footwear, etc.) is not required.

5.4 Secured Areas

Secured areas shall be identified and shown on the site maps. Procedures and responsibilities for maintaining secured areas must be described. Standard Laboratory security procedures should be followed for accessing secure areas. All contractors and visitors must be processed through the badge office before entering secure areas. It is the responsibility of the OUPL to see that contractor personnel have badges. It is the responsibility of all Laboratory employees to enforce security measures.

5.5 Communications Systems

Portable telephones, CB radios, and two-way radios may be used for on-site communications. This type of equipment must not be used in areas where there may be high explosives; hand signals and verbal communications should be used in these areas.

5.6 General Safe Work Practices

Workers will be instructed on safe work practices to be followed when performing tasks and operating equipment needed to complete the project. Daily safety tailgate meetings will be conducted at the beginning of the shift to brief workers on proposed activities and special precautions to be taken.

The following items are requirements necessary to protect field workers and will be reiterated in SSHSPs. Depending on site-specific conditions, items may be added or deleted.

- The buddy system will be used. Hand signals will be established and used.
- During site operations, each worker should be a safety backup to his/her partner. All personnel should be aware of dangerous situations that may develop.
- Visual contact must be maintained between buddies on-site.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of potentially contaminated material is prohibited in any area designated as contaminated.
- Prescription drugs should not be taken by personnel where the potential for contact with toxic substances exist, unless specifically approved by a qualified physical.
- Alcoholic beverage intake is prohibited during the work day.
- Disposable clothing will be used whenever possible to minimize the risk of cross-contamination.
- The number of personnel and equipment in any contaminated area should be minimized, but effective site operations must be allowed for.
- Staging areas for various operational activities (equipment testing, decontamination, etc.) will be established.

- Motorized equipment will be inspected to ensure that brakes, hoists, cables, and other mechanical components are operating properly.
- Procedures for leaving any contaminated area will be planned and reviewed before entering these areas.
- Work areas and decontamination procedures will be established based on prevailing site conditions and will be subject to change.
- Wind direction indicators will be strategically located on-site.
- Contact with contaminated or potentially contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, mud, or discolored ground surface; do not kneel on the ground or lean, sit, or place equipment on drums, containers, vehicles, or on the ground.
- No personnel will be allowed to enter the site without proper safety equipment.
- Proper decontamination procedures will be followed before leaving the site, except in medical emergencies.
- Any medical emergency supersedes routine safety requirements.
- Housekeeping will be emphasized to prevent injury from tripping, falling objects, and accumulation of combustible materials.
- All personnel must comply with established safety procedures. Any staff member or visitor who does not comply with safety policy, as established by the SSO, will be immediately dismissed from the site.

5.7 Specific Safe-Work Practices

5.7.1 Electrical Safety-Related Work Practices

The most effective way to avoid accidental contact with electricity is to de-energize the system or maintain a safe distance from the energized parts/line. OSHA regulations require minimum distances from energized parts. An individual working near power lines must maintain at least a 10 foot clearance from overhead lines of 50 kilovolts (kV) or less. The clearance includes any conductive material the individual may be using. For voltages over 50 kV, the 10 foot clearance must be increased 0.4 inches for every 1 kV over 50 kV. For underground electrical service the underground locator service should be contacted before digging.

5.7.2 Grounding

Grounding is a secondary form of protection that ensures a path of low resistance to ground if there is an electrical equipment failure. A properly installed ground wire becomes the path for electrical current if the equipment malfunctions. Without proper grounding, an individual could become the path to ground if he/she touches the equipment. An assured electrical grounding program and ground fault circuit interrupters are required.

5.7.3 Lockout/Tagout

All site workers follow a standard operating procedure for control of hazardous energy sources [Laboratory Administrative Requirement (AR) 8-6, LP 106-01.1). Lockout/tagout procedures are used to control hazardous energy sources, such as electricity, potential energy, thermal energy, chemical corrosivity, chemical toxicity, or hydraulic and pneumatic pressure.

5.7.4 Confined Space

Entry and work to be conducted in confined spaces shall adhere to procedures proposed in the Laboratory Confined Space Entry Program. These procedures require that a Confined Space Entry Permit be obtained and posted at the work site. Prior to entry, the atmosphere shall be tested for oxygen content, flammable vapors, carbon monoxide, and other hazardous gases. Continuous monitoring for these constituents shall be performed if conditions or activities have the potential to adversely affect the atmosphere.

5.7.5 Handling Drums and Containers

Drums and containers used during clean up shall meet U.S. Department of Transportation, OSHA, and EPA regulations. Work practices, labeling requirements, spill containment measures, and precautions for opening drums and containers shall be in accordance with 29 CFR 1910.120. Drums and containers that contain radioactive material must also be labeled in accordance with AR 3-5, Shipment of Radioactive Materials; AR 3-7, Radiation Exposure Control; and Article 412, Radioactive Material Laboratory, DOE Radiological Control Manual. Provisions for these activities shall be clearly outlined in the SSHSP, if applicable.

5.7.6 Illumination

Illumination shall meet the requirements of Table H-120.1, 29 CFR 1910.120. Table III-6 lists OSHA-required illumination levels.

Table III-6. Illumination levels

Foot-candles	Area or operations
5	General site areas
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas
5	Indoors: warehouses, corridors, hallways, and exitways
5	Tunnels, shafts, and general underground work areas. (Exception: a minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Bureau of Mines-approved cap lights shall be acceptable for use in the tunnel heading.)
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms)
30	First aid stations, infirmaries, and offices

5.7.7 Sanitation

An adequate supply of potable water shall be provided at the site. Nonpotable water sources shall be clearly marked as not suitable for drinking or washing purposes. There shall be no cross-connections between potable and nonpotable water systems.

At remote sites, at least one toilet facility shall be provided, unless the crew is mobile and has transportation readily available to nearby toilet facilities.

Adequate washing facilities shall be provided when personnel are potentially exposed to hazardous substances. Washing facilities shall be in areas where exposures to hazardous materials are below permissible exposure limits (PELs) and where employees may decontaminate themselves before entering clean areas. When showers and change rooms are required, they shall be provided and meet the requirements of 29 CFR 1910.141. In this instance, employees shall be required to shower when leaving the decontamination zone.

5.7.8 Packaging and Transport

The OUPL should contact EM-7 to determine requirements for storing and transporting hazardous waste to ensure that practices for storage, packaging, and transportation comply with ARs 10-2 and 10-3. Disposal of hazardous wastes generated from a project will be handled by EM-7.

5.7.9 Government Vehicle Use

Only government vehicles can be driven onto contaminated sites. No personal vehicles are allowed. All personnel must wear a seat belt when in a moving vehicle, whether it is government or personally owned.

5.7.10 Extended Work Schedules

Scheduled work outside normal work hours must have the prior approval of the OUPL and SSO.

5.8 Permits

5.8.1 Excavation Permits

Any excavation at OU sites must be conducted in accordance with Laboratory AR 1-12, Excavation or Fill Permit Review. Field team leaders will be responsible for determining when excavation permits are required. The OUPL and field team leader are responsible for requesting the excavation permit (Form 70-10-00.1) from the support services contractor. At the top of the form, indicate that this is an

ER Program activity. The permit is reviewed by Health and Safety and EM Divisions for environmental safety and health concerns.

5.8.2 Other Permits

The following permits may be required for field activities. The SSO and OUPL are responsible for obtaining permits and maintaining documentation. Permits are specifically addressed in the SSHSP.

- Radiation Work Permits
- Special Work Permit for Spark/Flame-Producing Operations
- Lockout/Tagout

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 General Requirements

PPE shall be selected, provided, and used in accordance with the requirements of this section.

If engineering controls and work practices do not provide adequate protection against hazards, PPE may be required. Use of PPE is required by OSHA regulations in 29 CFR Part 1910 Subpart I (see Table III-7).

Table III-7. OSHA standards for PPE use

Type of protection	Regulation
General	29 CFR Part 1910.132 29 CFR Part 1910.1000 29 CFR Part 1910.1001-1045
Eye and face	29 CFR Part 1910.133(a)
Hearing	29 CFR Part 1910.95
Respiratory	29 CFR Part 1910.134
Head	29 CFR Part 1910.135
Foot	29 CFR Part 1910.136
Electrical protective devices	29 CFR Part 1910.137

In addition, the use of PPE for radiological protection shall be governed by the Radiation Work Permit (or Safety Work Permits/Radiation Work). AR 3-7 and Article 325, Article 461, Table III-1, and Appendix 3C of the DOE Radiological Control Manual contain guidelines for the use of PC during radiological operations. Efforts should be made to keep disposable PPE used exclusively for radiological work from becoming contaminated with hazardous chemicals, which would generate mixed waste unnecessarily. In sites where both types of contaminants are present, this may not be possible.

6.1.1 PPE Program Elements

PPE programs protect workers from health and safety hazards and prevent injuries as a result of incorrect use and/or malfunction of PPE. Hazard identification, medical monitoring, training, environmental surveillance, selection criteria, use, maintenance, and decontamination of PPE are the essential program elements.

6.1.1 Medical Certification

Medical approval may be required before donning certain PPE. See Section 9 for more details.

6.2 Levels of PPE

The individual components of clothing and equipment must be assembled into a full protective ensemble that protects the worker from site-specific hazards and minimizes the hazards and disadvantages of the PPE. Attachment A lists ensemble components based on the widely used EPA Levels of Protection: Levels A, B, C, and D. These lists can be used as a starting point for ensemble creation; however, each ensemble must be tailored to the specific situation in order to provide the most appropriate level of protection.

The type of equipment used and the overall level of protection should be re-evaluated periodically as information about the site increases and as workers are required to perform different tasks. Personnel should be able to upgrade or downgrade their level of chemical protection with the concurrence of the SSO. The level of radiological PPE may only be downgraded as specified in the Radiation Work Permits (or Safety Work Permits/Radiation Work). The following are reasons to upgrade:

- known or suspected presence of dermal hazards,
- occurrence or likely occurrence of gas or vapor emission,
- change in work task that will increase contact or potential contact with hazardous materials, or
- request of the individual performing the task.

The following are reasons to downgrade:

- new information indicating that the situation is less hazardous than was originally thought,
- change in site conditions that decreases the hazard, or
- change in work task that will reduce contact with hazardous materials.

6.3 Selection, Use, and Limitations

Selection of PPE for a particular activity will be based on an evaluation of the hazards anticipated or previously detected at a work site. The equipment selected will provide protection from chemical and/or radiological materials contamination that is known or suspected to be present and that exhibits any potential for worker exposure.

6.3.1 Chemical Protective Clothing

The selection of chemical PC shall be based on an evaluation of the performance characteristics of the clothing relative to the requirements and limitations of the site, the task-specific conditions and duration, and the potential hazards identified at the site.

6.3.2 Radiological Protective Clothing

Radiological PC as prescribed by the Radiological Work Permit should be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, and regard for nonradiological hazards that may be present. A full set of radiological PC includes coveralls, cotton glove liners, gloves, shoe covers, rubber overshoes, and a hood. A double set of PC includes two pairs of coveralls, cotton glove liners, two pairs of gloves, two pairs of shoe covers, rubber overshoes, and a hood. The following practices apply to radiological PC:

1. Cotton glove liners may be worn inside standard gloves for comfort but should not be worn alone or considered a layer of protection.

2. Shoe covers and gloves should be sufficiently durable for the intended use. Leather or canvas work gloves should be worn in lieu of or in addition to standard gloves for work activities requiring additional strength or abrasion resistance.
3. Use of hard hats in contamination areas should be controlled by the Radiological Work Permit. Hard hats designated for use in such areas should be distinctly colored or marked.

Table III-8 provides general guidelines for selection.

Table III-8. Guidelines for selecting radiological protective clothing

Work activity	Removable contamination levels		
	Low (1 to 10 times Table III-10 values)	Moderate (10 to 100 times Table III-10 values)	High (>100 times Table III-10 values)
Routine	Full set of PC	Full set of PC	Full sets of PC, double gloves, double shoe covers
Heavy work	Full set of PC, work gloves	Double set of PC, work gloves	Double set of PC, work gloves
Work with pressurized or large volume liquids, closed system breach	Full set of non-permeable PC	Double set of PC (outer set nonpermeable), rubber boots	Double set of PC and nonpermeable outer clothing, rubber boots

6.3.3 Protective Equipment

Protective equipment, including protective eyewear and shoes, head gear, hearing protection, splash protection, lifelines, and safety harnesses, must meet American National Standards Institute standards.

6.4 Respiratory Protection Program

When engineering controls cannot maintain airborne contaminants at acceptable levels, appropriate respiratory protective measures shall be instituted. The Health and Safety Division administers the respiratory protection program, which defines respiratory protection requirements; verifies that personnel have met the criteria for training, medical surveillance, and fit testing; and maintains the appropriate records.

All supplemental workers shall submit documentation of participation in an acceptable respiratory protection program to the Industrial Hygiene Group (HS-5) for review and signature approval before using respirators on-site.

7.0 HAZARD CONTROLS

7.1 Engineering Controls

OSHA regulations state that, when possible, engineering controls should be used as the first line of defense for protecting workers from hazards. Engineering controls are mechanical means for reducing hazards to workers, such as guarding moving parts on machinery and tools or using ventilation during confined space entry.

7.1.1 Engineering Controls for Airborne Dust

Airborne dust can be a hazard when it is a nuisance or when radionuclides and/or hazardous substances attach to soil particles.

During drilling or any other activity where localized dust is being generated, a sprayer containing water or water amended with surfactants may be used to wet the soil and suppress the dust. Spraying must be repeated often to maintain moist soil.

A windscreen may be effective in reducing dust from relatively small earth-moving operations. In extreme cases, a temporary enclosure can be constructed to control dust. This method is the more expensive and may increase the level of PPE required for workers (in the enclosure).

Where there are high winds in an area of little or no vegetation or a large, dusty area, small quantities of water are not effective. In these instances, a water truck may be used to wet the area to suppress the dust. This may require frequent spraying to be effective. Other materials may also be considered for dust suppression. The amount of water applied needs to be carefully controlled so that enough is used to be effective without spreading contamination by runoff or as mud tracked off-site on vehicle tires. Positive air pressure cabs are an effective method for controlling equipment operator dust exposure.

7.1.2 Engineering Controls for Airborne Volatiles

Drilling, trenching, and soil and tank sampling activities may produce gases, fumes, or mists that may be inhaled or ingested by workers without protection. Engineering controls may be implemented to reduce exposure to these hazards. Natural ventilation (wind) can be an effective control measure; workers should be located upwind of the activity whenever possible.

Mechanical ventilation is desirable in closed or confined spaces. The fan or blower may be attached to a large hose to push or pull the contaminant from the confined space. Pulling the air from the space is more effective at removing the vapors, whereas forcing air into the confined area ensures acceptable oxygen levels from ambient air.

7.1.3 Engineering Controls for Noise

Drilling and trenching are likely to produce high noise levels. On most rigs, the highest noise levels are encountered on the side of the rig because the front and rear of the rig's engine is covered, whereas the sides are left open to cool the engine. Additional barriers may be constructed to reduce high noise levels on the sides of the rig. Insulated cabs usually reduce noise to an acceptable level for equipment operators.

7.1.4 Engineering Controls for Trenching

Entry into an excavation deeper than 5 feet should be avoided if possible. However, it is sometimes necessary to enter trenches to obtain needed information. OSHA regulations for trenches and excavations require engineering controls to prevent cave-ins. These controls include the use of shoring, sloping, and benching.

Benching is a series of steps dug around the excavation at a specified angle of repose determined by the soil type. Benching will normally be found in large excavations. Sloping is a similar system of stabilizing soil but is performed without the steps. Again, the angle of repose is determined by the soil type. This method is generally used for medium-sized excavations, such as tank removal.

Shoring is available in many different varieties, but the principle theory is the same. The sides of the excavation are supported by some type of wall that is braced to prevent cave-ins. This method is used most often in deep, narrow trenches for installing water pipe or drainage systems and exploratory trenching. Engineering controls for excavations should be approved by a competent person before entering the excavation.

7.1.5 Engineering Controls for Drilling

Working with and around drilling rigs presents workers with a number of hazards from moving parts and hazardous energy associated with the equipment. Engineering controls include guards to prevent crushing injuries and a maintenance program to ensure replacement of worn or broken parts. Inspections should be performed at the beginning of the job and periodically during the project.

7.2 Administrative Controls

Administrative controls are necessary when hazards are present and engineering controls are not feasible. Administrative controls are a method for controlling the degree of exposure (e.g., how long or how close to the hazard the worker remains). Worker rotation shall not be used to achieve compliance with PELs or dose limits.

7.2.1 Administrative Controls for Airborne Chemical and Radiological Hazards

Personnel should only enter the exclusion zone when required. Chemical and radiological hazards are to be monitored during performance of duties in the exclusion zone. If the concentration of radionuclides or toxic materials exceeds acceptable limits, personnel should be removed from the area until natural or mechanical ventilation reduces concentrations to an acceptable level.

7.2.2 Administrative Controls for Noise

Another approach to noise exposure control, besides engineering measures, is the use of administrative controls. This is often thought of as the rotation of workers between noisy jobs and less noisy jobs. This is not a good health practice because, while it may reduce the amount of hearing loss individuals incur, it spreads the risk among other workers. The final result tends to be that many workers develop small hearing losses rather than a few workers developing greater loss. One control than can partially mitigate the problem is to provide workers with rest and lunch areas that are quiet enough to allow some recovery from temporary threshold shifts. The levels in these areas should not exceed 70 decibels. Workers should also be located as far from loud noise sources as practicable. This allows for noise attenuation before it reaches the individual. Finally, duration of exposure should be limited to the minimum time. Under no circumstances should workers be exposed to noise levels in excess of the time limits specified in 29 CFR 1910.95, Occupational Noise Exposure, Table G-16.

7.2.3 Administrative Controls for Trenching

Trenches less than 5 foot deep do not require protective systems (sloping, benching, or shoring). All trenches should be excavated to a depth of less than 5 feet if possible. However, monitoring inside the trench and means of egress (every 25 feet) must be implemented when the trench reaches a depth of 4 feet. Soil piles, tools, and other debris must be stored at least 2 feet from the edge of the excavation. Inspections should be made by a competent person before any field team member is allowed to enter the excavation. When the area is not occupied, all excavations must be marked to restrict access.

7.2.4 Administrative Controls for Working Near the Mesa Edge

Slip, trip, and fall hazards exist around the mesa edge. These hazards may be avoided by good housekeeping in the work area near the edge of the mesa. Additionally, personnel shall remain 5 feet from the edge. If necessary, ropes or guards will be used to delineate this restricted area. Exceptions to this requirement are for canyon-side sampling and outfall sampling. In those instances, the worker taking the sample must be tied to a lifeline before descending over the edge. When working with a lifeline, an attendant must always be present.

8.0 SITE MONITORING

This section describes the requirements for chemical, physical, and radiological agent monitoring. This does not include biological monitoring, which is covered in Sections 9 and 10. This information will be used to delineate work zone boundaries, identify appropriate engineering controls, select the appropriate level of PPE, ensure the effectiveness of decontamination procedures, and protect public health and safety.

A monitoring program or plan that meets the requirements of 29 CFR 1910.120 will be implemented for each OU. Laboratory-approved sampling, analytical, and recordkeeping methods must be used. A detailed monitoring strategy will be incorporated into each SSHSP. The strategy will describe the frequency, duration, and type of samples to be collected.

If exposures exceed acceptable limits, the ER Program Manager and HSPL will be notified. An investigation of the source, exposures to personnel working in the OU and in adjoining areas, any bioassay or other medical evaluations needed, and an assessment of environmental impacts shall be initiated as soon as possible under the guidance of the Health and Safety Division.

Contractors will be responsible for providing their own monitoring equipment and for determining their employees' occupational exposures to hazardous chemical and physical agents during activities performed at the OU. The Laboratory will perform oversight duties during these activities.

8.1 Chemical Air Contaminants

DOE has adopted OSHA PELs and ACGIH TLVs as standards for defining acceptable levels of exposure. The more stringent of the two limits applies.

8.1.1 Measurement

Measurements of chemical contaminants can be performed using direct or indirect sampling methods. Direct methods provide near real-time results and are often used as screening tools to determine levels of PPE, the need for additional sampling, etc. Examples of direct-reading instruments include the HNu photoionization detector, the organic vapor analyzer with flame ionization detector, and a gas detector pump with colorimetric tubes. Generally, these instruments are portable, easy to operate, and durable. They are less specific and sensitive than many indirect methods.

Indirect sampling means that a sample is collected in the field and transported to a laboratory for analysis. This usually involves setting up a sampling train consisting of a portable sampling pump, tubing, and sampling media (cassette, sorbent tube, impinger, etc.). The advantage of the indirect method is greater specificity and sensitivity than many direct-reading instruments. The disadvantage is the longer turnaround time for results and the inconvenience.

Air sampling for chemical contaminants at this OU will use both direct and indirect methods. It will be up to the SSO to determine the most appropriate sampling method for each situation. If there are any questions about sampling methodology, the SSO should consult with the HSPL or a certified industrial hygienist.

8.1.2 Personal Monitoring

The site history should be used to determine the need for monitoring for specific chemical agents. Instruments that monitor for a wide range of chemicals, such as the organic vapor analyzer, combustible gas indicator, and HNu, may be used for screening purposes.

Initial air monitoring shall be performed to characterize the exposure levels at the site and to determine the appropriate level of personal protection needed. In addition, periodic monitoring is required when:

- work is initiated in a different part of the site,
- unanticipated contaminants are identified,
- a different type of operation is initiated (i.e., soil boring versus drum opening), or
- spills or leakage of containers is discovered.

Instrument readings should be taken in or near the worker's breathing zone. Individuals working closest to the source have the greatest potential for exposure to concentrations above acceptable limits. Monitoring strategies will emphasize worst-case conditions if monitoring each individual is inappropriate.

8.1.3 Perimeter Monitoring

Perimeter monitoring shall be performed to characterize airborne concentrations in adjoining areas. If results indicate that contaminants are moving off-site, control measures must be re-evaluated. The perimeter is defined as the boundary of the OU site.

8.2 Physical Hazards

Physical hazards of concern that can be readily measured include noise, vibration, and temperature. These variables must be monitored to prevent injuries and illnesses related to overexposure.

8.2.1 Measurement

Most of the instruments used to measure these agents are direct reading. Many have the ability to take short-term measurements and/or integrated, longer term measurements. Typically, short-term measurements are made during an initial survey. The results can then be used to determine whether longer term (i.e., full shift) monitoring is warranted.

8.2.2 Personal Monitoring

Noise dosimeters are used to estimate the actual exposure or dose that a worker receives during the shift. Results of personal noise monitoring should be compared to the ACGIH TLVs in accordance with Laboratory policy. These results dictate whether workers must be included in a hearing conservation program.

Instrumentation is now available for personal monitoring for heat stress. This type of measurement is not mandated but can provide useful exposure information.

Use of personal heat stress monitors must be approved by the HSPL prior to field use.

Personal monitoring for vibration and cold stress is generally not performed or warranted for this type of operation.

8.2.3 Area Monitoring

A sound level survey meter should be used to initially characterize sound pressure levels. These data can help guide the personal monitoring efforts. If the sound level survey and personal dosimetry indicate that sound levels exceed acceptable levels, then an octave band analyzer may be used to characterize the noise. This provides important data for designing engineering controls.

Area monitoring for temperature extremes are usually sufficient for determining whether workers are potentially exposed to harmful conditions. Thermometers, psychrometers, and anemometers are direct-reading instruments that provide the data necessary to make heat and cold stress calculations.

Accelerometers can be used to monitor vibration levels. Vibration is usually an isolated problem and does not warrant an ongoing monitoring program. Rather, the SSO should be alert for equipment and tasks that might expose workers to significant whole-body or hand and arm vibration. Typically, these include operation of dozers, scrapers, and other heavy equipment and power hand tools, such as impact wrenches and concrete breakers.

8.3 Radiological Hazards

When radiological hazards are known or suspected, workplace monitoring shall be performed as necessary to ensure that exposures are within the requirements of DOE Order 5480.11 and are as low as reasonably achievable (ALARA). Workplace monitoring consists of monitoring for airborne radioactivity, external radiation fields, and surface contamination. The Laboratory's workplace monitoring program is described in AR 3-7, Radiation Exposure Control. The success of the monitoring program in controlling exposures is measured by the personnel dosimetry and bioassay programs. Chapter 3, Part 7, of the DOE

Radiological Control Manual provides additional guidelines for radiological control during construction and restoration projects. All monitoring instruments shall meet the Laboratory's requirements for sensitivity, calibration, and quality assurance. In addition, all monitoring shall be carried out in accordance with approved procedures.

8.3.1 Airborne Radioactivity Monitoring

Air monitoring shall be performed in occupied areas with the potential for airborne radioactivity. Air monitoring may include the use of portable high and low volume samplers, continuous air monitors, and personnel breathing zone samplers. In areas where concentrations are likely to exceed 10% of any derived air concentration listed in DOE Order 5480.11, real-time continuous air monitoring shall be provided. Action levels based on air monitoring results shall be established to increase dust suppression activities, upgrade PPE, and stop work.

8.3.2 Area Monitoring for External Radiation Fields

Area monitoring for external radiation fields shall be performed with portable survey instruments capable of measuring a wide range of beta/gamma dose rates. In areas where dose rates above a preset action level are expected, the monitoring should be continuous. Additional action levels shall be established based on external radiation monitoring results.

8.3.3 Monitoring for Surface Contamination

Area monitoring for surface contamination during operations shall be conducted whenever a new surface is uncovered in a suspected radioactively contaminated area (i.e., the levels may exceed the surface contamination limits in DOE Order 5480.11). Personnel and equipment shall be monitored whenever there is reason to suspect contamination and upon exit from a suspected radioactively contaminated area. Action levels for decontamination shall be established.

8.3.4 Personnel Monitoring for External Exposure

Personnel dosimetry shall be provided to OU workers who have the potential in a year to exceed any one of the following from external sources in accordance with DOE Order 5480.11:

- 100 mrem (0.001 sievert) annual effective dose equivalent to the whole body,
- 5 rem (0.05 sievert) annual dose equivalent to the skin,
- 5 rem (0.05 sievert) annual dose equivalent to any extremity, or
- 1.5 rem (0.015 sievert) annual dose equivalent to the lens of the eye.

Normally, workers meeting the above criteria will be monitored with thermoluminescent dosimeters (TLDs). TLDs shall either be provided by the Laboratory or shall meet DOE requirements if provided by the subcontractor. Section 10 (Bioassay Program) discusses personnel monitoring for internal exposure.

8.3.5 ALARA Program

ALARA considerations in the workplace are best served by near real-time knowledge of personnel exposures and frequent workplace monitoring to establish adequate administrative control of exposure conditions. Consequently, for the OU site projects, ALARA efforts consist of two integrated approaches, which are described in the following sections.

8.3.5.1 Workplace ALARA Efforts

Judicious application of basic time, distance, physical controls, and PPE principles will be used to limit exposures to ALARA levels. To verify that established control is adequate, workplace monitoring for radioactive materials and field instrument detectable chemicals will be conducted in direct proportion to expected and/or observed levels of exposure. Activities that result in unexpectedly high potential exposures will be terminated until provisions are made that permit work to proceed in acceptable ALARA fashion.

8.3.5.2 Programmatic ALARA Efforts

External and internal exposures of record are comprised of TLD badges and bioassay data, respectively. Field dose calculation, direct-reading pocket meters, and event-based lapel air sampling data are used to maintain estimates of personnel exposures to both radioactive materials and hazardous chemicals. These estimates are correlated with job-specific activities (work location and work category) and individual-specific activities (job function).

Periodic reviews of personnel exposure estimates are conducted to identify unfavorable trends and unexpectedly high potential exposures. Activities (as functions of work location, work categories, and job functions) that indicate unfavorable trends will be investigated, and recommendations will be made for additional administrative and/or physical controls, as appropriate.

All unfavorable trends and unexpectedly high potential exposures must be reported to the HSPL, who will make recommendations for corrective action.

9.0 MEDICAL SURVEILLANCE AND MONITORING

9.1 General Requirements

A medical surveillance program shall be instituted to assess and monitor the health and fitness of workers engaged in HAZWOP. Medical surveillance is required for personnel who are or may be exposed to hazardous substances at or above established PELs for 30 days in a 12-month period, as detailed in 29 CFR 1910.120. Medical surveillance is also required for personnel with duties that require the use of respirators or with symptoms indicating possible overexposure to hazardous substances.

Contractors are responsible for medical surveillance of their employees. The Health and Safety Division will audit contractor programs.

9.2 Medical Surveillance Program

All field team members who participate in ER Program investigations shall participate in a medical surveillance program. The program shall conform to DOE Order 5480.10, 29 CFR 1910.120, AR 2-1, and any criteria established by the Occupational Medicine Group (HS-2) at the Laboratory. The program shall provide for initial medical evaluations to determine fitness for duty and subsequent medical surveillance of individuals engaged in HAZWOP. As a minimum, the program shall include:

- **Surveillance.** An occupational and medical history, a baseline exam prior to employment, periodic medical exams, and termination exams shall be included. The frequency of medical exams may vary because of the exposure potential at hazardous waste sites. The frequency of exams will be determined by the physician.
- **Treatment.** Immediate consultation shall be made available to any employee who develops signs or symptoms of exposure or who has been exposed at or above PELs in an uncontrolled or emergency situation.

- **Recordkeeping**. An accurate record of the medical surveillance required by 20 CFR 1910.120 shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1910.20.
- **Program review**. Contractors must provide adequate documentation that their medical program complies with all applicable standards, DOE orders, and Laboratory requirements. This documentation must be submitted for review and approval before work begins.
- **Program participation**. Line management is responsible for identifying employees for inclusion in the surveillance program.

9.2.1 Medical Surveillance Exams

AR 2-1 from the Laboratory's ES&H Manual specifies that medical surveillance examinations are required for employees who work with asbestos, beryllium, carcinogens, hazardous waste, high noise, lasers, and certain other materials. As specified above, Laboratory employees who work with hazardous waste must undergo periodic special examinations by HS-2.

The content and frequency of medical exams is dependent on site conditions, current and expected exposures, job tasks, and the medical history of the workers.

9.2.2 Certification Exams

In addition to the above medical surveillance requirements, medical certification is required for employees whose work assignments include respirator use, Level A chemical PC, and/or operation of cranes and heavy equipment. To become certified and maintain certification, medical evaluations as specified by HS-2 are required.

9.3 Fitness for Duty

A fitness for duty determination will be made for each site worker. The examining physician shall provide a report to the OUPL indicating:

- approval to work on hazardous waste sites,
- approval to wear respiratory protective equipment, and
- a statement of work restrictions.

9.4 Emergency Treatment

In the event of an on-the-job injury, HS-2 will implement required reporting and recordkeeping procedures. The SSHSP describes the actions to be taken by the employee at the time of the injury/illness.

10.0 BIOASSAY PROGRAM

The OU site field characterization efforts will include intrusive investigations of areas of unknown but highly probable contamination potential. Given the uncertainties associated with this type of field work, the project internal exposure monitoring program is based on the assumption that personnel will be exposed to significant quantities of radioactive and/or hazardous chemical contaminants. Accordingly, the project internal dosimetry program will be conducted in accordance with the requirements of HS-12. These requirements are outlined in the following sections. (Monitoring and control of internal contamination by hazardous chemical contaminants is included in the medical surveillance program.)

10.1 Baseline Bioassays

Individuals who are assigned to field activities or who have reason to visit or inspect field activities are assigned one of the following job categories:

I. Work involving full-time on-site activities.
II. Work involving support activities (e.g., supervision or inspection).
III. Work involving routine or frequent visits (e.g., observing, auditing, etc.).
IV. Work involving nonroutine or infrequent visits (e.g., management observations.

All such individuals (except category IV individuals) must submit urine samples and submit to whole-body counting prior to participation in field activities. The baseline urine samples are analyzed for the solubility Class D and Class W compounds that could reasonably be expected to be encountered at the Laboratory. Whole-body counting analyzes for the gamma-emitting radionuclides that could reasonably be expected to be encountered at the Laboratory.

Results of the baseline bioassay analyses are evaluated by a health physics specialist for evidence of previous exposure. Individuals exhibiting evidence of previous internal contamination will not be permitted to enter OU sites until an evaluation of the previous exposure indicates that additional, planned radiation exposure will not result in doses in excess of applicable regulatory limits. This evaluation may include additional, rigorous sampling and/or counting to establish the physical and temporal parameters necessary to adequately assess the committed effective dose equivalent.

10.2 Routine Bioassays

The routine bioassay program is used as a measure of the effectiveness of the respiratory protection program. As such, the bioassay frequency will be a function of potential exposure to airborne radioactive materials and will be determined by a health physics specialist.

Evidence of inadequate respiratory protection will be cause for an investigation of the responsible field operation(s). The HSPL is responsible for investigating and identifying probable causes of the respiratory protection program failure and for recommending corrective actions.

11.0 DECONTAMINATION

11.1 Introduction

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment and is critical to health and safety at hazardous waste sites. Decontamination protects workers from hazardous substances that may contaminate PC, respiratory protection equipment, tools, vehicles, and other equipment used on-site. It minimizes the transfer of harmful materials into clean areas, helps prevent mixing of incompatible chemicals, and prevents uncontrolled transportation of contaminants from the site into the community.

All personnel and equipment exiting an exclusion zone will be monitored to detect possible contamination. Monitoring will verify that all personnel and equipment are free of significant contamination prior to exiting the exclusion zone and shall be performed in accordance with Health and Safety Division requirements.

If monitoring indicates that an employee is contaminated with chemicals, biological agents, or radioactive materials, the employee's immediate supervisor shall notify the SSO, who records the details of the incident, determines whether any personal injury is involved, initiates decontamination, and, when necessary, notifies the OUPL and HSPL. All contamination incidents shall be immediately reported following Laboratory Occurrence Reporting Program requirements to ensure that prompt notifications and appropriate emergency response actions are enacted.

11.1.1 Decontamination Plan

A site decontamination plan is mandatory. The site decontamination plan shall be part of the SSHSP and must include:

- the number and layout of decontamination stations,
- the decontamination equipment needed,
- appropriate decontamination methods,

- procedures to prevent contamination of clean areas,
- methods and procedures to minimize worker contact with contaminants during removal of personal PC, and
- methods for disposing of clothing and equipment that are not completely decontaminated.

The plan should be revised whenever the type of personal PC or equipment changes, the site conditions change, or the site hazards are re-assessed based on new information.

11.1.2 Facilities

Clean areas shall be separate from contaminated areas and materials. The SSO will verify that decontamination facilities are maintained in acceptable condition and that supplies of decontaminating agents and other materials are available. Personnel decontamination facilities shall be equipped with showers, clean work clothing, decontamination agents, and, when necessary, a decontamination area where Health and Safety Division personnel can assist in decontaminating individuals. All wash solutions shall be retained for appropriate disposal.

11.1.3 General Decontamination Methods

Many factors such as cost, availability, and ease of implementation influence the selection of a decontamination method. From a health and safety standpoint, two key questions must be addressed:

- Is the decontamination method effective for the specific substances present?
- Does the method itself pose any health or safety hazards?

The details of decontamination techniques shall be included in the site decontamination plan. The following are some decontamination methods:

Removal

- Contaminant removal
  - Water rinse using pressurized spray or gravity flow shower
  - Chemical leaching and extraction
  - Evaporation/vaporization
  - Pressurized air jets
  - Scrubbing/scraping (using brushes, scrapers, or sponges and water-compatible solvent cleaning solutions)
  - Stream jets
- Removal of contaminated surfaces
  - Disposal of deeply permeated materials (e.g., clothing, floor mats, and seats)
  - Disposal of protective coverings/coatings

Inactivation

- Chemical detoxification
  - Halogen stripping
  - Neutralization
  - Oxidation/reduction
  - Thermal degradation
- Disinfection/sterilization
  - Chemical disinfection
  - Dry heat sterilization
  - Gas/vapor sterilization
  - Irradiation
  - Steam sterilization

11.1.3.1 Physical Removal

In many cases, gross contamination can be removed by dislodging/displacement, rinsing, wiping off, and evaporation. Physical methods involving high pressure and/or heat should be used only as necessary and with caution because they can spread contamination and cause burns. Contaminants that can be removed by physical means can be categorized as follows:

- **Loose contaminants.** Dusts and vapors that cling to equipment and workers or become trapped in small openings, such as the weave of fabrics, can be removed with water or a liquid rinse. Removal of electrostatically attached materials can be enhanced by coating the clothing or equipment with antistatic solutions. These are available commercially as wash additives or antistatic sprays.
- **Adhering contaminants.** Some contaminants adhere by forces other than electrostatic attraction. Adhesive qualities vary greatly with the specific contaminants and temperature. For example, contaminants such as glues, cements, resins, and muds have much greater adhesive properties than elemental mercury, and consequently, are difficult to remove by physical means. Physical removal methods for gross contaminants include scraping, brushing, and wiping. Removal of adhesive contaminants can be enhanced through certain methods such as solidifying, freezing (e.g., using dry ice or ice water), adsorption or absorption (e.g., with powdered lime or cat litter), or melting.
- **Volatile liquids.** Volatile liquid contaminants can be removed from PC or equipment by evaporation followed by a water rinse. Evaporation of volatile liquids can be enhanced by using steam jets. With any evaporation or vaporization process, care must be taken to prevent worker inhalation of the vaporized chemicals.

11.1.3.2 Chemical Removal

Physical removal of gross contamination should be followed by a wash/rinse process using cleaning solutions. These cleaning solutions normally use one or more of the following methods:

- **Dissolving contaminants.** Chemical removal of surface contaminants can be accomplished by dissolving them in a solvent. The solvent must be chemically compatible with the equipment being cleaned. This is particularly important when decontaminating personal PC. In addition, care must be taken in selecting, using, and disposing of any organic solvents that may be flammable or potentially toxic. Organic solvents include alcohols, ethers, ketones, aromatics, straight-chain alkanes, and common petroleum products.

Halogenated solvents are generally incompatible with PPE and are toxic. They should only be used for decontamination in extreme cases, when other cleaning agents will not remove the contaminant. Use of halogenated solvents must be approved by the HSPL.

Table III-9 provides a general guide to the solubility of several contaminants in four types of solvents: water, dilute acids, dilute bases, and organic solvents. Because of the potential hazards, decontamination using chemicals should only be performed if recommended by an industrial hygienist or other qualified health professional.

- **Surfactants**. Surfactants augment physical cleaning methods by reducing adhesion forces between contaminants and the surface being cleaned and by preventing redeposit of the contaminants. Household detergents are among the most common surfactants. Some detergents can be used with organic solvents to improve the dissolving and dispersal of contaminants into the solvent.
- **Solidification**. Solidifying liquid or gel contaminants can enhance their physical removal. The mechanisms of solidification are: (1) moisture removal through the use of adsorbents such as ground clay or powdered lime, (2) chemical reactions via polymerization catalysts and chemical reagents, and (3) freezing using ice water.
- **Rinsing**. Rinsing removes contaminants through dilution, physical attraction, and solubilization. Multiple rinses with clean solutions remove more contaminants than a single rinse with the same volume of solution. Continuous rinsing with large volumes will remove even more contaminants than multiple rinsings with a lesser total volume.
- **Disinfection/Sterilization**. Chemical disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization techniques are generally impractical for large

equipment and for personal PC and equipment. For this reason, disposable PPE is recommended for use with infectious agents.

Table III-9. General guide to contaminant solubility

Solvent	Soluble contaminants
Water	Low-chain hydrocarbons, inorganic compounds, salts, some organic acids and other polar compounds
Dilute acids	Basic (caustic) compounds, amines, hydrazines
Dilute bases — detergent — soap	Acidic compounds, phenols, thiols, some nitro and sulfonic compounds
Organic solvents[a] — alcohols — ethers — ketones — aromatics — straight-chain alkanes (e.g., hexane) — common petroleum products (e.g., fuel oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)

[a]WARNING: Some organic solvents can permeate and/or degrade the PC.

11.1.4 Emergency Decontamination

In the event of personnel contamination with highly caustic, strongly acidic, and/or high levels of radioactive materials (100 mrad/hour), emergency shower facilities shall be used as a first level decontamination. These facilities shall be adequate to treat a minimum of two contaminated individuals at one time. Appropriate medical and radiation safety personnel will be relied upon to assist as needed. Use of these facilities shall be in accordance with Health and Safety Division requirements.

11.2 Personnel

The SSO is responsible for enforcing the decontamination plan. All personnel leaving the exclusion zone must be decontaminated to remove any chemical or infectious agents that may have adhered to them.

11.2.1 Radiological Decontamination

Personnel exiting contamination areas, high contamination areas, airborne radioactivity areas, or radiological buffer areas established for contamination control shall be frisked for contamination. This does not apply to personnel exiting areas containing only radionuclides, such as tritium, that cannot be detected using hand-held or automatic frisking equipment.

Monitoring for contamination should be performed using frisking equipment that, under laboratory conditions, can detect total contamination of at least the values specified in Table III-10. Use of automatic monitoring units that meet the above requirements is encouraged.

Personnel with detectable contamination on their skin or personal clothing, other than noble gases or natural background radioactivity, should be promptly decontaminated.

11.2.2 Chemical Decontamination

The decontamination of chemically contaminated personnel will be detailed in the site decontamination plan. Section 11.1.3.2 provides guidance on chemical decontamination.

Table III-10. Summary of contamination values

Nuclide[a]	Removable (dpm/100 cm^2)[b,c]	Total (fixed + removable) (dpm/100 cm^2)
Natural uranium, uranium-235, uranium-238, and associated decay products	1,000 alpha	5,000 alpha
Transuranics, radium-226, radium-228, thorium-230, thorium-228, protactinium-231, actinium-227, iodine-125, and iodine-129	20	500
Natural thorium, thorium-232, strontium-90, radium-223, radium-224, uranium-232, iodine-126, iodine-131, and iodine-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except strontium-90 and others noted above. Includes mixed fission products containing strontium-90	1,000 beta-gamma	5,000 beta-gamma
Tritium organic compounds, surfaces contaminated by HT, HTO, and metal tritide aerosols	10,000	10,000

[a] The values in this table apply to radioactive contamination deposited on but not incorporated into the interior of the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently.

[b] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. For objects with a surface area less than 100 cm^2, the entire surface should be swiped, and the activity per unit area should be based on the actual surface area. Except for transuranics, radium-228, actinum-227, thorium-228, thorium-230, protactinium-231, and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination.

[c] The levels may be averaged over 1 m^2 if the maximum activity in any area of 100 cm^2 is less than three times the guide values.

11.3 Equipment Decontamination

11.3.1 Responsibilities and Authorities

The SSO is responsible for ensuring that tools and equipment are surveyed for contamination before they are removed from the site. The SSO is also responsible for ensuring that tools and equipment are decontaminated to acceptable levels prior to release for unrestricted use.

11.3.2 Facilities

Prior to release from the site, tools and equipment contaminated with removable radioactive and chemical materials in excess of applicable limits will be manually decontaminated at the field location.

Tools and equipment that cannot be field decontaminated to below applicable limits may be appropriately packaged and removed to a decontamination facility. Transportation of contaminated tools or equipment off-site must be approved by the HSPL.

11.3.3 Radiological

Decontamination of equipment must follow approved procedures. A surface shall be considered contaminated if either the removable or total radioactivity is detected above the levels in Table III-10. If an item cannot be decontaminated promptly, then it shall be posted as specified in AR 3-7. Radiological Work Permits or technical work documents shall include provisions to control contamination at the source to minimize the amount of decontamination needed. Work preplanning shall include consideration of the handling, temporary storage, and decontamination of materials, tools, and equipment.
Decontamination activities shall be controlled to prevent the spread of contamination. Water and steam are the preferred decontamination agents. Other cleaning agents should be selected based on their effectiveness, hazardous properties, amount of waste generated, and ease of disposal. Decontamination methods should be used to reduce the number of contaminated areas. Efforts should be made to reduce the level of contamination

and the number and size of contaminated areas that cannot be eliminated. Line management is responsible for directing decontamination efforts.

11.3.4 Chemical

Chemical decontamination is performed in accordance with product labels. Random sampling and analysis of final rinse solutions may be performed to check the effectiveness of the decontamination procedures.

11.4 Waste Management

Fluids and materials resulting from decontamination processes will be contained, sampled, and analyzed for contaminants. Those materials determined to be contaminated in excess of appropriate limits are packaged in approved containers and disposed of in accordance with EM-7 procedures.

12.0 EMERGENCIES

12.1 Introduction

Emergency response, as defined by 29 CFR 1910.120, will be handled by Laboratory personnel. ER contractors are responsible for developing and implementing their own emergency action plans as defined in 29 CFR 1910.38. All emergency action plans must be consistent with laboratory emergency response plans. The SSO, with assistance from the field team leader, will have the responsibility and authority for coordinating all emergency response activities until the proper authorities arrive and assume control.

12.2 Emergency Response Plan

The Laboratory Emergency Management and Response Organzation oversees and implements the full range of activities necessary for mitigating, preparing for, responding to, and recovering from emergency incidents at the Laboratory. Additional references for this section include Laboratory AR 1-1, Accident/Incident Reporting; AR 1-2, Emergency Preparedness; AR 1-8, Working Alone; and Technical Bulletin 101, Emergency Preparedness.

The Laboratory Emergency Response Plan establishes an organization capable of responding to the range of emergencies at the Laboratory. Provisions are made for rapid mobilization of the response organizations and for expanding response commensurate with the extent of the emergency.

An Emergency Manager with the authority and responsibility to initiate emergency action under the provisions of the Laboratory Emergency Response Plan is available at all times.

When an emergency occurs at the Laboratory, the Laboratory emergency response organization is responsible for all elements of response throughout the duration of the emergency. The Incident Commander is responsible for initial notification and communications and for providing protective action recommendations to buildings/areas within the emergency response zone and off-site.

The Laboratory Emergency Response Plan is designed to be compatible with emergency plans developed by local, state, tribal, and federal agencies through establishment of communications channels with these agencies and by setting criteria for the notification of each agency. This section considers contingency plans for specific types of emergencies. The SSO, with assistance from the field teams manager and, if needed, the field team leader, shall have responsibility and authority for coordinating all emergency-response activities until the proper authorities arrive and assume control. A copy of pre-existing OU 1100 emergency response plans shall be available at the work site at all times, and all personnel working at the site shall be familiar with the plans.

For general emergencies that require evacuation (i.e., fire, medical, security, releases, etc.) an emergency response plan specific to OU 1100 is required (OSHA 1986). This section will establish evacuation routes for personnel to follow in the event of an emergency. In a worst case, an evacuation of all personnel from the OU 1100 work area would be required; in most instances a safe distance may be established to protect personnel.

12.2.1 Fire/Explosion

In the event of a fire, the work area will be evacuated and the LANL Fire Department will be notified. In the event of an explosion, all personnel will be evacuated, and no one will enter the work area until it has been cleared by Laboratory explosives safety personnel.

If a major fire or explosion were to occur, site personnel with fire extinguishers would be of no use. The signal for a fire is a siren ("woop, woop"). The signal for an evacuation is a cam alarm with a wavering tone. The crew is to gather at a specified safe location. One person should find the nearest phone at a safe distance and call the fire department at 9-911. The phone and the evacuation route used by field personnel should be in the direction away from the fire and toward the nearest exit. The SSO will determine the next course of action.

A major release or fire involving hazardous or radioactive materials may warrant a different approach. When the emergency signal is heard, personnel will meet at a predetermined area, which will be determined based on the wind conditions. A portable wind sock or streamer will be positioned at each work location and personnel notified of the location. All personnel will move in an upwind direction as much as possible without entering a plume. If the source of the fire or release is directly upwind, personnel will move to the exit or gate side and away from the plume (if visible). Once a safe distance is reached, all personnel are to be accounted for. The field team manager and the SSO will be responsible for this task. At that time, the SSO will determine the next course of action.

For a less severe accident, such as a minor release or small fire, a full evacuation may not be necessary. All personnel will meet at a designated area and all personnel will be accounted for. The field team manager and the SSO will be responsible for this task, and personnel will be given instructions by the SSO. Emergency procedures will be reviewed at least once per week as a reminder to field personnel.

If a combustible gas meter indicates gas concentrations at levels of 10% of the lower explosive limit, personnel will be evacuated. The SSO will continue monitoring to determine when equipment should be removed or when personnel may re-enter the area and resume work.

12.2.2 Personnel Injuries

In case of serious injuries, the victim should be transported to a medical facility as soon as possible. The LANL Fire Department provides emergency transport services. Minor injuries may be treated by trained personnel in the work area. All injuries should be reported to HS-2 Occupational Medicine Group. In the event that an injured person has been contaminated with chemicals, decontamination will be performed to prevent further exposure only if it will not aggravate the injury. Treatment of life-threatening or serious injuries will always be undertaken first. If exposure occurs to hydrofluoric acid, special treatment is required. The hospital must be notified immediately and a special paste will be obtained and applied to the affected area. This paste is currently located at HS-2.

12.3 Emergency Action Plan

An emergency action plan provides emergency information for contingencies that may arise during the course of field operations. It provides site personnel with instructions for the appropriate sequence of responses in the event of either site emergencies or off-site emergencies. The emergency action plan will be included in the SSHSP. The following elements, at a minimum, shall be included in the written plan:

- pre-emergency planning,
- emergency escape procedures and routes/site map,
- procedures to be followed by personnel who remain to operate critical equipment before they evacuate,
- procedures to account for all employees after evacuation,
- rescue and medical duties for those who are to perform them,
- names of those who can be contacted for additional information on the OUHSP,
- emergency communications,
- types of evacuation to be used,
- dissemination of emergency action plan to employees initially and whenever the plan changes,
- agreement with local medical facilities to treat injuries/illnesses;
- emergency equipment and supplies,
- personal injuries or illnesses,
- motor vehicle accidents and property damage, and
- site security and control.

12.4 Provisions for Public Health and Safety

Emergency planning is presented in the Laboratory's ES&H Manual (LANL 1990, 0335). The Laboratory identifies four situations in which hazardous materials may be released into the environment. These categories are founded in part on Emergency Response Planning Guideline (ERPG) concentrations developed by the American Industrial Hygiene Association and on the basis of the maximum concentration of toxic material that can be tolerated for up to 1 hour.

The types of emergencies are defined as follows:

- **Unusual event**. An event that has occurred or is in progress that normally would not be considered an emergency but that could reduce the safety of the facility. No potential exists for significant releases of radioactive or toxic materials off-site.
- **Site alert**. An event that has occurred or is in progress that would substantially reduce the safety level of the facility. Off-site releases of toxic materials are not expected to exceed the concentrations defined in ERPG-1.
- **Site emergency**. An event that has occurred or is in progress that involves actual or likely major failures of facility functions necessary for the protection of human health and the environment. Releases of toxic materials to areas off-site may exceed the concentrations described in ERPG-2.
- **General emergency**. An event that has occurred or is in progress that substantially interferes with the functioning of facility safety systems. Releases of radioactive materials to areas off-site may exceed protective response recommendations, and toxic materials may exceed ERPG-3.

12.5 Notification Requirements

Field team members will notify the SSO of emergency situations; the SSO will notify the appropriate emergency assistance personnel (e.g., fire, police, and ambulance), the OUPL, the HSPL, the Laboratory Health and Safety Division according to DOE Order 5500.2 (DOE 1991, 0736), and DOE Albuquerque Operations Office (AL) Order 5000.3 (DOE/AL 1991, 0734). The Laboratory Health and Safety Division is responsible for implementing notification and reporting requirements according to DOE Order 5484.1 (DOE 1990, 0773).

The names of persons and services to contact in case of emergencies are given in Table III-11. This emergency contact form will be copied and posted in prominent locations at the work site. Two-way radio communication will be maintained at remote sites when possible.

The emergency contact number at the Laboratory is 9-911. Dialing 911 does work on Laboratory phones but it takes longer to get a response.

Table III-11. Emergency Contacts

Site Safety Officer Name:	Pager: Phone:
Environmental Restoration Health and Safety Project Leader Name:	Pager: Phone:
24-Hour LANL Health/Safety Coordinator Name:	Pager: Phone: (work) (home)

12.6 Documentation

An unusual occurrence is any deviation from the planned or expected behavior or course of events in connection with any DOE or DOE-controlled operation if the deviation has environmental, safety, or health protection significance. Examples of unusual occurrences include any substantial degradation of a barrier designed to contain radioactive or toxic materials or any substantial release of radioactive or toxic materials.

The Laboratory principal investigator will submit a completed DOE Form F 5484.X for any of the following accidents and incidents, according to Laboratory AR 1-1:

- **Occupational injury**. An injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment. Note: Conditions resulting from animal bites, such as insect or snake bites, or from one-time exposure to chemicals are considered injuries.
- **Occupational illness**. Any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

- **Property damage losses of $1,000 or more.** Regardless of fault, accidents that cause damage to DOE property or accidents, wherein DOE may be liable for damage to a second party, are reportable where damage is $1,000 or more, including damage to facilities, inventories, equipment, and properly parked motor vehicles but excluding damage resulting from a DOE-reported vehicle accident.
- **Government motor vehicle accidents with damages of $150 or more or involving an injury, unless the government vehicle is not at fault and the occupants are uninjured.** Accidents are also reportable to DOE if:
  - damage to a government vehicle not properly parked is greater than or equal to $250;
  - damage to DOE property is greater than or equal to $500 and the driver of a government vehicle is at fault;
  - damage to any private property or vehicle is greater than or equal to $250 and the driver of a government vehicle is at fault; or
  - any individual is injured and the driver of a government vehicle is at fault.

The HSPL will work with the OUPL and the field team leader to ensure that health and safety records are maintained with the appropriate Laboratory group, as required by DOE orders. The reports are as follows:

- DOE-AL Order 5000.3 (DOE 1990, 0253), Unusual Occurrence Reporting
- DOE Form 5484.3, Supplementary Record of Occupational Injuries and Illnesses, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.4, Tabulation of Property Damage Experience, Attachment 2, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.5, Report of Property Damage or Loss, Attachment 4, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.6, Annual Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials, DOE Order 5484.1 (DOE 1990, 0733)

- DOE Form 5484.8, Termination Occupational Exposure Report, Attachment 10, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form OSHA-200, Log of Occupational Injuries and Illnesses, Attachment 7, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form EV-102A, Summary of DOE and DOE Contractor Occupational Injuries and Illnesses, Attachment 8, DOE Order 5484.1 (DOE 1990, 0773)
- DOE Form F5821.1, Radioactive Effluent/Onsite Discharges/Unplanned Releases, Attachment 12, DOE Order 5484.1 (DOE 1990, 0773)

Copies of these reports will be stored with the appropriate Laboratory group. Specific reporting responsibilities are given in Chapter 1, General ARs, of the Laboratory ES&H Manual (LANL 1990, 0335).

13.0 PERSONNEL TRAINING

13.1 General Employee Training and Site Orientation

All Laboratory employees and supplemental workers must successfully complete Laboratory general employee training (GET). GET training is performed by the Health and Safety Division. The OUPL is responsible for scheduling GET training for supplemental workers.

Several types of training are required, including:

- OSHA-mandated,
- facility-specific,
- site-specific or pre-entry, and
- tailgate.

Site workers will receive each type of training during the course of field

13.2 OSHA Requirements

OSHA's HAZWOPER standard (29 CFR 1910.120) regulates the health and safety of employees involved in HAZWOP. This standard requires training commensurate with the level and function of the employee. Persons shall not participate in field activities until they have been trained to a level required by their job function and responsibility. The SSO is responsible for ensuring that all persons entering the exclusion zone are properly trained.

13.2.1 Pre-Assignment Training

At the time of job assignment, all general site workers shall receive a minimum of 40 hours of initial instruction off-site and a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Occasional site workers shall receive a minimum of 24 hours of initial instruction. Workers who may be exposed to unique or special hazards shall be provided additional training. The level of training provided shall be consistent with the employee's job function and responsibilities.

13.2.2 On-Site Management and Supervisors

On-site management and supervisors directly responsible for or who supervise employees engaged in HAZWOP shall receive at least 8 hours of additional specialized training on managing such operations at the time of job assignment.

13.2.3 Annual Refresher

All persons required to have OSHA training shall receive 8 hours of refresher training annually.

13.2.4 Site-Specific Training

Prior to granting site access, personnel must be given site-specific training. Attendance and understanding of the site-specific training must be documented. A weekly health and safety briefing and periodic training (as warranted) will be given. Daily tailgate safety meetings will be used to update workers on changing site conditions and to reinforce safe work practices. Training should include the topics indicated in Table III-12 in accordance with 29 CFR 1910.120(i)(2)(ii).

Table III-12. Training topics

Initial site-specific	Weekly	Periodic as warranted	Subject
X		X	Site Health and Safety Plan, 29 CFR 1910.120(e)(1)
X		X	Site Characterization and Analysis, 29 CFR 1910.120(i)
X		X	Chemical Hazards, Table 1
X		X	Physical Hazards, Table 2
X		X	Medical Surveillance Requirements, 29 CFR 1910.120(f)
X	X		Symptoms of Overexposure to Hazards, 29 CFR 1910.120(e)(1)(vi)
X		X	Site Control, 29 CFR 1910.120(d)
X		X	Training Requirements, 29 CFR 1910.120(e)
X	X	X	Engineering and Work Practice Controls, 29 CFR 1910.120(g)
X	X	X	PPE, 29 CFR 1910.120(g), 29 CFR 1910.134
X	X	X	Respiratory Protection, 29 CFR 1910.120(g), 29 CFR 1910.134, ANSI Z88.2-1980
X		X	Overhead and Underground Utilities
X	X	X	Scaffolding, 29 CFR 1910.28(a)
X	X		Heavy Machinery Safety
X		X	Forklifts, 29 CFR 1910.27(d)

Table III-12. (continued)

Initial site-specific	Weekly	Periodic as warranted	Subject
X		X	Tools
X		X	Backhoes, Front End Loaders
X		X	Other Equipment Used at Site
X		X	Pressurized Gas Cylinders, 29 CFR 1910.101(b)
X	X	X	Decontamination, 29 CFR 1910.120(k)
X		X	Air Monitoring, 29 CFR 1910.120(h)
X		X	Emergency Response Plan, 29 CFR 1910.120(l)
X	X		Handling Drums and Other Containers, 29 CFR 1910.120(j)
X		X	Radioactive Wastes
X		X	Explosive Wastes
X		X	Shock Sensitive Wastes
X		X	Flammable Wastes
X	X	X	Confined Space Entry
X			Illumination, 29 CFR 1910.120(m)
X	X	X	Buddy System, 29 CFR 1910.120(a)
X		X	Heat and Cold Stress
X		X	Animal and Insect Bites
X		X	Spill contaminant

13.3 Radiation Safety Training

Basic radiation worker training is required for all employees (radiation workers) (1) whose job assignments involve operation of radiation-producing devices, (2) who work with radioactive materials, (3) who are likely to be routinely occupationally exposed above 0.1 rem (0.001 sievert) per year, or (4) who require unescorted entry into a radiological area. This training is a 4-hour extension to GET for new employees.

Radiation protection training is required for all Laboratory employees, contractors, visiting scientists, and DOE and Department of Defense personnel. This is a 1-hour presentation as part of GET.

13.4 Hazard Communication

Laboratory employees shall be trained in accordance with Health and Safety Division requirements. Contractors shall provide training to their employees in compliance with 29 CFR 1910.120.

13.5 High Explosives Training

At PRSs where high explosives are known or suspected to be present, additional safety training may be required.

13.6 Facility-Specific Training

Certain areas of the Laboratory (e.g., firing sites) require additional facility specific training before personnel can enter.

13.7 Records

Records of training shall be maintained by the Health and Safety Division and in the project file to confirm that every individual assigned to a task has had adequate training for that task and that every employee's training is up-to-date. The SSO or her/his designee is responsible for ensuring that persons entering the site are properly trained.

14.0 REFERENCES

American Industrial Hygiene Association, 1986. "Noise and Hearing Conservation Manual," Fourth Edition, Akron, Ohio.

Information Labor Organization, 1989. "Encyclopedia of Occupational Health and Safety," Third Edition, Volume I.

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, "NIOSH Manual of Analytical Methods."

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, "Pocket Guide to Chemical Hazards."

American Conference of Governmental Industrial Hygienists, 1992. "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, 1992-1993," Cincinnati, Ohio.

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, October 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," U.S. Government Printing Office, Washington, D.C.

National Safety Council, 1988. "Fundamentals of Industrial Hygiene."

John Wiley & Sons, 1981. "Patty's Industrial Hygiene and Toxicology," Third Edition, Volume IIA.

Office of the Federal Register, National Archives and Records Administration, 1990. "Code of Federal Regulations, Title 29, Parts 1900-1910 and 1926." Washington, D.C.

U.S. Department of Labor, Occupational Safety and Health Administration, March 1989. "Industrial Exposure and Control."

U.S. Department of Labor Occupational Safety and Health Administration, March 1989. "Industrial Exposure and Control: Technologies for OSHA-Regulated Hazardous Substances," Volumes I and II, Washington, D.C.

Attachment A

LEVELS OF PPE

Attachment A
Levels of PPE

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
A	Recommended: • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA • Fully encapsulating, chemical-resistant suit • Inner chemical-resistant gloves • Chemical-resistant safety boots/shoes • Two-way radio communications Optional: • Cooling unit • Coveralls • Long cotton underwear • Hard hat • Disposable gloves and boot covers	The highest available level of respiratory, skin, and eye protection	• The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either: — measured (or potential for) high concentration of atmospheric vapors, gases, or particulates — site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin • Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible • Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined	• Fully encapsulating suit material must be compatible with the substances involved

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
B	Recommended: • Pressure-demand, full facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications Optional: • Coveralls • Disposable boot covers • Face shield • Long cotton underwear	The same level of respiratory protection but less skin protection than Level A It is the minimum level recommended for initial site entries until the hazards have been further identified	• The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection but less skin protection. This involves atmospheres: — with IDLH concentrations of specific substances that do not represent a severe skin hazard — that do not meet the criteria for use of air-purifying respirators • Atmosphere contains less than 19.5% oxygen • Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin	• Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin • Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates or splashes of material that will affect exposed skin

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
C	Recommended: • Full facepiece, air-purifying, canister-equipped respirator • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications Optional: • Coveralls • Disposable boot covers • Face shield • Escape mask • Long cotton underwear	The same level of skin protection as Level B but a lower level of respiratory protection	• The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant • All criteria for the use of air-purifying respirators are met	• Atmospheric concentration of chemicals must not exceed IDLH levels • The atmosphere must contain at least 19.5% oxygen

Level of protection	Equipment	Protection provided	Should be used when:	Limiting criteria
D	Recommended: • Coveralls • Safety boots/shoes • Safety glasses or chemical splash goggles • Hard hat Optional: • Gloves • Escape mask • Face shield	No respiratory protection. Minimal skin protection	• The atmosphere contains no known hazard • Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals	• The atmosphere must contain at least 19.5% oxygen

Attachment B

COMMON CHEMICALS IN PHOTOGRAPHIC PROCESSING

Attachment B
Common Chemicals in Photographic Processing

Common Developer Constituents

Metol (4-methylaminophenol)- black and white developers

Hydroquinone- black and white developers

Paraphenylene diamine derivatives CD2, CD3, etc : developers used for color developing

Ethylene diamine: constituent of certain developers

Pentachlorophenol and Sodium pentachlorophenolate: preservatives for developers Potassium phosphate, potassium hydroxide, and p-phenylenediamine, diethylene glycol: developer

Common Bleaching Constituents

Acetic Acid, ammonium bromide, and potassium nitrate: bleach replenisher

Ammonium Bromide, hydrobromic acid, ammonium tetraacetoferrate(III), and potassium salt of ethylenediamine tetraacetic acid: bleaching agents

Sodium ethylene diamine tetra-actetate (Na EDTA) and sodium diethene triamine pentacetate: constituents in bleaching solutions

Common Cleaning Constituents

Concentrated Formaldehyde, chlorinated and fluorinated solvents (1,1,1-trichloroethane, methylene chloride, Freon, etc.): used for cleaning and in protective products

Hydrochloric acid: used for cleaning

Miscellaneous

Potassium dichromate: used in reversal solutions

Formaldehyde: used as a stabilizer

Ammonia: adjusts pH values

Hydrochloric acid: used for cleaning

Sodium ethylene diamine tetra-acetate (Na EDTA) and sodium diethene triamine pentacetate: constituents in bleaching solutions

tert-Butylaminoborane: exposure

Sodium hydrosulphite: reducing agents

Methanol

Potassium sulfite, ethylenediamine tetraacetic acid and 1-tyioglycerol: conditioner and replenishers

Sources:

Encyclopedia of Occupational Health and Safety

Processing constituent list from KODAK C-41

Processing constituent list from KODAK Ektachrome E-6

Safe Handling Considerations for the EKTAPRINT 3 PROCESS - KODAK

Annex IV

Records Management Project Plan

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This work plan will follow the records management program plan provided in Annex IV of Revision 3 of the Installation Work Plan (LANL 1993, 1017).

REFERENCES FOR ANNEX IV

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. (LANL 1993, 1017)

Annex V

Public Involvement Project Plan

Executive Summary

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Annexes

Appendices

This work plan will follow the public involvement program plan provided in Annex V of Revision 3 of the Installation Work Plan (LANL 1993, 1017). The ER Program's public reading room is located at 1450 Central Avenue, Suite 101, Los Alamos, New Mexico. Additional information regarding this plan can be obtained by calling (505) 667-3033.

REFERENCES FOR ANNEX V

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. (LANL 1993, 1017)

Appendix A

Work Plan Contributors

Executive Summary

Chapter 1
Introduction

Chapter 2
Background Information for OU 1100

Chapter 3
Environmental Setting

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Sites

Chapter 6
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Appendices

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Appendix B

Standard Operating Procedures

Phase I investigations will be conducted using Laboratory-approved standard operating procedures (SOPs). The SOPs that will be used at each potential release site (PRS) are summarized in Table B-1. Most of these procedures are the Laboratory's Environmental Restoration Program SOPs (LANL 1993, 0875). The field screening procedure for high explosives is an analytical procedure developed by the Laboratory (Baytos 1991, 0741).

TABLE B-1

SUMMARY OF PROCEDURES FOR PHASE I INVESTIGATIONS AT OU 1100

LABORATORY ER PROGRAM SOPs	PRS																			
	20-001(a)	20-001(b)	20-001(c)	20-002(a)	20-002(b)	20-002(c)	20-002(d)	20-003(b)	20-003(c)	20-004	20-005	53-001(a)	53-001(b)	53-001(e)	53-001(g)	53-005	53-008	53-010	53-012(e)	72-001
General Field Operations																				
01.06 - Management of RFI-Generated Wastes	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
01.07 - Personnel Decontamination	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
01.08 - Equipment Decontamination	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Field Surveys and Screening																				
03.01 - Land Surveying Procedures	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
03.02 - General Surface Geophysics	X	X	X							X	X									
03.08 - Geomorphic Characterization								X					X						X	X
03.10 - Trenching and Logging	X	X	X							X	X					X				
06.23 - Measurement of Gamma Ray Fields Using a Sodium Iodide Detector																	X			
10.04 - MCA-465/FIDLER Instrument System				X	X	X	X	X	X											
Sample Collection																				
06.09 - Spade and Scoop Method for Collection of Soil Samples	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X		X
06.10 - Hand Auger and Thin Wall Sampler				X	X	X	X	X	X		X		X						X	
06.15 - Coliwasa Samples for Liquids and Slurries										X	X									
06.24 - Sample Collection from Split Spoon Samplers and Shelby Tube Samplers											X					X				
Sample Management																				
01.02 - Sample Container and Preservation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
01.03 - Handling, Packaging, and Shipping of Samples	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
01.04 - Sample Control and Field Documentation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
01.05 - Field Quality Control Samples	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LABORATORY ANALYTICAL PROCEDURE																				
Field Spot-Test Kit for Explosives, LA-12071-MS (Baytos 1991, 0741)	X	X	X	X	X	X	X	X	X	X	X									X

REFERENCES FOR APPENDIX B

Baytos, J. F., July 1991. "Field Spot-Test Kit for Explosives," Los Alamos National Laboratory Report LA-12071-MS, Los Alamos, New Mexico. (Baytos 1991, 0741)

LANL (Los Alamos National Laboratory), January 1993. "Los Alamos National Laboratory Environmental Restoration Program Standard Operating Procedures," Los Alamos National Laboratory report, Los Alamos, New Mexico. (LANL 1993, 0875)